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How Severe Will the Growth Slowdown in China Caused by the Structural Change be? – An Evaluation Based on Experiences from Japan and South Korea

by

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Abstract:
China has been growing at high rates during the previous three decades. The current process of rebalancing from an investment- and manufacturing-led growth model towards a consumption- and service-led model is associated with decreasing growth rates. We show that China's current state of structural change in terms of sectoral employment shares is similar to the historical developments in Japan and South Korea. We derive plausible scenarios for future growth rates in China and (by isolating the allocation effect, i.e. the pure effect of structural change) look at the effects of tertiarization on economic growth in China for the period 2016 until 2030 by applying a simple simulation study.

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1 Introduction

In terms of gross domestic product (GDP) per capita China has managed to develop from a low-income country in 1990 to a middle-income economy in an astonishingly short period of time. This fast development process in China has been based on a very traditional structural transformation process: huge migration of cheap labor from the agricultural (low-productivity) sector, particularly from the western parts of China, to newly developed industrial (high-productivity) centers, particularly in the eastern parts of China. In addition, China could profit from special factors, such as cheap imports of technology and knowledge from Western companies via joint venture-constrained foreign direct investments (FDIs).

However, China has now entered a new stage of structural change - an early phase of so-called de-industrialization or tertiarization. This new structural transformation has been affirmed and supported by the Chinese government (see the 12th and 13th Five Year Plans) because of the rising negative economic and social side effects of rapid industrialization. This structural transformation is also considered by some to be part of a necessary and fundamental rebalancing process in China, which is associated with moving up the production chain ("Made in China 2025" initiative).

In the course of this development, the service sector (which is often characterized as a sector with lower productivity compared to the industrial sector) has recently surpassed for the first time the industrial sector in China in terms of employment. Moreover, rebalancing is (intentionally) associated with a gradual shift from net exports to advanced economies toward domestic consumption, domestic investment, and intraregional exports (sometimes understood as a decoupling from industrial or advanced countries).

This characterizes China as an economy on the cusp of a new developmental path. The question that arises is what consequences this structural transformation will have in and for China. Theoretical arguments suggest that this rebalancing process may produce a reduction in economic growth, a decline in the current account surplus and thus in foreign reserves, and an increase in inflation (Wagner, 2013).

In this paper we make a simple scenario analysis to answer the question of how the ongoing structural change will influence China's economic growth in the years to come. Our question is: What are the effects of structural change given different labor productivity and tertiarization scenarios? Our approach focuses solely on the potential effects of structural change on economic growth in China. We do not want to give the impression that what we present here is a forecast in the narrower sense. We use a simple arithmetic model to illustrate possible effects of ongoing structural change and de-industrialization in China and draw comparisons with the developments in Japan and South Korea. Obviously, the outcome of our projection relies heavily on our assumptions made.

The rest of the paper is structured as follows. First, we first briefly review the literature related. Then we analyze the structural change developments in China and compare them with those in Japan and South Korea. Based on these comparisons we derive scenarios for future structural change and productivity developments and analyze the impact of structural change on economic growth in China until 2030. Finally, we draw conclusions in the last section of the paper.

2 Literature Review

The recent slowdown in Chinese GDP growth has attracted attention to the question of whether the growth slowdown in China is of temporary or permanent nature (see Bai and Zhang, 2017). Convergence theory predicts a gradual catch up of the Chinese economy with high income countries such as the US. However, Barro (2016) states based on cross-country regressions that per capita growth rates in China have been very high and are likely to fall down soon to a rate of 3-4 % per year. Lee (2016) comes to the same assessment and stresses the importance of economic reforms. Maliszewski and Zhang (2015) point out that China has so far followed the historical experience of the fast growing Asian tigers; however, they detected signs of declining productivity growth as well as overinvestment. Such factors are considered as a risk for China's growth and the authors therefore emphasize the need for reforms, and in particular an increase in the quality of institutions. In a similar assessment Albert et al. (2015) find evidence of overinvestment during the period 2009-2011. They also observe that the total factor productivity growth was partially nourished by labor reallocations from the agricultural to the manufacturing industries. They conclude that China's growth model has reached its limits and a more sustainable and balanced growth framework is needed. Following earlier work by Blanchard and Giavazzi (2006), rebalancing for China includes a decrease in savings, while the authors also stress the importance of private savings, an increase in the supply of services, particularly health services, and an appreciation of the Renminbi. Albert et al. (2015) define rebalancing as a reallocation from investment toward consumption, from manufacturing toward services, and from an extensive toward an intensive growth model. Such a process would include slower investment and hence capital accumulation and a shift in the allocation of inputs towards the service sector. This would lead to a slower convergence in per capita GDP as potential growth would be expected to slow down close to 5 percent by 2020 and 4 percent by 2030. However, growth would be more sustainable and rely more on within-sector productivity.

Barro (2016) points out that sustaining the above growth rates would be a great accomplishment and pave the way for China to a high-income status. Nonetheless Lin et al. (2016) allocate these views to the "pessimistic camp" as opposed to more optimistic views which expect higher growth rates. Those emphasize comparative advantages vis-à-vis other countries (Bosworth and Collins, 2008), remaining space for reforms (Zhu, 2012) and the size of China (Yao, 2016) as potential re-accelerators of Chinese growth. The most optimistic view is advocated by Lin et al. (2016). They attribute the slowdown mainly to cyclical and external factors and argue that a reacceleration of growth to 8% is possible in a favorable environment in the medium run.

According to Zhang et al. (2015) structural change is a result and a driver of economic growth:[1] As labor productivity in the non-agricultural sector is higher than in the agricultural sector, shifting labor from the agricultural to the industry sector will increase labor productivity and economic growth (see Lewis, 1954). Zhang et al. (2015) also argue that structural change is an

[1] However, later on, we will argue that structural change in later stages may also be growth decreasing.

important driver of economic growth, in addition to labor, capital and technology (see Stigler, 1956, Denison, 1967 and Kuznets, 1961). The Chinese economy has definitely profited from shifting labor from the agricultural to other sectors.

In the present paper the term "structural change" is understood as the change in relative importance of the agricultural, industrial, and service sectors, measured either in terms of value added or employment (see Wagner, 2013). The process toward a dominant service sector share can be called de-industrialization or tertiarization.

Wagner (2013) compares the share of the service sector in China to that in developed and developing countries from a historical perspective. He concludes that the share of the service sector in Chinese GDP is (too) small in comparison with other developed and developing countries when they were at the same stage of economic development. However, using the example of Germany, he shows that a dominant industrial sector can prevail for an extended period of time, but argues that it is questionable that this will be the case in China as the country urgently needs rebalancing (see Wagner 2013, 2015).

Wagner (2015) points out that after two decades of very high economic growth rates, China has reached the so-called mid-income range and must implement fundamental structural reforms to avoid getting stuck in the middle-income trap. Many others assume that the growth model pursued in China, together with measures taken to deal with the consequences of the financial and economic crisis as a result of the United States (US) subprime crisis, have led to imbalances in the Chinese economy, requiring a so-called rebalancing.

To forecast China's future economic growth there are essentially three approaches: cross country regressions (see Barro, 2016, Lee, 2016), estimating potential growth (see Albert et al. 2015, Haltmaier, 2013) while the third approach draws on international and historical comparisons with countries of the same economic structure (see Holz, 2008, Zhang et al., 2015). Holz (2008) analyzes future growth prospects of the Chinese Economy until 2025, assuming that China shares some common economic growth patterns with South Korea and Japan. He predicts a gradual slowdown in growth rates from 2015 onward. After decomposing GDP and explaining it by the quality and quantity of labor, growth forecasts are made by means of already available data on future labor for the period of 2010 until 2025. He estimates the growth rate to be between 7.06 and 9.42 percent. Zhang et al. (2015) estimate China's average annual per capita GDP potential growth rate for the period between 2015 and 2035 to be between 6.02 and 6.35 percent. According to the authors, unfavorable demographics may have an adverse effect on future developments in China on the one hand, but on the other hand a fast growth in human capital could compensate for this. However, there are a number of arrangements which have to be made to prevent China from falling much behind its potential growth rate.

3 Measuring the Progress of Structural Change in China in Comparison With Japan and South Korea

Structural change can be defined as a natural and consecutive transition from the dominance of agriculture over industry towards services (tertiarization) (Wagner, 2015). In this paper, however, the approach we take to identify common patterns in structural change deviates slightly from the methodology chosen by Wagner (2015). We use employment shares of the corresponding sectors instead of sectoral shares in GDP. Also we compare the process of structural change by dating the point in time when the service sector started to dominate the agricultural sector.[2] Figure 1 displays the employment shares of the agricultural, industrial, and service sectors (also addressed as primary, secondary and tertiary industries) in China from 1978 to 2015. In terms of employment share, the service sector started to dominate the industrial sector in 1994. But it is only recently, in 2011, that the service sector has started to dominate the agricultural sector, and it was only in 2014 that the employment in the industry sector had finally surpassed the employment in the agricultural sector.

[Figure 1 near here]

It is obvious that tertiarization in terms of employment is prevalent in the Chinese economy and we also see how strong the trend is as the employment share of the service sector has significantly increased since 2012. We now compare the structural change in terms of employment in China with the historical developments in Japan and South Korea.

Figure 2 displays the sectoral employment shares in Japan between 1954 and 2015.

[Figure 2 near here]

Here we observe a similar pattern of structural change. In 1956 the employment share of the service sector surpassed the employment share of the agricultural sector and a few years later (1962) the employment in the industry sector started to dominate the employment in the agricultural sector. The fact that this took six years in Japan instead of three years as in China displays again the current momentum of structural change in China.

Finally, we take a look at the structural change developments in South Korea between 1970 and 2013 in Figure 3.

[Figure 3 near here]

Again we obtain a very similar picture. In 1980 the service sector started to dominate the agricultural sector in terms of employment, and four years later, in 1984, the industry sector employment share surpassed the employment share in the agricultural sector. The sectoral employment shares when employment in the industry sector surpassed employment in the

[2] This is due to data availability.

agricultural sector were very similar in the three economies. In 1962, the employment shares in Japan were 28.68%, 29.75% and 41.57%, in 1984 in South Korea 27.10%, 30.50% and 42.40%, and in China in 2014 29.50%, 29.90%, 40.60% for the primary, secondary and tertiary sectors respectively. Based on our approach in terms of structural change, China would thus be 50 years behind Japan and 30 years behind South Korea.

Scenarios for the Future Structural Change in China

We start by extrapolating the previous developments in structural change in China as a percentage share of the employed in the respective sector. Figure 4 shows possible development (extrapolated lines after 2014) paths in case of linear (Figure 4 (a)) and non-linear (Figure 4 (b)) projections.

[Figure 4 near here]

With linear extrapolation we roughly get shares of 17 % for agriculture, 33% for industry and 50% for services in 2030.

We do not explicitly assume decreasing trends in the industry sector as this would be a strong assumption: we see from the projections as well as from the comparison with structural change in other countries that de-industrialization does not necessarily have to take place in the next decades in China. Instead, the share of the industry sector could remain at the current level or even increase a little further (see the developments in Japan and South Korea displayed in Figures 2 and 3 where the employment share of the industry sector approached 40% before decreasing). In the long-run, however, the comparison with the developments in the OECD-countries shows that the employment share of the industry sector is likely to decrease (see Wagner, 2013).

We assume that in 2030 the agricultural sector will account for about 11.5% of total employment, and the industry and service sector will account for about 31% and 57.5% respectively. If structural change proceeds faster (non-linear extrapolation) we can assume shares of 8%, 22% and 70% respectively. However, it took Japan almost 50 years and South Korea almost 30 years to achieve comparable shares of the service sector. As our projections feature developments until 2030, from the point in time when employment in the industry sector in China first surpassed the employment share in the agricultural sector in 2014 (covering a period of 16 years in the future), we look at the developments in Japan and South Korea in the corresponding time period. In Japan the sector shares in 1978 were roughly 12%, 34% and 54%, while sectoral employment shares in South Korea in 2000 were about 11%, 28% and 61%. Albert et al. (2015) follow World Bank (2013) and assume employment shares in agriculture to be 12.5%, 28.5% for industry and 59.0% for services in China. These projections match very well the results from Japan and South Korea and are relatively close to the projections we have obtained with linear extrapolation. Hence, we differentiate between three scenarios.

(1) Structural change as before: Here we assume a medium case between Japan and South Korea: [Agriculture: 11.5%, Industry: 31%; Services 57.5%].

(2) Structural change slows down: [Agriculture: 28%, Industry: 29%; Services 43%], which corresponds more or less to the status quo in China.
(3) Structural change accelerates: Here we would assume that China will experience a rapid evolution of structural change in the course of the next 16 years, a development which took Japan almost 50 and South Korea almost 30 years [Agriculture: 8%, Industry: 22%; Services 70%].

4 Labor Productivity in China, Japan and South Korea

To calculate labor productivity on a sectoral level we rely on sector gross domestic product (GDP) data for China and gross value added data for Japan and South Korea. For China we can obtain real GDP by industry from Datastream in prices of 1978. For Japan and South Korea our source is the AMECO database accessed via Datastream which provides data on gross value added by branch per employed person.

The historical labor productivity developments for China are displayed in Figure 5.

[Figure 5 near here]

When assessing labor productivity growth in China we see that labor productivity has increased in all sectors. However, the industrial sector (secondary industry) is clearly the most productive one. The output per person in this sector is more than three times higher than the output in the service sector. Moreover, the labor productivity in the service sector seems to have decreased slightly in the light of the recently increased reallocation of labor towards this sector (see Figure 1).

To make reasonable assumptions for future developments of labor productivity growth for our projections below, we look at the developments in Japan as well as in South Korea. Both countries can be characterized as having successfully managed the transformation from a middle income country to a high income country and are hence examples of successful structural change economies. Figure 6 shows the development of real labor productivity in Japan.

[Figure 6 near here]

While labor productivity in the service sector was even above labor productivity in the industry sector for some time, real output per person has remained constant or even decreased temporarily. However, as our focus is on the first 16 years after 1962 in the case of Japan, Figure 6 has only a limited informative value regarding future labor productivity in China. Thus we look next at labor productivity in South Korea which is displayed in Figure 7.

[Figure 7 near here]

In South Korea labor productivity increased in all sectors from 1985 until 2000. As in Japan the the level of labor productivity in the service sector was higher compared to the industry sector. Labor productivity growth in the industry sector was on average higher and thus around 1997 the industry sector became the most productive sector in South Korea.

In terms of labor productivity (per person) the examples of Japan and South Korea show that there may be slowdowns in labor productivity and in worst case scenarios even decreasing growth rates (see Japan). Also developments in the sectors need not be uniform, but may diverge considerably. In the next step nominal productivity growth rates in national currency and constant 1978 prices are calculated for the three countries. Table 1 in the Appendix displays nominal labor productivity growth rates in Japan, South Korea and China.

Table 1 illustrates that labor productivity growth rates in Japan and South Korea show a decreasing pattern after the employment share of the service sector surpassed the employment shares of the other sectors.

The next section theoretically illustrates the effects of tertiarization on economic growth.

5 An Illustration of Structural Change in a Theoretical Framework

We assume a neoclassical growth model where output is generated in the following way

$$Y_t = F(K_t, A_t N) \tag{1}$$

with K_t as capital stock and N the number of workers and A_t is labor productivity. We can then express output per effective worker y as

$$y = f(k) \equiv F(k, 1) \text{ with } f'(k) > 0 \text{ and } \quad f''(k) < 0, \tag{2}$$

where $y \coloneqq \frac{Y}{AN}$ (output per effective worker) and $k \coloneqq \frac{K}{AN}$ (capital per effective worker).

We assume labor productivity to grow or decrease at a constant rate λ so that

$$A_t = e^{\lambda t} \tag{3}$$

Further we assume every household to save a constant share s of their income, so that the economy's savings are sY. Savings are fully invested and add to the economy's capital stock

$$S = sY = I = \dot{K}. \tag{4}$$

It follows that

$$\dot{K} = sANf(k). \tag{5}$$

The growth rate of k is $\frac{\dot{K}}{K} - \frac{\dot{A}}{A} - \frac{\dot{N}}{N}$, here we assume $\frac{\dot{N}}{N} \equiv n = 0$ and $\frac{\dot{A}}{A} = \lambda$; since

$$\dot{k} = \hat{k}k, \text{ with } \hat{k} = \frac{\dot{k}}{k} = \frac{sf(k)}{k} - \lambda$$

it follows

$$\dot{k} = sf(k) - \lambda k. \tag{6}$$

As long as $sf(k) > \lambda k$, k will rise. By differencing[3] Y we get output growth

$$\frac{\dot{Y}}{Y} = sf'(k) + \lambda(1 - \frac{k}{f(k)}). \tag{7}$$

Per capita output growth is correspondingly given by

$$\frac{\dot{y}}{y} = \frac{\dot{Y}}{Y} - \lambda = sf'(k) - \frac{k}{f(k)}\lambda.^{4} \tag{8}$$

Looking at the possible consequences of rebalancing for economic growth in China, most previous research suggests that growth will most likely slow down as a result of tertiarization. Wagner (2013, 2015) points out that the decrease in economic growth associated with tertiarization is based on negative productivity growth effects due to Baumol's cost disease (see also Qin, 2006). Baumol and Bowen (1965, 1966) and Baumol (1967) show that rising wages in the service sector are generally not accompanied by corresponding increases in labor productivity so that the overall economic growth in a society with an increasing service sector will slow down. We can assume the growth in productivity in an economy in the period of industrialization (λ_{Ind}) is higher, than in an economy under teritiarization (λ_{Tert}): $\lambda_{Ind} > \lambda_{Tert}$.

[Figure 8 near here]

Figure 8 illustrates that per capita GDP growth slows down when the employment share of the service sector increases which could support the hypothesis of a lower productivity growth in the service sector.

We close this section with a simple counterfactual experiment derived from a discrete-time textbook (Solow) version of the model described above with a Cobb-Douglas production function and capital depreciation. This experiment shows the effect of varying labor productivity growth on per capita GDP growth. The production function is $Y_t = {K_t}^{\alpha}(A_t L_t)^{1-\alpha}$ for F. To integrate

[3] $Y = yAN = f(k)AN \Rightarrow \frac{\dot{Y}}{Y} = \frac{\dot{y}}{y} + \lambda = \frac{f\prime(k)\dot{k}}{f(k)} + \lambda = \frac{f\prime(k)(sf(k)-\lambda k)}{f(k)} + \lambda = sf'(k) + \lambda(1 - \frac{k}{f(k)})$

[4] Here we used a very simple version of a growth model without capital depreciation. With capital depreciation δ it is a standard Solow model: $\dot{K} = sANf(k) - \delta k$ and $\dot{k} = sf(k) - (\lambda + \delta)k$.

population growth, capital depreciation and technological progress we assume that the evolution of k is given by:[5]

$$\Delta k_t = \frac{1}{(1+n)(1+\lambda)}(sk_t^{\alpha} - (n + \lambda + \delta + n\lambda)k_t) \tag{9}$$

and output per worker is given by

$$y_t = k_t^{\alpha}(1 + \lambda)^t A_0 \tag{10}$$

We assume that only the parameter of technological progress λ varies and all other parameters remain unchanged.[6] The chosen parameter values mimic an economy with a relatively high savings rate and no population growth, as well as a major share of capital in the production function. We now compare the effects when labor productivity growth λ increases, stays constant or decreases (keeping all other parameters constant), where the latter case corresponds to an economy under tertiarization. The implied growth dynamics are displayed in Figure 9.[7]

[Figure 9 near here]

This simple example shows that the growth slowdown is considerably more pronounced if tertiarization is not accompanied by labor productivity gains. The next section describes the different scenarios we assume in our simple arithmetic.

6 Scenario Description

As an optimistic baseline scenario we assume more or less stable labor productivity growth of 6.5% in China, while in the case of a moderate decrease of productivity we assume 4.5% (see South Korea 1985-1994 and South Korea 1995-2004), in case of a less favorable development we assume 2.5% (see Japan 1973-1982). We do not consider a worst case scenario as the purpose of our calculations is to show the effects of structural change.

We basically differentiate between changes in the progress of structural change and changes in labor productivity growth.

While our baseline scenario for intersectoral migration is that the agricultural sector decreases to 11.5%, the industrial sector decreases to 31%, and hence the service sector increases to 57.5%, we also consider two other scenarios of structural change: a slowdown in structural change

[5] See Sørensen and Whitta-Jacobsen (2010) for the corresponding derivations.
[6] We assume: $\lambda = 0.04$, 0 and -0.04 respectively. $\alpha = 0.57$, $\delta = 0.06$, $n = 0.00$ and $s = 0.24$ (parameters were partly chosen according to Albert et al., 2015 and Sørensen and Whitta-Jacobsen, 2010).
[7] We have conducted a counterfactual experiment to illustrate that growth rates in an economy under tertiarization may be smaller than in an economy under industrialization. The growth rate dynamics should not be taken literally.

dynamics where the shares are 28%, 29% and 43% as well as an acceleration of migration resulting in shares of 8%, 22% and 70% for the three sectors.

In terms of labor productivity growth we consider a decrease in labor productivity growth in the industrial sector as well as a decrease in labor productivity growth in the service sector. Here, we consider either a moderate decrease to 4.5% productivity growth or even a more drastic decrease to 2.5%.

We think that our assumption on sectoral shares and our labor productivity assumption can be justified by the historical developments in Japan and South Korea as shown above.

Finally, we consider combinations of the different assumptions.

7 Calculations

To assess the effect of structural change on economic growth in China, we will calculate a real average growth rate per year between 2014 and 2030 and compare this with the growth rate we would expect if no structural change would take place, thus deriving the effect of structural change.

We define overall real GDP Y_t as the sum of the three sectors' respective production

$$Y_t = \sum_i Y_{i,t} \quad (11),$$

where $i = 1, 2, 3$ and t is 2014 and 2030 respectively. Further we define

$$Y_{i,t} = LP_{i,t} \cdot L_{i,t} \quad (12),$$

where $LP_{i,t}$ is the labor productivity in sector i at time t. $L_{i,t}$ is the number of people employed in this sector:

$$LP_{i,t} = \frac{Y_{i,t}}{L_{i,t}} \quad (13).$$

We calculate average GDP growth rate per year between 2014 and 2030 as

$$\sqrt[16]{\frac{Y_{2030}}{Y_{2014}}} - 1 \quad (14).$$

To assess the effect of structural change we additionally calculate Y_{2030} with $L_{i,2013}$ so as if no structural change took place.

8 Results

Table 2 (see Appendix) summarizes the results of this simple arithmetic. In some cases structural change has an additional small positive effect on economic growth. This is the case if the service sector is not or less affected by a slowdown in labor productivity growth. Here, structural change is able to mitigate productivity losses in the industry sector and leads to productivity gains from labor reallocation between the agricultural and service sector (for instance scenarios 2, 3, 16 and 17).

However, as a consequence of structural change we would expect labor productivity in the service sector to decrease or to be much lower than in the industry sector. In this case, a considerable and drastic slowdown in productivity growth in the service sector can have negative effects on economic growth (for instance scenarios 5, 12 and 19).

A singular slowdown of labor productivity growth in either the industry sector or the service sector leads to lower growth, while a slowdown in the service sector is more relevant for overall economic growth than a slowdown in the industry sector (compare scenario 17 versus scenario 19).

The importance of the service sector is emphasized by our simple arithmetic. As long as labor productivity growth in the service sector is maintained at a reasonable level it can to a certain extent compensate a slowdown in labor productivity growth, for instance, in the industrial sector (compare scenarios 2 versus 3 and 16 versus 20). As structural change in favor of the service sector is likely to have a decreasing effect on labor productivity growth in this sector, a likely scenario is a slowdown in economic growth and a negative effect of reallocation of labor to the service sector.

According to our simple model, the Chinese economy would grow at best at about 7.3% (if de-industrialization is enhanced and labor productivity growth in the service sector remains high). In middle case scenarios with either a labor productivity growth slowdown in the industry or service sector, growth rates around 4-5% can be expected. In less favorable scenarios with a simultaneous growth slowdown in both industry and service sector even annual growth rates as low as 2.6% could occur. However, we have to emphasize the simplicity of our approach and underline that the purpose of our calculations was primarily to illustrate potential effects of tertiarization on the economic growth in China. Several other important factors which could affect the economic development in China, such as exchange rate regimes, are not included in our analysis.

9 Policy Implications

The previous sections have shown that under unfavorable developments in labor productivity the slowdown in economic growth may be faster and more pronounced than if labor productivity growth is maintained at reasonable levels. What are the favorable and unfavorable conditions to

prevent a labor productivity slowdown? This section briefly sums up the main point from the relevant literature.[8]

First, Lin et al. (2016) suggests that China has a latecomer advantage. As such China is further away from the technological frontier and can generate higher growth rates through technological progress. This progress is achieved by imitation, the import of capital goods, integration and licensing. Lin et al. (2016) then compare the relative productivity in different manufacturing sectors and conclude that in some of them there is still room for improvement in productivity. In a footnote, Lin et al. (2016) mention that China has launched an initiative to boost indigenous innovation (the authors presumably point towards the "Made in China 2025" initiative of the Chinese government) and acknowledge that this could be both more risky and costly than exploiting the latecomer advantage.

Second, Lin et al. (2016) compare the education level in China with that in Japan and Korea. They argue that the average level of schooling in China was 8 years in 2010. Korea was at the same level in 1980 and it took 10 years to increase the average educational level by two more years. The improvement in the educational level was accompanied by high GDP per capita growth rates. In contrast, when average schooling reached 8 years in Japan in the early 1970s, growth rates in Japan had already declined. Holz (2008) also argues that improvements in tertiary education will allow for further productivity gains. Glawe and Wagner (2016) identify low levels of human capital or an inadequate educational system as one decisive middle-income trap triggering factor. Based on the Barro-Lee (2010) data set and international comparisons, the authors conclude that Chinese education levels have significantly improved since 1950, but have also been stagnating since the 2000s. These developments could be related to the still relatively high share of agricultural employment in China, which also points to rural-urban educational inequality.

Third, Lin et al. (2016) point out that there is further room for shifting labor from the agricultural sector to higher productivity sectors. The authors argue that Japan and South Korea experienced high growth rates of 8%-10% until the share of agricultural employment fell below 20%. Lin et al. (2016) expect this to happen by 2024.

However, Figure 10 displays that already after 1962 (1984) when the agricultural employment share in Japan (South Korea) fell below 30% (see Figures 2 and 3) per capita real GDP growth can decrease considerably. The graphs show GDP per capita growth for 16 years in case of Japan from 1962 onwards (Figure 10 (a)) and for South Korea from 1984 onwards (Figure 10 (b)). Average per capita GDP growth was 5.6 percent (Japan) and 6.8 percent (South Korea) for the 16 years. Against this experience, growth in China could fall below 8% by 2022.

[Figure 10 near here]

[8] This section partly draws on Lin et al. (2016).

Related to this topic is the point that China is facing problems of an aging population. Lin et al. (2016) propose to extend the retirement ages (50 for women and 60 for men). By extending the retirement ages China could thus offset negative effects of the aging population. The negative effects of the aging population could also be avoided by investing in human capital and improving the education level (see above).

Fourth, Lin et al. (2016) mention the rather slow progress of the state-owned enterprises (SOE) reform. SOEs are often characterized by excess employment, lower levels of productivity and distortions in factor prices. In addition they have access to credit from state-owned banks and debit interest rates are below those private companies have to pay. This shows that competition between state owned and privately run firms is unequal and that financial reforms are needed to allow for an allocation of capital which is in line with market requirements.

Fifth, Zhang (2017) argues that the gap between China and developed countries has decreased and further growth could come from entrepreneurial innovations. He states, that it is however doubtful if the existing industry in China can easily and without further reforms be transformed into an innovative industry. To allow for entrepreneurial innovations Zhang (2017) underlines the importance of the SOE reform. The main points are the monopoly status of state owned enterprises which prohibits the market entry of innovative firms. Preferential bank credit access of state owned firms prohibits private firms from financing or financing conditions are less favorable in comparison with state owned firms. If the market is dominated by state-owned firms there is also lesser need to be innovative, because private firms can already survive if they are only slightly more efficient than state-owned firms. Furthermore, if state-owned firms are suppliers of inputs to the private firms, for instance telecommunications, this may slow down the innovation process.

Finally, the quality of institutions is crucial to develop innovations especially if the service sector in China is developed towards business services. We compare China with South Korea and Japan based on the World Governance Indicators, which are an established measure to compare countries regarding their institutional quality. Figure 11 displays the quality of Chinese institutions in comparison with institutional quality in Japan and South Korea.

[Figure 11 near here]

We see that China likely needs to improve the quality of its institutions if it wants to allow for more competition to boost innovative developments in its industry and service sectors. However, if China is developing the service sector solely towards social services we would expect the productivity and growth in this sector to decrease considerably.

10 Conclusion

In the light of gradually decreasing economic growth rates in China, we have shown that the structural change pattern in China is very similar to that in Japan and South Korea as seen a couple of decades ago. Based on these striking similarities we derive scenarios for future

structural change and sectoral labor productivity growth in China. We then calculate a simple arithmetic and show how a likely decrease in labor productivity in the service sector may affect overall growth until 2030.

Our simple arithmetic shows that as structural change in China is likely to take place in favor of the service sector it is especially important for Chinese policymakers to keep labor productivity growth high in this sector. If China can find a good mix of industry-related services and social welfare services the service sector could also compensate for decreasing labor productivity in the industry sector. This is likely to be the case at least in a transition period if China changes its strategy from a so far export driven economy as the world's work bench to a strategy where investments are directed towards new technologies which aim at launching own innovations on the world market.

It is however very plausible that China which is confronted with inequalities in income distribution and rising unemployment numbers could develop the service sector by increasing social welfare expenditures in a way which will reduce its productivity. Our simple arithmetic indicates that in this case structural change will take place at cost of economic growth. Hence, finding the right mix for the service sector will be a key challenge for China in the years to come.

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Appendix

Table 1: Components of Growth in Japan, South Korea and China

Components of Japanese Growth (national currency, constant prices in %)					
	1963-1972	**1973-1982**	**1983-1992**	**1993-2002**	**2003-2012**
GDP	9.2	3.7	3.8	0.8	0.7
Productivity	7.9	2.9	2.8	1.1	0.7
Productivity Prim. Ind.	-	2.2	2.6	3.1	-0.2
Productivity Sec. Ind.	-	3.0	2.7	1.8	2.7
Productivity Tert. Ind.	-	2.3	2.1	0.6	0.0
Employment	1.2	0.08	1.1	-0.3	0.0
Components of South Korean Growth (national currency, constant prices in %)					
	1965-1974	**1975-1984**	**1985-1994**	**1995-2004**	**2005-2014**
GDP	-	8.2	8.8	5.4	3.7
Productivity	-	5.8	5.6	4.2	2.4
Productivity Prim. Ind.	-	14.7	6.0	4.5	3.7
Productivity Sec. Ind.	-	13.5	5.4	6.6	4.0
Productivity Tert. Ind.	-	-	3.7	2.2	1.4
Employment	-	2.3	3.2	1.2	1.3
Components of Chinese Growth (national currency, constant prices in %)					
	1962-1971	**1972-1981**	**1979-1988**	**1989-1998**	**1999-2008**
GDP	-	-	7.4	7.9	7.6
Productivity	-	-	5.0	5.6	7.0
Productivity Prim. Ind.	-	-	4.1	3.2	5.2
Productivity Sec. Ind.	-	-	4.8	8.3	8.2
Productivity Tert. Ind.	-	-	4.9	2.2	7.7
Employment	-	-	2.4	2.3	0.6

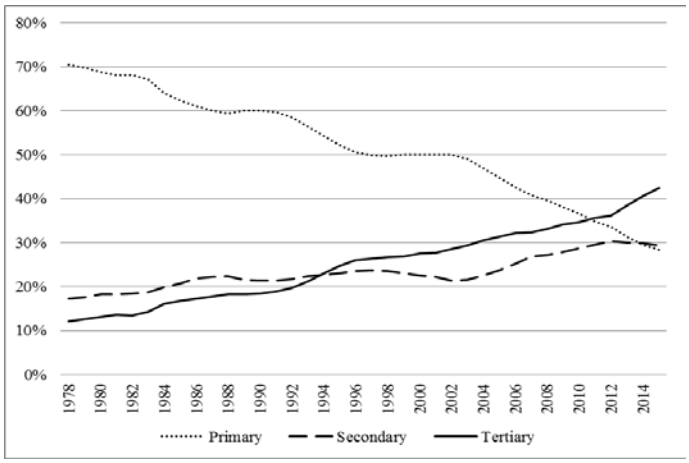
Source: Own calculations.

Table 2: GDP growth in different scenarios

Scenario Description		**Average growth per year in %**	
		with structural change	without structural change
Structural Change as before [Employment shares in 2030: 11.5, 31 and 57.5]			
1	Labor productivity (LP) growth of on average 6.5 percent in all sectors	7.3	6.5
2	As above, but LP growth falls to 4.5 percent in the industry sector	6.1	5.2
3	As above, but LP growth falls to 2.5 percent in the industry sector	5.1	4.1
4	As above, but LP growth falls to 4.5 percent in the service sector	6.6	6.0
5	As above, but LP growth falls to 2.5 percent in the service sector	6.0	5.5
6	As above, but LP growth falls to 4.5 percent in the industry sector and to 4.5 percent in the service sector	5.3	4.6
7	As above, but LP growth falls to 2.5 percent in the industry sector and to 2.5 percent in the service sector	3.3	2.7
Structural Change slows down [Employment shares in 2030: 28, 29 and 43]			
8	Labor productivity (LP) growth of on average 6.5 percent in all sectors	6.5	6.5
9	As above, but LP growth falls to 4.5 percent in the industry sector	5.3	5.2
10	As above, but LP growth falls to 2.5 percent in the industry sector	4.2	4.1
11	As above, but LP growth falls to 4.5 percent in the service sector	5.9	6.0
12	As above, but LP growth falls to 2.5 percent in the service sector	5.4	5.5
13	As above, but LP growth falls to 4.5 percent in the industry sector and to 4.5 percent in the service sector	4.6	4.6
14	As above, but LP growth falls to 2.5 percent in the industry sector and to 2.5 percent in the service sector	2.7	2.7
Structural Change accelerates [Employment shares in 2030: 8, 22 and 70]			
15	Labor productivity (LP) growth of on average 6.5 percent in all sectors	6.6	6.5
16	As above, but LP growth falls to 4.5 percent in the industry sector	5.7	5.2
17	As above, but LP growth falls to 2.5 percent in the industry sector	4.9	4.1
18	As above, but LP growth falls to 4.5 percent in the service sector	2.6	2.7
19	As above, but LP growth falls to 2.5 percent in the service sector	4.8	5.5
20	As above, but LP growth falls to 4.5 percent in the industry sector and to 4.5 percent in the service sector	4.6	4.6
21	As above, but LP growth falls to 2.5 percent in the industry sector and to 2.5 percent in the service sector	2.6	2.7

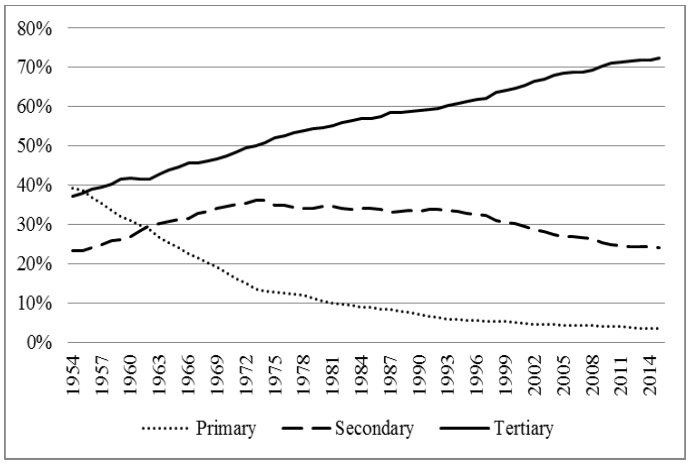
Source: Own calculations.

Figure 1: Changes in sectoral employment shares in China in percent 1978-2015



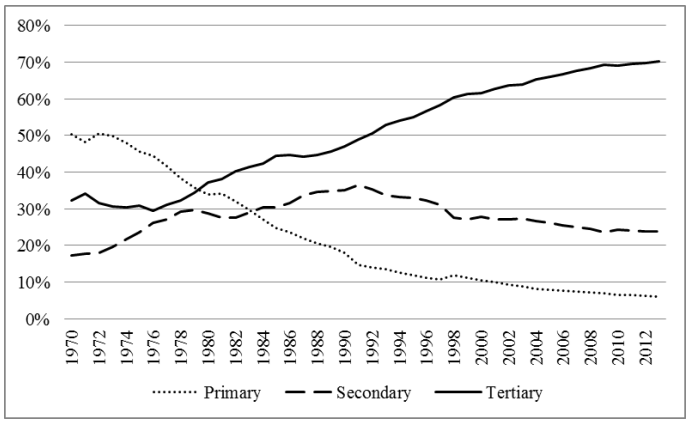
Source: Datastream, Ministry of Human Resources and Social Security, China, own calculations.

Figure 2: Changes in sectoral employment shares in Japan in percent 1954-2015



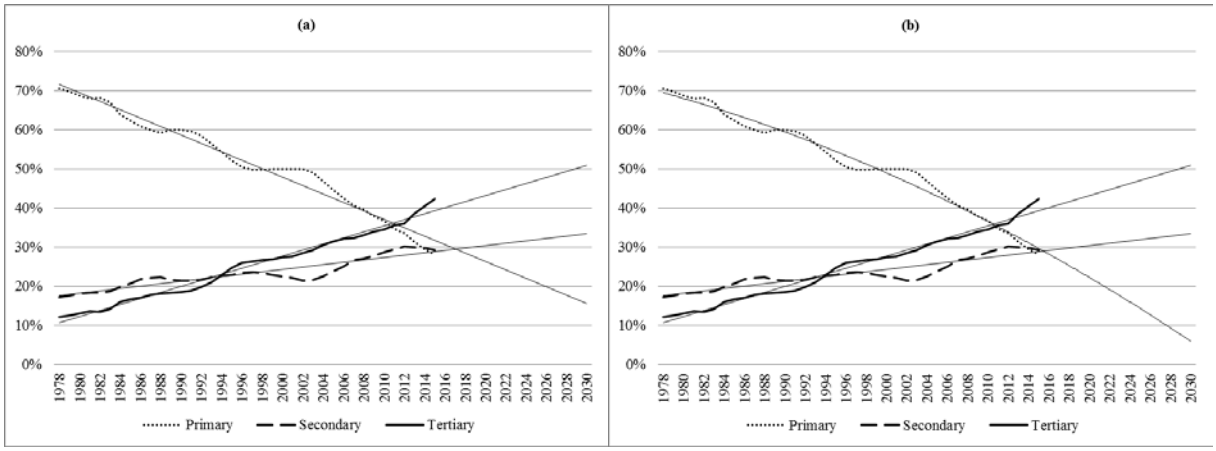
Source: Datastream, Ministry of Internal Affairs and Communications, Japan, own calculations.

Figure 3: Changes in sectoral employment shares in South Korea in percent 1954-2013.



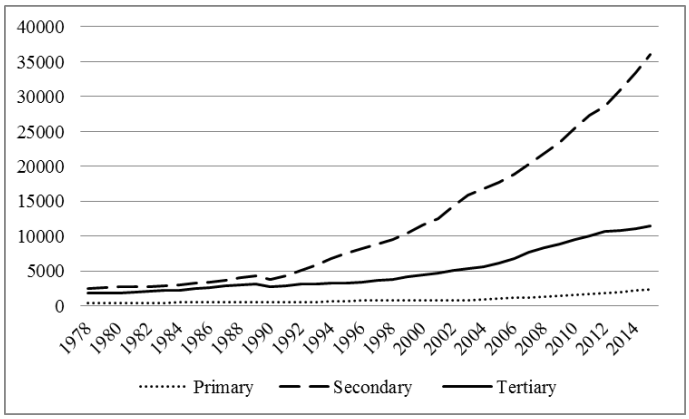
Source: The Conference Board, International Comparisons of Annual Labor Force Statistics, Update 2013, own calculations.

Figure 4: Possible developments of structural change in China until 2030



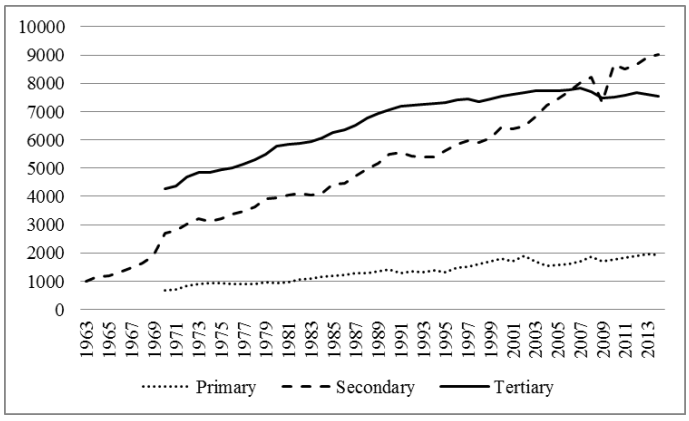
Source: Datastream, Ministry of Human Resources and Social Security, China, own calculations.

Figure 5: Developments in labor productivity in China, national currency, base year 1978.



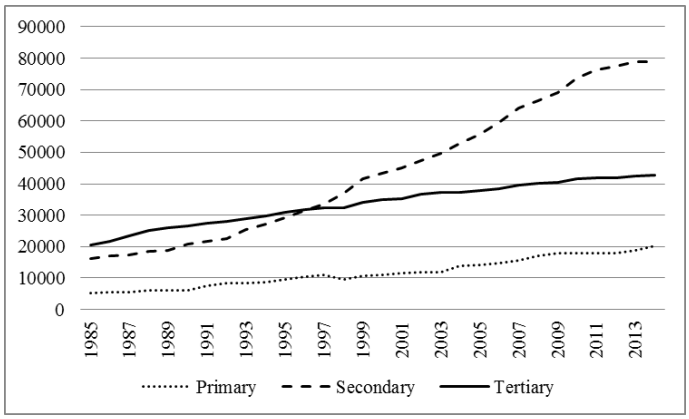
Source: Datastream, Ministry of Human Resources and Social Security, China, own calculations.

Figure 6: Developments in labor productivity in Japan, national currency, base year 2010.



Source: Datastream, own calculations.

Figure 7: Developments in labor productivity in South Korea, national currency, base year 2010.



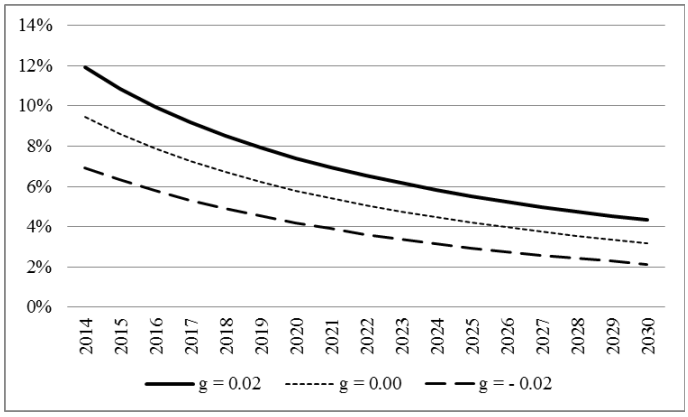
Source: Datastream, own calculations.

Figure 8: Relation between tertiary employment and per capita GDP growth[9]

Source: World Bank, World Development Indicators, Data for Japan, Korea and Israel. Years excluded 1980 (Outlier Korea), 1997-1999 (Asian Crisis), 2008 following (Financial Crisis).

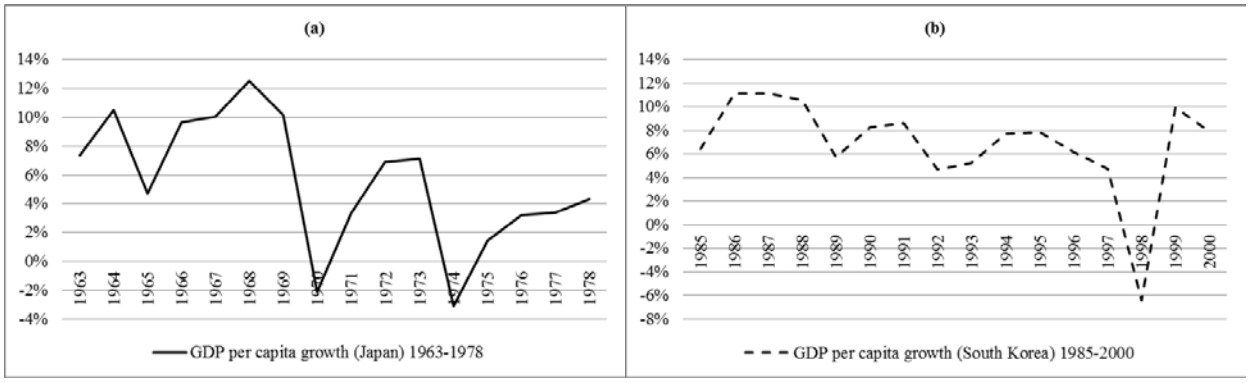
[9] $y = -0{,}18\,x + 16{,}0$; $R^2 = 0{,}2894$

Figure 9: Results of the counterfactual experiment



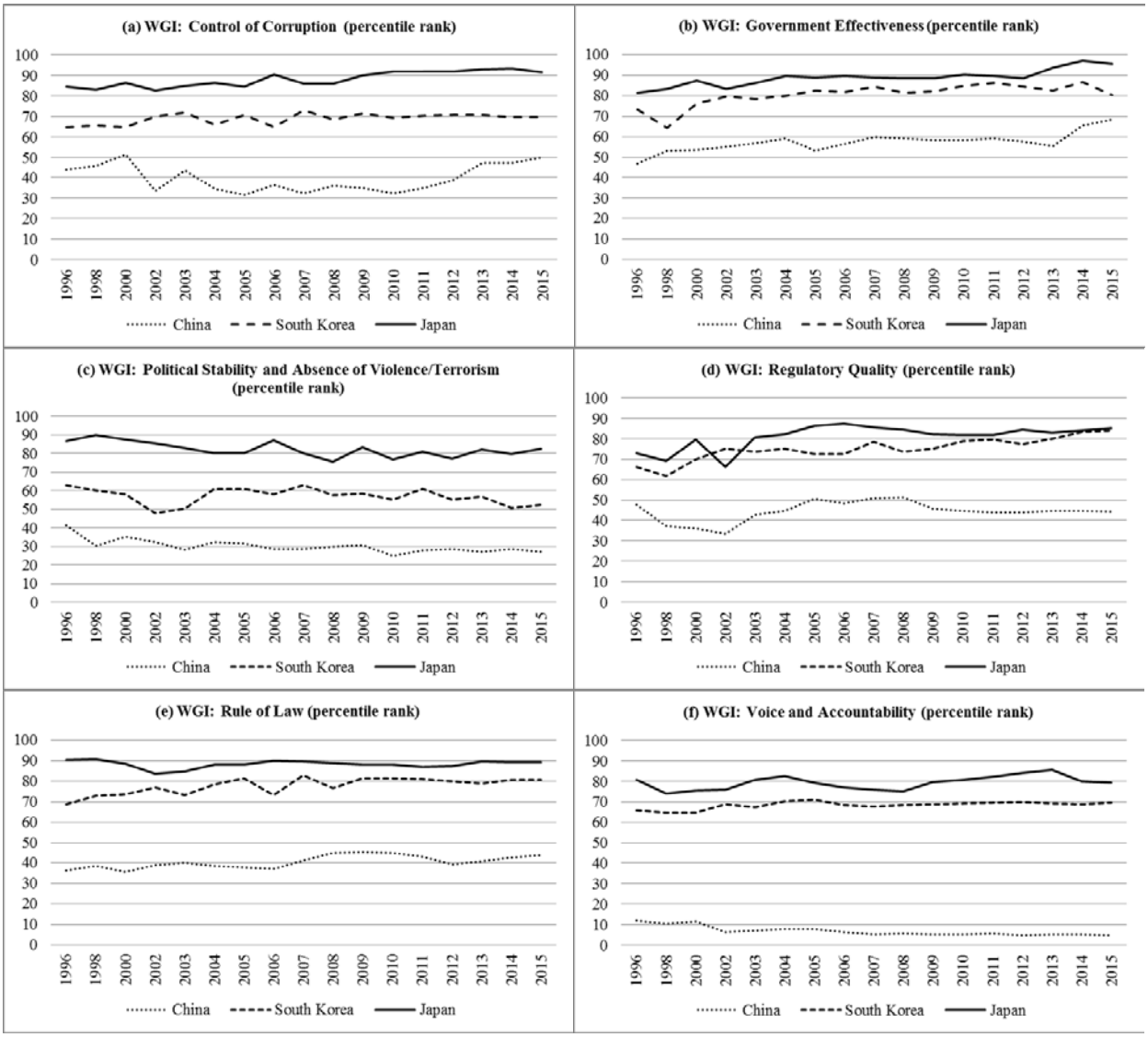
Source: Own calculations.

Figure 10: Per Capita GDP Growth Rates in Japan and South Korea



Source: World Bank, World Development Indicators, own calculations.

Figure 11: Per Capita GDP Growth Rates in Japan, South Korea and China



Source: World Bank, World Government Indicators, own representations.