Chapter 2
2. Korea's Industrialisation and Technological Development, 1961-81

BACKGROUND

The sudden, arbitrary and artificial division of Korea arising out of the understanding of the US and USSR and the turn of events leading to the emergence of two states with remarkable ethnic and linguistic homogeneity had unprecedented and disastrous consequences. The division of the peninsula, among other things "totally destroyed the inter-industrial and geographical complementarity that was existent to some extent under the colonial rule". What emerged as Republic of Korea in terms of effective administrative control, was cut off from badly needed raw materials and electricity as well as market for the agricultural produce. With only light industries on its side, it also had a rather lop-sided structure that was strained by the need to absorb the larger share of population.

Korea's paradigm shift in favour of export-led industrialisation in 1962 and the consequent impressive economic progress have been extensively analysed by scholars, policy planners and others cutting across the systems and nationalities. It is, therefore, not surprising that there is voluminous literature on the 'Korean Model'. Much of the literature has understandably focused on the unprecedented process of transformation.

However, there are studies that have had a closer look at ante state historical experiences especially during the colonial era of institutions and instruments of

the state, forms and features of capitalism, the extent and effectiveness of state intervention in socio-economic development, state’s support to public and private sectors even while recognising that Japanese colonialism’s objective was to exploit the human, agricultural and industrial resources to serve its interests to sustain and strengthen its industrial and military complexes and realize its multiple goals in the vast formal and informal colonial empire and beyond. This was evident in the deformed, distorted and dependent economy that Korea inherited when the Japanese colonial order collapsed.

Korea was primarily used as a supply base for food raw materials, finished products and labour force. The Japanese for their narrow colonial interests developed irrigation facilities in the South and mining and electricity in the North. According to Shinn-Rinn Sup et al, “In 1940, the North’s estimated share of heavy industry production was 86 per cent of the total for Korea. By 1944, it was producing 92 per cent of the total electricity power, 88 per cent of the fuel, 28 per cent of the mineral output and 82 per cent of the chemical output.”

The turn of events following the end of the colonial period, saw the US and the USSR taking control of the post-colonial situation in Korea. Although the American Military Government effective in the area south of the 38th parallel was primarily concerned with a whole range of political issues, it did promulgate a series of economic measures. For example, “it confiscated the Japanese investments. It also distributed government holdings formerly owned by the Japanese to almost a quarter of tenant population”. It has also been argued that the land reform initiated by the AMG “prevented the resurgence of the traditionally powerful land class and subsequently contributed to the formation of industrial and

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bureaucratic elites in the political and economic arena". The AMG also emphasized the “free market economy” and between 1945 and 1948 “poured a total of $410 million of economic aid in current prices to rescue the urgent economic situation with much emphasis on relief supplies”.

The outbreak of Korean War solidified Korea-US relations and the US became the crucial factor in the defense of the Republic of Korea as its assistance took several forms including massive economic aid. According to one estimate, between 1946 and 1952 Korea received $679 million of economic and military aid from the US. How significant was the US assistance could be seen from the fact that “during the 1952-61 period US donated 95 per cent of total foreign aid which amounted to some 8 per cent of Korea’s GNP, 71 per cent of total imports”. Nearly, 90 per cent of Korea’s manufacturing industries relied on foreign grants during the subsequent post-war reconstruction period of 1953-1960, almost half of the total government expenditure were financed by this foreign aid, as elaborated below.

The three turbulent years of the War ravaged the whole structure of Korea. In fact, it brought the largest devastation in the history of unified Korea for, out of the combined 30 million people at that time, 1.3 million people were recorded as killed and 2.8 million wounded. Non-military war damage to building and infrastructures equipment, furniture and other movable assets was estimated at over 400 billion won at July 1953 prices, US $3.1 billion at the implicit exchange rate for 1953.

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According to an estimate made by the Ministry of Commerce, war damage to manufacturing facilities was equivalent to 42 to 44 per cent of the pre-war facilities. As shown in another source, 57 per cent of the textile industry, 40 per cent of the food processing industry and 57 per cent of the metal industry were destroyed. To put it in other words, it destroyed majority of Korea’s industrial facilities. Particularly, industries like textiles, shipbuilding, printing and publishing located at Seoul-Inchon and Samchok areas suffered heavy damages.\(^8\) Immediately after the war there was acute shortage of capital goods and the manufacturing sector was in bad shape. By 1953, the manufacturing sectors' share in GDP reduced to 8 percent.\(^9\) Korea possessed all the distinctive characteristics of an underdeveloped economy.

Following the signing of the Armistice Agreement on 27 July 1953, which brought an end to the war, Korea was entrusted with the gigantic task of building the economy from scratch. Given its poor economic endowments, combined with the internal political chaos and social upheaval at the time, Korea had to rely completely on foreign assistance. The process of reconstruction and rehabilitation was undertaken with massive financial aid largely from the US and the UN. In the beginning it had to depend entirely on imports of manufactured goods that were financed by foreign aid as noted earlier.

The government policies soon focused on initiation of the industrialisation process with the production of consumer goods through the establishment of light industries and boosting of exports to finance the huge foreign exchange gap.\(^10\) The


\(^10\) Ibid.
foreign aid in the form of raw material or capital and production facilities was distributed directly to the producers at much cheaper prices. Procurement of these foreign aids meant huge profits and to easily access these aids, trade associations began to appear which could monopolise the procurement of aids in forms of raw materials. The profits gained in the industries based on foreign aid were not invested for improvement in production sectors.\textsuperscript{11}

In the course of the import-substitution industrialisation process large-firms accumulated their capital through profits in consumer good industries and access to foreign aid. Small and medium enterprise remained underdeveloped due to lack of managerial know-how and technicians and suffered from a sub-optimal level of production.\textsuperscript{12} It is important to mention here that all major economic decisions during this period were jointly made by the Korean government led by Syngman Rhee and the US aid mission to Korea (Office of Economic Coordinator). To effectively implement the import-substitution industrial policies, aimed at protecting and promoting the domestic industries, the government imposed high-tariffs, quota restrictions and rules for approval of imports. It also took several other measures such as financial market regulation and various quantitative restrictions to overcome the problem of progressive inflation of the currency.\textsuperscript{13}

The economic recession of 1956-57 and the subsequent decline in foreign aid to Korea threw many emerging domestic firms into bankruptcy and in order to withstand further deceleration, a number of mergers and acquisition of firms took place. This resulted in diversification of many firms and restructuring of the import-

\textsuperscript{11} Sung-Woong Hon and Jay-Hyung Kim, "Regional Development and Infrastructure Construction" in Dong-se Cha et al, n. 7, pp. 623-629.
\textsuperscript{12} Ibid.
\textsuperscript{13} Choong Yong Ahn and Joo-Hoon Kim, "The Outward-Looking Trade Policy and the Industrial Development of South Korea", in Dong-se Cha et al, n.7, p. 344.
substitute consumer goods industries. The rapid growth of chaebol and their significant contributions to the economic development in later decades can be traced to this period. Out of the ten largest chaebol, that dominated the industrial scene in the later phase, nine (except the Daewoo group) had already established their core companies in the 1950s.\textsuperscript{14}

Table 2.1: Composition of GNP by \textbf{Industrial Origin (1953–60)} (Unit:Percentage)

<table>
<thead>
<tr>
<th></th>
<th>1953</th>
<th>1955</th>
<th>1958</th>
<th>1960</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Fisheries etc.</td>
<td>48.2</td>
<td>47.2</td>
<td>44.6</td>
<td>41.4</td>
</tr>
<tr>
<td>Mining and Manufacturing</td>
<td>8.8</td>
<td>11.1</td>
<td>13.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Social Overhead</td>
<td>4.0</td>
<td>4.7</td>
<td>5.6</td>
<td>6.3</td>
</tr>
<tr>
<td>Other services</td>
<td>39.0</td>
<td>37.0</td>
<td>36.3</td>
<td>37.2</td>
</tr>
</tbody>
</table>


The overall growth rate of economy and export was discouraging despite a considerable growth of manufacturing output. While the contribution of agriculture to total output was 46.42 per cent in 1953 and 46.27 per cent in 1961, manufacturing’s share in the total output was 10.68 per cent and 20.35 per cent in the corresponding years. Taken as a whole, the share of heavy and light industry in total manufacturing was 4.26 per cent and 16.09 per cent respectively in 1961.\textsuperscript{15} Following the ISI strategy, the output grew at an annual average rate of 14.7 percent over the period 1954–59. The growth of GNP was dismal averaging 4.6 per cent per annum over 1953-59 that showed the failure of industries in generating


\textsuperscript{15} These figures are taken from Bank of Korea, \textit{Korea's Economic Indicators}, (Seoul: Bank of Korea, various years).
During 1959-1961, the economic and industrial performance remained stagnant at the level of 1959. Due to poor harvest and the student revolution and military coups in 1960 and 1961, the development process got derailed.

The period 1953-1961, from the point of view of industrial development, can be said to have passed through many ups and downs. But given the severity of the losses incurred during the war, whatever progress was made cannot be ignored. The reconstruction and rebuilding of the shattered economy was possible mostly due to foreign aid. It has been observed that as domestic savings was almost at zero level, about 70 per cent of all reconstruction projects were funded by foreign aid. In the same period, the amount of foreign aid received by Korea totalled 2.3 billion dollars, an average of 500 million dollars per annum.

Of these the official United States assistance constituted approximately 1,745 million dollars including 158 million dollars of PL 480 goods for good assistance. The American economic assistance averaged about 10 percent of Korean GNP between 1953 and 1960. Korea was able to recover by the time the aid was completely withdrawn. A look at Table 2.1 suggests that although there was some increase in mining and manufacturing sector’s share in the total GNP, Korea remained an agriculture-led economy.

The most notable thing, however, during this phase is the recognition of the development of human resources that could facilitate the process of industrial as well as economic development. Korea realised the fact that technological capability required for industrial development is embodied in human resources and human resource development, in turn, is impossible without providing education to the

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16 Moreira, n. 51, p. 33.
18 Ibid.
people. Hence it began to focus on the expansion of education at all levels. With the help of U.S. aid and its people's strong commitment to education, the overall literacy rate witnessed remarkable improvement by recording extraordinary growth. Enrolment at various levels of the formal education increased rapidly in this period.

The Scientific Research Institute established by the Ministry of National Defence in 1954, including some other research institutes, which in the later stage became the pioneering institutes for technology, began to engage in R&D activities. This institute played a key role in this period by producing scientists and engineers required for the defence sector and other industrial sectors.19

Also, thousands of Koreans were financed by U.S aid to take up overseas education and training. Many American defence experts trained the Korean military in modern concepts and techniques of management and organisation, as well as in operating and maintaining all types of machinery and equipment. Under the economic assistance programmes, senior government officials, business and academic personnel were sent abroad, mainly to the U.S., for training.

The direct transfer of industrial technology began with the inflow of technical advisers and a modest volume of project assistance. The U.S. military was the main source of transfer of technology as its local procurement programme offered assistance to producers in a number of sectors in the form of learning-by-doing to meet the exact product specifications. Construction, plywood and tyre manufacturing industries, which later became major exporters, greatly benefited from this.20 Such achievements at the educational and training fronts during this period encouraged the successive governments to emphasise on creation of

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adequate human resources. Also, it greatly eased up the task of accumulation of low-skilled labour force in the 1960s.

Korea embarked on a new pattern of economic development with the initiation of the First Five-Year Plan in 1962. In the next twenty years it witnessed the implementation of a series of industrial as well as economic policies, which were meant to pull out Korea from the shackles of grim poverty and generate substantial growth. Put differently, Korea was avowed to remove the tag of 'underdeveloped' being attached to it and become a self-sufficient economy by adopting an export-led industrialisation strategy during the time span of 1961-81. It is unanimously recognised that the pace of progress of the Korean economy during this period was amazing by any account.

Having discussed the developments of the phase prior to the 1960s, this chapter lays emphasis on first analysing the industrialisation process during the successive post-reconstruction industrialisation phase. As the central focus of the study is on technology, the chapter examines the strategies of the government and the industrial firms with regards to acquisition of technologies. Third, it gives special attention to the technology accumulation process of consumer electronics and steel sector. Finally, an assessment has been made to measure the contribution of technology in the overall economic growth relying on data collected from various sources. For this purpose the chapter is divided into five sections as discussed below.

2.1 ECONOMIC AND INDUSTRIAL DEVELOPMENT

2.1.1 The Beginning of Export-led Industrialisation (1962~72)

Assumption of power by General Park Chung Hee and the establishment of an authoritarian government marked a turning point in the modern economic
history of Korea. At the time of his taking over, the country was on the verge of acute poverty. Its economic condition was grim with uncertain future. The policy of import-substitution industrialisation implemented by the previous Rhee government turned out to be a major failure. There was scarcity of capital to carry out its industrialisation process. With a strong resolve to restructure the economy and remove the hurdles, the military regime began to implement policies for economic development under the encompassing ideology of ‘modernizing the fatherland’. Thus economic development became the main national goal.

To this effect, creation of appropriate institutions was seen as the foremost task. Accordingly, Economic Planning Board (EPB) was constituted in July 1961 and was entrusted with the multiple tasks of formulating economic policies and supervising its implementation. In addition, the Ministry of Finance (MOF) and Ministry of Trade and Industry (MITI) were expanded and strengthened. These two along with the EPB formed the nucleus of the developmental state.

The major objectives of these agencies were to (i) provide comprehensive economic development plans, devise long term goals, make projections for the entire economy; (ii) provide capital for investment through domestic and foreign capital loans, capital assistance for technological development specially research

and development; and (iii) act as mediator with MNCs for FDI and technology transfers, establish trade offices etc.\textsuperscript{23}

With the launch of the First Five-Year Plan in 1962, the government focused on the development of an economy by adopting an industrial strategy based on the principles of export-orientation (EO) model to achieve sustained growth. In other words, the policy of ‘nation building through exports’ was implemented. This new strategy did not mean that the IS strategy should be completely abolished. The government preferred to continue the promotion of IS industries wherever necessary. In particular, the government resembled a form of ‘guided capitalism’ in which the principle of free enterprise would be nurtured, but the government would either directly participate or indirectly render guidance to the industries.\textsuperscript{24}

Three different reasons could be identified as to know why it became inevitable for Korea to choose the strategy of export-oriented industrial development. First, it had poor natural resource endowment. Second, its domestic market for import-substitute products was too small. Third, being one of the densely populated regions in the world, Korea possessed abundant well-educated labor force that could be effectively used by positive government

\textsuperscript{23}Eun Mee Kim, “The Developmental Alliance for Industrialisation in East Asia: State and Business in South Korea and Taiwan” in Jeffery Henderson (ed.), \textit{Industrial Transformation in Eastern Europe in the Light of East Asian Experience}, (Hampshire and London: Macmillan, 1998), p. 191. The Deputy Prime Minister served as the head of the EPB.


The first plan envisaged to invest heavily in infrastructure and find financing for industrial investments by private firms that were willing to follow the norms set up by the government. In reality the five-year Economic Development Plans largely reflect the objectives of the industrialisation strategy.

Also see, Sang-woo Nam and Jun-II Kim, “Macroeconomic Policies and Evaluation”, in Dong Se Cha et al., n. 7, pp. 143-185. Prior to the announcement of this plan, the government unveiled the first Three Year plan (1960-62) and another Five Year plan for the period of 1961-1965. But these plans could not be implemented due to social and political disturbances caused by the 1960 Student Revolution and military coup.
policies for production of labor-intensive light export manufactures.\textsuperscript{25} Besides, the favorable international trading environment supported this strategy.

As export promotion became the central premise of the economic policy, several measures were implemented step-by-step. The nationalization of all commercial banks allowed the state to allocate monetary resources directly to manufacturing industries. The control over all the financial assets by the state made it easier for the planners to distribute resources to the major industries. Moreover, the Ministry of Commerce and Industry (MOCI) began to prepare complex export promotion policies every year. Monthly Export Promotion Meeting was initiated in 1965 to discuss the effective implementation of the export-led strategy and the performance of industries. This meeting served as a forum for government officials, businessmen, economists and policy makers to exchange views and discuss the institutional arrangements, legal and procedural issues for promoting exports and improving trade policies. In this way, a direct communication channel between the government and exporting firms was established.\textsuperscript{26}

The export-oriented industrialisation strategy resulted in heavy dependency of Korean firms on foreign raw materials and capital goods. In its attempt to fulfill these requirements of the industries, the government offered various incentives which included easy access to credit, tax favors, administrative supports, exemption from import duties on raw materials and intermediate goods meant for export etc. Some other incentives introduced to further reduce the difficulties of the companies were favorable exchange rate, loans against

\textsuperscript{25} The Federation of Korean Industries, n.8, pp. 169-172.
\textsuperscript{26} L.J. Cho and Y.H.Kim, n. 22, p. 21. Also see, Haeran Lim, Korea’s Growth and Industrial Transformation, (Hampshire and London: Macmillan, 1998), p. 63. The ministry had to set annual export targets by commodity as well as by region and country of destination.
<table>
<thead>
<tr>
<th>Plans</th>
<th>Broad Objectives</th>
<th>Avg. Economic Growth Rate</th>
<th>Avg. Export Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Five-Year Plan</td>
<td>Correct vicious circle of social &amp; economic aspects.</td>
<td>7.8 (7.1)</td>
<td>27.0</td>
</tr>
<tr>
<td></td>
<td>Expand basic industry and utilize idle resources.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Emphasize Science &amp; Technology.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Five-Year Plan</td>
<td>Modernization of industrial structure.</td>
<td>9.6 (7.0)</td>
<td>29.7</td>
</tr>
<tr>
<td></td>
<td>Improve basic infrastructure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Focus on technical education.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd Five-Year Plan</td>
<td>Maintain balanced growth &amp; stabilization.</td>
<td>10.1 (8.6)</td>
<td>29.3</td>
</tr>
<tr>
<td></td>
<td>Develop human resource.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th Five-Year Plan</td>
<td>Promote social development.</td>
<td>5.8 (9.2)</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td>Increase investment in S&amp;T and manpower planning.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Promote equity and efficiency.</td>
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</tbody>
</table>

Source: The economic objectives are compiled from various books on the topic. The figures are calculated from National Statistical Office, *Annual Statistical Reports*, (various issues) and Korea Development Institute, *Major Indicators of Korean Economy*, (various issues). The figures in parentheses indicate the target growth rate. Economic Development Plans and Growth Rate (in per cent)
preferential rates and reduced prices for electricity and railway transportation. However, enterprises failing in their duty to fulfill the obligations were subjected to heavy penalty.

The manufacturing sector was given ample importance and the government established a basic investment priority for it. As the domestic saving rate was very low, attracting foreign capital through Foreign Direct Investment (FDI) was necessary. The government made efforts to mobilise foreign capital as a result of which during 1962-1966 foreign saving (the sum of foreign aid, borrowing, and investment) contributed for around 60 per cent of the total investment of local firms. It also adopted measures to increase domestic savings. The administration also took several other measures including creation of special banks with public ownership. To encourage firms to compete in the world market, some imports were liberalized. However, the amount of FDI during this period was very low.

The first two Five-Year Plans (1962–1966; 1967–1971) were directed toward building a self-sufficient and modern industrial structure. The principal manufacturing industries established during this period included import-substitution industries like cement, synthetic fabrics, steel, machinery, fertilizers, oil-refining; and export-oriented light industries like electronics consumer goods, footwear, textiles and processed foods... all of which were low technology and labor-intensive in nature. Of these, synthetic fibres, fertilizer and oil refining, which were almost new industries in Korea, were developed at the Ulsan complex.

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27 E.S. Mason and others, n. 22, p. 129.
28 Ilpyong J. Kim and Uk Heon Hong, “The Republic of Korea: The Taming Tiger”, International Social Science Journal, (March, 2000, vol. 163), p.61-76. To increase domestic savings the government raised interest rates on saving deposits. Also see, The Federation of Korean Industries, n. 8, pp. 169-171. What may be considered as another significant step taken by the government was the normalization of relations with Japan in order to secure foreign loans necessary for industrialisation. At home, mobilization of domestic capital through compulsory savings, increased issuance of money and collection of taxes was given priority to support the establishment of industries.
29 The Federation of Korean Industries, n. 8, pp. 7-8. The import-substitution industries later on became the engine behind the outward-looking industrialisation.
with the assistance of foreign capital and external loan. With the protection granted to domestic assemblers, assembly of automobiles also started. It can also be said that in the first two plan periods groundwork was done for development of heavy and chemical industries and foundation was laid for machinery, ship building iron and steel and petrochemical industries.

2.1.2 Shift to Heavy and Chemical Industries (1972~1981)

Remarkable growth in exports was possible due to the rapid expansion of the labor-intensive industries in the 1960s. However, this also resulted in chronic trade deficit, as the industries remained dependent on imported machinery and raw materials. Also, the US decision to withdraw its troops from Korea following the Vietnam War forced the country to create defense industries. Moreover, protectionism in the industrialised countries, oil crises and a worldwide slump further deteriorated Korea’s balance of payment. All these factors led to a strategic shift in the industrialisation process, i.e., towards heavy industries.  

A new Heavy and Chemical Industry Plan was announced in 1973 soon after the introduction of the Yushin (Revitalizing) Reforms. In fact, this plan provided an opportunity to deepen the nation’s industrial structure, to switch over to capital and technology-intensive industries and to diversify the composition of exports to ensure steady growth. The goal of industrial restructuring through the implementation of the HCI plan was to complete the transition toward HCI by the beginning of 1980s. The targets set for this purpose included the following:

54 The various factors responsible for Korea’s drive towards HCI are discussed in Suk chae Lee, “The Heavy and Chemical Industries Promotion Plan (1973-77)”, in L. J. Cho and Y. S. Kim, n. 22, pp. 437-8. Also see I.J. Kim and U.H. Hyung, n. 8, pp. 65-67. As these authors note, ‘...in the New Year’s Message of 1973, President Park declared that the government would actively pursue the HCI drive between 1973-1978. This was to involve the equivalent of US$ 9.6 billion for six HCI projects, and it was a particularly ambitious plan given that exports in 1971 only equalled about US$ 1 billion’. Also see, M.H. Kang, The Korean Business Conglomerate: Chaebol Then and Now, (Berkeley: University of California, 1996), p.46. Because of the small size of the domestic market, the importance of economies of scale and huge capital requirement in the HCIs, the government formulated the Plan to deliberately promote an oligopolistic structure led by the chaebol.
the primary sector was to decrease from 25.5 per cent in 1972 to 15.9 per cent; the secondary sector was to increase from 26.3 per cent in 1972 to 42.9 per cent; and the tertiary sector was to decrease from 48.2 per cent in 1972 to 41.2 per cent. Moreover, the heavy manufacturing products would increase their share in the nation’s total manufacturing from 35.2 per cent in 1972 to 51.0 per cent in 1980.\footnote{These figures are taken from Eun Min Kim, n. 23, pp. 188-204.} Under the HCI plan six strategic sectors were selected for promotion as future leading export industries, viz. iron and steel, non-ferrous metals, shipbuilding, industrial machinery (including automobile) electronics and petrochemicals.

The government set targets that were to be accomplished by the end of the period. These included substantial increase in the share of HCIs in the national output as well as in the share of HCI products in exports; and establishment of six industrial estates for each strategic HCIs, namely, Kumi for electronics; Changwon 'base' for machinery and defense; Pohang for iron and steel (already established but production began in 1973); Ulsan, Ok-po and Chukdo for shipbuilding; Ulsan and Yeochun for petrochemicals; and Kunsan for non-ferrous metals.\footnote{Suk Chae Lee, n. 30, p. 432.} The reasons behind selecting these six sectors were to make use of most of the domestic resources, particularly of Korea's relatively abundant human resources and to attract foreign investments to finance these projects.

After the announcement of the Plan, the immediate job before the government became the allocation of financial resources to the HCI projects. It offered priority loans (through special banking arrangements) to investors in HCI projects and industry and even firm-specific incentives such as tax benefits, preferential interest rates etc. for the six strategic sectors. A National Investment Fund (NIF) was established by mobilizing pension funds and private savings. The
government allocated funds from NIF as subsidized credit to the firms.\textsuperscript{33} The interest rate was kept at low level artificially in order to reduce the cost of capital investment. In addition the government provided many newly built industrial sites to the private firms for undertaking the HCI projects except the iron and steel; and chemical sectors, which remained under public undertaking.\textsuperscript{34}

What may be considered, as one of the most important developments in this phase, is the establishment of the General Trading Companies (GTCs). The idea behind the government’s selective promotion of a few GTCs was to become internationally competitive by specializing in international trade and to appropriate economies of scale. Accordingly, a restricted number of large firms received administrative and financial privileges to operate in various fields of businesses. As many as thirteen newly designated GTCs set up new companies thus diversifying their activities in order to increase the groups’ respective exports share and meet the export targets.\textsuperscript{35}

The chaebol’s rise to prosperity can be easily said to have begun with such decision of the government to promote GTCs. By 1975, major projects were completed by the chaebol such as Hyundai, Samsung and Daewoo while the government-owned Pohang Steel Company, Korea Shipbuilding and Engineering and Korea Chemical Company expanded somewhat.\textsuperscript{36} Another consumer of steel, i.e. the automotive industry was developed by the initiatives of Daewoo, General

\textsuperscript{34} Suk Chae Lee, n. 30, p. 465.
\textsuperscript{35} M.H. Kang, n.30, p.50. The GTC is a large scale international trader whose products and markets are highly diversified. Also see, Byung-Nak Song, \textit{The Rise of the Korean Economy}, (Hong Kong: Oxford University Press, 1994), pp. 98-100. The Ministry of Trade and Industry established the legal framework in 1975 for the creation of GTC (following the Japanese model) in order to speed up export expansion. Samsung Trading Company was the first to be designated as a GTC. To get the benefits from the government, the firms had to achieve a minimum annual level of exports, which was raised at regular intervals.
\textsuperscript{36} John Woronoff, \textit{Asia's Miracle Economies: Korea, Japan, Taiwan, Singapore, Hong Kong}, (Seoul: Si-Sa-Yong-o-Sa Inc., 1986), p. 110.
Motors and Hyundai. The small and medium enterprises (SMEs) had to bear the brunt of government policy of favoring the Large Enterprises (LEs) and making economic adjustments. Besides, the LEs did not regard the genuine development of the SMEs as beneficial for themselves as a result of which the growth of SMEs was restrained.\textsuperscript{37}

At the same time the New Village Movement (Saemul movement) was carried out to modernize the rural areas. Better infrastructure facilities, promotion of agriculture sector and employment to the rural youth were the basic objectives of the movement. The government created electricity lines nationwide, extended roads, expanded other communication facilities and subsidized the purchase of farm machines and insecticides for the farmers. The movement succeeded in realizing the goals of increasing the income level and improving the living conditions of the rural people.\textsuperscript{38}

Promotion and expansion of the HCIs during this phase definitely resulted in significant changes in the industrial structure. At the end of 1970s it appeared that the economic structure of Korea was heavily dominated by a few chaebol. Although economic performance was noteworthy in the mid-1970s, serious distortions were visible by the end of the decade.

\textsuperscript{37}Haeran Lim, n. 26, p. 84.

\textsuperscript{38}B.N Song, n. 35, p. 137. Also see Pal Yong Moon and Kwang-Eon Sul, "Agricultural Policies and Development" in Dong Se Cha et al, n. 7, pp. 491-497. By an official definition, 'the Saemul Undong is a new community movement in which people cooperate with one another in order to construct better and richer villages and hence a richer and stronger nation'. Rural enlightenment, social and economic development were the three objectives of this movement.
### Table 2.3: Industrial and Technology Policies

<table>
<thead>
<tr>
<th>Industrial Policies &amp; Objectives</th>
<th>1960s</th>
<th>1970s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Adoption of Export-led Industrialisation</td>
<td>- Development of large-scale Heavy and Chemical Industries</td>
</tr>
<tr>
<td></td>
<td>- Promotion of Light Low-skilled Intensive Industries</td>
<td>- Financial and Administrative Support to Chaebols</td>
</tr>
<tr>
<td></td>
<td>- Improvement of Infrastructure Facilities</td>
<td>- Restriction on entry of Foreign Firms</td>
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<tr>
<td></td>
<td>- Financial incentives to Industries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Textile &amp; Clothing, Fertilizer, Electronics mainly Black &amp; White</td>
<td></td>
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<tr>
<td></td>
<td>- TV, Radio etc</td>
<td></td>
</tr>
<tr>
<td>Major Industries &amp; Export Items</td>
<td>- Textile &amp; Clothing, Fertilizer, Electronics mainly Black &amp; White</td>
<td>- Fertilizer, Steel, Electronics such as Color TV, VCR, Shipbuilding, Industrial Machinery</td>
</tr>
<tr>
<td></td>
<td>- TV, Radio etc</td>
<td></td>
</tr>
<tr>
<td>Technology Policies &amp; Institutional Mechanism</td>
<td>- Building up Technological Infrastructure</td>
<td>- Promotion of Government Research Institutes (GRIs)</td>
</tr>
<tr>
<td></td>
<td>- Initiation S&amp;T Education</td>
<td>- Deepening the Process of Assimilation and Adaptation of Imported Technologies</td>
</tr>
<tr>
<td></td>
<td>- Implementation of Long-term S&amp;T Development Plan</td>
<td>- Establishment of strategic Industrial Technology Research Institutes in the selected HCI</td>
</tr>
<tr>
<td></td>
<td>- Emphasis on Assimilation of Imported Technologies</td>
<td>- Recognition of R&amp;D</td>
</tr>
<tr>
<td></td>
<td>- Establishment of MOST through S&amp;T Promotion Act and KIST.</td>
<td>- Strengthening Linkage between demand and supply of Industrial Manpower</td>
</tr>
<tr>
<td></td>
<td>- Establishment of Cooperative R&amp;D Fund.</td>
<td></td>
</tr>
<tr>
<td>Technology Accumulation Strategies of Firms</td>
<td>- Technology Acquisition through import of capital goods and turnkey plant</td>
<td>- Technology Import through Licensing Agreements</td>
</tr>
<tr>
<td></td>
<td>- Emphasis on Learning-by-doing Approach</td>
<td>- Improvement of Assimilative Capacity through Reverse Engineering</td>
</tr>
<tr>
<td></td>
<td>- Focus on On-the-job training by Foreign Expertise</td>
<td>- Emphasis on Learning-by-observing Complex Technologies</td>
</tr>
</tbody>
</table>

Source: Prepared from various sources.
2.2 FEATURES OF TECHNOLOGY POLICY

2.2.1 Technology Policies and Institutional Mechanisms

From the beginning of the development process Korea has acknowledged science and technology as essential components of industrialisation. The patterns of technological development have closely followed the industrialisation process and the economic development plans. In other words, "Korea's scientific and technological development directly mirrors its stages of industrialisation."39 The analyses in chapter 1 suggest that in any economy the building of scientific and technological capabilities is determined by a set of policies it adopts and implements.

Simultaneously, with the formulation of the First Five-year Plan in 1962, the EPB published a report on the status of Korea's technological development. In the assessment of this report Korea was characterized as 'technologically underdeveloped'.40 Recognising this fact, the government immediately took steps to devise technology policies as per the requirements of its export-led industrialisation strategy. A Technology Management Division was established within the EPB and was given the task of drawing a comprehensive S&T plan.

To support the process of industrialisation at the first stage, the leadership and policy makers devised a complementary two-pronged strategy to increase Korea's absorptive science and technology capabilities. This was to be sought (i) by the acquisition of foreign technology and (ii) through building up a domestic science and technology infrastructure, both by expanding and improving Korea's

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40 Cited in Jin W. Cyhn, Technology Transfer and International Production: The Development of the Electronics Industry in Korea, (Cheltenham, Northampton: Edward Elgar, 2002), pp. 112-113. The major factors responsible for this underdevelopment were lack of comprehensive administrative system, lack of appropriate institutes, inadequate educational facilities and inactiveness of the government.
indigenous scientific and technical education. As a result, a plan entitled as the "First Five-year Technology Development Plan" was launched in 1962 to deal with the demand and supply of technical manpower, technology transfer and the national system of S&T development. It also included plans about strategic fields of R&D and international cooperation. Based on a national survey of manpower the Technology Management Division also announced a Five-year 'Human Resource Development (HRD) Plan'. 41 Also keeping in mind the necessity of science education, the government imposed a tight quota system for college enrollments in order to change the ratio between the arts and science (and engineering) students.42

The Korea Institute of Science & Technology became the first major institute established under the HRD Plan in 1966. The KIST was also the first comprehensive and interdisciplinary research institute in the field of industrial technology. Its main task was to serve as the principle agency for industrial research in order to eliminate the bottlenecks and to give impetus to the growth of industrial sectors. 43 After doing a survey which covered 600 industrial plants in 25 industrial sectors to find out the needs of Korean industries, KIST identified key areas such as materials and metallurgical engineering, food technology, chemical

42 Ha Joon Chang, "Institutional Structure and Economic Performance: Some Theoretical and Policy Lessons from the Experience of the Republic of Korea", Asia Pacific Development Journal, (Vol.4, No.1, 1997), p. 51. For example, the universities in Korea produced 0.4 'science' students for each 'arts' student. The composition began to change after the issuance of the Executive Order on University Enrolment Control in 1965 and by 1980 the ratio was brought to 1 to 1.
engineering, electronics, mechanical engineering and industrial economics and management for concentrating its research activities. On the other hand, the Ministry of Science and Technology (MOST) was established through the ‘Science and Technology Promotion Act’ in 1966 to coordinate and promote S&T policies and activities. The missions of the MOST were as follows: (i) integrated general planning for S&T development, (ii) coordinating functions of test, survey and research, (iii) international cooperation on S&T and (iv) research and utilization of atomic energy. Empowered with the assignment to devise S&T policies for national development, MOST announced the ‘Long Term Plan for S&T Development’ (1967-1986). The objectives and targets of the plan are mentioned in the table below (Table 2.4).

### Table 2.4 MOST’s Initial Targets and Objectives

<table>
<thead>
<tr>
<th>Major Objectives</th>
<th>Major Industries and Technologies Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Transfer, adoption and diffusion of foreign technologies;</td>
<td>1. Metal and ceramic materials technology;</td>
</tr>
<tr>
<td>2. S&amp;T related human resource development;</td>
<td>2. Design technology in machinery and chemical engineering;</td>
</tr>
<tr>
<td>3. Support private R&amp;D activities; and</td>
<td>3. Electronics material technologies; and</td>
</tr>
<tr>
<td>4. Development of specific technologies based on international division of labor.</td>
<td>4. Agricultural breeding and processing; and ocean technology.</td>
</tr>
</tbody>
</table>


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45 Sun G Kim, n.41, p. 11. Among developing countries Korea became the first nation to have a ministerial level administration for science and technology. However, during the 1960s the implementation of S&T policy by and large came under the purview of Economic Planning Board with partial participation of the ministry of commerce and trade in policy making.
The Plan also recommended that the share of national R&D investment in GNP should be raised to 0.5 per cent in 1967 to 2.5 percent in 1986 and the number of professional researchers should be increased from about 4,000 in 1967 to about 50,000 in 1986.\textsuperscript{46} In line with the objectives of the plan, the MOST emphasized on the establishment of industrial research institutes.

As already mentioned, KIST was established prior to the emergence of MOST. Supported fully by the government, KIST took the leading role in developing and upgrading Korea's industrial technology in the 1960s and 1970s. Its wide spectrum of tasks ranged from helping in the diffusion process of imported technology to serving as a problem-solving, contract research association. It also succeeded in reversing the brain drain, by providing attractive benefits to the top-quality Korean scientists and engineers working abroad.\textsuperscript{47} These highly skilled personnel were involved in separate areas of research and enormously contributed to the improvement of Korea's technological infrastructure. In addition, KIST also undertook a number of studies of Korea's technology development potential, which in later years provided valuable inputs to the formulation of national science and technology policies.

Noting that KIST alone could not meet the demands rising out of the need for developing adequate absorptive capabilities (especially after the HCI Plan), the government accelerated its efforts to build more S&T institutions. As a result, a number of 'satellite institutes' each having specialization in an area of industrial priority such as ship building, machinery, chemicals, telecommunications, energy conservation and marine science were established with financial assistance from

\textsuperscript{46} Ibid, p.12. Although by 1986 a substantial increase in the number of researchers in the field of S&T was noticed the ratio of R&D expenditure to GNP did not reach the recommended level. The ratio of expenditure to GNP was 1.73 % in 1986.

the government and granted autonomy in their functioning.\textsuperscript{48} Since their establishment these specialized institutes have been undertaking broad range of qualitative research and producing expertise in the related fields.

A new graduate school of engineering and applied sciences, the Korea Advanced Institute of Science (KAIS) was set up by a special presidential decree in 1971. KAIS, under the jurisdiction of MOST, was assigned with the task of cultivating top-line scientists and engineers through training to improve scientific and technological education and to fulfill the demand for high-skilled technicians required by the industries. It became the first university to be asked by the government to start a special programme, which would train professional engineers and contribute to the industrial development.

These graduates had to be capable of creating original designs of manufacturing plants initially in petrochemical and machinery industries.\textsuperscript{49} Also another major institute, the Korea Science and Engineering Foundation (KOSEF) was established in 1977 to conduct basic research. Soon it began to play an important role in bringing about closer cooperation between graduate schools, research institutes and the industrial sectors.

The establishment of these institutions was followed up by the promulgation of a series of legal provisions for development of technology. A series of fundamental laws aimed at providing support to the policy leadership were implemented. These included the ‘Law for the Industrial Technology Promotion’ to facilitate technology development activities of private enterprises by providing various financial tax privileges; ‘Engineering Services Promotion

\textsuperscript{48} See for detail APCTT, n. 44, pp. 97-99.

\textsuperscript{49} Ibid, pp.49-51. Also see, Young-Gul Kim, “Innovation and the Role of Korea’s University”, in Branscomb and Choi (eds.), n.47, pp. 128-129. The KIST and KAIS were merged and formed the Korea Advanced Institute of Science & Technology (KAIST) in 1981 to integrate high level research with quality education. But KIST became independent again in 1983.
Law’ to further the improvement of plant engineering and to ensure quality performance for professional engineers; ‘Law for the Development of Specially Designated Research Organisation’ to provide help and assistance to R&D institutes such as KIST and KAIST; and the ‘National Technical Qualification Law’ to raise the professional standard of engineers and technicians through an examination and certification system.50

2.2.2 Channels of Technology Transfer

At the outset of its export-oriented industrialisation process, Korea lacked technological capacity to carry out its ambitious plans. It had to rely solely on imported technology. Given the several modes, by which foreign technology could be imported, the government had to make appropriate judgement over selection. As discussed earlier (in chapter 1), the major means available for any developing country to import technology are foreign direct investment (FDI), foreign licensing (FL), joint ventures, import of capital goods and turnkey plants and technical consultancy.

With the implementation of the Foreign Capital Inducement Law in 1966 the process of technology imports began. During the early stage of industrialisation, a decision was made to acquire technology through import of capital goods and turnkey plants.51 Although Korea's policy on foreign direct investment (FDI) was quite free and liberal allowing any form of foreign capital

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50 The laws are discussed at length in APCTT, n. 44, Chapter 2.

Another important law, i.e., the Engineering Export Promotion Service Law also came into effect to facilitate transfer of technology. Under the provision of this law, a number of agreements between foreign and Korean firms were concluded which in turn helped the later to seek foreign engineering services in critical areas.
with various incentives, it could not attract much foreign investment due to doubts over political stability and uncertain economic future. The policy on Foreign Licensing (FL) was quite restrictive in the 1960s but helped some local licensees to bargain in purchasing generally known matured technologies. Such a policy in the DFI and FL was adopted at that time because Korea faced a serious shortage of foreign exchanges.

These policies were reversed in 1970s in the wake of the industrial policy shift towards capital-intensive sector. The government tightened its control over FDI to weed out the fear that excess flow of foreign investment would have an adverse effect on its domestic economy. FDI was permitted only in the case where other alternatives of obtaining the technology or gaining access to world markets could not be sought. The principal sectors to attract FDI were textiles and apparels, chemicals, electrical and non-electrical machinery.

As demand for complex technologies that were not available from domestic sources peaked up, Korea had to bring in foreign technologies through various formal and non-formal mechanisms other than FDI. Restrictions imposed on FL in the 1960s were eased to allow transfer of sophisticated technologies with high royalty rate. The industries accounted for the major share of FL were the shipbuilding and machinery sectors. The electronics and automobile industries also resorted, though to a lesser extent, on FL for technology acquisition.

Technology transfer through procurement of turnkey plants and made-to-order capital goods continued like in the 1960s. To fulfil the demands of a rapidly growing and diversifying industrial sector, massive amount of capital goods embedded with built-in technology were imported which increased the investment

53 Ibid.
in production facilities. Imports of capital goods were more than 20 percent of the total value of investment in Korea.

It can be observed from Table 2.5 that technology import in the form of capital goods far surpassed other means of technology throughout the period. For instance the investment made to acquire foreign technology by means of capital goods imports was more than 22 times that of all other categories combined. Although Korea's FDI steadily increased from $ 47.4 million during the First Five Year Plan (1962-1966) to $ 720.9 in the Fourth Plan (1977-81), it had the lowest level of reliance on FDI among other developing countries, such as Brazil, Singapore, Hong Kong, Taiwan, etc. with the exception of India.54

Table 2.5 Modes of Technology Transfer to Korea (in Million Won)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign Direct Investment</td>
<td>47.4</td>
<td>219.0</td>
<td>879.4</td>
<td>720.9</td>
</tr>
<tr>
<td>Foreign Licensing</td>
<td>0.8</td>
<td>16.3</td>
<td>96.5</td>
<td>451.4</td>
</tr>
<tr>
<td>Technical Consultation</td>
<td></td>
<td>16.8</td>
<td>18.5</td>
<td>54.7</td>
</tr>
<tr>
<td>Capital Goods Import</td>
<td>316</td>
<td>2,541</td>
<td>8,841</td>
<td>27,978</td>
</tr>
</tbody>
</table>


The royalty payments for FL increased from $ 0.8 million to $ 451.4 million over the same period. If the share of countries exporting technologies to Korea during the period 1962~1981 is taken into account, Japanese technology accounted for 57 per cent of the total foreign sources. Out of the 1,977 cases of

54 Ibid.
imports in Korea, Japanese firms accounted for 1,125 cases. The USA was at the second place followed by West Germany, England and France respectively. The machinery sector registered the highest amount of technology imports followed by electronics and communication sectors respectively. The reason for Japan's dominance in supplying technologies could be (i) close proximity of Korea to it; and (ii) the similar patterns of industrialisation and technology acquisition by Korea and Japan.

2.3 INTERNALIZATION OF IMPORTED TECHNOLOGIES

2.3.1 Strategy of the Government

Once technologies are imported in various forms, the most formidable task to be carried out simultaneously is the process of building the capacity to absorb, assimilate and adapt these technologies. Such capacity rests in the workforce of the nation where both the government and private enterprises have to play their role. In this regard the main duty of the government is to provide training and technical education to the workforce and to facilitate learning.

The technologies imported for the industries in the 1960s were very simple in nature. The main task of the labor force was to know how to operate the machines. The industries were basically labor-intensive and Korea had a well-educated labor force. So it did not have much difficulty in assimilating these foreign technologies. Moreover, most of the local firms’ participation in the assembly-type electronics industries (which involved relatively better technologies) was quite insignificant in this phase. Foreign firms dominated this sector.

55 See Table 3.10 (on payment for technology transfer and by nation) in Chapter 3 of this study.
When the emphasis of industrial development shifted to capital-and-technology intensive sector, the nature of imported technologies became more complex. Most of the technologies were imported in the form of capital goods and composed of tacit elements. It required highly skilled personnel to understand and assimilate such technologies and diffuse them to the various industries. In realization of such necessity, the government focused on expanding technical and engineering education and emphasizing research and development (R&D) in the related fields.

As noted earlier, three premier Government Research Institutes (GRIs) KIST, KAIS and KOSEF and some other specialized research institutes, in the areas where HClS were concentrated, took the challenging job of national technological capability building. In an effort to receive and host these GRIs, the construction of Daeduk Science Town began in 1973. Apart from giving directions to the development of high quality human resources, their functions involved assisting firms in learning foreign technologies as well as diffusing such technologies.

The government took steps to encourage students towards vocational and technical education. After the establishment of KAIS, graduate education was extended further to science and engineering and strengthened through the establishment of more graduate schools. The government strongly encouraged vocational training through implementing the Vocational Training Law (enacted in 1966) and made vocational training compulsory in 1974 for all industrial firms.

56 These included the Korean Ship Research Institute, the Korean Electronics Technology Research Institute, the Korean Machinery and Metal Research Institute, the Korean Institute of Chemistry and the Ocean Development Research Institute.
with 300 or more workers. This 'compelled firms to train a certain number of skilled workers, proportionate to the number of regular employees: if they failed to carry out this duty, then they were obligated to pay contributions to commit the public vocational training programs'. In addition, a number of technical high schools, junior technical colleges, specialized technical schools and four-year engineering colleges were established resulting in quantitative expansion in enrolment rates.

In order to promote cooperative R&D among the GRIs, universities and industries, the government provided financial support by establishing the Cooperative R&D Fund in 1967. Since private firms had to pay only 30-40 per cent of the total project expenses, it encouraged them to participate in cooperative R&D. However, the 'Technology Development Reserve System' started in 1973 was the most extensive financial support policy by the MOST. It had a tax deduction plan for firms' R&D investment from the earmarked reserves. It required firms to reserve a certain amount of income for R&D investment and the amount actually used for R&D investment was to be deducted from the corporate income tax base. The amount of reserves is up to 20 per cent of the total income of the year and it must be used within two years.

This reserve fund could be used for all activities such as assimilation of imported technologies, information gathering, training manpower etc. The sectors targeted for the reserve funds were manufacturing, construction, mining, computer processing, military supply and machine engineering. Under this

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Under this law many firms established their own vocational training institutes to train at least 10 per cent of their workforce each year.
system 80 firms received a total of 3,000 billion won in 1973 and in 1978 and 163 firms used a total of 30,500 billion won.\(^{58}\) In addition, to provide fund for technological development, the Korea Development Bank initiated the Technology Development Loan System and the Industrial Technology R &D Consortium system was introduced to promote cooperation among firms. The government also enacted the specialized Research Institute Law in 1973 with legal provisions for government financial support and free lease to national assets. Preferential participation rights were extended in national research projects and research equipment were freed from custom duties. Greater autonomy in their function was granted to new research laboratories.\(^{59}\)

The government also introduced the information and documentation services with the enactment of "Policy and Strategy for Science and Technology" document prepared by MOST. The objectives of these services included provision of access to information through library service and providing assessments, interpretations and analysis and facilitating exchange of technical information as and when the industries needed.\(^{60}\) Accordingly, the government set up information gathering institutes of which the most important was the KOTRA (Korea Trade Investment Promotion Agency). Established in 1962, this Agency served as a forum for various trade promotion activities, such as trade-related information, market research services and business matchmaking. Besides, it also supplied foreign buyer contacts, product samples and publications. Another institute, the Korea Research and Development Information Centre (having its ten

\(^{58}\) This paragraph and the above heavily draw from Kim, Sun G, "S&T Promotion Policy and the Incentive Scheme for Technological capability Building in Korea: Facts and Characteristics", in STEPI, n. 41, pp. 70-73. Also see, Jin W. Cyhn, n. 40, pp.116-117.

\(^{59}\) Choi Young-Whan and Byoong-kyu Lee, "The Importance and Needs of Public Laboratories", in Branscomb and Choi (eds.), n. 47, pp. 144-145.

\(^{60}\) APCTT, n. 44, pp. 77-78.
regional centres worldwide), began its operation to help disseminate the new production methods.  

For the transfer of technical knowledge theoretically embodied in various technology related journals and periodicals, on-line computer systems was seen as a way to collect, process and disseminate information across the firms with the help of technical information services. To give an example, Technology Transfer Center (TTC) at KIST was established in 1976 to act as an advisor to the Government on technology import policy-making and provide information, assistance and advice to industries on all related aspects of technology transfer. The TTC maintained close links with advanced information centers of USA, Japan, Europe and the UN system to facilitate information acquisition. It had compiled information on more than 20,000 technologies by 1979.  

Several large firms or Chaebol, which began to play a dominant role after the introduction of HCI Plan, were selectively chosen to undertake joint research with KIST. Such research helped them in acquiring prior knowledge about the technology to be imported and successfully assimilating and adapting it. Besides, other government research institutes also engaged in cooperating with firms to develop technology and improve their R&D ability by bringing back Korean scientists, engineers and entrepreneurs from abroad. The chaebol were also allocated maximum possible resources to speed up their acquisition capability so as to compete in the international market. With favourable incentives and

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61 Cyhn, Jin W., n. 40, p.133.
KOTRA has set up about a hundred trade centres around the world for this purpose. As in the later stage the chaebol established their own outposts abroad KOTRA'a role changed. But it still remains a key source of information for government and the SMEs.
62 Ibid.
The KIST played an important role by assisting the firms to develop technologies for black & white television sets, telephone and calculators which were major technology-intensive export items of Korea during this phase. One interesting factor to notice was the funding pattern of KIST for corporate/contract research. From the early 1960s to the early 1970s, government accounted for the bulk of the funding. But by the late 1970s, about 60-80 percent of KIST's funding was contributed by the private sector. See, Jin W. Cyhn,, n. 40, p. 122.
preferential treatments obtained from the government, the chaebols were in most advantageous position to draw best quality human resources, to identify, negotiate and finance foreign technology transfer. By the end of 1970s, Korea had the largest textile plant, the largest plywood plant, the largest shipyard, the largest cement plant and the largest heavy machinery plant in the world.64

Further, the acquired foreign technology needed to be effectively distributed across the industries within the economy even in the early years. The government promoted the distribution process through specialized agents such as capital goods producers, engineering consulting firms, and public research institutes. The Engineering Service Promotion Law of 1973, which stipulated that all engineering projects, if possible, should be given to local firms as major contractors with foreign partners as minor participants, helped in the development of local consulting engineering firms thus providing them with opportunities to learn from experienced foreigners.65 Foreign personnel were also employed in different foreign and indigenous firms introducing new production process, managerial know-how and financier expertise.

Table 2.6 shows that the total R&D expenditure increased steadily from 2.1 billion won in 1965 to 282.5 billion won in 1980. In terms of share the government made major contribution during this phase. But over the years from 1963 to 1980, the state's share of total R&D witnessed a declining trend. With the help of financial and preferential incentives offered by the government the number of corporate R&D centres increased significantly, i.e., from 1 in 1971 to 54 by

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1980. Also, share of R&D investment to GNP increased considerably from 0.26 per cent in 1965 to 0.77 percent in 1980.

Table 2.6 R&D Expenditures in Korea (1965-1980) (Unit: W Billion Won, %)

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<thead>
<tr>
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<tbody>
<tr>
<td>R&amp;D expenditure</td>
<td>2.1</td>
<td>10.5</td>
<td>42.7</td>
<td>282.5</td>
</tr>
<tr>
<td>Government (G)</td>
<td>1.9</td>
<td>9.2</td>
<td>30.3</td>
<td>180.0</td>
</tr>
<tr>
<td>Private sector (P)</td>
<td>0.2</td>
<td>1.3</td>
<td>12.3</td>
<td>102.5</td>
</tr>
<tr>
<td>Ratio(G:P)</td>
<td>61:39</td>
<td>97:03</td>
<td>71:29</td>
<td>64:36</td>
</tr>
<tr>
<td>R&amp;D/GNP</td>
<td>0.26</td>
<td>0.38</td>
<td>0.42</td>
<td>0.77</td>
</tr>
<tr>
<td>-R&amp;D Exp. of Manuf. Sector</td>
<td>N/A</td>
<td>N/A</td>
<td>16.7</td>
<td>76.0</td>
</tr>
<tr>
<td>-Per cent of sales of Manuf. Sec.</td>
<td>N/A</td>
<td>N/A</td>
<td>0.36</td>
<td>0.50</td>
</tr>
<tr>
<td>No. of Researchers/10,000 Pop.</td>
<td>0.7</td>
<td>1.7</td>
<td>2.9</td>
<td>4.8</td>
</tr>
<tr>
<td>No of corporate R&amp;D Centers</td>
<td>0</td>
<td>1</td>
<td>12</td>
<td>54</td>
</tr>
</tbody>
</table>


2.3.2 Strategy of Firms

The discussion on the strategies and policies adopted by the government for internalizing the imported technologies led to the postulation that the role of the state was vital. But ultimately it is the industry that has to pay even greater attention to reap the imported technologies effectively. It is, therefore, necessary to focus on the strategies adopted by the firms to learn and use the technologies.

To reiterate, during the two decades of 1960s and 1970s, the major industries in Korea were textiles and apparels (small-scale industries) machinery, chemical, fertilizers, cement, steel, electronics and shipbuilding (big industries). However, the limitations of the study do not permit us to discuss each sector individually. Hence, a general analysis of the technology accumulation strategies
by the major industries is presented in the following few paragraphs. The most important sector of consumer electronics has been dealt in a different sub-section.

The identification of foreign technologies and the negotiation for it had been carried out according to the nature of industries. So the pattern of technology transfer differed slightly across industries. The vital unit production industries, such as shipbuilding and machinery focused on developing capability to design and manufacture products. For the initial erection of production facilities and design of products, they chose to import technologies in the form of foreign licensing and technical consultancy. For instance, between 1962 and 1981, the machinery industry accounted for almost half of all technology imports (by number) but barely 10% of total domestic value added. However, small units involved in shipbuilding and machinery sectors at the beginning relied on their own efforts to establish their production facilities with limited technologies available in their hands and later on upgraded their production system through imitative reverse engineering of foreign products and processes.

As the case study of Hankook by Enos and Park (later in 1976 merged with the Daewoo Machinery Company) points out, Hankook for the production of diesel engines entered a license agreement in 1970 with Germany's MAN, Augsburg. Under this agreement the licensor MAN authorized Hankook to manufacture diesel engines, to contact third parties for parts, to market the engine throughout Asia except in India and Turkey and to manufacture and market single parts as spares for the engines. When the diesel engine plant designed by the German engineers began its production in 1975 (by the time it came to know as Daewoo engine), the demand for local diesel engine was insufficient as most of

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the vehicles were dependent on imported engines, which were superior in quality.\textsuperscript{67}

To enhance the quality of the engine, Daewoo began to work with KIST and MAN for seeking solution to its technical problems. Finally, after a year Daewoo overcame the problems and by 1978 the domestic market for medium size engines was being entirely supplied by Daewoo. The Korean engineers made further improvements in production and design by acquiring training from MAN.

In mass production industries such as electronics and automobiles, which produce less differentiated products, the large firms were dependent on foreign licensing but comparatively lesser than in shipbuilding and machinery industries. Many firms at the domestic level opted for technical assistance agreements with leading foreign firms to secure packaged technology (including assembly processes, product specifications, production know-how, training local technical personnel, and component parts) for setting up their initial production facilities. Once the technologies were acquired for the assembling of imported components required only engineering efforts. Then the production and product design technologies were diffused within the country with the help of experienced technical personnel from existing firms to new firms.\textsuperscript{68}

For improving the products and creating new designs with idea, the firms also began to focus on research and development. Small firms in the automobiles sectors depended heavily on foreign licensing to get technical assistance and information for the production of sophisticated vehicles and parts. Industries such as chemicals, cement and steel, which produce the least differentiated products in highly capital-intensive processes, were initially established on turnkey basis by

\textsuperscript{67} J.L. Enos and W.H. Park, n. 51, pp. 147-175.
\textsuperscript{68} Linsu Kim and Hosun Lee, n. 66, pp. 266-268.
western firms. The foreign engineers and technicians engaged in the turnkey plant provided on-job training to the local personnel on skills of maintaining and operating such process-oriented industries and helped in developing the production capability of domestic entrepreneurs.

The local firms, however, adopted deliberate strategies to acquire capability not only for the operation and maintenance of process technologies but also for creating and developing new plants. Such efforts helped the firms to consistently improve the quality and increase their productivity. Over the years they became capable of managing on their own.69 For instance, many large pharmaceutical firms in Korea, in the beginning, started as small importers/dealers of packaged imported drugs and then entered the drug manufacturing business by packaging imported bulk drugs. Later on they gradually moved into production designs and applied the designs to their own production process.

The petrochemical industry in Korea heavily relied on foreign capital. Except one all petrochemical plants set up in the Ulsan Petrochemical complex were built as joint ventures between a Korean firm and a major petrochemical company either from the US or Japan. The projects were undertaken on the basis of sharing equally the equity ownership of the joint venture 50-50 with the Korean government. Under the contract, the foreign firms were to invest half of the capital and provide technology while the government firms had to provide the other half of the capital, the site and most of the personnel.70 In case of the Chungju Fertilizer Company, which signed agreement with DOW Chemical Company for joint venture; DOW had to provide the 'know-how' techniques, exchange all technical information to the domestic engineers to such an extent

69 Linsu Kim, n. 64, p. 365.
70 Enos and Park, n. 51, p. 48.
that they could become able to design the basic plant and produce individual
equipment.\textsuperscript{71}

2.3.3 Technology Acquisition of a Public Sector Enterprise

The technology acquisition strategy followed by the Pohang Steel Company (POSCO) offers an interesting account. It provides an example of how a fully government-owned enterprise learned and mastered the imported technologies in the shortest possible time. In fact, the government intended to use the company as an instrument of its industrial policy.\textsuperscript{72} When the construction of the first phase began in 1970, POSCO did not have even the minimum amount of technical knowledge of steel making on a large scale. To secure the technology, it signed an agreement with the so-called Japan Group, comprising of the two giants, Nippon Steel Co. and the Nippon Kohan.\textsuperscript{73}

As per the provisions of the contract, the ‘Japan Group’ was to supervise the construction work and plan lay-out, assist in the planning of operation, inspect the progress, provide training to engineers and specialists for the construction of the integrated steel mill and on-site assistance for start-up and operation.\textsuperscript{74}

\textsuperscript{71} Ibid., pp. 63-64. For detail on technological development strategy of the petrochemical industry see, pp. 59-113.


\textsuperscript{73} POSCO was established in 1968 with arrangement of $ 30 million from the war reparation fund and $ 50 million from Japan’s Export-Import Bank. See D’Costa, Anthony P., “State, Steel and Strength: Structural Competitiveness and Development in South Korea”, Journal of Development Studies, (Vol. 31, No.1. October, 1994), p. 57.

\textsuperscript{74} Enos and Park, n. 51, pp. 178-179.

According to Amsden, two points about the technological alliance with the JG are noteworthy. First, as admitted by POSCO, the JG in the name of friendship and economic development was very enthusiastic to provide assistance. Second, while steel mills in other developing nations suffered from second rate technology at the hands of the only source of finance available to them, POSCO was fortunate to raise capital in a country that boasted the most efficient steel making process. See, Alice Amsden, Asia’s Next Giant, (New York: Oxford University Press, 1989), p. 295.

77
Engineers and technicians from POSCO were sent to the sites of the Japan Group to receive training on production and engineering technologies. This alliance encouraged the POSCO engineers to work closely with the world-class experts from the beginning. It can be said that in the initial stage POSCO acquired the matured technologies through overseas training.

Simultaneously, POSCO emphasised on building its own human resources through efficient management techniques. It distributed the work between two separate teams, namely the operational team to lead the construction and operation work and the maintenance teams to oversee the construction work. For instance, its iron-making factory provided operation employees with professional education, practice and comprehensive training in three stages in 1973 in preparation for the operation. Inspired by the enthusiasm of the Japanese trainers, POSCO staff even worked for 16 hours a day. They studied problems and their countermeasures and shared the views with the Japanese and their own colleagues. Such practices enabled them to rapidly absorb the imported technologies and acquire the initial operational capabilities within a very short time. "The time taken from start up to normal operations averaged only three months for POSCO, compared to six to twelve months for steel mills in developed countries".

When operations began in 1973, it was observed that POSCO reached the desired level of steel production in 80 days setting a record in the field of steel making in the world. In the next stages of production although the same procedure of acquiring technologies mainly through overseas and on-the-job training continued, the level of dependency on the foreign firms decreased

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75 See for detail, Sung Soo Song, "Historical Development of Technological capabilities in POSCO", in STEPI, Case Study on Technological Innovation of Korean Firms, (Seoul: STEPI, 2002), pp. 97-131.
76 S. Juhn, n. 72, p. 282.
77 A Amsden, n. 74, pp. 296-297. 'POSCO managed to complete the first phase of its mill in a mere twenty seven months...Of a total of 27 facilities 23 were completed ahead of schedule'.

78
significantly. To cope with the more skill-demanding activities for upgradation of the designing process, the management decided to establish an R&D centre.

The technology development department of POSCO was enlarged in 1977 and when it embarked on producing special steels it did not delay in setting up a research laboratory.\textsuperscript{78} As a result, the Research Institute of Science and Technology was formally established in 1978. During the period 1977-1983, the investment in R&D was 1.13 billions won constituting 7.3 per cent of POSCO's profit. In 1981 the corresponding figure was 3.44 billion won and 6.6 percent and in 1983, 9.78 billion won and 12.5 percent.\textsuperscript{79}

In this way POSCO developed its technological capabilities and successfully managed to gain efficiency in both process and production techniques. However, POSCO's production design during this period was limited to the production of ordinary iron and steel in relatively simple shape. Since the 1980s it has been making progress on a scale hardly seen in case of any other steel industries across the world.

2.4 CONSUMER ELECTRONICS SECTOR: GROWTH PATTERN AND TECHNOLOGY ACQUISITION STRATEGY

Since its inception in the early 1960s the electronics sector has consistently increased its share in the total exports of Korea. Although its domination in the export structure is noticed to have begun from the mid-1980s, much of the growth and development of electronics industry can be traced to the preceding phase. It, therefore, becomes important to analyse the growth patterns of the

electronics sector and particularly, the learning process by which it accumulated the technological requirements.

2.4.1 Evolution and Growth of the Industry

The establishment of the first major electronics company, named as Goldstar Electrical (now known as LG Electronics), in 1958 is considered as the starting point. Set up in Pusan, the Goldstar Company began manufacturing AM radio sets for the consumption of the domestic market. Within two years it received an order to export 5,000 transistors to a New York mail order firm and started exporting in 1962. Two more transistor plants were built in 1961-1962 under the technical guidance of Japanese companies, Matsushita and Sanyo. The government facilitated these industries by imposing a ban on import of small radio sets and contraband electronics products. In the mid-1960s along with a few companies, the electronics sector began to produce black and white TV sets and stereos.

Surprisingly, at the same time foreign companies, mainly from the US and Japan, moved their assembly line operations to Korea and invested heavily in such activities from 1966 onwards. What influenced the foreign firms to do so was definitely the availability of cheap labor force that could reduce their production cost and increase the profit margins. The government implemented the Foreign Capital Inducement Act to encourage inward investment by foreign firms that could provide technology and know-how needed by the Korean firms. Of particular note, two more plans, the Basic Plan for Electronics Industry Promotion

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81 Jin W. Cyhn, n.40, p.82. As stated by Cyhn, the government publicised Korea's low-wage but relatively well-educated labour force in order to attract foreign investments. In 1969, it even prohibited labour strikes in the foreign firms.
(an eight year development program from 1969 to 1976) and Electronics Industry Promotion Law (in 1973) were announced. According to the provisions of these plans, firms were supported with tax breaks, direct subsidies to buy foreign technologies or establish export operations overseas.\textsuperscript{82}

Top brass US companies Motorola, Signetics, Fairchild Semiconductor and Control Data began their assembly operations in the mid-1960s. Also some Japanese firms entered into the stream on joint ventures with local firms started. As a result of the promulgation of Electronics Industry Promotion Law of 1969, electronics became a strategic export sector and Free Export Zone in the southern port city of Masan was opened. This attracted foreign firms to invest in Korea and take part in Korea's electronics sector. It was noticed that following the establishment of Masan Zone, Japanese electronics firms began to invest heavily. By 1974, Japanese firms contributed 95 percent of the total investment in the Zone, one third of which was through joint ventures.\textsuperscript{83} The establishment of Kumi electronics complex in 1970 also encouraged foreign firms to invest by providing them a package of incentive and privileges. To further accelerate the growth of electronics industry, the government announced more sectoral and product-specific measures during the Fourth Five-year Plan.

The major products identified as strategic development products for the consumer electronics sector, included radios, black & white TVs, microwave ovens, VCRs, digital watches and tape recorders.\textsuperscript{84} The promotion of technical...
development was emphasized for standardization of the products, renovation of designs and improvement of manufacturing processes. The primary objective of these measures was to boost the electronics sector as a leading export sector and diversify the export markets.⁸⁵

The dominance of foreign firms in the electronics sector during this period cannot be overruled. However, the noteworthy feature to observe from the beginning of 1970s was the rapid growth of chaebol (and also small local companies) in the domestic industry following the series of policy measures initiated by the government. Expansion of these industries also led to the gradual declination of foreign firms. For instance, ‘only 41 companies were registered in the electronics industry in 1965. In the next decade, 172 joint ventures and 44 foreign invested firms entered Korea, and 536 local companies started operations, bringing the total of registered firms to 752 in 1979.⁸⁶

2.4.2 Acquisition of Technology

The above account suggests that the electronics industries in Korea during the 1960s and early 1970s basically involved assembly production of standardized goods. As in the 1960s, foreign firms almost entirely represented the industry; the scope for local firms was limited. However, a small number of local firms engaged in manufacturing of transistor and black & white TV.

Most of the parts and components were imported and given final shape by assembling which required limited engineering skill. For example, in the first year all parts except the cases and capacitors were imported in the initial phase of black & white TV production. Although no comprehensive account is available on the

⁸⁵ Tony Mitchell, n. 80, p. 144.
issue of their technology accumulation strategy, it is evident that they solely relied on assistance of foreign firms in assembling the parts.\textsuperscript{87} Since the workforce of the local firms had such skill, they easily learned the techniques of assembly.

The foreign firms imported most of their inputs and imparted very little technical know-how to the Korean labour working for them. Nevertheless, the domestic workers utilized such opportunities to learn the technology at the lower level and made valuable contribution in the success of the foreign firms. In other words, even if these firms had imported the critical elements of technology from their parent firms, their success would hardly have been possible without Korea’s domestic endowment.

The rapid increase in the local firms’ involvement in joint venture from the late-1960s onwards with the Japanese firms provided the best opportunity for the engineers to learn and master the technology. In fact, the joint venture type of arrangement proved mutually beneficial. While the foreign firms gained much from the low-cost finance and labour, the local firms benefited from exchange of know-how. Samsung and Goldstar were the two chaebol who took most of the benefits from Japanese investments by strengthening their ties with Japanese firms in the period.

For example, when Samsung electronics began as a joint venture with Sanyo of Japan in 1969, its first task became the acquisition of overseas training, machinery, components and management techniques from Sanyo. In return, it offered the Japanese companies capacity for producing large-scale, low-cost, standardized goods.\textsuperscript{88} Samsung’s engineers began to assemble black & white

\textsuperscript{87} Cited in M. Hobday, n.83, pp.57-61. The two transistor factories set up by Goldstar and Samsung in 1961 and 1962 received technical assistance from Matsushita and Sanyo. In addition, another Japanese company, Toshiba, formed two major technical agreements and joint venture in Korea in the late-1960s to assemble consumer goods and cathode ray tubes (CRTs).

\textsuperscript{88} M. Hobday, n.83, p.65.
television in 1969 following technology transfer agreements with Sanyo. In 1970, Goldstar Electric and Samsung-NEC (later named Samsung Electronic Devices) were established by joint ventures. Three years later in 1973, Samsung's joint venture with Sanyo resulted in the establishment of Samsung-Sanyo electronics. 89

Similarly, two other major firms benefited from the joint venture with Japanese firms. On one hand, Anam Industrial reached a licensing agreement through jointly owned venture with Matsushita of Japan in 1973. It easily learned and absorbed the assembly technology from Matsushita and became the first Korean Company to produce colour TVs. This joint venture produced and marketed colour television, digital watches, calculators, stereos and telephone equipment during the phase 1973-1980. 90 On the other hand, the Korea Electronics Company (originally called Toshiba Korea) was established under the joint venture with Toshiba of Japan. In fact, Toshiba set up the factory with production lines, just like those at the Toshiba factory and handled the export of production into Japan. Although initially this company engaged in assembly of semiconductor chips, it entered the consumer electronics field in 1972 with technical assistance from its partner. 91

Once the finns gained sufficient experience in learning the assembly operation techniques, they moved into the next stage of production technology. They resorted to the practice of importing technology in 'packaged' form, which was relatively complex.

The desire of the Korean finns to import the best practice production equipment could be seen in their payment toward technology licensing fees.

89 M. Hobday, “East Asian Latecomer Firms: Learning the Technology of Electronics”, World Development. (Vol. 23, No. 7, 1995), p.1173. A number of employees (106 employees) from Samsung were sent to Sanyo and NEC to receive training in the production technology of radios, television sets and simple components. 90 Ibid., p. 1179.
91 T. Michell, n.80, p.142. Also see, Jin W. Cyhn, n. 40, p. 217.
Already in the 1970s, most of the firms spent roughly 3 per cent of their sales on royalty payment. After the transferred elements were distributed across the firms, it required conscious efforts on the part of the firms to develop the knowledge and skills to monitor, unpackbag and adapt these to their own needs. So they began to focus on shop-floor experience through learning-by-doing.92

Apart from continuing with the joint venture and technology licensing practices, the firms began to emphasize on OEM (original equipment manufacturing) arrangement.93 This kind of arrangement was considered appropriate as the domestic consumer market for electronics goods was small and the large firms could not take the risks for developing a full-scale mass production system. Instead, they worked hard to become OEM suppliers through OEM agreements with foreign firms and expanded their market share in electronics products. Learning from the buyers under the arrangement through training enabled the Korean firms to gain sufficient knowledge about the equipment as well as technological solutions to the problems.

To give an example, Samsung reached numerous OEM arrangements with international distributors to assemble electronics products for them. These distributors provided Samsung with design and engineering support. This helped the firm in extending its product lines to two new products- VCRs with the OEM buyer Toshiba and microwave ovens with NEC. However, Samsung developed most of the products through joint venture and licensing agreements. In addition, the firm adopted the process of reverse engineering when it became difficult to acquire technology through licensing in certain products. With such efforts Samsung was able to acquire mass production capabilities in products such as

92 Mytelka and Ernst, n. 84, p. 126.
93 It is explained in the theoretical chapter of this study (Chapter. 1) that OEM arrangement offers better learning opportunities to a firm. Also it allows the firms from less-developed countries to enter new markets. For more discussion see, Cyhn, n.40, pp. 44-69.
colour and black & white TV sets, VCRs and microwave ovens and increased its export share.\textsuperscript{94}

Besides, the Korean firms began to focus on RD&E (research, development and engineering) productivity improvement. As the study by Kim observes, (study conducted taking 31 firms into account) "21 out of the 31 productive units had a separate R&D departments. Many productive units also attempted to introduce industrial engineering and production management to rationalize production process. The average annual production value per productive unit increased almost four times from US $ 5.8 million in 1970 to US $ 22.4 million in 1975, productivity per worker also increased, about 2.3 times from US $ 3,600 in 1970 to US $ 8,340 in 1975."\textsuperscript{95}

The government also encouraged the firms to engage in OEM activities. Its trade promotion agencies such as KOTRA and FIC (Fine Instrument Centre) helped the local firms in selecting the alliance partners. The FIC also had a role in qualifying technicians and testing the quality of products so as to ensure that Korean exports meet the minimum requirements in importing countries.\textsuperscript{96} The government established research institute, ETRI, also took some consortium projects with the Korean firms although not in a large scale.

2.4.3 Export Account

Table 2.7 shows that parts and components had the largest share in the total electronics export throughout the period. But consumer sector recorded substantial increase in export and in the year 1980 it surpassed the share of parts and


\textsuperscript{96} T. Michell, n.80. pp.143-144. In 1979, the FIC was absorbed in the Electronics Association to form the Electronics Industry Association of Korea.
components. On the other hand, the share of parts and components in export declined by over 40 per cent from 81 per cent in 1968 to 45 per cent in 1980. This implies that the Korean electronics sector rapidly moved away from assembly production to mass production activities. In other words, it achieved significant economies of scale.

Table 2.7 Exports by product group (Electronics sector) and Investor (Unit: per cent, %)

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumer Sector</th>
<th>Industrial Equipment</th>
<th>Parts &amp; Components</th>
<th>Local Firms</th>
<th>Joint Ventures</th>
<th>Foreign Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>18</td>
<td>1</td>
<td>81</td>
<td>21</td>
<td>8</td>
<td>71</td>
</tr>
<tr>
<td>1972</td>
<td>19</td>
<td>8</td>
<td>73</td>
<td>27</td>
<td>18</td>
<td>55</td>
</tr>
<tr>
<td>1975</td>
<td>34</td>
<td>6</td>
<td>60</td>
<td>26</td>
<td>23</td>
<td>51</td>
</tr>
<tr>
<td>1977</td>
<td>43</td>
<td>6</td>
<td>51</td>
<td>33</td>
<td>19</td>
<td>48</td>
</tr>
<tr>
<td>1980</td>
<td>49</td>
<td>6</td>
<td>45</td>
<td>48</td>
<td>15</td>
<td>37</td>
</tr>
</tbody>
</table>


In the initial years, the foreign firms accounted for two-thirds of the total exports. But the local firms’ share began to increase after 1970. For instance, while the local firms’ contribution in the total exports increased from 27 per cent in 1972 to 48 percent in 1980, the share of foreign firms decreased from 55 per cent to 37 per cent over the same period. This points to the fact that the foreign firms still held a major share in the export despite its steady decline. The exports from joint venture firms also witnessed increase over the period.
2.5 ANALYSIS AND ASSESSMENT

2.5.1 Structure of Production

Table 2.8: Composition of GDP in Korea (1963-1985)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Fisheries &amp; Forestry</td>
<td>40.1</td>
<td>25.1</td>
<td>14.9</td>
<td>12.8</td>
</tr>
<tr>
<td>Mining</td>
<td>1.8</td>
<td>1.1</td>
<td>1.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>14.7</td>
<td>25.2</td>
<td>29.6</td>
<td>30.3</td>
</tr>
<tr>
<td>Electricity, Gas &amp; Water</td>
<td>0.9</td>
<td>1.4</td>
<td>2.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Construction</td>
<td>2.6</td>
<td>4.4</td>
<td>8.3</td>
<td>7.7</td>
</tr>
<tr>
<td>Transport &amp; Communication</td>
<td>4.7</td>
<td>6.8</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>Wholesale &amp; Retail Trade</td>
<td>12.1</td>
<td>17.6</td>
<td>12.7</td>
<td>12.2</td>
</tr>
<tr>
<td>Finance, Insurance &amp; Real Estate</td>
<td>10.6</td>
<td>7.0</td>
<td>10.9</td>
<td>11.8</td>
</tr>
<tr>
<td>Other Services &amp; Government</td>
<td>12.5</td>
<td>11.4</td>
<td>12.7</td>
<td>13.9</td>
</tr>
</tbody>
</table>


To a large extent, the government’s development policy during this phase was focused more on quantitative expansion of industries rather than on the qualitative aspects. Still it can be interpreted that in comparison to many other nations with the same economic potential, Korea’s production structure was in a qualitatively better shape. The share of agriculture, fisheries and forestry in the total GDP decreased from 40.1 per cent in 1963 to 14.9 percent in 1980 while that of manufacturing sector rose from 14.7 to 29.6 percent in the respective years (see Table 2.8). The average growth rate of agriculture, fisheries & forestry in the period, 1963-73 was 4.3 per cent and that of manufacturing sector was 19.1 per cent. But during the phase 1973-79 both sectors saw a slow down in growth rate, i.e., the agriculture sector grew at 3.1 per cent and manufacturing sector at 16.3 per cent.
Good performance was also noticed in the transport and communication as well as construction sector due to the expansion of capital-intensive industries.\textsuperscript{97} The share of HCl in the manufacturing sector peaked up from 34.9 per cent in 1972 to 51.2 percent in 1982 thus fulfilling the target set forth.\textsuperscript{98} Such transformation was possible because of heavy investment in HCl. The average overall economic growth for the period 1963-79 was more than 9 percent, far exceeding the target set by the government (see Table-2.2). On the whole, the manufacturing sector expanded at an annual average rate of 15.9 per cent in the period 1962-1982 increasing its share in the economy from 9 per cent in 1962 to 34 per cent in 1982.\textsuperscript{99}

Taking a different approach, measured in terms of output and TFP (total factor productivity) growth of some selected manufacturing sectors over the period 1967-79 in a study, it is seen that output growth was highest for electrical machinery & apparatus i.e., 47.6 per cent followed up by plastic products, scientific & measuring equipments and transport equipment. As far as TFP growth is considered, which also reflects the technological progress of the individual industry, the electrical machinery & apparatus and scientific & measuring equipment registered 15.0 and 14.5 per cent respectively (Table 2.9). The TFP growth for all manufacturing sectors was averaging 5.0 percent.

\textsuperscript{97} The figures are derived from Table 5.2 in Dirk Pilat, \textit{The economics of Rapid Growth: The Experience of Japan and Korea}, (Cheltenham: Edward Elgar, 1996), p. 79
Table 2.9: Output Growth in Manufacturing Industry, 1967-1979 (selected sectors)
(Units: %)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Output Growth</th>
<th>TFP Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific &amp; Measuring Equip.</td>
<td>44.0</td>
<td>14.5</td>
</tr>
<tr>
<td>Plastic products</td>
<td>47.5</td>
<td>16.3</td>
</tr>
<tr>
<td>Electrical machinery &amp; Apparatus</td>
<td>47.6</td>
<td>15.0</td>
</tr>
<tr>
<td>Machinery</td>
<td>29.1</td>
<td>5.9</td>
</tr>
<tr>
<td>Textiles</td>
<td>25.0</td>
<td>7.9</td>
</tr>
<tr>
<td>Transport Equipment</td>
<td>30.5</td>
<td>7.2</td>
</tr>
<tr>
<td>Manufacturing Total</td>
<td>24.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Source: Note that here the original source is not referred. Instead, this table is taken from Wan Soon Kim and Hojin Kang, "Development Strategies and Productivity Issues in Korea, ROC (Taiwan) and Hong Kong: A Comparative Study", in Shinichi Ichimura (ed), Challenge of Asian Developing Countries: Issues and Analysis, (Tokyo: Asian Productivity Organization, 1988), p. 302.

2.5.2 Composition of Exports

The total commodity exports from Korea witnessed a surprising increase from US$ 55 million in 1962 to US$ 21.9 billion in 1982, an average annual growth rate of 34.9 per cent. Of these manufactured products made up nearly 94 percent in 1982.100 The manufacturing industry’s share of GDP increased about 10 percentage points per decade during this phase. For instance, its share of GDP in 1960 was 20.1 per cent. This figure increased to 29.1 percent in 1970 and by the 1980 it accounted for 41.3 per cent of the GDP. The total export as percentage of GDP expanded from 2.4 per cent in 1962 to 30.7 percent in 1982.101

As presented in Table 2.10, the composition of exports in this phase reveals several notable trends. In the 1960s, exports were concentrated in primary

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100 Ibid.
materials such as textile and clothing, food products and raw materials. Such light industry products dominated the export structure throughout the period. But its share substantially declined from 84.7 per cent in 1966 to 78.4 per cent in 1971 and finally to 55.3 per cent in 1979.

Table 2.10 Change in Export Structure by Sectors

(Unit: in percent)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HCI Products</td>
<td>15.3</td>
<td>21.6</td>
<td>37.0</td>
<td>44.7</td>
</tr>
<tr>
<td>Iron &amp; steel</td>
<td>8.9</td>
<td>3.7</td>
<td>7.9</td>
<td>14.6</td>
</tr>
<tr>
<td>Gen. Machinery</td>
<td>2.7</td>
<td>0.3</td>
<td>1.0</td>
<td>4.4</td>
</tr>
<tr>
<td>Electronics</td>
<td>3.1</td>
<td>7.6</td>
<td>14.2</td>
<td>13.6</td>
</tr>
<tr>
<td>Vessels</td>
<td>0.1</td>
<td>0.4</td>
<td>4.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Others</td>
<td>0.5</td>
<td>9.6</td>
<td>8.0</td>
<td>8.3</td>
</tr>
<tr>
<td>Light Ind. Prod.</td>
<td>84.7</td>
<td>78.4</td>
<td>63.0</td>
<td>55.3</td>
</tr>
<tr>
<td>Textiles</td>
<td>48.5</td>
<td>49.2</td>
<td>37.6</td>
<td>33.2</td>
</tr>
<tr>
<td>Ply &amp; wood</td>
<td>18.4</td>
<td>11.1</td>
<td>4.9</td>
<td>4.2</td>
</tr>
<tr>
<td>Others</td>
<td>17.8</td>
<td>18.1</td>
<td>20.5</td>
<td>17.9</td>
</tr>
<tr>
<td>Manuf'd. Products</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>


At the same time, the share of HCI remarkably increased from 15.3 per cent to 21.6 per cent and 44.7 per cent in the corresponding years. A break up of the HCI sector indicates that Electronics and Iron & Steel industries together accounted for 28.2 per cent of the total export with the former topping the list in terms of growth rate. Transport equipment also increased its share in total exports
marginally. In the light industry product category, the textile sector represented 49.2 per cent in 1971. Despite its share going down to 33.2 per cent in 1979, it still remained the single largest exporting sector.

It is true that HCI made major contribution in increasing the production and export volume of Korea. But by the end of 1979, many heavy industries were running below capacity. For instance, machinery industry was operating at 60.1 per cent; non-ferrous metals and electronics equipment industries were operating at just over 69 per cent. The operational level of transport equipment was estimated at 35 per cent. Looking from the technological efficiency point of view, it cannot be denied that most of these industries were export-competitive and in later phase also remained the same. However, as the HCI policies promoted more diversifications among the chaebol, it also, to some extent impeded the deepening of technological activities of the firms. This is manifested in the statement of EPB, which said:

"Investments to HCI required mobilization of huge amounts of funds and high which could not be afforded in the mid-1970s. .......Over allocation of limited resources to HCI weakened the growth of the light industry, which was major export industry, exacerbated trade deficit and unbalanced industrial structure."102

As Kuznets has observed, the share of exports in the GDP of Korea rose from 9 per cent in 1965 to 37 per cent in 1983 which was much higher than that of Japan but lower than Taiwan. In the same period, while Japan’s share increased from 11 per cent to 14 per cent that of Taiwan went up from 19 per cent to 55 per cent. In the phase 1973-83, the average annual growth of exports in middle-income countries was 0.5 per cent. But in case of Korea and Taiwan the figures

were 14.8 per cent and 11.8 per cent respectively. This shows that Korea and Taiwan were the two best performers among the export-led economies.\textsuperscript{103}

2.5.3 Technology Structure of Exports

The technology intensity of export products of Korea in this phase can be classified into three broad categories, namely, resource-based, low technology intensive and medium technology intensive products.\textsuperscript{104} Items included in the resource-based group are basically food products, plywood and mineral resources. Low-technology intensive items comprise of textiles and clothing, footwear etc. The medium technology intensive items consist of ships, vessels, electrical goods and automobiles. The iron and steel sector includes both low-technology and medium technology intensive products. Electronics sector in general is considered as a high-tech intensive one. But during these two decades of 1960s and 1970s, most of the electronics products exported from Korea by nature consisted low-end medium-technology intensive assembled consumer goods such as black & white and colour TV sets, transistors, VCRs, audio equipment, microwave ovens etc.

To measure the technological intensity of each single product representing each of the three groups, the study has taken the top ten export items of three individual years, 1960, 1970 and 1980. As shown in Table 3.10, in 1960 all the ten items that accounted for 62 per cent of the total exports were from the resource-based group. However, this year's export account could not be considered as having a major implication on the study.


\textsuperscript{104} This classification is based on the technological classification of exports by the OECD and the author Pavitt. For detail on the classification, see, Lall, Sanjay, Competitiveness, Technology and Skill, (Cheltenham: Edward Elgar, 2001), pp. 122-123.
Table 2.11: Korea's Top Ten Exports (1960 ~ 1980)

Share (per cent) in total exports

<table>
<thead>
<tr>
<th>Item</th>
<th>1960</th>
<th>1970</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Share</td>
<td>Share</td>
<td>Share</td>
</tr>
<tr>
<td>Iron ore</td>
<td>13.0</td>
<td>40.8</td>
<td>28.8</td>
</tr>
<tr>
<td>Tungsten</td>
<td>12.6</td>
<td>11.0</td>
<td>11.4</td>
</tr>
<tr>
<td>Raw silk</td>
<td>6.7</td>
<td>10.8</td>
<td>9.0</td>
</tr>
<tr>
<td>Anthracite</td>
<td>5.8</td>
<td>5.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Cuttle fish</td>
<td>5.5</td>
<td>3.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Live fish</td>
<td>4.5</td>
<td>2.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Natural graphite</td>
<td>4.2</td>
<td>1.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Plywood</td>
<td>3.3</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Rice</td>
<td>3.3</td>
<td>1.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Bristles</td>
<td>3.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Total top ten exports</td>
<td>62.0</td>
<td>81.1</td>
<td>69.3</td>
</tr>
<tr>
<td>Total exports</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>


Notable change could be observed in the year 1970. In that year the share of low technology intensive products in the total exports was about 45 per cent and medium technology intensive product (only electronics) was 3.5 per cent of the total exports. But as discussed earlier, the foreign firms almost entirely represented the electronics sector. Finally, in the year 1980 the low technology intensive products accounted for about 40 per cent including half of iron and steel products (on the basis of the assumption that the other half was included in the medium technology category). Substantial gain is noticed in the share of medium technology intensive products i.e., from 3.5 per cent in 1970 to 21 per cent. Electronics products accounted for half of this category with a higher rate
of local firms' participation. In 1981, the export of consumer electronics reached a peak of 55 per cent.\textsuperscript{105}

Another important trend to be observed here is the export of technology from Korea to the other third world nations. Initially, after gaining experience in construction engineering, Korean contractors were involved in some construction projects such as building schools, apartments, offices etc. in the Middle East region in 1975. Korean manufacturing plants in the late 1970s were also engaged in several manufacturing projects in Middle East, and to a less extent in Africa. Through the plant exports Korean firms provided techniques of basic engineering design embodied in the capital equipment.

Besides, the flow of outward investment grew over the years. "By the end of 1981, the cumulative licensed outflow of direct investment was US$ 323 million, of which US$ 103 million was in manufacturing or social overhead sectors".\textsuperscript{106} Again these investments were made in Middle East, Africa and Malaysia. These firms also provided general technical assistance in production engineering and maintenance after 1978 to Middle East region through licensing and technical agreements.

Taken as a whole, it can be said that Korea's achievements far exceeded the general expectations. Although much of the exports generated by the industries were in nature assembled low-technology intensive products, nevertheless it provided sufficient opportunities for learning. This proved to be an invaluabie asset for the firms when in the later phases they moved into more advanced technology intensive industries.

\textsuperscript{105} Mytelka and Ernst, n. 84, p. 114.

The biggest achievement for Korea came when it succeeded in overtaking its main competitor, Taiwan, and became the second largest supplier to the United States consumer electronics market in 1984.