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This study explores China's economic growth performance and prospects in global and Asian comparative perspectives. Using a general framework of cross-country analysis, the study identifies and discusses major factors underlying China's strong growth over the past decades and those contributing to its recent growth slowdown. The study also adopts detailed industry-level data to assess structural changes and sectoral growth in the Chinese economy. China's low initial per capita income relative to its own long-run potential provided the opportunity for faster capital accumulation and technology diffusion. Good policy and institution factors, such as a high investment rate, strong human capital, high trade openness, and improved institutions, guided the economy to realize its strong potential for convergence to advanced economy income level. China's average potential GDP growth will decline significantly over the coming decade due to convergence effect and structural problems, unless China substantially upgrades institutions and policy factors and improves productivity, particularly in its services sector.

Keywords

Economic growth, convergence, productivity, structural change, China

JEL Classification

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China's Economic Growth and Convergence*

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1. Introduction

China's economic performance—with an average annual GDP growth of 9.3% from 1980–2015—has been astonishing, enabling the miraculous transformation of a rural and command economy into a global economic superpower. The startling long-term performance has significantly improved real income and living standards of over 1.3 billion people. China's economic power continues to rise, making it the largest economy in the world. China's share of world GDP in PPP terms reached about 17% in 2015, exceeding that of the US and EU.[1]

However, China's economy is now slowing down. Its GDP growth rate in 2015 was 6.9 percent, the lowest since 1990, and is predicted to be lower in the coming years. China is struggling in advancing from upper middle-income to high-income economy. Considering its's sheer economic size and influence in the world economy, its growth future is of serious concern to all.

This study analyzes Chinese economic growth in global and Asian comparative perspectives. Using growth accounting methodology and cross-country regression analysis, this study identifies and discusses the major factors that enabled China to achieve strong growth over the past four decades and that caused the recent growth slowdown. China's performance is examined in comparison with that of Japan and South Korea (henceforth, Korea) for an equivalent period. Furthermore, this paper adopts industry-level data to assess structural changes and sectoral growth in the Chinese economy. It then discusses the prospects of Chinese economic growth in the coming decades and suggests possible policy measures that China could adopt to sustain strong growth and thereby continue its convergence to advanced economies' income level.

China has developed its own economic development model over the past 35 years since Deng Xiaoping embarked on economic opening and reforms. Since then, the government has implemented structural change and growth-enhancing policies in gradual and pragmatic ways.[2]

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[1] IMF, World Economic Outlook Database, January 2016.

[2] Under Deng Xiaoping's policy, expressed as "cross the river by feeling the stones (摸着石头过河)," the government implemented reforms partially in an experimental manner, often in a few regions, and further expanded the scope of application upon the fruitful outcomes of the reforms. Gradual reform was considered as a pragmatic way in a heavily distorted environment where "first best" solutions were unlikely to apply and an indirect means to resolve political resistance against sudden reforms. See Naughton (2007).

The model has own unique historical features. China also differs significantly from other economies in many aspects, such as country size and economic and political institutions. Despite these differences, however, cross-country comparative analysis can be useful in identifying common features that can be observed in economic successes and failures over the world history. In fact, many factors behind fast growth and convergence of the Chinese economy can be also found in the other fast-growing East Asian economies, which are Japan and Korea. These economies' remarkable economic performance and transformation are characterized by fast industrialization and export-orientation, with the manufacturing sector being a key growth driver. Outward-looking development-strategy has provided access to inexpensive imported intermediate goods, larger markets, and more advanced technologies, and thereby contributed to rapid productivity growth of manufacturing industries. The governments played an important role in promoting export-oriented industrialization. With undervalued exchange rates and direct financial supports, exporters were able to build up their comparative advantages in labor-intensive manufacturing and then, to move to more capital-intensive and technology-intensive industries. Government interventions with a pragmatic and flexible approach are considered to have contributed to productivity growth of the overall economy (World Bank, 1993).[3]

Following fast structural transformation and income growth, many advanced East Asian economies experienced economic crises and significant growth slowdown. Japan suffered a significant growth slowdown since the early 1990s and entered its so-called "lost decades" following the burst of asset bubbles in the 1990s. The burst caused a huge debt in the financial system and the private sector. The dysfunctional financial system and lack of private demand resulted in prolonged deflation and stagnation. Korea also suffered a sudden financial crisis in 1997 despite its strong macroeconomic fundamentals— such as growth, savings, price stability, and budget balance. The direct cause of the Korean crisis was a huge, sudden reversal of short-term capital flows (Radelet, Sachs, and Lee, 2001). However, structural problems underlying the

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[3] A dispute on an appropriate degree of government intervention in targeting specific industries and its contribution to economic growth is on-going. The developmental state view, such as that of Amsden (1992), highlights positive effects of the selective government policies to "pick winners". By contrast, the World Bank (1993) asserted that government intervention conformed to the market, rather than replaced the market, using a pragmatic and flexible approach. Lee (1996) claims a detrimental effect of targeting specific industries to total factor productivity growth in the economy.

economy, including under-supervised financial systems, an over-leveraged corporate sector, and mismanagement of international reserves made the Korean economy significantly susceptible to a panicked outflow by foreign creditors holding short-term claims.

Analyzing the growth and crisis experiences in advanced East Asian economies can provide useful lessons for China. China is at a critical development stage of transitioning from a middle-income to a high-income economy. Recently, the Chinese economy has experienced asset bubbles, debt increase, and financial instability. For China to continue catching up and to achieve a higher level of development comparable with that in Korea, Japan, or the US, strong and sustainable growth is required in the coming decades. It should be useful for China to investigate and learn from the experiences of Japan and Korea, and to revise and improve its growth strategy.

The remainder of this paper is organized as follows. Section 2 describes the economic performance of the Chinese economy over the period of 1960-2015 and, using growth accounting methodology, assesses the sources of China's economic growth. Section 3 uses cross-country panel datasets to examine the determinants of per worker output growth. Using the results, the critical factors behind China's growth and convergence performance relative to other countries are explained. Section 4 analyzes the patterns in structural change and output growth at the sectoral level. It also examines the impact of labor reallocation on aggregate labor productivity growth using the "shift-share analysis" technique with industry-level data. Section 5 discusses the growth prospects over the next decades of the Chinese economy and suggests policies for China's sustained growth. Section 6 provides concluding observations.

2. China's Economic Growth and Convergence

During the past half century, the Chinese economy showed outstanding performance, with the average annual per capita GDP growth rate surpassing 6.2%, raising the level of real per capita GDP over 30 times (Table 1). Average per capita GDP growth rate was initially low and then accelerated since the 1980s when China embarked on economic opening and reforms. It increased from 2.6% in 1960–1980, to 8.1% in 1980–2000 and 8.6% in 2000–2015 (Figure 2).

China’s average growth rate was the fastest among the sample of 105 countries for which GDP data are available for the period 1960–2015.[4] Figure 1 plots the growth rate over 1960–2015 against the 1960 level of real per capita GDP across the sample countries. Poor countries in 1960 showed quite diverse performance over the period: the best 15 performers and the worst 15 performers are indicated in different colors. Table 1 lists the 15 economies with the highest per capita GDP growth rates from 1960 to 2015. This group contains eight economies in East and Southeast Asia (China, Korea, Taiwan, Singapore, Thailand, Hong Kong, Malaysia, and Indonesia). Also included are two in South Asia (Sri Lanka and India), two in the Middle East and North Africa (Malta, and Egypt), Botswana and Romania. By contrast, the group of the 15 slowest-growing economies over the same period includes 13 African economies (D.R. Congo, Niger, Central African Republic, Guinea-Bissau, Madagascar, Senegal, Zambia, Guinea, Gambia, Burundi, Zimbabwe, Togo, Cote d'Ivoire, and two Latin American economies (Venezuela and Jamaica) (Table 2).

As known in the growth literature, a country’s growth performance was not always persistent across periods (Easterly et al. 1993, and Pritchett and Summers 2014). Figure 2 shows low persistence in growth rates over the long-term periods. The correlation between growth rate in 1960–1980 and that in 1980–2000 in the whole sample is 0.48, while it is only 0.24 between growth rate in 1980–2000 and that in 2000–2015.[5] However, among the sample, China’s performance has been consistently strong over the three periods, in particular since 1980.

China’s strong economic growth contributed to narrowing its gap with advanced economies in per capita income. Figure 3 shows the evolution of per capita GDP levels of three Asian economies (China, Japan, and Korea) and the US over the period, 1950–2015. Since 1980, China has caught up fast to the US in per capita income, increasing from mere 7% that of the US to 25% in 2015. Its current per capita income reached approximately 33% of Japan and 37% of Korea.

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[4] The underlying data are the adjusted PPP values from the Penn-World Table 8.1 (Feenstra, Inklaar, and Timmer, 2015). The values for 2012, 2013, 2014 and 2015 are estimated from information on real GDP growth rates from the IMF, World Economic Outlook Database. The sample does not include Equatorial Guinea that had the highest GDP growth rates of 16.8% over 1995-2011.

[5] For the sample of 81 emerging and developing economies, the correlation across decades is more persistent in the later period: the correlation is 0.48 between 1960–1980 and 1980–2000, and 0.38 between 1980–2000 and 2000–2015.

Figures 4A and B show the change in 5-year average per capita GDP growth rates of the three Asian economies over time. The values are matched with initial levels of real per capita GDP (in international price) in Figure 4A, and that of real per capita GDP relative to the US in Figure 4B, for an equivalent period. Based on per capita GDP level (relative to the US) China is approximately 20 years (25 years) behind Korea and more than 40 years (50 years) behind Japan.

China's growth performance broadly resembles the historical experiences of Japan and Korea. Figure 4A shows that the pace of the catch-up slowed when per capita income in Japan and Korea exceeded approximately 8,000 dollars.[6] The same pattern also occurred in China since 2010. Figure 4B shows that, as an economy narrows its per capita income gap compared to that of the US, the convergence slowed. Japan's annual per capita GDP growth dropped dramatically from 8.6% in the 1960s to 3–4% in the 1970s and 1980s as its per capita income jumped from less than 20% to over 50% of the US level over the period. Similarly, Korea's annual per capita GDP growth dropped from 7–8% in the 1970s and 1980s, when Korea's per capita income was less than 20% of the US average, to 3–4% in 2000s when Korea's per capita income increased to over 50% of the US average. China's relative per capita income also rose rapidly in the previous decades, and consequently its growth rate began to fall.

For China as well as Japan and Korea, its evolution of per capita income level and growth rates over time can be explained by the "conditional convergence" theory.[7] It suggests that as a country has a low level of initial per capita output relative to its own long-run (or steady-state) potential, it has a higher growth rate compared to a country which has a higher level of per capita output. The further the distance between a country's current output level and its steady-state output or income level, the greater the gap with its long-run level in terms of physical and human capital stock and productivity (technology). A country with the significant gap is able to begin its rapid catch-up process through high rates of physical and human capital accumulation, owing to higher rates of the return to investment. Additionally, a country facilities technology diffusion

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[6] Some argue that China may get into the "middle-income trap" indicating that when an economy reaches middle income, there will be a sharp slowdown in the growth rate (see Eichengreen, Park and Shin, 2012 and Zhuang, Vandenberg and Huang, 2015). Empirical evidence, however, does not support strongly that a transition from middle-income to high-income status is more likely to lead to a low-growth trap (Barro, 2016).

[7] Conditional convergence of per capita (or per worker) output is predicted by an extended version of the neoclassical growth model. See Barro and Sala-i-Martin (2004).

and imitation from more technologically advanced economies to fasten productivity improvement, and thereby fill up the technology gap.

We can assess the role of factor accumulation and productivity growth in the China's convergence process of per capita income by using Solow's growth accounting. Growth accounting is a methodology that is used for decomposing the growth rate of the total output of an economy into the contribution of four productive components including growth in physical capital stock, growth in labor force, growth in human capital per worker, and total factor productivity (TFP) growth, which reflects technological progress and other elements.[8]

This approach is applied to decompose output growth rates in China by decade during 1961––2010. Data on GDP, physical capital stock, and labor shares are collected from the Penn-World Table (PWT) 8.1. The working-age population sourced from the United Nations is used as a measure for the number of workers. The available cross-country sources of labor force or employees are less reliable than those of the working-age population. An average human capital (that is, aggregate labor quality) is measured as the weighted sum of the shares of workers multiplied by the relative marginal products (or relative wage rates) across all education categories.[9]

Table 3 summarizes the growth accounting estimates by decade. In China, the contributions of labor to GDP growth were 1.2%, 1.4%, 1.4% points in the 1960s, 1970s and 1980s (about 52%, 28%, and 18% of annual GDP growth), respectively. Its contributions declined to 0.7% points in 1990s and 2000s (about 7.5% of annual GDP growth). The contributions of human capital to annual GDP growth were 0.5–0.7% points in 1960–2000 and dropped to 0.1% points in 2000–2010.

The accumulation of physical capital accounts for the largest portion of output growth over the overall period. The physical capital's contribution was about 0.9% points in the 1960s (40% of the average GDP growth rate), and then jumped to about 2.2% points in the 1970s and 1.9% in

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[8] Growth accounting is subject to a number of limitations. For example, the basic growth accounting methodology assumes perfect competition, and therefore factors of production are paid the value of their marginal product. It accounts for the direct contribution of each of the factors of production and disregards interaction effects between inputs. For more details, see Barro and Sala-i-Martin (2004).

[9] The relative wage rate of a worker with schooling S is determined by the rate of constant marginal return to an additional year of schooling of 10.1%. The number of average years of schooling as well as rate to return does not take into account differences in quality of schooling across countries. See the discussion of educational quality and adult skills in Barro and Lee (2015).

1980s (45% and 25% of the average GDP growth), respectively. It was further accelerated to 3.9% points in 1990–2000 and 5.2% points in 2000–2010 (42% and 56% of the average GDP growth rates, respectively).

During the 1960s and 1970s, the annual growth rate of the TFP in China was only -0.5% and 0.6% points, but, over the following three decades (i.e., 1981–2010), it increased significantly, contributing to the acceleration of GDP growth. TFP growth contributed to about 3.9% points (50% of the average GDP growth rate) in 1980–1990, and 4.1% points (44%) in 1990–2000. Its contribution, however, declined to 3.2% points (35% of the average GDP growth rate) in 2000–2010.

Our estimate of TFP growth in the range of 3–4% in 1980–2010 is broadly consistent with that in the previous literature. For instance, Bosworth and Collins (2008) estimated that during 1978–2004, TFP growth was 3.6%. Lee and Hong (2010) and Brandt and Zhu (2015) also showed similarly high TFP growth rates. However, a number of researchers raised questions about the reliability of Chinese national accounts data. Using alternative data, they found lower TFP growth. Young (2003) estimated that TFP growth contributed to non-agricultural output growth rate during 1978–1998 only by 1.4% points, while rising labor participation rates, improvements in educational attainment, and the transfer of labor out of agriculture were the major part of the growth. Wu (2014) estimated -0.5% and 1.1% of average TFP growth rate for the pre-reform (1952-1977) and post-reform (1978-2012) period, respectively.

The results of growth accounting explain that China's output convergence process was associated with strong growth in human resources, physical capital accumulation, and TFP. The contribution of physical capital accumulation and TFP has been dominant for the past two decades, while the relative contribution of raw labor and human capital has been declining (Figure 5).

During China's fast catch-up phase of development, capital accumulation played an important role, as much as it did in Japan and Korea in the early period. The strong capital accumulation reflects strong investment and high return rates to investment in the Chinese economy. Figure 6 shows China's investment rates continued to increase gradually over the 1960s, 1970s, and 1980s, and more rapidly from the early 1990s. China currently invests almost 50% of GDP, which is disproportionately high, compared to the historical experience of Japan and Korea. Japan’s investment rates increased to 40% in 1973 prior to the oil shock and then have slowed gradually to 20%. Korea has maintained very high investment rates throughout its catch-up process. Investment rates continued to increase over time, from approximately 10% of GDP in the early 1960s to close to 40% during the 1990s prior to the financial crisis. It dropped significantly during the crisis, recovered gradually to 35%, and then declined again. Considering that China now faces a smaller gap in physical capital stock from its long-run potential and consequently returns to investment fall, China will experience slowdown in investment rates and physical capital accumulation than it did in the previous decades.

China also faces smaller gaps in human capital stock and TFP levels from their long-run potential levels, encountering difficult challenges to maintain the same growth rates of human capital accumulation and TFP increase as China did. Concerning the accumulation of human capital, China’s performance has been quite remarkable. As shown in Figure 7, educational attainment expanded significantly over the past half century. China’s dramatic catch-up reflects the rapid increase in school enrollment rates for all education levels. However, China’s human capital growth was slow in the recent decade. Although TFP growth was important during China’s convergence phase, its growth rate and contribution to GDP growth have declined.

3. Cross-country Analyses of Economic Growth and Conditional Convergence

This section adopts the framework of cross-country analyses of economic growth in order to investigate the major factors that can explain China’s growth and catch-up experience over the past half century. The empirical framework is represented by a reduced form of “conditional convergence,” such as[10]

$$Dy_{i,t} = \beta_0 + \beta_1 \log(y_{i,t}) + \beta_2 X_{i,t} + \varepsilon_{i,t}, \qquad (1)$$

where Dy_{it} is country i’s per worker GDP growth rate in period t, and y_{it} the country’s per worker output at the beginning of the period. X_{it} denotes a group of the external environmental and policy variables that influence country i's steady-state level of per worker output. They

[10] The specification and data are adopted from Lee (2016).

include investment, fertility, average years of schooling, life expectancy at birth, government consumption, overall maintenance of the rule of law, inflation rate, trade openness, and democracy. In addition, the regressions include period dummies to control for common shocks to per worker GDP growth in all countries.

The regression of specification (1) applies to a panel set of cross-country data for 75 countries over 10 five-year periods from 1960 to 2010, corresponding to the periods 1960–1965, 1965–1970, 1970–1975, 1975–1980, 1980–1985, 1985–1990, 1990–1995, 1995–2000, 2000–2005, and 2005–2010. This system of 10 equations is estimated by adopting instrumental variable (IV) estimation techniques to control for the endogeneity of explanatory variables. Instruments are mostly lagged values of the explanatory variables. The results of the IV panel estimation with and without country fixed effects are presented.

Column 1 of Table 4 presents the regression results of the basic specification (1) without country fixed effects. The negative estimate of the coefficient on the log of per worker GDP at the beginning of each period shows a strong "conditional convergence" effect. The estimated speed of conditional convergence is about 2.3% per year, indicating that given the same level at the steady state, when a country has half the per worker output level of an advanced economy, it is highly likely to have faster growth rate by 1.6% (= 2.3 * ln(2)) points than the advanced economy.

The investment rate, which is the ratio of investment to GDP, is estimated to have a significantly positive impact on growth. The estimated coefficient of the log of the total fertility rate is significantly negative. The estimated coefficient on the reciprocal of life expectancy is negative and statistically significant, meaning that improved health condition has a positive effect for growth.

Human capital stock and per-worker GDP growth in Column 1 of Table 4 show a nonlinear relationship, as discussed in Barro and Lee (2015). The coefficients on average years of schooling and its square term are negative and positive, respectively. The schooling variable is only marginally statistically significant, but the square term is significant at the 5% level. The pattern of the coefficients demonstrates that the growth rate increases with the level of educational attainment only when the society has attained 6.0 average years of schooling. Hence, only countries that have accumulated human capital above a certain threshold are able to experience higher GDP growth induced by an increase in educational attainment for given values of the other explanatory variables.

As shown in Table 4, government policies and institutions are also important factors for economic growth. The maintenance of the rule of law is estimated to have significantly positive effect for growth. International trade openness has a positive impact on per worker GDP growth, although the estimated coefficient is marginally significant.

The level of democracy has a nonlinear relationship with growth, as suggested by Barro (1996). The coefficients on the indicator of democracy and its square term are positive and negative, respectively, and both coefficients are statistically significant. The pattern of the coefficients shows an inverted U-shaped relationship between GDP growth rate and political freedom. GDP growth rate declines when a nation has attained a certain level of political freedom, which is 0.53. The nonlinearity not only indicates negative effects of autocracy on growth if a dictator plunders the nation's wealth, but those of higher level of democracy above the threshold on growth if it promotes income-redistributive policies, rather than pro-growth ones, in systems of majority voting.

The effect of Inflation, an indicator of macroeconomic instability, for growth is negative and is marginally statistically significant. The estimated coefficient of the ratio of government consumption to GDP is statistically insignificant. The growth rate of the terms of trade (export prices relative to import prices) is estimated to have a significantly positive impact on growth.

Column 2 of Table 4 shows the result of regression with the inclusion of China dummy. It shows that China dummy is a statistically significant coefficient, (0.023, standard error =0.0113), which indicates that besides the explanatory variables included at the right-hand side, China has higher growth rates than the average (applied to all countries across time) by about 2.3% points over the sample period.

Column 3 includes an East Asia dummy representing the eight East and Southeast Asian countries, including China, which have shown the fastest growth (Table 1). The estimate shows that East Asian economies have higher growth rates than the average by about 1.3% points over the sample period. Column 4 included both China and East Asia dummies. The East Asia dummy has a statistically significant coefficient, (0.011, standard error =0.005), while China dummy is statistically insignificant, (0.014, standard error =0.012). Thus, in the current empirical framework East Asia as a group, rather than China alone, has significantly higher growth rates than the average. Chinese growth performance, over the whole period between 1960 and 2010, can be considered as a part of East Asian growth history. With the two dummies controlled, the regression shows that most of the explanatory variables are still significant and have the estimated coefficients of the same magnitude, compared to those in column 2 of table 4.

Column 5 of Table 4 adds country fixed effects. The results are quite similar to those of column 1. The estimated coefficient on the log of per worker GDP remains statistically significant. The estimated speed of conditional convergence increases to about 3.4% per year. The results with country fixed effects show that some economic policy and institutional factors, such as rule of law and trade openness, become statistically insignificant.

Overall, the regression results in Table 4 show that per capita GDP growth has strong relationships with the initial per capita GDP level, investment, fertility, the quality of human resources, rule-of-law maintenance, trade openness, inflation, and democracy. The growth regression results imply that China's growth performance relative to other economies can be explained by many factors, including convergence effect, which is attributed to its low level of per worker output relative to the long-term level, as well as favorable environmental and policy factors influencing the long-term potential level of per worker output.

We would analyze the growth performance of China relative to the performance of the US, using the regression results of Table 4. The point estimates are used for the accounting that examines the contributions from each of the explanatory variables to the fitted growth rates for each country.[11] While the "average" relationship applied to all countries across time would be captured in the cross-country regressions, there is no doubt that individual economies varies in the magnitude of the relationships, and in the explanatory variables for growth. Despite substantial residual errors in individual country's fitted growth rates, it is still worthwhile to examine how the explanatory variables differ across countries and how these differences explain the differences in the fitted growth rates.

Table 5 uses the results from columns 4 and 5 of Table 4 to assess China's actual and the model-estimated per worker GDP growth rates by decade. The estimates based on column 4 are

[11] Using the same technique, De Gregorio and Lee (2004) compare the economic performance of East Asian economies relative to Latin America, and Lee (2016) compares that of Korea relative to the US.

about 0.4%–1.5% points higher than the estimates based on column 5. The differences are due to the differences in the estimated coefficients such as the convergence term and democracy variables and the inclusion of China and Asian dummies. The model-based estimates for per worker GDP growth rates exceed actual rates in the earlier period, 1960–1980, but under-predict the actual rates in the later periods since 1980. The residuals are significantly larger in the later three decades. For 2000–2010, for instance, the actual per worker growth rate of 8.5% is far larger than the fitted values of 6.0%, the estimate based on column 4, and 4.4%, the estimate based on column 5. For the overall period of 1960–2010, China's actual growth rate of 5.6% is below the fitted value of 6.1%, based on column 4 of Table 4, while it is slightly above the fitted value of 5.3%, based on column 5.

The accounting results can be used to explore where the differences in the fitted growth rates between China and the US (or any other country) come from. Table 6 presents the results of the accounting exercise for per worker GDP growth rate differentials between China and the US over three subperiods, 1960–1980, 1980–2000, and 2000–2010. The results are based on the estimates in column 5 of Table 4 with the fixed effects.[12] The accounting result shows that the estimated average growth rate differentials between China and the US are 3.9%, 4.9%, and 5.7% points for each subperiod, 1960–1980, 1980–2000, and 2000–2010, while the actual differences are 0.5%, 5.7%, and 8.2% points. Therefore, the model overestimates China's relative growth performance in 1960–1980, and underestimates that in the later subperiods. Hence, the accounting results indicate that although the basic set of explanatory variables explains a significant part of the differences in growth rates between China and the US, there are other unexplained factors that made China grow slower or faster than the international average predicted by the model.

The accounting exercise breaks down the predicted differences separately into the contributions from the 11 explanatory variables. The result shows that the strong convergence effect, due to the lower income level of China compared to that of the US, led to higher per worker GDP growth. However, the magnitude of the convergence effect became smaller as

[12] When the estimation results in column 4 of table 4 are used, the accounting exercise provides qualitatively similar results although the China and Asian dummies account for a significant part of the average growth rate differentials.

China raises its capita income: this effect declined from 6.3% points a year over 1960–1980 to 5.6% points a year in 1980–2000, and then to 4.9% points a year in 2000–2010.

While the convergence effect was an important in explaining China's growth performance, the rest of the explanatory variables also influenced a significant part of the growth differences. For example, during 2000–2010, the higher investment rate in China contributed 0.4% points of per worker GDP growth differential, while the lower level of average schooling years contributed negative 1.3% points.

The exercise shows that the improvements in investment rate, fertility, life expectancy, and institutional quality contributed positively to China's growth accelerations. The relative low life-expectancy had made China grow 1.1% points lower than the US in 1960–1980, but as China improved life expectancy, its contribution declined to 0.3% points in 1980–2010. The relatively low level of the rule-of-law variable accounted for about 0.7−0.9% points of slower growth of China in 1980–2000, and then only 0.2% points in 2000–2010.

China had higher fertility rates in the earlier periods, but now has lower rates than the US. The change in the fertility gap between China and the US is predicted to contribute positively to the higher growth of China. The relatively high fertility rate accounted for about 1.6% points of slower growth of China in 1960–1980, whereas the relative low fertility contributed positively to China's growth by 0.5% points in 2000–2010. Note that the estimated positive effect on growth of lower fertility is applied to per worker GDP growth rates rather than GDP growth rates. The decrease in fertility has a positive effect on per worker output growth by lowering age-dependency ratio and population growth rate, which raises the steady-state per worker output and stimulates capital accumulation. However, it eventually has a negative effect on output growth when it leads to a decline in the working-age population. For China, the decline in the working-age population growth had additional negative effects on GDP growth over time. The working-age population growth rates declined steadily from 2.3% in 1960–1980 to 1.5% in 2000–2010. The growth rates are estimated to drop sharply to 0.2% in 2010–2015 and -0.3% in 2015–2020 (Table 7).

The gap between China and the US in average schooling years has been substantial, contributing to lowering growth of China relative to the US significantly over the period. It contributed to the growth rate differentials by 0.6% points in 1960–1980 and 1.2–1.3% points in 1980–2010.

China's level of democracy indicator remains quite low, with the current level of 0 (Figure 8). Interestingly, due to the nonlinear relationship between democracy and growth, the lower democracy level has not been a major determinant of the growth gap between China and the US. The improvement in democracy will contribute positively initially, up to the critical level of 0.53, and then negatively to the Chinese growth and convergence to the US per capita income. When China improves democracy level to the critical point of 0.53, the growth rate would increase by 0.8% points per year. With the US level of democracy (1.0), China's growth rate would increase by 0.5% points.

Overall, China's historical experience of economic convergence and growth is largely attributed to China's favorable growth factors including relatively low per worker output level, high investment rate, low fertility, improved life expectancy and institutional quality, Since China has continued to narrow the income gap with the advanced economies, it has inevitably encountered a slowdown in growth potential. However, the convergence path is conditional on the levels of environmental and institutional variables. The accounting exercise show that if China had improved human capital, rule-of-law, and democracy up to the US levels, the GDP growth rate would have increased about 2 percentage points per year in the overall period of 1980–2010. .

4. Structural Change and Sectoral Growth in China

A stylized pattern of structural change is that an increase in GDP per capita is associated with a decrease in agricultural employment and an increase in employment in the services sector.[13] China is not the exception (Figure 9). There have been major employment shifts toward services sector over 1981–2010. In China, the employment share of services sector increased fast over the period from 16.4% to 39.3%. In Korea, the share of employment in the services sector increased dramatically from 37% to 67.5% over the same period, while it increased in Japan from 53.1% to

[13] See Chenery (1960), Herrendorf, Rogerson and Valentinyi (2014), and Lee and McKibbin (2014).

70.2%. If China continues to follow the stylized pattern, its employment will move further to services sector as income rises.

The data on labor productivity growth rates at the sectoral levels are shown in Table 8. The sectors are classified by 4 aggregate sectors—agriculture, manufacturing, services and others. Services and others sectors are divided further by 4 and 3 industries, respectively. Per-worker valued-added growth rate in the services sector was merely 1.3% in the overall period of 1981–2010, lower than 3.1% in the agriculture sector and 15.1% in the manufacturing sector in the same period. Table 8 shows that the average annual growth in labor productivity (i.e. per worker valued added) in services sector accelerated in the recent decade, jumped from -0.7% in 1981–1990 and -1.3% in 1990–2000 to 5.8% in 2000–2010. However, growth rates in labor productivity in services sector were consistently lower than those in the manufacturing sector.

Chinese services industries, in particular the wholesale and retail trade, hotels, and catering and the transport, storage, and communications services, showed strong, positive growth of per worker value added in the recent decade. However, the finance, real estate, and business services industry showed negative growth.

In this section, to examine the impact of employment reallocation across sectors on overall economic growth in China, the technique of "shift-share" analysis was adopted. The analysis shows the association of aggregate labor productivity growth with differential growth of labor productivity in individual sectors and with labor reallocation across the sectors. Recent papers such as Maudos et al. (2008), Maroto-Sánchez and Cuadrado-Roura (2009), McMillan, Rodrik, and Verduzco-Gallo (2014), and de Vries et al. (2012) have used shift-share analysis to explore the impact of structural change on economic growth in different countries. Our focus is the changes in employment shares in the services sector and its impact on aggregate labor productivity growth in China.

The accounting technique decomposes aggregate labor productivity growth over a period of time into a "within effect" (labor productivity growth within each industry), and a "structural change effect" (labor productivity change due to employment shifts across sectors). Let y_i denote value added per worker in sector i, s_i the share of each sector in total employment, and superscripts 0 and T the beginning and end of the period. Then the following equation presents the decomposition of overall labor productivity growth in an economy over the period:

$$y^T - y^0 = \sum_{i=1}^{n} (y_i^T - y_i^0)\overline{s_i} + \sum_{i=1}^{n} (s_i^T - s_i^0)\overline{y_i}\,, \qquad (2)$$

where a bar indicates the arithmetic average over period [0, T]. In equation 2, the aggregate labor productivity growth is divided into two components. The first is the contribution from labor productivity growth within individual sectors weighted by the share of employment in each sector ("within effect"). The second is the contribution from labor reallocation across different sectors, defined by the change of employment shares multiplied by labor productivity levels across sectors ("structural change effect").

In the standard shift-share method, aggregate productivity growth is decomposed into within and structural change effects. In the structural change effect, all expanding sectors contribute positively to aggregate productivity growth, even when they have below-average productivity levels. Hence, this standard method is not well-suited to measure accurately the contribution of individual sectors to aggregate labor productivity growth. Consider, for example, employment shifts from high-productivity sector to low-productivity sector. As a result, aggregate productivity growth becomes lowered and the expanding sector contributes negatively to labor productivity growth. The seminal paper by Baumol (1967) presents a model of "unbalanced growth," in which higher productivity growth in the "progressive" sector than in the "stagnant" sector causes shifts of labor from progressive to stagnant sector and as a consequence aggregate output growth slows down over time.

We adopt a modified shift-share method in which the structural change effect of an expanding sector takes into account its relative productivity level (Timmer and de Vries, 2009). The decomposition in (2) is modified as follows:

$$y^T - y^0 = \sum_{K,J} (y_i^T - y_i^0)\overline{s_i} + \sum_{K,J} (s_i^T - s_i^0)(\overline{y_i} - \overline{y_J}), \qquad (3)$$

where K denotes the set of expanding sectors and J the set of shrinking sectors, and $\overline{y_J}$ average labor productivity in shrinking sectors, defined as:

$$\bar{y}_J = \frac{\sum_{i \in J}(s_i^T - s_i^0)\bar{y_i}}{\sum_{i \in J}(s_i^T - s_i^0)} \qquad (4)$$

In the modified decomposition, expanding sectors contribute positively to aggregate productivity growth only if their productivity level is higher than average productivity level of the shrinking sectors. By contrast, the expansion of sectors with productivity level below that of the shrinking sectors makes a negative contribution to aggregate productivity growth. If there is labor reallocation from high productivity growth to low productivity growth sectors, combining all of the contributions from individual sectors makes the structural-change term negative, which indicates deterioration of economy-wide productivity growth,

Table 9 shows employment share and relative productivity levels by sector. Employment share in the agricultural sector declined significantly over the period from 1981-2010. The analysis is based on data on 9 sectors which were constructed from CIP 3.0 data.[14] While employment share in the manufacturing decreased slightly, the services sector showed strong employment growth. In the services sector, employment shares increased substantially in the wholesale and retail trade (from 4.8% to 11.4%), the finance and real estate (from 0.8% to 5.5%), and the community and government services industries (from 7.7% to 19.9%). On the contrary, employment shares decreased slightly in the transport, storage, and communications services industries.

For the relative productivity level, the services sector was consistently higher than agricultural sector. Hence, the reallocation of labor from the below-average productive agriculture to the above-average productive services sector contributed to labor productivity growth in the overall economy. In contrast, as the services sector had on average lower labor productivity than the manufacturing, employment reallocation from manufacturing to services sector decreased overall labor productivity. In particular, compared to the manufacturing sector, whole and retail trade, and community and government services recorded lower productivity level.

[14] The original CIP 3.0 data are available for 37 sectors.

Table 10 presents the results of the shift-share analysis during 1981–2010. It shows that the within effects contributed a larger portion of the overall average labor productivity growth (5.0% points in 7.4%). The most of the within effects came from strong labor productivity growth in manufacturing sector, a salient feature of the Chinese economic growth, which contributed 5.1% points. Agriculture also contributed 0.7% points of the within effects. On the contrary, the within effect of the services sector was -1.2% over the period.

Structural change also made a significant contribution of 2.4% points to the overall labor productivity growth in the past three decades The effect of structural change in both the agriculture and services sectors was positive, contributing 0.2% points and 2.1% points respectively. The services sector made strong contribution to the overall structural change effect and the overall labor productivity growth due to the increasing employment share and high productivity level. The structural change effect in the finance, real estate, and business services contributed the most to the overall average labor productivity growth by 1.2% points. In contrast, the structural change effect of the manufacturing sector contributed almost zero to the overall average labor productivity growth due to the declining employment share.

The decomposition results show the services sector contributed strongly to aggregate labor productivity growth by its strong structural change effect. However, the within effect of the services sector (which is average labor productivity growth rate multiplied by the employment share) was negative. Hence, the total contribution of the services sector to aggregate labor productivity growth was only 0.9% points over the period 1980–2010, far below 5.0% points by the manufacturing sector.

The low labor productivity growth of the services sector relative to the manufacturing sector tends to hamper overall productivity growth. Lee and McKibbin (2014) show a negative relationship between the overall labor productivity growth rate and the employment share of its services sector across Asian economies. Lee (2016) explains that the large differentials in labor productivity and the growth rates in labor productivity between manufacturing and services sectors caused significant slowdown to overall per worker GDP growth rate in Korea over the past three decades. China lags about 20 years Korea in terms of the relative size of service sector in the economy. China's growth will also decline significantly, unless substantial increase in productivity of service sector takes place.

5. Outlook for China's Economic Growth

China's unprecedented economic growth since the 1980s reflects a strong convergence effect due to low initial per worker output relative to its own long-run potential. Good environmental and policy factors, such as a high investment rate, strong human capital, high trade openness, and improved institutions, guided the economy toward a higher level of long-run steady state compared to other economies, enabling China to realize its strong potential for catching up.

China's economic growth was accelerated since the late 1970s, and has remained high, which highlights China's successful transition from a command economy to a market economy and in rapid integration into global markets. Korea and Japan also experienced the growth acceleration in the take-off stage of development until the 1990s and until the 1970s, respectively (Figure 4). With economic reform and opening, they were able to achieve rapid growth and convergence.

The Chinese economy has slowed since 2010, and recorded a 6.9% GDP growth rate in 2015, the slowest since 1990. A lower return to investment has caused a reduction in physical capital accumulation. Fertility decline and population ageing have exerted downward pressures on labor inputs. Limited institutional and innovative capability hinders technological development and advancement.

Economic forecast for China including mid- and long-term growth is a matter of great interest among scholars and policymakers. In regard to this matter, China's growth experience is discussed in a global and historical context. For instance, Pritchett and Summers (2014) argued that, based on the historically prevalent growth path of "regression to the mean", China's growth rate could drop to 2–4% over the coming decades. They suggested that China's high levels of state control and corruption can cause a sudden drop of growth towards international average. However, the "regression to the mean," a critical assumption of this view, may not be applied to China's economic growth as it has been an exception to the stylized growth pattern, as much as other East Asian fast-growing economies did, and could continue to be for the foreseeable future.

On the other hand, Lin (2015) and Lin and Zhang (2015) forecasted 8% of growth rate in China for the next 20 years. According to Lin's argument, China can still exploit "latecomer advantage," to continue to grow by narrowing the gap in per capita income with the US through technological imitation and adaptation. Because the current levels of China's physical capital stock per worker, human capital stock, and TFP still remain small relative to the US, China must have a significant room to catch up to the US in per worker output by increasing factor accumulation and productivity growth (Lee, 2016). However, there is no theoretical background confirming that an economy's grow rate is determined by its per capita income relative to the US level. What matters more for China is the per capita income relative to its own potential level.

Reflecting the experiences of Japan and Korea as well as a broad sample of countries over time, our analyses in the previous sections point out that China's growth deceleration seems inevitable owing to the diminishing pace of convergence. If the estimated convergence effect from the cross-country regression with the country fixed-effects in column 5 of Table 4 prevails, China's per worker GDP growth is expected to decline by 2.4% points when its per worker GDP doubles. China's per worker GDP growth rate was 7.3% over 2010–2015, increasing per worker GDP by approximately 1.44 times over the period. The increase in per worker GDP level will exert a downward pressure on output growth in the coming years. Due to the convergence effect, the increase in per worker GDP would lower the per worker GDP growth rate to 6.1% in 2015–2020. Since the working-age population growth rate is estimated to be approximately -0.3% in 2015–2020, the GDP growth rate would decline to approximately 5.8%.

This projection is subject to the assumption that other environmental and policy variables remain unchanged. Steady change in fertility, life expectancy, and human capital variables will have an impact on growth. When the UN (2015)'s projections on fertility and life expectancy and Barro and Lee (2015)' projection on average years of schooling are assumed, China's per worker GDP growth rate over 2015-2020 will increase by approximately 0.2% point per year, raising the estimate for GDP growth rate to 6.0%. Thereafter the convergence effect will continue to exert downward pressure on growth beyond 2020. The convergence estimate implies that a 6% per worker GDP growth in 2015–2020 will increase per worker output level and thereby lower potential GDP growth by 1.0% point in 2020–2025. Hence, China's growth rate will be lowered to 5.0%.

In addition, improvement of institutions would have a significantly positive impact on growth. If China improves the rule-of-law from the current level of 0.75 to 0.83 (the level of Japan and Korea) and the democracy index from the current level of 0 to 0.25, the GDP growth rate would increase by about 0.6% point per year. Hence, the regression predicts that China's potential GDP growth rate would become approximately 6.6% over 2015-2020 and then 5.5% over 2020-2025, with such institutional reforms.[15] If China can improve the quality of human capital much faster and succeed in profound structural and institutional reforms, the growth rate would increase further. However, it is highly unlikely that China can achieve them in a short period. China's GDP growth rate will be eventually lowered to 5–6% in the coming decade.

Over the long-run, as happened to Japan and Korea, it is unlikely that China's growth remains as an exception. It would follow the growth path constructed based on international experience under the framework of conditional-convergence (Figure 4). Ultimately, the growth rates of the Chinese economy would fall to 3–4%.

Our forecasts are broadly consistent with views claiming a "soft landing" of the Chinese economy, including Lee and Hong (2012), the World Bank and DRC (2013), Cai and Lu (2013), and Perkins (2015). For example, an earlier study by Lee and Hong (2012) predicted (gradual) decline in China's average potential per worker GDP growth to approximately 6.1% over 2011–2020 and 5% over 2021–2030 under the baseline scenario where a steady improvement in human capital but no serious policy and institutional reform is assumed. This long-run GDP forecast is constructed by combining separately estimated physical and human capital accumulation and TFP growth within the conditional convergence framework using cross-country growth regression analysis. In addition, as shown in the alternative scenario, the implementation of policy reforms would bring substantial growth gains: when China significantly improves education, R&D stock growth, and maintenance of rule of law, its average potential per worker GDP growth would increase by approximately 1% point.

Thus, the future of China's growth hinges on productivity growth. In order to improve productivity and sustain strong convergence and growth, China needs a set of well-designed policies to upgrade human resources, tackle structural bottlenecks, and promote technological

[15] This projection assumes that the growth rate in 2015–2020 will decline from the actual GDP level and growth rates in 2010–2015. Alternatively, the results from column 5 of Table 4 can be used directly to project China's economic growth into the future. When the same steady improvement in human capital and institutional reform are assumed, a projected GDP growth rate for 2015–2020 is 4.0% per year. Thus, consistent with the model's under-estimation of Chinese economic growth in the recent decades (as shown in Table 5), the model may be under-predicting growth from 2015 on. If the results in column 4, with Asia and China dummies, is used, the projected grow rate is 6.0%.

development. China must improve the quality of its labor force. China's demographic transition is now headed in an unfavorable direction for economic growth, owing to low fertility rates and population aging. China's prime working-age population (15-59 years) is expected to shrink by 67 million people between 2010 and 2030, according to UN population projections. In 2015, China formally ended its one-child policy, which had been in force for 35 years. However, the effect could be limited as Chinese people have become accustomed to having a single child. Even if births increase, at least 15 years will be needed to help the working population numbers.

Along with the expansion of higher-level of education, in particular upper secondary and tertiary, improvements in quality must be pursued (Lee, 2014). This would reduce substantial disparities in the quality of higher education across regions and social groups. Employer surveys reveal that graduates of upper secondary schools and universities usually lack the required technical knowledge and soft skills, such as communication and teamwork. The government must enhance quality of education by adopting policies to ensure better financing, recruitment and compensation, and promoting decentralized decision making system in school. In addition, fragmented and ineffective technical vocation education and training programs must be improved in order to appropriately respond to the changing skill demands amid the rapid globalization and technological innovation.

The abundance of educated workers contributes to the higher productivity. Given access to advanced technology, having a pool of well-educated and skilled workers is a crucial determinant of the domestic absorptive capacity or the capability to absorb the spillovers of foreign technologies, and therefore the extent and speed of technological diffusion in the country. Better-quality human capital becomes more important for China in moving up the value chain towards more sophisticated, high-value products and transitioning to a more innovative economy. According to Fleisher et al. (2010), human capital positively affected output and productivity growth across Chinese provinces by promoting both technology spillovers and domestic innovation activities.

In addition, China needs to implement policies to stimulate technological innovation and industrial upgrading, which could help increase productivity in both the manufacturing and services sectors. China's research and development (R&D) investment has been rising rapidly. According to the OECD (2014)'s prediction, China will be the world's top R&D spender by around 2019. Policies aimed at strengthening the research capacity of domestic firms and promoting more efficient allocation of R&D expenditures are important to stimulate productivity growth. Direct investment by advanced foreign firms and technology spillovers to domestic firms should be encouraged. Considering that China's intellectual property rights regime is relatively weak, improving the protection of intellectual property rights is necessary to stimulate innovative activities.

China must remove structural bottlenecks that impede productivity growth (Lee, 2015). Under the management of the Chinese government, structural reforms are on the way in order to ensure greater labor market flexibility, to liberalize the financial sector, and to privatize state owned enterprises. The success of these reforms will improve environmental and policy variables and support productivity growth, thereby offsetting the convergence effect.

Reform in factor markets— labor, land, and finance— is essential (World Bank and DRC, 2013). Reform policies must target greater labor market flexibility and labor mobility as well as the higher efficiency of land use, acquisition and compensation. China needs to continue reforms in the factor markets of labor, finance, and land. China's financial system, highly regulated, government-controlled and dominated by banks, is subject to reform. The government needs to promote market-based credit allocation and develop a capital market. An improved financial sector, linked to an effective supervision and regulation system, supports productive and innovative firms. Hseih and Klenow (2009) found that distortions in capital allocation reduced TFP in the Chinese manufacturing sector by 30–50% relative to the US.

Improving the efficiency of the state-owned enterprises (SOEs) and stimulating domestic competition is key to enhancing productivity in the Chinese economy. In the earlier period, the Chinese government did not introduce rapid privatization, but chose to implement reforms of SOEs in a gradual way. It then rapidly restructured and downsized SOEs in order to improve the efficiency. Figure 10 shows that SOEs' share in the Chinese economy has been declining due to massive restructuring and privatization since 2000. However, large SOEs still maintain a significant market power in important industrial sectors. Recently they have become less competitive than private firms, indicated by lower profitability and higher leverage. Chines government announced SOE reform aiming to promote mixed ownership involving private capital and to strengthen corporate governance and operations for commercial motives. It will allow non-state investors to participate in the energy, resources, and telecom industries. This new round of SOE reform should be pushed hard.

Chinese authorities are striving to make the shift from an investment and export-driven economy to a domestic-consumption and services-based economy. Effective rebalancing is critical for sustainable growth, especially under great global economic uncertainties. Due to its greater export share in global markets, China will face more challenges in maintaining its export-led growth than Japan and Korea have done. But, China must be aware that without preparations or sound economic environment, the shift to service-based economy often refers to resources reallocation from a productive export-oriented industry to a highly unproductive services industry may impede overall productivity growth (Kim, Lee and McKibbin, 2014). Rebalancing policies that encourage firms to increase wages will raise household income and domestic consumption, but wage increases can lead to a loss of export competitiveness and foreign direct investment inflows (Lee, 2015). Hence, China should pursue successful rebalancing along with improved productivity.

The Chinese government is keen to maintain decent growth of about 6.5% annually by 2020 while pushing for rebalancing and reform. China would achieve this target under the assumption that the government were able to manage soft and smooth transition to a more balanced and more productive growth path. However, the economic slowdown could be worsened if major policy mistakes occurred in managing domestic weaknesses, external shocks, and political transformation. As reform measures take time to prove effective, authorities may rely too much on short-term stimuli to meet the growth target, aggravating resource misallocation and structural vulnerabilities. Shadow banking, and local government and corporate debt present significant vulnerabilities and risks to the Chinese economy. Total debt in the economy hit 282 percent of its GDP in 2014, larger than that in the U.S. (Dobbs et al., 2015). Government debt is lower than the international standard, but, local governments' borrowing, including off-budget borrowing by local government financing vehicles, has soared since 2007, now accounting for more than half of the public debt (IMF, 2015). Corporate sector debt has been rising and, albeit still low nonperforming loans ratio, raised vulnerabilities and risks. Reckless lending to local governments and private enterprises from the shadow financial sector would increase the risk of a financial crisis and further endanger the economy.

China's authoritarian government was able to adopt the right growth-enhancing policies at critical points because it was not unduly swayed by any interest group (Yao, 2013). It is unclear whether the authoritarian Chinese regime can continue to maintain its neutrality and perform better than other regimes. With the economy having grown larger and more unpredictable, government intervention, including macroeconomic management, face more challenges and become less effective. Furthermore, the rise of the middle class would likely promote political development, particularly democracy, which could lead the population to push for government focus on social welfare policies, which are important but do not necessarily enhance growth.

5. Concluding Remarks

As presented in the experiences in Japan and Korea, economic slowdown in the Chinese economy following economic success is inevitable. As it narrows the gap of capital stock and productivity levels with their potential levels, maintaining a rapid pace of capital accumulation and technological progress becomes more of a challenge. Our analyses based on cross-country regressions and comparison with earlier experiences of advanced Asian economies (i.e. Japan and Korea) show that China's average potential GDP growth will decline due to the convergence effect and decreasing working-age population. If there is no progress in institutions and policy factors, sustaining 5–6% of GDP growth in the coming decades will be challenging. Soft-landing and steady growth require that no major policy mistakes will occur in managing domestic weaknesses, external shocks, and political transformation.

The recent slowdown of Chinese economy shows that structural problems and stagnant productivity growth have increasingly weighed on economic growth. Despite difficult challenges ahead, the future of economic growth in China is not preordained, and hinges critically on reforms and policies that could contribute to increasing productivity, thereby at least partially offsetting the growth deceleration due to the convergence in the coming decades. China must pursue the right policies to upgrade human resources, address structural bottlenecks, and enhance productivity, especially in the services sector, while managing macroeconomic and financial vulnerabilities.

China's strong and stable growth over the past three decades undoubtedly has benefitted the world economy. Strong demand from China has supported its trading partners' export-led growth. With appropriate policies and structural reforms, China can continue to show the dynamism and achieve strong and sustained growth, leading the global economy onto a high economic growth path as well.

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Table1 The Fifteen Fastest Growing Economies, 1960–2015

Economy	Per capita GDP growth rate (%)				Factor increase		Per capita GDP 2015
	1960–2015	1960–1980	1980–2000	2000–2015	2015 /1960	2015 /1980	
China, P.R.	6.24	2.55	8.14	8.63	31.0	18.6	11,514
Korea	5.54	6.01	6.80	3.24	21.1	6.3	30,799
Botswana	5.53	7.17	6.04	2.66	20.9	5.0	16,370
Taiwan	5.26	6.59	5.57	3.09	18.1	4.8	36,271
Singapore	4.89	6.74	4.82	2.50	14.7	3.8	64,655
Thailand	4.67	5.65	4.65	3.38	13.0	4.2	11,538
Hong Kong	4.43	5.90	3.80	3.29	11.4	3.5	51,072
Malta	4.34	7.26	3.58	1.48	10.9	2.6	27,861
Romania	4.00	7.77	-0.16	4.51	9.0	1.9	17,302
Malaysia	3.91	4.85	3.68	2.97	8.6	3.3	20,615
Sri Lanka	3.82	3.15	3.57	5.06	8.2	4.4	8,134
Panama	3.55	4.36	1.59	5.09	7.1	3.0	15,321
Japan	3.34	5.88	2.61	0.94	6.3	1.9	34,414
India	3.29	1.40	3.47	5.56	6.1	4.6	4,661
Egypt	3.28	3.78	3.67	2.08	6.1	2.9	5,911

Notes: The data are from the Penn World Table version 8.1 (Feenstra, Inklaar, and Timmer, 2015). Per capita GDP levels are based on the international prices of 2005 (adjusted for purchasing power parity) and growth rates are based on real per capita GDP in national prices.

Table 2 The Fifteen Slowest Growing Economies, 1960–2015

Country	Per capita GDP growth rate (%)				Factor increase		Per capita GDP 2015
	1960–2015	1960–1980	1980–2000	2000–2015	2015 /1960	2015 /1980	
D.R. Congo	-1.83	-1.65	-5.35	2.61	0.36	0.51	492
Central Afri. Rep.	-1.56	-0.93	-1.02	-3.11	0.42	0.51	498
Niger	-0.92	-0.84	-2.62	1.25	0.60	0.71	687
Madagascar	-0.90	-0.52	-1.75	-0.29	0.61	0.67	931
Guinea-Bissau	-0.79	-1.97	-0.38	0.23	0.65	0.96	1,148
Zambia	-0.06	-0.20	-2.00	2.71	0.97	1.01	2,636
Senegal	-0.04	-1.17	0.20	1.14	0.98	1.23	1,787
Guinea	0.11	0.13	0.19	-0.03	1.06	1.03	980
Burundi	0.17	1.63	-1.23	0.09	1.10	0.79	498
Zimbabwe	0.18	0.87	-0.27	-0.15	1.10	0.93	4,318
Gambia	0.28	-0.03	0.23	0.76	1.17	1.17	1,579
Togo	0.38	2.47	-1.75	0.45	1.24	0.75	1,244
Venezuela	0.50	2.16	-0.95	0.22	1.31	0.85	9,840
Cameroon	0.51	1.81	-1.36	1.27	1.32	0.92	2,423
Cote d'Ivoire	0.53	2.51	-1.47	0.58	1.34	0.81	2,198

Notes: The data are from the Penn World Table version 8.1 (Feenstra, Inklaar, and Timmer, 2015). Per capita GDP levels are based on the international prices of 2005 (adjusted for purchasing power parity) and growth rates are based on real per capita GDP in national prices.

Table 3 Growth Accounting for China, 1960–2010

	GDP Growth Rate	Contribution from			
		Labor	Human Capital	Physical Capital	Total Factor Productivity
1960–1970	0.0227 *(100%)*	0.0117 *(51.5%)*	0.0070 *(30.8%)*	0.0090 *(39.6%)*	-0.005 *(-22%)*
1970–1980	0.0489 *(100%)*	0.0139 *(28.4%)*	0.0070 *(14.3%)*	0.0219 *(44.8%)*	0.0061 *(12.5%)*
1980–1990	0.0771 *(100%)*	0.0140 *(18.2%)*	0.0053 *(6.9%)*	0.0193 *(25%)*	0.0385 *(49.9%)*
1990–2000	0.0928 *(100%)*	0.0070 *(7.5%)*	0.0064 *(6.9%)*	0.0386 *(41.6%)*	0.0408 *(44%)*
2000–2010	0.0917 *(100%)*	0.0067 *(7.3%)*	0.0012 *(1.3%)*	0.0516 *(56.3%)*	0.0322 *(35.1%)*

Notes: Data are sourced from the PWT 8.1 and Barro-Lee human capital data (www.barro-lee.com). GDP growth is an average annual GDP growth rate over the period, and data on working-age population are sourced from the United Nations (2013). Human capital per worker is measured by the weighted sum of the shares of workers multiplied by the relative wage rates across all education categories. Relative wage rates are constructed assuming that the rates of return to an additional schooling year are constant at 10.1%.

Table 4 Cross-country Panel Regressions for Per Worker GDP Growth Rate

	(1)	(2)	(3)	(4)	(5)
Log (per worker GDP)	-0.0230***	-0.0219***	-0.0213***	-0.0208***	-0.0343***
	(0.00236)	(0.00238)	(0.00235)	(0.00236)	(0.00352)
Investment/GDP	0.0364**	0.0360**	0.0308*	0.0313*	0.0353*
	(0.0162)	(0.0161)	(0.0161)	(0.0160)	(0.0208)
Log (total fertility rate)	-0.0246***	-0.0233***	-0.0225***	-0.0220***	-0.0185***
	(0.00445)	(0.00446)	(0.00445)	(0.00445)	(0.00622)
Average schooling years	-0.00352*	-0.00348*	-0.00327*	-0.00328*	-0.00552**
	(0.00183)	(0.00181)	(0.00180)	(0.00180)	(0.00243)
Average schooling years^2	0.00029**	0.00029**	0.00027**	0.00027**	0.00037**
	(0.000122)	(0.000121)	(0.000120)	(0.000120)	(0.000158)
1/Life expectancy	-3.275***	-3.129***	-3.036***	-2.976***	-2.157**
	(0.662)	(0.662)	(0.655)	(0.656)	(0.990)
Trade openness	0.00616**	0.00645**	0.00429	0.00471	0.00702
	(0.00302)	(0.00298)	(0.00298)	(0.00299)	(0.00601)
Government consumption	-0.00954	-0.00913	-0.00560	-0.00585	-0.00697
	(0.0127)	(0.0126)	(0.0126)	(0.0126)	(0.0153)
Rule-of-law index	0.0184***	0.0183***	0.0183***	0.0183***	0.0115
	(0.00572)	(0.00567)	(0.00563)	(0.00561)	(0.00806)
Inflation rate	-0.0163*	-0.0151	-0.0152*	-0.0147	-0.0272**
	(0.00942)	(0.00934)	(0.00922)	(0.00921)	(0.0132)
Democracy index	0.0402**	0.0486***	0.0413**	0.0463**	0.0249
	(0.0181)	(0.0187)	(0.0178)	(0.0187)	(0.0224)
Democracy index^2	-0.0380**	-0.0443***	-0.0363**	-0.0404**	-0.0200
	(0.0164)	(0.0167)	(0.0162)	(0.0168)	(0.0203)
Terms of trade change	0.0665**	0.0668**	0.0688***	0.0687***	0.0588**
	(0.0262)	(0.0263)	(0.0262)	(0.0263)	(0.0264)
China		0.0228**		0.0137	
		(0.0113)		(0.0117)	
ASIA8			0.0132***	0.0114**	
			(0.00457)	(0.00481)	
Country fixed effect	no	no	no	no	yes
No. of economies, obs.	75,713	75,713	75,713	75,713	75,713

Notes: The system has ten equations, corresponding to the periods 1960–1965, 1965–1970, 1970–1975, 1975–1980, 1980–1985, 1985–1990, 1990–1995, 1995–2000, 2000–2005, and 2005–2010. The sample consists of 75 economies. This system of 10 equations is estimated by adopting instrumental variable (IV) estimation techniques. Instruments are mostly lagged values of the explanatory variables. Period dummies are included. The dependent variables are the growth rates of per worker GDP. Standard errors are shown in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Per worker GDP levels and growth rates are based on 2005 international prices (adjusted for PPP). The investment ratio is the ratio of real investment (private plus public) to real GDP. The government consumption measure is the ratio of real government consumption to real GDP, based on the Penn-World Tables 8.1. They are averaged over the period. Schooling data represent the average years of schooling for the population aged 15-64 from Barro and Lee (2013). Life expectancy at birth and the fertility rate are from the World Bank's *World Development Indicators*. The rule-of-law index, expressed on a zero-to-one scale, with one being the most favorable, is based on the maintenance of the rule-of-law index of the Political Risk Services' *International Country Risk Guide*. The inflation rate is the growth rate over each period of a consumer price index. The trade openness variable is the ratio of exports plus imports to GDP. The democracy index, expressed on a zero-to-one scale, with one being the most favorable, is based on the indicator of political rights compiled by Freedom House. The growth rate of the terms of trade is the change of export prices to import prices over the period. Asia8 is East Asia dummy representing the eight East and Southeast Asian countries, including China, which are included in the group of the 15 fastest growing economies, as shown in Table 1.

Table 5 Per Worker Growth Rates in China— Actual and Fitted Values

Period	Per worker GDP growth rate				
	Actual value	Fitted value (column 4 of table 4)	*Residual (column 4 of table 4)*	Fitted value (column 5 of table 4)	*Residual (column 5 of table 4)*
1960–1970	0.0110	0.0635	*-0.0525*	0.0593	*-0.0483*
1970–1980	0.0349	0.0674	*-0.0325*	0.0633	*-0.0284*
1980–1990	0.0631	0.0582	*0.0049*	0.0492	*0.0140*
1990–2000	0.0859	0.0578	*0.0281*	0.0466	*0.0393*
2000–2010	0.0851	0.0595	*0.0256*	0.0442	*0.0408*
1960–2010	0.0560	0.0613	*-0.0053*	0.0525	*0.0035*

Note: The fitted values and residuals for per worker GDP growth rates come from the panel regression in columns (4) and (5) in Table 4.

Table 6 Contributions to Growth Differentials between China and the US 1960–1980, 1980–2000, and 2000–2010 (annual average rate, %)

Contributions to the difference in per worker GDP growth of China relative to the US						
Period	*1960–1980*		*1980–2000*		*2000–2010*	
Difference in						
Actual Growth	0.0054		0.0565		0.0817	
Predicted Growth	0.0389	*(100.0%)*	0.0485	*(100.0%)*	0.0566	*(100.0%)*
Initial income	0.0630	*(160.0 %)*	0.0558	*(115.1%)*	0.0486	*(86.0%)*
Investment rate	-0.0016	*(-4.1%)*	-0.0003	*(-0.6%)*	0.0042	*(7.5%)*
Fertility	-0.0163	*(-41.9%)*	-0.0036	*(-7.4%)*	0.0049	*(8.6%)*
Schooling	-0.0057	*(-14.7%)*	-0.0122	-*(25.2%)*	-0.0133	*(-23.6%)*
Life expectancy	-0.0112	*(-28.8%)*	-0.0036	*(-7.4%)*	-0.0029	*(-5.2%)*
Gov. consumption.	-0.0004	*(-1.0%)*	-0.0011	*(-2.3%)*	-0.0011	*(-1.9%)*
Rule of law	-0.0091	*(-23.4%)*	-0.0067	*(-13.8%)*	-0.0022	*(-3.9%)*
Inflation rate	0.0004	*(1.0%)*	-0.0005	*(-1.0%)*	0.0000	*(0.0%)*
Democracy	-0.0013	*(-3.3%)*	-0.0010	*(-2.1%)*	-0.0043	*(-7.6%)*
Openness	-0.0006	*(-1.5%)*	-0.0006	*(-1.2%)*	0.0000	*(-0.1%)*
Terms of trade	0.0004	*(1.0%)*	-0.0002	*(-0.4%)*	-0.0001	*(-0.2%)*

Note: The predicted per capita growth rates are based on the estimation result of column (5) in Table 4..

Table 7 Population and Working-Age Population Growth for Korea, Japan, China, and the US (per year, %)

		1960–1980	1980–2000	2000–2010	2010–2015	2015–2020	2020–2025	2025–2030	2030–2035	2035–2040
China	GRp	2.10	1.28	0.56	0.86	0.39	0.17	0.01	-0.10	-0.19
	GRw	2.34	1.95	1.45	0.16	-0.29	-0.18	-0.44	-0.99	-1.13
Japan	GRp	1.07	0.41	0.07	0.01	-0.24	-0.36	-0.45	-0.52	-0.57
	GRw	1.38	0.47	-0.54	-1.07	-0.86	-0.62	-0.73	-1.01	-1.43
Korea	GRp	2.19	1.03	0.47	0.86	0.38	0.28	0.21	0.08	-0.12
	GRw	2.59	1.74	0.66	0.80	-0.19	-0.82	-1.01	-1.07	-1.12
US	GRp	1.10	1.03	0.94	0.72	0.72	0.68	0.61	0.53	0.46
	GRw	1.54	1.07	1.05	0.35	0.25	0.10	0.05	0.36	0.40

Note: GRp indicates average annual growth rate for total population and GRw for working-age population. Source: Author's calculation based on the United Nations (2015).

Table 8 Growth Rates of Value Added and Per Worker Value Added by Sector in China, 1981-2010 (per year, %)

	Value added growth				Per worker valued added growth			
Sector	1981–1990	1990–2000	2000–2010	1981–2010	1981–1990	1990–2000	2000–2010	1981–2010
Aggregate economy	7.40	8.45	10.81	8.94	4.72	7.25	9.94	7.39
Agriculture, hunting, forestry, and fishing	3.69	2.72	1.40	2.57	2.34	2.73	4.14	3.09
Manufacturing	12.69	18.43	17.55	16.35	10.64	19.51	14.54	15.04
Services	5.04	3.26	9.23	5.87	-0.70	-1.33	5.78	1.32
Wholesale and retail trade, hotels, and catering	-9.07	1.33	11.44	1.59	-16.0	-2.76	8.64	-2.95
Transport, storage, and communications	5.73	4.31	10.33	6.83	0.87	4.83	11.22	5.80
Finance, real estate, and business services	15.48	7.22	10.18	10.80	11.02	3.41	-3.00	3.56
Community and government services	3.08	-2.58	5.44	1.94	-2.35	-8.90	2.63	-2.89
Others	5.57	2.36	7.08	4.98	-1.31	-0.19	4.78	1.17
Mining and quarrying	-0.47	3.18	1.30	1.40	-3.65	6.39	1.43	1.56
Electricity, gas, and water	12.62	-4.22	14.58	7.49	6.63	-8.75	12.46	3.34
Construction	6.47	3.03	6.31	5.23	-3.87	-1.93	3.38	-0.70

Note: Author’s calculation of Annual valued added growth rates and per worker value added growth using CIP 3.0 Database.

Table 9 Employment Shares and Relative Productivity Levels by Sector in China, 1981 and 2010

Sector	Employment share		Relative labor productivity	
	1981	2010	1981	2010
All sectors	100%	100%	1.0	1.0
Agriculture, hunting, forestry, and fishing	58.1%	31.6%	0.56	0.32
Manufacturing	20.2%	18.8%	1.64	1.73
Services	16.5%	39.3%	1.34	1.10
Wholesale and retail trade, hotels, and catering	4.79%	11.39%	1.22	0.96
Transport, storage, and communications	3.17%	3.07%	1.45	2.19
Finance, real estate, and business services	0.82%	4.98%	6.25	3.00
Community and government services	7.66%	19.88%	0.84	0.54
Others	3.95%	8.97%	3.15	1.58
Mining and quarrying	1.53%	0.69%	3.25	7.58
Electricity, gas, and water	0.24%	0.51%	13.56	4.65
Construction	2.18%	7.78%	1.94	0.85

Source: Author's calculation using CIP 3.0 Database.

Table 10 Decomposition of Labor Productivity Growth in China, 1981-2010 (annual average rates)

Sector	Within effect	Structural change effect	Total
All sectors	4.97	2.43	7.39
Agriculture, hunting, forestry, and fishing	0.74	0.23	0.97
Manufacturing	5.09	-0.06	5.03
Services	-1.19	2.10	0.91
Wholesale and retail trade, hotels, and catering	-1.32	0.37	-0.94
Transport, storage, and communications	0.78	-0.01	0.77
Finance, real estate, and business services	0.25	1.15	1.40
Community and government services	-0.90	0.59	-0.31
Others	0.33	0.15	0.48
Mining and quarrying	0.21	-0.16	0.05
Electricity, gas, and water	0.20	0.11	0.30
Construction	-0.08	0.21	0.13

Source: Author's estimates based on equation 3.

Figure 1 Growth Rate versus Initial GDP, 1960–2015

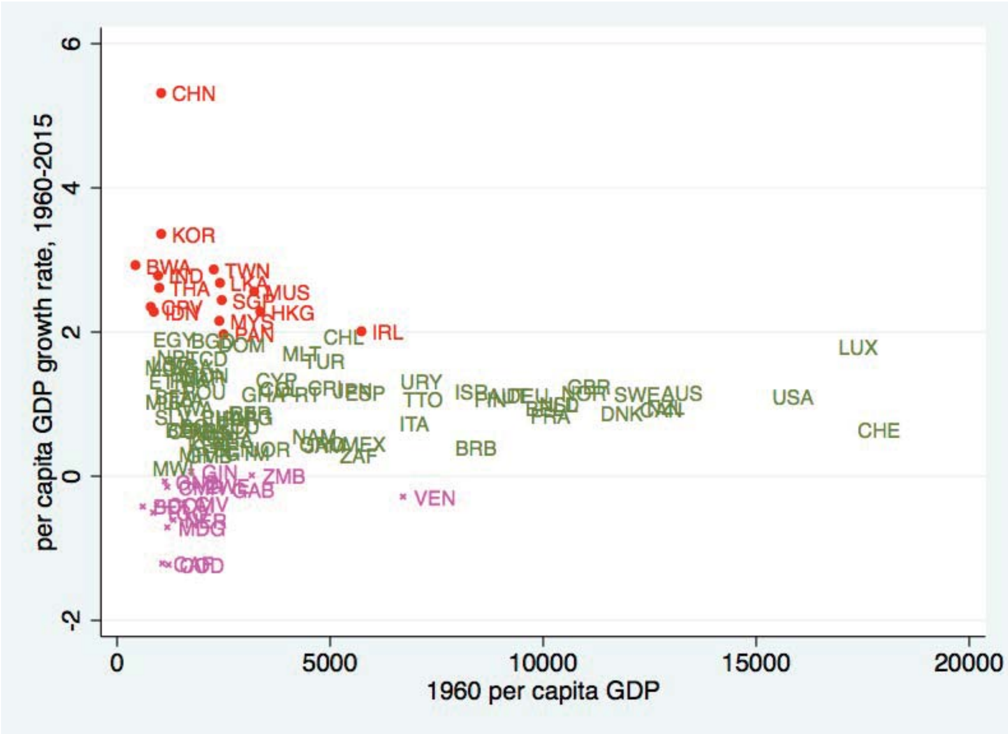
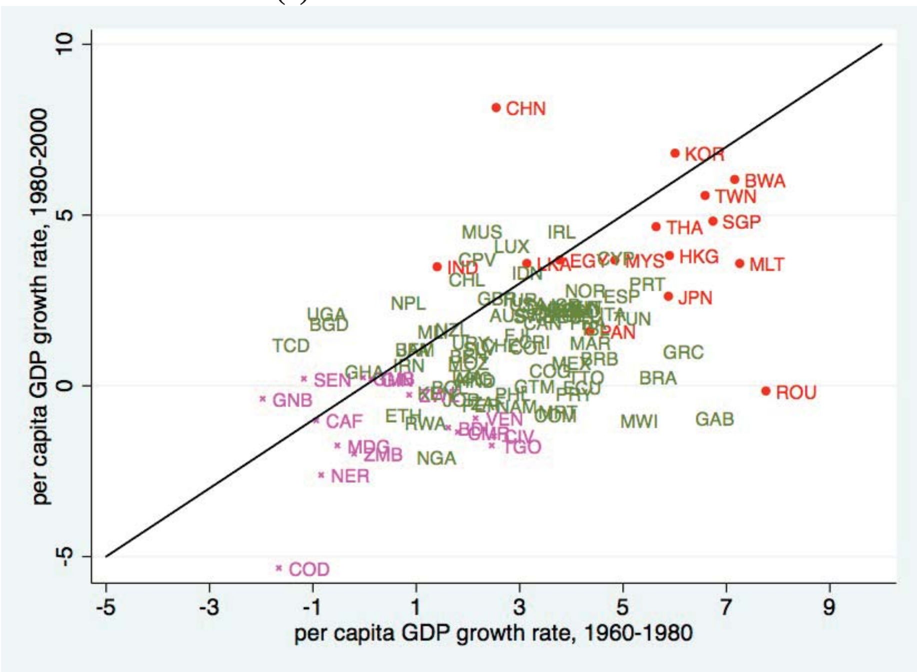


Figure 2 Correlations of Per Capita GDP Growth Rates over the Periods

(a) 1960–1980 versus 1980–2000



(b) 1980–2000 versus 2000–2015

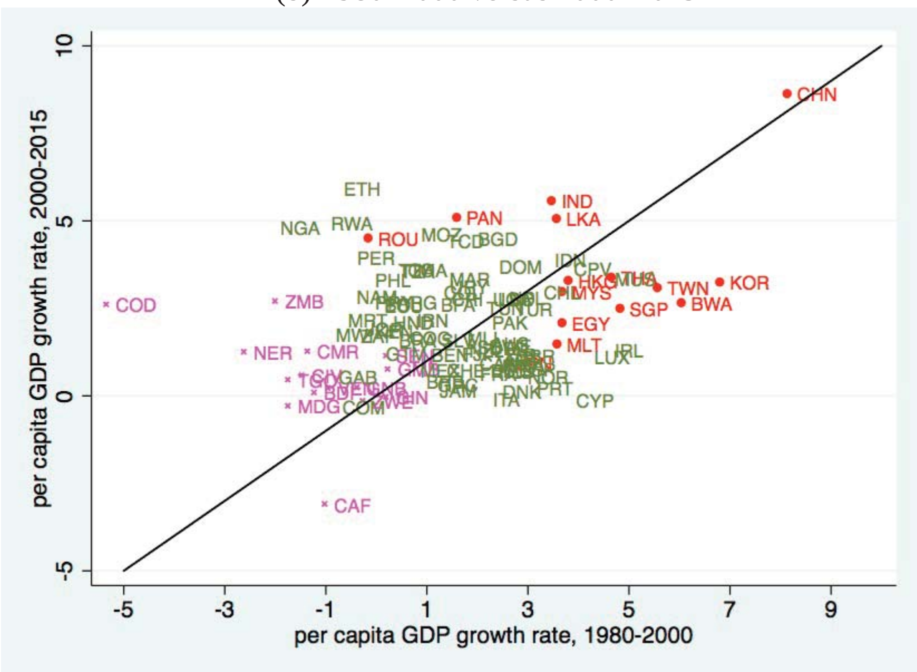
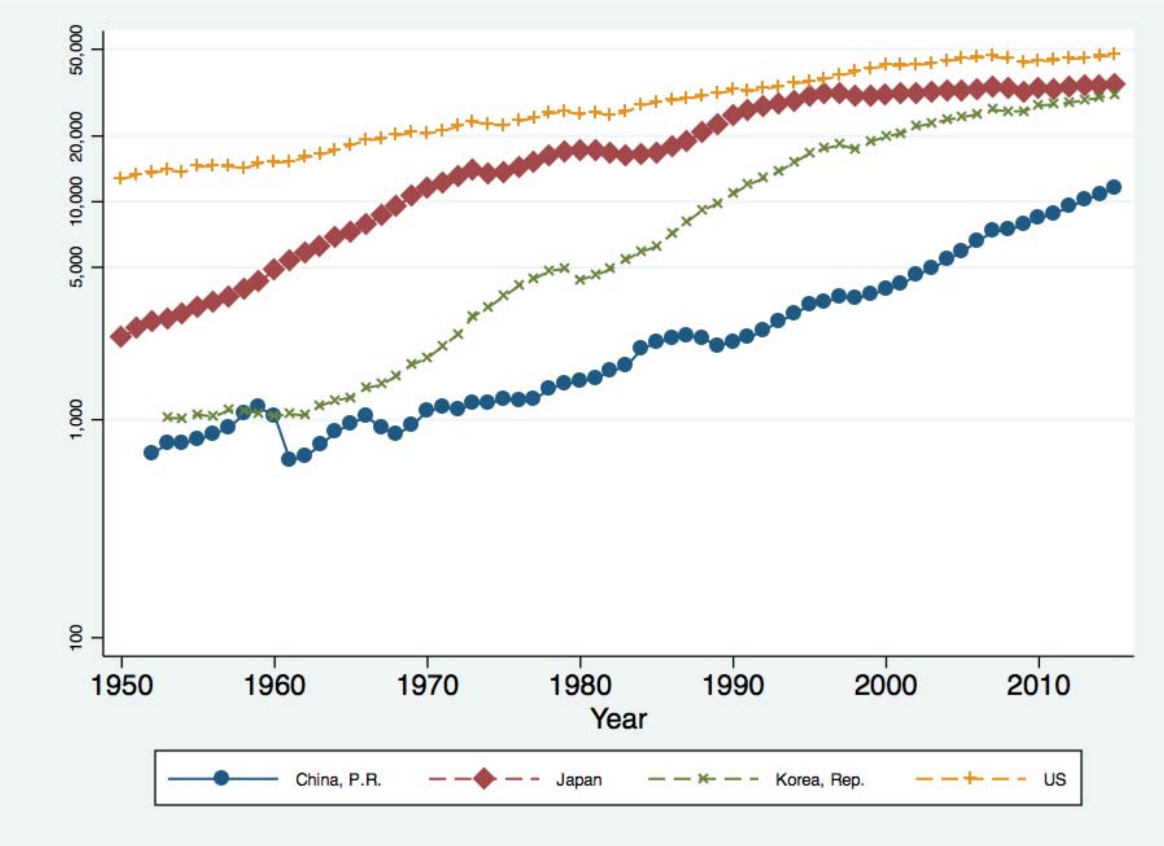


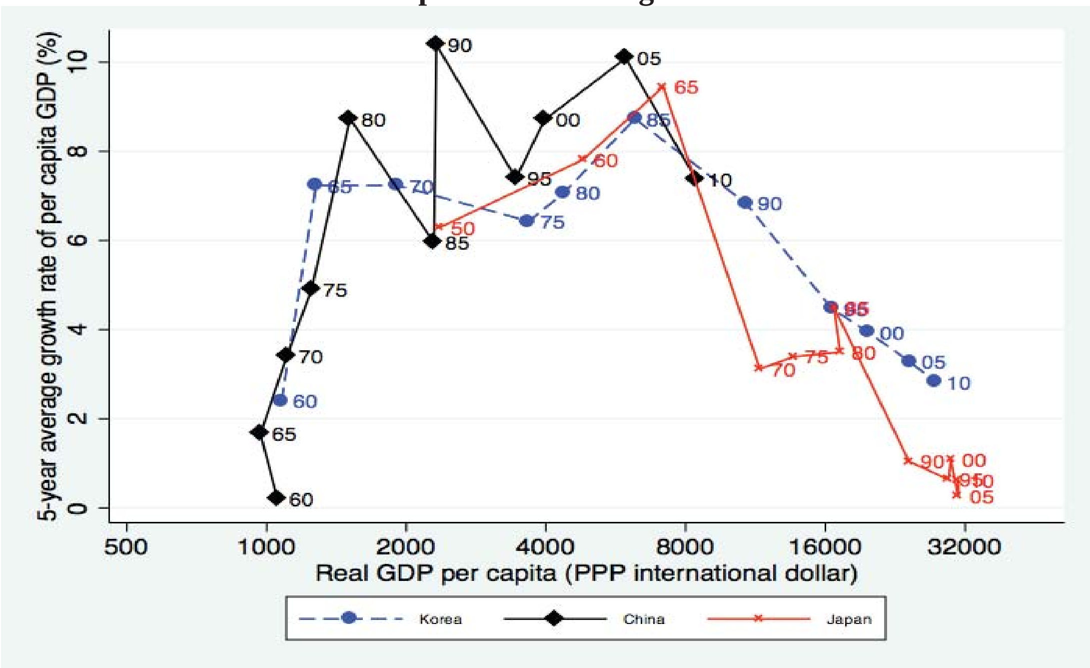
Figure 3 Trends in Per Capita Gross Domestic Product in Selected Economies



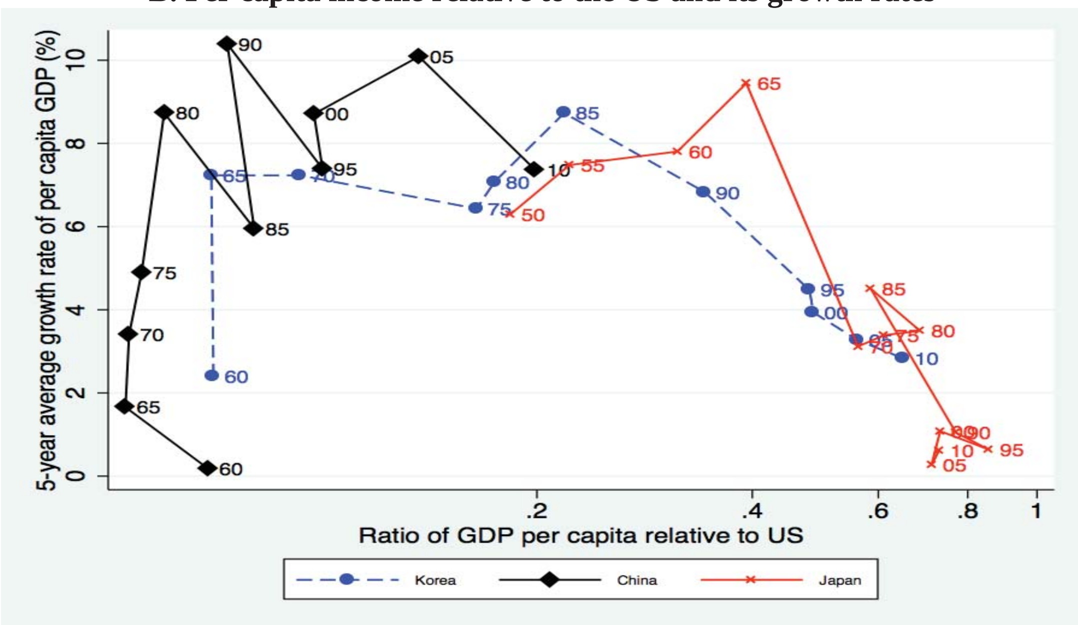
Source: Data on GDP per capita in purchasing power parity International dollar in 2005 constant prices are from Penn World Table 8.1 (Feenstra, Inklaar, and Timmer 2015). The data from 2012 to 2015 are extended using information from the IMF, World Economic Outlook Database,

Figure 4 Per Capita Income Level and Growth Rates of Korea, Japan, and China

A. Per capita income and growth rates



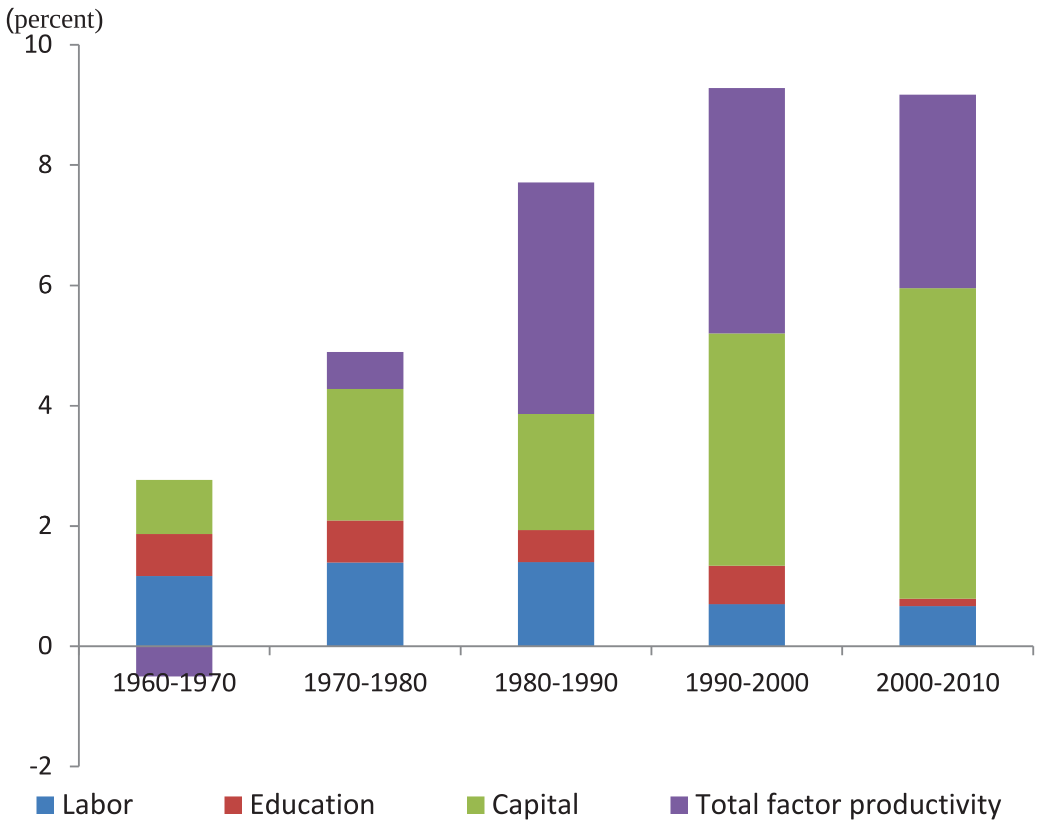
B. Per capita income relative to the US and its growth rates



Notes: The figure shows per capita income (relative to the US) and its growth rates over the corresponding 5 years. For the five-year average growth rates, 60 indicates 1960–1965,… , and 10 indicates 2010–2015. The data from 2012 to 2015 are from the IMF, World Economic Outlook Database,

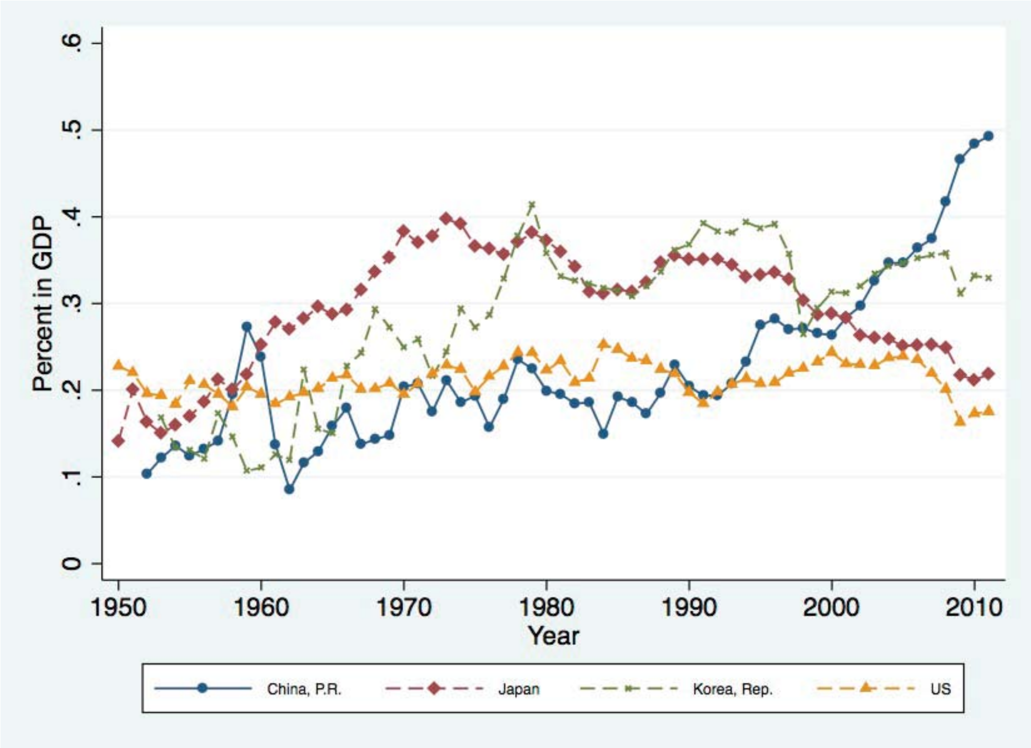
Source: Author's calculation based on data from Penn World Table 8.1 (Feenstra, Inklaar, and Timmer, 2015) and the IMF, World Economic Outlook Database.

Figure 5 Growth Accounting for China by Decade, 1960–2010



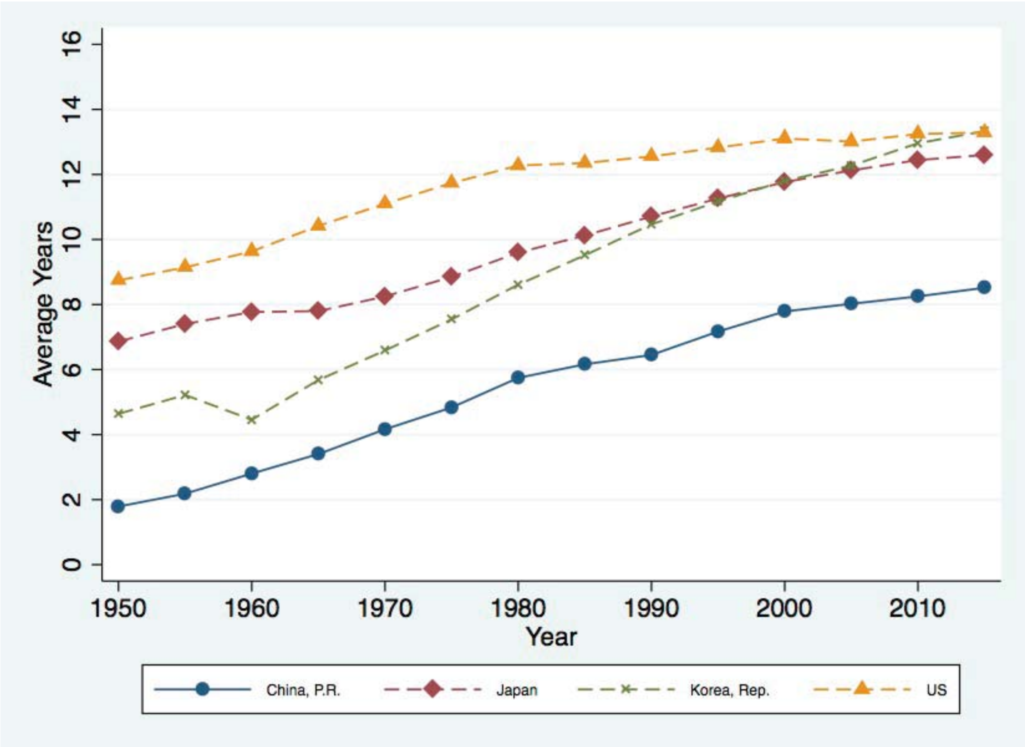
Note: See Barro, R. and J.-W. Lee (2015) for the underlying data and methodology.

Figure 6 Investment Rates of Korea, China, Japan, and the US, 1960–2011



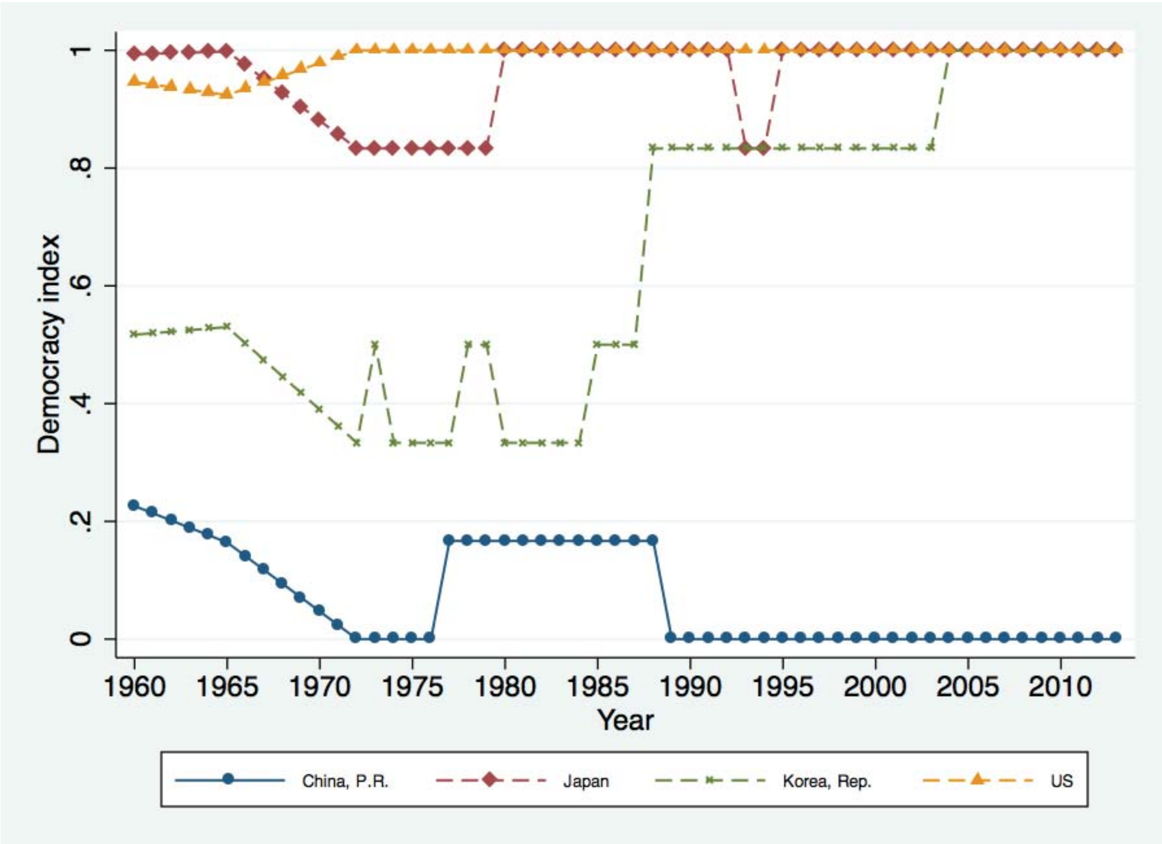
Source: Penn World Table 8.1 (Feenstra, Inklaar, and Timmer, 2015)

Figure 7 Trends of Average Schooling Years of Total Population Aged 15-64, 1960–2015



Source: Barro and Lee (2015)

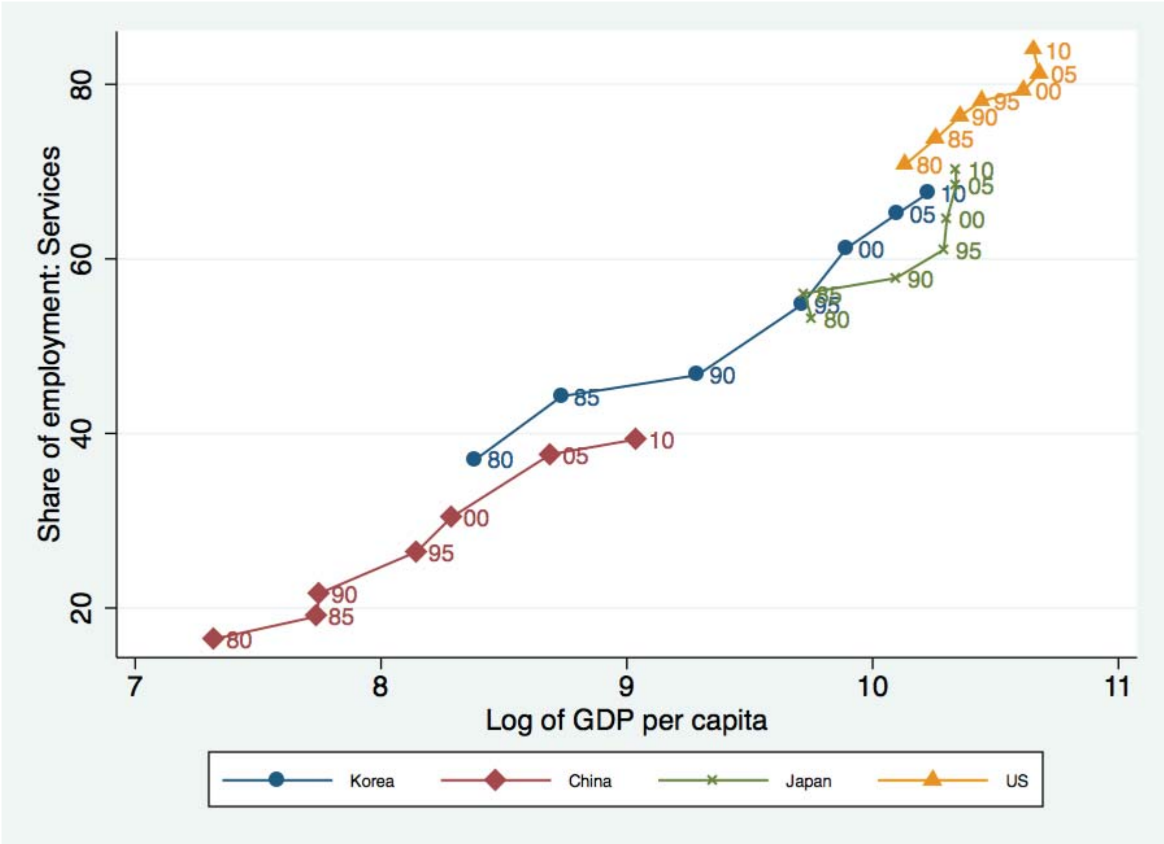
Figure 8 Democracy Index in Selected Countries



Notes: The measure of democracy is the Freedom House Political Rights Index (converted from seven categories to a 0–1 scale, with higher values representing the increasing presence of political rights) since 1970. The data for 1960 and 1965 are from Barro(1996).

Source: Freedom House (freedomhouse.org)

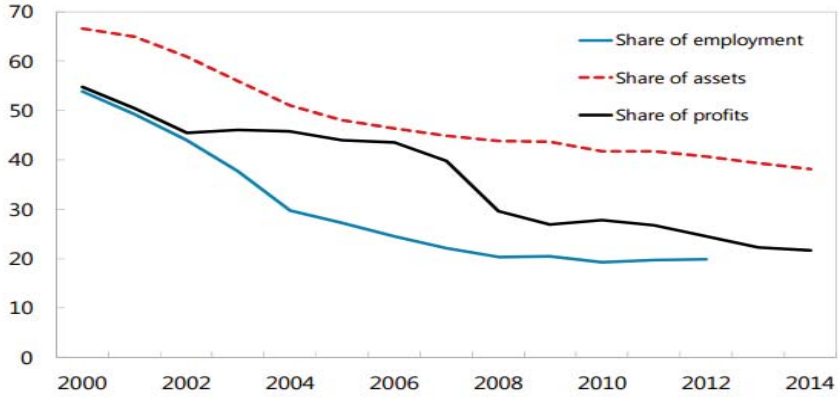
Figure 9 Employment Shares of Services Sector in China, Japan, Korea and the US, 1980–2010 (%)



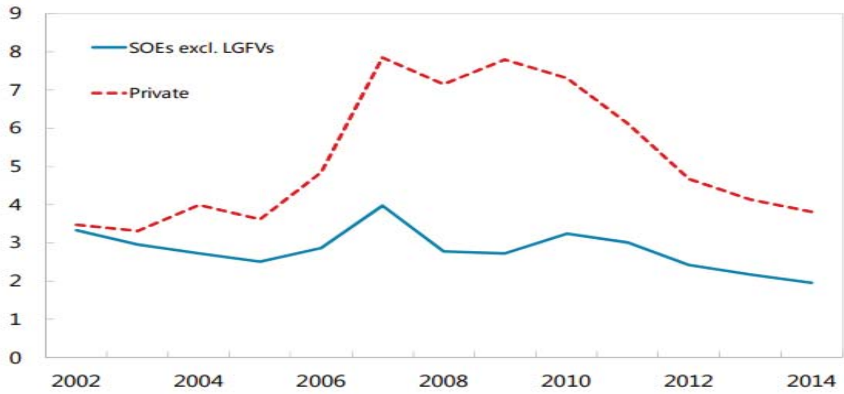
Sources: Author’s calculation based on sectoral employment data from WORLD KLEMS Database (US), ASIA KLEMS Database (Korea, Japan), and CIP 3.0 Database (China). GDP per capita (2005 constant international prices) data are from Feenstra, Inklaar, and Timmer (2015).

Figure 10. China's State-Owned Enterprises

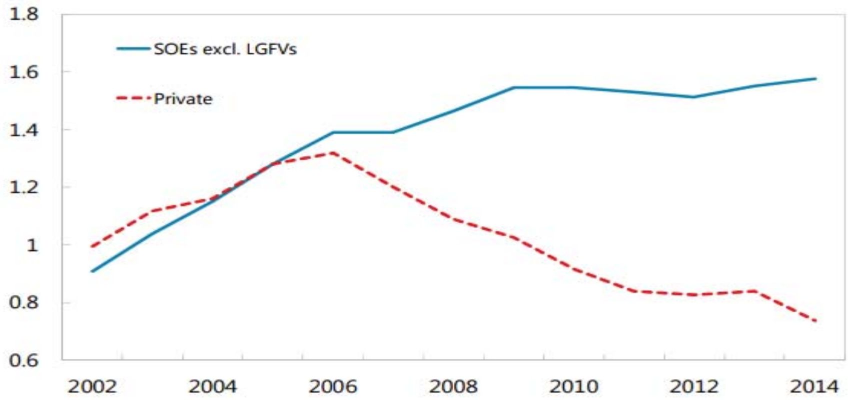
A. Share



B. Return on Assets



C. Leverage Ratio



Note: LGFVs represents local government financing vehicles.
Source: IMF, People's Republic Of China 2015 Article IV Consultation—Staff Report; Press Release; and Statement By The Executive Director For The People's Republic Of China, August 2015