

# South Korea's catch-up strategy Revisited: economic growth and technological innovation

Wonpyo HONG (department of future strategy research, Chungnam Institute, South Korea)

**Abstract:** catch-up technological innovation strategy has played important role in South Korea's remarkable economic growth. At its initial stage, successive governments had led the process with government-run R&D institutes. With regard to China, along with the growth of private sector in economy as well as in R&D activities, the role of government has to be shifted from player to referee, national governance should be formed and creativity should be encouraged with corresponding rewarding system for the pioneering R&D activities.

**Key words:** catch-up, technological innovation, South Korea, economic conversion

South Korea is cited as one of the few successful countries in the world which had gone through dramatic economic success along with substantial progress in democracy. In the past 60 years it has risen to most qualified country for advanced economy from poverty and disorder in 1950s. Now that South Korea is about to touch per capita income of USD 30, 000, it is high time to look back upon the path that South Korea has walked in technological innovation process, which can be characterized as "catch-up strategy". This could be a good reference to China, which is pursuing high quality society based on the success of 40 years of opening up and economic miracle.

## 1. South Korea's remarkable economic achievement

South Korea's economic growth has started in 1962 when the 1st five-year economic development plan (1962-1966) was launched. Since then even amid the turmoil of the two times of Oil Crises, Asian Financial Crisis and Global Financial Crisis South Korea has marked outstanding economic performance compared with other peer countries or regions.

### 1.1 Overview of South Korea's economic growth

South Korea was one of the poorest countries in the world when South Korean War ended in 1953.<sup>1</sup> Wrecked with three-year long war, South Korea had almost nothing but the ashes and internal antagonism among people. In the aspect of economy, South Korea had to rely heavily upon international aid for food and daily necessities.

In 1962 South Korea began to put into effect the first five-year economic development plans (1962-1966). In terms of economic growth, it had focused on the boosting of export as well as the restoration of energy-related facilities and stabilization of agricultural production. Export drive directly targeted light industry like textiles, shoes and the production sites formed around cities. This move proved to be successful: annual economic growth rate marked 7.9%, followed by 9.6% at 2nd five-year economic development plan period (1967-1971). In those periods, annual growth rate of export reached 43.6% and 33.7%.

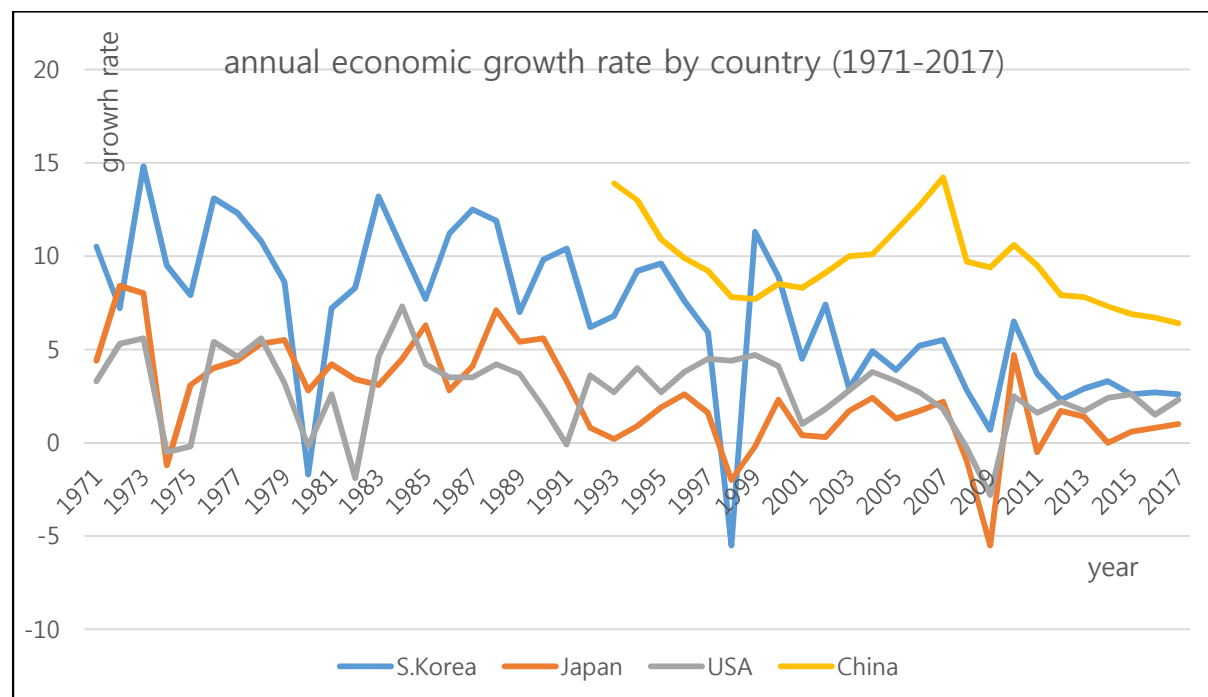
In 1970s, however, South Korea had witnessed two times of Oil Shocks, which made disruptive effects on its overall economy since it was then moving onto heavy industry including petro-chemistry and steel making in preparation of the boosting of shipbuilding or machinery industry. 3rd five-year socio-economic development plan (1972-1976) put an emphasis on the large scale investment on the heavy industry like Pohang steel and Ulsan petro-chemical complex. Amid the turmoil of 1st and 2nd Oil Shock, annual growth rate marked 9.2% and 5.8% respectively at the 3rd five-year and 4th five-year each. As a result, by 1980 steel and shipbuilding accounted for 10.6% and 3.5% while textiles took up less than 30%.

From middle 1980s on, South Korea had made an outstanding economic performance benefiting from "three lows", which means cheap US Dollar, cheap oil, cheap money (low interest rate). Almost every part of industry in South Korea marked stunning growth. Along with 1987 democracy movement, South Korean per capita income had made substantial increase. By the time of mid 1990s, South Korea's companies with sufficient money and confidence, began to make massive investments on the electronics and machinery and automotive industry. For instance, Samsung, LG electronics and Hyundai Motors channeled a

<sup>1</sup> . According to the statistics, South Korea's per capita GNP was just USD 65 in 1955, ranking the second poorest country in the world. (sources: 'from the poorest to 30 thousand USD of per capita GDP'(2014.12.25), YonhapNews, Korea

lot of resources to R&D and plant building. Even after Asian Financial Crisis in 1997, South Korea resumed quickly to economic normality.<sup>2</sup>

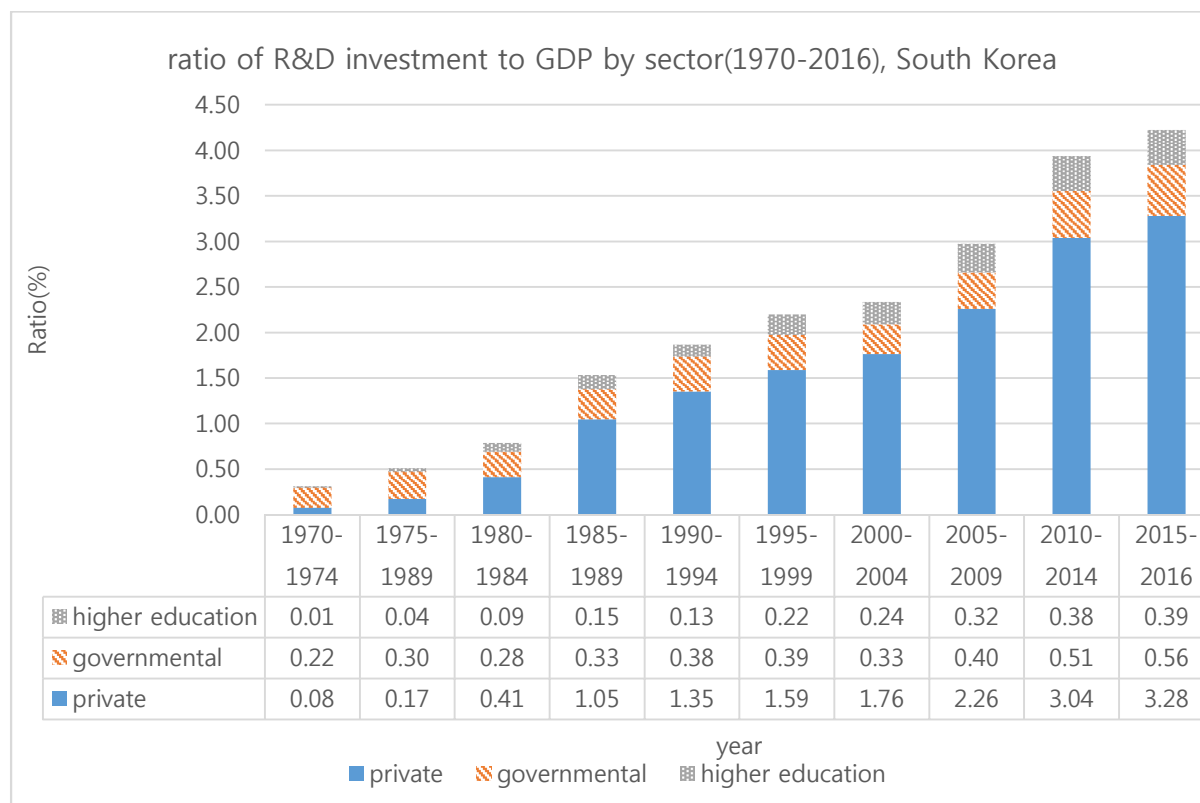
In the peak times of Global Financial Crisis (2008-2012), South Korea managed to cope with the economic shock taking advantage of China's mammoth investment in infrastructure and housing. Recently, however, South Korea boom up in housing industry has come to an end, causing wide spread worry over potential economic depression due to too much household debt.



[figure 1] annual economic growth rate by country (1971-2017)

Data: Korean Administration of Statistics (<http://www.kosis.kr>)

<sup>2</sup> Nonetheless, Asian Financial Crisis and South Korea's response in favor of deregulation and opening up of financial sectors make a far-reaching repercussions resulting in the irrevocable engagement in global economic fluctuation.



[figure 2] ratio of R&D investment to GDP by sector (1970-2017), South Korea

Data: Korean Administration of Statistics (<http://www.kosis.kr>)

## 1.2 two times of successful economic conversion

Looking back on South Korea's economic growth path, it is widely accepted that there were twice economic take-offs. One is economic conversion from light industry to heavy industry during 1970s and the other is conversion from heavy industry to electronics and precision machinery in 1990s. In terms of industrial sectors, textiles were replaced by petro-chemicals and steel, and then followed by electronics and automotive.

the transformation of economic structure to heavy industry came into force mainly through the state-led establishment of national heavy industry parks located along the coast in East southern regions. Exemplary are Pohang Steel Complex<sup>3</sup> (1972) or Ulsan petro-chemical complex (1967), soon followed by successive establishment of Guangyang steel complex and Yeosu Petro-chemical complex. This conversion was led by government mainly financed by foreign lending, even though large conglomerates had cooperated in the process.

<sup>3</sup> It was renamed as POSCO in 2002 soon after successive privatization measures of Pohang Steel highlighted at the sale-off of 36% stock held then by Korea Development Bank in 2000.

The other conversion happened in 1990s when automotive and semiconductors including precision machinery attracted intensive investment in place of shipbuilding and petrochemicals. In terms of location new investment was concentrated around large cities. Most of the new plants were built around Seoul Metropolitan Area. This conversion is said to be initiated by private sector headed by Samsung, LG or Hyundai, even though extensive intervention by the government was made particularly with financial and tax means. Such conversions were the core of South Korea's economic take-offs and came into fruit when China's economy burst into stunning growth since its entry to WTO in 2000.

What would be, then, South Korea's next conversion? So far there have been various debates, public and private, over the next growth engine for the future without unified consensus. Meanwhile it began to dawn that such past conversion strategy is not relevant anymore and that shift in growth strategy is to be worked out in the context of quite different social elements. In fact, with Asian Financial Crisis as turning point, South Korean economy has gone through dramatic change. Full-fledged deregulation and incorporation into global economy makes state-led economic conversion ineffective or, at best, inefficient.

### 1.3 catch-up technological innovation of South Korea

So far we have reviewed the overall process of South Korea's economic growth. Now we need to pay attention to technological innovation process which underlay the successful economic conversion.

When South Korea launched economic growth drive in early 1960s, there were little technological resources to rely on. As a consequence, new technology has to be imported in order to boost economic growth. As a small and poor economy at 1960s, South Korea adapted catch-up technological innovation by learning or imitating the technology developed by advanced countries or simply following the technological path set by them.

Catch-up technological innovation strategy played pivotal role in the course of two times of economic conversions. R&D institutes were established by the governments. Typical was the establishment of KIST or Korean Institute of Science and Technology in 1966. It was the first comprehensive R&D institute of South Korea established by government absorbing scientists and engineers who was then studying in foreign countries. Since then R&D institutes of specific fields were successively established and the year of 1974 witnessed national R&D complex

located at Daedeok, Daejeon city<sup>4</sup>. Engineers and technicians were fostered in large volume through education, with more emphasis placed on higher education in university and college. In private sector, conglomerates were the partner of the “developmental state”. Through the financial and institutional means, government encouraged conglomerates to concentrate investment on the targeted industry. In compliance with export-oriented growth strategy set by government, conglomerates had made intensive investment in plant building which produced exported goods in return for foreign currency.

In the course of 1<sup>st</sup> economic conversion, technological innovation was led by state-run R&D institute, while in the 2<sup>nd</sup> economic conversion, private sectors led by conglomerates make a crucial role under the full support from government.

## 2. characteristics and problems of South Korea's catch-up technology innovation strategy

### 2.1 concept of catch-up technological innovation strategy

We can define the South Korea's technological innovation strategy as catch-up strategy. Generally speaking, catch-up strategy refers to narrow down the gap in technology with reference to advanced countries in order to support economic growth. Otherwise its economy may fall behind or be stuck with structural dependency on advanced economies. Even though technological innovation strategy aims to catch up with the advanced economies, it is not just importing advanced technology or following the technological path that advanced economies established. If this is the case, it would at its best benefit from the relocation of industrial activities where advanced economies lost competitiveness, thereby to be stuck with structural dependency on the advanced economies. Consequently, we have to look into details of South Korea's strategy if we are to catch the whole picture of its remarkable success. by preempting the sector that expects rapid growth through strategic investment concentration in the course of modernization. As a strategy, however,

<sup>4</sup> The establishment of Daedeok national R&D complex was planned in 1973 and construction was launched in 1974 to finally end in 1992. As of 2017, Daedeok national R&D complex has 1,705 institutions including 26 government-run research institutes, 24 public institutes, 23 non-profit institutions, 7 universities or colleges, and 1,613 firms.

## 2.2 characteristics of South Korea's strategy

First, South Korea had made strategic targeting on where to concentrate massive investment. The targeted sector had to be big enough to enjoy economy of scale thereby earning sizable foreign currency to feed the cooperating sectors or players. Given that South Korea's domestic market size was very limited, the targeted sector had to be export-oriented.

In terms of technology, mass production was possible only when the product or production system proves stable. That is, In the sense of product life cycle theory, mature or standardized product was suitable for mass production. As a matter of course, targeted technological innovation was directed to applied technology rather than basic or original technology. At the initial stage, since applied technology was not domestically available, technological learning was done in the form of technology licensing or transfer and then later in the form of learning by doing. Scholars and engineers who studied abroad no doubt played important role in this process of technological learning.

Second, position of South Korea in global value chain of the targeted sector was mass assembler or system integrator, since otherwise it had to compete with advanced economies in the sectors like R&D, material or components. Material or components was supplied by foreign suppliers at initial stage to be replaced by domestic suppliers at a later stage.

For instance, Samsung electronics in 1990s decided to make investments in flat panel production and It built assembly line near Seoul Metropolitan Area. The material and components and facilities were imported. Along with the increase of the production the suppliers of material and components began to build their own local production sites in vicinity of Samsung's assembly plants. As times went by, domestic players began to compete with foreign suppliers and in some area replaced them at all aspects.

Third, South Korea's technological innovation is characterized by cooperation between government and conglomerates. Even though there are some differences in who initiated the conversion drive between 1<sup>st</sup> conversion and 2<sup>nd</sup> conversion, the economic conversion was possible only with the concerted action of government and conglomerates.

Korean conglomerates, *chaebuls* in Korean, are quite similar to Japanese *zaibachu* or family-owned company engaging in various business. At the beginning it was predominantly dependent on government's policy. As they grew in size and economic influence, it became

increasingly independent. As a consequence of deregulation and full incorporation into global economy in the process of Asian Financial Crisis in 1997, the government's control on them weakened substantially.

In terms of R&D activities, conglomerates-led private sector began to overtake governmental sector from early 1980s on, accounting for about 80% of total R&D expenditure in 2015-2016 (see figure 2).

### 2.3 problems of South Korea's technological innovation

The catch up strategy has proven successful to the extent that the very success has driven South Korea stuck in the trap of path dependency. It is evident in three problems: irrelevancy of catch-up strategy, weakness of small to medium forms in R&D capability, and sectoral imbalance.

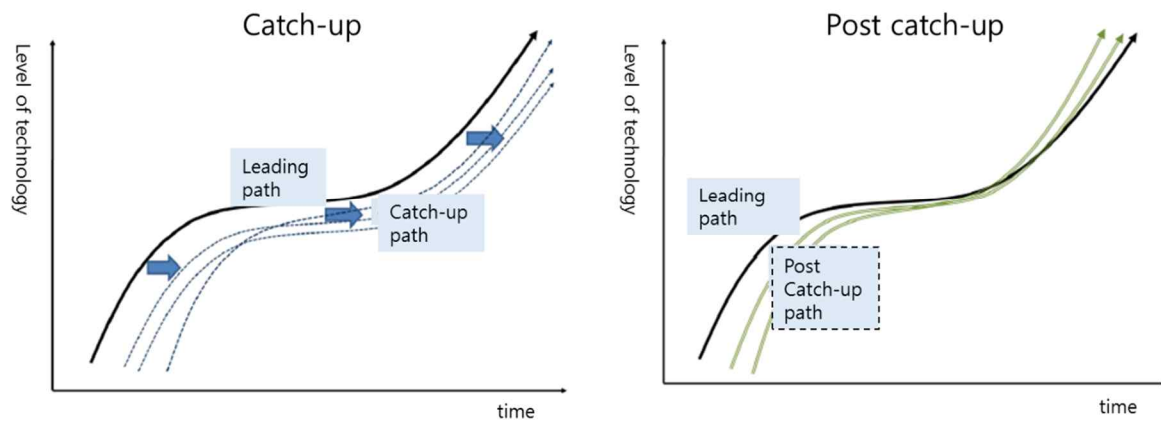
First of all, it is widely contended that catch-up strategy is no long relevant to current South Korean context. It is asserted that the elements that contributed to the success of past catch-up strategy are missing or changed. Government's initiative is not inhaled by private sector, whereas private sector is still opportunistically relying on governmental policy. The global competition has become ever fierce with new formidable players like China and South East Asia at one hand and competitive players like Japan, German or USA on the other hand, which are very cautious about technology transfer to South Korea.<sup>5</sup>

Related reports have come up with "post catch-up strategy", asserting that South Korea has to break up with past catch-up strategy and make its own way to post catch-up strategy in technological innovation. Technology deepening, technology differentiating or technology pioneering was proposed as three ways of post catch-up strategy.<sup>6</sup>

<sup>5</sup> In a word, South Korea's economic success has changed its status, thus making its once relevant strategy obsolete. In analogy to marathon game, if a player was far behind at the marathon, there is no choice but to catch up with the leading group. it would be waste of time to think much of his own strategy. Once, however, he found himself running shoulder by shoulder with leading players, he should work out how to play his own game.

<sup>6</sup> For details, see Lee&Lee (2010).





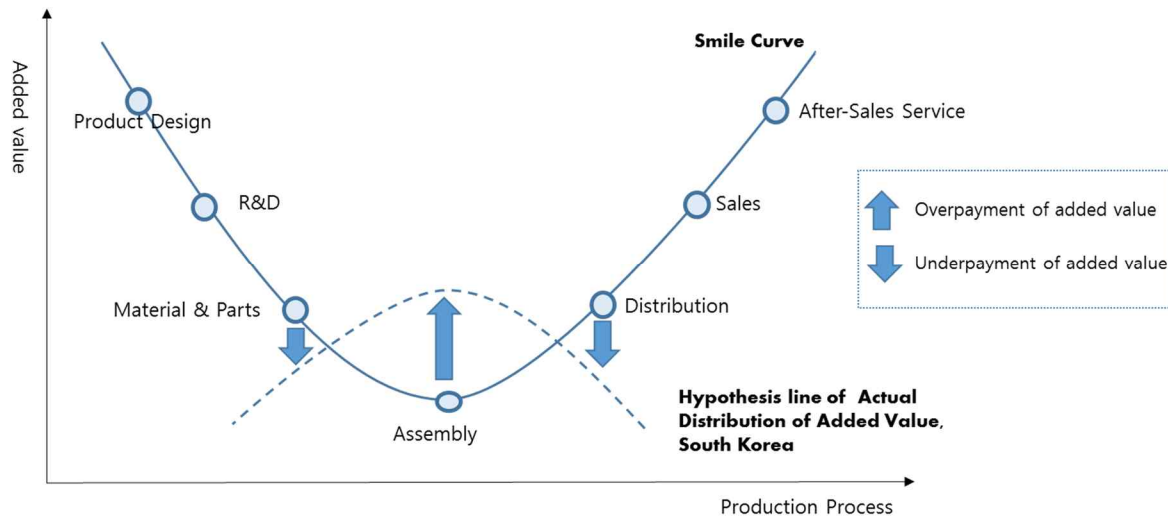
[Figure 3] comparison of catch-up and post catch-up path

Sources: Lee & Lee (2010), KISTEP, Korea

Second, weakness of small to medium firms in R&D capability sets barrier to technological innovation. As a consequence of conglomerates-led economic setup, small to medium firms in South Korea have played filling-out role in terms of global value chain. With conglomerates as assembler or system integrator, small to medium firms have acted as subcontractor of material and components, guaranteed with marginal profit. Consequently, South Korea's small to medium firms has little resource to do their own R&D activities. This makes stark contrast with Japan where small to medium firms are strong enough to play substantial role in overall R&D activities.

This paradoxical situation can be shown in figure 4.<sup>7</sup>

<sup>7</sup> It should be noted that figure 4 is illustrated just on the basis of hypothesis, which yet to be verified by further study.



[figure 4] hypothesis on added value distribution of South Korea along smile curve

Sources: illustrated by author

According to smile curve, overall seen, assembling production activities yield lowest profit whereas material or parts production brings higher profit. In case of South Korea, however, conglomerates or large firms are taking assembling production activities claiming higher profit while small to medium firms are engaging in material or parts supply with marginal profit. As a result, most of small to medium firms have little to invest into R&D activities. This paradox may impose very hard burden on South Korea's post catch-up strategy. The reason for this paradox can be explained in socio-economic relations between assembler and suppliers.

Third, sectoral imbalance is pointed out as one of structural problems that the past economic success story has left. Export-oriented economic growth strategy has placed emphasis on manufacturing or the second industry. Unlike other countries where the first industry such as agriculture has contributed a lot to the formation of primitive capital, South Korea's boosting of manufacturing was made at the risk of agriculture or the first industry.<sup>8</sup> Agriculture was set up as the source for food and the utmost objective of agricultural policy was to maximize food production to keep the labor cost as low as possible. Since manufacturing was not based on the material from agriculture but on directly imported material or processed material of imported sources, the industrial linkage between the first industry and the second industry was left

<sup>8</sup> South Korea's policy with regard to agriculture was different from Taiwan's in that South Korea boosted manufacturing sector at the risk of agricultural sector, while Taiwan developed manufacturing based on agricultural sector. (Fagerberg & Godinho)

neglected at large. The same applies to service sector. As the demand for South Korea's export has come from overseas market, it has had little opportunities to engage in service business. Except for a few producer service, rest part of service industry was dominated by self-employed or small to medium firms.

This in turn has worsened imbalance of R&D sector. In addition to the chronic imbalance between applied technology and original technology, undue attention has been made to agriculture and service sector. Given that R&D in agriculture plays as basic technological assets, sectoral imbalance would make a negative effect on South Korea's post catch-up.

It should be noted here, however, that recent rise of Korean Wave in culture among East Asian countries provides South Korea with first and last opportunity to regenerate its ever-declining agriculture and service industry. As Korean Wave means the formation of Korean Premium about the thing Korea, it can lead to the increasing interest and potential demand for Korean goods and service. This offers a favorable condition for a new take-off of agriculture and service industry in South Korea, still to be responded with indigenous capability to crystalize it to business.

### 3. Lessons of South Korea's experience and its implication for China

So far we have reviewed South Korea's economic success and the problems it is facing in the context of economic growth and technological innovation. To be sure, technological innovation is inseparably connected with social environment and it should not be treated irrespectively of surrounding social systems. The concept of post catch-up strategy points out the same perspective.

China is no doubt quite different from South Korea in several aspects. Nonetheless, China is also one of the late comers in the course of modernization and South Korea's experience could provide some implications for China's sustainable development in the future. Here we have first to review the differences that China is facing and then conclude by proposing three implications for China.

#### 3.1. different settings that China faces

Before we go into details of what South Korea's experience implies, we have to distinguish the differences that China has with respect to South Korea. Two points are worth mentioning here. One is the synchronization of global economy characterized by accelerated flow of economic assets, while the other is big economy effect. The former is global environment, while the latter is the very characteristics of China.

Synchronization of current global economy has multi-faceted meanings for any developing countries. First, accelerated global circulation of economic assets including information, labor force, finance, capital and natural resources increases the instability and uncertainty of effect of economic policies designed by individual national government. Compared with the situations that South Korea's government faced, those of today's China are more open to fluctuations from within and without. Second, many resources valued in the past is now readily accessible. A firm can get access to valuable technology at market instead of developing it on its own and even can buy foreign firms. Nonetheless, to accumulate technological or social capability is different story from buying technology. We cannot downplay the importance of the accumulation process of technological innovation that is regarded as indispensable in order to rise to leadership in technology. Ever-increasing competition for frontier technology among advanced economy convinces us of the hard fact.

Big economy effect of China provides favorable settings for the technological innovation and economic growth. The very largeness of the economy size, even though severely challenging in politics, become a blessings for economic growth. Big size makes economy of scale effect easily reachable and diversity of economic activities encouraged not only due to the variety of many localities but also emergent market that size itself generates. Big economy size is the fountain of diversity, where millions of new emergent market can flourish. In addition, various mix of ethnicity and nationals can provide good social background for the boost of diversity. Big economy is, however, a sword with two blades. As any structural conversion in big economy may make an enormous impact on global economy, it has limited options for growth strategy. Big economy cannot pursue sustained development by heavily depending on export nor take on the path of extensive use of natural resources, thus making compressed economic conversion unlikely.

### 3.2. Implications of South Korea's experience for China

The long-term risk of catch-up strategy is evident. Long-standing practice of state-led economic growth strategy, despite its success, has resulted in the habitual dependency of private sectors on government or the opportunistic attitude to impute the risk to public side or taxpayers in the end.

This problem applies the same to the R&D activities. Government-run R&D institutes played leading role during 1<sup>st</sup> economic conversion when private sector's role remained negligibly small. During the period of 2<sup>nd</sup> economic conversion in 1990s when private sector's R&D activities had grown to the extent that it overtook public sector in quantity as well as quality, repositioning of public R&D activities became the pending issue.

What has to be done when private sector has grown to the extent that they are getting out of government's control? There are three things to make. One is to shift government's role from player to referee. Another is to help establish national or in part international governance. The last is to encourage creativity at the level of social system. These are in fact what are missing in today's South Korea.

Firstly, China has to make a timely shift of government's role from player to referee so that it may ensure the fair play among all players. Instead of playing actors on the ground of economy, government has to become regulator with its institutional resources in support of increased transparency and fairness of the game. In South Korea's experience, Asian Financial Crisis brought about revolutionary impact on government's policy environment. With full-fledged opening up of domestic market to foreign investors, the financial means of government by which once influenced the decision making of private sector has weakened to the extent that governmental policy had to take into account foreign investors' response if the measures would hold effective. Institutional rearrangement seems inevitable but the inertia persists.

Talking of technological innovation, the situations are direr. Facing the growing role of private sector in R&D activities, government had rightfully placed emphasis on the close cooperation between public sector and private sector. Nevertheless, it determined that public sector had to serve the private sector. In action, government introduced performance-based system to evaluate the outcome of research mainly by the standard of number of published articles, patents or technological transfer. Given that private sectors are preoccupied with applied technology, public sector had to organize R&D activities for the securing of basic or original technology, which was what South Korea as a whole lacked.

Secondly, Chinese government has to help establish national or in part international governance to set up social system to guide the social development direction. Increasing diversity and complexity of the economy makes governmental policy measures alone less effective or even useless. It would be another illusion to expect market economy to operate automatically in service of public good. National governance would be correct answer to this question, which will encourage the social consensus about the direction of social development and redistribution of economic resources. In case of South Korea, social split is growing evident along the line of regular workers and non-regular workers. It also reflects the social divide between conglomerates and small to medium firms. No further progress seems imaginable without social consensus on this dormant conflict.

In R&D activities, governance system is in dire need. In order to make a synergic effect between public and private there must be some platform where they meet each other and talk about how to cooperate for the sake of mutual benefit.

Third, China is to encourage creativity in society as a whole not to mention R&D activities. Creativity is the core of liveliness and competitiveness of the economy. Advent of knowledge-based economy emphasizes the importance of creativity. In South Korea's context, creativity has remained one of the top issues ranging from education to R&D activities. Since former president, Roh had put forward "innovation" as keystone, "green growth", "creative economy" and "the 4<sup>th</sup> industrial revolution" became the mottos of successive governments

With regard to technological innovation, social rewarding system for challenging R&D activities should be prepared and put into place. One of drawbacks of the performance-based system is that it hinders researchers from actively taking part in joint-research or open-ended research. Considering that original technology-related research is often beyond evaluation by market mechanism, South Korea should reshuffle new social reward system for technological pioneering.<sup>9</sup>

<sup>9</sup> Currently in South Korea, there is robust debate on how to reshuffle the national system to encourage the accumulation of concept designing capability introducing trial and error in policy as well as private sector's activities. Noteworthy here is the decentralization of national system, which aims to empower the local government at sub-national level and private sectors. Combining decentralization with deregulation, South Korea expects to strengthen autonomy of the local government and entrepreneurs. This seems to be the only way to cultivate the future-designing capacity. This way, any policy or business model tested and verified through experiment can be speeded to national level or business as a whole.

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