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Avoiding the middle-income trap: Korean lessons for China?

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Avoiding the middle-income trap: Korean lessons for China?

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Abstract. We analyze and compare the pattern of economic growth and development of China and South Korea in the postwar period. Geographical proximity and cultural affinity between the two countries, as well as the key role of the developmental state in the economies of both countries, suggests that an analytical comparison would be a meaningful and valuable exercise. Furthermore, Korea is one of the few economies that jumped from middle income to high income in a short period, and thus offers potentially valuable lessons for China. The Asian giant moved from low income to middle income very quickly but now faces the challenge of graduating to high income. In this paper, we empirically assess the main drivers of economic growth in China and Korea, and then identify the time period when Korea was at a similar state of structural change as today's China. In addition, we examine the trend and pattern of Korea's economic growth from that point on. We will analyze and compare key reforms that promoted growth in the two countries. Lastly, we sift through our empirical evidence to assess the prospects for China to follow Korea's footsteps in transitioning from middle income to high income relatively quickly.

Keywords: China; Korea; middle-income trap; economic growth; economic development; growth policy; development policy

JEL Classification Codes: O57, O47, O53

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1 Introduction

Since the introduction of market reforms in 1978, decades of world-topping economic growth transformed China into the world's second biggest economy and an upper middle-income economy. China's remarkable economic transformation, triggered by a systemic shift from a centrally planned economy to a market-oriented economy, may indeed be the most significant development in the global economic landscape since the Second World War. However, since the global financial crisis of 2008-2009, China's growth has slowed down visibly although it continues to grow at a healthy pace. While the slowdown is partly due to a less benign external environment, it is largely due to structural factors such as rebalancing toward domestic demand and consumption, rapid income convergence toward high-income countries, and population aging. China is already an upper middle-income country with an income level at which growth typically slows down. (See, for example, Eichengreen *et al.*, 2012) Therefore, to some extent, the slowdown is a natural, healthy and welcome transition to a more balanced and sustainable growth paradigm. Therefore, there is no cause for undue alarm or pessimism about the on-going deceleration of China's growth from the exceptional to the merely robust.

At the same time, there is no guarantee that China's transition from middle income to high income will be as smooth and fast as its transition from low income to middle income. In fact, economic theory suggests that sustaining rapid growth will be difficult because marginal returns to capital eventually decline as an economy grows richer and acquires a larger stock of capital. The gains of shifting workers from low-productivity agriculture to higher-productivity manufacturing also eventually decline. Furthermore, as countries approach the global technology frontier, they must begin to develop new technology on their own rather than rely exclusively on importing advanced technology from abroad. More broadly, the essence of economic growth shifts from input accumulation – i.e. deploying more capital, labor and other inputs – to total factor productivity growth – i.e. using all those inputs more efficiently – as a country moves from low income to middle income. But growth based on productivity improvement is intrinsically more challenging than growth based on more inputs.

Furthermore, empirically, a large number of middle-income countries have failed to graduate to high income in a reasonable period of time. This well-known stylized fact has given rise to the concept of the middle-income trap, alternatively known as the middle-income

challenge. Low income countries can grow rapidly and graduate to middle income but then find it difficult to sustain rapid growth after they reach the middle income status. One group of countries that struggled to move up from middle income to high income can be found in Latin America, which had become a predominantly middle-income region long ago but has remained there for a long time. But the poor growth performance of middle-income countries is not confined to Latin America. In fact, its global empirical prevalence is what gave rise to the concept of the middle-income trap in the first place. The evidence from more rigorous econometric studies on the middle-income trap is mixed. While some studies fail to find evidence of a middle-income trap, other studies find that economic growth slows down at middle income.[1]

Overall, the global experience of middle-income countries should serve as a stark warning to China against harboring any illusions that its journey from middle income to high income will be as fast and smooth as its journey from low income to middle income. However, a handful of middle-income countries, located mainly in East Asia, has successfully made the transition to high income status. Most strikingly, Korea and other newly industrialized economies (NIEs) moved up from middle income to high income in a quarter century. While these economies are the exception rather than the rule, the experience of these countries provides grounds for optimism about China's prospects for overcoming the middle-income trap. A combination of innovation, human capital, and infrastructure enabled the NIEs to make the leap. Of special interest and relevance for China is the experience of Korea, which is a relatively large country with a population of more than 50 million. Although Korea is nowhere near as large as China, it is much larger than the small city-states of Hong Kong and Singapore, and substantially larger than Taiwan.

The central objective of our paper is to empirically assess China's prospects for transcending the middle-income trap along the lines of Korea's past experience. To do so, we analyze and compare the economic growth and structural transformation trajectory of China and Korea. There are obvious differences between the two countries. To name just two, China is much larger than Korea and, unlike Korea, it had a centrally planned economy for decades prior to market reforms. Nevertheless, in some important ways, China seems to be following in

[1] A number of empirical studies do not support the notion of a middle-income trap. Examples include Barro (2016), Im and Rosenblatt (2015), Han and Wei (2015), and Bulman *et al.* (2014). On the other hand, other studies find evidence that growth slows down when economies reach middle income. Examples include Agénor *et al.* (2012), Spence (2011), Eichengreen *et al.* (2012, 2014), Aghion and Bircan (2016), and Zhuange*t al.* (2012). Overall, the evidence on the middle-income trap is mixed.

Korea's footsteps. Above all, both countries kicked off their sustained growth on the back of export-oriented industrialization. They both began their industrialization process with labor-intensive industries such as clothing and textiles to leverage their large pool of workers and subsequently shifted to capital-intensive industries. Korea has moved up the global technology ladder to transform itself into an innovative, skill-intensive economy. Similarly, China has made technological progress in a very short period of time and has become a global technological leader in some sectors such as drones and solar power. China is also closely following Korea's demographic footsteps. Korea is one of the world's most rapidly aging countries, and China too is aging rapidly.

There are many other factors that bind the two countries, including geographical proximity and cultural affinity. Korea is China's Northeast Asian neighbor, and it borrowed heavily from the more advanced Chinese culture throughout its history. But perhaps the biggest reason for analytically comparing China and Korea to draw inferences about China's growth prospects is the prominent role of the developmental state. Korea's growth model is widely viewed as being based on activist industrial policy, at least during the early stages of the country's economic development. Broadly speaking, according to this view, a relatively competent and honest government nurtured promising private sector companies into large national champions – i.e. chaebols – which eventually became highly competitive, globally influential companies. The state plays an even more direct and significant role in the Chinese economy, which has become synonymous with state capitalism. Therefore, it is not surprising that the Chinese authorities, who are keen to build their own globally competitive national champions, view the Korean experience as a benchmark model.

The rest of this paper is organized as follows. Section 2 provides a broad overview of economic growth experiences of China and Korea. The section divides the experiences of both countries into different stages of economic development and structural transformation. Section 3 reviews the relevant literature. Section 4 takes a more in-depth look at the growth experiences of the two Northeast Asian countries. The stylized facts of their economic development and structural transformation are laid out in greater detail. Section 5 analyzes and compares the Chinese and Korean growth experiences more rigorously based on quantitative and econometric analysis. Such analysis can give us deeper insights into China's prospects for moving up to high income. Section 6 concludes the paper.

2 A Comparative Overview of the Chinese and Korean Growth Experience

In this section, we take a broad view of the growth experience of China and Korea for comparative purposes. To be sure, there are fundamental differences between the two economies. For example, China is a transition economy that has shifted from central planning to the market while Korea was never a centrally planned economy. Nevertheless, the developmental state has been instrumental in the industrialization and development of both China and Korea. At a broader level, the growth experience of both economies reflects a steady decline in the role of the state in the allocation of resources and a corresponding increase in the role of the market.

2.1 Different Stages of Korea's Economic Development

Korea's postwar economic development can be roughly divided into four stages – beginning of a modern market economy (1948-1959), economic takeoff (1960-1979), stabilization and transition toward high-income economy (1980-1997), and restructuring, reinvention, and maturation (1998-present). We now briefly discuss each of the four stages.

The first stage – beginning of a modern market economy – extended from 1948 to 1959. Japan's defeat in the Second World War liberated Korea from 36 years of colonial rule in 1945. Upon the end of the war, the Korean peninsula was divided between a communist north and a capitalist south. The American military government, which controlled South Korea from 1945 to 1948, introduced the modern capitalist, market-based economic system. Two milestone reforms were the consolidation of private property rights and agricultural land reform which benefited small farmers. In June 1950, North Korea invaded South Korea, precipitating the fratricidal, three-year Korean War, which left over three million dead and destroyed the economy. Macroeconomic and political instability further held back growth. Government intervention was extensive during this period, as evident in price controls, trade protectionism, and financial repression. Overall, Korea was a poor agricultural economy which was relatively closed and highly dependent on foreign aid. Nevertheless, the foundations of a modern market economy were laid during this period.

The second stage – economic takeoff – was the period of the Miracle on the River Han, and it covered 1960 to 1979. This period marked the remarkable transformation of Korea from a typical struggling developing country into one of the most dynamic and successful economies in the world. Under the effective leadership of the government of President Park Chung-Hee, Korea achieved greater macroeconomic stability, and invested heavily in both physical and human capital. The government invested heavily in physical infrastructure, epitomized by the 400 km expressway which linked Seoul, the capital and largest city, with Busan, the main port and the second largest city on the southern coast. This period is widely associated with activist Japanese-style industrial policy in which the government selected and assisted specific firms and industries. Critically, Korea's industrial policy was highly selective and linked to superior performance. More specifically, government assistance was strictly temporary and limited to companies that met export and innovation targets. The government's key policy during this period was thus export promotion policy rather than industrial policy. Furthermore, the primary agents of the Korean miracle were not bureaucrats but bold and visionary entrepreneurs like the founders of the Samsung and Hyundai groups. This period was also marked by continued financial repression and trade protectionism, large increase in foreign borrowing, and a shift from light industry to heavy and chemical industries. Overall, this period saw sustained rapid growth based on export-oriented industrialization which was driven by a close partnership between bold entrepreneurs and competent government.

The third period – stabilization and transition to a high-income economy – spanned 1980 to 1997. This period witnessed the moderation of growth from very high rates to somewhat slower but still high rates in the international context. To a large extent, the moderation reflects Korea's transformation from a low-income to middle-income economy. At middle income, productivity growth, as opposed to more capital and labor, assumes a bigger role in economic growth but productivity growth is inherently difficult. During this period, the government accorded a higher priority to macroeconomic stability and ceded a larger role to the private sector. Nevertheless, despite some retreat from economic management, as evident in limited interest rate deregulation and trade liberalization, the government continued to interfere extensively in the economy. Anti-competitive government regulations and high entry barriers limited competition in much of the economy. The consequent buildup of corporate and financial sector imbalances – e.g. excess capacity in some industries and growth of non-performing loans – combined with

dependence on foreign borrowing to precipitate a severe financial and economic crisis in late 1997. Notwithstanding the crisis, Korea continued to grow rapidly during this period.

The last stage – restructuring, reinvention, and maturation – extends from 1998 to the present. Korea, along with Indonesia and Thailand, turned to the International Monetary Fund (IMF) for help during the Asian financial crisis of 1997-1998. In return for financial assistance, the Korean government carried out extensive restructuring and reform of the corporate and financial sectors. During this period, Korea matured into a full-fledged high-income economy which typically experiences significantly slower growth than developing economies. More significantly, Korea managed to reinvent itself as a highly innovative economy that manufactures and exports skill-, knowledge- and technology-intensive products. For example, Samsung's Galaxy has emerged as the main rival to Apple's iPhone in the global market. More generally, Korean firms have become global heavyweights in high-end semiconductors and other advanced information technology (IT) hardware. Overall, this period marks the evolution of Korea into a mature and innovative high-income economy. Growth has accordingly slowed down to high-income levels.

2.2 Different Stages of China's Economic Development

China's postwar economic development can be broadly divided into three different stages – centrally planned economy (1949-1977), transition to market economy and economic takeoff (1978-2000), and post-WTO globalization, technological upgrading, and transition toward high-income economy (2001-present).

The first stage – centrally planned economy – spanned 1949 to 1977. The civil war between Kuomintang and communists which erupted in the midst of China's military conflict with Japan during the Second World War ended with a communist victory in 1949. The communist government swiftly dismantled the infrastructure of a market economy – for example, replacing private property rights, including private land ownership, with government ownership of all means of production. In agriculture, which employed the bulk of the workforce, private farms were replaced by collective farms. During this period, the economy was a classical Soviet-style command economy in which the government, rather than the market, dictated the allocation of resources – i.e. which goods and services would be produced, how they would be produced, and how they would be allocated among households. The predictable result was a severe

misallocation of resources and economic stagnation. Central planning was usually associated with poor economic performance and China was no exception. To compound matters, a disastrous economic and social campaign to accelerate China's transition from agricultural economy to an industrial economy – Great Leap Forward of 1958-1962 – severely disrupted the economy and caused a famine which took millions of lives. Political turmoil associated with Cultural Revolution of 1966-1971 further held back growth.

The second stage – transition from central planned economy to market economy and economic takeoff – extended from 1978 to 2000. The period was marked by sustained rapid growth, which transformed China from a struggling developing country into a globally significant economy. Deng Xiaoping was the transformational leader who spearheaded the market reforms that began in 1978. The market reforms were a response to the economic stagnation that China suffered under central planning. Poor economic performance, which inflicted a great deal of hardship on the Chinese people, was in marked contrast to the rapid growth and development enjoyed by other East Asian economies – Japan, Korea, and Taiwan. The market reforms began in the agricultural sector, where farmers gained greater control over their own production. This significantly increased farm output and encouraged policymakers to privatize other parts of the economy. Overall, the market reforms centered on strengthening private property rights, replacing plan prices with market prices, reducing tariffs and liberalizing trade, opening up to foreign investment, and building up market institutions and infrastructure – e.g. re-opening of the Shanghai Stock Exchange after 40 years of closure. Throughout this period, there was a steady increase in the role of the private sector and market forces in resource allocation, and a corresponding decline in the role of the state. Fueled by large amounts of FDI in export-oriented manufacturing, especially in coastal regions, China became the factory of the world. China's remarkable growth and transformation since the market reforms of 1978 is probably the single most significant shift in the global economic landscape in the last half-century. The shift brought about a quantum leap in general living standards and a massive reduction of poverty in the world's most populous country.

The third stage – post-WTO globalization, technological upgrading, and transition toward high-income economy – spans 2001 to the present. In December 2001, China joined the World Trade Organization (WTO), cementing and accelerating the country's integration into the global trading system. Indeed integration into the world economy was equally important as market

reform in China's stunning rise. China surpassed Japan to become the world's second biggest economy in 2009 and is now widely viewed as one of the world's two most important economies, along with the US. The private sector's relative importance continues to grow but the state continues to play a major role, as evident in the dominance of state-owned firms in key sectors such as banking and oil. China became an upper middle-income country around 2010 and thus now faces the challenge of shifting from labor- and capital-intensive growth to productivity-led growth. Higher productivity, in turn, depends on technological innovation and highly skilled workers. China's rapid population aging and the decline of working-age population further strengthens the case for a new growth paradigm based on higher productivity rather than more workers. The government is highly aware of the central importance of technological upgrading in the transition to high income and has strategically top-prioritized state-of-the-art technologies such as artificial intelligence (AI). In 2015 the government announced its goal to produce national champions in ten high-tech manufacturing sectors by 2025. Private sector companies such as Alibaba are also investing heavily in new technologies. The concerted national effort by China to wean itself off foreign technology and accelerate the shift toward a more innovative economy was given fresh impetus by the US government's growing protectionism in high-tech sectors since 2017, epitomized by its sanctions against Chinese mobile device maker ZTE in April 2018.

2.3 Parallels Between the Korean and Chinese Development Experience

The above excursion through the different phases of the Korean and Chinese development experience suggests that there are indeed strong parallels between the two countries' industrialization and development. Of course, there are many structural differences as well. For one, China is a much larger economy with a much larger domestic market and consequently a lower degree of dependence on foreign markets. This means that Korea's economic performance is much more dependent on the global economic outlook. In fact, the Chinese economy has become so large that its outlook is now a key dimension of the global outlook. Furthermore, in contrast to China, Korea was never a centrally planned economy where the government dictated the allocation of resources. Even today the government plays a markedly larger economic role in China, where the government continues to be heavily involved in the production of goods and services, as evident in the big role of state-owned firms in many industries. Although Korea's

initial industrialization process is often associated with an activist industrial policy, the government left production to the private sector and the extent of government intervention was tangibly lower.

However, there are unmistakable and significant similarities in the development trajectories of the two countries, which is why the Korean experience can offer some clues as to whether China can emulate Korea and graduate to high income in a relatively short period of time. By the same logic, the Korean experience can also help inform China about what it must do going forward.

Above all, the developmental state, or a relatively honest and effective government dedicated to economic progress and improvement in the living standards of its citizens, played a vital role in the economic success of the two countries. In both China and Korea, it is the private sector rather than the government that drove economic growth and development. But critically, the governments created an enabling environment for the private sector and entrepreneurs to thrive. In particular, they built up good infrastructure, invested a lot in education, and maintained a stable and predictable economic policy environment. Broadly speaking, the key catalyst of economic growth in both countries was export-oriented industrialization, which transformed them into manufacturing powerhouses. Both China and Korea began their industrialization with labor-intensive, low-tech light manufacturing such as clothes and textiles before moving on to heavy and chemical industry and, finally, IT and other high-tech manufacturing.

The main difference between China and Korea, and it is a key difference which motivates this paper, is that Korea began its industrialization process earlier. As a result, Korea is tangibly ahead of China in the global technology ladder and value chain. For example, Samsung Electronics is a world-class tech company that is Apple's biggest competitor in the global mobile phone market. Korean companies form the world's second largest semiconductor manufacturing industry and specialize in high-end memory chips, accounting for 70% of the global DRAM market and 50% of the global NAND flash market. More broadly, Korea remains substantially richer than China. Korea's 2017 per capita income was around US$40,000 while the corresponding figure for China was around US$16,5000. Korea is thus what China aspires to be – a rich, technologically advanced, innovative economy which rose from an upper middle-income to high income economy in a short period of time. At first glance, the chances of China's emulating Korea look promising. China is investing furiously in R&D and technological

upgrading geared toward shifting from investment-led growth model to innovation-led growth model. China is already home to one of the world's most vibrant tech industries and a plethora of visionary tech entrepreneurs such as Jack Ma and Robin Li. Promising signs notwithstanding, more accurately assessing China's prospects for following Korea's footsteps in successfully overcoming the middle-income trap requires a rigorous, in-depth analysis of data. Such an analysis is the central objective of our paper.

3 Literature Review

As mentioned earlier, while many low-income countries moved up to middle-income, only relatively few middle-income countries managed to graduate to high-income. Furthermore, a large number of countries, most notably in Latin America but also elsewhere, has remained middle-income for a long period of time. The transition from middle income to high income is intrinsically more difficult than the transition from low income to middle income since productivity growth assumes a larger role in economic growth at middle income. Therefore, both theory and evidence do not provide much ground for optimism about China's prospects for achieving high-income status. In fact, Albert *et al.* (2015) conclude that among countries which had growth and development models comparable to China's recent growth paradigm, Japan, Korea, Taiwan and Israel are the only countries that managed to reach high income.

Lee (2016) compares the economic performance of China with Japan and Korea. Based on per capita GDP relative to the US, he points out that China is approximately 20-25 years behind Korea and 40-50 years behind Japan. Based on this fact, he concludes that growth in China has to slow down. Wagner (2015) comes to a similar conclusion. Some studies thus highlight the risk that China might get caught in the so-called middle-income trap and fail to advance to high-income (See Eichengreen *et al.*, 2012, Zhuang *et al.*, 2012). However, the concept of the middle-income trap is not without controversy. Glawe and Wagner (2016, 2017) show that whether a country is in a middle-income trap or not depends heavily on the definition of the concept and on the data. Barro (2016) concludes that historical convergence experience suggests that it is very likely that China will proceed towards high-income status. Theoretical models relevant to China's prospects for transitioning from middle to high income include Song *et al.* (2011) and Chang *et al.* (2015). Song *et al.* (2011) examine different financing conditions

for private and state-owned enterprises. They look at a puzzling stylized fact - China simultaneously experienced accelerated productivity growth and large balance of payment surpluses. The key to the puzzle is that private firms enjoyed higher total factor productivity but suffered from more restricted access to external financing. That is, private firms had lower capital intensity and a higher rate of return on capital. This situation led to a reallocation of resources from financially integrated, state-owned firms to entrepreneurial private firms. The reallocation brought about external imbalance in the form of a large and persistent balance of payment surplus. Song *et al.* (2011) draw parallels between the developments in China on one hand and Korea and Taiwan on the other. According to the authors, both countries experienced an acceleration of productivity growth and large balance of payment surpluses, similar to China 20 years later. In the case of Korea, the authors explain that the industrialization process was financed primarily by foreign loans, resulting in a high foreign debt-to-GDP ratio. This imbalance was redressed in the 1980s, which witnessed high growth rates and large current account surpluses. Between 1960 and 1980 the Korean government provided strong support to large local conglomerates or so-called chaebols. The chaebols were granted access to low cost credit from banks and enjoyed other significant assistance. As a consequence, the relative importance of small and medium enterprises (SMEs) declined while that of the chaebols rose correspondingly.

According to Song *et al.* (2011), after an economic downturn in 1979-1980, government policies changed drastically and Fair Trade Act was enacted in 1980 to reduce entry barriers for new firms and small firms and thus to promote market competition. As a result, SMEs began to play a larger role in the economy. However, comprehensive financial reforms did not take place until the Financial Sector Reform Plan of 1993-1997. The differences in access to financing between larger companies and medium and smaller companies meant that "in the latter half of the 1980s the chaebol placed an increasingly disproportionate emphasis on capital-intensive industries using their ability to raise funds as the main source of their competitiveness"[2].

Chang *et al.* (2015) describe a Chinese pattern similar to the Korean pattern in Song *et al.* (2011). They find that heavy industry, dominated by relatively few large firms, gained ascendancy in the 1990s. That is, policymakers prioritized heavy industry over light industry, which led to rising investment in heavy industry. According to the authors, it is important to distinguish between in-sector and between-sector reallocation of resources. The two studies show

[2] See Smith (2000).

that the dynamics of capital and labor in China are sometimes better understood from a more granular, disaggregated perspective.

However, economic reforms and the government's strategic decisions are key to understand macroeconomic developments. In this connection, Chow (2015) analyzes the dynamics of GDP, capital, and labor in China for the period 1952-2012 in the framework of a model based on a Solow (1956) - type neoclassical model. In line with the existing literature, he finds a relatively high coefficient of 0.69 for share of capital and 0.21 for the share of labor. Chow (2015) excludes the years from 1958 to 1969 because he sees them as abnormal years. Besides, since he applies linear cointegration techniques, his coefficients should be seen as the average share of capital and labor in GDP and thus might be time-dependent. While the Cultural Revolution period clearly had different dynamics from the post-1979 rapid growth period, the former may have nevertheless contributed to the latter.

Cheremukhin *et al.* (2015) analyze the 1953-2012 period and compare the pre-1978 reform sub-period and post-1978 reform sub-period. Their results challenge the widely held view that post-1978 growth was only due to high savings and investment. Furthermore, in a counterfactual analysis, they find that the pre-1978 period had at least some positive effect and was not as disruptive as widely claimed. This is why we include this sub-period in our empirical analysis below.

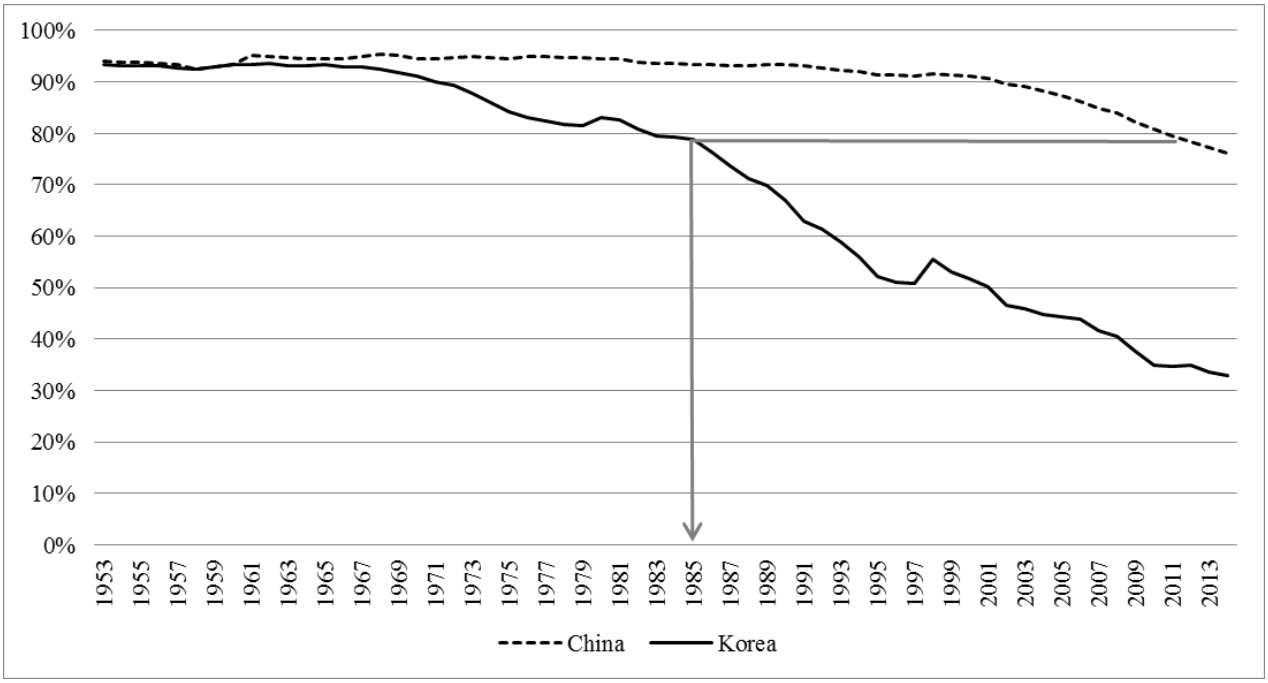
4. The Structural Change and Growth Dynamics in Korea and China

To see whether our assumption that structural change in Korea leads the developments in China, we apply two techniques of dating the point in time when China and Korea were in a similar state of development in terms of per capita GDP and structural change (see, Zhang *et al.*, 2015, Lee, 2016). Lee (2016) argues, based on a comparison of figures of per capita GDP, China would be 23 years behind Korea, with a similar approach Zhang *et al.* (2015) find that the distance would be 24 years.

Figure 1 displays per capita GDP in Korea and China relative to the USA as a benchmark country.[3]

[3] We use PWT 9.0 and divide the logs of rgdpe (Expenditure-side real GDP at chained PPPs in mil. 2011US$) by the corresponding figures for population.

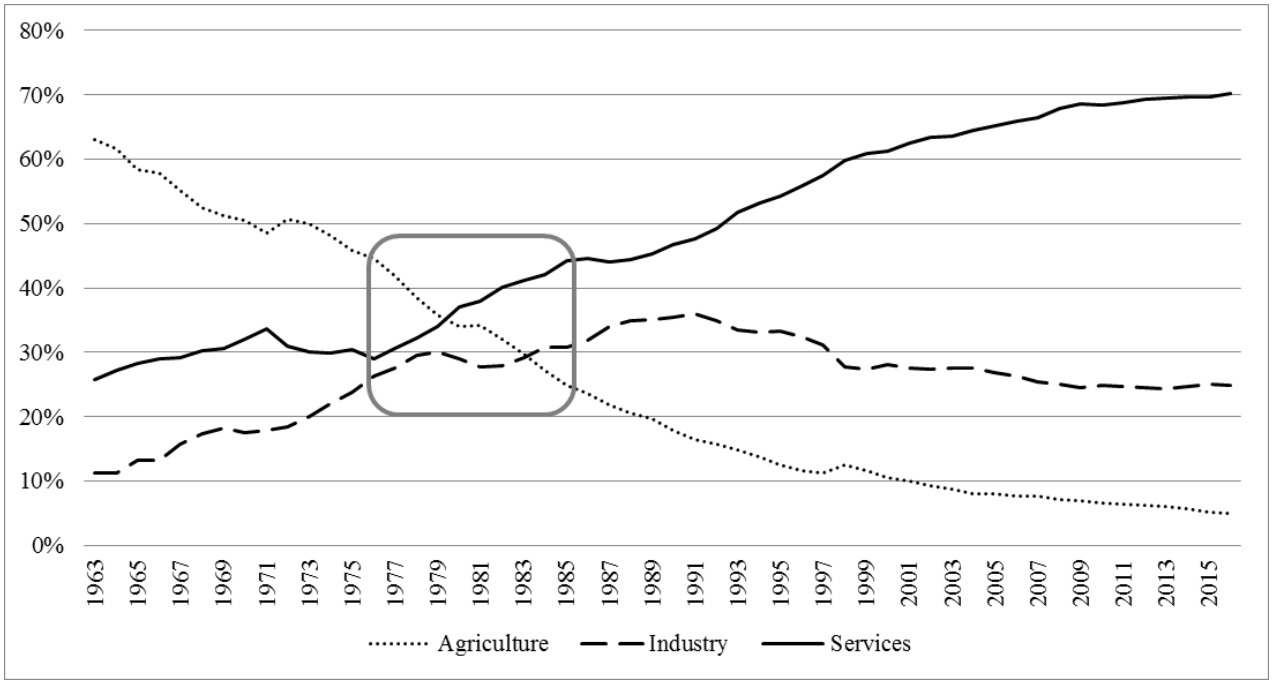
Figure 1: Per Capita GDP in Korea and China relative to the USA



Source: Own calculations based on PWT 9.0.

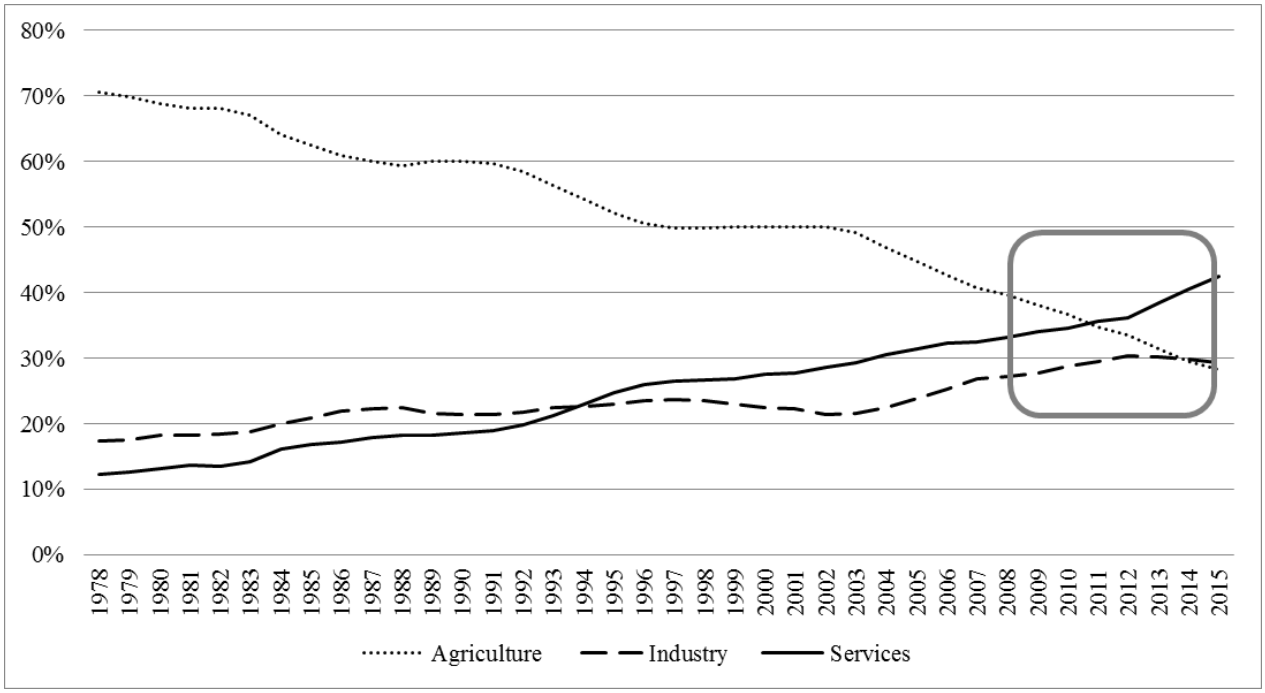
The figure displays the time dependent catching-up potential of the respective country, i.e. a value of 75% indicates that the country's per capita GDP was at 25% of the US level in the corresponding period. Shortly after the Second World War, Korea and China were on a similar level of economic development relative to the USA. Korea began a rather rapid catching-up process already in the early 1960s, while China did not start to catch up with the USA until around 1978 (when Deng Xiaoping started his reform efforts). Towards the end of the growth process initiated by the Deng strategy in 2011, China had reached about 20% of the US GDP per capita (leaving a catching-up potential of about 80%, see Fig. 1). A level of economic development Korea had (already) reached in 1985. Hence, the lead-lag distance between the two countries would be around 26 years. Murach and Wagner (2017) use a different approach to time similar periods of structural change in Japan, Korea and China. They use the point in time when the service sector (or industry sector) employment share surpasses the employment share in the agricultural sector. This was 1980 (1984) in Korea (see Fig. 2) and in 2011 (2014) in case of China (see Fig. 3), which delivers a distance of about 31 years.

Figure 2: The Structural Change Process in Korea



Source: Own calculations based on Datastream data from national sources.

Figure 3: The Structural Change Process in China



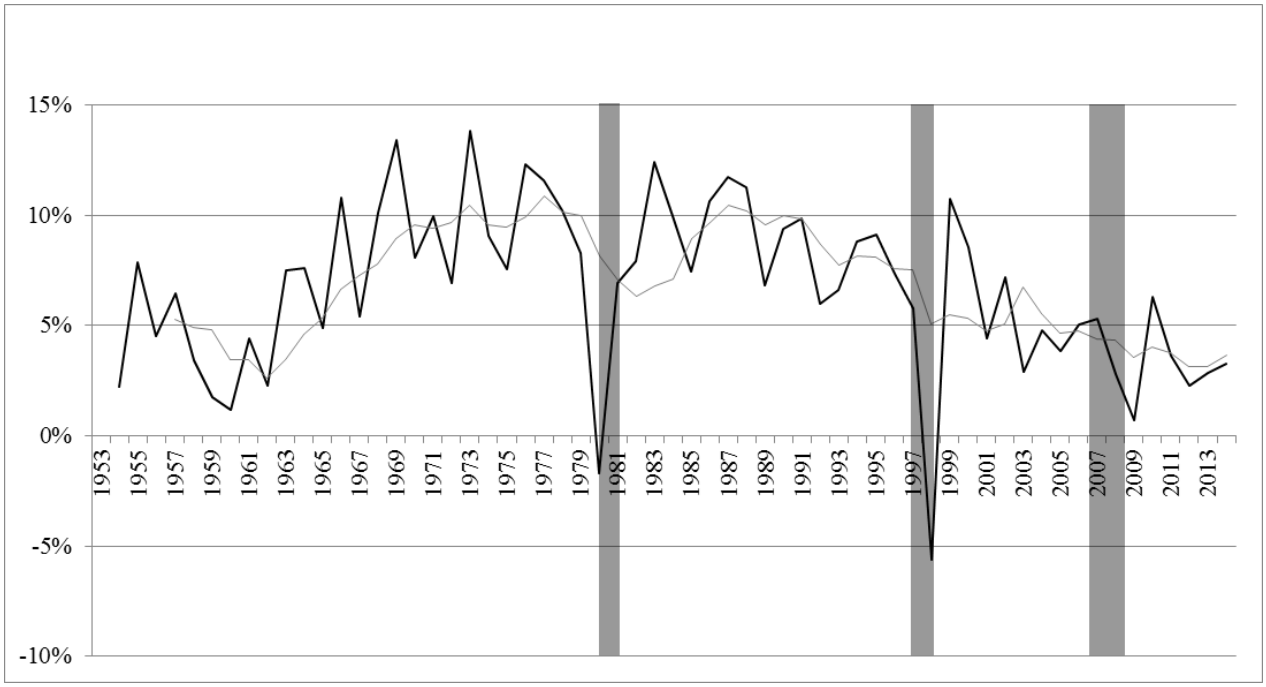
Source: Own calculations based on Datastream data from national sources.

Although the above mentioned approaches are very different in terms of data, they come to relatively similar results in terms of structural change in Korea and China. The main take away is that developments in Korea in terms of catching up with the US and structural change lead the developments in China, and do so by 24 to 31 years. We assume that the 12th Five-Year Plan (2011-2015) and the following Five-Year Plan of the Chinese Government mark a new reform phase which will lead to different dynamics in China's growth than previous reforms. The corresponding point in time when South Korea was at the same stage in terms of catching up and structural change are the years 1980-1985. Not surprisingly this was also the period when growth in Korea started to slow down and when Korea undertook measures to reduce the negative side-effects caused by its industrial policy in the 1960s and 1970s.

Figure 4 depicts the growth dynamics of Korea between 1953 and 2014. Growth seems to have been relatively stable in Korea in the period under investigation resulting in an arc-shaped pattern significantly interrupted only by three major economic crises (shaded areas around 1980, 1998 and 2007/08) which appear to divide four major growth phases, which largely correspond to

our observations in Section 2.1. China should be at the stage of economic development Korea was between 1980 and 1985, which would imply that China is currently embarking on a path with slowly decreasing growth rates if it follows Korea's example.

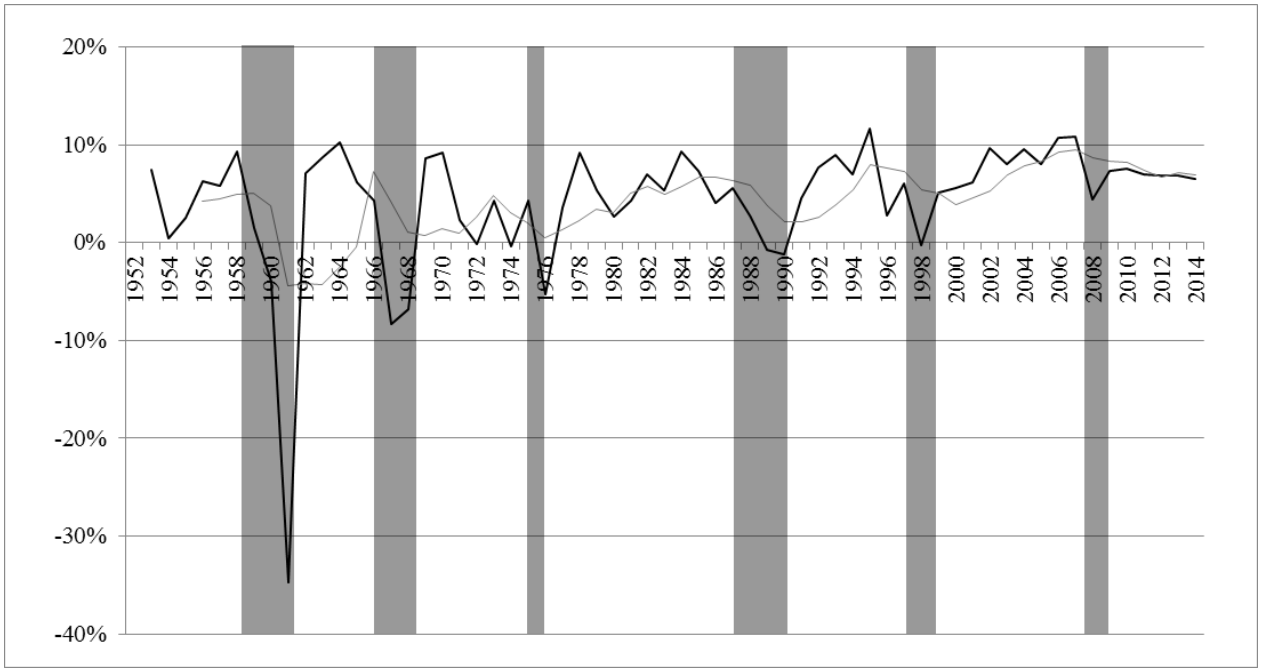
Figure 4: Growth Experiences of Korea



Source: Own calculations based on PWT 9.0

Figure 5 presents the growth dynamics for China for the corresponding time period. While the growth pattern of the pre-reform period of 1953-1978 is very unstable from 1979 onwards China's growth pattern is relatively similar to Korea's over the 1960-1980 periods.

Figure 5: Growth Experiences of China



Source: Own calculations based on PWT 9.0.

5. Empirical Analysis

5.1 Data and Empirical Approach

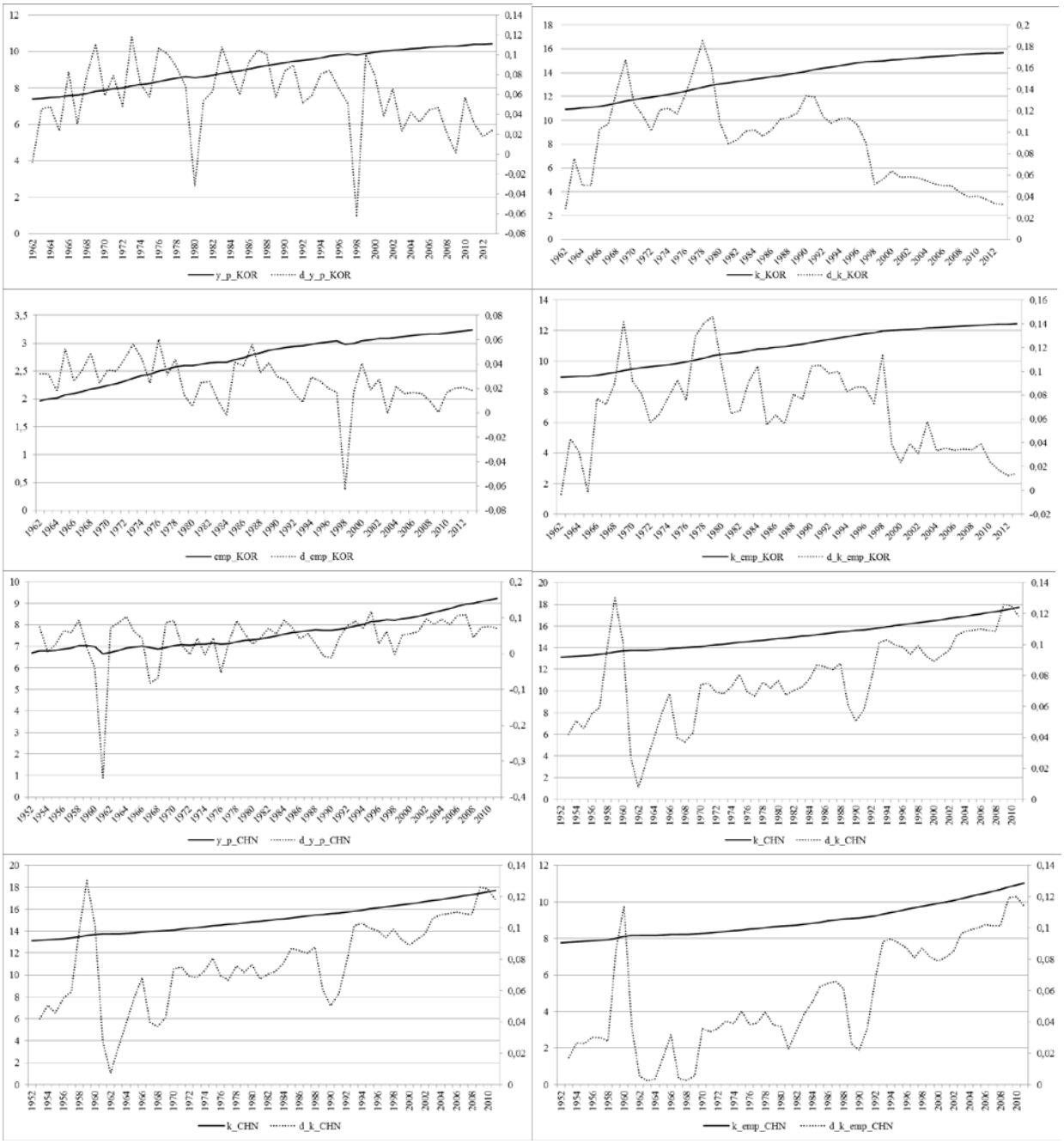
We use Penn World Tables (PWT) of the most current version 9.0 for our estimations. For Korea and China we collect data for gross domestic product (gdp), capital, employment and population. Data are available from 1953 until 2014 for Korea and 1952 until 2014 for China. Chow (2015) constructs capital data for China from publications of the China Statistical Yearbook. However, Holz (2006) discusses an earlier version of Chow‘s data set and lists a number of shortcomings of Chow’s measures and, lately, himself proposes some newly constructed capital measures for China (see Holz and Yue, 2017). We do not try to construct capital measures for Korea or China ourselves, but instead rely on the time series provided by the PWT. Relying on PWT data naturally brings difficulties as it has been shown that conclusions drawn under one version of the PWT may not hold under another version (see Ponomareva and Katayama, 2010). We leave the use of alternative measures of capital for future research to check the robustness of our results.

The empirical part of this paper has been especially inspired by the publications of Chow (1993), Chow and Lin (2002) and Chow (2015). We analogously assume a simple Cobb-Douglas production function

$$Y = AK^{(1-\alpha)}(L)^{\alpha} \tag{1}$$

to be able to capture the growth dynamics in Korea and China appropriately. The above equations will serve as our basic theoretical guideline when we try to identify long-run relationships in the data in the following. Figures 6 displays gross domestic product per capita, capital and employment as well as the capital-employment ratio for Korea and China. Solid lines correspond to the levels in logarithms and dashed lines to first differences of the corresponding time series.

Figure 6: Data for Korea and China



Source: Own calculations based on PWT 9.0.

We can directly relate our observations about reforms from Sections 2 and 4 periods to the corresponding time series. In Korea employment growth was high until the mid-1980s and

then started to decline. Similarly capital growth reached its peak in 1979 and then decreased drastically.

At the same time Korea's growth steadily increased until the beginning of the 1980s and then started to decline, yet much slower than the capital growth rates. The capital-employment ratio has also been on the decline since the early 1980s.In China gross domestic product per capita growth was more volatile in the pre-reform periods. We can assume that the political events of this period were also responsible for some very large outliers in the employment and capital time series. Since the beginning of the Deng Xiaoping reforms, employment growth has been steadily decreasing, while capital growth has increased strongly, which might nourish the assumption that China has to deal with overinvesting. We also see that the capital-employment ratio has been rising strongly.

For our estimations we use cointegrated VAR (CAVR) models which allow us to analyze long-run equilibrium relationships among the variables under consideration. The error-correction representation of the CVAR is of the form

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \phi D_t + \varepsilon_t \qquad (2)$$

X_t is a vector that contains the variables included in the model. D_t is a vector of deterministic components of the model containing constants, linear trends and dummy variables. The Γ_i matrices contain the short-run information of the model, while Π contains the information about long-run relationships and can be rewritten as a vector product of $\alpha \cdot \beta'$. Here β' comprises the long-run information, while α contains the information on how and how fast deviations from the long-run relations are corrected. Engle and Granger (1987) have shown that between two or more non-stationary time series there may be a linear combination which gives a stationary time series. Juselius (2006) explains that this is the case when two or several non-stationary time series are driven by the same persistent shocks. In our case we assume that the shocks driving our cointegrating relationships derive from economic policies measures implemented in the corresponding reform periods. Long-run relations can then be interpreted as economic steady-state relations. To draw valid statistical inference from the models certain assumptions of the statistical model must not be severely violated. Extraordinary events can lead to outliers violating the normality assumption as they lead to excess skewness and kurtosis (See Juselius, 2018). Some of these problems can be resolved by including intervention dummies to account for

significant political or institutional events in the sample. We expect our sample to include such events. Less feasible seems the possibility to split the sample into more homogenous periods as only yearly data for our variables is available over the full sample period, so that a subsample analysis would suffer from problems associated with small samples.

5.2 Unit Root Tests

For Korea we analyze the period of 1962 until 2013. This includes the full range of reform periods. For China we include the period of 1952 until 2011, corresponding to the pre-reform period and several periods of fast growth until 2011. In contrast to Chow (2015) we do not ex-ante exclude the years between 1958 until1969 as according to Cheremukhin *et al.* (2015) these years may have paved the way for the latter rapid economic growth. We therefore decided to include these years and treat outliers with deterministic components such as dummy variables. From the previous section we have seen that growth rates de- or increased over time. We thus assume that the time series under consideration present deterministic trends and hence test especially for unit roots of the most general form allowing for a constant and a deterministic trend. Unit root test for Korea and China are displayed in Table 1 and 2 respectively.

Table 1. Unit root tests for Korea

	Augmented Dickey Fuller Test	**Phillips Perron Test**
Levels	Intercept & Trend	Intercept & Trend
Y_P_KOR	0.9995	0.9992
K_KOR	0.9852	1.0000
EMP_KOR	0.9472	0.9422
K_EMP_KOR	0.9960	0.9996
1. Differences		
Y_P_KOR	0.000***	0.000***
K_KOR	0.0943*	0.1286
EMP_KOR	0.000***	0.000***
K_EMP_KOR	0.0525*	0.0635*

Source: Own calculations. *p < 0.05; **p < 0.01; ***p < 0.001

Table 2. Unit root tests for China

	Augmented Dickey Fuller Test	Phillips Perron Test
Levels	Intercept & Trend	Intercept & Trend
Y_P_CHN	0.9791	0.9950
K_ CHN	0.9999	0.9998
EMP_ CHN	0.9991	1.0000
K_EMP_CHN	1.0000	1.0000
1. Differences		
Y_P_ CHN	0.0001***	0.000***
K_ CHN	0.0000***	0.2771
EMP_ CHN	0.0327**	0.0787*
K_EMP_CHN	0.0038***	0.1547

Source: Own calculations. *p < 0.05; **p < 0.01; ***p < 0.001

According to the ADF-test all time series can be assumed to be trend-stationary. The PP-test leads to less convincing results especially for the capital and employment series in China. As the PP test is less powerful in finite samples it may be less surprising that it comes to other results compared to the ADF-test. We conclude that the levels of the time series are integrated of order one (I(1)).

5.3 Identifying Possible Long-Run Relations

We now analyze the above data for long-run relationships. The variable set we use is relatively small, and for instance, omits several variables which now are considered as important drivers of economic growth such as human capital. The problem however is to find data for the relevant periods and in sufficient quality. Indeed PWT also offer a measure of human capital, but it offers not enough variability to give any hope to successfully integrate it into an error-correction model. In any case cointegrating relationships which have already been identified should remain stable when additional variables are added.

As mentioned in the previous section we take a simple Cobb-Douglas production function as the starting point of our analysis. Our vectors X_t for Korea and China are

$$X_{t\_KOR} = (Y\_P\_KOR_t, K\_KOR_t, EMP\_KOR_t) \quad (3)$$

and

$$X_{t\_CHN} = (Y\_P\_CHN_t, K\_CHN_t, EMP\_CHN_t) \quad (4)$$

We start by specifying the model for Korea. In order to test for cointegration we first have to obtain a well specified VAR model of the data. This includes the choice of lag length as well as the decision to whether or not include dummy variables and deterministic trends in the model. We include an intercept into the VAR and the cointegration space. As TFP usually is captured by the residuals of the equation, we also take into consideration that we will have to capture technological progress by the introduction of deterministic trends. Juselius (2006) generally proposes two approaches when identifying cointegrating relationships: The general-to-specific and the specific-to-general approach. We find it more appropriate to start with a very narrow model which we borrow from Chow (2015) and then step-by-step loosen our restrictions and hence use the specific-to-general approach. Imposing restrictions on the model is crucial to decide how well the data fit our theoretical assumptions. We hence rearrange our baseline theoretical model to obtain a representation which allows us to impose over-identifying restrictions on β.

Taking logarithms from the above production function (equation 1) delivers

$$y = a + (1 - \alpha)k + \alpha l \tag{5}$$

Subtracting l on both sides and rearranging terms we get

$$y - l = a + (1 - \alpha)k - (1 - \alpha)l \tag{6}$$

Finally to avoid problems of collinearity and as we are interested in the drivers of actual growth in the two countries we assume

$$l \sim \ln(N) = n \tag{7}$$

where N is the population. This finally gives

$$y - n = a + (1 - \alpha)k - (1 - \alpha)l \tag{8}$$

with per capita gross domestic product as a function of inputs capital k and labor l. Chow (2015) estimates several specifications of this equation. The most specific is one with a fixed capital-labor-ratio (k/l).

Analysis of Korea

There is some controversy on the sources of growth in Korea. For instance Young (1995) argues that most of the dynamic growth in the so-called Four Asian Tigers can be explained by factor accumulations and labor reallocations between sectors. Accounting for these explanatory variables would lead to much lower estimates of total factor productivity growth. In a more recent analysis by Jeong (2017) the results are in so far similar as it is explained that human capital was the main driver of growth during the 1960s and capital deepening in the 1970s. Productivity growth was then the main driver of growth in the 1980s, 1990s and 2000s. This would justify two possible specifications of deterministic components. Either we could include a deterministic trend over the whole sample period. This implies that there was more or less productivity growth over the whole sample. Or we could include such a trend only from 1980 on with the initiation of the stabilizing stage in Korea.

We start with the most general setting concerning deterministic components in our model. We allow the data to be trend-stationary and to have non-zero intercepts and see whether trends persist or cancel in the cointegrating relations. We first analyze the specific relation between gross domestic product per capita and the capital-employment ratio. When introducing dummy variables there is a permanent tradeoff between the properties of the residuals and adding additional dummy variables to the system. Outliers specifically emerge in the first fast growing stage of the Korean economy (1960s), around the transition from the fast growing stage to the stabilization stage (1980), and also around the years of the Asian Crisis of 1998. In this model we decide to use only three dummy variables for the years 1969, 1980 and 1998. Diagnostic tests are presented in Table 3. The model has to be well specified especially regarding skewness and autocorrelation of the residuals. While skewness is not an issue, we observe autocorrelation in the first lag, however not in the second. Heteroscedasticity is rejected.

Table 3: Residual analysis – diagnostic testing on the unrestricted VAR (1)-Model

Multivariate Test				
Residual autocorrelation:				
LM (1):	ChiSqr(4) = 17.474 [0.002]			
LM (2):	ChiSqr(4) = 7.405 [0.116]			
Test for ARCH:				
LM (1):	ChiSqr(9) = 9.452 [0.397]			
LM (2):	ChiSqr(18) = 14.979 [0.663]			
Univariate Tests				
	ARCH(1)	Normality	Skewness	Kurtosis
Y_P_KOR	0.033 [0.855]	0.179 [0.914]	0.085	2.496
K_EMP_KOR	4.425 [0.035]	14.108 [0.001]	-0.390	5.295

Source: Own calculations.

The results for the trace test are presented in Table 4. The results can be interpreted as the presence of one cointegrating relationship. More than one cointegrating relationship is rejected at the 10% significance level. We hence restrict the rank of Π to one.

Table 4: LR Trace Test for the unrestricted VAR (1)-model

r	p-r	Eigenvalue	Trace	95% crit. Value	p-value
2	0	0.531	50.743	25.731	0.000
1	1	0.212	12.161	12.448	0.056

Source: Own calculations.

Normalizing one of the variables is sufficient to obtain the just-identified model. We normalize on per capita gross domestic product as from theory this is the dependent variable. The obtained long-run relationship (see Table 5) is in line with our theoretical expectations.

Table 5: The just-identified long-run cointegration relations for r = 1

	Y_P_KOR	K_EMP_KOR	TREND
$\hat{\beta}_1$	1.000	-0.448	-0.033
	(.NA)	(-7.166)	(-6.773)
$\hat{\alpha}_1$	0.154	0.350	
	(3.048)	(7.592)	

Source: Own calculations.

This relationship implies that gross domestic product per capita and the capital employment ratio move together positively in the long-run. A deterministic trend which we assume to capture total factor productivity growth has the expected (positive) sign indicating an annual percentage growth rate of 3.3 percent (interpretation of $\hat{\beta}_1$). In the next step we check the results for the alternative assumption that TFP-growth only significantly set in from the 1980s onwards, which implies that prior to the 1980s economic growth can be predominantly related to input factor growth. Such a model is also compatible with the data. Table 6 displays the corresponding just-identified long-run relationships.

Table 6: The just-identified long-run cointegration relations for r = 1

	Y_P_KOR	K_EMP_KOR	T(1980:01)	TREND
$\hat{\beta}_1$	1.000	-0.579	-0.031	-0.000
	(.NA)	(-5.724)	(-7.910)	(-0.052)
$\hat{\alpha}_1$	0.128	0.220		
	(5.217)	(11.847)		

Source: Own calculations.

Assuming that TFP-growth set in around 1980 supports the assumption that the forces which drove Korea's growth actually changed during this period. Introducing a brokenlinear trend in 1980 actually renders TFP-growth over the whole period to zero and more importantly insignificant (while still having the correct sign). The coefficient of the capital-employment ratio increases, which is in line with assuming that prior to 1980 input factors had a more significant impact on economic growth. Specifying the model without the deterministic trend over the whole sample period and only containing the broken linear trend from 1980 onwards gives coefficients of similar size and direction.

In the next step we loosen our restrictions by allowing capital and employment to move independently. In the following we assume that TFP-growth significantly set in around 1980. With just one more dummy variable than in the previous modelling cycle (for 1968), we obtain a fairly well specified model of the data. Table 7 displays the diagnostic test of the residuals of the VAR(1) with three variables.

Table 7: Residual analysis – diagnostic testing on the unrestricted VAR (1)-Model

Multivariate Test

Residual autocorrelation:
LM (1): ChiSqr(9) = 14.378 [0.109]
LM (2): ChiSqr(9) = 7.486 [0.587]

Test for ARCH:
LM (1): ChiSqr(36) = 48.500 [0.080]
LM (2): ChiSqr(72) = 113.956 [0.001]

Univariate Tests

	ARCH(1)	Normality	Skewness	Kurtosis
Y_P_KOR	0.728[0.394]	0.076 [0.963]	-0.072	2.571
K_KOR	2.299 [0.129]	0.970 [0.616]	-0.074	3.127
EMP_KOR	0.188 [0.665]	2.047 [0.359]	-0.109	3.391

Source: Own calculations.

We do not observe autocorrelation in the residuals and the assumption of normality can be accepted. There is some heteroscedasticity in the second lag, but according to Juselius (2006) this is unlikely to bias our rank tests. The corresponding rank test indicates one single cointegrating relationship between the three variables (see Table 8). We thus assume the rank of Π to be one.

Table 8: LR Trace Test for the unrestricted VAR (1)-model

r	p-r	Eigenvalue	Trace	95% crit. Value	p-value
3	0	0.979	232.426	58.540	0.000
2	1	0.319	34.577	36.872	0.086
1	2	0.255	14.999	18.477	0.149

Source: Own calculations.

With r=1, we get the following just-identified model (see Table 9).

Table 9: The just-identified long-run cointegration relations for r = 1

	Y_P_KOR	K_KOR	EMP_KOR	T(1980:01)	CONSTANT
$\hat{\beta}_1$	1.000	-0.703	0.843	-0.024	-1.148
	(.NA)	(-10.951)	(4.255)	(-11.578)	(-3.440)
$\hat{\alpha}_1$	0.162	0.283	0.079		
	(13.035)	(45.812)	(10.515)		

Source: Own calculations.

Here we can rely on the above equation where we assume the coefficients of capital and employment to be of the sample size (see equation 9). We can already strongly assume that this restriction will be accepted as in absolute value the coefficients of K_KOR and EMP_KOR are of the same size. This is basically an assumption of constant returns of scale. The over-identified model is presented in Table 10.

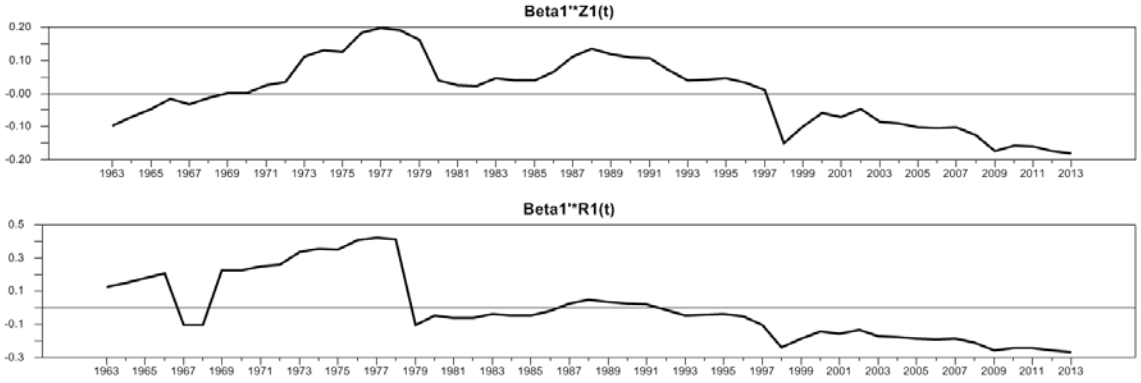
Table 10: The over-identified long-run cointegration relations for r = 1

	Y_P_KOR	K_KOR	EMP_KOR	T(1980:01)	CONSTANT
$\hat{\beta}_1$	1.000	-0.664	0.664	-0.023	-1.237
	(.NA)	(-34.952)	(34.952)	(-16.613)	(-6.835)
$\hat{\alpha}_1$	0.179	0.312	0.087		
	(12.961)	(45.283)	(10.564)		

Source: Own calculations.

The over-identifying restrictions are accepted with a p-value of 0.662 and a $\chi^2(1)$ of 0.243. Figure 7 displays the corresponding cointegration graph.

Figure 7: Cointegrating Relation for Korea



Source: Own calculations.

Analysis of China

We now turn to the analysis of the Chinese economy during 1952 until 2011. As we include also the pre-reform years which are excluded in Chow (2015), we expect to observe many outliers in the data. As in Chow (2015) we include a broken linear trend starting in 1979, the beginning of the first reform period. We have to include a number of dummy variables mostly to account for events during the years of the Great Leap Forward Campaign and the years of the Cultural Revolution. In the subsequent years some dummies are necessary to account for events around the break-up of the eastern bloc and the Asian Crisis, we hence include dummies for the years1958-1962, 1967, 1968, 1989-1991, and 1998. With these dummy variables we obtain a relatively well specified model as displayed in Table 11.

Table 11: Residual analysis – diagnostic testing on the unrestricted VAR (1)-Model

Multivariate Test				
Residual autocorrelation:				
LM (1):	ChiSqr(4) = 5.781 [0.216]			
LM (2):	ChiSqr(4) = 1.561 [0.816]			
Test for ARCH:				
LM (1):	ChiSqr(36) = 0.900 [1.000]			
LM (2):	ChiSqr(18) = 18.132 [0.447]			
Univariate Tests				
	ARCH(1)	Normality	Skewness	Kurtosis
Y_P_CHN	1.265 [0.261]	5.819 [0.054]	-0.169	4.038
K_EMP_CHN	0.369 [0.543]	1.188 [0.552]	-0.252	3.127

Source: Own calculations.

The trace tests propose up to two cointegration relationships, but from theory we would only expect one relationship. We thus restrict the rank to be equal to one. This gives the following just-identified model (see Table12).

Table 12: The just-identified long-run cointegration relations for r = 1

	Y_P_CHN	K_EMP_CHN	T(1979:01)	CONSTANT
$\hat{\beta}_1$	1.000	-0.332	-0.022	-3.965
	(.NA)	(-7.063)	(-4.825)	(-10.307)
$\hat{\alpha}_1$	0.117	0.112		
	(4.605)	(24.230)		

Source: Own calculations.

All variables have the expected sign. As in Korea gross domestic product per capita and the capital-employment ratio commove in a positive long-run relationship. The coefficient of the capital employment-ratio is, however, much smaller in comparison to Korea (0.332 versus 0.579). We have to be cautious not to over-interpret this result. It could point towards a less prominent role of capital in the production function of China in the period under investigation. This result would hence fit into the picture that physical capital in China is partly over-invested or of lower quality. In comparison to the results obtained for Korea, capital in Korea seems to play a more

important role in the period under investigation. Here we have to keep in mind that our samples include different stages of structural change in both countries, i.e. the Chinese sample includes years up to 1979 which were marked by a severe misallocation of resources which led to economic stagnation. TFP-growth proxied by the broken linear trend has a positive effect on output and a coefficient of 0.022, which is again smaller in comparison with Korea (0.033). Again we analyze the dynamics of capital and employment separately. By including the same dummy variables we obtain a rather well-specified model without autocorrelation and mild skewness. The Trace test indicates that there could be one or two cointegrating relationships. We continue to assume that the rank of Π is equal to one, which means that there is one single equilibrium relationship among the variables. The just-identified model is displayed in Table 13.

Table 13: The just-identified long-run cointegration relations for r = 1

	Y_P_CHN	K_CHN	EMP_CHN	T(1979:01)	CONSTANT
$\hat{\beta}_1$	1.000	-0.248	0.276	-0.039	-4.604
	(.NA)	(-4.610)	(2.574)	(-9.121)	(-18.861)
$\hat{\alpha}_1$	0.081	0.128	0.061		
	(5.684)	(53.997)	(19.323)		

Source: Own calculations.

Table 14 displays the results for imposed overidentifing restrictions on capital and employment.

Table 14: The over-identified long-run cointegration relations for r = 1

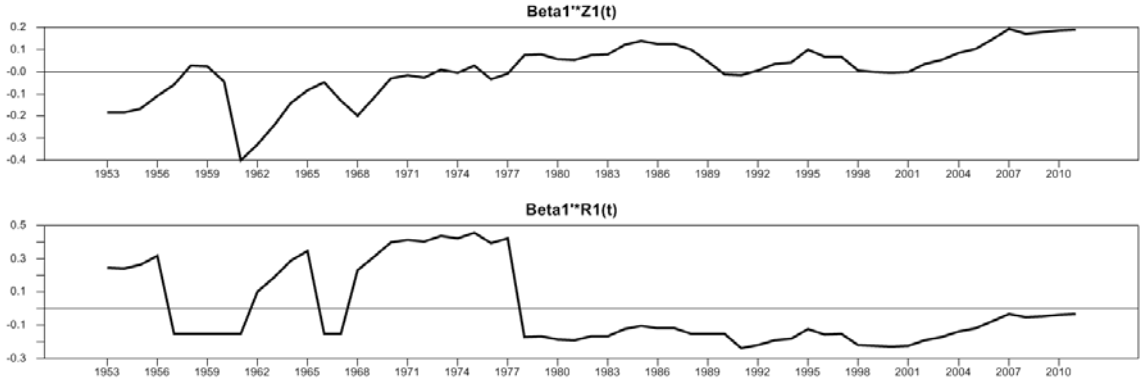
	Y_P_CHN	K_CHN	EMP_CHN	T(1979:01)	CONSTANT
$\hat{\beta}_1$	1.000	-0.228	0.228	-0.040	-4.613
	(.NA)	-7.758)	(7.758)	(-14.320)	(-19.177)
$\hat{\alpha}_1$	0.081	0.128	0.062		
	(5.701)	(53.162)	(19.575)		

Source: Own calculations.

The over-identifying restrictions are accepted with a p-value of 0.693 and a $\chi^2(1)$ of 0.156. The coefficients of capital and employment are again considerably smaller than in the corresponding model for Korea (0.228 versus 0.664). The reform-induced change in total factor

productivity is now however much higher than in Korea (0.040 versus 0.023). Figure 8 displays the corresponding cointegrating relationship.

Figure 8: Cointegrating Relation for China



Source: Own calculations.

5.4 Did Reforms Cause Structural Changes in the Long-Run Relationships?

While the modelling of the cointegrating relationships has already given us some evidence about different regimes ruling the relationship between per capita gross domestic product, capital and employment, we also want to analyze the stability of the cointegration relations. We are especially interested in the stability of the long-run relationships, i.e. the stability of $\hat{\beta}$. $\hat{\beta}$ can be seen as the average of the related coefficients over the sample period.

It could be assumed that structural change induced by reforms not only affected TFP-growth, but also the output elasticity of inputs. The optimal capital intensity could hence have changed (see Stijepic and Wagner, 2011). Theoretically this has also been proved by works of Acemoglu (2003). To test this we perform a test of "known beta". This test checks for the consistency of beta, i.e. the stability of the long-run relations. The basic idea is that the model is estimated for a subsample period 1 to T_1, with $T_1 < T$, and then the recursive sample is extended until T is reached. The backward recursive testing follows the same strategy, but here the subsample T_1 to T is extended backwards (see Juselius, 2006).

We start with the forward recursive tests on the long-run relations of the Korean economy. It is not necessary to impose the restrictions on the coefficients. For many reference

samples the test indicates that the β_t equals a known β. However, we are especially interested whether a structural change in the parameters occurred during the stabilization and transition toward a high-income economy (1980-1997) (see Section 2.1). As reference sample we hence choose the years of 1963 until 1979 roughly corresponding to the period of high growth. The sample for known beta is 1963 to 2013.

We observe instability of the parameters around 1982 until 1991. These years fall into the period of the stabilization stage. The later periods appear to have had no effect on the stability of the long-run relationship, although we observe some renewed increase around the years of the Asian crisis. To test the robustness of our results we also perform a backward recursive test on the stability of beta. The backward recursive test allows concluding on the stability of the parameters at the beginning of the sample. Here we choose the baseline sample to be 1999 until 2013. This period corresponds to the last stage – the restructuring, reinvention and maturation (see Section 2.1). As result we get, that the second phase of the fast growing stage (1972-1979), as well as the first half of the stabilizing stage (1980-1987), display instability in the cointegrating relations. After a short phase of stabilization (1988-1993), the first restructuring stage (1993-1998) again introduced some instability.

Altogether this supports the assumption that the last period of our sample may have different dynamics in comparison with the earlier stages. This assumption is also supported by the visible drop in capital growth during this stage as displayed in Figure 6. This may have been related to the new focus on the production of highly innovative knowledge and technology intensive goods during this period.

For China we perform the same type of test. Here our baseline sample is 1953 until 1978.This shows that the relationship appears to have experienced mild instability over the 1980s and the early 1990s. Since then the relation appears to have been relatively stable, while the WTO entry may have introduced some (insignificant) instability.

For the backward recursive estimation we choose the sample of 1985 until 2011. We observe again some (mild) instability during the years of the Cultural Revolution and at the

beginning of the reform period. The most pronounced increase is found around the introduction of Deng Xiaoping's reforms. Altogether these results are less interpretable.

Not surprisingly the tests suggest that the data actually display several different regimes for both countries as described in Section 2.

6. Conclusions

Sustained rapid growth has transformed China from a low income economy into a middle income economy in a remarkably short period of time. The next challenge for China is to graduate from middle income to high income in a relatively short period of time, like Korea or Taiwan, rather than be trapped in middle income for a prolonged time, like some Latin American countries. How well and smoothly China tackles this difficult challenge has sizable ramifications not only for China but given China's large and growing footprint on the global economy, for the rest of the world.

In this paper, we sought to get some clues about the future dynamics of China's economic growth by looking at Korea's past pattern of growth. To do so, we analyzed and compared the structural change and growth experiences of the two countries, which share many similarities. Perhaps the most significant common denominator was a capable bureaucracy and developmental state that prioritized economic growth and played a catalyst role in the rapid growth and structural transformation of the two countries. As such, structural policies and reform played a major role.

Our analysis and comparison of the patterns of economic growth and structural change in Korea and China yields a number of interesting findings. The pattern of structural change in Korea and China seem to be broadly similar, with China following in Korea's footsteps by about 20 to 25 years. The descriptive analysis of Section 4 and the more in-depth econometric analysis of Section 5 both support the view that many features of China's economic development mirror earlier Korean experience. GDP growth and the capital-labor ratio moved together in a positive long-run relationship in both countries. However, there is one interesting and significant difference between the two countries in their economic growth and structural change trajectory. Specifically, our analysis indicates that China shifted from input-based growth of deploying more

capital and labor to growth based on total factor productivity (TFP) gains at a much earlier stage in its development path. If China shifted toward TFP-growth at a similar stage as Korea, the shift would have occurred around 2011. In fact, the shift in China began as early as 1979.

The broader question that we seek to address through our comparative analysis of the growth and structural change experiences of China and Korea is whether China can replicate Korea's success in smoothly graduating from middle income to high income in a relatively short period of time. Our comparative analysis suggests that China's economic growth is likely to slow down steadily in the coming years, just as Korean growth did over the last three decades. In fact, China's growth has already started to slow down since the global financial crisis, although to levels that still exceed 6%. However, at a broader level, the balance of evidence from our analysis provides cautious grounds for optimism about China's prospects for a smooth and quick transition to high income. Above all, the fact that China's growth has been led by TFP growth rather than factor accumulation suggests that China's growth is sustainable and still has some ways to go.

However, to sustain its enviable track record of rapid TFP growth, China must forcefully implement structural reforms such as state-owned enterprise (SOE) reform and reducing the role of the state in the financial system. Structural challenges such as population aging and new risks such as rising global protectionism further strengthen the case for such TFP-promoting reforms.

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