Chapter 3

Approach from Industries — Comparison and Analysis of the Contagion

Foreword

The aim of this chapter is to provide a concrete illustration the above-mentioned hypotheses by focusing on the integrated circuit and the iron and steel industries. The case of the IC industry clearly shows the differences between South Korea and Taiwan. The iron and steel industry is a case where we can recognize the similarities between the two countries, and from which we can trace the spread of the crisis from Korea to Taiwan.

3.1 The Integrated Circuit Industry

It is very appropriate to focus on the integrated circuit (IC) industry for the purpose of comparing South Korea and Taiwan. This is firstly because the IC industry plays very important roles in the manufacturing sectors of the two countries. In Korea particularly, the IC industry is a shining symbol of the country's economic development. In Taiwan, too, the IC industry developed fast in the 1990s, and found itself in the spotlight as the banner bearer of Taiwan's industrial future. The second reason is that there are distinct differences between the IC industries of the two countries. The differences involve the pace of development, the nature of the enterprises engaged in it, product compositions, and the structure of the division of labor. Since these differences are caused by the different mechanisms of industrial development of the two countries, the IC industry enables us to identify the problems from which Korea is suffering, and to learn about Taiwan's strengths. Thirdly, the IC industries in Korea and Taiwan now demonstrate obviously different performances. While the Korean IC industry has suffered, since its peak in 1995, from a drastic drop in the value of output , its Taiwan counterpart is celebrating successful growth (Table 3-1 and 3-2). This industry plays an important role in both economies, and the contrasting performance of the IC sector has an impact on the general performance of the two economies.

In the following section, we will present an overview of the development process of the IC industries in the two countries, and then examine dif-

Table 3-1 Output of Korean IC Industry (in US$ 1 mil.)

	1994	1995	1996	1997
IC output	8,565	16,150	11,914	9,713
Share of Mos-Memories (%)	87.9	91.1	85.6	82.5

Note: The output includes only products of integrated IC makers and excludes output by specialized back-end makers.
Source: The Federation of Korean Industries, *Korean Economic Yearbook*, 1998.

Table 3-2 Output of Taiwanese IC Industry (in NTD100 mil., and US$ 1 mil.)

	1991	1992	1993	1994	1995	1996	1997
Design	73	86	117	124	193	218	363
Fabrication process	168	235	415	700	1,193	1,256	1,532
Assenmbly and testing process	—	—	—	—		408	584
Total	—	—	—	—		1,882	2,479
Converted in US dollars	—	—	—	—		6,846	7,611

Source: Industrial Technology Research Institute, *Bandaoti Nianjian* (Yearbook of semiconductor industry), in relevant years.

ferences between them. Next, we will examine the meaning of the differences in the IC industries as indicators of the general differences of industrial development in South Korea and Taiwan.

3.1.1 The same starting point, but diverging development paths [1]

As with the general electronics industries, the IC industry in Korea and Taiwan started in almost an identical way. In both countries, the industry was inaugurated in the second half of the 1960s by foreign firms that arrived to build assembly plants. The assembly processes in IC making were labor-intensive ones. Foreign firms came into Korea and Taiwan to take advantage of the low wages which were still common in that decade.

The crucial process in IC manufacturing is the fabrication process, in which circuits are printed on wafers. In advancing into this area, again, the two countries behaved similarly. In both, the governments began importing and developing related fabrication technologies in the 1970s. In South Korea, the Korea Institute of Electronics Technology and Korea Institute of Science and Technology conducted research on technologies for the manufacture and development of ICs. In Taiwan, the Electronics Research and Service Organization (ERSO), which belong to the government-managed Industrial Technology Research Institute (ITRI), undertook an IC project based on technology inducted from the U.S. firm RCA.

But when the stage was reached in the 1980s where the fabrication process was to be commercialized, the courses of development of the two countries diverged. In Korea, the government's R&D efforts did not directly lead to commercial IC production. Commercial IC manufacture started only after the big business groups called the chaebol decided to go in fully for it. The pioneer in this area was the Samsung group. Earlier, in the 1970s, two venture firms, Korea Semiconductor Inc. and Taehan Semiconductor, had been established to undertake semiconductor business, but both quickly failed and were absorbed by the Samsung group and Lucky Goldstar (LG) group. For some time after buying out Korea Semiconductor Inc., the Samsung group used it for the small-scale production of transistors and ICs for watches, but in 1982 decided to make it part of the group's core business. Following this decision, the group bought design technology from Micron Technology and manufacturing technology from Sharp. It developed 64K DRAM in 1983 and commenced mass production in the following year.

Following suit were the Hyundai and LG groups. Hyundai set up its electronics arm, Hyundai Electronics Ind. in 1983, and started 64K DRAM manufacture in 1984. LG had within its group Goldstar Semiconductor (originally Taehan Semiconductor) which it had purchased in 1979, and which was producing ICs for communication as well as bi-polar and linear ICs. Stimulated by Samsung and Hyundai, the LG group made up its mind to advance into the DRAM business, and in 1988 reoriented its business structure toward IC production. Goldstar Electron (now LG Semicon) was thus established in 1989, and all the IC business of the group was transferred there.

The Korean IC industry achieved fantastic growth following the advance of the three chaebols into this area. In 1992, Samsung Electronics Co. outstripped its Japanese rivals to reach the number one position which it had in the world in terms of DRAM market share. Today Samsung Electronics Co., Hyundai Electronics Ind., and LG Semicon are among the world's top ten DRAM manufacturers, with Samsung topping the list. But as a slump has set in in the industry, they are now suffering from an excessive concentration on DRAM production (Table 3-2)[2].

In Taiwan, ERSO's R&D project was successfully completed, but no private company volunteered to use the fruits of the research on a commercial basis. It was Robert Tsao and other members of the institute project who ventured to undertake the industrialization of the IC technology. They inaugurated United Microelectronics Corp. (UMC) in 1980, absorbing the visible and invisible achievements of the institute project, and received financial support from the government. This was the first private company in Taiwan to undertake the IC fabrication process.

ERSO, in the meantime, continued with its IC R&D project. In 1985, Morris Chang, who had long been working in the U.S. semiconductor business, was invited to join ITRI as its president. When Taiwan Semiconductor Manufacturing Co. (TSMC) was set up in 1987 to utilize the institute's R&D achievements in actual business, Chang was appointed chairman. He nurtured

TSMC as an IC company specializing in the foundry business, which means subcontracting fabrication. The choice of this route by TSMC oriented the whole Taiwanese IC industry, as will be explained later. This pattern of development has helped to protect the Taiwan IC business from the global semiconductor slump. In the mid-1990s, UMC also drastically reorganized itself and specialized in the foundry business.

In the second half of the 1980s, private business began to enter into IC areas by setting up new IC manufacturing firms. In DRAM production, Acer group and Texas Instruments set up a joint venture in 1989, which became the first DRAM manufacturer in Taiwan. In the 1990s, a series of new IC companies were set up and existing firms entered the DRAM business. But as a result of the semiconductor slump, all of them are now suffering from stagnant business performance, and some are planning to join the foundry business.

3.1.2 Differences and factors behind the differences

In some respects, there are marked differences between the IC industries of South Korea and Taiwan. The first difference pertains to the pace of development. The Korean IC industry developed more quickly than its Taiwanese counterpart. Even now, the Korean IC industry is larger in scale. Though a strict comparison is made difficult by different patterns of division of labor, as we shall later explain, the size difference is clear in the fact that the integrated IC makers in Korea alone (excluding specialized assembly firms) produced 9.7 billion U.S. dollars of products in 1997 while in Taiwan the whole IC industry produced just 7.6 billion dollars (Tables 3-1 and 3-2).

The second difference relates to the nature of the IC enterprises. In Korea, ICs are produced by three major chaebols (excepting specialized assembly firms), while the Taiwanese IC industry is led by TSMC and UMC, two enterprises originating from the government's development projects. These two firms specialize in IC production. Other IC makers in Taiwan are either venture enterprises or enterprises that have stepped into the area from related business lines.

The third difference is in product composition. Korea has overwhelmingly concentrated on memory, and DRAMs in particular (Table 3-1). Table 3-3 refers to Mos-Memory, but in substance this means DRAM. The weight of DRAM in Taiwan did increase in the 1990s, but is still not as heavy as in Korea. Taiwan's IC industry is largely still in the foundry business (Table 3-3).

These differences explain why the IC industries in the two countries performed differently in the IC slump after 1996. Table 3-4 compares the performance of Samsung Electronics Co. and TSMC, the leading IC companies in Korea and Taiwan, respectively. It is clear from this comparison that though Samsung Electronics Co. is far larger in size, TSMC is ahead in profitability (Samsung Electronics Co. has business lines other than IC). The sharp drop in IC prices seriously undermined Samsung Electronics Co.'s profit position, as the firm concentrated on DRAM production. By contrast, TSMC was not seriously affected, as the foundry business was a niche industry without overly sharp competition. TSMC produces on an individual contract basis a wide range of products whose prices do not fluctuate as vio-

Table 3-3 Composition of the Fabrication Processes of Taiwanese IC Industry (%)

	1992	1993	1994	1995	1996	1997
Standard products	60.0	59.7	63.4	63.8	54.0	44.4
Memories	29.2	36.0	43.0	50.9	42.6	38.1
DRAMs	—	15.1	21.9	26.5	26.8	27.4
Others	30.8	23.7	20.4	12.9	11.4	6.3
Contract-based production of ASIC	4.2	3.5	3.5	2.8	1.6	0.4
Foundry	35.8	36.8	33.1	33.4	44.4	55.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Same as Table 3-2.

Table 3-4 Performance of TSMC and Samsung Electronics Co. (in US$1 mil.)

	1994	1995	1996	1997
TSMC				
Sales (A)	737	1,055	1,443	1,349
Before-tax profit (B)	327	525	690	476
B/A (%)	44.4	49.8	48.2	35.3
Samsung Electronics Co.				
Sales (A)	14,336	20,991	18,804	19,411
Before-tax profit (B)	1,427	3,881	259	161
B/A (%)	10.0	18.5	1.4	0.8

Note: The figures are obtained by dividing the local currency-denominated figures by the average annual exchange rate of each year.
Source: Taiwan: Commercial Times, *Gongshang Shibao Shangshi Shanggui Sijibao Jikan* (Commercial Times listed and counter stock qurtely), 1997 Winter issue and *Caixun*; Korea: Korean Information Service Inc., *Sangjang Kiuo Boonsuk* (The analysis of listed companies).

lently as DRAM prices do. This has helped the firm to maintain its relative stability.

The fourth difference lies in the structure of the division of labor. In Korea, integrated IC makers form the core of the IC industry. There are specialized assembly firms as well, but they are all independent of the integrated manufacturers. In contrast, Taiwan has lacked, and still lacks, integrated IC manufacturing firms. Some moves are now being seen toward integrated IC manufacturing, the overwhelming majority of IC firms are still engaged either in the fabrication or assembly processes. Consequently, they are linked by trading relationships.

The characteristics of the two countries are not totally independent. In Korea, the fact that the IC business is undertaken by the chaebols alone has caused three other characteristics. Moreover, this fact is not accidental. In general in the Korean economy, resources are heavily concentrated in the hands of the chaebols, and these groups have definite advantages in starting new business. By the same token, venture businesses are seriously disadvantaged doing so. In addition, the chaebols had good reason to choose IC manufacturing as the main pillar of their business. As IC has broad uses not only in electronics but also machinery, chemical and other industries, the major Korean business groups found in it the key to their effort to become all-encompassing business concerns[3]. Their business development strategies also were harmonious with their concentration on IC. As we explained in the introductory chapter, the Korean chaebols, as well as the Korean government, took Japan as their model of development. Thus, they first chased and overtook Japan in the production of black-and-white and color TV, and in the 1980s almost caught up with Japan in VTR production. The next natural goal Korea set itself was outrivaling Japan in IC production.

These two factors, namely, the chaebols being at the core of the nascent IC industry, and Japan being set as the model, determined the course of development of the Korean IC industry. DRAM was chosen as the mainstay product line because it was one of the main products of the Japanese IC industry. Moreover, DRAM was suited for production and marketing by chaebols. On the production side, as Seo pointed out, the core of the DRAM making technology is embodied in the equipment itself[4]. The development of IC business therefore depends largely on the capacity to make huge investment into plants and equipment at an opportune time and to continue it. The chaebols had the capacity to mobilize large funds. They were also capable of quick decision-making, as the top owner-leaders would decide by themselves. In sense, DRAM was an ideal product for chaebols. On the marketing side, it was a commodity suited to chaebols because it was a standardized commodity[5]. The chaebols, who were not strong in marketing, were thus spared major effort to sell the IC products, and there was no need for them to cultivate special client relations with system product makers as end-users.

Integrated production was preferred because

the Korean groups took Japan as their model. There was no reason for them not to make this choice since they had enough funds to carry it out. In this sense, the Korean case stands in sharp contrast to Taiwan.

In Taiwan, the large business groups that characterized the Korean economy did not exist. It was therefore unrealistic to expect one or more of the existing enterprises to venture into this expensive and risky area of business. This means that financial limitations strongly characterized the Taiwan IC industry in its initial stage. Under these restrictions, the fabrication process firms had to work through existing assembly firms and never had the ambition to become integrated IC makers. In particular, foundry business firms do not need the funds required for designing nor marketing for themselves.

But fiscal structures alone cannot fully explain the characteristics of Taiwan's IC industry. There are positive aspects to the fact that IC firms were spin-offs of government projects, and that they opted for the foundry business. The strong entrepreneurship of Taiwanese businesspeople was behind the spin-offs. Though the historical origins of Taiwanese entrepreneur zeal are difficult to identify, at least since the 1970s there has been a strong social enthusiasm for individual enrichment through entrepreneurship, as people learned of a number of success stories. We call this the "Taiwan Dream[6]." Morris Chang preferred the strategy of specializing in the foundry business because he had a deep understanding of the U.S. IC industry. He knew that there were a large number of independent design houses in the U.S., and that if his firm offered foundry services on a contract basis, they would certainly welcome it.

3.1.3 The significance of the differences

In the following section, we further scrutinize the above-mentioned differences and the causes behind the differences. In this discussion, we first show that the chaebols, which brought about the success of the Korean IC industry, were also the cause for Korea's current difficulties. Second, we examine the significance of Japan and the United States as the predecessors for the Korean and Taiwanese IC industries. Third, we look at specialized Korean assembly firms in order to elaborate on the differences between the two countries.

3.1.3.(1) Merits and demerits of the chaebol-led development

Let us here summarize the reasons why the big Korean business groups succeeded in the IC industry, and particularly in the DRAM business: (1) DRAM is a standardized commodity, (2) it is an "equipment investment-dependent" type of product, (3) technological development in this area means more sophistication of fine processing techniques, and the pattern of development competition is rather simple, so therefore the future of this technology is easy to predict[7], (4) the factors crucial to this industry were fund-mobilizing capacity and the timing of decision-making, and the chaebols could meet these requirements perfectly, and (5) the development was accelerated by competition among the chaebols[8]. These advantages, however, had negative sides as well: the chaebols had the potential to overconcentrate their resources into a particular sector, leading to overheated and ultimately counter-productive competition.

In fact, the first weakness became apparent the moment the Korean IC industry became concentrated on DRAM production. To be competitive in the areas of other IC products, the manufacturers must develop design capacities and work together closely with manufacturers that produce systems equipped with ICs. The Korean IC makers lagged in both areas. For this reason, despite their advanced processing technology, they failed to multiply their business lines beyond DRAM production. Besides, chaebols with similar qualities were aiming at the same direction, not only each chaebol but in fact the entire Korean economy were increasingly concentrating on DRAM.

As regards competition, it is difficult to significantly differentiate DRAM products, as DRAM by nature is a standardized product. DRAM production is subject to economies of scale. By the same token, learning effects also work promptly. Therefore, excessive investment competition can easily occur. As Korean firms, now no longer chasing others but running at the top, continue the same old investment and development race, they found themselves falling into a trap which they themselves had set.

3.1.3.(2) Japan as the model, and linkages with the United States

South Korea has long emulated the Japanese industrial development model. Korea chose the IC industry as a strategic industry, and decided to concentrate on DRAM in the early half of the 1980s, precisely because of this orientation.

Emulating the Japanese model had a few advantages. First, it was relatively easy for Korea to take a bite of areas of business already mature in Japan. This was because in these areas Korea was able to turn to advantage its relatively low cost structure, and low wages in particular. Also, whenever Japan developed trade conflicts with importing countries, and the latter restricted imports from Japan, Korea would be in a position to fill in the lacuna with its own exports. As the IC industry was an advanced industry, Korea could not benefit much from the first factor, but did benefit significantly from the second. The U.S.-Japan semiconductor agreement signed in 1986 offered Korea a golden opportunity to make inroads into the international market. However, now that Korea has caught up with Japan in the IC business, there are good reasons to suspect that the advantages of following the Japan model may have been exhausted. In fact, no new post-DRAM frontline industry has emerged in Japan. Having achieved the number one position in the DRAM business, South Korea now finds that it must decide where to go itself.

In Taiwan, too, the government for long regarded Japan as a model. But since the 1980s and with the rise of the personal computer and IC industries, Taiwanese business began to deviate from this model. Instead, Taiwanese businesspeople began to decide their course in consideration of their linkages with the United States. The IC industry's option for the foundry business is a case in point. Today, there are intimate linkages between Taiwan IC makers in the foundry business and their client design houses in the United States. Though these are not closed relationships, the U.S. and Taiwan partners are organically linked. Precisely because of this division of labor, the Taiwanese IC industry has become able to enjoy good performance by sharing the benefits of a vigorous U.S. economy with its U.S. partners.

3.1.3.(3) Why is Anam Industrial Co. suffering?

So far, we have talked mainly of integrated IC manufacturers in South Korea. But the country also has specialized assembly IC makers. This business area was first opened in the 1960s by foreign companies, but was later joined by Korean firms. One of them, Anam Industrial Co. is said to be the world's largest company specializing in this business.

Like the integrated IC firms, Anam Industrial Co. is suffering from stagnant performance. Given the global semiconductor slump, this may come as no surprise. Even so, a question remains: why is Anam Industrial Co. doing poorly when its counterparts in Taiwan are doing well? Certainly, the general sluggishness of the market cannot explain Anam Industrial Co.'s plight. Besides, the company has been developing quite independently of the integrated IC makers. Its business style resembles that of Taiwanese foundry makers in that it too has as clients companies in the United States and other advanced industrial countries. It could thus be a model showing Korean industry an alternative path of development. Why then is it suffering?

Anam Industrial Co.'s difficulties stem from two factors[9]. On the one hand, it was affected by the general crisis of the Korean economy. On the other hand, it had the same problems as other Korean firms. Concerning the first aspect, the sudden drop in the won's exchange rate dealt a heavy blow to Anam Industrial Co. Before the crisis, the company had borrowed foreign currency-denominated money, and so its debt became inflated as the won drastically lost value. This, added to other factors explained later, pushed up the firm's debt-equity ratio from 429% in 1996 to 2167% in 1997. The exchange fluctuations are of course beyond the control and prediction of any single firm. In this sense, It was a victim of the economic crisis.

But the firm itself was not without problems. First, its debt-equity ratio was already alarmingly high before the crisis. In 1996, Taiwanese assembly makers had much lower debt-equity ratios: 47% for Advanced Semiconductor Engineering, Inc. and 18% for Siliconware Precision Industries Co., against 429% for Anam Industrial Co.. According to a survey by China Credit Infomation Service[10], the Taiwanese assembly IC firms (including mask makers) had an average debt-equity ratio of 71%,

with the highest being 212% and the lowest 9%. This comparison indicates that though its business lines resembled those of Taiwanese firms, Anam Industrial Co. had a much different financial structure. It is similar to other Korean firms in this respect.

Second, Anam Industrial Co., like the other chaebols, was trying to diversify its business lines and to branch out into non-IC areas. In this regard, Anam Construction, which suffered seriously from the construction slump, put a brake on the group's operations. On more than twenty occasions, the Anam group had to inject rescue funds totaling 1.02 trillion won into this one firm. Some Taiwanese firms have diversified into other business areas, but the industry as a whole is not as active in business line multiplication as its Korean counterpart. Electronic firms in particular rarely step into other businesses, though other firms have occasionally entered into electronics.

The case of Anam Industrial Co. shows major differences between Korea and Taiwan even in the assembly IC business, where visible similarities also exist.

3.1.4 Perspectives

Samsung Electronics Co. will start the mass production of 256 megabite DRAMs in the spring of 1999, according to the *Nihon Keizai Shimbun*, Jan. 6, 1999. Devoid of alternative choices, Korean IC makers have been compelled to stake their survival on DRAMs. Fortunately, the DRAM market is expected to improve in 1999, thus the Korean IC industry is likely to recover. But as DRAM prices are bumpy, the Korean IC industry will not be able to free itself from the vagaries of the market.

In Taiwan in the meantime, the highly profitable position of the foundry business is being gradually undermined. As is usual in the capitalist economy, high profits attract new entrants. Quite a few new firms from within and without Taiwan entered this business toward the end of 1998. They include Acer Semiconductor Manufacturing, Inc. (the descendant of Texas Instruments-Acer Inc.) of the Acer group, Nan Ya Technology Corporation of the Taiwan Plastics Group, Pacific Semiconductor Manufacturing of the Pacific Electric Wire & Cable group, all supported technologically by IBM. Under these circumstances, the profitability of the early starters, TSMC and UMC, will inevitably fall. But Taiwan as a whole may develop further as a global foundry business center.

3.2 The Iron and Steel Industry

In both South Korea and Taiwan, the steel industry has been an important industry, developed with government support. In the blast furnace sector which undertakes upstream steel production processes, Korea created Pohang Steel Corporation (POSCO) and Taiwan the China Steel Corporation (CSC), both state-owned corporations. With increasing demand after the late 1980s in the background, the privatization of these state corporation induced them to extend their business into the downstream sector, with this in turn causing the downstream steel makers to go into the upstream sector to break the blast furnace operators' monopoly there. It should be pointed out that this process occurred both in Korea and Taiwan, breaking the traditional division of labor pattern and invigorating investment. It is also important to note that the excessive production capacity in Korea invited overproduction and steel business failures, and the overproduced steel was rushed to Taiwan, causing a serious steel business slump there.

3.2.1 Korea

3.2.1.(1) The privatization of POSCO and its advance into the downstream sector

The full scale development of the Korean steel industry began with the commissioning in 1973 of the Pohang steel mill by the state-owned POSCO. The Park Chung-hee regime, right from the beginning, was strongly anxious to cultivate Korea's own steel industry. Ignoring Western countries' doubts about the feasibility of such a project, the Park government finally managed to complete the integrated steel mill, with an annual output capacity of 1.3 million tons, using Japanese compensation for Korean claims and technological assistance from the Japanese steel consortium. With the government's strong support, POSCO continued to grow, with the Pohang steel mill eventually

achieving an annual output capacity of 8.5 million tons. In parallel with the development of POSCO, private electric furnace and rolling makers in the downstream sector also made great progress. This division of labor soon became entrenched. State-owned POSCO monopolized the blast furnace and converter operations, as well as hot-rolling processes, while downstream private companies undertook to produce cold-rolled steel sheet and long products.

However, this upstream/downstream division of labor began to collapse in the 1980s as POSCO was privatized. POSCO's major stockholders, Korea Development Bank and the Ministry of Finance, in 1988 sold 27.3% of their shares on the stock exchange, as "people's shares." By 1992, their share had risen to 41.8%. Thus privatized, POSCO ceased to be a state arm for achieving national objectives, and become a business firm anxious to increase profits for the sake of its stockholders.

This transition coincided with a period when the Korean economy was growing rapidly thanks to increasing demand for steel products. Taking advantage of this situation, POSCO quickly advanced into downstream operations. It began in 1987 by starting the operation of its no.2 cold rolling mill, with a capacity of 1.02 million tons per year. As POSCO was fully equipped with hot-rolling processes, which are the preliminary stage for cold-rolling, its full-scale advance into cold-rolling came as a serious threat to the existing cold-rolled steel manufacturers such as Dong Bu Steel Corp. and Union Steel Mfg. In 1998, it introduced electric furnaces to fully enter integrated hot- and cold-rolling operation for the manufacture of stainless steel products. At that time, stainless steel makers such as Sammi Steel Corp. were merely buying hot-rolled plates, cold-rolling them, and sell the products. With the entry of POSCO into this business, these special steel firms found themselves in an inferior position to POSCO both in cost and output volume.

3.2.1.(2) Downstream makers go upstream and POSCO fights back

In this situation, downstream makers attempted to challenge POSCO's monopoly of the upstream sector by going upstream themselves. In the housing boom of the early 1990s, the demand for bar steel and rods for reinforced concrete increased rapidly, bringing windfall profits to electric furnace operators. These firms rushed to expand their production capacities. In fact, Korea's electric furnace and long products doubled from 1988 through 1994 (Table 3-5). During this boom, Hanbo, originally a housing company, advanced into the steel business by buying a steel rod maker, and decided to start hot-rolled steel using electric furnaces (Actual production started in 1996). This company also decided to begin production of cold-rolled plates and to build a Corex furnace mill which, though not a large facility, would produce high quality pig iron.

More shocking to the existing steel makers was the Hyundai group's decision to build an integrated steel mill including blast furnaces. Hyundai included in its group automobile, shipbuilding, and construction businesses, all which consumed a

Table 3-5 Korean Steel Industry's Production Capacities by Product (1000MT)

	1985		1988		1991		1994		1997	
	No. of enterprises	Capacities	No. of enterprises	Capacities	No. of enterprises	Capacities	No. of enterprises	Capacities	No. of enterprises	Capacities
Steel	14	15,612	13	21,656	13	25,860	14	35,329	14	43,354
Converter	1	9,100	1	14,500	1	17,500	1	21,154	1	21,154
Electric furnace	13	6,512	12	7,156	12	8,360	13	14,175	13	22,200
Bar steel	66	6,238	55	7,755	52	9,446	55	15,476	49	19,067
Hot-rolled coils	1	4,777	1	7,940	1	13,525	1	17,061	2	21,061
Cold-rolled steel belts	3	2,006	3	3,344	3	5,310	3	7,770	3	9,804
Stainless steel plates	5	213	7	278	12	501	11	549	11	719

Source: Korea Iron and Steel Association, *Steel Statistical Yearbook*, in relevant years.

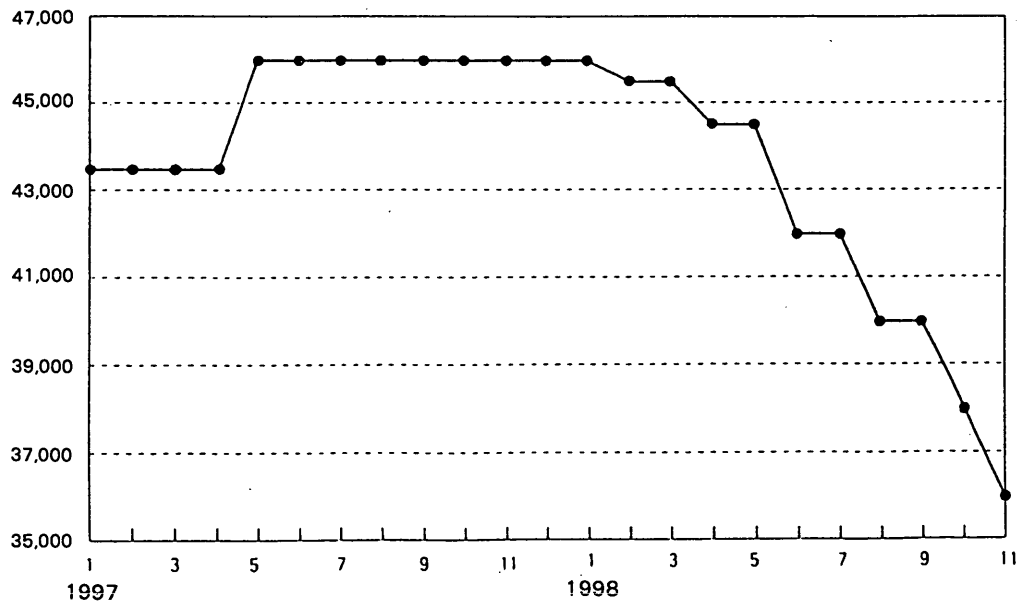
large amount of steel. Toward the end of the 1970, a project for building Korea's second integrated steel mill following the Pohang mill surfaced. Hyundai bidded for this project, but was defeated by POSCO. However, Hyundai never abandoned the ambition to have its own integrated mill. In 1994-95 Korea's export further expanded, stimulating the whole economy and invigorating demand for steel. In this situation, Hyundai was reported to have selected a site for its steel mill and started concrete planning. At that time, Hyundai Pipe Corp. decided to introduce a large 1.8 million ton-capacity cold-rolling facility, a move believed to be integral to the integrated mill project.

These moves by Hanbo and Hyundai shocked POSCO as well as downstream makers, and provoked counter actions. POSCO was the first to react. Simultaneously with Hanbo, it decided to begin producing hot-rolled steel using electric furnaces and also to build a Corex furnace. In May 1995, POSCO revived its once abandoned plan to build its No. 5 blast furnace as part of the Kwangyang mill. Reacting to Hanbo's and Hyundai's plans to advance into cold-rolling, Dong Bu, Union Steel, and POSCO expanded their capacities, in obvious moves to preempt their entry. As a consequence of these competitive moves, Korea's cold-rolled steel plate production capacity grew to 14 million tons by 1999.

3.2.1.(3) Failures

This frenzied expansion race gradually began to affect the steel makers' performance. The construction boom in the early 1990s that had brought windfall profits for the steel business soon gave place to a slump. The bar steel and rods makers, that had over-expanded their capacities, began to suffer from difficulties in raising operational funds. Added blows came in the form of rising interest rates and the won's depreciation beginning in the second half of 1996. Electric furnace operators went bankrupt one after another, culminating in Hanbo's bankruptcy in January 1997. The crisis then hit the special steel sector. Competition in this sector became intense as medium-sized manufacturers entered in the middle of the 1990s, following POSCO's entry in 1989. In stainless bar steel and some other specific areas, Sammi Steel and Kia Special Steel became engaged at the end of the

Figure 3-1 Inter-wholesaler Price of Korea-made Hot-rolled Steel Plates in Osaka (yen/ton)



Source: Made from *Quaterly Nikkei Shohin Joho* (Quarterly Nikkei Commodity Information). Jan.-Mar. 1999.

1980s in cutthroat competition through capacity expansion. As a result, Korea's stainless bar steel capacity by the middle of the 1990s was twice as large as domestic demand could justify. Nor did exports increase to absorb the surplus. The branch of industry thus quickly slipped into crisis. Sammi went bankrupt in March, 1997, followed by Kia in July and Seoul Steel toward the end of the year. As they went under with huge debts, their failures shock the banking business to its foundation.

The Korean economy contracted sharply in 1998 as the IMF-recommended demand-management program was implemented at a time when banks, who were saddled with accumulated bad loans, became reluctant to lend. Accordingly, demand for steel products dropped sharply. Steel makers, all of whom were suffering from fund shortages, turned to exports. Even virtually insolvent firms continued production, trying to sell products abroad. As the result of this, Korea's steel product exports reached 17,560,000 tons in 1998, up 51.9% from the previous year. Korean steel rushed to relatively well performing North America and Europe, as well as to Japan and Taiwan, at low prices (Figure 3-1), causing trade frictions.

3.2.2 Taiwan

3.2.2.(1) CSC and downstream steel makers

While POSCO leads the Korean steel business, CSC is the leader of the Taiwanese steel industry[11]. Aside from imports, crude steel is supplied by blast furnace and electric furnace operators. CSC is the only blast furnace operator in Taiwan (Table 3-6). Having a strong competitiveness vis-a-vis imports, this company has been in a position to fix the domestic primary product prices by itself. The firm has now seen its profitability go down drastically because of the current recession, but it still holds its price leader role. Although CSC's privileged position is a source of strong complaints from the downstream steel makers (*Economic Daily*, Dec. 8, 1998), they still have to continue to buy from it.

CSC is engaged not only in the integrated production of ordinary steel. Its facilities, including some under construction, encompass a broad range of capacities from facilities producing bar steel, rods, cold-rolled coils, galvanized plates, and painted plates to converters for stainless steel and stainless plates. In terms of stainless steel, which CSC began producing in 1994, and galvanized plate, the plant for which will be completed in 1999, other producers already existed in Taiwan. The competition between CSC and existing downstream makers on other products is also becoming serious. With its decisive advantage in financial and personnel capacities, and with its control over steel material supply, CSC is a formidable competitor to the downstream steel makers.

CSC's business expansion strategy has been internally motivated. Aware that its success has been due to incentives for workers which management was able to increase in accordance with the development of the company, CSC realized that this harmonious relation with workers could only be maintained by constantly expanding the size of business. Though it was privatized in 1995, this expansionist thrust remained as the company was allowed to retain its system of insider control. Being a company with good performance, CSC also en-

Table 3-6 Taiwan Steel Industry's Production Capacities by Product (July 1998, in 10,000 tons)

	Existing		Capacities under construction	Capacities under planning
	No. of enterprises	Capacities		
Converter	1	805	0	990
Electric furnace	17	812	0	370
Bar Steel	50	943	0	0
Hot-rolled coils	3	1,044	0	300
Cold-rolled coils	9	590	30	30
Cold-rolled stainless steel coils	6	70	21	16

Source: Taiwan Steel and Iron Industries Association, *Taiwan's Iron and Steel*, 1998.

joys an excellent cash position. This has enabled the firm to continue to expand and use its cash effectively. Privatization freed CSC from the restrictions on business diversification to which it had been subjected as a state-owned corporation. It started to set up a number of subsidiaries, and its advance into downstream business came as part of its business diversification efforts.

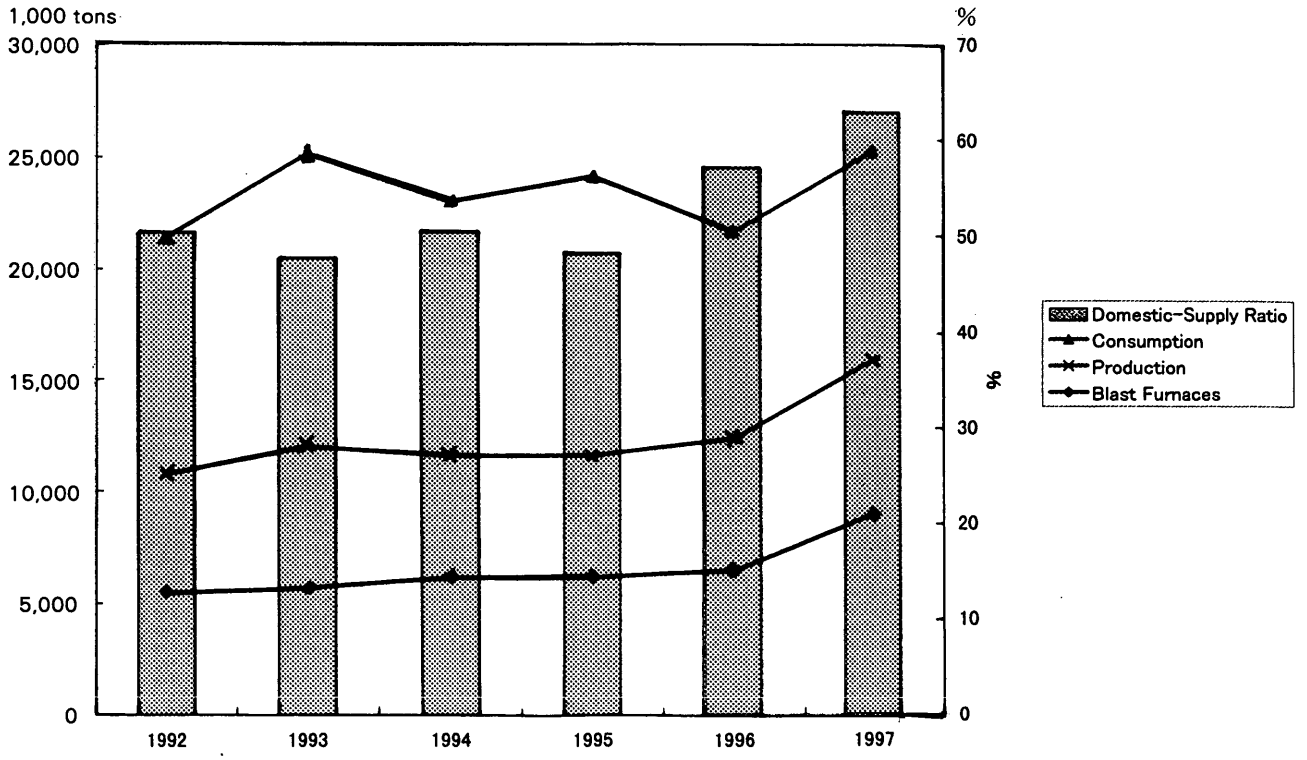
3.2.2.(2) The expanding supply-demand gap and downstream firms' entry into the blast furnace business

While CSC and the electric furnace operators rapidly expanded their production, the demand for steel grew even faster. CSC commissioned its fourth blast furnace nine years after the third was put into operation. In that period, Taiwan's demand for steel continued to rise, and exceeding supply by 10 million tons. Taiwan came to heavily depend on imports for its steel supply (Fig. 3-2).

The presence of this large supply-demand gap prompted downstream steel makers to go upstream. The Yieh Long group is one such steel maker. This group, which originally produced steel tubes, has already diversified its product lines and started making hot-rolled coils using imported slabs. Under the leadership of Y.T. Kuo, who moved there from CSC, the Yieh Long group initiated plans to build an integrated steel mill with three blast furnaces of an output capacity of 7.5 million tons, and applied to the government for support. But this project has not yet been launched, as the planned site is a reserve for migratory birds. Besides, water is not available in sufficient quantity, and proper carbon dioxide exhaust control measures have not yet been worked out. As an alternative, this group is now considering the construction of an integrated steel mill abroad.

Another business group which is anxious to acquire blast furnaces is the An Feng group. This group originated in alloy maker Feng An Metal Industrial Co., set up in 1983. In 1986, the firm established An Feng Steel Co. jointly with the Yieh Long group to produce hot-rolled coils. In 1994, it established Jenn An Steel Co. to go into cold-rolled coil production. The group also produces cement. The An Feng group planned a steel mill project

Figure 3-2 Apparent Consumption and Production of Iron and Steel in Taiwan



Source: Made from Taiwan Steel and Iron Industries Association, *Taiwan's Iron and Steel*, 1998.

with an Australian partner, and according to the plan, a 2.4 million ton-capable steel mill was to be built in Australia to supply crude steel slabs to Taiwan. But in July 1998 the group encountered financial difficulties. The KMT business sector reportedly extended a helping hand (*Economic Daily*, Aug. 3, 1998) but made it clear that it did not mean to rescue the whole group (*China Times*, Oct. 31, 1998). CSC, at the request of the KMT business sector, investigated the soundness of the Australia project and reported that the project would hardly pay, deciding not to take over it (*China Times*, Oct. 1, 1998).

In the end, the blast furnace projects planned by downstream firms have all been stranded. There is little prospect that they will materialize in the near future, as the steel business stagnation reached Taiwan while they were being delayed.

3.2.2.(3) Taiwan and the global steel slump

In 1998, Taiwan like other countries was affected by the worldwide steel business slump. As part of the globally-formed steel product market, Taiwan could not escape the influence of the worldwide supply-demand situation. The steel slump reached Taiwan in the form of growing imports of cheap steel products, including from South Korea. These imports have decreased in volume since 1997[12], but domestic prices of steel products have fallen drastically.

Cheap imports came as a blow to Taiwan's cold-rolled steel makers, who were already suffering from sharp mutual competition, as well as the electric furnace-operators and stainless steel makers. Moreover, from the autumn of 1988, banks began considering the steel enterprises, along with construction and foodstuff firms, to be risky, and subjected them to severe loan conditions. The failure of the An Feng group was partly due to this worsening of economic circumstances, along with its mismanagement. The import price of hot-rolled sheet, one of the main products of the An Feng group, is reported to have declined by half in the third quarter of 1998 compared with the end of 1997.

3.2.3 Conclusion

As explained above, a division of labor with public companies engaged in the upstream blast furnace sector and private companies in downstream steel products, had been established in both Korea and Taiwan since the 1970s. But in the late 1980s the traditional division of labor pattern broke because of the rapid increase in domestic demand and the privatization of public firms, as a result, the investment competition through mutual entering into each others' sectors intensified. This stemmed from the common development strategy of Korea and Taiwan, where the state itself had constructed integrated steel mills in the 1970s. And in the mid-1990s, Korea's steel companies, facing investment competition that was more serious than Taiwan, suffered from a serious business deterioration, and this situation influenced Taiwan through the inflow of cheap steel products from Korea.

Today, the steel business is suffering from stagnation both in Korea and Taiwan. Most of the downstream makers' earlier plans to go upstream have been canceled or postponed. In both countries, weaker downstream firms are being weeded out. In contrast, POSCO and CSC are operating profitably despite the steel slump. It is still anybody's guess whether, when the steel business recovers, downstream firms in the two countries will be able to resume their advance into the upstream area. But it is noted that the Japanese upstream sector already has excessive capacity. The steel business under these circumstances may be gradually reorganized in favor of a horizontal and vertical international division of labor.

Notes:

1. Regarding the similarity of the Korean and Taiwanese IC industries at their beginning and their later divergence, we base our analysis on Sato, Yukihito, "Diverging Development Paths of the Electronics Industry in Korea and Taiwan," *The Developing Economies*, 35 (4).
2. The LG group is likely to sell its semiconductor section to the Hyundai group in response to the impact of the economic crisis (*Nihon Keizai Shimbun*, Jan. 7, 1998). After buying it, Hyundai Electronics Ind. will become the second largest DRAM maker in the world.
3. Seo, Joung-hae, *Kigyo Senryaku to Sangyo Hatten : Kankoku Handotai Sangyo no Kyacchiappu Purosesu* (Corporate strategies and industrial development: the Korean semiconductor industry's catching up process), Tokyo: Hakuto Shobo, pp.79-80.
4. Ibid., pp.146-147.

5. Ibid., p.147.
6. Sato, Yukihito, "Taiwan no Keizai Hatten ni Okeru Seifu to Minkan Kigyo: Sangyo no Sentaku to Seika" (The Government and Firms in Taiwanese Economic Development) in Hattori, Tamio and Yukihito Sato ed. *Kankoku/Taiwan no Hatten Mekanizumu* (Development Mechanisms in Korea and Taiwan), Tokyo: Institute of Developing Economies, 1996, p.111.
7. Seo, op.cit., p.149.
8. Ibid., pp.177-178.
9. *Korea Economic Daily*, Oct. 26, 1998.
10. China Credit Information Service, *General Corporation Financial Analysis in Taiwan,* 1998.
11. CSC was established in 1971 as a joint venture between the government and private companies. But the foreign firm which had once participated withdrew, and few Taiwanese private firms took part in it. As a result, it was nationalized in 1977.
12. Steel consumption in Taiwan did not decrease sizably. The apparent consumption volume from January through August 1998 was 98% of the comparable volume for the same period of the previous year, according to the Taiwan Steel and Iron Industries Association.