
Prospects for China's Long-Term Growth amidst Population Aging¹

December 12, 2023

I. Introduction

1. China is undergoing a great demographic reversal. The country's reform and opening-up over the past four decades, combined with favorable demographic dynamics, have played a crucial role in driving rapid economic growth, lifting China to the status of global economic powerhouse. However, some positive trends for China's growth are now reversing. After the working age population (ages 15–64) peaked in 2013, China's total population fell by 850,000 people in 2022 to 1.41 billion, marking its first drop since 1961. The declining fertility rates and increased longevity have resulted in a rapidly aging population. The demographic dividend that China has enjoyed for the past decades is turning into a demographic burden.

2. This note presents a set of long-term growth projections for China in the context of its rapid demographic transition. It examines China's demographic trends and growth potential, explores various scenarios to account for uncertainty in productivity trends, and discusses policy options to mitigate demographic and other growth headwinds.

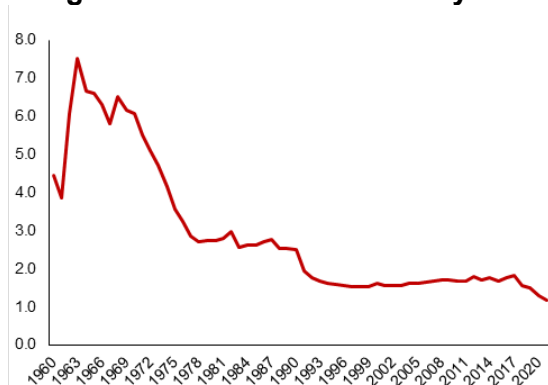
II. Demographic Headwinds

3. Policy-induced demographic changes have generated a strong tailwind for China's economic growth from the 1980s through the 2010s. Before the well-known one-child policy took effect in 1979, China had already enforced stringent family planning policies in the early 1970s (Zhang, 2017). As a result, China's total fertility rate (TFR) declined drastically from 5.7 in 1969 to 2.7 in 1978. With the introduction of the one-child policy, the TFR fell below the replacement rate of 2.1 in the early 1990s and further declined to 1.6-1.7 in the first two decades of this century (Figure 1). Lower fertility led to slower population growth and reduced youth dependency ratios (Figures 2 and 3). By bringing economic benefits such as rising savings rates, higher female labor force participation and better health and education for children, a decrease in the youth dependency ratio constitutes the key element of the so-called demographic dividend (Bloom et al, 2016). In China, the two periods with rapid declines of youth dependency ratio in the past forty years – 1978-1985 and 2000-2006 – led the two

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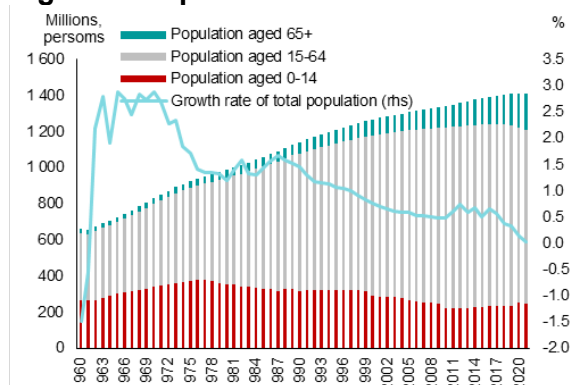
phases of high cyclical growth by roughly two years (Figure 4), possibly suggesting an important role played by demographic factors in China's post-reform growth.²

Figure 1. China's Total Fertility Rate



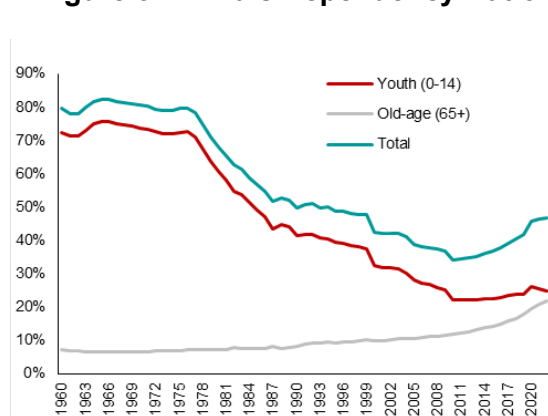
Source: United Nations Population Database.

Figure 2. Population and its Growth Rate



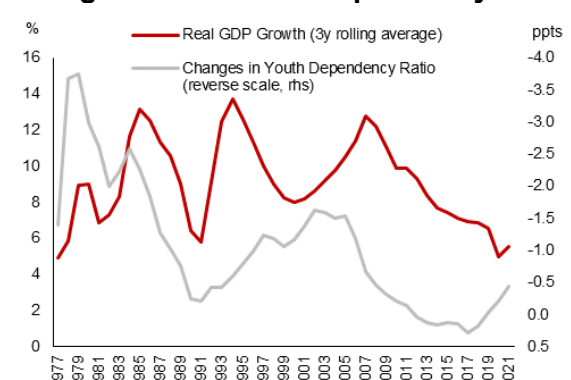
Source: China NBS, United Nations Population Database.

Figure 3. China's Dependency Ratio



Source: China NBS, United Nations Population Database.

Figure 4. China's GDP Growth and Changes in the Youth Dependency Ratio



Source: China NBS, United Nations Population Database.

4. However, the tailwinds have now shifted to headwinds, as the declining fertility rate has ultimately reduced the size of the working-age population. The working-age population has trended down since 2014, and the total population also started to shrink in 2022. More pronounced changes occurred in the age structure of the population. The proportion of working-age population decreased from its peak of 74.5 percent in 2010 to 68.1 percent in 2022, while the elderly population aged 65 or above increased from 8.9 percent to 14.9 percent of total population. Concurrently, the old-age dependency ratio, which measures the number of elderly individuals relative to the working-age population, climbed from 11.9 percent to 21.9 percent, contributing more than two-thirds of the rise of the total dependency ratio (Figure 3). In addition to the fertility decline, rising longevity, partly associated with improved medical care and living standard, has also contributed to the increase in the old-age dependence ratio (Figure 5).

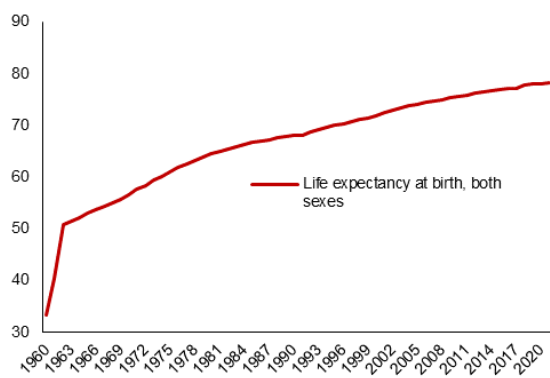
5. The ongoing adverse demographic dynamics are anticipated to persist. Demographic changes occur slowly but are often unstoppable once they take root. In the

² The start of reform and opening up following the 1978 Third Plenary Session and China's accession to the World Trade Organization in 2001 may be deemed more influential factors than population alone in driving the high growth observed in these two periods. These events played a crucial role in shaping China's economic landscape.

coming decade, with the post-famine baby boomers entering the 65-plus age group, China's rapid aging will further accelerate (Figure 6). Over a longer time span, the UN projects that the share of old-age population in China will double to 30.1 percent in 2050, lifting the old-age dependency ratio and total dependency ratio to 51 percent and 71 percent respectively. Under this baseline projection, total population is expected to shrink by 7 percent to 1.31 billion in 2050, with sharper contractions in youth and working-age populations (Figure 7).

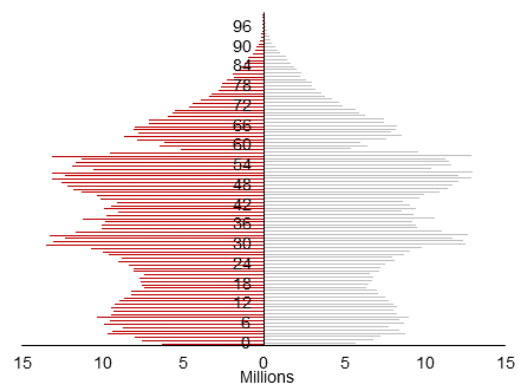
6. The low fertility rate is challenging to reverse, especially when considering the historical trends observed in other regional economies. Despite the relaxation of the one-child policy in 2013 and 2016, China TFR continued to fall. Partially reflecting the impact of the COVID-19 pandemic, China's TFR in 2022 plummeted to 1.09. However, even before the pandemic, China's TFR was 1.5 in 2019, a level known as the threshold of "low fertility trap".³The UN's "medium-fertility" baseline projection assumes the China's fertility rate will rise to 1.39 in 2050 and 1.44 in 2100, which may still prove to be overly optimistic considering the prevailing low birth rates observed in other East Asian economies. In most of China's neighboring economies, TFR continues to fall along with income growth, even though it is already at very low level (Figure 8).

Figure 5. China's Life Expectancy at Birth



Source: United Nations Population Database.

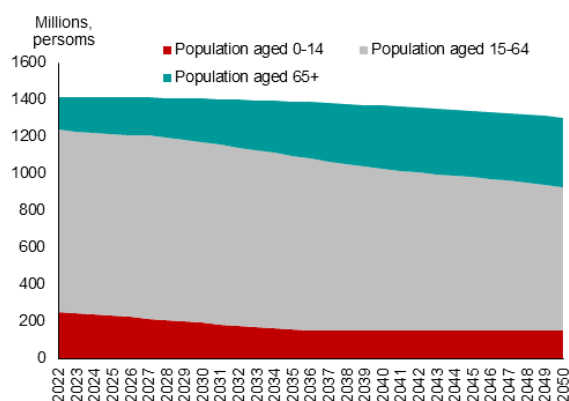
Figure 6. China's Population Pyramid, 2020



Source: The Seventh National Population Census, China NBS.

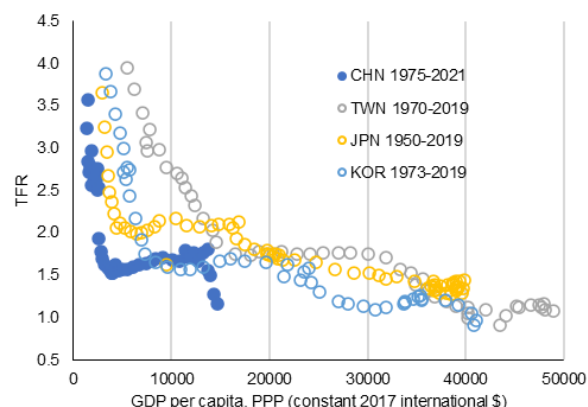
³ The hypothesis of a 'low-fertility trap,' proposed by Lutz et al. (2006), posits that once the Total Fertility Rates (TFRs) have declined to a level below 1.5, three self-reinforcing mechanisms - demographic, sociological, and economic - work toward maintaining a downward spiral in fertility that is difficult to recover from. Lutz et al. (2006) observed that no country with a fertility rate below 1.5 has successfully reversed this trend.

Figure 7. UN Population Projection for China (medium variant)



Source: The 2022 Revision of World Population Prospect, United Nations.

Figure 8. Total Fertility Rate and per Capita Income in Selected East Asian Economies



Source: United Nations Population Database, Penn World Table.

7. The shifting demographic forces will affect China’s growth prospects in various ways. One key impact will be the reduction in labor supply due to the decline in the working-age population. As the proportion of elderly individuals increases, overall labor force participation is expected to decline as they tend to participate less in the labor force. Population aging may also lead to a reduction in productivity, as the benefits of greater work experience may be offset by the loss of knowledge and skills and poorer health of older workers. Low job mobility among older workers may also impede the diffusion of knowledge and technology. Empirical studies have generally found a negative correlation between the age structure of the population and overall productivity, although the extent may vary across different sectors and types of jobs.⁴ The IMF (2017a) estimated that the projected aging of the workforce in China will reduce the growth of total factor productivity by 0.3 percent per year over the period 2020-2050. In addition, population aging is often associated with higher government expenditure on healthcare and social services, which requires higher taxation or the crowding out of potentially productive public spending such as education and research, further impairing long term growth potential.

8. The expected population aging is likely to dampen investment, posing challenges to China’s economic landscape. As the share of the labor force in the population decreases, aging raises the amount of capital per worker. In a typical emerging economy with a high degree of complementarity between capital and labor, a rising capital-labor ratio will lower the return to capital relative to return to labor⁵, reducing the firms’ incentive to invest. In China, with the total population shrinking at an accelerating pace and urbanization decelerating, the projected demographic changes may also dampen demand for investment in housing and infrastructure, the two key drivers of growth during the past two decades.

9. The connections between population transition and savings are more intricate. Falling fertility gradually reduces the number of dependent children and related childcare spending, enabling people to save more for the future. Rising longevity and the motivation to

⁴ See, for example, Feyrer (2017), Aiyar, Ebeke and Shao (2016), Westelius and Liu (2016) and Daniele, Honiden and Lembcke (2019).

⁵ Although early studies often found that the elasticity of substitution between capital and labor is below unity, more recent cross-country studies provided contradictory estimates (Duffy and Papageorgiou, 2000; Karabarbounis and Neiman, 2014). IMF (2017b) suggested that the elasticity of substitution is greater than one for advanced economies and less than one for emerging economies.

finance old-age consumption can also encourage household saving. Coupled with the rising share of prime savers, i.e., populations between 45 and 64 years of age, the early stage of population aging tends to lift private savings. In the late stage of aging, in which the share of the 70-plus age group rises, private savings are expected to fall as the retired dissavers dominate savers.

III. Predicting Growth Potential

10. Demographic changes, demand restructuring, and decelerating productivity growth may collectively impede China's growth in the coming decades. Economists widely use growth accounting to dissect the sources of economic growth and project the future growth potential. Based on the neoclassical production function, the growth accounting approach breaks down economic growth into components associated with changes in factor inputs and a residual, total factor productivity (TFP). As discussed in the previous section, population dynamics affect all these supply-side factors of economic growth. However, the prospects of these growth sources are also determined by other key features of the Chinese economy. Specifically, the ongoing domestic rebalancing may necessitate maintaining investment growth at a slower pace than GDP growth for an extended period, suggesting a diminishing contribution from capital accumulation to economic growth. China's productivity is also likely to slow down as the economy has shifted from manufacturing to services (Baumol, 1967), and the once high efficiency gains from market-oriented reform have largely been exhausted. Moreover, the rising geopolitical tension with the US is expected to weaken China's economic ties with the developed world, slowing the related technology transfer, learning and spillover.

11. In a standard growth accounting exercise, China's potential growth is projected to average 3.2 percent over the coming three decades.⁶ The trend growth is expected to gradually decelerate from the current 4.9 percent to 3.7 percent by 2030, and further ease to around 2.4 percent in 2040s (Figure 9).

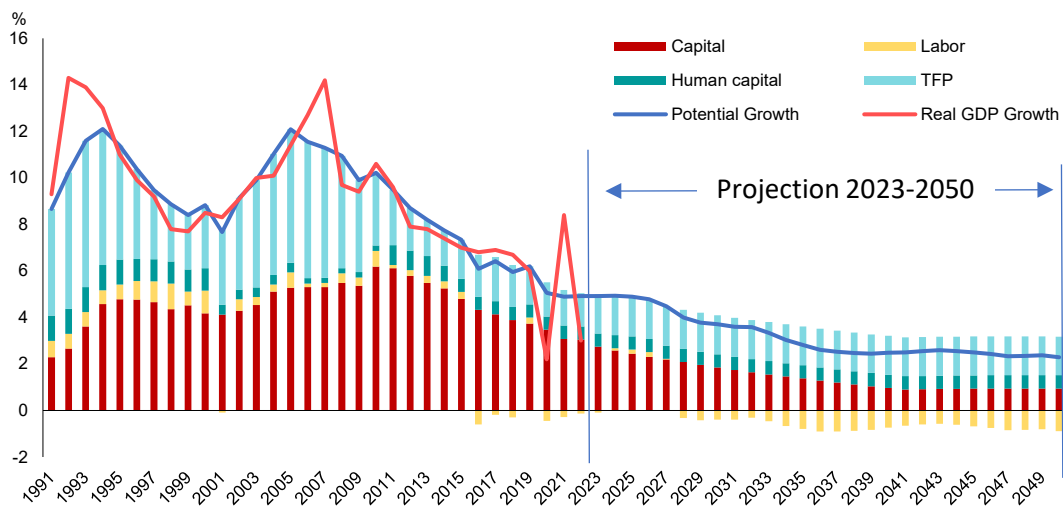
- **(Labor)** The projection of labor force is based on the UN's medium variant population scenario (Figure 7) and assumes a constant labor force participation rate in the future. Albeit declining in recent two decades, China's aggregate labor force participation rate is still higher than those in Japan and Korea (Figure 10). Human capital is assumed to grow at its current pace of 0.95 percent per year in the next thirty years. As a result, China's human capital index is projected to reach the same level as Japan and Germany in 2019 by the year 2050. Overall, over the period of 2023-2050, the increase in human capital will fully offset the drag from a shrinking labor force on potential growth.
- **(Capital)** The continuation of growth rebalancing will lower China's investment rate in the coming decades. Drawing insights from the historic experiences of Japan and Korea, it is assumed that China's share of gross fixed capital formation in GDP will decrease to 36 percent in 2030 and further to 30 percent in 2040, stabilizing thereafter (Figure 11). Despite the decrease in the investment rate, the capital stock will grow at a compound annual rate of 3.6% from 2023 to 2050, contributing to 46 percent of the GDP growth.

⁶ See Appendix A for the methodological description.

- **(Productivity)** Over the past decade, China's productivity gains have slowed significantly, partly attributed to its growth model that is heavily reliant on investment after the GFC (Brandt et al, 2020). The impact of the COVID-19 pandemic has further dampened productivity growth during the years 2020-2022. Given the productivity headwinds outlined above, this projection assumes that China's TFP will grow by 1.7 percent per year from 2023 to 2050. The growth rate is 0.25 percentage points lower than the pre-pandemic level observed from 2010 to 2019.

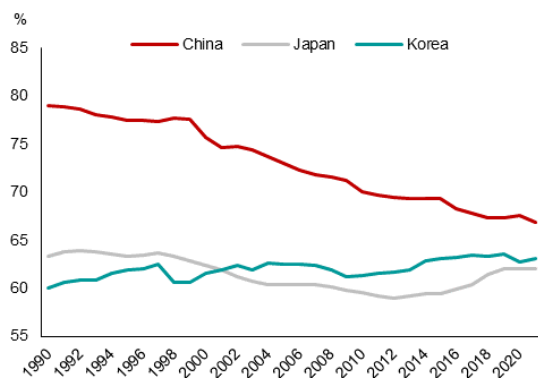
12. Our projection is broadly consistent with various recent estimates of China's growth potential. While earlier studies tended to be more optimistic about China's medium-term growth, most recent estimates of the potential growth rate of the 2021-2030 period cluster within a relatively narrow range of 4.0 percent to 5.0 percent (Table 1). Furthermore, the available estimates indicate a notable deceleration in growth during the 2030s. This suggests that China may face challenges in sustaining the higher growth rates witnessed in the past and may need to address potential factors contributing to the growth slowdown in the coming years.

Figure 9. Estimate and Projection of China Potential GDP Growth Rates



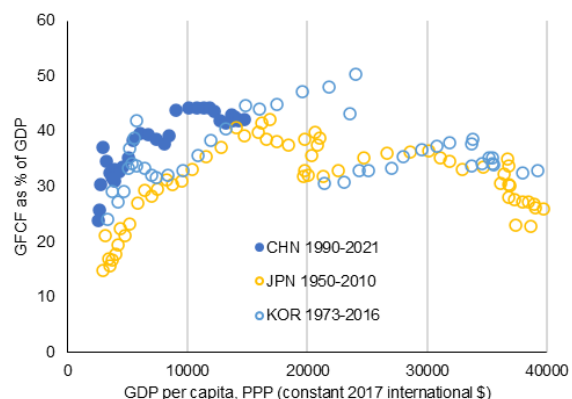
Source: Authors' estimation

Figure 10. Labor Force Participation Rate (age 15+)



Source: World Bank.

Figure 11. Gross Fixed Capital Formation and per Capita Income in China, Japan and Korea



Source: China NBS, Penn World Table.

Table 1. Comparison of Long-Term Growth Forecasts for China

	2021-30	2031-40	2021-50
This study	4.5	2.9	3.1
IMF – Oeking, Novta and Zhang (2023)	4.0 (2023-2027)	3.0 (2028-2037)	
CASS - Zhang and Wang (2023)	5.0	4.0	4.0
ADB - Peschel and Liu (2022)	4.4	2.3	
S&P - Kuijs (2022)	4.5	3.1	
Lowy Institute - Rajah and Leng (2022)	4.2		2.5
Bank of Japan – Sasaki et al (2021)	5.2		
People’s Bank of China (2021)	5.1-5.7 (2021-25)		
World Bank – World Bank (2020)	6.0		

Source: Authors' compilation.

IV. Alternative Growth Scenarios

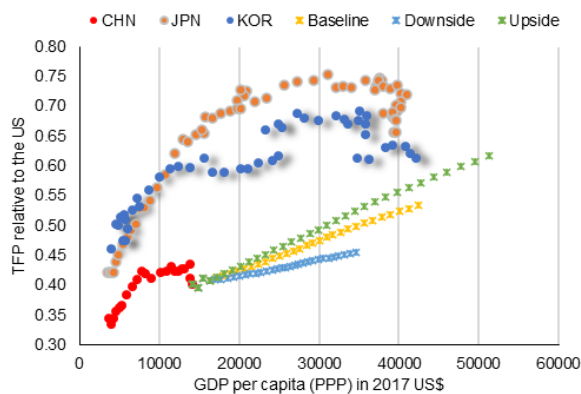
13. The trajectory of China’s productivity trend is marked by a significant degree of uncertainty; nevertheless, the sustained growth of the nation is intricately tied to the direction in which productivity unfolds. Given the challenging demographic outlook and limited scope for additional expansion through the accumulation of capital, the attainment of rapid productivity growth is key for China to sustain its economic expansion. In comparison with regional peers such as Japan and Korea, China still lags significantly behind the global productivity frontier, implying considerable potential for further fast catch-up growth (Figure 12). However, potential per se does not guarantee its exploitation. The "club convergence" hypothesis posits the existence of multiple steady states, with members in different clubs converging toward different steady-state equilibria depending on their structural characteristics and initial conditions. Analyzing China’s growth experience from 1995 to 2019, Fernández-Villaverde *et al* (2023) argue that China’s TFP catch-up may follow a parsimonious model, resulting in a final TFP of 46.7 percent of the U.S. level, significantly falling short of Japan and Korea, which stand at around 65 percent. Indeed, the risks of deglobalization and the less favorable external environment have clouded China’s technological convergence, presenting obstacles to its progress toward the global frontier. However, further policy and institutional reform would help foster a growth-enhancing domestic environment, unleashing untapped growth potential and expediting the convergence process.

14. We explore two alternative scenarios to account for uncertainty with productivity growth. The upside scenario assumes that China’s TFP growth in 2023-2050 accelerates to 2.2 percent per annum, reflecting a more optimistic outlook for China’s future domestic reform and opening-up, along with a more benign international environment. Consequently, China’s TFP level relative to the U.S. is projected to increase from 41 percent in 2023 to 62 percent in 2050,⁷ reaching a level comparable to what Korea achieved in late 2010s. In contrast, the downside scenario assumes a slower TFP growth of 1.1 percent per annum for China. In this scenario, China’s productivity relative to the U.S. is projected to catch up only modestly, increasing only to 46 percent in 2050, which falls below the upper limit of 46.7 percent predicted by Fernández-Villaverde *et al* (2023) (Figure 12). In the upside scenario, real GDP growth averages a respectable 3.9 percent annually over 2023-2050,

⁷ The TFP growth of the U.S. in 2022-2050 is assumed to be similar to its annual average during 2001-2022, i.e., 0.7 percent per annum according to the estimate by the Federal Reserve Bank of San Francisco. See Fernald (2014) for details on estimation methodology.

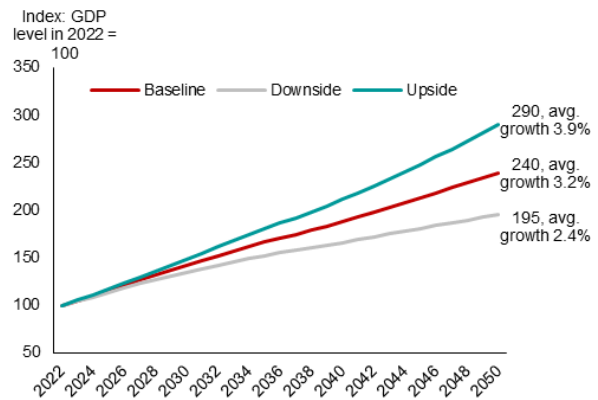
resulting in nearly a twofold increase in real GDP by 2050 (Figure 13). In contrast, the downside scenario suggests a slowdown in the average GDP growth rate to 2.4 percent, with real GDP barely doubling over the 28-year horizon. Assuming a constant purchasing power parity (PPP) exchange rate, China's per capita GDP is projected to increase from US\$16,306 in 2022 to US\$34,561 in the downside scenario, US\$42,432 in the baseline, and US\$51,346 in the upside scenario in 2050 (all values in 2017 prices).

Figure 12. Comparison of Relative Productivity Level



Source: Penn World Table, Authors' estimation.

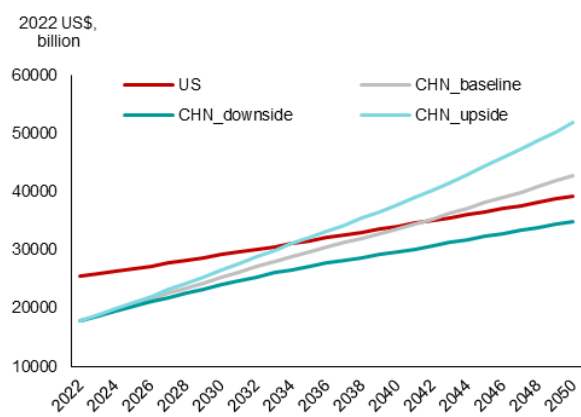
Figure 13. China's Potential GDP under Three Scenarios



Source: Authors' estimation.

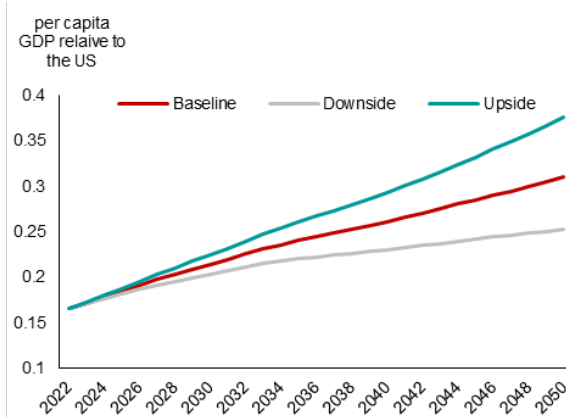
15. According to the baseline scenario, China is projected to become the world's largest economy by 2042, with its per capita GDP reaching 31 percent of the U.S. by 2050. Recent growth projections from the OECD (Guillemette and Turner, 2018) and Goldman Sachs (Daly and Gedminas, 2022) suggest that the U.S. economy will grow at an annual rate of 1.5-1.6 percent from 2023 to 2050. By averaging the forecasts provided by the OECD and Goldman Sachs, we predict that the U.S. real GDP will rise from US\$25.5 trillion in 2022 to US\$39.3 trillion in 2050. Assuming that the real exchange rate between the U.S. dollar and the Chinese yuan remains constant at its 2022 level, the baseline projection of China's growth suggests it will overtake the US economy as the world's largest economy by 2042, with its GDP being 9 percent larger than that of the U.S. in 2050 (Figure 14). In the upside scenario, the timeline for China overtaking the U.S is brought forward to 2035, with the Chinese GDP projected to be 32 percent larger than that of the U.S. by 2050. In the downside scenario, China will not surpass the U.S. in terms of GDP throughout the projection period. Under the baseline scenario, China's per capita GDP is expected to reach US\$32,970 by 2050 (in constant 2022 prices and market exchange rate), about 31 percent of the projected future U.S. level (Figure 15). The alternative downside scenario predicts that China's per capita income will reach 24 percent of the U.S. level by 2050, while the upside scenario forecasts a higher convergence at 38 percent of the U.S. level during the same period.

Figure 14. GDP Projection for the US and China



Source: Authors' estimation.

Figure 15. GDP Per Capita Projection for China



Source: Authors' estimation.

V. Conclusion and Policy Discussions

16. China is anticipated to endure its growth deceleration in the coming three decades but remains positioned to emerge as the world's largest economy. Ongoing trends, including population aging, a shift from investment to consumption-driven demand, and a deceleration in productivity, may contribute to a significant long-term growth slowdown in China. According to standard growth account exercises, China's annual growth rate is forecasted to slow to 2.2 percent by the year 2050. Alternative scenarios on productivity growth could yield a more conservative estimate of 1.5 percent or a more optimistic projection of 3.0 percent for the GDP growth in 2050. Despite this deceleration, China is expected to achieve high-income status, and surpass the U.S. in terms of GDP size by mid-century under both baseline and upside scenarios.

17. A comprehensive, multi-pronged mitigation strategy needs to be pursued to address both short- and long-term demographic challenges.

- **Boost fertility rates:** International experiences show that pronatalist policies often have only modest and short-lived effects on the birth rates. After introducing a range of very generous policies to encourage births, Nordic countries saw fertility rates rise by 0.3-0.5 percentage points in 1980s and maintained them stable in 1990s and 2000s. However, since 2010, the TFR has been declining, reverting to historically low levels in many Nordic countries. China can hardly follow the Nordic model of family policies given its lower income level and limited fiscal resources. However, policy efforts can still be directed toward reducing the housing and educational costs of raising children, enhancing the economic certainty of young people, and developing social infrastructure for child rearing.
- **Encourage labor force participation and prompt human capital accumulation:** China's statutory retirement ages are among the lowest globally. Raising the retirement ages, coupled with providing more flexible retirement arrangements to enhance incentives for continued employment, will be beneficial for increasing older age labor force participation. Policies also need to be developed to facilitate women in combining childbearing with employment. Furthermore, effective labor supply can be increased by improving the quality of workforce through increased investment in education and health.

- **Invest in labor-augmenting technology:** There is significant potential for China to develop and more widely apply automation technology to mitigate the negative impacts of a shrinking labor force. For example, in 2021, China had 322 industrial robots per 10,000 employees, ranking fifth globally but falling considerably behind the leading country, Korea, which boasts a robot density of 1,000 per 10,000 workers. The Chinese government has initiated the “Robot + Application Action Plan” with the aim of accelerating the application of robotics across various sectors and doubling China’s robot density from 2020 to 2025. Technological progress will play a crucial role in enabling China to sustain its industrial competitiveness in the face of aging workforce and rising labor costs.

18. More importantly, to raise TFP and achieve sustainable growth, China must continuously strengthen structural reforms. To achieve this, China should prioritize three critical areas, each playing a pivotal role in fostering sustainable development and global collaboration. Firstly, to remain at the forefront of innovation and productivity, China must continually invest in cutting-edge technologies and R&D initiatives. Secondly, a thriving market economy is essential to create a competitive environment that fosters entrepreneurship, innovation, and efficiency. China should prioritize reforms that enhance market competition, reduce regulatory burdens, and create a level playing field for businesses of all sizes. Thirdly, collaboration on the global stage is indispensable in today's interconnected world. China should work closely with partner countries to strengthen rules-based multilateral frameworks that facilitate trade, investment, and economic cooperation.

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Appendix A: The Growth Accounting Approach

The methodology of the growth accounting exercise used in this note follows AMRO (2018). Assuming a Cobb-Douglas production technology with constant returns to scale, potential output can be decomposed into capital, labor, human capital and the trend levels of total factor productivity:

$$\ln Y = \ln A + \alpha \ln K + (1 - \alpha) \ln L + (1 - \alpha) \ln H$$

where Y is potential GDP, A is total factor productivity, K is capital input, L is labor input, H is human capital and α is the output elasticity of capital.

Historic potential GDP estimate

The data on output (real GDP) and employment are from China's National Bureau of Statistics (NBS). The capital stock is estimated using the perpetual inventory method with 1952 as the base year. A constant depreciation rate of 6 percent is used for the estimation of capital stock. The human capital data is from Penn World Table (PWT) 10.01 (Feenstra et al., 2015). α is assumed constant at 0.4, consistent with the estimates of the PWT.

A is calculated as a trend component of the residual between actual real GDP growth rate and the contribution from factor inputs. Lastly, the potential growth rate is obtained by adding up all four estimated inputs.

Projection to 2050

We use the UN's medium variant population scenario for the growth projection of working-age population. A constant labor force participation rate is assumed for the future. Human capital is assumed to grow at its current pace of 0.95 percent per year in the next thirty years.

The investment-to-GDP ratios is assumed to decline from 42 percent in 2020 to 36 percent in 2030 and 30 percent in 2040 and stay at that level thereafter. Further assuming a capital depreciation rate of 6 percent, we derive projections of capital input for 2023-2050.

Finally, A is assumed to grow by 1.7 percent per year in 2023-2050, 0.25 percentage points lower than the pre-pandemic level of 2010-2019.