Small and Medium-Sized Enterprises in the Republic of Korea: Implications for the Development of Technology-Intensive Industries

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ABSTRACT. Korea's miraculous growth and meteoric rise as a newly industrializing economy have carried with them considerable costs. Initial reliance on Korean large business groups, the *chaebol*, was an appropriate policy choice for creating competitive advantage through economies of scope for the export market. However, the neglect of the small and medium-sized industrial sector and resulting weak backward linkages with parts industries have become a burden on the performance of these same big businesses. This issue is particularly critical because Korea must make a transition into more knowledge- and technology-intensive industries in the face of a rising real wage level. This paper examines how the underdevelopment of the small and medium-sized industrial sector undermined the overall efficiency of the Korean economy, in terms of added costs and low quality of final products produced by big businesses, thus hindering Korea's transition into more technology-intensive industries.

I. Introduction

The Republic of Korea's miraculous economic growth and meteoric rise to the ranks of an industrialized nation have carried with them considerable costs. Initially, government policy relied on the development of large business groups, the *chaebol*, in order to achieve economies of scale and realize competitive advantage in export markets. Korea's economic miracle based on big businesses is well documented and praised in the developmental literature as an example of successful institution building to facilitate rapid economic growth (Amsden, 1989; Chang, 1993; Fields, 1991; Johnson, 1986; Luedde-Neurath, 1986).

However, as a result of the economic growth policies that emphasized big businesses, the development of the small and medium-sized industries that are parts producers was neglected. The hurried and relentless drive for export promotion placed too much emphasis on the absolute value of exports by granting privileges to export industries in proportion to gross exports rather than value added. Since the incentives given to exporters at the early stage of Korea's development were quite lucrative, there was a natural tendency to import parts and to assemble them for re-export to increase the entitlement privileges granted to exporters (Park, 1985). Since there were no incentives for Korean businesses to develop products and produce parts on their own, many of Korea's export industries were geared to assemble imported parts. As a result of this heritage, growth of small and medium-sized parts producers was hampered compared to big businesses, which tended to be assemblers. Thus, Korea's industrial structure came to develop weak backward linkages with component production, while assemblers' capability to develop and design products on their own became limited.

Such an industrial structure served Korea well while the country was able to maintain competitive advantage in the assembly of labor-intensive products. However, underdevelopment in small and medium-sized industries emerged as a liability for big businesses as Korea began to face the challenge of making a transition into more technology-intensive industries that require support from parts and intermediate product producers.[1] In particular, an underdeveloped subcontracting system of parts suppliers has resulted in low efficiency, low

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quality, long lead times, and thus high economy-wide costs (Amsden and Kim, 1986).The present study examines the impact of weak backward linkages with local parts industries that are small and medium-sized enterprises (SMEs) on the economy-wide production costs.

Information was collected through in-depth interviews with SMEs in electronics and automobile parts manufacturing industries located in the Banwol Industrial Complex.[2] Other sources include interviews with D Elevator Company, C Consulting Firm, parts industry experts in electronics and automobile associations, experts in small and medium-sized industry associations, financiers in venture capital firms, and Ministry of Industry and Resources officials in charge of small and medium-sized industries. While the strength of the qualitative interview method lies with the in-depth nature of the information, one natural limitation is the inability to generalize. Whenever appropriate, supporting statistics are presented to strengthen the argument.

II. Agglomeration and flexibility

In recent years, the role of agglomeration economies has been revived as a crucial variable of regional growth dynamics. Scott (1988a, b) pointed out the importance of urban agglomeration in facilitating inter-firm linkages. He suggests that inter-firm linkages become difficult in long-distance locations; thus, spatial and urban agglomeration is the mechanism of regional growth. Krugman (1991) argues that agglomeration economies are pervasive in increasing returns. Gertler (1988, 1993) emphasizes the importance of local industrial linkages in productivity increases.

Other characteristics such as size and type of firms as well as supporting infrastructure have been identified as factors that determine the effectiveness of forward and backward linkages in industrial districts. Sweeney (1985) maintains that areas dominated by large firms tend to have low entrepreneurial vitality, because big firms have internalized their information resources and networks. Lacking the network of local suppliers, subcontractors, and customers, regions dominated by large firms and by branch production plants are less likely to have the level of information exchange, of R&D, and of knowledge of the state of the art needed to spawn new firms. Glasmeirer (1988) and Hagey and Malecki (1986) have also identified some of the product- and firm-level factors that influence spinoff and local industry linkage effects.

Thus, at the local economy level, literature dealing with agglomeration economies maintains that the network of industries with efficient forward and backward linkages creates economies of scope that lower production costs and increase productivity of firms in the region. Certain areas are better equipped to provide such agglomeration economies than others. General industry composition, infrastructure, and policy choices are some of the variables that determine the effectiveness of local economic performance (Amin, 1989; Miller and Coté, 1987; Saxenian, 1986).

At the firm level, the traditional Fordist mass production system based on economies of scale has given way to flexible manufacturing systems to save costs and increase productivity. Cost savings in modern firms come from producing a variety of products in small quantities at economical prices. Factories operating with such systems can supposedly produce different products at the same cost as identical products. Simplified product design to minimize the number of parts and standardization of parts in different final products further facilitate the productivity of flexible manufacturing systems (Charles et al., 1989).

Another important concept associated with flexible manufacturing is just-in-time-inventory (JIT). The JIT concept – called the *kanban* system in Japan – calls for the elimination of waste in all forms and removes safety nets for mistakes at the component supplier level. In JIT, strict quality control of parts is required to minimize the defect rate. Inventory cost is minimized by having most of the inventory in transit and delivered just in time to be processed. The reduction in inventory costs and throughput time becomes a source of profitability. These changes in turn induce improved quality, revamped factory layouts, stabilized production schedules, and minimization of engineering changes. The efficient production system based on the flexible manufacturing system and agglomeration of economies thus demands a well-developed supporting industrial structure and

suppliers with the high technical capability to uphold strict quality control standards and timing of delivery.

Studies by Amin (1989), Miller and Coté (1987), and Saxenian (1986) discuss the limitations to regional industrial development and formation of agglomeration economies when the local infrastructure is not adequate or when political economic factors are working against it. Up until now, most of the economic literature dealing with agglomeration economies covered the cases of advanced economies. Little attention has been paid to the implications of agglomeration economies and its relationship with local infrastructure in the process of economic development.

The fact that institutional efficiency determines the level of economic development (North and Thomas, 1973; Weingast, 1989) is now widely accepted among institutional and transaction cost economists. North (1991) noted that developing countries, lacking the formal structures that underpin efficient markets, are forced to incur higher transaction costs, and the institutional framework that determines the basic structure of production tends to perpetuate underdevelopment. In an underdeveloped infrastructure, creation of agglomeration economies is difficult, because institutions that can facilitate development of forward and backward linkages also do not function efficiently. Especially when there is a bias toward forward linkages of market and customers by policy choices, the resulting weak development of backward linkages into subcontractors and suppliers could lower the efficiency of the overall economy.

III. Underdeveloped SMEs and structural weaknesses in Korean industry

Three linkages provide the key concepts in agglomeration economies: forward linkage with market and customers, backward linkage with suppliers and subcontractors, and exchange of information and technology through trained labor mobility among the firms in the region. Korea's economic development in the past three decades has solved many of the problems associated with forward linkages with customers and markets. Its successful export drive policy and assembly-oriented industry development have laid a solid ground for forward linkages of local economy to the world market. However, institution building that facilitated economic growth based on big companies did not necessarily provide a nurturing ground for SMEs or backward linkages into subcontractors and suppliers in Korea. Such policy choices caused SMEs to suffer from high interest costs, high bankruptcy costs, and high transaction costs. Underdevelopment of backward linkages of parts and intermediate materials producers thus resulted in a low subcontracting ratio of 44.6% for the automobile industry for example (Kim and Cho, 1991, p. 140),[3] and the specialization rate is also low.[4] Not only are linkages with big businesses weak, but also linkages among SMEs are not well developed compared to a more advanced industry such as Japan's. As illustrated in Table I, out-sourcing in Korean SMEs is approximately 40% of that of Japanese SMEs. Relative underdevelopment of SMEs in Korea and the consequent inability to create a network of SMEs that can support final product makers has made it difficult for Korea's industries to achieve production efficiencies and cost reduction from economies of scope.

TABLE I
Classification of production costs for SMES: Comparison of Korea and Japan (1991)

Classification	Korea	Japan
Materials	63.41%	52.1%
Labor	15.09%	17.7%
Subcontracting	6.50%	16.1%

Source: Korea: Small and Medium-Sized Industry Promotion Corporation, 1991.

The specific problems related to weak backward linkages include (1) strategic vulnerability due to reliance on Japan for core parts supply, (2) substandard parts produced in Korea, (3) poor access to appropriate production equipment, (4) inability to utilize equipment efficiently, (5) inability to provide appropriate support to assemblers and final product producers, and (6) difficulty in accumulating soft skills due to shortages of trained labor. This last category deserves separate attention because it is the third variable explaining the benefits of agglomeration economies. However, since the paper's scope is

limited to the problems associated with weak backward linkages in the Korean industrial structure, the labor issue is also addressed under the context of backward linkages.

A. *Strategic vulnerability*

Reliance on foreign sources for key components and strategically important capital equipment has been a source of concern for many scholars (Sandholtz et al., 1992). Especially when a country has to rely on foreign sources for strategically important inputs, vulnerability increases. The problem is further complicated when there is no choice of diversifying the sources of these inputs, because of limited technological know-how.

As mentioned earlier, Korean industries have put little effort into cultivating their product development capability, and local product design capacity is rather limited. Therefore, final product designs either are largely copied by reverse engineering Japanese products or are licensed wholesale from foreign producers (Kang et al., 1993). Since the final product design is closely linked to the functions of key components, dependency on design also leads to dependency on components. Korean parts producers usually cannot copy the key components by reverse engineering because much technological and manufacturing know-how is involved in producing them. For example, even in a field such as semiconductors where Korea is renowned for its major breakthroughs in DRAM (dynamic random access memory) production, Korea still relies on Japan for logic chip[5] supply. Logic chips control the function of various final products such as TVs and VTRs, and they are closely related to the design of the sets in which they are used. In semiconductors, therefore, Korea's dependency on Japanese parts and intermediate materials increased from 32.4% in 1987 to 50.2% in 1991 as Korea was producing more high end electronics products (Kang et al., 1993).

Dependency on Japanese parts brings many problems to Korean industries and complicates the further development of Korea's parts industries. In general, there are three broad categories of problems associated with the dependency on Japanese parts supply: (1) increased price and limited quantity of parts supplied from Japanese companies to control Korean competition in final products market; (2) "system part supply" that limits the growth of even the most elementary general application components; and (3) difficulty of standardizing parts design and production due to dependency of set design on foreign sources.

1. When Korea was not even a remote threat to Japan's economic prowess, securing parts from Japan was not a serious problem. After the Plaza Accord in 1985, however, the Japanese yen appreciated sharply against the U.S. dollar, eroding Japanese industry's competitiveness. In the meantime, the Korean won's exchange rate in relation to the U.S. dollar stayed the same. The relative advantage of the won over the yen gave Korea an advantage in the export market vis-à-vis Japan, and Korean products began taking Japanese market shares in low-end products and heavy and chemical industries such as shipbuilding. When Japan started to feel the pressure of Korean competition, industries in Korea began to experience Japanese reluctance to supply parts as well as intermediate materials. Japan increased parts prices overnight and began to control the timing and quantity of parts supplied. Many Korean companies set out to seek alternative parts suppliers throughout the world. However, since parts have to be made to fit product design specifications, unless the design of the final products is altered, parts sourcing could not be easily changed. Korean industries did not have the technological know-how to alter the product design to accommodate the cheaper parts they could procure from elsewhere, and so they lost market opportunities.

D Elevator Company, a large elevator producer, is one of many companies with such experiences (see Kang et al., 1993, for more examples). Starting immediately after the Plaza Accord, D Elevator's technology licensing source in Japan – T Electronics – began to charge high costs for key parts for the elevator models it licensed to D. T also delayed delivery and limited the quantity of parts supplied. Faced with parts prices several times higher than in the past and the uncertain timing and quantity of parts delivered, the company sought alternative sources to buy components throughout the world. However, it realized that without completely changing the design of the elevator models it licensed from T Electronics, it

could not change the sources of parts. Developing the elevator design from scratch was beyond D's capability because it had not developed engineers and technicians trained in designing elevators. Having little recourse but to pay high prices for its parts, D Elevator could not take advantage of that window of opportunity when the Korean won was relatively undervalued in relation to the Japanese yen and increase their market share vis-à-vis Japan.

2. Korea's domestic market size is small enough that it is not economically feasible to produce many parts internally. Added to the limitations of small domestic market size, the reliance on Japan brings further complications which makes it difficult to develop a parts industry in Korea. It is the recent trend that Japanese industries are increasingly supplying key components and other general application parts in one "system" to Korean electronics firms for profit motives. After Japan faced *yen daka*, there was much effort to restructure industries to bring down the production costs to regain competitiveness in the world market for Japanese products. As part of this cost reduction measure, Japanese producers have tightened their subcontracting structure so that the primary subcontractors would have more authority and control over other lower level subcontractors. It became the responsibility of the primary subcontractors now to supply pre-assembled "system parts" to the final set makers so that the management and assembly cost of the final assemblers could be reduced (KAMA, 1989). For example, dash boards of automobiles are pre-assembled before they are shipped to the final assemblers.

Such tightening and restructuring of subcontracting system was enormously successful in bringing down costs of Japanese manufacturers, but it had the effect of restricting the growth of Korea's parts producers. Usually, parts industry development starts with the general application parts that do not require high levels of technology. When many of these general application parts are already included in the system parts supplied by the Japanese, it is not economically feasible to develop these parts for limited Korea's domestic market.

In addition, a case of Y Industry illustrates a practice where Japanese producers use their superior position in technology transfer to sell other general application parts. Y Industry is a producer of hinges and pedals for automobiles. Until 1994, Y could not supply hinges to K Motors even though its product quality was equal and its price was half that of the hinges K was buying from M Automobile company of Japan. When K licensed the design of automobiles from M, the terms of the licensing agreement included obligatory purchase of certain components at prices dictated by M. The parts M supplied included not only key components for transmissions and brakes that K could not produce on its own but also many general application parts such as hinges at significantly above market prices. Consequently, even though domestic parts industries develop general application components at competitive prices and overcome the disadvantage of small domestic market size, there is no outlet for such products.

3. Standardization of parts is one of the leading trends in today's manufacturing system, due to the obvious reason of cost savings in parts production. Because Korean final products are dependent on Japanese designs and key components, however, standardization of parts produced in Korea is difficult. Because licensing agreements are made without systematic cooperation among different companies, many different types of models are produced in Korea even in one product category. Because different models of products have non-standardized parts, domestic demand for parts comes in only very small lots and pushes up the parts production costs. SMEs in Korea are undercapitalized and the cost of financing is high for them (Chon and Lee, 1994).[6] Having to invest in several different dies, jiggers, and testing equipment for different parts that they can supply in only small quantities hurts SMEs' profitability.[7] Especially, when implementation of flexible manufacturing system is difficult for the reasons that will be discussed later, producing small batches of multiple product lines significantly cuts into the profit margins of parts producers. Not only does non-standardization of parts affect the cost structure of SMEs; in the end, the high price of parts is transferred to assemblers.

Japan is increasingly becoming reluctant to transfer state-of-the-art technology to Korea because it views Korea as an emerging competitor.

In fact, not just export to Korea but overall technology export from Japan to other countries is decreasing in recent years. Partly because of their recent industrialization experiences, Japan knows how developing countries can catch up with the simplest of technology transfers from advanced countries, and is trying to slow the pace of competitors' development. Perpetual dependency on a reluctant partner for technology transfer in strategic areas such as product design and key components supply makes it difficult to develop technology-intensive industry in Korea. Such dependency also creates structural impediments to domestic parts industry development and to actively taking advantage of emerging market opportunities on the part of Korean industries.

B. *Substandard quality of parts*

While Korea is strategically vulnerable to Japanese willingness to supply parts, its own underdeveloped parts suppliers are hampering the production capability of its big businesses. S Electronics (one of the largest and best-managed *chaebol*) in Korea was experiencing several times higher defect rates in VTR production than its Japanese competition in 1991,[8] primarily because of substandard quality of over 2,000 different parts used in VTR assembly. Automobile production has been affected the same way (Kim and Cho, 1991). Thus, underdevelopment in small and medium-sized producers of parts and intermediate goods has emerged as a serious hinderance for Korea's ability to manufacture reliable, high-quality goods.

In Korea's industrial structure, where business conglomerates dominate the scene, many of the *chaebol* developed their own parts-producing subsidiaries. Since independent SMEs usually do not have sophisticated production techniques, mature technology, or good quality control, *chaebol* prefer to produce key components such as VTR heads and automobile transmissions in-house or through affiliated companies. However, in VTR production, for example, a *chaebol* electronics company cannot possibly organize and coordinate production of 2,000 different parts among its subsidiary and affiliated companies alone. Because there are limits to the number of parts producers a *chaebol* company can oversee, reliance on independent subcontractors is inevitable. Here the underdeveloped SMEs became the bottleneck that is now preventing Korea from making a transition into a producer of knowledge-intensive and high-quality goods.

Substandard quality of parts is attributable to several aspects of underdevelopment in basic manufacturing technology (KIET, 1989). First, backward linkages with intermediate product and materials industries in Korea are weak. As mentioned earlier, there were financial incentives for companies to import intermediate products and assemble final products rather than to produce them on their own. As a result, domestic materials used in parts production are often of poor quality, which in turn affects the parts' durability and function. Even though some of the intermediate materials producers are large conglomerates with high level of technology by Korean standards, often they cannot meet the standard of various materials needed in the manufacture of parts and products.[9]

Second, because Koreans have not yet developed in-depth know-how in precision machining, error margins in precision parts tend to be high. Similarly, durability of metal parts is low because of the backwardness of heat treatment techniques used in die manufacturing.[10] For parts that are durable and heat resistant, the dies that mold the parts should be made of even more durable and heat-resistant materials; advanced techniques to coat the insides of the dies to increase the durability are required. In addition, advanced know-how related to preventing dies from disfiguring molded parts in high-temperature environments is needed. Such skill-intensive heat treatment techniques take time for a company to develop, and only a few Korean companies have rudimentary skills in this area.[11] Underdevelopment in such heat treatment techniques results in high defect rates in casting (roughly 10–15% in general machinery parts production alone), increasing the unit cost of parts (KIET, 1989).

In addition, welding techniques for handling new materials such as stainless steel are at an elementary stage in Korea. Use of electronic beams or laser beams for welding is also at the initial stage of development, and electroplating techniques need improvement. Until the manufacturing technology in these areas improves significantly, it will be difficult to improve the

overall quality of parts produced in Korea. Because manufacturing technology at the parts producer level is based on soft skills that accumulate over a long period of time, the source of underdevelopment cannot be addressed overnight simply by purchasing production equipment. It will take time to build well-functioning backward linkages with parts industries, even though Korean industries are painfully aware of the limitations in their technological capability.

C. *Inaccessibility to production equipment*

Equipment used by parts producers is highly specialized, and production technology is embodied in the machinery. Since many parts are design-specific and cannot be easily produced by standardized machinery, parts manufacturers often have to design and make their own equipment. To be able to design and manufacture machinery to their specification, however, parts producers require high levels of design capability and need supporting industries such as tool and die industries. In an economy where skilled labor is very expensive and in short supply, few SMEs can afford technicians who can design equipment in-house. They usually have to rely on outsiders such as government research organizations for technical assistance. However, rarely can outside support meet all the needs of the parts producers, since a third party does not have information on company-specific needs. Supporting organizations' own lack of industry experience and engineering know-how also put limits on their ability to assist SMEs' technological needs.[12]

Building one's own equipment is not easy even when the design problems can be overcome. Weak backward linkages with machine tool and die industries and their own parts industries make it virtually impossible to make high-precision equipment domestically (KIET, 1989). Lack of technicians trained in operating machinery further complicates the problems. In addition, SMEs face the barrier of financing in equipment procurement. Parts-production equipments are technology-intensive and user-specific, requiring special licenses; thus, they are expensive. For example, imported small hobbing machines cost about 60 million won each while domestic equipment costs 18 million won per unit (KIET, 1989). Undercapitalized SMEs in Korea do not have the financing capability to purchase such expensive imported equipment, even though it is better and lasts longer than domestically produced machines. Due to these complications, many Korean parts producers do not have access to appropriate equipment, lowering their productivity.

D. *Inefficient utilization of equipment*

Gertler (1988, 1993) argues that efficient utilization of equipment depends on the ability of the users to support the system and to alter it to meet their own needs. Weak backward linkages affect the users' ability to understand the underlying technology that drives production equipment making it difficult for them to realize the machines' full potential. Korea's experience is a classic example of Gertler's paradigm.

The key advantage of flexibility is that it obviates the need to scrap fixed capital in order to produce new products (Gertler, 1988). Instead, machines can be reprogrammed to produce other products, extending their technical life. The ability of flexible machines to switch from one operation to another drastically reduces downtime and lowers the capital cost of the machine. In an economy that is not technologically advanced, users may have a limited capability to improve upon imported machinery and advance their technological know-how. Downtime of machinery is also long when there is trouble, since technicians do not have the expertise or know-how to fix the machinery.

In the past, Korea was able to have an efficient temporal utilization of capital assets simply by increasing the number of shifts per day (Ranis, 1973; Kwon and Kim, 1973). In a Fordist mass production system, such an operation enabled Korean industries to gain an edge in competition by lowering capital costs. However, as the market demand for products has changed to multiple product lines in small quantities, knowledge of techniques for efficient mass production of single items is no longer sufficient to keep an enterprise competitive in the world market. In particular, when Korea became a leading producer of original equipment manufacturing (OEM) products, many different parts with user-specific needs had to be produced in small quantities. The need to produce

many different parts in small batches necessitated adaptation of flexible manufacturing system using automated equipments. Lack of trained technicians who understand the fundamentals of equipments they use made it difficult for Korean manufacturers to efficiently utilize their automated capital investment. Especially for SMEs who cannot afford to hire a technician specifically to operate one piece of equipment, retrieving investment from capital equipment is rather difficult.

Kang et al. (1993) identified four problem areas associated with operation of production equipment in Korea.[13] First, one of the major stumbling blocks in utilizing production equipment for Korea's SMEs starts with selecting equipment that suits their needs.[14] Since SMEs in Korea do not have the in-depth understanding of equipment and production processes, they frequently choose equipment that is inadequate for their needs. Access to information on what types of machines are available is also a factor that hinders the right choice. Second, when SMEs have to select new equipment different from their previous procurement, interfacing the old and new equipment is difficult because of the lack of properly trained technicians to create a network of systems. Third, since technicians cannot or do not want to read manuals written in English, there are frequent troubles with the operation of machines.[15] Also, because technicians who do not understand the fundamentals of the equipment have limited abilities to repair it, downtime is long. Finally, software development skills that can facilitate system design are low. Even the leading semiconductor producers owned by *chaebol* have to rely on Japanese software companies to design their production systems (Kang et al., 1993). This is a practice that Korean DRAM producers would rather avoid if they had the choice. The simple know-how in increasing wafer yield is the name of the game in DRAM production, and letting the Japanese know about Korea's DRAM production process can be detrimental to Korea's competitive position vis-à-vis their Japanese rivals.

With the advancement of flexible manufacturing techniques, retrieving capital investment from production equipment increasingly depends on the technology level of the users. The short supply of trained technicians who can operate production equipment to its full potential prevents many of Korea's SMEs and even some big businesses from utilizing production equipment efficiently. Even though the cost of capital in Korea throughout most of its development period (Table II) has been significantly higher than in other developed countries, Korea was able to overcome this handicap in the past by efficient utilization of mass production equipment. But the high cost of capital becomes a burden on businesses when they cannot utilize their equipment to its full potential.

TABLE II
Interest rate differentials among countries

	Korea	U.S.A.	Japan	U.K.
1985	14.2	7.2	4.9	11.2
1986	12.8	5.9	2.9	10.8
1987	12.8	5.8	2.4	8.3
1988	14.5	8.4	2.4	12.6
1989	15.2	7.9	4.1	14.6
1990	15.5	8.0	5.1	14.7
1991 (Jan.)	18.4	6.4	8.1	14.0
1991 (June)	19.3	5.7	7.7	11.4
1992 (Jan. 3)	19.4	3.8	5.5	10.1
1992 (June)	16.9	3.6	4.5	10.2
1993 (April)	12.0	–	–	–

U.K.: 90 day Gilts.
U.S.: Treasury Bill (90 days).
Japan: Government Securities.
Korea: Guaranteed Corporate Bond Market Yield.

E. *Inability to support final product producers*

As illustrated by the Japanese automobile industry's just-in-time inventory system (*kanban*), sophisticated parts producers are the backbones of an efficient production system and superior final products. The ingenious subcontracting structure that combines the efficiency of market transactions and internal transactions minimized transaction costs and played a pivotal role in reducing production costs in Japan. Such institution building that can increase productivity and reduce transaction costs is, however, only possible with the support of well-developed parts industries. When parts producers are underdeveloped, they cannot meet stringent requirements such as producing high-quality products and delivering goods in time at minimum costs.

For example, Korean parts producers' inability to develop and design parts on their own forces

the assemblers to engage in the parts design and manufacturing of its subcontractors, thus diverting energy from new product development and increasing indirect costs. This is especially a burden on assemblers in industries such as automobiles and electronics, where the number of parts needed is large. It is a well-known fact that an efficient information exchange between final assemblers and subcontractors developed from a long term relationship brought the Japanese companies competitive edge over US companies who solely relied on market transactions. Given their sophisticated design capability, parts producers, instead of passively producing predesigned parts, could improve on the functioning of parts, enhancing the quality and reliability of final products. In contrast to the case of the Japanese, many of Korea's parts producers are unable to produce complex parts unless assemblers provide them with designs and other technical assistance.[16] In many cases, subcontractors blindly follow the diagrams provided by the assemblers, not really understanding how the part fits in the whole scheme of the final product. Parts produced in this manner often do not fit the specifications required by assemblers. Consequently, assemblers not only have to incur the added costs of providing design capabilities and technological assistance to the subcontractors, but also have to contend with low-quality parts. The opportunity cost of not having proper support from subcontractors adds to the assemblers' burden.

Thus, underdevelopment of Korean parts producers in the past was a major cause of the antagonistic relationship between assemblers and subcontractors in Korea (Kwak and Kim, 1991). Defective parts and untimely delivery increased assemblers' opportunity costs and management costs. Given the circumstances, implementation of a just-in-time-inventory system is at a preliminary stage at best. Assemblers tried to cut their losses as much as possible by negotiating rock-bottom prices for parts and throwing the burden of financing inventory costs onto the subcontractors. Payment in promissory notes with long-term maturity was a most serious element in the SMEs' financial plights. Such transactions placed subcontractors in a financially weaker position, which in turn hindered their capital and technological accumulation. The vicious cycle continued.

A survey conducted by KIET (Kim and Cho, 1991) shows that these antagonistic relationships are slowly changing, mostly because of the necessity for assemblers to nurture subcontractors for their own survival. According to the survey, one of the biggest difficulties faced by SMEs in parts manufacturing in 1991 was the stringent quality control requirements of the assemblers (Kim and Cho, 1991). The same survey indicates that the most commonly cited hardship faced by SMEs – the high cost of financing associated with receiving payment in discounted notes with long-term maturity – is no longer the leading problem. This change in attitude on the part of assemblers came with the awareness that their own survival now depends on the performance of SMEs. Interviews by the author with a number of automobile parts producers in July 1994 also revealed that the payment terms are no longer such serious problems, even though the terms varied with the *chaebol* group involved. Assemblers have become more concerned about parts quality than about the short-term benefits of throwing the burden of working capital financing onto the SMEs. Such a trend is certainly a change in the right direction. But, although organizational changes in subcontracting systems can improve the productivity of parts producers in a relatively short time, limitations from underdeveloped industrial infrastructure are harder to overcome.

F. *Labor supply and soft skill accumulation*

One of the benefits derived from agglomeration economies in industrial districts is the abundant pool of skilled labors. Mobility of skilled technicians and engineers facilitates information and technology exchange within the district, diffusing innovation and technology to other firms. However, when the labor market is underdeveloped, exchange of information through labor mobility comes at a significant cost to the firm that initially trains the labor.

Soft skills related to innovation and technology accumulation in applied technology are usually developed by subcontractors who specialize in narrow manufacturing fields. Soft skills are developed in daily production experiences, including efforts to improve the production process, and

accumulate in the know-how of technicians. Thus, technology development and innovation at the subcontractor level depends on human capital investment more than it does at the assembler level. Accordingly, a shortage of skilled technicians can be a big hindrance to the development of parts producers.

Much development literature cites the high level of education among the labor force as one of the major factors in the fast economic growth of Korea. However, as Amsden (1989, p. 219), Jacobs (1985, p. 269), and McGinn (1980, p. 228) point out, elitism of parents who desired valid credentials for their children for social advancement, along with too much emphasis on moral values, led to a surplus of trained personnel at the middle and higher educational levels. On the other hand, most vocational high schools were vocational in name only, since they lacked both equipment and the instructors qualified to demonstrate practical work skills. As a result, these schools became a refuge for students who were unable to pass examinations for academic schools or who lacked funds (Dodge, 1971, and McGinn et al., 1980, cited in Amsden, 1989). In addition, since there are no adequate social provisions for upward mobility for blue collar workers in a society ruled by Confucian ethics and values, there is little incentive to choose a technical career track. In a fast-growing economy, there is always an excess demand for skilled technicians, as was the case in Japan in the 1920s through 1940s (Lockwood, 1968). However, as a result of the bias in the educational system toward moral and political training and low social prestige attached to technical careers, there is no systematic solution to relieve the chronic shortage of trained technicians in Korea.

Vocational school graduates often come into the job market without adequate training; therefore, the burden of training falls on the shoulders of employers. Once the technicians are trained, they become targets for recruitment of both other SMEs and big businesses who need trained technicians. Since most of Korea's SMEs are not sophisticated enough to have their own production know-how, company-specific skill training is rather difficult – thus making it difficult for the companies to keep trained labor and making it easier for employees trained in general skills to leave the firm in search of higher pay and better working conditions.[17]

Until the SMEs can increase their productivity through technology development, it will be hard for them to increase their productivity through company specific training. Presently, the salaries paid to the technicians by the SMEs exceeds the salaries paid by the big businesses in Korea, if the salary levels are standardized by the productivity.[18] This unusual phenomenon potentially has many explanations but illustrates the difficulty of procuring labor for the SMEs. Thus, SMEs cannot take advantage of the differential labor market wages as the Japanese subcontractors do, making it difficult for them to reduce production costs (Hattori, 1991). High labor costs of SMEs translates into high production costs of final assemblers through intermediate input prices. The implications of the labor market where the wages of SMEs are higher than big businesses deserves further investigation, because soft skill accumulation holds the key to Korea's transition into technology intensive industries.

IV. Concluding remarks

With rapidly rising real wages that exceed productivity increases, Korea has lost much of its competitive advantage in labor-intensive industries, and a transition to technology-intensive industries has become necessary. The Korean government now realizes the limitations of such industrial infrastructure and is making a concerted effort to create effective backward linkages and to develop technology-intensive industries. But the catch-phrase used by the government and businesses – "Hi-Tech" industry development – will not materialize unless there is an accumulation of manufacturing technology at the level of parts producers so that they can adequately support the final product producers. Technology intensive industries need strong backward linkages with subcontractors who are capable of supplying quality parts in time to increase their productivity.

For the future economic growth of Korea, assembly of imported parts does not value add much for the regional economy. For example, OEM (original equipment manufacturing) of consumer electronics yields only 10–15% of value added. Margins in the garment industry are even

lower. Gereffi (1994) argues, economic development is better defined by the proportion of value added in a commodity chain, rather than whether the goods produced in the country are agricultural commodities or manufactured products as Chase-Dun suggested (1989). Developing backward linkages with subcontractors not only will increase the efficiency of production in Korea's manufacturing system, but also will result in higher value-added in Korea's manufactured goods. As parts are more technology intensive and provide higher profit margins, producing intermediate products is a key strategy to join the ranks of core countries. The multiplier effect of creating an extensive subcontracting structure within the economy will be also beneficial.

Notes

[1] One of the major details overlooked by government policy was the effect of industrial success on Korea's long-stable labor market. The population growth decreased from 2.4%, during the period 1964–1970 to 1.2% during the 1980s. This decrease was due to a highly successful population planning program initiated by the Korean government. In principle, once the labor supply becomes less elastic, even though in-migration from rural areas to urban centers continues, real wages start to increase (Lim, 1993). Thus, in 1975 the Korean economy passed the point of a perfectly elastic labor supply (Bai, 1982). However, despite this marked reduction in the size of the labor force, Korea did not experience a serious labor shortage. In spite of seemingly high wage hikes during these periods, productivity increases still exceeded wage increases, keeping Korea's export sector competitive. Further, in some years during the 1960s and early 1970s, wage hikes were often below the high inflation rate and real wages actually decreased. But in the second half of the 1980s, theory finally caught up with reality when structural imbalances in the labor market of this fast-growing economy accelerated real wage increases. As Korea began to experience increasing labor shortages in relation to supply, wage increases rose from 5.5% between 1970 and 1975 to 15.6% between 1976 and 1980 (Lim, 1992). During the three years 1988–1990, the average rate of wage increase was 18.5%, far exceeding the productivity growth for the same period (Lim, 1993). This condition continued to worsen after presidential candidate Roh Tae Woo declared political liberalization in June 1987, thus ushering in a more favorable social and political environment for militant labor union movements. Structural labor shortages combined with social and political changes forced real wages to continue to increase faster than productivity between 1990 and 1992. As a result, Korea's competitiveness in the labor-intensive product export market was seriously affected.
Highly dependent on exports for economic growth, Korea now faces the need to make a transition to more technology-intensive industries or to relocate its industries to areas with cheaper labor costs. Already, many of Korea's labor-intensive industries have relocated to Southeast Asia (Lee, 1994). Restructuring the domestic industries into more technology-intensive industries is less disruptive in terms of social stability than relying on direct foreign investment to solve problems derived from high wages.

[2] Companies interviewed at Banwol include Young Lim Industry, Dongyang Precision Gasket, Sambo Metal Industry Co., Ltd., Young Heung Industry, Jung Wha Politech Industry Ltd., Wooshin Electronics, and Samchun Electric Co., Ltd.

[3] The subcontracting ratio is defined as the number of subcontractors divided by the total number of small and medium-sized firms (times 100). Compared to Japanese automobile industry's subcontracting ratio of 43.7%, Korea's ratio of 44.6% seems very high. However, the number of subcontractors and parts producers in Japan include only the first level subcontractors, whereas in Korea the figure reflects the total number of parts producers. Thus, the two figures are not really comparable. The reason that Korean statistics reflect the total number of parts producers rather than the first tier subcontractors is because the parts industry structure is not multi-layered as that of the Japanese. Lack of specialization and other economic factors that can not be elaborated in-depth in this paper account for such anomalies.

[4] The specialization ratio is the number of specialized firms divided by the total number of small and medium-sized firms in one sector (times 100).

[5] Logic chips are also called ASICs (application specific integrated circuits).

[6] SMEs in Korea usually have to pay interest rates that are much higher than those paid by big businesses, above and beyond their business risk. Unlike Japan and Taiwan which managed to lower the interest rates of SMEs to accurately reflect their business risk, Korean SMEs continue to be plagued by high financing costs – primarily because of the financial policies the Korean government adopted in the past to promote fast economic growth (Chon and Lee, 1994). See Table III for differential interest rates SMEs have to pay (curb market rate) versus interest rates charged to mostly big companies who have access to bank loans.

[7] To develop one type of pedal for automobiles, for example, it costs about US$500,000 for dies, jiggers, and testing equipment. Because there are numerous models of automobiles even for one assembler, parts companies have to invest in several different types of dies.

[8] Interview with Bank of Korea, May 1994.

[9] For example, C Consulting Firm received a request from a German chemical company to find a metal fabrication shop that could manufacture tanks for chemical storage. Specifications required that the inside of the tank be coated with explosive titanium coating. Since the present supplier of tanks in Japan charged high prices for the tank, the German company was looking for alternative sources. C Consulting Firm asked Korea's leading steel manufacturer and metal fabricator, P Steel, to submit a bid. Surprisingly, the bid from P Steel was 150% of the price the Japanese charged the German firm. Since P Steel did not have technology that could coat steel with explosive titanium coating, it had to purchase the intermediate material from Japan. The Japanese competi-

TABLE III
Interest rates on various loans

Year	Curb market	Corporate bond	Bank loans	
			General	Export
1971	46.41	–	22.0	6.0
1972	38.97	–	19.0	6.0
1973	33.30	–	15.5	7.0
1974	40.56	–	15.5	9.0
1975	41.31	20.1	15.5	9.0
1976	40.47	20.4	17.0	8.0
1977	38.07	20.1	15.0	8.0
1978	41.22	21.1	18.5	9.0
1979	42.39	26.7	18.5	9.0
1980	44.94	30.1	24.3	15.0
1981	35.25	24.4	17.5–18.0	15.0
1982 (June)	33.12	17.3	10.0	10.0
1983	25.77	14.2	10.0	10.0
1984	24.84	14.1	10.0–11.5	10.0
1985	24.00	14.2	10.0–13.0	10.0
1986	23.10	12.8	10.0–12.0	10.0
1987	23.95	12.8	10.0–12.0	10.0
1988	23.07	14.5	10.0–12.0	10.0
1989	21.60	15.2	10.0–12.0	10.0
1990	–	16.4	16.4	10.0
1991	–	18.9	10.0–12.0	10.0

Source: Bank of Korea.
Unit: Percentage.

tion charged high prices for the material, knowing their business was being diverted away to Korea.

[10] Considering the impressive presence of world-renowned machinery makers in Korea such as Hyundai Heavy Industries and Daewoo Heavy Industries, it is surprising that Korea's tool and die industries remain undercapitalized and underdeveloped. They are so because Korea's drive for heavy and chemical industry development initiated in the 1970s concentrated on large scale-investment in capital equipment. Along with procuring heavy and chemical machinery from abroad, the government promoted general machinery industries including construction equipment and power generating equipment. The rapid rate of investment in the general machinery subsector resulted in an average annual growth rate of tangible fixed assets of 54% between 1975 and 1982 (Kim, 1983, cited in Amsden and Kim, 1986). Gross capital stock rose at an average annual rate of almost 60% between 1973 and 1981 (KDI, 1982, cited in Amsden and Kim, 1986).

As capital was channeled into big businesses during the heavy and chemical industry development stage, *chaebol* came to own the majority of the general machinery sector. The basic technology was not endogenously developed but largely licensed from abroad, partly because development costs of machinery from the ground up was too costly in this underdeveloped infrastructure. The fact that the general machinery sector accounted for a large fraction of foreign licenses, purchased from a multitude of sources and used for diverse purposes, indicates the difficulty of technology transfer that Korea began to face (Amsden and Kim, 1986). Also, the manufacture of industrial machinery, which was often regarded as one rough indicator of a country's technological stature, accounted for as little as 20% of the total general machinery production.

Because the reliance on foreign parts was high and most machinery shops were big assemblers of general machinery, the tool and die industry had little room for growth. Domestic demand for sophisticated machine tools was too small to nurture the growth of such infant industries. The advantages of tool and die industries lie with SMEs because these industries produce numerous product lines in small quantities. Accumulation of soft skills in the tool and die industry to handle materials and to design and manufacture quality parts provides the very basic know-how of capital equipment and parts production. The basic knowledge in these areas spreads into parts production and efficient utilization of purchased capital equipment.

[11] Why accumulation of soft skills such as heat treatment techniques is difficult in Korea is discussed later.

[12] Interview with Ministry of Trade and Resource officials in charge of SME development, July 1994.

[13] Also includes information from interview with D Precision Industry, officer in charge of SME automation at the Small and Medium-Sized Industry Promotion Corporation, and the official in charge of SMEs at the Ministry of Trade and Resources, July 1994.

[14] Interview with Korea Federation of Small Businesses, manager in charge of assisting automation of SMEs, July 1994.

[15] Such problems are not limited to SMEs but also affect advanced industries such as DRAM fabricators. Interview with semiconductor manufacturing equipment company in Santa Clara, California, August 1994.

[16] A KIET report from 1989 points out that parts manufacturers' lack of design capability is a major hinderance to quality parts production.

[17] Fundamentals of labor economics theory dictate that, if a company wants to keep trained labor, it should train employees for company-specific skills only. Training laborers in general skills gives them motivation to leave the company because general skills are marketable elsewhere. In addition, the company should pay workers below market wage during training and pay wages higher than market rate after training. The steep wage profile gives the employees less incentive to leave the company.

[18] Aoki's data (1988) show that the wage gap between the big companies and the first-tier subcontractors in Japan was reduced to an almost negligible difference in recent years. He interprets the narrowing wage gaps as caused by decreasing productivity differentials between the big companies and first-tier subcontractors.

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