China's Growth Outlook: Is High-Income Status in Reach?

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OVERVIEW

- Decades of rapid economic growth have propelled China out of poverty and into middle-income status. Now the country faces a new challenge: escaping the so-called "middle-income trap."
- To gauge the likelihood of success, the author develops a set of growth projections, drawing on the experience of other countries that have reached China's current income level.
- The results are stark: Given an aging population and diminishing returns to capital, China can only achieve high-income status in the coming decades by sustaining productivity growth at the top end of the range attained by its Pacific Rim neighbors. Further, productivity gains on that scale would likely require extensive institutional development, including a marked reduction in state direction of the economy.
- Though high-income status is probably not just over the horizon, China's years of rapid expansion are hardly over, with "catch-up" effects and continued urbanization offering plenty of fuel for future growth.

Can China build on its development success to achieve high-income status in the decades ahead? The experience of Japan, South Korea, and some smaller Pacific Rim economies suggests that such an outcome is possible. But most economies deliver unimpressive growth after reaching China's current income level, giving rise to the notion of a "middle-income trap." To shed light on what the future may hold for China, we rely on a neoclassical growth framework. Our key finding is that China would need to sustain total factor productivity growth at the top end of the range achieved by its Pacific Rim neighbors in order to match their success in raising per capita incomes. Whereas fast-growing working-age populations boosted per capita income growth in the Pacific Rim, a rapidly aging population will act as a powerful drag on income growth in China. Moreover, China's capital-intensive production structure will make it difficult to match the returns to capital accumulation achieved by those countries at a similar level of income.

This article proceeds as follows: Section 1 places China's growth performance of recent decades in international and historical perspective and also wades into the debate concerning the accuracy of China's growth statistics. We find that China's growth performance remains among the

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strongest on record, regardless of whether official figures or skeptics' estimates are closer to the mark. Section 2 shows how the neoclassical growth model can be used to break down GDP growth into contributions from labor force growth, capital accumulation, and technological change. The framework enables us to show how China's growth performance is already feeling the weight of slower labor-force growth and diminishing returns to capital. Section 3 reviews the evidence for a "middle-income trap," confirming the finding from other studies that middle-income countries tend to remain in that category for decades. Section 4 relies on the neoclassical model to analyze countries' growth performance after reaching China's current income level. We find a strong tendency toward growth slowdowns, with notably reduced contributions from capital accumulation and technical change. These results help inform parameter choices for our projection exercise. Section 5 details our projection results, which highlight that rapid growth will require exceptional productivity gains, given drags stemming from demographic pressures and diminishing returns to capital. Section 6 considers factors that could provide scope for continued rapid growth in China as well as factors that could impede it. China's low current per capita income relative to that of global leaders and its low rate of urbanization point to clear upside potential for growth. But to realize this potential, China must overcome challenges stemming from lagging institutional development and the state's pervasive role in the economy. Section 7 concludes.

1. China's Growth in Perspective

China's growth performance has been remarkable following the introduction of economic reforms in the late 1970s. According to the official data, real GDP growth has averaged 9.0 percent since 1978. Growth over the past twenty years has been almost as fast, at 8.7 percent (Table 1).

Table 1
Growth over the Two Decades Prior to Reaching China's 2018 Real Income Level

	GDP Growth (Percent)	GDP Growth Per Capita
China (2018)	8.7	8.1
Singapore (1984)	9.4	7.6
Taiwan (1987)	8.8	6.8
South Korea (1994)	8.7	7.4
Japan (1976)	7.9	6.8
Hong Kong (1983)	7.6	5.4

Sources: Penn World Table version 9.1; The Conference Board, Total Economy Database; national sources.

Notes: Real income relative to China evaluated at constant 2011 purchasing power parities. Figures in parentheses show the year in which each economy first reached $16,100 in real per capita GDP (China's 2018 level).

That makes China the fastest growing economy in a sample of 124 economies during both periods. China's performance stands out all the more for its consistency. When its growth is averaged over rolling five-year periods, China has remained above the 90th percentile of the growth distribution since 1982, a feat no other economy has accomplished.

Rapid economic growth has led to a similar increase in living standards, lifting China out of poverty and into middle-income status. According to official figures, real per capita income has risen by a factor of 25 since 1978. Annual per capita income now stands at about $16,100 measured at purchasing power parity, in "2011 international dollars." (Unless otherwise noted, real income figures rely on this measure throughout this article.) This places China at roughly the 60th percentile of the global income distribution, though still slightly below 30 percent of the U.S. level.

We have to go back to before the start of China's reform period to find clear precedents for the country's growth performance. Singapore's economy grew even faster over the twenty years before it reached China's current real income level, while the economies of South Korea and Taiwan grew just as fast as China's. Growth rates in Hong Kong and Japan over similar twenty-year periods were less than 1 percentage point below China's. On a per capita basis, however, China's growth has outpaced that of all these economies, reflecting its slower rate of population growth.

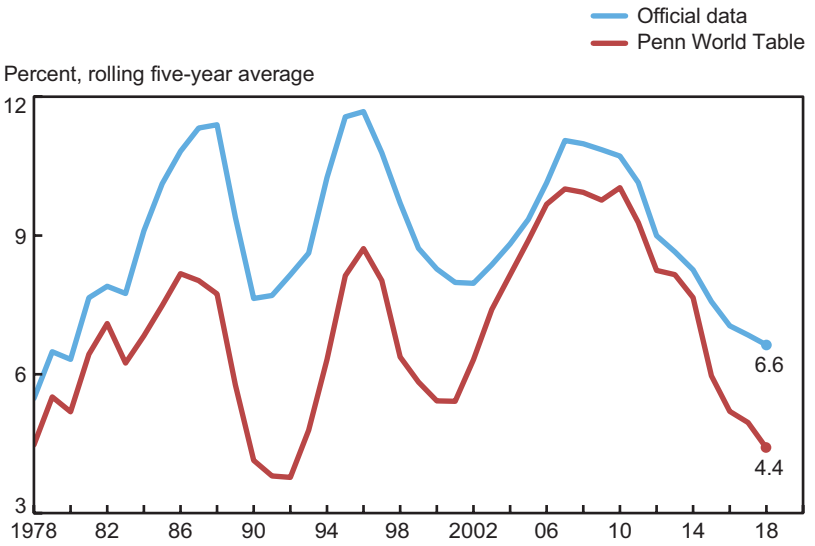
Many observers believe that the official GDP data overstate China's growth performance. The most comprehensive critique of the official statistics comes in a series of papers by Harry Wu of Hitotsubashi University, some written in collaboration with analysts at the Conference Board, and, earlier, with Angus Maddison. Wu goes beyond critique, developing alternative annual GDP estimates for China by drawing on a variety of official and unofficial data. This work has been influential enough for Wu's methods to be employed in the Penn World Table, the leading data source for international growth studies.

According to these data, Chinese real GDP growth has averaged 6.9 percent since 1978, more than 2 percentage points below the official figure. (Chart 1 shows these data as five-year averages.) The estimated overstatement of growth varies considerably over time, from more than 3 percentage points for much of the 1990s to less than 1 percentage point until recently. But China's growth performance remains remarkable. For our sample of 124 economies, China has come in above the 90th percentile of the global growth distribution more than half the time since 1982, and above the 75th percentile until just last year. China's growth over the past twenty years (7.5 percent) somewhat lags that of the high-income Pacific Rim economies listed in Table 1 during the periods in which they rose to China's current income level, but stands in the middle of the pack in per capita terms (6.9 percent).

The debate over the accuracy of China's GDP statistics goes back more than two decades, and some observers believe the official data are basically accurate. It is beyond the scope of this article to provide a detailed assessment of the evidence. In our view, however, the implications for past living standards provide strong evidence that official growth figures for earlier decades are too high.

Given current incomes, the faster China has grown, the poorer it must have been in the past. Official growth rates, together with a consensus estimate for real per capita income in 2011, imply that China was one of the poorest countries in the world well into the 1980s.[1] Indeed, real per capita income at the start of the decade would have been below that of most countries in sub-Saharan Africa as well as neighbors such as Bangladesh, Laos,

Chart 1
Real GDP Growth in China



Sources: Penn World Table (version 9.1); The Conference Board, Total Economy Database; IMF, World Economic Outlook database.

Note: In the Penn World Table series, GDP growth for 2018 (as part of a five-year average) is taken from the Total Economy Database.

and Myanmar. Although China was clearly a poor country at the time, few would have rated it as one of the poorest. Such a ranking is also inconsistent with data on life expectancy, literacy, and other quality-of-life indicators. Growth rates from the Penn World Table, more plausibly, place China at roughly the 30th percentile of the global income distribution in the early 1980s, ahead of most countries in sub-Saharan Africa but still behind neighbors such as Indonesia, the Philippines, and Thailand.

A look at living standards, however, provides little help in judging the accuracy of the recent data. Extrapolating from the consensus figure for 2011 at official growth rates, the International Monetary Fund (IMF) and World Bank place current real per capita income in China at about $16,100. Extrapolating from the same starting point using Wu's methods, the Penn Table places current incomes at about $13,600. This gap is not that large in context, however, barely affecting China's ranking in the global income distribution.[2] In what follows, we will assume that the recent official data are accurate, noting the implications of assuming a lower initial income level where relevant.

In this connection, some recent research implies that the Penn Table might overcorrect the recent official data. An analysis of nighttime lights data shows growth since 2011 slowing less sharply than in the official statistics (Clark, Pinkovskiy, and Sala-i-Martin 2017). So does an analysis of other alternative growth indicators (Clark, Dawson, and Pinkovskiy [2020], also in this special issue). The Penn Table, in contrast, shows growth slowing *more* sharply than in the official statistics.[3] These conflicting signals carry an important lesson: There is irreducible uncertainty as to how fast China has been growing.

2. The Sources of China's Growth

The neoclassical growth model has provided the standard framework for studying long-term economic growth since it was introduced by Robert Solow (1956, 1957) more than six decades ago. Under the model, economic growth comes from two basic sources: increases in capital and labor inputs, and improvements in technology. The basic growth accounting equation is given by:

$$\hat{Y}_t = \hat{A} + \alpha\hat{K}_t + (1-\alpha)\hat{L}_t \tag{1}$$

In equation (1), Y represents real GDP, A the economy's technology level, K the quantity of capital inputs, and L the quantity of labor inputs. The ^ symbol denotes a proportional rate of change or percentage increase. The terms α and 1- α represent the elasticity of output relative to, respectively, capital and labor inputs. (Thus, a 1 percent increase in capital inputs would raise GDP by the factor $\alpha < 1$ percent). The fact that these terms sum to 1 expresses constant returns to scale, so that a 1 percent increase in both inputs results in a 1 percent increase in GDP. In a competitive economy, with factors of production paid their marginal product, these terms also represent the shares of national income accruing to capital and labor. The term A captures the efficiency with which capital and labor inputs are used, or total factor productivity (TFP). A higher value for A means that greater output can be produced from given factor inputs. Given measures for these terms, equation (1) can be used to decompose observed growth into contributions from factor accumulation and technological change.

The evolution of the capital stock is determined by the economy's savings rate and the rate of depreciation:

$$K_{t+1} = (1-\delta)K_t + s_t Y_t, \tag{2}$$

where δ is the rate of depreciation and s_t is the economy's investment rate. Equations (1) and (2), taken together, have a surprisingly powerful implication: An economy's long-run growth rate is independent of its investment rate. To be sure, a high-investment economy will follow a higher income trajectory and will grow faster than its long-term rate if it begins below that trajectory. But high investment is a self-limiting path to growth. Over the long run, the economy settles at an equilibrium with a constant capital-to-output ratio, with GDP growth determined solely by the pace of TFP and labor input growth. This equilibrium takes hold more quickly the faster the existing capital stock depreciates.[4]

Our empirical analysis uses capital input data from the Penn World Table, based on disaggregated investment outlays in nine categories. The composition of investment matters for the aggregate capital stock because some capital assets depreciate more rapidly than others. (Consider structures compared with software.) The latest edition of the Penn Table, released this year, also reports estimates of the flow of services provided by the capital stock.[5] This is the preferred measure of capital inputs from a theoretical perspective. In equilibrium, rapidly depreciating assets must yield a higher service flow to equalize investment returns across asset types. While our growth accounting exercise relies on these capital services data, our results would be basically the same using the capital stock series.

Data on employment and average hours worked are also taken from the Penn Table. In addition, the Penn Table contains data on labor quality, derived from underlying data on

average years of schooling and estimates of the economic returns to education (Barro and Lee 2013). Labor inputs here are measured by a composite variable taking in all three of these elements:

$$L_t = hc_t avh_t N_t, \tag{3}$$

where hc_t represents the average level of human capital, avh_t average hours worked, and N_t total employment. This is in line with the emphasis on human capital in the recent growth literature and follows many studies in using the "extended Solow model" introduced by Mankiw, Romer, and Weil (1992).

The expanded Solow model implies that long-term GDP growth depends on the pace of human capital development as well as on TFP and raw labor input growth. A further interesting implication concerns the drivers of per capita income growth (assuming that long-run growth involves constant values for labor force participation and average hours worked). Per capita income growth now depends only on the pace of human capital upgrading and TFP growth.[6]

What about TFP growth? The neoclassical growth model treats this term as a residual—that is, as the part of GDP growth not accounted for by capital and labor accumulation (including human capital accumulation in the extended Solow model). While this is an important limitation of the neoclassical model, growth accounting studies based on the model have yielded important insights.[7] As we'll see, capital and labor accumulation play a diminishing role as growth drivers as economies ascend the global income ladder. Economies that fall into the middle-income trap fail to make the transition from growth based on factor accumulation to growth based on technology and education.

What does the neoclassical model tell us about the sources of growth in China? Table 2 shows the breakdown for the two most recent five-year periods (2008-13 and 2014-18) and for the prior ten years (1998-2007). Growth in total hours worked makes a steadily diminishing contribution to growth, falling to zero for 2014-18. This owes to the aging of China's population. Indeed, the working-age (20-64) population began shrinking in 2017, helping to drag the growth contribution from raw labor inputs below zero in 2017 and 2018.

Improvements in labor quality make a steadily increasing contribution throughout this twenty-year period, reaching 0.8 percentage point for 2014-18. The larger contribution reflects rapid gains in average years of schooling, partly because of the aging out of the labor force of earlier, less-educated population cohorts.

Capital accumulation makes the largest contribution to growth throughout, peaking at 5.0 percentage points for 2008-13 but falling to 3.0 percentage points for 2014-18. The reduced growth contribution from capital comes despite little change in the average share of capital expenditure in GDP (45 percent for 2014-18, compared with 47 percent for 2013-17). China is already seeing the self-limiting nature of capital accumulation as a source of growth. As the capital intensity of production rises, an ever-higher investment rate is needed simply to keep the growth contribution from capital accumulation at its current value. A simple back-of-the-envelope calculation indicates that China would now need an investment rate of roughly 55 percent of GDP to prevent this contribution from continuing to decline.

Since TFP growth is calculated as a residual, the difference in GDP growth between the official data and the Penn Tables falls entirely on TFP. Based on the official data, TFP

Table 2
The Sources of Growth in China

	2014-18	2008-13	1998-2007
1) Labor hours	0.0	0.5	0.6
2) Labor quality	0.8	0.6	0.5
3) Capital	3.0	5.0	4.7
4) Total factor productivity: Official data	2.8	2.6	3.9
5) Total factor productivity: PWT data	0.6	2.1	2.9
GDP: Official data	6.6	8.7	9.7
GDP: PWT data	4.4	8.2	8.7

Sources: Penn World Table (PWT) version 9.1; The Conference Board, Total Economy Database; national sources; author's calculations.

Notes: The Penn World Table ends in 2017; the Total Economy Database is used to fill in values for 2018. Offical GDP growth equals the sum of rows 1 through 4. PWT GDP growth equals the sum of rows 1 through 3 plus row 5. Figures refer to growth *from* 2013 to 2018, or equivalently, *during* 2014 through 2018, and so on for earlier periods.

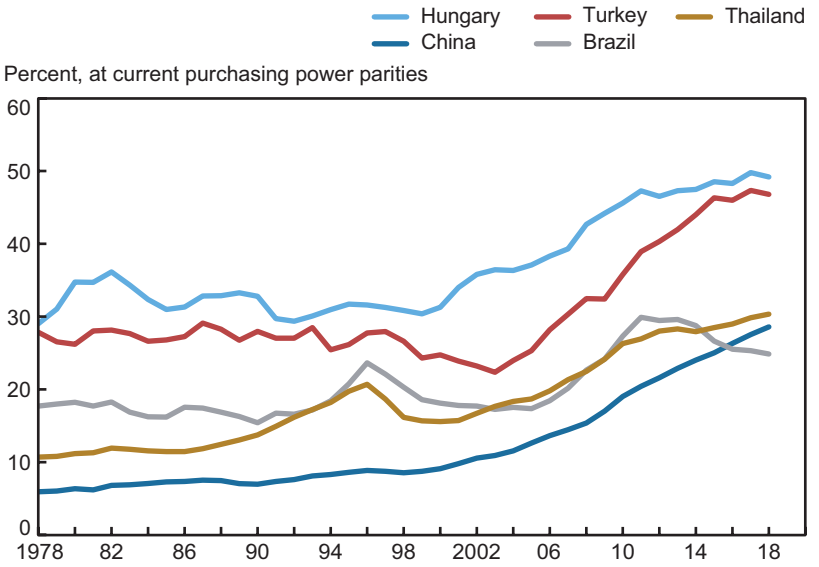
growth stands at 2.8 percent for 2014-18, up slightly from 2008-13. Based on the Penn Table data, TFP stands at just 0.6 percent for 2014-18, down sharply from the prior ten-year period.

In sum, our analysis points to one clear and one possible limit to China's future growth. The growth contribution from capital expenditure is already shrinking fairly rapidly. And if the alternative growth estimates from the Penn World Table are on target, the growth contribution from technological change is falling very rapidly. To gain better insight into what the future might hold, we turn to an analysis of growth experiences in other middle-income countries.

3. The Middle-Income Trap

The "middle-income trap" refers to the fact that many countries have failed to sustain rapid growth after reaching middle-income status. While the general idea of a middle-income trap is plain enough, there is no clear consensus as to how the term should be operationalized. Many studies define the trap in relative terms, that is, as a failure to rise past a certain fraction of income in the richest economies. Other studies define the trap in terms of income levels. (Within this group, studies differ as to where to draw the line between middle-income and upper-income status, whether and how rapidly income thresholds should be adjusted over time, and whether to define thresholds in purchasing power parity or U.S. dollar terms.) Some researchers deny that a middle-income trap even exists, arguing that the risk of a shift to sluggish growth is independent of income level. Agénor (2017) provides a useful and comprehensive review.

Chart 2
Per Capita Income Levels Relative to the United States



Sources: Penn World Table; IMF, World Economic Outlook database.

The notion has penetrated Chinese official circles. Premier Li Keqiang stated that China must "take particular care to avoid falling into the middle-income trap" at the Twelfth National People's Congress in 2016.[8] This statement followed then-Finance Minister Lou Jiwei's remark a year earlier that China faced a "50/50 chance" of sliding into a middle-income trap. Chinese policymakers are intent on avoiding that outcome. Although Premier Li remarked in 2018 that "there is a long way to go before China is a high-income country," he maintains that this outlook provides scope for China "to sustain medium-high growth for a long time to come."

We find a relative metric to be most informative, corresponding to Chinese authorities' stated goal of joining the ranks of the most advanced economies. Our middle-income category includes countries with per capita incomes at 10 to 50 percent of the U.S. level (at current purchasing power parities); our high-income category includes anything above that. The resulting country groupings are similar to the IMF's, but more stringent as to high-income status than the World Bank's.[9]

The global income distribution is roughly stable under our metric. Out of 124 countries, 52 qualified as middle-income in 1978 and 49 in 2018. Of the original cohort of 52 middle-income countries, just 8 had advanced to high-income status by 2018. (Chart 2 displays growth experiences in a handful of these economies as well as in China.) An equal number slipped into low-income status, with per capita incomes falling below 10 percent of the U.S. level.

Advancing to high-income status remains challenging even given a lower, fixed metric. Suppose we freeze income categories in real terms in 1978, the start of our sample. (Thus, middle-income status corresponds to 10 to 50 percent of U.S. real per capita income

back then.) Out of 54 middle-income countries in 1978, just half had attained high-income status by 2018; 25 countries remained in the middle-income ranks and 2 slipped back into the low-income ranks, with per capita incomes actually declining in real terms.

The relatively low rate at which countries advance from middle- to high-income status reflects the simple fact that doing so requires sustaining a high growth rate for decades. To take an extreme case, a country with incomes at 10 percent of the U.S. level in 1978 would have needed to sustain growth above 5½ percent to reach 50 percent of the U.S. level in 2018. Even a country starting at 30 percent of the U.S. level would have needed to sustain income growth at a still-impressive 3 percent pace.

That said, similar arithmetic implies that China is well on track to high-income status if the trends in the recent official data can be sustained. After all, per capita income growth has averaged 6.2 percent over the last five years, implying a doubling roughly every eleven years, and per capita income is already close to 30 percent of the U.S. level. But as we'll see, the old investment adage holds true for countries' growth rates: Past performance is no guarantee of future results.

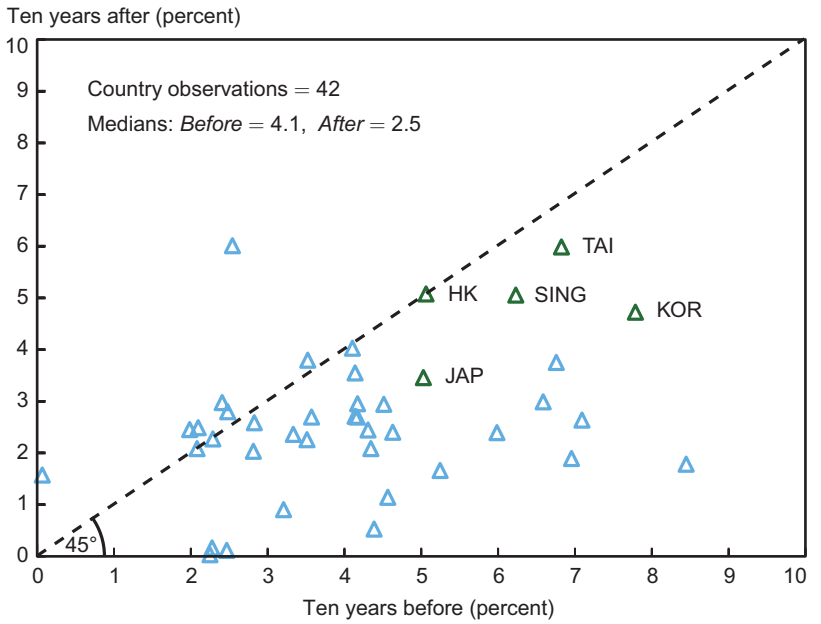
4. The Anatomy of Growth Slowdowns

How much is growth in China likely to slow? In what follows, we take a two-part approach to shedding light on this question: first, by looking at growth performance in other countries after they reached China's current real income level; second, by zooming in on the sources of that performance through the lens of the Solow growth model.

Consider countries' growth performance over the ten years after reaching China's current real income level compared with the previous ten years (Chart 3).[10] (We assume for now that China's real per capita income stands at slightly above $16,000, as implied by the official data.) There are 42 country cases with the requisite data. Several features of the historical record stand out.

- Per capita income growth tends to slow after countries reach China's current level. Some 33 of the 42 country cases experienced slowdowns, as evidenced by the preponderance of observations below the 45-degree line, with the median growth rate falling from 4.1 percent to 2.5 percent. Where growth does speed up, the increase tends to be small.
- The decline in growth rates extends across the distribution, with the 90th, 75th, 25th, and 10th percentiles all moving markedly lower.
- The relationship between growth before and growth after reaching China's income level is fairly weak. Indeed, a univariate regression yields an $\overline{R}^2$ of just 0.15. As applied to China, the estimated relationship points to a per capita income growth rate of 3.6 percent over the next decade, but with a roughly one-in-four chance of exceeding 4.5 percent and a similar chance of falling below 2.7 percent.
- The weak relationship between past and future growth implies that slowdowns tend to be sharpest where growth had previously been fastest. This result mirrors the finding in Pritchett and Summers (2014) that regression to the mean is a robust feature of cross-country growth rates.[11]

Chart 3
Real Per Capita GDP Growth, Before and After Reaching China's 2018 Level

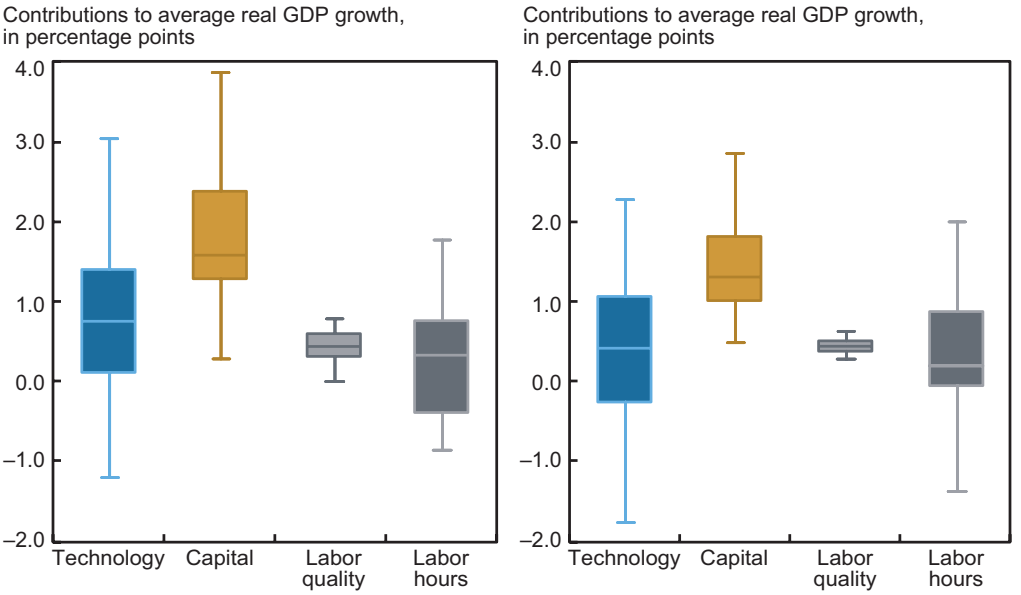


Sources: Penn World Table (version 9.1); IMF, World Economic Outlook database; author's calculations.

Chart 4 contains "box and whiskers" diagrams for the sources of growth after countries reach China's current income level, with the top panel referring to the first ten years. The boxes contain the interquartile range (25th to 75th percentiles) and a line for the median outcome. The whiskers show the upper and lower limits of the distribution after excluding extreme outliers.[12] Note that these distributions do not sum to the distribution for GDP growth. For example, the sum of 75th percentile values for the four categories is well above the 75th percentile for GDP growth.

- Capital accumulation is typically the largest source of growth in the decade after countries reach China's income level, with the median annual contribution at 1.6 percentage points, and the 25th percentile not that much lower, at 1.3 percentage points. Moreover, the distribution is skewed to the upside, with one-fourth of the sample seeing a contribution greater than 2.4 percentage points.
- Productivity gains are typically the second largest source of growth, with a median annual contribution of 0.8 percent. Dispersion in TFP growth is fairly wide. While nearly a quarter of the sample saw TFP growth of more than 1.4 percent, another quarter saw negligible or even negative growth.
- Improvements in labor quality typically contribute about 0.5 percentage point to annual GDP growth after countries reach China's income level. Dispersion is small. No country saw a negative growth contribution—something that would correspond to a drop in average years of schooling—and only a few saw contributions of above 0.8 percentage point.
- Growth in aggregate hours worked is typically the smallest source of growth, with a median annual contribution of just 0.3 percentage point. Dispersion is relatively wide, with roughly a quarter of the sample seeing contributions above 0.7 percentage point,

Chart 4
Sources of Growth after Reaching China's 2018 Income Level: First Decade



Source: Penn World Table.

Notes: Figures show distributions for the sources of growth in the decade after countries pass China's 2018 real income per capita level. Boxes contain interquartile range (25th to 75th percentiles) and median line. "Whiskers" show minimum and maximum values. Extreme outliers excluded via "Tukey industry standard." Number of observations = 43 (left panel); 26 (right panel).

and another quarter seeing contributions below -0.3 percentage point. Keep in mind, however, that the implications for *per capita* income growth are more muted, given that total and working-age populations tend to move together. More important for our purposes, the evolution of these variables in China over the next two decades is largely predetermined, making other countries' experiences of limited relevance.

Two points are worth noting concerning how growth contributions change relative to the prior decade. First, there is a strong tendency toward declines. Across the four categories, contributions fall for between roughly 60 and 75 percent of the sample. The largest declines are for TFP growth (median = −1.0 percentage point) and capital accumulation (median = −0.4 percentage point). For countries where growth contributions do pick up, the increases tend to be small.

Second, there is a strong tendency toward regression to the mean, with countries putting in the strongest performance in the pre-threshold decade likely to see the sharpest declines in the subsequent decade. Across the four categories, growth contributions move an average of 50 to 70 percent closer to the mean outcome. This fact provides a strong argument against building a growth projection for China by carrying forward its recent history.

Unfortunately, the number of country cases falls to 26 when looking to the second decade after countries reach China's income level. Moreover, the sample narrows in a way that makes

it potentially less relevant to prospects in China, now consisting largely of countries in Europe or of European settlement (for example, Australia and Canada) that passed China long ago. Nevertheless, these experiences are our best available guide to China's prospects. What lessons do they provide?

- Growth tends to slow further. In 22 of the 26 countries in our sample, growth slowed in the second post-threshold decade relative to the first, with the median growth rate (on a consistent-sample basis) falling from 2.6 percent to 1.9 percent. The rest of the growth distribution also shifts down, with the upper end of the distribution moving down especially sharply.
- Capital accumulation is typically the largest source of growth in the second decade (Chart 4, bottom panel). The median contribution comes to 1.3 percentage points, though with fairly wide cross-country dispersion. TFP growth comes next, with a median contribution of 0.5 percentage point, again with significant dispersion. Labor quality improvements also make a meaningful contribution (median = 0.4 percentage point), but growth in aggregate hours typically makes a small contribution (median = 0.2 percentage point).
- Contributions from TFP and capital accumulation typically decline relative to the previous decade, falling for about three-fourths of the sample, and with median changes of -0.5 percentage point and -0.4 percentage point, respectively. Contributions from labor quality improvements and growth in hours worked typically remain roughly stable.
- Regression to the mean continues to operate powerfully, both for per capita income growth and for growth contributions. Indeed, TFP growth and the capital contribution in the second post-threshold decade are essentially uncorrelated with their values in the first decade.

If the experience of other countries at China's income level is a good guide, per capita income growth should slow significantly over the next two decades, particularly given the country's earlier high growth rate. The slowdown should feature markedly reduced contributions from TFP growth and capital deepening. But we've left out an important part of the story thus far: China's strikingly unfavorable demographic trajectory.

5. Projections

5.1 Methodology

The key question is how to use the information developed above to inform growth projections for China. We build projections that we term the Humdrum, Pretty Good, and Golden scenarios, as follows.

The Humdrum scenario sets TFP growth over the next two decades at the median values found above, while the Pretty Good and Golden scenarios set TFP growth at the 75th and 90th percentiles, respectively (see again Chart 4). Note that the TFP gains in the latter two scenarios would be extremely difficult to achieve. In our sample of 26 economies,

only Taiwan achieved TFP growth above either the 75th or the 90th percentiles in both decades.

We considered but rejected setting the growth contribution from capital accumulation in the same manner. But matching even the 50th percentile of the contribution in our sample would require keeping investment spending as a share of GDP at close to 35 percent through the next two decades, well above the rates in other countries. (Capital expenditure spending in Japan and the Asian Tigers leads our sample, averaging roughly 30 percent of GDP.) Matching the 75th percentile would require capital expenditure spending of 40 percent of GDP, only slightly below its current level and, excepting China, higher than that of any country in the world with a GDP of more than $100 billion.

These high investment rate requirements reflect the diminishing returns to capital accumulation discussed in Section 2. Maintaining them would be inconsistent with the Chinese government's stated goal of rebalancing the economy away from an excessive reliance on investment and toward consumption. Moreover, remaining on a high-investment trajectory would result in an increasingly capital-heavy production structure, an outcome at odds with the necessity of sustaining rapid productivity growth.

In light of these facts, the Humdrum scenario assumes that investment spending as a share of GDP declines gradually from its current level, bottoming out at 25 percent in the early 2030s. This is about the 75th percentile for the 37 economies the IMF classifies as advanced. The Pretty Good and Golden scenarios assume that investment declines still more gradually, bottoming out at 30 percent in the early 2030s.

The Humdrum scenario sets the future pace of labor quality improvement at the 50th percentile of our sample of similar countries. The Pretty Good and Golden scenarios set this parameter at, respectively, the 75th and 90th percentiles.

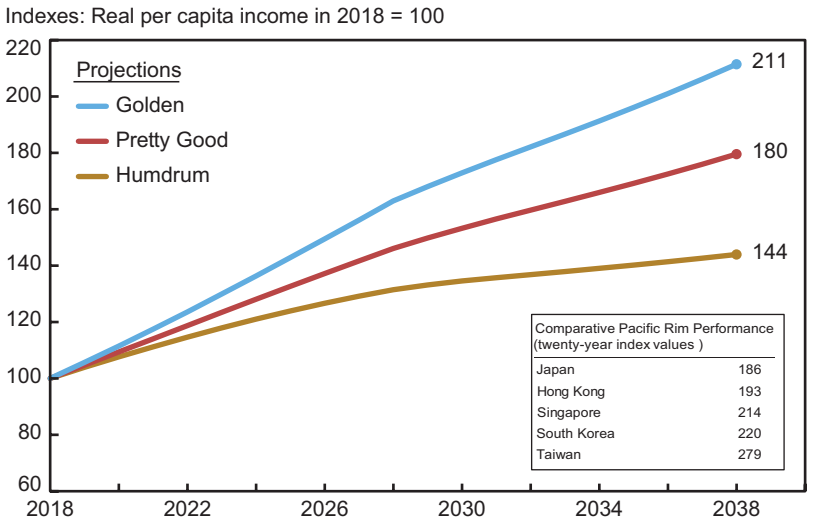
All three scenarios assume that aggregate hours worked evolves in line with China's working-age population over the projection horizon. This implicitly sets age-specific labor-force participation rates and average hours per worker at current levels. We discuss below whether plausible changes in participation or average hours might materially alter our results.

5.2 Results

In the Humdrum scenario, real per capita income growth averages a respectable 2.7 percent over the next decade. But growth falls sharply from 2028 to 2038, averaging just 0.9 percent. This would leave real per capita income 44 percent above its current level (Chart 5). By comparison, China's fast-growing Pacific Rim neighbors achieved gains of between 86 and 179 percent over a similar period. This performance would leave China well short of advanced economy status. At the end of the projection horizon, real per capita income would be just over 40 percent of the current U.S. level, and just over one-third of the future U.S. level, assuming annual increases of 1 percent for the latter.

The slowdown in growth largely reflects a reduced contribution from capital accumulation, from an average of 1.9 percentage points over the first decade of projection to just 0.4 percentage point in the second. About two-thirds of this step-down is the result of the diminishing

Chart 5
Real Per Capita Income Projections for China



Sources: Penn World Table (version 9.1); The Conference Board, Total Economy Database; national sources; author's calculations.

Note: See the text of the paper for details on the three projections.

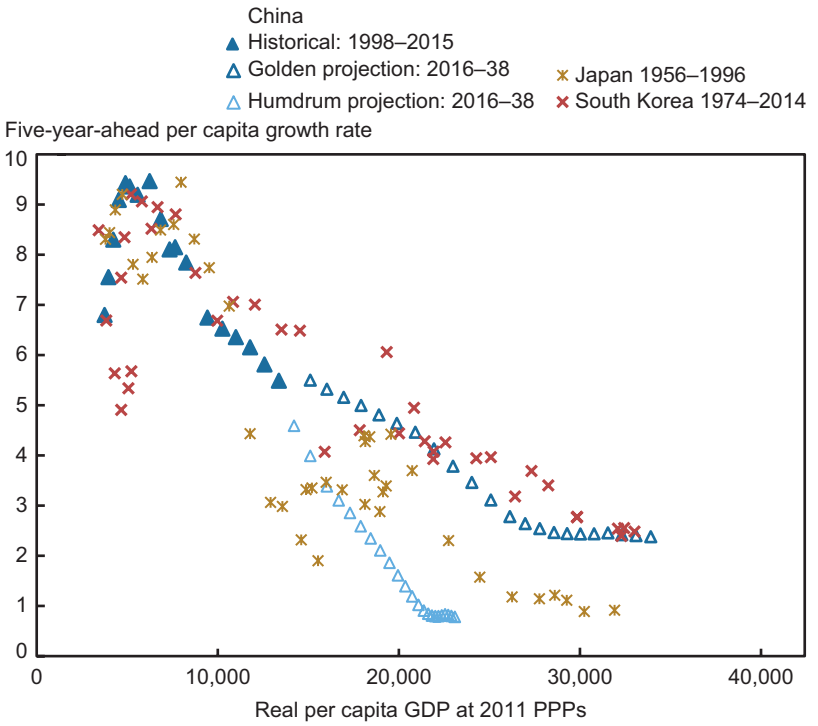
returns to capital accumulation, and the other third is from the assumed gradual decline in capital spending as a share of GDP. Demography also exerts a greater downward weight over time, with the working-age population declining by a little over 0.2 percentage point per annum over 2018-28 but by almost 0.9 percentage point per annum over 2028-38. Meanwhile, the contribution from TFP growth moves down by 0.3 percentage point, while the contribution from labor quality improvement remains essentially stable, consistent with performance by peer economies at the 50th percentile.

In the Pretty Good scenario, real per capita income growth averages a rapid 3.8 percent over the first decade of the projection and slows to 2.1 percent in the second. This performance leaves real incomes up by 80 percent from their current level, only slightly below what Japan achieved over a similar period. China would now be at the margins of high-income status. Real per capita income would be just above 50 percent of the current U.S. level, but only slightly above 40 percent of the assumed future U.S. level.

As before, a reduced contribution from capital accumulation—from 2.3 percentage points to 1.0 percentage point—explains most of the slowdown between the two decades. The contribution from TFP growth also falls, from 1.4 percentage points to 1.0 percentage point, consistent with peer performance at the 75th percentile. Changes in other factors influencing growth are much the same as in the Humdrum scenario.

In the Golden scenario, real per capita income growth averages a very rapid 4.9 percent from 2018 to 2028, slowing to a still strong 2.6 percent over 2028-38. This leaves real incomes up by 111 percent from their level in 2018, a performance comparable to what the Asian Tigers achieved over a similar period. China now achieves high-income status,

Chart 6
Per Capita Income Growth vs. PPP Income Levels



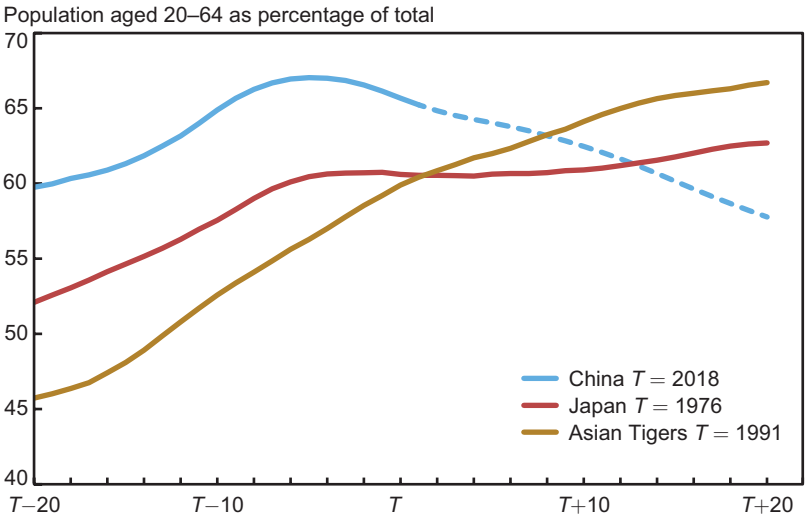
Sources: Penn World Table (version 9.1); The Conference Board, Total Economy Database; national sources; author's calculations.

Note: See the text of the paper for projection details.

with real incomes at slightly above 60 percent of the current U.S. level, or exactly 50 percent of the assumed future U.S. level. As before, the slowing in growth between the two decades mainly reflects a reduced contribution from capital accumulation (from 2.4 to 1.2 percentage points) and a slower assumed pace of TFP growth (from 2.2 to 1.3 percent).

We make no judgment as to the relative likelihood of the various projection scenarios. What the projections do make clear, however, is that events would have to unfold in a strikingly favorable manner for China to approach or reach high-income status over a two-decade horizon. As we've already noted, both the Golden and Pretty Good scenarios build in considerable upside. Among peer economies, only Taiwan placed at or above the 75th percentile for TFP growth in consecutive decades (though it also placed above the 90th). Moreover, in all three scenarios, a gradually declining but still high share of capital spending in GDP works to support growth. It also results in an increasingly capital-heavy production mix, pushing China's real capital-output ratio from near the top to the very top of the current range for major economies. There is good reason to doubt that China could sustain rapid TFP growth with such a production mix, especially given already pressing concerns about the efficiency of new investment spending.

Chart 7
Working-Age Populations, Before and After Reaching China's Current Income Level



Sources: Penn World Table; United Nations Population Database.

Notes: "*T*" indicates the year in which each economy reached China's 2018 level of per capita income at 2011 purchasing power parities. The "Asian Tigers" are Hong Kong, South Korea, Singapore, and Taiwan.

Chart 6 compares the joint evolution of real per capita income growth and per capita income levels in the Humdrum and Golden Scenarios with observed outcomes in Japan and South Korea. Income growth is shown on a leading five-year average basis, in line with the notion that growth will generally slow as an economy climbs the income ladder. The series for Japan and South Korea show outcomes from the two decades before and after the point at which those countries reached China's current real income level (1976 and 1994, respectively).

As can be seen, growth in China has tracked growth at similar income levels in Japan and South Korea fairly closely thus far. Growth in China continues to track growth in South Korea fairly closely in the Golden scenario, but falls well below outcomes in both countries in the Humdrum scenario. Although we don't show the Pretty Good scenario for reasons of legibility, China's growth rates in that case would track slightly below historical outcomes in Japan.

The aging of China's population weighs heavily on projected income growth in all three scenarios. According to U.N. figures, China's working-age population is expected to decline by about 12 percent over the next twenty years even as the total population rises slightly. As a result, the working-age (20-64) population share is on track to decline by roughly 8 percentage points over the next twenty years, from 65 percent to 57 percent (Chart 7). In contrast, the median country reaching China's income level saw its working-age population share increase by 5 percentage points over the next twenty years. The Asian Tigers did even better, with working-age population shares rising by about 7 percentage points. This is a key reason why highly favorable assumptions are needed

to support income growth projections that are in line with the achievements of China's neighbors.

Recall that the projections assume that aggregate hours worked will evolve in line with China's working-age population over the projection horizon, thus holding hours per worker and employment-population ratios constant. Could changes in these variables soften the demographic blow?

In fact, any changes are more likely to be a source of additional downside. The average Chinese worker puts in 2,175 hours per year; that's high for a country at China's current income level—100 hours above the 75th percentile for the countries in our sample. Moreover, almost all of those countries saw average hours fall over the next two decades, with the median change at -9 percent. Similarly, labor-force participation in China is quite high for a country that has reached its income level. Total employment stands at 85 percent of the working-age population, above the 90th percentile in our sample. And more than half these countries saw their employment-population ratios drop over the next two decades, although generally by only a few percentage points.

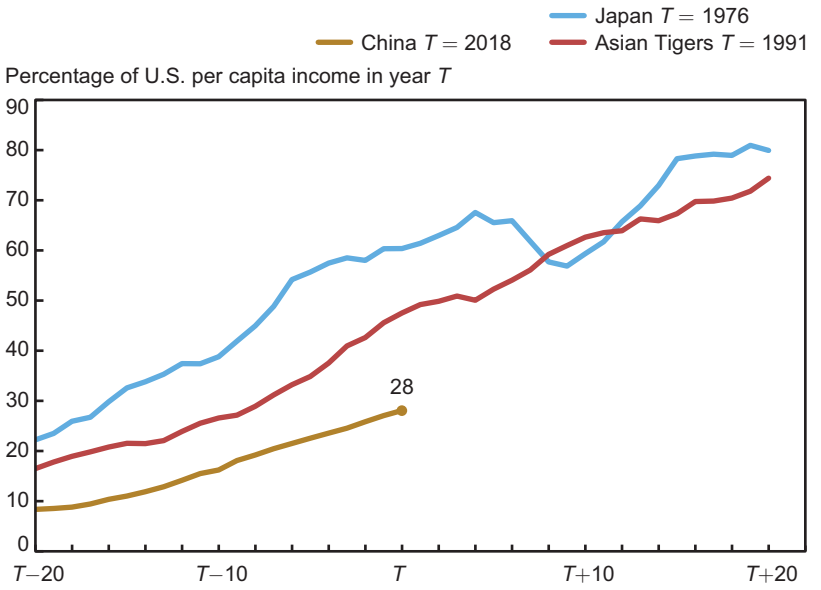
To be sure, the record does contain more hopeful precedents. Employment in Japan is now equivalent to more than 95 percent of the working-age population, up more than 10 percentage points from a decade ago. (The figure is so high because of rising employment among persons 65 and older, who are not normally counted in the working-age population.) It is possible that China will be able to replicate Japan's success. But the upside growth potential is limited. Back-of-the envelope calculations indicate that growth might run 0.3 percentage point higher were China's labor-force participation rate to reach Japan's level over the next two decades. That would raise incomes by about 7 percentage points by the end of our projection horizon—a welcome boost, but not a game-changing development. Moreover, this calculation assumes no decline in average hours worked; Japan has seen a significant drop because so many of the elderly work part-time.

Recall also that the projections assume that China's recent official GDP data are accurate. As we've discussed, the developers of the Penn Table accept the argument from Wu and other critics that recent official growth rates are overstated. As a result, real per capita income from the Penn Table is now about 18 percent lower than estimates derived from official sources (roughly $13,000 compared with $16,000). How would the different "jumping off" point affect our projection results?

Our analysis of growth experiences in other countries that have reached China's income level would now be based on a different and somewhat larger group of countries (53 cases for the first decade). Over the two-decade span, TFP growth and the growth contribution from human capital accumulation would be slightly higher, especially at the 75th and 90th percentiles of the distribution. As a result, our projections would call for a slightly faster pace of income *growth* in China. But this would not be enough to make up for the lower initial *level* of income, leaving it roughly 10 percent lower in 2038 than in the projections above.

While our projections illustrate plausible future paths, they provide only loose guidance on what is likely to occur. We don't know how growth fundamentals will evolve in China in the coming decades (even if we have a fairly good grasp of the demographic outlook). Nor do we know how policy will respond. Take the results with a healthy (unhealthy?) dose of salt.

Chart 8
Income Levels Relative to the United States



Sources: Penn World Table; The Conference Board, Total Economy Database.

Notes: "*T*" indicates the year in which each economy reached China's 2018 level of per capita income at 2011 purchasing power parities. The "Asian Tigers" are Hong Kong, Singapore, South Korea, and Taiwan.

6. Opportunities and Challenges

Prospects for rapid growth in China are buoyed by two key factors: the country's distance behind current global income leaders and its relatively low rate of urbanization. These factors could provide scope for continued rapid growth through "catch-up" effects and structural transformation.

In this connection, China is much further behind global leaders than its Pacific Rim neighbors were when they reached China's income level. At present, real per capita income in China is slightly below 30 percent of the U.S. level (Chart 8). When Japan reached China's current income level in the mid-1970s, real incomes stood at about 60 percent of the U.S. level. When the Asian Tigers reached China's current income level in the early 1990s, real incomes stood at slightly below 50 percent of the U.S. level. This introduces the possibility that China faces greater opportunities for growth via technological upgrading and adopting best practices.

Empirical studies show that there is no general tendency for countries with lower initial income levels to grow more rapidly. (See Johnson and Papageorgiou [2018] for a recent review.[13]) Many studies, however, support "conditional convergence," finding that income growth rates are negatively related to initial income levels subject to appropriate controls. (Mankiw, Romer, and Weil [1992] and many later studies condition on the determinants of steady-state incomes identified in the Solow model.) A common estimate is that countries converge toward their steady-state income levels at a rate of roughly 2 percent a year. Applied

to China, this estimate would imply a growth advantage of roughly 2.4 percentage points relative to the United States, although one that would diminish over time as the income gap narrowed.

Other studies, however, find that traditional convergence tests lack power against the alternative of multiple steady states, some involving catch-up with global leaders and some involving falling further behind (Durlauf, Johnson, and Temple 2009). From this viewpoint, countries belong to different "convergence clubs," and the issues for policy purposes concern the sorting process.

Our core point, however, holds regardless of the general power of convergence effects. The wide current income gap between China and global leaders means that China can grow rapidly for a long time before it approaches the technological frontier. There is plenty of upside, just no guarantee that it will be exploited.

China's relatively low rate of urbanization also provides upside for growth. The urban-rural income gap in China is particularly wide, and some of the historical and prospective TFP growth reflects the movement of workers from the rural sector to the higher-productivity urban sector. At present, China's urban population share stands at 58 percent. This compares with an average of 70 percent for our sample of countries reaching China's 2018 income level, and an average of roughly 80 percent among advanced economies. Very likely, China has a lower "natural" urbanization rate than many countries given its sheer size. But even roomy Russia, sprawled across eleven time zones, has a current urbanization rate of 74 percent. Migration from country to city could add to growth in China for the next decade or two.

Perhaps surprisingly, however, empirical studies do not support a clear connection between the pace of urbanization and economic performance (Bloom, Canning, and Fink 2008). While urbanization and per capita income *levels* are strongly correlated, urbanization and per capita income growth rates are not. Indeed, in recent decades, countries falling into stagnation have often seen urbanization continue apace. China will need to maintain a dynamic urban sector if it is to unlock this source of upside growth potential. Not surprisingly, generating urban employment remains a top official priority, highlighted in successive five-year plans.[14]

In short, the take-away here is much the same as for convergence. China's unfinished structural transformation leaves it with plenty of room to run. How fully China exploits this potential will depend largely on its own policies.

In this connection, institutional underdevelopment represents perhaps the biggest roadblock on China's path to high-income status. The World Bank's Worldwide Governance Indicators (WGI) data set is the most comprehensive data source on countries' institutional quality. The WGI draws on a large number of surveys from a variety of sources, normalizes them, and summarizes them according to six governance categories. Importantly, the WGI takes in assessments of norms and practices as well as formal institutional arrangements. Establishing the rule of law, for example, is not simply a matter of putting the right statutes on the books.

A look at China's performance over time, and compared with other upper-middle-income and high-income economies, is far from encouraging (Table 3). Across most governance categories, China's performance in 2017 was little better than in 2005. Moreover, China scores below the average for its upper-middle-income peers in all governance categories. Not surprisingly, then, China scores far below upper-income norms in all categories. Indeed, in five of six categories, China scores below the *worst-performing* high-income economy.[15]

Table 3

Institutional Underpinnings for High-Income Status

World Bank Governance Indicators (mean = 0, standard deviation = 1.0)

	China 2005	China 2017	Upper-Middle Income Average	High-Income Average
Regulatory quality	-0.08	-0.19	0.36	1.53
Rule of law	-0.41	-0.19	0.23	1.61
Control of corruption	-0.45	-0.15	0.10	1.64
Government effectiveness	-0.05	0.42	0.34	1.55
Voice and account-ability	-1.39	-1.48	0.35	1.28
Political stability, control of violence	-0.21	0.00	0.44	1.08

Source: World Bank, World Development Indicators database.

Notes: Each indicator is constructed from a variety of surveys, which are normalized and combined via unobserved components analysis. The sample includes 121 countries, and excludes OPEC countries and those with populations of less then 3 million. Income categories are based on 2017 per capita income (in U.S. dollars). High-income countries occupy the top quintile (>$21,150, about 35 percent of the U.S. level), and upper-middle-income countries occupy the next highest quintile ($6,732 - $21,149).

China's current governance rankings allow for three distinct possibilities:

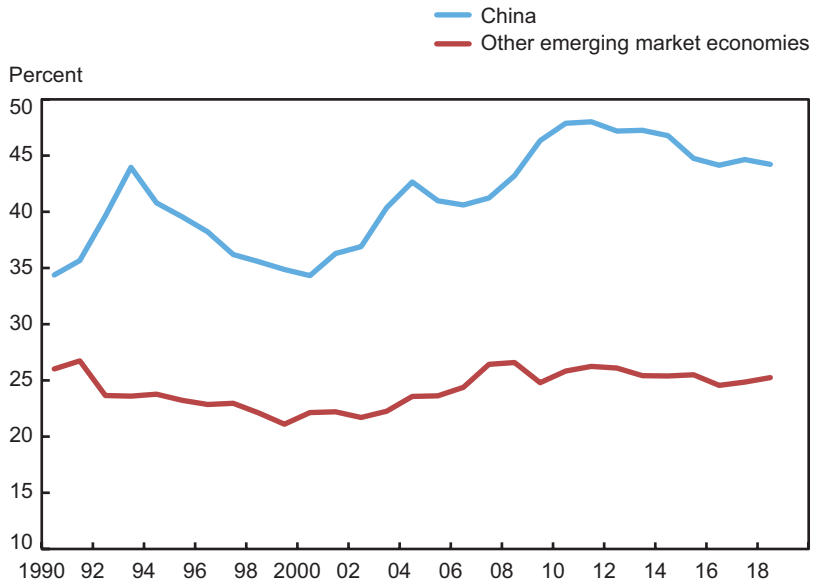
- China's governance quality will rise over time, either through deliberate reform efforts or endogenously with the country's level of income, allowing it to achieve high-income status.
- China will fail to achieve adequate governance improvements, leaving it caught in the middle-income trap.
- China will prove a unique case, attaining high-income status while retaining governance features unlike those of all current high-income economies.[16]

Chinese authorities have been clear about their plans to proceed with market-oriented reforms. But authorities have been equally clear that the Communist Party will retain control over the commanding heights of the economy and over political life. And in this connection, policy is currently moving in the wrong direction, toward greater state and party control of the economy. (Lardy [2019] provides a comprehensive account of the policy shift.) In short, we face a test of the third possibility above.

We close by briefly taking note of some additional obstacles to continued rapid growth.

China faces a daunting rebalancing challenge. The share of capital expenditure in GDP has been close to or above 45 percent since 2009 and above 30 percent since the late 1970s (Chart 9). This represents a lopsided expenditure profile even by the standards of China's high-income East Asian neighbors. Japan, Taiwan, and Hong Kong never saw capital

Chart 9
Capital Spending as a Share of GDP



Sources: IMF, World Economic Outlook database; author's calculations.

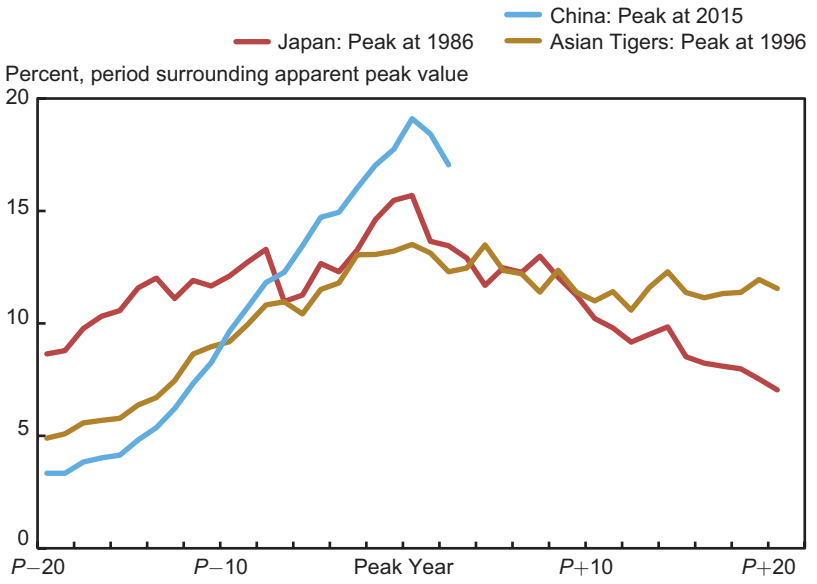
expenditure reach 40 percent of GDP during their high-growth periods; South Korea reached that level only once. None of these economies sustained capital expenditure shares above 30 percent for much more than twenty years; China is approaching 50 percent. Only tiny Singapore devoted a comparable share of national income to capital accumulation during its high-growth period.

The need to rebalance China's growth model away from excessive reliance on investment spending, and toward greater reliance on consumption, has been widely discussed for at least two decades. Rebalancing has been an official goal of economic policy since the implementation of the Eleventh Five-Year Plan in 2004, with capital expenditure as a share of GDP falling by almost 3½ percentage points over the past five years. Yet, at that pace of decline, China's capital expenditure share would remain above 30 percent until the early 2040s. Faster progress will be essential for a successful transition from resource-led to innovation-led growth.

China's credit-centered growth model has pushed credit to the private nonfinancial sector relative to GDP to the highest in the world (except for a few financial entrepôts), resulting in significant legacy financial problems. The need to restrain credit growth weighs on growth prospects in two ways. Most immediately, it limits authorities' ability or willingness to employ a primary macroeconomic support tool when growth falters. Less immediately, to the extent that the credit tool is employed, the odds of an eventual growth-crimping credit shakeout mount that much higher.

A final headwind for growth comes from the external side. China's fast-growth neighbors reached China's current income level during a period in which global trade growth was running well ahead of global production growth, underwriting export-oriented

Chart 10
Shares of Global Manufacturing Exports



Sources: IMF, *World Trade Statistics*; World Bank, World Development Indicators database.

Note: The "Asian Tigers" are Hong Kong, Singapore, South Korea, and Taiwan.

development strategies. Global trade volumes grew more than twice as fast as production volumes from 1991 to 2001, the decade after the newly industrialized economies (NIEs; Hong Kong, Singapore, South Korea, and Taiwan) reached China's income level. Global trade volumes grew roughly 1½ times as fast as production volumes from 1976 to 1986, the decade after Japan reached China's income level. This support for growth is apparently a thing of the past. Since 2011, global trade volumes have grown no faster than production volumes.

Moreover, China's already high penetration of foreign markets will make it difficult to expand exports via gains in market share (Chart 10). Indeed, China's share of global manufacturing exports has apparently already peaked, mirroring developments in Japan and the NIEs from similar income levels. Last but not least, external support for growth will remain scarce absent a resolution of the current trade dispute with the United States.

7. Conclusion

China's growth record has been remarkable, lifting the country from poverty to middle-income status in the span of a few decades. Analysis based on the neoclassical growth model reveals that China's rise has come from high, sustained productivity growth, alongside an outsized contribution from capital accumulation given the country's high investment rate. The question for the future is whether this growth recipe will be enough to propel China to high-income

status. To address it, we develop a set of projections informed by the experience of other countries at China's income level. The results are stark. Given growing drags from an aging population and diminishing returns to capital, China can attain high-income status in the coming decades only through productivity gains at the top end of the observed historical range. In short, reaching the income frontier depends on a successful transition from resource-led to innovation-led growth.

To succeed, China will almost certainly need to make large strides in institutional development, putting in place the legal, regulatory, and informal frameworks that support high-income status elsewhere. The apparent turn back toward a more state-directed development strategy leaves ample room for skepticism about China's growth prospects. But we shouldn't be too sure. China's growth performance has surprised the skeptics thus far.

Appendix: Data Sources and Projection Methods

Our projections are benchmarked to the latest vintage of the Penn World Table (Version 9.1, 2019). Feenstra, Inklaar, and Timmer (2015) provide a comprehensive treatment of the conceptual and measurement issues involved in constructing the data set. This source provides data or estimates over 1950-2017 for 182 countries on the following key variables: real GDP, real capital stock, employment, average hours worked (most countries), labor quality (most countries), the labor income share, the depreciation rate of the capital stock, and total factor productivity.

For real GDP, there are three important series: one with real expenditure measured at constant national prices (RGDPN), another with real expenditure measured at current purchasing power parities (CGDPE), and a third with real expenditure measured at constant purchasing power parities (RGDPE). The first is suited to measurement of growth rates over time in a given country; the second is suited to the comparison of living standards at a given time; and the third is designed for comparing living standards across countries and over time. Figures cited in the text and charts conform to this breakdown.

The Penn Table relies on the work of the Income Comparisons Project (ICP). The ICP is a World Bank initiative under the auspices of the United Nations and represents a multi-decade effort to place countries' national accounts on a comparable basis. The project involves periodic, highly detailed surveys of prices and expenditure patterns for a large number of countries. The World Bank statisticians then use this information to restate national GDP figures in purchasing power parity terms, that is, with reference to a standard consumption basket. The IMF's WEO Database and the Penn World Table also rely on the results of the ICP to construct cross-country databases on GDP at purchasing power parity. Also, all of these sources supplement the ICP data with more frequent surveys conducted by Eurostat and the Organisation for Economic Co-operation and Development (OECD) for member countries.

Purchasing power parity estimates are subject to error. Countries differ widely in their consumption and production baskets at a given time, and consumption and production baskets change widely over time. Data construction inevitably involves imputations and, at times, judgmental adjustments. Comparisons of real income levels across countries—and especially, across countries and over time—should be regarded as approximate.

The data in the Penn Table go only through 2017. To fill in data for 2018, we take data from Chinese official sources and, for some variables, the Conference Board's Total Economy Database. Also, as noted in the text, our projections assume that the GDP growth rates in the Chinese official data are accurate after 2011, the date of the last ICP benchmark survey. In certain places in the text, however, we make comparisons between official and "Penn Table" values for 2018. These Penn Table values are also derived from the Total Economy Database, since it also incorporates downward adjustments to Chinese official growth rates based on the work of Wu and his coauthors.

Three variables are missing for a few countries involved in our analysis: average hours per worker, human capital per worker, and the input to GDP from capital services. (The number of countries without these series is, respectively, two, one, and three.) Where average hours and human capital levels are not reported, we treat them as constant. Where the input from capital services is not reported, we set growth in this variable equal to growth in the real capital stock.

Appendix (Continued)

For countries where both variables are available, this relationship tends to hold quite closely, especially over spans of more than a few years. A regression of services growth on stock growth over non-overlapping ten-year periods yields the following: $\hat{\beta} = 0.99, t - stat. = 40.8, \overline{R}^2 = 0.75, N = 591$.

Our projections for China also assume that future growth in capital services is equal to growth in the real capital stock, with the latter derived in the usual manner from the perpetual inventory method. Finally, it should be noted that our projections implicitly assume that relative prices and the composition of capital expenditure across types of goods remain at their current values. Large departures from these assumptions could have a meaningful impact on our results, though in a direction that would depend on their precise character.

Notes

[1] The Penn Table and official sources such as the IMF and World Bank report similar figures for real GDP at purchasing power parity in 2011, based on the latest multi-country price and expenditure survey conducted for the United Nations' Income Comparisons Project. Outside of 2011, figures for China diverge. The IMF and the World Bank derive figures for other years via extrapolation at official growth rates; the Penn Table relies on its own growth estimates. Figures for other countries also diverge outside, albeit less dramatically, with the Penn Table data adjusted to align with the results of earlier ICP surveys. See the Appendix for details.

[2] Chinese real per capita income at purchasing power parity ranks 43rd out of 106 countries in 2018 using the IMF or World Bank data. China ranks 45th among the same 106 countries in the Penn Table.

[3] Growth has averaged 5.1 percent since 2011 in the Penn Table, a decline of 5.2 percentage points from the previous seven-year period. Growth has averaged 7.1 percent since 2011 in the official data, a decline of 4.0 percent from the earlier period.

[4] With a constant savings rate s^*, a capital depreciation rate δ, and labor force growth at the rate $\widehat{N}^*$, the long-run capital-output ratio is given by: $k^* = s^* \left\{ \left(1+\widehat{N}^*\right)\left(1+\hat{A}\right)^{1/1-\alpha} - (1-\delta) \right\}^{-1}$ The contribution of capital accumulation to growth in the steady state is given by: $\frac{\alpha}{1-\alpha}\hat{A} + \alpha\widehat{N}^*$.

[5] See Inklaar, Woltjer, and Gallardo Albarrán (2019) for details on the theoretical background and data construction.

[6] In particular, per capita income growth will be given by: $\widehat{Y}^* - \widehat{N}^* = \hat{A}^*/(1-\alpha) + \widehat{hc}^*$, where the * denotes long-run values. Of course, population growth and human capital upgrading—especially if the latter is based on average years of schooling—could settle at zero in the long run.

[7] This limitation spawned a large literature featuring endogenous technological change beginning in the mid-1980s under the banner of the "new growth theory." But this effort petered out by the late 1990s without reaching a clear consensus, and with little impact on subsequent growth accounting studies. See Romer (2015).

[8] The official transcript of Premier Li's remarks is at: http://www.npc.gov.cn/zgrdw/englishnpc/Speeches/2016-03/18/content_1985677.htm. See also Li's remarks in the Netherlands in 2018, at: http://english.gov.cn/premier/speeches/2018/10/18/content_281476350372342.htm. Former Finance Minister Lou's comments on the risk of a middle-income trap were covered extensively in the press, including at: https://www.scmp.com/news/china/economy/article/2116295/has-china-really-avoided-middle-income-trap. Lou has since said that recent reforms have substantially diminished that risk.

[9] The IMF offers no precise definition for its high-income grouping, but membership has conformed quite closely to the "greater than 50 percent of U.S." metric since that organization introduced income categories in the May 1980 *World Economic Outlook*. (The high-income group is now referred to as "advanced economies" but originally went by the moniker "industrial countries.") The World Bank's classification scheme is defined in U.S. dollar terms, with income thresholds adjusted upward over time based on inflation in special drawing rights countries to preserve a link with real purchasing power. But these thresholds seem unreasonably low. The upper-income category includes countries with per capita incomes as low as $12,056, just 19 percent of the current U.S. level. The upper-middle-income category extends down to $3,896, just 6 percent of the U.S. level.

[10] Our selection algorithm in fact requires at least seven years of growth history before and after passing this threshold. (Growth rates are annualized.) In addition, we eliminate cases in which countries slip back below the income threshold within three years.

[11] Consider regression to mean from the standpoint of a simple linear model. Given the data in Chart 3, we can estimate $After = \alpha + \beta^* Before + \varepsilon$. We derive the estimate $\hat{\beta} = 0.31$, with a t-statistic of 2.89. The change in growth rates is simply, $After - Before$ with an implied coefficient of $\hat{\beta} - 1 = -0.69 (t - \text{statistic} = -6.35.)$ A country that grows 1 percentage point faster in the "before" period tends to grow roughly 0.3 percentage point faster in the "after" period, or equivalently, to slow by roughly 0.7 percentage point more than the norm.

[12] The "Tukey industry standard" calls for excluding observations that reside more than 1.5 times the length of the interquartile range outside of it. Under a normal distribution, such outliers would include roughly the lower and upper 0.3 percent of outcomes.

Notes (Continued)

[13] Lee (2017) considers convergence in the context of China's growth experience.

[14] See the plan draft at: https://en.ndrc.gov.cn/newsrelease_8232/201612/P020191101481868235378.pdf. A natural counterpart to urbanization is a shift in the composition of employment, out of agriculture and into the industrial and service sectors. Agricultural employment remains at 27 percent of the labor force, compared with an average of 12 percent for countries reaching China's income level, and an average of 3 percent for advanced economies. The ongoing shift of labor from agriculture to higher-productivity sectors should add to productivity growth in the coming decades. However, "shift-share" analysis reveals that productivity gains from labor reallocation are past their high point. (We rely on data on real output and employment in agriculture, industry, and services.) Over the past five years, labor reallocation has added an average of 1.2 percentage points to growth in output per worker, down from a five-year average of 1.8 percentage points five years ago, and a peak of 2.6 percentage points ten years ago. The key reason is that labor has now begun to shift out of the industry and into services, a sector with an intermediate level of productivity.

[15] China scores above Israel in Political Stability and Control of Violence, a category that also encompasses the incidence of terrorism.

[16] A comparison with Singapore is instructive, since Chinese officials often cite that country as a model for their own: Singapore has attained exceptional institutional effectiveness and high-income status despite having political institutions that are well short of fully democratic. Singapore is the lowest-rated high-income country in the most relevant category, Voice and Accountability, at -0.11, slightly below the average for all countries. China has a long way to go to match its putative model, scoring -1.48.

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ECONOMIC POLICY REVIEW

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