Conclusion
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The analytical framework developed in the study on the basis of a survey of the available literature reveals that the rate of success is higher in the case of export-oriented pattern of industrialisation. As the market is larger for the products, there are immense opportunities for gains in terms of economy of scale and scope. Interaction with and competition in the international market motivate the firms to maximise their production efficiency in order to increase their share and become potentially strong players. Much of the success of an export-oriented economy is due to the process of technology accumulation. Therefore, this study has adopted the capability building approach to analyse the pattern of technological development and its crucial role in shaping the export-led economic growth of Korea. As Korea experienced much of its growth as a developing country (often considered as a latecomer), the study has sought to explain the Korean example within the framework of industrialisation process in developing countries.

Some important themes discussed in the framework need to be re-emphasised here. Unlike an advanced country where technological capability is accumulated mainly through R&D, such capability building in a developing country is largely dependent on the transferred technology. However, in the later stage of diffusion and innovation, R&D plays an extremely crucial role. Successful internalization of imported technology depends on a set of variables, including the modes of transfer, the methods of learning and R&D, educational base and the macroeconomic environment. The government plays a crucial role by devising appropriate policies as well as facilitating firm-level technological efforts. Taking these dimensions into consideration, the observations and conclusions made by this study are discussed below.
The adoption of an export-oriented industrialisation in Korea in the early 1960s could be justified given its small domestic market, lack of adequate natural resources and unsuccessful experience in ISI strategy pursued immediately after the Korean War. Further, Korea's ambitious vision to establish itself as a self-reliant and prosperous economy manifest in the First Five-Year Plan document encouraged it to adopt such a strategy. Taking note of the industrialisation process of other countries with a similar status at that time, the adoption of EOI was surely a bold and challenging decision for Korea involving a greater risk.

The greatest asset for Korea when it initiated the export-led industrialisation process was the availability of educated human resources. In addition, massive investment in education and training with foreign aids, especially from the US, during the reconstruction phase led to a surplus in educated labour force. This factor could be considered as an important foundation for the subsequent industrial development.

To examine the process of technological capability building for realizing the industrial policy objectives in a systematic manner, the concerned period is divided into two phases viz., the initial phase, covering the first four Five-Year Plans, (1962–1981) and the progressive phase, i.e., 1982 to the present (Chapter 2 and 3 respectively). This has been done to spell out the strategic changes and reforms in industrial, technology and overall economic policies as well as the technological capability accumulation process adopted by the Korean firms.

The industrial policy from the early 1960s to the mid-1970s focused on the production of labour and low-technology intensive products for exports, such as textile yarns, leather goods, synthetic fabrics, assembly type consumer electronics goods etc. It may also be noted here that the import-substitution strategy in some sectors was pursued till late. The government fully mobilized labour, borrowed capital and other resources to the benefit of these industries. Facilities such as
transport and communication were improved in order to remove the critical barriers to the growth of the industries.

Priorities shifted in the mid 1970s toward development of heavy and chemical industries realizing that concentration in light and basic industries would not secure Korea’s future. The shift towards heavy and chemical industries in the later years reflected the transition of the economy from labour-intensive structure to that of a capital-and-technology intensive one. The chaebol were encouraged through preferential financing and various tax incentives to establish modern plants in petrochemicals, electronics, shipbuilding and automobiles sectors.

A number of external and internal factors such as heavy borrowing for HCI, loss of low-cost labour advantage, protectionist policy of advanced countries and second oil crisis were responsible for Korea’s economic downturn in the late 1970s. These factors seem to have influenced the changes in its economic policy planning since the 1980. Among the most fundamental of these changes have been liberalisation and globalisation of the economy, reduction in government intervention, rationalisation of business practices, promotion of SMEs, opening of the domestic market to foreign goods and promotion of the market mechanism to enhance competition. In a sense, open and fair competition following the international trade principles has become the new directional guideline in formulating industrial policy.

These changes have resulted in the shift of Korean industries to high technology and knowledge intensive sectors. Willingly or otherwise, they have had to do so in order to survive profitably both in the international and domestic markets. Advanced consumer electronics products, automobiles, computer peripherals, semiconductors, telecom equipment, digital devices etc. are the key sectors promoted in this phase.
The policies and strategies on building technological capabilities have been effectively linked to the process of industrialisation from the beginning. Even though the demand for technology was little given the nature of the primary industries in the 1960s, the government took steps to import the required technology and develop a technology infrastructure by establishing institutes and allocating resources for industrial training. Worth noting is also the fact that vocational and technical education were given priority in order to enhance the quality of the workforce.

The expansion of HCIs in mid-1970s and the further transition into high technology and knowledge intensive sphere since the early 1980s have generated a demand for importing more complex technologies and developing indigenous capability. Simultaneously, new approaches to explicit technology policy formulation also became visible.

The explanations of technology transfer suggest that both formal and informal modes have been preferred according to the time-to-time requirements of the highly diversified industrial structure. Korea’s policy on formal technology imports through foreign direct investment (FDI) and foreign licensing (FL) was quite restrictive in the initial phase of industrialisation. The rationale behind such protectionist measures may be explained as for creating a protective wall for the domestic firms against foreign competition. Instead, technology transfer through informal modes, such as import of capital goods and procurement of turnkey plants was encouraged. In the progressive phase, restrictions on FDI and FL have been relaxed to facilitate the absorption of complex technologies. Along with FDI and FL, OEM arrangement, joint venture have also been preferred as important modes of technology transfer. However, in comparison to others, the amount of FDI flown to Korea has been low and technology transfer through capital equipment import and FL still account for a major portion.
The government's role in promoting the building of technological capabilities has by nature been highly interventionist and selective. This is clearly visible from the directives enunciated by the industrial and technology policies. The government's priority-based approach in selecting and promoting strategic industries for speeding up exports has been a prominent feature. Regardless of some reforms in line with the functional approach, the government has been constantly designating certain industries as priority sectors and providing them adequate support, both financial and administrative, with a view to realising its export goals. Although this might have proven detrimental in some instances, it cannot be refuted that such a strategy has also helped in upgrading the industrial structure.

As the technology policy in Korea is largely seen as an integral part of the industrial development strategy, the incentives and subsidies are seized by a few selected sectors. The government initiative in monitoring export performance through monthly export promotion meeting and withdrawal of support in case of firms' failure to fulfil the target have acted as powerful incentives for the firms to enhance their technological capabilities.

Another significant effort by the government to upgrade the diffusion and innovative capacity of the industries is the expansion of institutional network, development of innovation clusters and establishment of linkages among the government, private and university research institutes under the framework of the 'National System of Innovation'. By establishing special institutes like SRCs, ERCs and RRCs, it has been able to supply high calibre research manpower. The success of cooperative research is revealed in the development of new products such as ultrasonic scanner and electronic switching system.

As we have seen, the government has consistently set long-term national goals by announcing a series of R&D programmes. These programs have targeted key technologies and focused on mission-oriented projects. Although the private
sector has a greater participation in R&D related activities, the GRIs (Government-supported Research Institute) participation and contribution in this regard cannot be ignored.

The firms have been supported by the government wholeheartedly in their process of product diversification and design implementation. In the initial stage, as Korean firms obtained the required technologies by licensing product designs and importing most of the production equipment, they became able to master the production techniques, which were relatively simple, through learning-by-doing and reverse engineering. They not only utilized it effectively for assembly, but increasingly also for related support services and for mass production lines.

In the progressive stage realizing that the tacit and implicit elements of the imported technologies cannot be internalized only through simple learning mechanism and reverse engineering, the firms have been involved in other modes of learning. Interactive learning and learning by searching appear to have brought the desired result. Further, the firms' concern for generating innovation-led growth can be seen from the rapid rise in the number of cases of strategic technological alliances with the market leaders.

Encouraged by the various tax incentives and concessions, the private sector has been consistently increasing their expenditure in R&D related activities. This is evident from their share in the total R&D expenditure over the years. According to the measurement followed in advanced nations, an increase in R&D investment is directly related with innovative aspects of the firm. In Korea's case this is partially true. In fact, a major portion of these investments at least until the mid 1990s. was for adaptation and diffusion of imported technologies.

In their attempt to integrate with the international production network, the Korean firms are outsourcing their R&D activities. This has helped the firms in securing advanced technologies, learning form observations and enhancing their
competitiveness. Also, the keen interest shown by many TNCs to forge alliances with Korean chaebol on equal footing shows the improvement in the status of the chaebol.

The study has further focused on firm-level analysis of the technology acquisition process in some important sectors. For the initial phase, the cases of steel and consumer electronics sectors have been dealt with. For the progressive phase, it has focused on the telecom sector (mobile phone industry) along with a general discussion on consumer electronics and computers.

As seen in the case of POSCO, a government-owned integrated steel mill, the establishment of the plant was realised with the complete help of Japanese firms. Factory operations techniques were acquired through training and conducting trouble-shooting exercise in the manufacturing facility with the assistance of the Japanese engineers in order to increase productivity. An important aspect was the effective utilisation of engineering graduates and technicians through formation of taskforces to work on core technological projects. As a result POSCO became able to establish a few units and increase production by the end of 1970s. However, it did not emphasise on quality enhancement at this stage.

While much of its success can be attributed to the efforts made in the later phase, this would not have been possible without the initiatives in the initial phase. Also, when compared to many firms from other developing countries such as Brazil and India, POSCO was way ahead in terms of production and export. The case of POSCO is a unique example for countries where public sector enterprises have lagged behind in productivity and growth.

The growth experience of the consumer electronics sector illustrates several notable features. The scope of development for local enterprises was limited in the 1960s due to the dominance of foreign firms. However, many local firms started entering this sector as assemblers of simple products and subsystems.
The presence of several Japanese and American company subsidiaries encouraged the Korean firms to license and subcontract arrangements with them to acquire technology. Encouraged by the success in assembling techniques, the firms moved into the next stage of mass production. For this purpose, they began to import the best practice production equipment and focus on shop-floor training and learning-by-doing practices from the buyers. They also emphasised on alliances with advanced firms through OEM arrangement and conducting selective in-house R&D, which helped them in diversifying their product ranges.

It was in this sector that the government encouraged FDI and announced favourable policy measures with a view to creating an atmosphere of learning among the local firms. It also set up special institutes to help the local firms in selecting partners and gathering technology-related information. The export performance of this sector during the period 1961~1980 reveals a significant increase in the share of local firms since the early 1970s. Again, the edge of consumer goods over parts and components in terms of export affirms the steady technological improvement in the product structure.

The explanations on the capability accumulation of consumer electronics sector in the progressive phase stress upon the importance of OEM as the major form of learning and training. Through OEM, this sector has immensely benefited in increasing its production capacity by mastering much of the production and design know-how. The greatest advantage of being engaged in OEM activities for the Korean firms is of course the expansion of their export market base. However, as the firms have succeeded in catching up with their buyers of OEM, they have adopted other strategies such as collaborative alliances and joint product development with other advanced firms.

In contrast, the success of the computer sector is largely attributed to its technology acquisition through cross licensing arrangements, joint research and
strategic alliances. The globalisation of R&D by many of the chaebol is considered to have brought significant returns. Also, the efforts by GRIs, mainly the ETRI, to cooperate with the private firms in conducting research on multimedia devices should not be overlooked.

The telecom sector exemplifies Korea's progress at the innovation front, as Korea became the first country to develop and commercialise the CDMA technology for mobile communication. This sector is one where both the government and private firms have had an equal share in product development.

The role of ETRI, a government research institute, has been quite prominent in this area. This institute initiated the project not only by licensing the technology from original designer firm from the US but also by participating in joint research with the designer. What could be said to have worked in favor of ETRI was its earlier experience in similar R&D projects. Once the technology was developed, its successful commercialisation required further technological improvement. To achieve this goal, ETRI and the private sector undertook joint research. This provides one more example of the effectiveness of linkages between government and private research institutes. The government has extended help to the willing firms in this regard. The development of CDMA 2000-1X, which is often considered as 2.5-generation technology and unprecedented, indicates the tremendous technological advancement of Korean firms. The remarkable export performance can be judged from Korea's share in the world CDMA market, which is estimated to be more than 50 per cent.

The chaebol have been the driving force behind Korea's export-led economic development. To show their contribution, the study has taken into account the cases of Samsung Semiconductor Unit and Hyundai Motors in the fourth chapter. It has focused on the stage-wise technological progress of these two firms and explained their astounding performance.
In view of DRAM being considered as a high technology intensive product, Samsung's success could not have been possible without its emphasis placed on and intensive learning and continuous upgrading of its technology base. From the beginning, Samsung has orchestrated its technology accumulation strategy in a way as to catch up and compete with the advanced technologies. For this, it preferred a stage skipping (or leapfrogging) approach by directly entering into the final product development at the initial stage. Earlier, the company used to source core technological components from pioneering firms to develop the basic design.

When Samsung moved into the next stage of production, it wanted to develop the process technology on its own while securing the circuit design from abroad. This complex task required in-house R&D efforts. The workforce was engaged in rigorous training both at home and in the Silicon Valley to acquire the production technology. With such efforts, it was able to achieve its target in a short period. The dependency on imported technology began to decline gradually in the successive stages and by the early 1990s, Samsung became capable of designing the more advanced version of DRAM independently by outsourcing its R&D, mobilising its manpower and working under a strict time schedule to achieve the target. It may also be emphasized that the firm sought the help of the government for jointly undertaking research on such advanced versions.

However, in comparison to foreign firms, Samsung’s focus appears to be one-sided in nature. While, its competitors have the capacity to develop both memory and non-memory chips, Samsung lacks the capability to produce non-memory chips. Besides, the effectiveness of its R&D is not as strong as that of its rivals.

The technology acquisition process of Hyundai Motors has been through the step-wise approach. Starting with assembling of the knocked down parts, it has moved into the stage of designing its own model. Its technological alliances with
foreign firms have been varying with the changing nature of production requirements. Also, its dependency on foreign firms for core technologies has declined. It has devised various strategies in response to the demand in the international market and followed the patterns adopted by the leading firms.

Both the firms have adopted independent strategies for enhancing the quality of their products. Moreover, their learning practices have many similarities. Both have practised the major forms of learning in different stages. They have also been the most dynamic among the Korean firms in terms of R&D investment. The imposition of a crisis construction approach seems to have served as a means for expediting learning for them. International networking and joint research have offered them sufficient scope for exchange of knowledge in critical technologies, which in turn have been proved to be cost-effective, time saving and market conforming.

The successful process of technology acquisition and improvement in the first two decades helped Korea achieve an impressive growth in exports. By the end of the 1970s, Korea was relatively well placed among the less developed countries in the world export market. Its composition of export items was gradually changing towards more value-added products from that of labour-intensive goods. This was largely possible as a result of the government's policy initiatives and the response of firms to learn and utilise the imported technologies effectively.

Analysis of the technology intensity of total industrial exports for the initial phase reveals a notable increase in the share of HCIs in general and electronics sector in particular. It also brings into notice the decline in the share of labour-intensive industries over the period. Further, by classifying the export structure into three different categories for the period, the study has established the fact that medium-technology intensive products accounted for over one-fifth of Korea's total exports.
The study notes that the Korean firms resorted heavily to imitative practices and much of the products were designed by copying the technologies of developed nations in the initial stage. Considering that mere imitation is not an easy practice and it also requires consistent technological efforts from all the players involved in case of a developing country, the study gives credit to the firms for their performance as well as the government for its support through intervening heavily to overcome the market uncertainties. Only low-cost labour cannot always make such a big difference.

With respect to the figures on Korea’s market share in the total world export in the progressive stage, it is observed that among the three categories of LT, MT and HT products, the contribution of HT products is the highest. Perhaps Korea is one among the few latecomers with a greater share of HT products in world market. Over this period although the share of LT products in Korea’s total export has decreased by a larger margin, interestingly, it still accounts for a greater share than that of MT products in the world market. The export growth rate of both MT and HT products is amazing.

Further, to measure the technology intensity of exports more deeply, the study has calculated the share of the three sectors in Korea’s total exports in different years by choosing some selected products in each category. The account reveals a mixed trend for MT and HT products. For example, in the MT category, while the share of road vehicles has gone up, that of transport equipment has decreased. Similarly, in the HT category, office and data processing equipment is the best performer as far as its growth rate is concerned. Electronics equipment presents a fluctuating trend with a rapid increase in its share up to 1994 and then a slight decline. Data on the share of telecom equipment also offers a similar trend. But taking into consideration other external factors, it may be said that MT and HT products dominate the export structure of Korea.
Regarding the comparative advantage indicator, which in a way reflects the firm’s competence in price competitiveness, labour input and productivity growth, it is found that telecom equipment, road vehicles and office and data processing instruments have gained. A disturbing trend is observed in case of electronics and other LT products. Considering a few indicators on Korea’s international competitiveness, it can be said that as a late entrant its achievement rate is more than one would have expected. Its recognition both in the Global Competitiveness Report and the Human Development Report as a core innovator and technological leader is a testimony to its stupendous achievement.

In sum, Korean firms have been able to diversify into new products and increase their share in the international market within a very short period of time largely due to their focus on accumulating technological capability through creation of technical skills and learning. The export orientation of the industrialisation strategy has created a favourable environment for the firms to acquire technology by exposing them to international production network and competition.

In retrospect, the study has also observed several inherent weaknesses in the Korean development pattern. A few relevant issues, which have badly affected the growth potential, may be highlighted here. Also, some suggestions to overcome these bottlenecks can be put forward.

The industrial policy orientation is largely skewed towards the nurturing of the chaebol. The government’s deliberate attempt to foster these big conglomerates has resulted in an oligopolistic market structure. Although realising its mistake, the government has taken several measures to promote SMEs, these have not been up to the expectations. Most of the SMEs suffer from resource crunch, as their financial and technological needs have not been appropriately addressed. Instead, a larger proportion of the government funds and other incentives are directed toward the chaebol.
The development of SMEs requires less investment due to their smallness and involves less risk, as they are more adaptive to the changes in the market. The government must take this into consideration and concentrate more on the development of SMEs. The discriminatory incentive pattern in favour of the chaebol needs to be corrected and a fine balance should be made in the industrial policy to ensure equal treatment for both the chaebol and SMEs. In other words, the government must pursue a balanced industrial structure by allocating incentives to chaebol for specializing in final products and to SMEs for production of parts and other small components.

Too much leverage to the chaebol has resulted in independent and unchecked functioning of the chaebol. Rather than streamlining into core business, the chaebol over-diversified into several unproductive business practices and invested their financial resources, which they accumulated through debt in the late 1980s and early 1990s. One of the reasons behind this was the emerging threat of competition from others such as China and South-east Asian countries in the same products where the chaebol enjoyed advantage. Furthermore, the government’s policy of selective promotion led to the problem of overcapacity in some vital sectors. All of these factors partially contributed to the financial crisis of 1997-98. Since the crisis, initiatives have been taken to restructure the chaebol. Still it is felt that the reforms to restructure the chaebol need more attention.

Taking note of the increasingly competitive environment in the international market, there is a need for the government to increase investment in R&D. Though Korea’s ratio of investment to R&D is much higher than many advanced countries, its effectiveness in enhancing the innovation capability of the firms is comparatively low. One should remember here that Korea has already joined the club of industrialised countries, the OECD. Hence its industrial and technological development process should match the patterns of advanced countries. Emphasis
must be placed on cooperative R&D network, especially between the chaebol and SMEs, which will help reduce the cost of new product development.

Korea’s ‘National System of Innovation’ has undoubtedly brought some significant results. But, still it is thought to be in the formative stage and a lot more is to be done for further improvement. The universities are not well linked with the other private and government research units. Productive fundamental research, which usually takes place in universities, has been grossly neglected. The government should pay attention to integrate research network of Korean universities with other internationally acclaimed institutions. The inter-firm and intra-firm R&D networking also needs to be broadened.

The Korean firms have relied too much on the US and Japan for securing high technologies. In the wake of the growing protectionist stance from these nations towards transfer of core technologies, the firms must find some alternative sources by establishing and strengthening networks with other advanced foreign firms. It is also seen that Korea’s FDI is regulated in service sector which includes the IT industry. Acknowledging the growing importance of FDI as a powerful mode of technology transfer, it becomes essential for the policy makers to liberalise FDI in the IT sector.

To conclude, more qualitative changes in the engineering and technical education system will help in coping up with the requirements of the industrial facilities. Further investment in human capital and scientific and technical infrastructure building would be beneficial. Also, the debt ratio has to be kept at a sustainable level. This would help in directing more resources for technological development and reinforcing the growth potential of the industries.