China's Productivity Challenge[1]

Xiaodong Zhu[2]
University of Hong Kong

First draft: March 30, 2023
Current draft: July 7, 2023

[1] Paper prepared for the Arc of Chinese Economy conference at the University of Pennsylvania I would like to thank Nan Jia and Hongxin Zhao for the useful discussions of the paper at the conference.

[2] Professor of Economics, Faculty of Business and Economics, University of Hong Kong, email: xdzhu@hku.hk, and Professor Emeritus, Department of Economics, University of Toronto.

China's economic growth has slowed significantly in recent years, with potential factors such as trade tensions, high debt levels, a struggling real estate sector, and an aging population being cited as possible causes. However, the slowdown actually began much earlier, with GDP growth rates trending downward since peaking at 13% in 2007. What are the long-term factors behind China's growth slowdown?

In this article, I will argue that there is one key long-term factor behind China's GDP growth: productivity improvement. China's total factor productivity (TFP), which measures the aggregate production efficiency of the economy, grew at an impressive rate of over 4% per year between 1978 and 2007. This rate is even higher than the TFP growth rates of Hong Kong, Singapore, South Korea, and Taiwan during their own periods of rapid economic expansion from 1965 to 1990. As a result, China's GDP growth rate averaged 9.5% per year during this period. However, over the last fifteen years of growth slowdown, China's TFP growth rate has declined considerably, averaging only 1% per year. I show that this change in the speed of productivity improvement is the main reason for China's differential growth performance before and after 2007. In contrast, changes in investment rates and demographic factors played only a minor role.

After establishing the crucial role of productivity improvement in China's economic growth, I will examine the potential sources that may have contributed to this improvement. These sources include factor reallocation, trade liberalization, migration, institutional change, and technological diffusion and innovation. Surprisingly, despite years of banking and financial market reforms, capital reallocation has had little or even negative impact on China's productivity growth. The contribution of export expansion following China's accession to the WTO has also been limited. Instead, domestic reforms that reduced barriers to internal trade and internal migration has had a more significant impact on productivity growth. Ultimately, it is the economic reform and decentralization that have spurred bottom-up institutional change and market-based technology diffusion and innovation aided by international trade that are the driving forces behind China's impressive productivity growth before 2007.

Unfortunately, since 2007, the Chinese government has shifted away from the bottom-up approach and placed greater emphasis on top-level policy design (*ding cen she ji*) and mobilizing national resources (*ju guo ti zhi*). While this approach has achieved some short-term goals such as the temporary growth recovery in 2010 after the global financial crisis and the rapid expansion of infrastructure projects, it has come at a significant cost to economic efficiency. The centralization of policy-making has resulted in fewer policy reforms and institutional changes initiated from below, and various top-down industrial policies aimed at boosting China’s technological capabilities have not achieved the desired results. As a result, China’s productivity has improved at a much slower pace under the new policy regime.

In the final section of the article, I examine China's future growth prospects and the challenges it must overcome to achieve its goals. In its 14th Five-Year Plan (2021-2025), the Chinese government has set a target of achieving an average annual GDP growth rate of over 6%. However, achieving this target will be difficult if China’s TFP growth remains at 1% per year or slower, even if the government increases the already high investment rate. On the other hand, if China can increase its TFP growth rate to 3%, it could easily achieve the growth target not only for the 14^{th} Five-Year Plan but also the following decade, even if the investment rate declines by half a percentage point each year. Therefore, the biggest challenge facing China is improving its productivity. To address this challenge, China needs to decentralize policy-making, rely more on market competition than top-down industrial policies, and continue to engage with the global economy.

Productivity Improvement as the Driver of China's Growth

Many people have suggested that China's rapid growth between 1978 and 2007 was fueled by high and rising rates of fixed capital investment, often led by local governments and the state sector, the so-called investment-driven growth model of China. This characterization of China's growth is wrong.

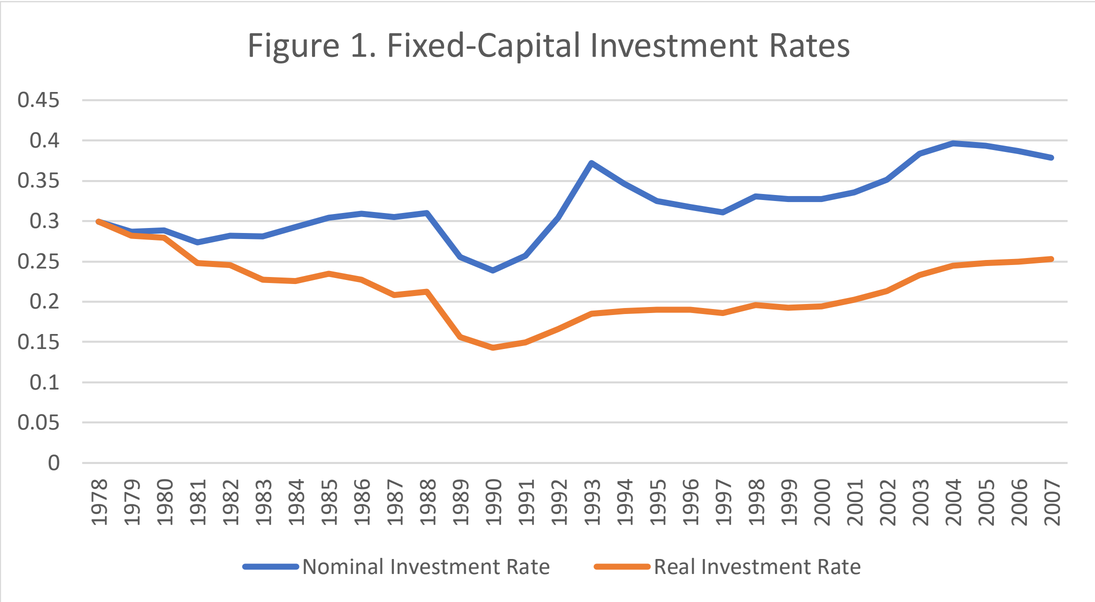


Figure 1 shows the fixed capital investment rates of China for the period of 1978-2007. The nominal investment rate, measured as the amount of RMB spent on fixed capital formation as a percentage of nominal GDP, indeed rose from about 30% in 1978 to 38% in 2007. Before 1990, however, the increase in the nominal investment rate was due to the rise in the costs of investment. The real investment rate, which measures the real value of investment as a percentage of real GDP after controlling for the changes in the costs of investment, [3] actually declined from 30% to 15% between 1978 and 1990. Therefore, China's growth before 1990 could not have been driven by any increase in the investment rate.

Since 1990, the real investment rate did increase from 15% to 25%. How much did this increase in the investment rate contribute to China's growth between 1990 and 2007? The

[3] More specifically, the real investment rate is the ratio of fixed-capital formation valued using 1978 prices to GDP valued using 1978 prices.

answer is not much. During the period, China's GDP growth rate averaged 9.5 percentage points a year. Using a standard growth model, we simulate the counterfactual GDP growth under the assumption that the real investment rate was held at 15% throughout the 17-year period.[4] The simulation shows that, without the increase in the real investment rate, the average GDP growth rate would have been reduced slightly, to 8.5 percentage points a year. That is, the increase in the investment rate contributed only 1 percentage point to China's GDP growth between 1990 and 2007.

During the period, China's total employment also grew more rapidly due to the favorable demographic changes. According to the World Bank's estimates,[5] China's age dependence ratio (number of young and old people who are not in the labor force to the number of working age people) declined from 0.52 in 1990 to 0.38 in 2007. Correspondingly, China's total employment grew at an average rate of 0.89% per year. Employment growth, however, also contributed little to China's GDP growth. If we assume that China's total employment and fixed-capital investment rate both remained at their 1990 levels, China's GDP growth during the period would have averaged a rate of 7.87%. Therefore, employment growth contributed to only 0.63 (8.5-7.87) percentage points of GDP growth during this period.

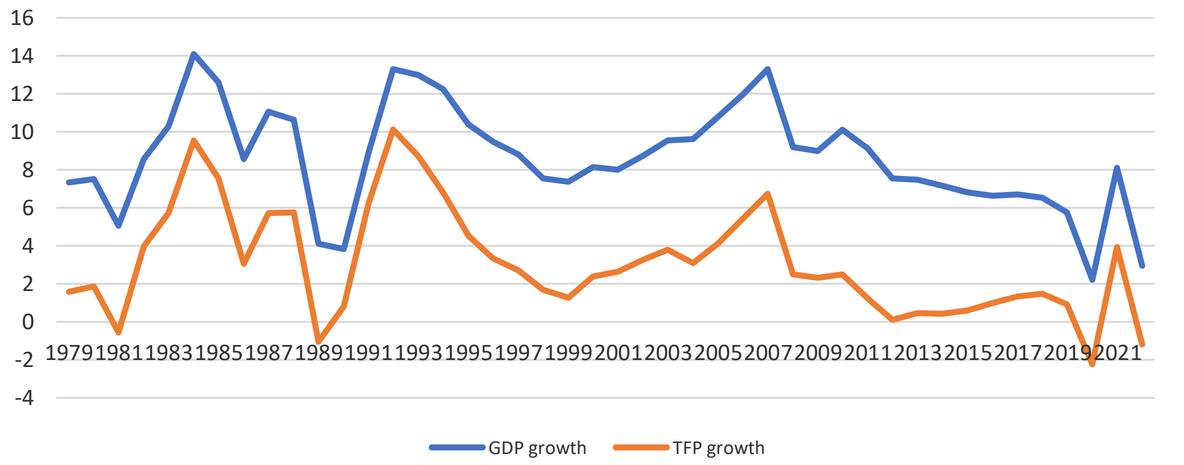
What is then the main driver of China's growth during the period? In Zhu (2012), I argued that it is the productivity growth. Between 1990 and 2007, China's TFP grew at an average rate of 4.5% a year. Fast TFP growth contributed to GDP growth not only directly, but also indirectly by allowing capital to accumulate faster for the same rates of investment. Again, a simulation using the standard growth model shows that, if there were no TFP growth during the period, China's average GDP growth rate would have been significantly reduced to only 3.5 percentage points per year, a 6-percentage point

[4] The model used for simulations is the standard Solow growth model. The details of the data and simulation method are available on the author's website: www.xiaodongzhu.net.
[5] https://data.worldbank.org/indicator/SP.POP.DPND?end=2021&locations=CN&start=1990

reduction, even with the real investment rate rising from 15% to 25%. These simulation results show clearly that TFP growth, not the increase in the investment rate nor the employment growth, is the main driver of China's GDP growth between 1990-2007.

TFP growth is important to China's GDP growth not only in the period of 1990-2007 but throughout the last four and a half decades. Figure 2 plots China's GDP and TFP growth rates between 1978 and 2022. As can be seen, episodes of accelerating GDP growth are invariably associated with rising TFP growth, and periods of growth slowdown are also the periods of declining TFP growth. During the fast growth period of 1978-2007, China's TFP growth rate averaged more than 4% a year. In the last fifteen years of growth slowdown, on the other hand, the TFP growth rate averaged only 1%.

Figure 2. GDP Growth and TFP Growth in China: 1978-2022

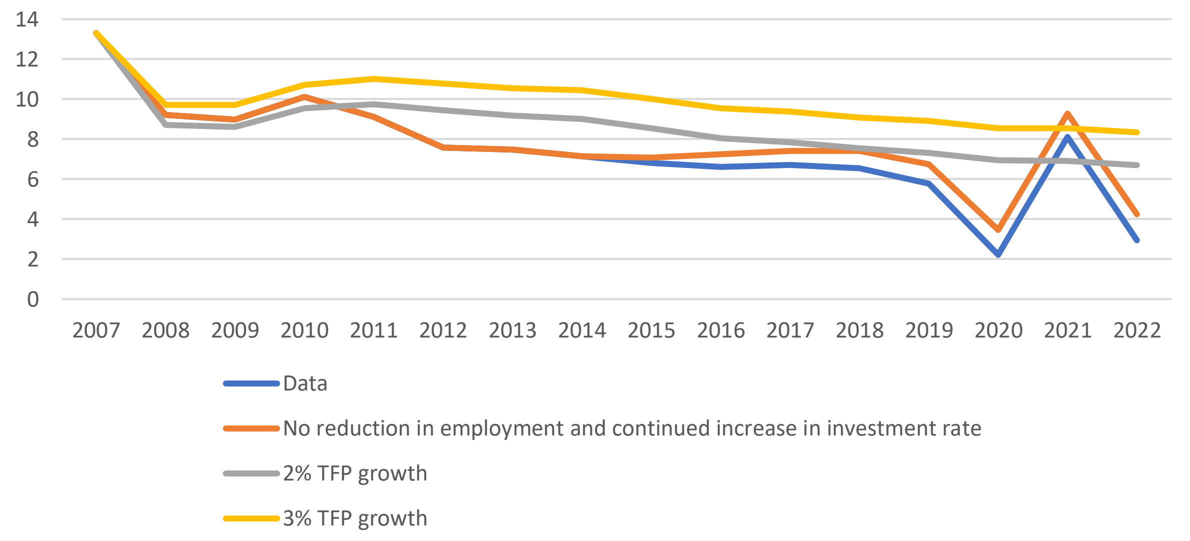


To be sure, there are also other factors for China's growth slowdown. Starting in 2008, China's dependence ratio started to rise and reached 0.45 in 2021. The aging population has caused a decline in total employment since 2015. The Chinese government's large fiscal stimulus in 2008-2009 also resulted in high debt levels, which have limited the government's ability to use fiscal and monetary policies to stimulate investment demand. After rising steadily for two and a half decades, China's real fixed-capital investment rate has remained stable at 31% since 2015.

To assess the impact of these changes on China's growth slowdown, I simulated GDP growth rates between 2007 and 2022 assuming that total employment would remain at the 2014 level and the fixed-capital investment rate would continue to increase by 0.65 percentage points per year after 2014. Figure 3 plots the simulated GDP growth rates under these assumptions, as well as the actual GDP growth rates. The results suggest that without the decline in employment and with continued increases in the investment rate, which would result in a nominal investment rate of over 50% in 2022, the average GDP growth rate would have increased by less than 0.5%.

Figure 3 also plots the GDP growth rates under the assumptions of 2% and 3% TFP growth, respectively. If TFP grows at 2% per year, the average GDP growth rate would have increased by 1.25%. If TFP grows even faster at 3% per year, the average GDP growth rate would have increased by 2.67%.

Figure 3. GDP Growth Rates: 2007-2022



In summary, slow pace of productivity improvement, rather than population aging or a lack of investment rate increase, is the primary reason for China's relatively poor growth performance since 2007. In the following section, I examine the various sources of China's remarkable productivity growth between 1978 and 2007, and discuss the potential reasons for the slowdown in productivity improvement since 2007.

Sources of China's Productivity Growth

There are several potential sources of China's productivity growth, including factor reallocation, trade liberalization, migration, institutional change, and technology diffusion and innovation. I will discuss each of these sources in turn.

Agricultural Productivity Growth and Labour Reallocation

In the late 1970s, factor allocation in China was highly distorted. Around 70% of the labour force was employed in agriculture, and outside agriculture, much of employment was in the state sector and most of the capital stock was controlled by the state. Through institutional and market reforms, agricultural productivity grew at 4% a year between 1978 and 2007 (Zhu, 2012). The agricultural productivity growth allowed a large amount of farmers to be reallocated from agriculture to non-agriculture. This reallocation is vital for the rise of the non-state sector in China because most of the reallocated workers went to private-owned enterprises (POEs) and township and village enterprises (TVEs) rather than state-owned enterprises (SOEs). Since the non-state enterprises are more productive than both agriculture and SOEs, the reallocation of labour contributed positively to the aggregate TFP growth. Overall, the agricultural productivity growth and the resulting labour reallocation contributed to 1.5% TFP growth between 1978 and 2007, with much of the contribution concentrated in the first decade of the period, according to Brandt and Zhu (2012).

Capital Reallocation

However, the reallocation of capital did not contribute much to China's TFP growth. Brandt, Tombe, and Zhu (2013) found that returns to capital were much lower in the state sector than in the non-state sector, indicating a clear sign of capital misallocation. Although capital allocation improved in the 1980s and early 1990s through a more decentralized banking system, it stopped improving after the banking and fiscal reforms in 1994. Zhu (2021) argued that both the banking reform and the fiscal reform under former premier Zhu Rongji resulted in a re-centralization of China's banking and fiscal system, made it difficult for small and medium-sized private enterprises to obtain financing and support from banks and local governments. By 2007, the TFP loss due to capital misallocation was as high as in 1985, indicating that capital reallocation did not contribute to China's TFP growth for the entire period of 1985 to 2007. For the period after 2007, Bai et al. (2016), Ho et al. (2018) and Cong et al. (2019) all found that capital allocation had further deteriorated after the implementation of the central government's large fiscal stimulus in 2009. Hao et al. (2020) also found small negative effect of cross-region capital reallocation to China's TFP growth between 2005 and 2015.

Trade Liberalization

With a declining contribution from agriculture and a negative contribution from capital reallocation, China's TFP growth slowed down in the second half of the 1990s, so did the China's GDP growth. However, starting from 2000, a series of new reforms provided impetus to a new round of accelerating TFP growth.

During this period, the event that received most attention was China's accession to the World Trade Organization (WTO) at the end of 2001. This move resulted in a significant reduction in China's import tariffs and eliminated uncertainty for Chinese exporters about the tariffs they would face when exporting to the United States.[6] The resulting international

[6] China had already enjoyed low tariffs on exports to the United States as a designated Most Favored Nation before its accession to WTO, but the designation was subject to annual renewal and therefore there had been uncertainty about the potential tariffs the US government would impose on Chinese exports.

trade liberalization led to China’s rapid trade expansion, eventually making it world’s largest trading nation in 2013.

What is less well known is that internal trade liberalization also occurred around the same time. In the 1990s, China had high internal trade barriers (Young, 2000; Ponce, 2005) due to local market protections, which were often related to the size of a region’s state sector (Bai et al., 2004). But between 2000 and 2005, these internal trade barriers fell significantly due to both the newly implemented market integration policy by the central government and the state-owned enterprise (SOE) reform that reduced the size of the state sector and, therefore, local governments’ incentives for local protection.

Tombe and Zhu (2019) estimated the impact of the reductions in both international and internal trade barriers on China’s productivity growth between 2000 and 2005, and found that internal trade liberalization contributed to productivity growth by 2% per year, while international trade liberalization contributed to productivity growth by less than 1% per year. These results suggest that domestic reforms were more crucial than international trade expansions for China’s productivity growth during this period.

Unfortunately, trade liberalization seemed to have stalled after 2007. Hao et al. (2020) estimated the changes in trade costs of Chinese regions between 2007 and 2012. They found small increases in both internal and international trade costs for almost all regions, indicating a modest retreat from the significant trade liberalization before 2007.

Migration

During the period between 2000 and 2005, in addition to internal trade liberalization, there had also been reforms that reduced costs of internal migration in China. Fan (2019), Tombe and Zhu (2019), and Hao et al. (2020) all provide detailed discussions on the high migration costs posed by China’s *hukou* registration system, and the reforms that helped to reduce these costs. Tombe and Zhu (2019) estimated that the reduction in migration costs contributed to China's productivity growth by 1.1% per year between 2000 and 2005, and most of the productivity gains came from migration of farmers from interior regions to work in industry and services in the coastal cities of China. Productivity improvement due to reduction in migration costs is one factor that continued to have positive contribution to TFP growth after 2007. Hao et al. (2020) estimated that reduction in migration costs contributed to China's productivity growth by an average of 1.2% a year between 2005 and 2015.

However, Hao et al. (2020) also show that, even after controlling for the contributions of trade and migration, there is still a large residual in aggregate productivity growth that is not accounted for. I will argue next that bottom-up institutional change and technology diffusion aided by international trade are potentially two important sources of productivity growth in China.

Bottom-up Institutional Change

One important characteristic of many of China's successful economic reforms and institutional changes is that they are initiated from below rather than designed by the central government. The most well-known example of bottom-up institutional change is the Household Responsibility System (HRS) in agriculture. At the end of 1978, some villagers in Anhui and Sichuan provinces secretly abandoned collective farming and adopted the HRS for agricultural production, despite it being illegal according to the central government's official policy at the time. The provincial leaders in the two provinces (Wan Li and Zhao Ziyang) recognizing the effectiveness of the HRS in improving agricultural productivity, allowed more villages to adopt the system instead of punishing the villagers for violating the central government's policy. The HRS then rapidly spread to other provinces, and by the end of 1981, 45% of villages in China had adopted the system. It is only then that the central government approved the HRS as the official policy and began implementing it nationwide.

The HRS was incredibly successful in improving agricultural productivity in China. Between 1978 and 1984, when the HRS became adopted nationwide, China's agricultural TFP grew at a rate of 5.62% per year. McMillan, Walley, and Zhu (1989) and Lin (1992) estimated that most of the TFP growth could be attributed to the HRS, which generated strong positive incentive effects on farmers' efforts and input and output choices.

Bottom-up institutional change also played an important role in the reform of SOEs in urban areas. In the early 1990s, downstream industries' SOEs faced stiff competition from rapidly growing township and village enterprises (TVEs), which were not only more productive but also more adapted to market competition. Due to rigid management structures and a lack of incentives for employees, SOEs directly competing with TVEs often incurred losses.

In Zhucheng, a county-level city located in Shandong province, there were many money-losing SOEs. In a 1992 audit of 150 municipal enterprises, the city government discovered that 103 of them were losing money, and 43 were insolvent. At that time, local government fiscal revenues primarily came from SOEs under their supervision. As a result, the SOEs' financial problem also translated into the city government's fiscal woes. In October 1992, Mayor Chen Guang of Zhucheng initiated an ownership reform. All 282 SOEs and collective enterprises in Zhucheng were restructured, with over 90% of the enterprises becoming joint-stock cooperatives that sold the enterprises' net assets to internal staff. Within 15 months, the majority of the enterprises were "sold" to internal staff. The reform successfully turned many money-losing SOEs into profitable enterprises, but it also attracted national attention. Some people criticized Chen Guang for selling state-owned assets and gave him a nickname of "*Chen Mai Guang*" or "Selling-out Chen".

In 1996, Vice Premier Zhu Rongji sent a state council group to investigate the enterprise reform in Zhucheng, and later he visited Zhucheng himself and decided that Chen

Guang's approach could be the right method for SOE reform. Between 1996 and 2000, SOE reform was carried out nationwide. The reform sold or closed many small and medium-sized SOEs and corporatized large SOEs, and it reduced the state sector's share of total employment from 16% to 13%. According to Hsieh and Song (2015), the so-called "grasp the large, let go of the small" SOE reform contributed to about one-fifth of China's TFP growth between 1998 and 2007.

However, the downsizing of the state sector did not continue after 2007. After the global financial crisis in 2008-2009, the Chinese government has emphasized more on building bigger and stronger SOEs.

Technology Diffusion

When economic reform started in the late 1970s, China was a technologically backward country at an early stage of development. It is natural then China's technological change in the early decades of economic reform were mainly in the form of adaptation of existing technologies from the advanced economies rather than innovation of new technologies (Acemoglu, Aghion and Zilibotti, 2006). According to Hsieh and Klenow (2022), this was still true in more recent years. Their analysis of data for the period of 1991-2016 showed that most of China's technological changes were quality upgrading on existing products that were originally created in advanced economies. In contrast, during the same periods, most of US's technological changes were creating new product varieties.

There were two distinct approaches to technology adaptation that were pursued by Chinese enterprises. SOEs often set up joint ventures with foreign enterprises, giving them market access in exchange for technology blueprints. This approach could be an effective way for Chinese firms to master foreign technologies quickly (Bai et al. 2020), but also reduces Chinese partner enterprises' incentives to innovate themselves (Howell, 2018).

In contrast, private enterprises in China often learn about foreign technologies through market interaction with foreign firms. By either importing foreign products or serving as sale representatives, OEMs, or suppliers of foreign firms, Chinese enterprises could learn about the market demand of products produced using foreign technologies, but could not have access to blue prints of the foreign technologies. To imitate, they have to rely on reverse engineering, learning by doing, and trial and error, which actually help them develop innovation capability.

A good example of such enterprises is Huawei, which was founded by Ren Zhengfei in 1987 with registered capital of 21,00RMB. The initial business of Huawei was acting as a sales agent of a Hong Kong company, selling Private Branch Exchange (PNC) systems (telephone switchboards) in China. In the early 1990s, when the Hong Kong company stopped using Huawei as its sales agent, Huawei decided to produce its own telephone switchboards. At the time, the telecommunication equipment market in China was dominated by foreign producers such as Ericsson, Siemens, Alston, NEC, etc. and a state-controlled joint-venture, Shanghai Bell. Huawei could not compete with these brand names and were forced to target lower-tier cities in rural areas. Its first self-produced switchboard model, City and Countryside 08, was sold to Yiwu county in Zhejiang province. In mid and late-1990s, still not being able to penetrate into the market of upper-tier cities in China, Huawei started to sell its products to the former Soviet Union countries, Africa and Latin America. As it grew, Huawei hired IBM in 1999 as its consultant to learn how to build an integrated management system for a R&D intensive enterprise. From its founding in 1987 until early 2000s, Huawei received little support from the Chinese government. It was only after its impressive performance in the international market when the Chinese government viewed Huawei as a “national champion” and started to provide the company with financial support through the China Development Bank. To help Huawei to further expand its export markets, the China Development Bank provided trade credits to potential buyers from developing countries.

Another example is Zhenhua Port Machinary Corporation (ZPMC). The company was founded in 1992 by Guan Tongxian, a retired government official from China's Ministry of Transportation. At the time, all port machinery in China were imported from Germany, Japan and Korea. Seeing the high demand for port machinery and the high costs of importing them, Mr. Guan believed that ZPMC could compete in the international market by producing these machineries at much lower costs. He was right. Through reverse-engineering and imitation, he and his engineers were able to produce their first batch of port machinery in 2013 and, impressively, exported them to ports in Vancouver and Miami. ZPMC secured the exporting deals with one business innovation: promising to deliver assembled port machinery that is ready-to-use upon delivery to its customers. This is an important competitive advantage because all other competitors in the market could only deliver parts that would need to be assembled at customers' sites, which would be costly in terms of both time and labor. ZPMC was able to gain this competitive advantage by buying and refurbishing a military ship that it found abandoned in a port near its factory. Like Huawei, ZPMC looked to global rather than domestic markets for growth. As the company grew, its product quality also improved steadily through imitation and learning by doing, and it was able to penetrate markets all over the world. By 2008, ZPMC had become one of the most successful heavy machinery companies in the world, and its share of the global port machinery market was a remarkable 70%.

However, as ZPMC became a "national champion", in 2009 it was merged with a poorly performing SOE, Shanghai Port Machinery Corporation, and became a state-controlled enterprise. In addition, the Chinese government encouraged the newly merged company to expand into one of the government's strategic areas: ocean oil exploration. Under the big fiscal stimulus plan rolled out in 2009, ZPMC made an enormous investment in building four ocean oil exploration and drilling platforms, and the investment was financed by a combination of cheap credits from state-owned banks and issuing new equity in the stock market. Unfortunately, the market for these platforms waned and ZPMC could only find buyers for two of its four platforms. The remaining two are still unsold as of today. As a result, most of the profits ZPMC generates from its core business of port machinery are now used to cover the financial losses it incurred from investing in the ocean oil exploration and drilling platforms.

There are two lessons one could learn from the case of ZPMC. First, like Huawei, ZPMC learned about the market for its product from observing foreign exports to China and, by competing in the global markets and through imitation and learning by doing, ZPMC was able to continuously upgrade its product quality and close its productivity gap with the global technology leaders in the industry. Second, the government's industrial policy distorted the enterprise's incentives and diverted it away from its core business that it has a clear competitive advantage in the global market.

Re-examining the Contribution of External Trade Liberalization

According to Tombe and Zhu (2019)'s estimate, the direct impact of external trade liberalization on China's productivity growth is limited. However, as Huawei, ZPMC, and numerous other Chinese enterprises' experiences indicate, many Chinese enterprises learned and imitated foreign technologies and management practices through their market interactions with foreign companies from advanced economies. Therefore, international trade liberalization also contributed to China's growth through technology diffusion. In addition, international trade liberalization also provided impetus for domestic reforms. It was after China officially joined the WTO when the central government adopted a policy of promoting integrated domestic markets (Holz, 2009) and the increases in labor demand for exporting firms led some local governments to reduce their restrictions on migrant workers (Tian, forthcoming). Therefore, while the international trade's direct effect on growth may be limited, its indirect effects, through facilitating technology diffusion and providing impetus for domestic reforms, are significant.

From Imitation to Innovation?

In recent years, the Chinese government has put a lot of emphasize on indigenous innovation and promoted a transition from imitation to innovation with various industrial policies. However, the implementation of these policies have resulted in significant misallocation in R&D investments, as documented by Chen et al (2021) and Wei et al (2023). Furthermore, Konig et al (2022) argue that government subsidies may encourage the wrong firms to innovate and therefore lower the aggregate TFP growth: Firms that could still benefit significantly from imitation could be induced to innovate to because of subsidies, like the ZPMC example we discussed earlier. The increasing emphasize on the role of SOEs is also not conducive to innovation. Liu, Jia and Seamans (2023) provide evidence that SOEs lag behind private firms in robot adoption and in using robots to increase productivity because they lack incentives to make complementary investments. Finally, even without misallocation in R&D investments, it would generally difficult to generate high TFP growth through innovation, as documented by Bloom et al (2020) for the US economy.

Summary

Taking stock, there have been four main sources of productivity growth in China: (1) labor reallocation from agriculture to non-agriculture in the early years of reform and rural-urban migration in more recent years, (2) internal trade liberalization, (3) bottom-up institutional change, and (3) market-based technology diffusion aided by international trade.

Recent years' growth slowdown is associated with a lack of further internal trade liberalization, more top-down rather than bottom-up institutional change, and more government directed industrial policies on technology innovation rather than market based technology diffusion.

Projecting China's GDP growth up to 2035

Given the importance of TFP growth, we now examine China's growth prospect under different scenarios of future TFP growth, again by using the simulations from the standard growth model. For the simulation exercise, we need to make some assumptions about China's future employment and human capital growth. We assume that the aggregate employment declines by half a percentage point a year due to population aging, and average human capital of the workforce increase by 1.3 percentage points a year, which is roughly the average growth human capital growth rate in China over the last ten years. We consider five different scenarios:

(1) TFP does not grow at all, and fixed-capital investment rate increases by half a percentage point a year

(2) TFP grows at one percent a year, and fixed-capital investment rate increases by half a percentage point a year

(3) TFP grows at two percent a year

(4) TFP grows at two percent a year, and fixed-capital investment rate decreases by half a percentage point a year

(5) TFP grows at three percent a year, and fixed-capital investment rate decreases by half a percentage point a year

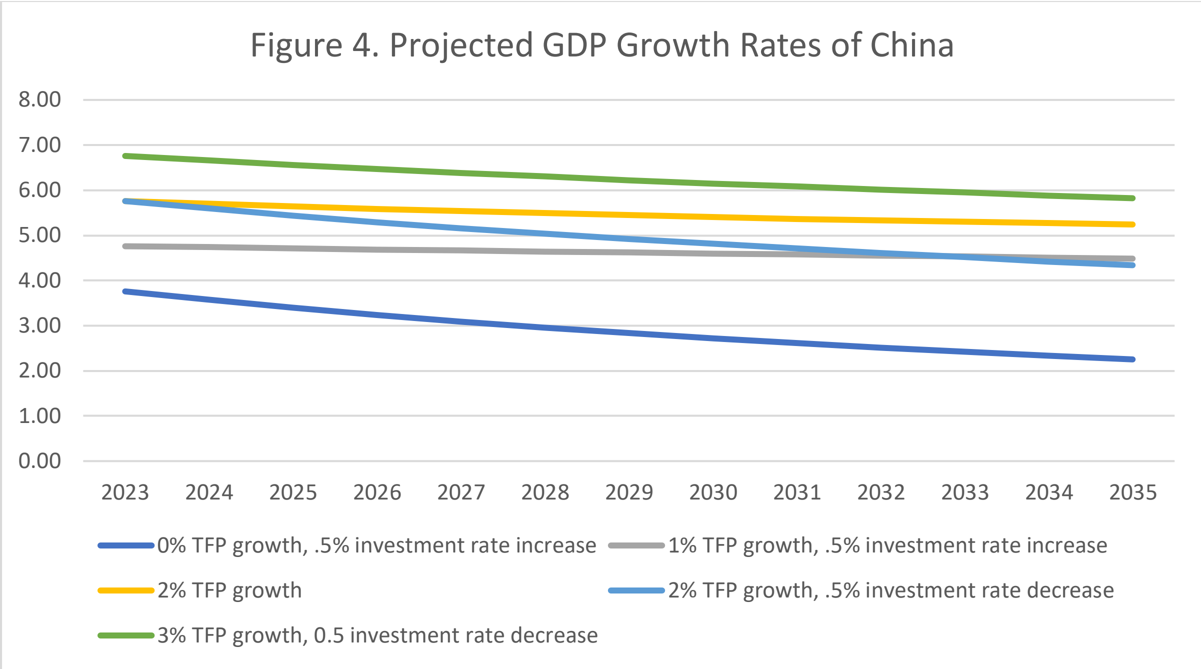


Figure 4 and Table 1 show the projected GDP growth rates for the period of 2023-2035 under all five scenarios. The case of zero TFP growth is the worst among the five scenarios. In this case, the aggregate production efficiency does not improve at all. Without TFP growth, the projected GDP growth rate in 2023 is only 3.76%, far short of the Chinese government's stated target of 5%. We assume that the government tries to stimulate growth by increasing the fixed-capital investment rate by half a percentage point each year, which implies that the nominal investment rate will be more than 51% by 2035. Despite the rising investment rates, the 3.7% GDP growth rate in 2023 cannot be sustained due to diminishing returns to capital investment. The projected GDP growth rate will fall to 2.25% by 2035, and the average GDP growth rate between 2023 and 2035 is projected to be 2.9%.

Next, consider the case of 1% TFP growth. This is the rate at which China's TFP has grown in the last 15 years. Again, we assume that the government increases the fixed-capital investment rate by half a percentage point each year. In this case, the GDP growth rate in

2023 will be 4.76%, still slightly lower than the government's target of 5%. For the entire period of 2023-2035, the average GDP growth rate is projected to be 4.62% in this case.

In the third scenario, we assume that the TFP grows at 2% a year, and the investment rate does not increase. In this case, the GDP growth rate will be 5.76% in 2023, exceeding the government's target of 5%. The growth rate will decline only slightly in the next 12 years and will still be more than 5% in 2035. The average GDP growth rate between 2023 and 2035 is projected to be 5.47% in this case.

So far, we have assumed that the fixed-capital investment rate either increases or stays constant. One plausible scenario is that the investment rate declines due to a decline in the saving rate associated with population aging, which is the experience of Japan since 1970. Assume that the TFP grows at 2% a year, but the investment rate declines by half a percentage point each year. In this case, the GDP growth rate will decline faster and fall to 4.34% by 2035. Still, the average GDP growth rate between 2023 and 2035 is projected to be 4.97%, close to the 5% target the Chinese government set for 2023.

Finally, we consider the most optimistic scenario in which the TFP grows at 3% a year, but still assume that the investment rate declines by half a percentage point each year. Then, the GDP growth rate will be 6.76% in 2023, and then decline slowly to 5.82% in 2035. For the entire period between 2023 and 2035, the average growth rate is projected to be 6.25%.

In summary, China's future GDP growth depends crucially on its TFP growth. If there will be no TFP growth, then China's GDP growth rate would average less than 3% a year between 2023-2035 even if the government increases the fixed-capital investment rate by half a percentage point each year. If the TFP will grow at 2%, however, even with a declining investment rate, China's GDP growth rate would still average close to 5% a year between

2023 and 2035. If the TFP grows even faster, at 3% a year, China's GDP would grow at an average rate of over 6% per year between 2023 and 2035.

Table 1. Projected GDP Growth Rates for China 2023-2035

Annual TFP growth rate Annual change in investment rate	0% 0.50%	1% 0.50%	2% 0%	2% -0.50%	3% -0.05
Year					
2023	3.76	4.76	5.76	5.76	6.76
2024	3.57	4.74	5.70	5.59	6.66
2025	3.39	4.71	5.64	5.44	6.56
2026	3.24	4.69	5.59	5.29	6.47
2027	3.09	4.67	5.54	5.16	6.38
2028	2.95	4.64	5.49	5.04	6.30
2029	2.83	4.62	5.45	4.92	6.22
2030	2.72	4.60	5.41	4.81	6.15
2031	2.61	4.57	5.37	4.71	6.08
2032	2.51	4.55	5.33	4.61	6.01
2033	2.42	4.53	5.30	4.51	5.95
2034	2.33	4.51	5.27	4.42	5.88
2035	2.25	4.48	5.24	4.34	5.82
Average	2.90	4.62	5.47	4.97	6.25

Conclusion

The key question about China's future growth is how can China raise its TFP growth rate from 1% to 2% or even 3%? Before 2007, China's TFP growth rate averaged more than 4% a year because of economic reform and decentralization that resulted in constant policy and institutional changes that was often started from below. Since 2007, the Chinese government has moved away from the bottom-up approach and emphasized more on policy design at the top and mobilizing national resources (*ju guo ti zhi*). This approach may have achieved some short-term goals such as the growth recovery in 2010 after the global financial crisis and the rapid expansion of infrastructure projects, but at a great cost of economic efficiency. Without bottom-up policy reforms, China had poor TFP growth performance, with the TFP growth rate averaging 1% a year, much lower than the 4% achieved before 2007. In a recent press conference, Premier Li Qiang told the reporters that China should revitalize the entrepreneurial spirit of Zhejiang and Jiangsu provinces in the 1980s and 1990s. I hope this signals a potential change away from the top-down approach of policy design and a return to bottom-up policy changes that was so effective and successful in generating remarkable TFP growth in the 1980s and 1990s.

References

Acemoglu, Deron, Philippe Aghion, and Fabrizio Zilibotti. 2006. "Distance to Frontier, Selection, and Economic Growth." *Journal of the European Economic Association*, 4 (1): 37-74.

Bai, Chong-En, Yingjuan Du, Zhigang Tao, and Sarah Y. Tong. 2004. "Local Protrectionism and Regional Specialization: Evidence from China's Industries." *Journal of International Economics*, 63 (2): 397-417.

Bai, Chong-En, Chang-Tai Hsieh, and Zheng Michael Song. 2016. "The long shadow of China's fiscal expansion." *Brookings Papers on Economic Activity* 60, 309–327.

Bai, Jie, Panle Jia Barwick, Shengmao Cao, and Shanjun Li. 2020. "Quid Pro Quo, Knowledge Spillover, and Industrial Quality Upgrading: Evidence from the Chinese Auto Industry." NBER Working Paper No. 27644.

Bloom, Nicholas, Charles I. Jones, John Van Reenen, and Michael Webb. 2020. "Are Ideas Getting Harder to Find?" *American Economic Review*, 110 (4): 1104-1144.

Brandt, Loren, Trevor Tombe, and Xiaodong Zhu. 2013. "Factor Market Distortions Across Time, Space and Sectors in China," *Review of Economic Dynamics*, 16, 39-58.

Brandt, Loren and Xiaodong Zhu. 2010. "Accounting for China's Growth," Working Papers tecipa-394, University of Toronto, Department of Economics.

Chen, Zhao, Zhikuo Liu, Juan Carlos Suarez Serrato, and Daniel Yi Xu. 2021. "Notching R&D Investment With Corporate Income Tax Cuts in China," *American Economic Review*, 111 (7): 2065-2100.

Cong, Lin Wiiliam, Haoyu Gao, Jacopo Ponticelli, and Xiaoguang Yang. 2019. "Credit Allocation under Economic Stimulus: Evidence from China." Review of Financial Studies, 32 (9): 3412-3460.

Fan, Jingting. 2019. "Internal Geography, Labor Mobility, and the Distributional Impact of Trade." *American Economic Journal: Macroeconomics*, 11 (3).

Hao, Tongtong, Ruiqi Sun, Trevor Tombe, and Xiaodong Zhu. 2020. "The Effect of Migration Policy on Growth, Structural Change, and Regional Inequality in China" *Journal of Monetary Economics*, 113, 112-134.

Hsieh, Chang-Tai and Pete Klenow. 2022. "Romer or Ricardo." Unpublished working paper.

Hsieh, Chang-Tai and Zheng Michael Song. 2015. "Grasp the Large, Let Go of the Small: The Transformation of the State Sector in China." Brookings Papers on Economic Activity, Spring, 295-346.

Ho. Chun-Yu, Dan Li, Suhua Tian, and Xiaodong Zhu. 2018. "Policy Distortion in Credit Market: Evidence from an Economic Stimulus." Unpublished manuscript.

Holz, Carsten. 2009. "No Razor's Edge: Reexamining Alwyn Young's Evidence for Increasing Inter-Provincial Trade Barriers in China." *Review of Economics and Statistics*, 91 (3): 599-616.

Howell, Sabrina. 2018. "Joint Ventures and Technology Adoption: A Chinese Industrial Policy that Backfired." *Research Policy*, 47: 1448-1462.

Konig, Michael, Kjetil Storesletten, Zheng Song, and Fabrizio Zilibotti. 2022. "From Imitation to Innovation: Where Is All That Chinese R&D Going?" *Econometrica*, 90 (4): 1615-1654.

Lin, Justin Yifu. 1992. "Rural Reforms and Agricultural Growth in China," *The American Economic Review*, 82:1, pp. 34-51.

Liu, Qiren, Nan Jia, and Robert Seamans. 2023. "Robots at Work in China." Unpublished working paper.

McMillan, John, John Whalley, and Lijing Zhu. 1989. "The Impact of China's Economic Reforms on Agricultural Productivity Growth," *Journal of Political Economy*, 97 (4): 781-807.

Poncet, Sandra. 2005. "A Fragmented China: Measure and Determination of Chinese Domestic Market Disintegration." *Review of International Economics*, 13 (3): 409-30.

Tian, Yuan. 2022. "International Trade Liberalization and Domestic Institutional Reform: Effects of WTO Accession on Chinese Internal Migration Policy." *Review of Economics and Statistics*, forthcoming.

Wei, Shang-Jin, Jianhuan Xu, Ge Yin, and Xiaobo Zhang. 2023. "Mild Government Failure," Unpublished working paper.

Young, Alwyn. 2000. "Razor's Edge: Distortions and Incremental Reform in the People's Republic of China." *Quarterly Journal of Economics*, 115 (4): 1094-1135.

Zhu, Xiaodong. 2021. "The Varying Shadow of China's Banking System", *Journal of Comparative Economics*, 49 (1), 135-146.