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KOREAN

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SEMICONDUCTOR

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INDUSTRY

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ANALYSIS

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**Dataquest**

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## TABLE OF CONTENTS

| <u>Title</u>                                   | <u>Page</u> |
|--|-------------|
| INTRODUCTION                                   | 1           |
| CHAPTER 1--GEOGRAPHY AND DEMOGRAPHICS          | 3           |
| Geography                                      | 3           |
| Climate  | 4           |
| Population                                     | 5           |
| Language                                       | 6           |
| CHAPTER 2--HISTORICAL OVERVIEW                 | 9           |
| CHAPTER 3--KOREA AND THE UNITED STATES         | 11          |
| CHAPTER 4--CURRENT POLITICAL PERSPECTIVE       | 14          |
| CHAPTER 5--GOVERNMENT                          | 16          |
| Structure                                      | 16          |
| Ministries                                     | 17          |
| Financial Structure                            | 21          |
| Taxation                                       | 23          |
| CHAPTER 6--ECONOMY                             | 25          |
| Overview                                       | 25          |
| Current Five-Year Plan                         | 25          |
| Economic Analysis                              | 26          |
| CHAPTER 7--INDUSTRY                            | 31          |
| Overview                                       | 31          |
| Strategy for Industrial Development            | 31          |
| Foreign Investment                             | 33          |
| Work Force Profile                             | 37          |
| Infrastructure                                 | 39          |
| CHAPTER 8--SOUTH KOREAN SEMICONDUCTOR INDUSTRY | 41          |
| Historical Overview                            | 41          |
| Production                                     | 42          |
| Consumption                                    | 44          |
| Market Share                                   | 45          |
| Semiconductor Equipment and Materials Supplies | 46          |

# TABLE OF CONTENTS (Continued)

| <u>Title</u>   | <u>Page</u>  |
|--|--|
| CHAPTER 9--NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS | 49   |
| Review of Big Four Semiconductor Operations                | 51   |
| Semiconductor Plant Locations                              | 53   |
| Native Semiconductor Production                            | 56   |
| Joint Ventures and License Agreements                      | 58   |
| Capital Spending   | 60   |
| CHAPTER 10--COMPANY PROFILES                               | 63   |
| Daewoo   | 64   |
| Gold Star  | 68   |
| Hyundai  | 75   |
| Korea Electronics  | 80   |
| Samsung  | 85   |
| KETRI  | 93   |
| Dong Sung Moolsan  | 95   |
| Karibong Electronics                                       | 96   |
| KOMY Semiconductor   | 97   |
| Korea Diode  | 98   |
| Korea Fuji Electronics                                     | 99   |
| Korea Optoelectronics                                      | 100  |
| Rohm Korea   | 101  |
| APPENDIX A   | South Korean Semiconductor Industry Production,<br>Consumption, Imports, and Exports |
| APPENDIX B   | South Korean Semiconductor Market Share  |
| APPENDIX C   | South Korean Assembly Industry<br>Assembly Revenue by Company<br>Company Profiles    |
| APPENDIX D   | Semiconductor Wafer Foundry  |
| APPENDIX E   | Facilities Data  |

# LIST OF TABLES

| <u>Table</u> | <u>Title</u>  | <u>Page</u> |
|--------------|---|-------------|
| Table 1      | Climate Data--Seoul Area  | 5           |
| Table 2      | South Korean Population Statistics  | 6           |
| Table 3      | Population Density--1984  | 6           |
| Table 4      | Major Economic Indicators, History and Forecast   | 27          |
| Table 5      | Import/Export/Balance of Trade, History and Forecast  | 29          |
| Table 6      | Foreign Direct Investment by Country  | 34          |
| Table 7      | Work Force Profile  | 37          |
| Table 8      | South Korean Educational System--1983   | 38          |
| Table 9      | Average Monthly Wages and Workdays of<br>Industrial Production Workers                                  | 39          |
| Table 10     | Estimated South Korean Semiconductor Industry<br>Production   | 43          |
| Table 11     | Estimated Worldwide Semiconductor Industry<br>Production  | 43          |
| Table 12     | Estimated South Korean Semiconductor Industry<br>Consumption  | 44          |
| Table 13     | South Korean Semiconductor Consumption, Estimated<br>Share of Worldwide Manufacturers, Regional Summary | 45          |
| Table 14     | Materials Suppliers in South Korea  | 47          |
| Table 15     | Native South Korean Semiconductor Manufacturers   | 49          |
| Table 16     | Wafer Production Capacity of Selected Manufacturers--<br>1985   | 55          |
| Table 17     | Production Capacity by Wafer Size--1985   | 55          |
| Table 18     | Semiconductor Revenues of Samsung, Gold Star,<br>and KEC  | 56          |
| Table 19     | Native Semiconductor Revenues of Samsung, Gold Star,<br>and KEC by Technology                           | 57          |

LIST OF TABLES (Continued)

| <u>Table</u> | <u>Title</u>                                     | <u>Page</u> |
|--------------|--|-------------|
| Table 20     | Semiconductor Technology Alliances by Company    | 58          |
| Table 21     | Estimated Semiconductor-Related Capital Spending | 60          |
| Table 22     | Research and Development Facilities              | 61          |

## LIST OF FIGURES

|           | <u>Title</u>   | <u>Page</u> |
|-----------|--|-------------|
| Figure 1  | Location of Korea  | 3           |
| Figure 2  | South Korea  | 4           |
| Figure 3  | Korean Alphabet  | 7           |
| Figure 4  | Economic Planning Board  | 18          |
| Figure 5  | Ministry of Trade and Industry   | 19          |
| Figure 6  | Ministry of Science and Technology   | 20          |
| Figure 7  | South Korean Financial Institutions  | 22          |
| Figure 8  | GNP and GNP/Capita   | 28          |
| Figure 9  | Balance of Trade, History and Forecast   | 28          |
| Figure 10 | Share of Direct Investment by Country  | 35          |
| Figure 11 | Procedures for Foreign Investment Proposals                                      | 36          |
| Figure 12 | Semiconductor Manufacturing Locations  | 54          |
| Figure 13 | Daewoo Electronic Components Co., Ltd.--Manufacturing Facilities                 | 66          |
| Figure 14 | Gold Star Semiconductor, Ltd.--Manufacturing Facilities                          | 70          |
| Figure 15 | Hyundai Electronics Industries Co., Ltd.--Manufacturing Facilities               | 76          |
| Figure 16 | Korea Electronics Co., Ltd.--Manufacturing Facilities                            | 82          |
| Figure 17 | Samsung Semiconductor and Telecommunications Co., Ltd.--Manufacturing Facilities | 87          |



## INTRODUCTION

South Korea's rapid entry into the international semiconductor marketplace will have a measurable effect on the development of the worldwide semiconductor industry throughout the 1980s.

The course of South Korea's industrial growth has been, in the words of the World Bank, ". . . one of the outstanding success stories of international development." Beginning from a position near the bottom of the international income scale, and without the benefit of principal natural resources, South Korea launched itself into a series of economic development programs. In only two decades, these five-year programs have transformed the country from a marginally subsistent agricultural economy into one of Asia's major industrial nations.

As semiconductors become more important to the economic and defense strategies of all nations, governments are becoming increasingly concerned about establishing an indigenous semiconductor industry. South Korea is no exception. Only five years ago, South Korea's participation in the semiconductor industry was limited to discrete device production and circuit assembly. Now, it is taking the necessary steps to develop VLSI capability and become a major semiconductor supplier.

Reports in the business and electronics press represent South Korea as a threat to the current market leaders in the international semiconductor industry. The country's approach to the industry has been likened to that of Japan, with major government support and the involvement of powerful multibillion-dollar conglomerates. With the help of low labor costs and government financing, South Korea is working to achieve a position of world dominance in semiconductor production, similar to that it has already achieved in ship building, construction textiles, and steel. Together, industry and government are investing more than \$1 billion in production capacity and R&D activities. DATAQUEST estimates that South Korean semiconductor industry production (includes components and assemblies produced by native and foreign-owned manufacturers) grew at a 30 percent CAGR, from \$648 million in 1982, to \$1,259 million in 1984.

A significant difference between the South Korean strategy and the approach to developing a native semiconductor industry followed by Japan in the 1970s, is the South Korean willingness to form partnerships and alliances with foreign firms. With virtually no background in VLSI technology, the South Koreans are receiving technology licenses from foreign firms to help acquire state-of-the-art knowledge and techniques for producing high-end integrated circuits such as memories, microprocessors, and semicustom circuits.

South Korea's drive to acquire technology has been represented as a major aspect of the South Korean threat. It has been reported that Japan has in the past held back from transferring technology to South Korea for fear it will be used against Japan in the competition for world markets.

However, in spite of these negative reports, the large number of alliances already in effect between South Korean and foreign electronics manufacturers serves to underline the fact that alliances are playing an ever-growing role in the international electronic production business. South Korean firms have more than 200 technology agreements with Japanese companies. Samsung is manufacturing a 16-bit microcomputer under license to NEC. Daewoo is assembling an IBM PC-compatible with a high ratio of components from Japan; the computer is shipped to a U.S. manufacturer for sale. Further, South Korea has entered into more than 15 alliances and technology agreements with U.S. semiconductor manufacturers since 1981.

Currently, the native South Korean companies are suffering very badly as a result of the world recession in semiconductors. It is unfortunate that they entered the industry in a big way at its peak in 1984 and then suffered huge financial losses in 1985. South Korean companies now have the manufacturing expertise, the technology licenses, and the people in place to produce the product, but no market. DATAQUEST believes that lack of marketing in the United States and Europe is the principal weakness of the major South Korean semiconductor manufacturers. They are now being forced not only to be subcontractors for assembly and test but, through joint venture agreements, also to become foundries for major U.S. and European manufacturers and, to a lesser extent, for second-tier Japanese companies. However, DATAQUEST expects the Korean companies to design, fabricate, and market their own products in the West during the next business cycle.

South Korea's emergence as an internationally competitive semiconductor supplier provides a situation in which both threat and opportunity are present. DATAQUEST's Korean Semiconductor Industry Analysis provides detailed information on the South Korean semiconductor market and the native manufacturers' activities in developing semiconductor technology and production capacity. The report also describes the country's economy, government structure, and industrial policies as they relate to the semiconductor industry participants.

## CHAPTER 1--GEOGRAPHY AND DEMOGRAPHICS

### GEOGRAPHY

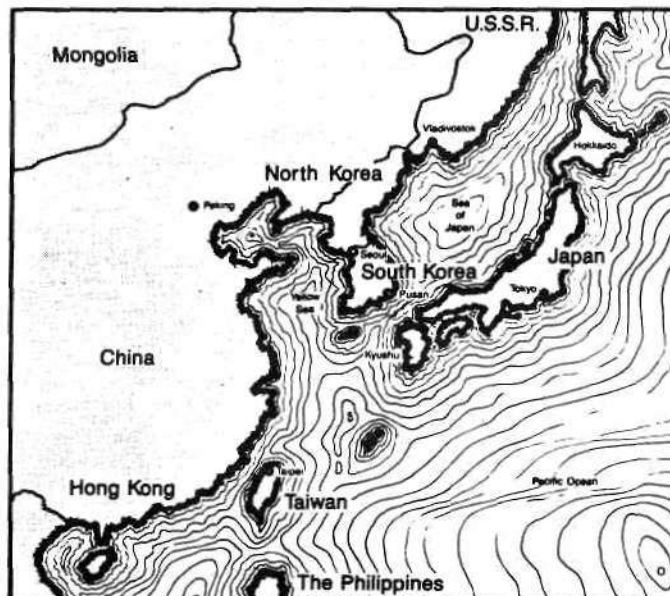
The Korean peninsula resembles Italy on the European continent. Its location relative to Asia and Japan is shown in Figure 1. The peninsula extends south from Manchuria, pointing toward Kyushu in southern Japan. The Korean peninsula is flanked by two oceans, the Sea of Japan on the east and the Yellow Sea on the west. Japan lies 125 miles off the southern tip of the peninsula.

The Korean peninsula was a single nation from the time the Silla Dynasty took power in 676 A.D., until World War II and the Korean War resulted in the politically separate North and South Korean nations. (For further details, see Chapter 3, Korea and the United States.) Bordered by China and Russia in the north, the Democratic People's Republic of Korea (North Korea) occupies the mountainous peninsula's upper half, while the Republic of Korea (South Korea) occupies the lower half and includes 3,579 contiguous islands.

The total area of the Korean peninsula is about 86,328 square miles. From north to south, the longest distance in the peninsula is 600 miles, and from west to east, the average distance is 170 miles. The Korean peninsula is comparable in size to the British Isles or New Zealand.

**Figure 1**

#### **LOCATION OF KOREA**



Source: DATAQUEST

South Korea comprises only 38,672 square miles. Its average width is 130 miles, and its length is approximately 300 miles from the demilitarized zone forming the boundary with North Korea at the 42nd parallel, to the southern tip of the peninsula. South Korea is shown in Figure 2.

Figure 2

**SOUTH KOREA**



Source: DATAQUEST

**CLIMATE**

South Korea lies in the northern temperate zone with a climate that has four distinct seasons. Influenced by monsoons, the latitudinal position and terrains of the country, and the currents running along its coasts, the climate shows wide variations and differences. The country spans nine latitudes and the elevation of terrain is greater in the north than in the south. Due to these geographical factors, the nearer the northern frontier, the lower the average temperature. The average temperature throughout the year is 13 degrees C along the southern coast and drops as low as 10 degrees C over the central and northern zones of Korea. The average monthly temperature, humidity, and precipitation in the Seoul area are shown in Table 1.

Table 1  
CLIMATE DATA--SEOUL AREA

| <u>Month</u> | <u>Temperature<br/>(Degrees C)</u> | <u>Humidity</u> | <u>Precipitation<br/>(mm)</u> |
|--------------|------------------------------------|-----------------|-------------------------------|
| January      | -3.7                               | 64%             | 28.0                          |
| February     | -3.2                               | 64%             | 5.0                           |
| March        | 5.2                                | 63%             | 32.8                          |
| April        | 10.1                               | 65%             | 216.7                         |
| May          | 16.5                               | 65%             | 90.3                          |
| June         | 21.6                               | 76%             | 118.8                         |
| July         | 22.7                               | 80%             | 259.2                         |
| August       | 22.8                               | 76%             | 331.5                         |
| September    | 19.6                               | 66%             | 58.3                          |
| October      | 13.0                               | 62%             | 44.9                          |
| November     | 8.6                                | 65%             | 10.6                          |
| December     | -3.8                               | 64%             | 46.3                          |

Source: Central Meteorological  
Office of Korea

#### POPULATION

According to the census completed on November 1, 1980, South Korea's total population stood at 37,436,315, an increase of 2,729,695 or 7.9 percent over the 1975 population estimate. This population growth rate of 7.9 percent represents the lowest for the country since 1960, and was 2.5 percentage points lower than the 10.4 percent growth rate reported during the 1970 through 1975 period. The population growth has continued to slow during the 1980s. The average yearly increase from 1980 to 1984 was less than 2 percent per year. Population statistics and projections for the years 1982 through 1986 are given in Table 2.

Prior to 1930, only 6 percent of the South Korean population lived in cities. Now, 60 percent of the population lives in cities and towns. Seoul, the capital of South Korea, is one of the world's largest cities, with a population approaching 10 million. The second largest city is Pusan, the country's principal port on the southeastern end of the peninsula.

South Korea has a total land area of 38,672 square miles inhabited by more than 40 million people. This equals an average population density of 1,038 people per square mile. South Korea is compared with Japan and Taiwan in Table 3. South Korea's 1984 population density of 1,038 people per square mile is higher than Japan's at 827 people per square mile, and lower than Taiwan's at 1,400 people per square mile.

Table 2

**SOUTH KOREAN POPULATION STATISTICS**  
(Thousands)

|            | <u>1982</u>   | <u>1983</u>   | <u>1984</u>   | <u>1985*</u>  | <u>1986*</u>  |
|------------|---------------|---------------|---------------|---------------|---------------|
| Men        | 19,847        | 20,162        | 20,479        | 20,798        | 21,116        |
| Women      | <u>19,484</u> | <u>19,789</u> | <u>20,099</u> | <u>20,411</u> | <u>20,723</u> |
| Total      | 39,331        | 39,951        | 40,578        | 41,209        | 41,839        |
| Birth Rate |               |               |               |               |               |
| Increase   | 1.57%         | 1.57%         | 1.57%         | 1.56%         | 1.56%         |

\*Estimated

Source: Korean Census Bureau

Table 3

**POPULATION DENSITY--1984**

| <u>Country</u> | Area<br>(Thousands of<br><u>Sq. Miles</u> ) | Population<br>( <u>Millions</u> ) | People/<br><u>Square Mile</u> |
|----------------|---|-----------------------------------|-------------------------------|
| Japan          | 146   | 120.8                             | 827                           |
| South Korea    | 39  | 40.5                              | 1,038                         |
| Taiwan         | 14  | 19.6                              | 1,400                         |

Source: DATAQUEST  
Asian Economic Journal, 1985

LANGUAGE

The origin of the Korean language has not been established definitely, but because the Korean people are primarily of Mongolian origin, it is believed that the Korean language is somewhat related to Manchu or Mongolian. However, the Korean and Mongolian languages are much further apart, both in vocabulary and syntax, than are English and German, or English and French.

The generally accepted theory indicates that the archetype of the Korean language was developed in the southern part of the peninsula among agrarian tribes. Another language developed among the hunting tribes in northern Korea. Although it is certain that the Chinese language and letters greatly influenced the language, Korean grammar is entirely different from Chinese grammar.

Koreans wrote exclusively in Chinese characters until the fifteenth century. In 1443, King Sejong of the Yi Dynasty, with the aid of several scholars, invented a phonetic alphabet called Hangul, which has been in use ever since.

The Korean alphabet is illustrated in Figure 3. It consists of 24 letters, of which 10 are vowels and 14 are consonants.

Figure 3

#### KOREAN ALPHABET

##### Consonants:

|          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>ㄱ</b> | <b>ㄴ</b> | <b>ㄷ</b> | <b>ㄹ</b> | <b>ㅁ</b> | <b>ㅂ</b> | <b>ㅅ</b> | <b>ㅇ</b> | <b>ㅈ</b> | <b>ㅊ</b> | <b>ㅋ</b> | <b>ㅌ</b> | <b>ㅍ</b> | <b>ㅎ</b> |
| G        | N        | D        | R        | M        | B        | S        | NG       | J        | CH       | K        | T        | P        | H        |

##### Compound Consonants (Hard Sounds):

|           |           |           |           |           |
|-----------|-----------|-----------|-----------|-----------|
| <b>ㄱㄱ</b> | <b>ㄷㄷ</b> | <b>ㅂㅂ</b> | <b>ㅅㅅ</b> | <b>ㅈㅈ</b> |
| GG        | DD        | BB        | SS        | JJ        |

##### Vowels:

|          |          |          |          |          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>ㅏ</b> | <b>ㅑ</b> | <b>ㅓ</b> | <b>ㅕ</b> | <b>ㅗ</b> | <b>ㅛ</b> | <b>ㅜ</b> | <b>ㅠ</b> | <b>ㅡ</b> | <b>ㅣ</b> |
| A(h)     | YA       | U(p)     | You(ng)  | O        | YO       | U        | YU       | EU       | I        |

\*EU is to indicate the silent vowel as in chick(e)n.

##### Compound Vowels:

|          |          |          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>ㅘ</b> | <b>ㅙ</b> | <b>ㅚ</b> | <b>ㅜ</b> | <b>ㅝ</b> | <b>ㅞ</b> | <b>ㅟ</b> | <b>ㅡ</b> |
| A(i)     | Ye(i)    | E(h)     | Ye(s)    | Oe(h)    | We(i)    | Uwi      | Eui      |

## CHAPTER 2--HISTORICAL OVERVIEW

Koreans are generally considered descendants of two strains--the nomadic tribes from Mongolia and the Aryan migrants from central and western Asia. Koreans are predominantly Mongoloid, but they have both Occidental and Oriental characteristics. They are a homogeneous race and are somewhat taller and hardier than the Chinese and Japanese.

Archaeologists believe that the original Koreans migrated from Manchuria during the Neolithic Age. Because of its situation as a land bridge between Asia and Japan, the Korean peninsula has been the site of power struggles and occupation forces throughout its history.

The Korean peninsula was ruled by three warring kingdoms between 57 B.C. and 676 A.D., when with the aid of China, the Silla Dynasty took power. During the next 200 years, Chinese cultural influence passed through Korea to Japan. In 918, the Silla Dynasty fell to the Koryo Dynasty, which gave Korea its present name. Korea was invaded by Mongol and Tartar armies in the eleventh century, and fell under the rule of Kublai Khan in 1213. The Mongols occupied Korea for the next 130 years. The Yi Dynasty brought the peninsula back under Korean rule in the late thirteenth century.

Korea was invaded by Japan in 1592 during its attack on China, and by Manchuria at the time of the Ming and Manchu power struggle in China. Korea withdrew from all foreign contact for the next 250 years, earning the name the "Hermit Kingdom." It did not again initiate contact with the outside world until the 1870s, when it opened its ports to Japanese ships, and signed treaties with the United States and several European countries.

Japan annexed Korea in 1910 during a power struggle with China and Russia, and ruled the peninsula until 1945. After Japan's defeat in World War II, Korea fell under the joint occupation of Russian and American troops, Russian in the north and American in the south. North Korean troops attacked and captured South Korea in June of 1950, and were pushed back by United Nations and South Korean forces several months later. The Korean War technically ended in June of 1953, and the Korean peninsula has remained divided into the two separate nations of North and South Korea.



### CHAPTER 3--KOREA AND THE UNITED STATES

Official relations between the independent nation of Korea and the United States opened on May 22, 1882 with the signing of a Treaty of Peace, Amity, Commerce and Navigation. The treaty, which marked the opening of Korea, signaled the end of Korea's preferred status as an isolationist nation, the so-called Hermit Kingdom.

The earliest contacts between Americans and Koreans came almost immediately after the signing of the treaty when American educators and medical missionaries journeyed to Korea and began the process of modernizing the Kingdom. American businessmen also arrived. Many took part in the process of laying down the first modern infrastructure of the country, such as railroads, electric generating plants, and other key enterprises.

Official U.S. interest in Korea was, however, overshadowed by U.S. concern with the rising power of Japan, especially as a naval presence in the Pacific. Japan's desire for Korea were of long standing, and when Japan formally annexed Korea as a colony in 1910, the United States raised no objection since its major objective was to secure the Philippines as its chief Asiatic outpost with the concurrence of the Japanese.

U.S.-Korean trade, which had initially been fairly significant, fell off markedly. The American diplomatic presence in Korea had already been ended in deference to Japanese desires, and contact between the two countries was largely carried on by the American Christian missions in Korea.

Many of these early Americans in Korea supported and encouraged the Koreans who were determined to regain Korea's independence and freedom from Japan. Many also encouraged Koreans who were dedicated to the establishment of a modern democracy on the peninsula.

At the Yalta and Potsdam meetings in 1945, detailed planning for the post-World War II future of Korea took place. It was agreed that there should be two separate Soviet and U.S. occupation zones on the peninsula to make it possible to accept the Japanese surrender, disarm Japanese troops, and evacuate them to Japan. For a variety of reasons, these two temporary occupation zones became permanent and in 1948, after an election sponsored by the United Nations, the Republic of Korea (South Korea) was established and the U.S. occupation was terminated. In the north, the Soviets refused to countenance elections and the Communist North Korean regime came into being with its leader, Kim Il-sung, installed by Joseph Stalin.

The North Korean communist regime attacked South Korea in 1950. The Truman administration saw this invasion as a threat not only to South Korea but to Japan as well, and the possible harbinger of a general

Soviet advance into non-communist Asia. American policy was reversed. The United States led the way in the formation of a United Nations military force to repulse the invasion and, after three years of fighting, the war ended in an armistice in 1953.

The United States entered into a treaty of mutual defense with South Korea three months after the armistice and restationed American military forces on the peninsula. The American government also entered into a program of economic and military aid to the Republic of Korea. This program assisted Korea's rapid economic development and, after 30 years of effort, culminated in South Korea's emergence as a major economic power in Asia.

Because there is a high degree of congruence in the foreign policy and domestic aims of both the U.S. and South Korean governments, relations between them are characterized by a sense of common purpose and a mutual desire for cooperation and partnership.

The U.S. and South Korean views on Northeast Asian defense and security are virtually identical. On the U.S. side, this has meant a continued significant American troop presence in South Korea at a high state of readiness and a steady upgrading of its arms and materials. On the South Korean side, it has meant a commitment of 600,000 men and women of the Korean armed forces to deter a renewed attack by Communist North Korea.

This degree of cooperative effort has taken institutional form in the creation of a Combined Forces Command. It has resulted in annual joint U.S.-South Korean defense preparedness exercises such as Team Spirit, which maintain a high state of readiness.

The two economies are complementary. Both nations are dedicated to the free enterprise capitalist system and the principles of free trade. This has made possible a high level of trade between the two countries, as significant American equity investment in South Korea, and growing Korean investment in the United States with its accompanying contributions to job creation and mutual economic gain. American lending institutions have also made possible advances in South Korean economic development.

Trade relations between the two countries have not been without friction, however. More than 46 percent of South Korean exports to the United States face nontariff barriers of one form or another. Anti-dumping actions have proved burdensome to Korean exporters, and losses have been high even when such dumping actions have been disallowed. More recently, the United States has moved to negotiate voluntary limits on Korean steel exports to America.

These problems have, however, been solved in the cooperative spirit that characterizes the overall relationship, and the basic friendship between the two countries has not been affected. The United States is clearly striving to keep its markets open to South Korean exports, which

are vital to the country's economic growth. The Generalized System of Preferences, although somewhat modified, has been extended to the continuing benefit of South Korea.

For its part, South Korea has made strong efforts to ensure that U.S. exporters have even greater access to its markets. Under its present Import Liberalization Program, the process is continuing. Revisions to its foreign investment law resulted in a major surge in U.S. investment in South Korea during 1984.

In an effort to reduce the U.S. trade deficit with South Korea, a South Korean purchasing mission visited the United States in February and March of 1984. The mission concluded well over \$2 billion in American purchases to help lower the deficit.

The United States has actively supported the Republic of Korea as South Korea has sought to attain its foreign policy goals. Among other forms of support, the United States has endorsed proposals from South Korea to open a dialogue with North Korea aimed at bringing about the peaceful unification of the Korean peninsula.

Looking to the future, it seems clear that the spirit of partnership and friendship will increase, and that new and more fruitful forms of economic cooperation will evolve, especially in the Pacific Basin area.

#### CHAPTER 4--CURRENT POLITICAL PERSPECTIVE

Within the foreseeable future, significant changes in the strategic environment surrounding Korea are unlikely. The powers surrounding the peninsula--the U.S.S.R., the People's Republic of China (PRC), and Japan--are not likely to undergo drastic changes either in terms of the direction of their political policies or in the balance of power among the nations.

The role of the United States in the security of South Korea will remain essentially unchanged as will the requirements placed upon it for the fulfillment of this role. As the country's economy grows and trade and economic relations between the United States and South Korea expand, so does America's and the West's stake in continued Northeast Asian security.

The Soviet interest in the Korean peninsula is linked to its global competition with the United States. The growth of South Korea's strength with a steady U.S. commitment is not likely to tempt the Soviets into risky initiatives. Prudential Bache notes that moves by South Korea to re-establish relations with the Soviet Union is a positive factor. Recently the Soviet Union announced it would participate in the 1988 Olympic Games in Seoul. Furthermore, North Korea is unlikely to make a move on its own without the Kremlin's backing, considering its almost total dependence on the Soviet Union for petroleum supplies (only three-day reserve in stock) and military equipment.

Prudential Bache also notes that recently both North and South Korea have started to seek mutual gains in the economic arena instead of the political arena. They are talking about exchanging their commodities and a possibility of co-managing the 1988 Seoul Olympic Games. Also, they agreed in principle, that families separated by the Korean War can meet each other in either country.

Although the PRC's interest in the Korean peninsula is more direct than the U.S.S.R.'s, its resources are more limited. The growth of a more liberal Chinese economic policy would highlight the already significant differences between the PRC and North Korea, as would a successful "non-Communist" change of power in the north. Despite these problems, the PRC's interest in keeping North Korea from siding with the U.S.S.R. are high. Thus the demands on the PRC for continuing present policies toward the peninsula also remain high.

South Korea's economy is expected to continue to grow at an annual rate exceeding 5 percent. By the end of this century, it is plausible to assume that the Republic will reach the present per capita income levels of West European nations. Korean economic planning will continue to be pragmatic, market oriented, and adaptive.

## CHAPTER 5--GOVERNMENT

### STRUCTURE

The Republic of Korea (South Korea) is a constitutional democracy. It is committed to democratic and peaceful pursuit of its domestic and international policies, renounces aggressive war, and abides by all international treaties and agreements.

The president of South Korea, as chief executive of the administration, represents the state vis-a-vis foreign states.

The legislative power is exercised by a unicameral National Assembly, whose members are elected by popular and secret vote under the party system.

The judiciary is independent and carries out its duties without outside interference. The judiciary functions on three levels: the Supreme Court, appellate courts, and district courts. The Supreme Court is empowered to rule on the constitutionality of a law or administrative decree. It also hears all final appeals from the courts and courts-martial.

Administratively, the country is divided into nine provinces and four special cities, Seoul, Pusan, Taegu, and Ichon, which enjoy provincial status. The president appoints the heads of all local governments either directly or indirectly.

### Executive Branch

Presidential Office: The Blue House  
1 Sejong-ro, Chongro-gu, Seoul

Office of Prime Minister: 77 Sejong-ro, Chongro-gu, Seoul

18 Ministries and 2 Boards

### Legislative Branch

National Assembly: 1 Youido-dong, Yongsungpo-gu, Seoul

15 standing committees  
National Assembly Secretariat  
National Assembly Library

## Judicial Branch

Supreme Court: 37 Sosomun-dong, Chung-gu, Seoul

3 appellate courts  
13 district courts  
1 family court

## MINISTRIES

The executive branch of the government is composed of presidential agencies and the cabinet. The cabinet has within its jurisdiction the state council, the Economic Planning Board, the National Unification Board, and 18 ministries. The ministries are listed below:

|                           |                           |
|---------------------------|---------------------------|
| Agriculture and Fisheries | Health and Social Affairs |
| Communications            | Home Affairs              |
| Construction              | Justice                   |
| Culture and Information   | Labor                     |
| Education                 | National Defense          |
| Energy and Resources      | Science and Technology    |
| Finance                   | Sports                    |
| Foreign Affairs           | Trade and Industry        |
| Government Administration | Transportation            |

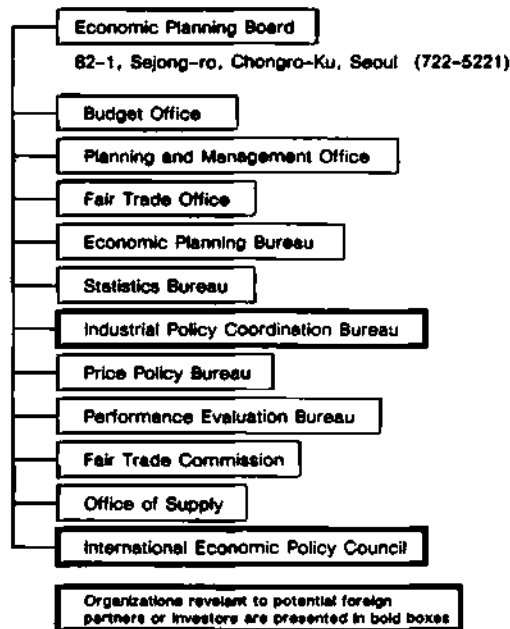
The ministries of primary interest to foreign investors are described in the following paragraphs.

## Economic Planning Board (EPB)

This board takes charge of matters related to overall planning for development of the national economy, formulation and execution of the government budget, overall coordination of plans for mobilization of resources, investment, technical development, and economic cooperation with foreign countries and international organizations. The Minister of Economic Planning is concurrently a Deputy Prime Minister, and coordinates business related to economy and finance among the ministries. The EPB has Offices of Budget, Planning and Management, and Fair Trade, and Bureaus of Economic Planning, Statistics, Industrial Policy Coordination, Price Policy, and Performance Evaluation. The EPB also has under its control and supervision the Fair Trade Commission, the Office of Supply, and the International Economic Policy Council. The agencies under the jurisdiction of the EPB are illustrated in Figure 4.

Figure 4

**ECONOMIC PLANNING BOARD**



Source: Ministry of Finance

**Ministry of Foreign Affairs (MFA)**

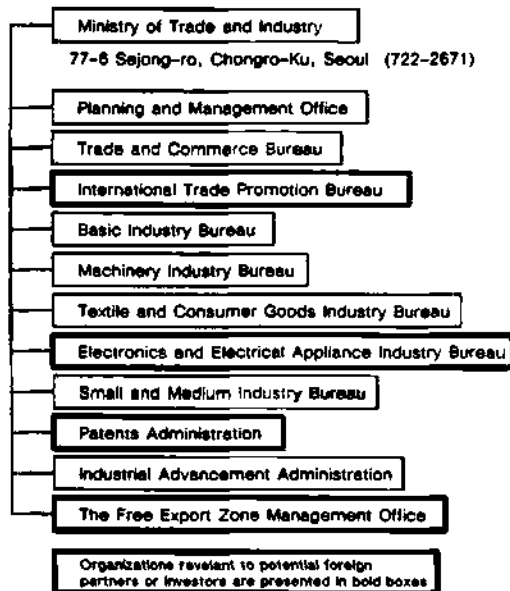
This ministry has jurisdiction over matters concerning diplomacy, trade and treaties with foreign countries, other international agreements, protection and guidance of South Korean nationals abroad, and international organization. The MFA Offices of Planning and Management, and Bureaus of Asian Affairs, European Affairs, African Affairs, Middle Eastern Affairs, American Affairs, Economic Affairs, Consular and Overseas Residents Affairs, Information and Cultural Affairs, and International Organizations and Treaties. It maintains the Foreign Affairs and National Security Institute, which trains diplomatic service officials. The MFA coordinates foreign investment activities. A further discussion of the procedures to be followed by foreign manufacturers in establishing local facilities is given in Chapter 7, Industry.

**Ministry of Trade and Industry (MTI)**

The structure of the MTI is shown in Figure 5. This ministry handles matters related to commerce, foreign trade, industry, patents, and standards of mineral and manufactured products. This ministry has the Office of Planning and Management, and the bureaus of Trade and Commerce, International Trade Promotion, Basic Industry, Machinery Industry, Textile and Consumer Goods Industry, Electronics and International Appliance Industry, and Small and Medium Industry. The ministry also controls such separate agencies as Patents Administration, the Industrial Advancement Administration, and the Free Export Zone Management Office.

Figure 5

**MINISTRY OF TRADE AND INDUSTRY**



Source: Ministry of Finance

**Ministry of Energy and Resources (MER)**

This ministry is in charge of development, production, import, and all other matters related to energy and other resources. It comprises the Offices of Planning and Management, and of Resources Policy, and the Bureaus of Electric Power, Mine, and Resources Development. It controls the Mines Registration Office and the Mines Safety Office.

**Ministry of Communications (MOC)**

This ministry controls postal affairs, telecommunications, postal exchange, postal savings, postal pension, and national life insurances. It comprises the Office of Planning and Management, and the Bureaus of Postal Service, Telecommunications Administration, Radio Regulation, and Postal Savings, Insurance, and Finance. The MOC has under its control the Local Communications Office, Postal Service Research Institute, Postal Giro and Money Order Center, Electronics and Telecommunications Research Institute, Central Radio Monitoring Office, and Communications Officials Training Institute.

**Ministry of Science and Technology (MST)**

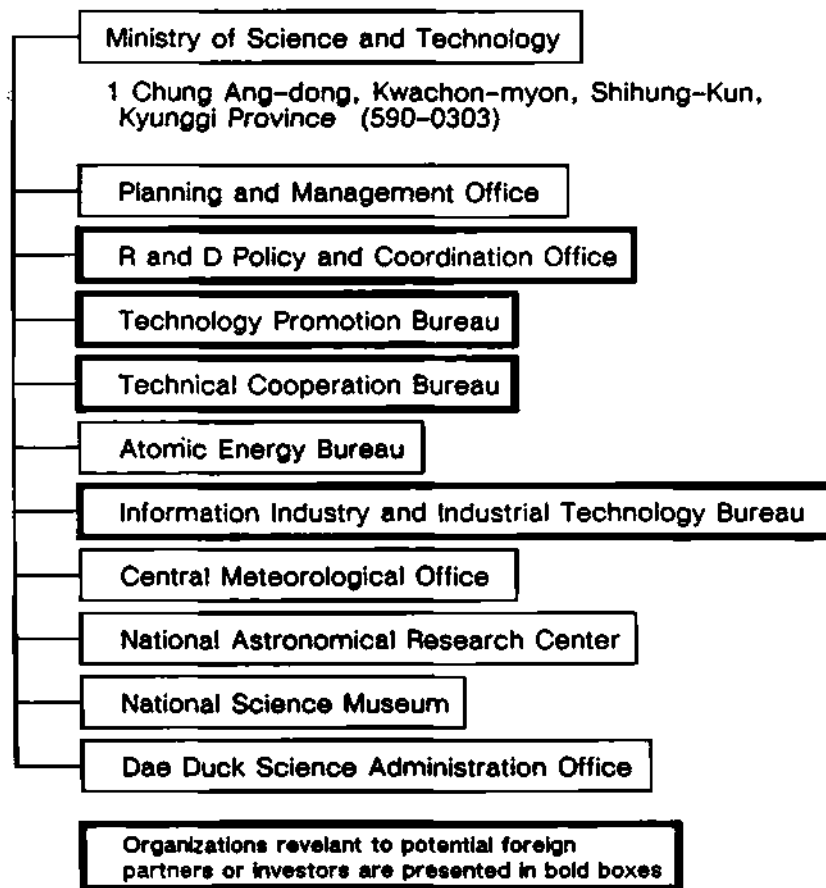
The structure of the MST is shown in Figure 6. The ministry handles matters related to the development and application of science and technology and the management of industrial and technical manpower. It



comprises the offices of Planning and Management and of R&D Policy and Coordination, and the bureaus of Technology Promotion, Technical Cooperation, Atomic Energy, and Information Industry and Industrial Technology. The Central Meteorological Service, National Astronomical Research Center, the National Science Museum, and the Dae Duck Science Administration Office are under its control.

Figure 6

MINISTRY OF SCIENCE AND TECHNOLOGY



Source: Ministry of Finance

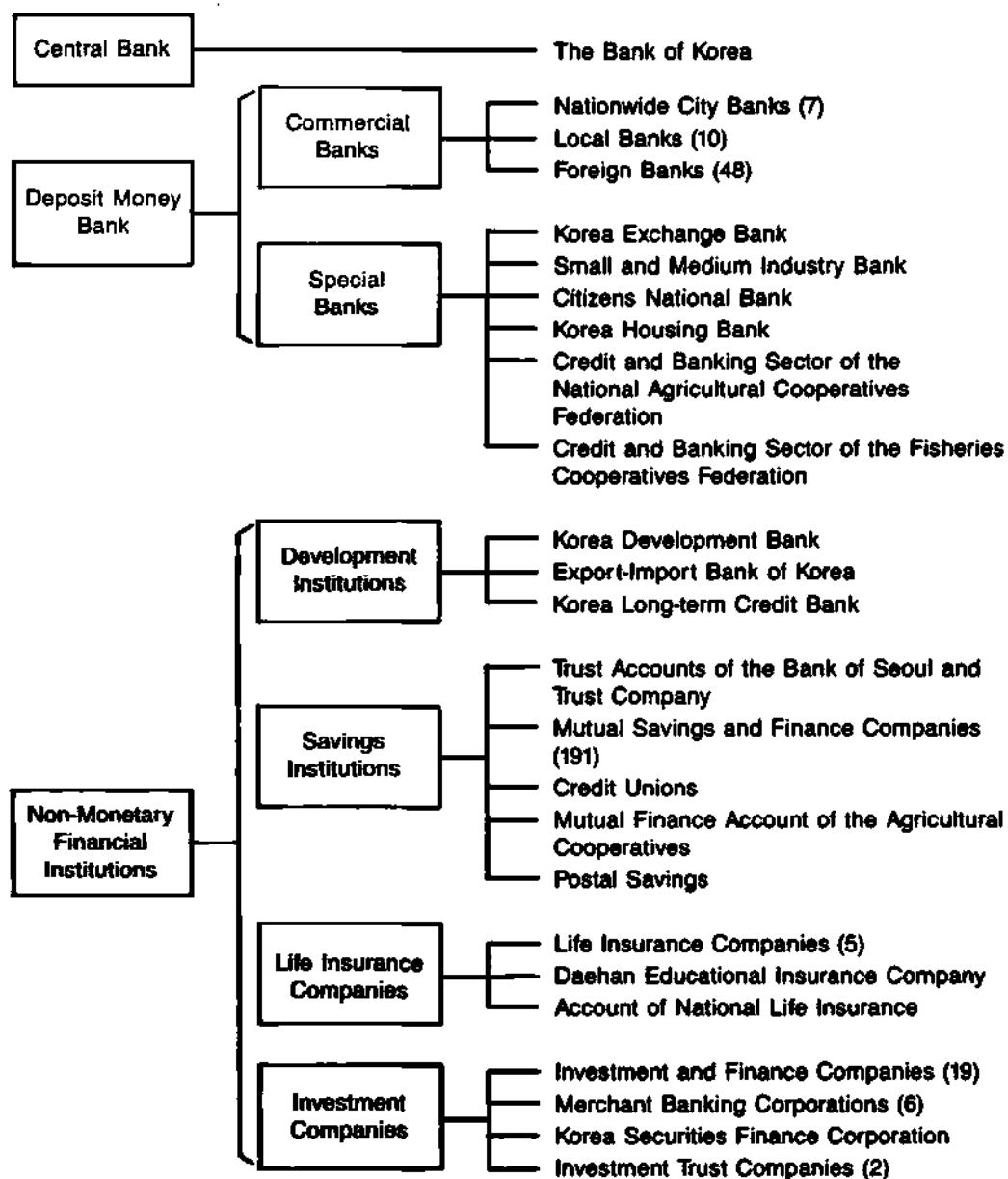
## FINANCIAL STRUCTURE

South Korea's financial sector includes a diversified commercial banking system, a wide range of secondary financial institutions, and a securities market. The development of the financial sector, particularly the banks, has not kept pace with the rest of the economy because it has been closely controlled. The government plans to turn over its share of national commercial banks to private interests while relying on the market mechanism and indirect means of control, such as reserve requirements, to regulate the industry. The securities, which permitted indirect foreign investment through unit trusts in 1981, will be further opened to foreign investors.

South Korea's financial institutions are as shown in Figure 7. They can be divided into two main categories: monetary institutions and other financial institutions. The former category includes the Bank of Korea and the deposit money banks, which, in turn, can be classified into the commercial banks and special banks according to their government economic goals.

Figure 7

**SOUTH KOREAN FINANCIAL INSTITUTIONS**



Note: Figures in parentheses denote the number of institutions as of the end of 1983

Source: Bank of Korea

## TAXATION

### Enactment of Tax Legislation

Under the South Korean constitution, tax legislation is enacted by the National Assembly. Proposed tax legislation is drafted by the related ministries (e.g., national taxes by the Ministry of Finance and local taxes by the Ministry of Home Affairs) and submitted to the National Assembly through a resolution by the State Council. Such proposals may also be submitted by members of the National Assembly. After passage by the National Assembly, the new tax laws are transmitted to the Administration for promulgation by the president. The law takes effect 20 days after promulgation, unless otherwise provided.

Generally, changes in South Korean tax laws become effective on the first day of January of the following year.

### Tax Systems

The Korean tax system comprises both national and local taxes. National taxes are divided into internal taxes, customs duties, defense taxes, and education taxes. The latter two are temporary taxes with revenues for a specific purpose; they are due to expire at the end of 1985 and 1986, respectively. Internal taxes that are presently in force consist of five direct and six indirect taxes. Dividends received are taxable. Dividends paid to nonresident foreign shareholders are subject to withholding taxes at the source.

## CHAPTER 6--ECONOMY

### OVERVIEW

In the early 1960s, the South Korean government introduced a system of five-year economic plans to provide a framework for economic development. These plans were drawn up by the government in consultation with other relevant bodies. In the years following the introduction of the first plan in 1962, South Korea achieved remarkable growth, with the gross national product increasing 4.5-fold in real terms to US\$57.4 billion in 1980.

During this period, South Korea's development was led by a variety of government incentives and an emphasis on exports, which reached US\$29.2 billion in 1984, compared to only US\$55 million in 1962. Expansion was also supported by successfully raising the share of domestic savings as a percent of GNP from 2.9 to 21.6 percent.

### CURRENT FIVE-YEAR PLAN

The rapid development during the 1960s and 1970s resulted in great changes in the economic environment in Korea. There was a marked shift in employment from agriculture to the manufacturing industry, and labor-intensive production gradually gave way to more technology and capital-intensive manufacturing processes. Inevitably, the speed of these changes led to a number of structural imbalances that became more and more problematic as the seventies drew to a close.

The current five-year plan (for the period from 1982 through 1987) was formulated to settle such problems as high inflation, the uneven distribution of financial assets, and many environmental problems.

Although high growth of about 7 to 8 percent a year was still envisaged, the emphasis shifted from the previous plans toward measures designed to promote stability, enhance efficiency, and balance future development. Great attention was also given to the question of social welfare and equity, in recognition of the public's growing concern over these matters.

The highest priority of the plan was to achieve economic stability, which was considered essential to strengthening industrial competitiveness and improving the balance of payments. The government expected the trade deficit to decline from US\$4.4 billion in 1980 to US\$2.4 billion in 1982, due to more rapid growth in exports than imports.

However, the international economic recession of 1980 through 1982 led to a vastly different outcome during the first two years of the plan's implementation than the government expected. While the average

GNP growth was fairly close to projections, the world recession was deeper and longer than expected, and export growth did not begin to reach the planned levels until the middle of 1983. On the other hand, the decline in crude oil prices and some other raw materials, together with very successful harvests and appropriate monetary and fiscal policies, allowed the fight against inflation to succeed far beyond expectations. Lower costs also reduced the value of imports, despite the gradual liberalization of import restrictions, and the 1983 trade deficit was only about a third of that experienced in 1981. The balance of trade improved more over the two-year period than was originally planned for the whole five-year period.

In 1984, the plan was revised to reflect the impact of the worldwide recession of 1980 through 1982. As well as updating the macroeconomic forecasts, the revised five-year plan further stresses the importance of linking the benefits of future economic growth to the enhancement of the people's general quality of life. The policies to be emphasized in the remaining three years of the plan period include reducing pollution, further improving the transportation system, encouraging more balanced regional development, and expanding public health facilities.

As originally drafted, the 1982 through 1987 five-year plan concentrated on solving the structural problems that had developed over the previous two decades of rapid growth and absorbing the effects of the second oil shock. The revised plan, seeks to deal with only those structural problems remaining after the successful adjustment to a low-inflation environment in 1982 and 1983, and is set against a different international environment.

### ECONOMIC ANALYSIS

The year 1983 was a period of regaining the growth momentum following the recession of the 1970s. South Korea's 1983 real GNP grew 9.5 percent over 1982. Consumer prices rose only 2.4 percent, wholesale price inflation was essentially flat, and the current account deficit declined 40 percent (see Table 4). In addition, the growth of external debt slowed substantially. For example, every year from 1978 to 1982, about US\$5.6 billion was added to South Korea's foreign debt. But in 1983, the increase was only US\$3.3 billion. South Korea's exports increased by US\$2.6 billion, reaching US\$24.4 billion in 1983, an 11.9 percent increase over 1982.

The year 1984 was another good period for the South Korean economy. GNP growth was robust at 7.7 percent, prices were stable, and the international balance of payments improved. In addition, government policies continued to make structural improvements to enhance efficiency and promote fairer competition in many areas of the economy.

Table 4

**MAJOR ECONOMIC INDICATORS  
HISTORY AND FORECAST  
(U.S. Dollars)**

|                               | <u>1962</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985*</u>             | <u>1986*</u>              |
|-------------------------------|-------------|-------------|-------------|-------------|--------------------------|---------------------------|
| GNP (Millions)                | 2,315       | 68,743      | 75,280      | 81,073      | 88,080 <sup>91,420</sup> | 97,300 <sup>108,822</sup> |
| Percent Growth                | 2.2%        | 5.6%        | 9.5%        | 7.7%        | 8.5%                     | 10.6%                     |
| Per Capita GNP                | 87          | 1,800       | 1,884       | 1,998       | 2,135                    | 2,331                     |
| Revenue (Billions of Won)     | N/A         | 10,858      | 11,075      | 13,721      | 13,275                   | N/F                       |
| Expenditure (Billions of Won) | N/A         | 11,125      | 11,424      | 13,346      | 12,934                   | N/F                       |
| Exchange Rate (Won/US\$)      | 257         | 749         | 796         | 827         | 260 <sup>850</sup>       | 260 <sup>900</sup>        |
| WPI** (100 at 1980)           | N/A         | 126.0       | 126.3       | 127.2       | 129.5                    | 130.3                     |
| CPI† (100 at 1980)            | N/A         | 130.1       | 134.5       | 137.6       | 141.5                    | 144.9                     |
| National Savings Ratio        | N/A         | 22.4%       | 24.4%       | 26.7%       | 28.1%                    | 29.3%                     |
| Total Investment to GNP       | N/A         | 27.0%       | 27.6%       | 28.7%       | 29.1%                    | 29.5%                     |
| Debt (Millions of Dollars)    | 89          | 37,200      | 40,500      | 43,100      | N/A                      | N/A                       |
| Debt to GNP                   | 3.8%        | 52.5%       | 53.8%       | 53.2%       | N/A                      | N/A                       |

\*Estimated

\*\*WPI = Wholesale Price Inflation

†CPI = Consumer Price Index

N/F = Not Forecast

N/A = Not Available

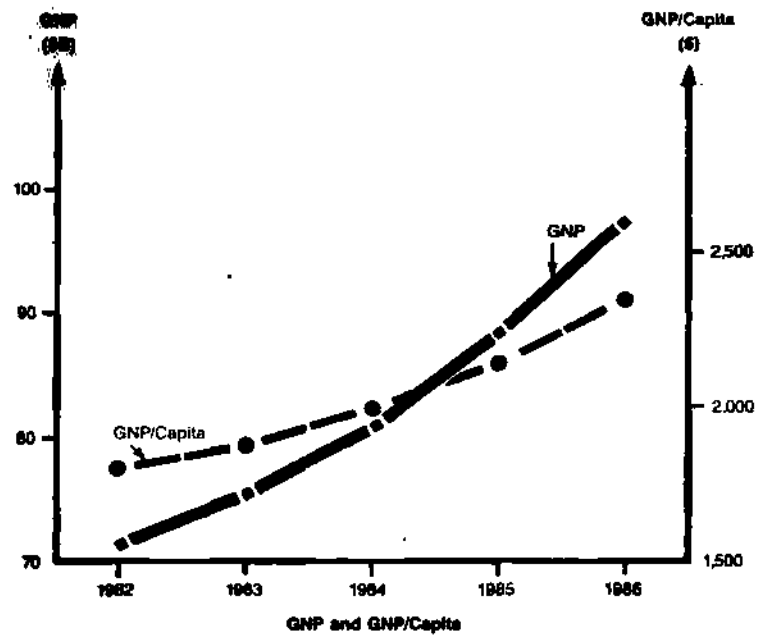
Source: South Korean Economic  
Planning Board

Because the 1983 South Korean economy surpassed virtually all principal goals under the old plan, GNP is now forecast to reach US\$97.3 billion by 1986, as opposed to US\$90 billion, while per capita GNP is expected to reach US\$2,331. Figure 8 illustrates the historical and forecast growth in GNP and the concurrent growth in per capita GNP for the years 1982 through 1986. The higher GNP should be sufficient to reduce unemployment to 3.8 percent from the 4.0 percent expected under the old plan.

Most striking in the revised economic plan's projections are the substantially lower inflation forecasts. The GNP deflator, widely regarded as the most important inflation indicator, is now expected to be rising at an annual rate of 2.0 percent at the end of 1986, as opposed to the 9.5 percent increase envisaged in the original plan.

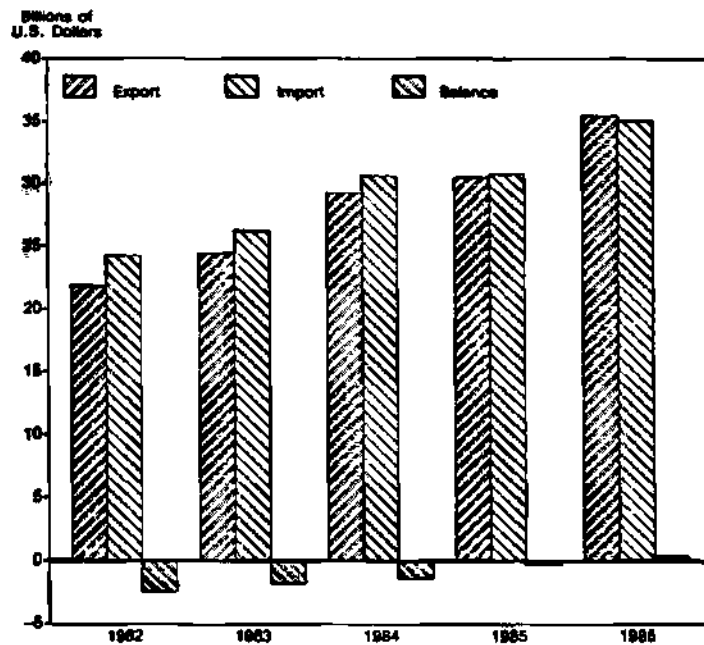
Another major feature of the plan is the recognition that South Korea's dependence on external trade will have to fall, given the continued rise in protectionism evidenced by the country's trading partners. The projection for 1986 merchandise exports has been decreased from US\$53.0 billion to US\$35.5 billion. The domestic market will continue to give impetus to growth, as it has done in the past two years, when export growth has been relatively sluggish. South Korea's balance of trade for the years 1982 through 1986 is illustrated in Figure 9.

**Figure 8**  
**GNP AND GNP/CAPITA**



Source: South Korean Economic Planning Board

**Figure 9**  
**BALANCE OF TRADE**  
**HISTORY AND FORECAST**



Source: Economic Planning Board  
Projection 1985-1986



Table 5 shows South Korean imports and exports by its major trading partners. South Korea is a net exporter to the United States, and increased its exports to the United States from \$6.2 billion in 1982 to \$10.5 billion in 1984. Imports from the United States have been held at a much lower growth, increasing only slightly from \$6.0 billion in 1982 to \$6.9 billion in 1984.

Table 5

IMPORT/EXPORT/BALANCE OF TRADE  
HISTORY AND FORECAST  
(Millions of U.S. Dollars)

| Geographic Segment | 1982    | 1983    | 1984    | 1985*  | 1986*  |
|--------------------|---------|---------|---------|--------|--------|
| United States      |         |         |         |        |        |
| Export             | 6,243   | 8,245   | 10,479  | N/F    | N/F    |
| Import             | 5,956   | 6,274   | 6,876   | N/F    | N/F    |
| Balance            | 287     | 1,971   | 3,604   | N/F    | N/F    |
| Japan              |         |         |         |        |        |
| Export             | 3,388   | 3,404   | 4,602   | N/F    | N/F    |
| Import             | 5,305   | 6,238   | 7,640   | N/F    | N/F    |
| Balance            | (1,917) | (2,834) | (3,038) | N/F    | N/F    |
| Asia**             |         |         |         |        |        |
| Export             | 4,856   | 5,690   | 5,906   | N/F    | N/F    |
| Import             | 6,693   | 6,535   | 6,940   | N/F    | N/F    |
| Balance            | (1,837) | (845)   | (1,034) | N/F    | N/F    |
| Europe             |         |         |         |        |        |
| Export             | 3,741   | 3,803   | 4,048   | N/F    | N/F    |
| Import             | 2,126   | 2,740   | 3,535   | N/F    | N/F    |
| Balance            | 1,615   | 1,063   | 513     | N/F    | N/F    |
| ROW                |         |         |         |        |        |
| Export             | 3,625   | 3,303   | 4,210   | N/F    | N/F    |
| Import             | 4,171   | 4,405   | 5,641   | N/F    | N/F    |
| Balance            | (546)   | (1,102) | (1,431) | N/F    | N/F    |
| Total              |         |         |         |        |        |
| Export             | 21,853  | 24,445  | 29,245  | 30,500 | 35,500 |
| Import             | 24,251  | 26,192  | 30,631  | 30,800 | 35,100 |
| Balance            | (2,398) | (1,747) | (1,386) | (300)  | 400    |

\*Estimated

\*\*Excluding Japan

N/F = Not Forecast

Source: Economic Planning Board  
Projection, 1985-1986

South Korea has been a net importer from Japan, importing \$5.3 billion of goods in 1982 and exporting only \$3.4 billion. This negative balance of trade with Japan has intensified over the last two years as imports from Japan have risen faster than exports to Japan. The negative balance of trade of \$1.9 billion in 1982 rose to \$3.0 billion in 1984.

The Asian category of trading partners includes Taiwan, Hong Kong, Malaysia, the Philippines, Singapore, and India. The Asian group represents a larger block of trade with South Korea than does Japan and has lower trade deficit. Europe represented a larger export market for South Korean products in 1982 and 1983 than Japan. In 1984, South Korean exports to Japan exceeded those to Europe by an estimated \$554 million.

Increased South Korean interaction with U.S. markets over this period have placed the United States at the top of South Korea's major export market at \$10.5 billion in 1984. During 1984, the United States and Europe represented the only positive balance of trade partners for South Korea among the five regional trading partners.

## CHAPTER 7--INDUSTRY

### OVERVIEW

During the last two decades, South Korea has made remarkable economic progress and the rapidly expanding economy has provided increased markets for domestic products. Although the oil and resources crises have created difficulties for the economy, South Korea has maintained a rising GNP during the 1980s. The 1982 GNP was 5.6 percent over the previous year, and 1984 was 7.7 percent higher than 1983. The government will continue its long-term economic development plan without significant deviation from its original objectives. As a growing economy with room for development, South Korea currently offers substantial investment opportunities, particularly in the electronics and semiconductors areas.

While the country has no significant natural physical resources, its abundant labor force provides one of the country's most important assets. This well-educated labor force has proven to be easily trainable, productive, highly motivated, and dedicated to work. The tax incentives offered to assist targeted industries are considered more advantageous than those offered by other developing countries, and the government gives strong tax and banking incentives for export promotion. In addition, repatriation of capital and profit remittances are legally guaranteed, and the property of foreign investors is protected by law. Adequate electricity, transportation, communication, industrial water, and industrial estate infrastructural facilities have been developed for high-technology manufacturing industries.

The following section describes the South Korean government's strategy for attracting and supporting industrial development, including the financial incentives offered to non-Korean investors and the project application process. Foreign direct investment in South Korea is described, as is the work force and the industrial infrastructure.

### STRATEGY FOR INDUSTRIAL DEVELOPMENT

Quality has become increasingly important in the international electronics marketplace. Strengthening the industrial infrastructure and raising the level of technology is essential to achieve this. Major aspects of South Korean industrial policy reflect these goals, and include free market competition, increased levels of research and development, support for the small and medium industrial companies, and selection of industrial winners. The South Korean government is supporting a range of programs designed to speed the country's transition into a significant participant in the worldwide high-technology marketplace. The following sections describe the programs and policies that are most relevant to the South Korean electronics industry.

## Science and Technology Investment

Under the current five-year economic plan, the ratio of the government's science and technology investments against its GNP will rise from 0.89 percent in 1981 to 2 percent by 1986. South Korea's level of investment as a percent of GNP is approaching that of the world's industrial leaders. West Germany tops the list with a ratio of 2.7 percent, followed by the United States at 2.6 percent and Japan at 2.4 percent. South Korea's industrial development strategy calls for raising a "special technology development fund." The value of this fund is estimated at \$380 million, and is earmarked to finance specified science and technology projects over the five-year period of the current economic plan (1982 through 1987).

The Ministry of Science and Technology developed a list of target industries, and has asked private businesses and government research institutions to place emphasis on developing 635 technologies essential to promote the target industries. The target industries are:

- Semiconductor
- Computer
- Biochemical
- Precision machinery
- Bioengineering
- Materials
- Textiles
- Energy and resources
- Plant engineering industries

The government also offers financial and technological support to venture groups seeking to establish new, technology-intensive businesses that use newly developed technological know-how.

## Tax Incentives

South Korean tax law grants a variety of tax incentives, including reduced corporate and individual income taxes, five-year tax holidays, and additional first-year depreciation or special depreciation allowances designed to encourage certain capital expenditures. Exporting firms are allowed special reserves for the development of overseas markets. These firms are also allowed certain deductions from revenues received from foreign transactions.

Further temporary tax incentives are granted under the Foreign Capital Inducement Act (FCIA) of 1982. This law states that a foreign investment company is fully exempt from income taxes on the portion of taxable income attributable to the foreign investment for a period of five years. After five years, the exemption is reduced to 50 percent for the next three years.

Under the FCIA, a foreign investment company is also exempt from property taxes and sales acquisition taxes in the same manner as stated above. A foreign shareholder is exempt from taxes on income from investments in South Korea at 100 percent for the first five years, and 50 percent for the succeeding three years. Interest and related income from foreign-currency loans are tax exempt.

Further, the FCIA states that royalties to foreigners are fully exempt from income taxes for five years from the date of government approval and are 50 percent exempt for the succeeding three years.

#### **FOREIGN INVESTMENT**

As clearly stated in the FCIA, the government's fundamental policy regarding foreign capital is ". . . to effectively induce and protect foreign capital conducive to the sound development of the national economy and the improvement of the international balance of payments, and to properly manage such foreign capital."

Based on this policy, the South Korean government has developed policies designed to attract and protect the foreign investment that is vital to the economy. Government policy contributes not only to the promotion of economic cooperation with foreign countries, but also strengthens the international competitiveness of the nation's industries, and fosters development of advanced technology.

In addition, the government has revised the FCIA, introducing an automatic approval system and a negative list system that was devised to more clearly define desirable projects. These revisions effectively simplify the authorization procedure for some projects. Further, by stating those projects not eligible for support, the negative list system has substantially widened the range of projects that may be considered.

### Foreign Direct Investment

The level of foreign direct investment in South Korea is increasing. As shown in Table 6, total foreign direct investment for the 22-year period from 1962 through 1984 was \$2.1 billion. Yet the amount of foreign investment in 1984 alone consisted of nearly 20 percent of the total investment for the previous 22-year period.

The major foreign investor over the 1962 through 1983 period was Japan, which accounted for 49.5 percent of the total dollars. However, U.S. participation is increasing. As shown in Figure 10, the United States was the largest investor in South Korea in 1984, accounting for 45.6 percent of total investment dollars in that year.

Table 6

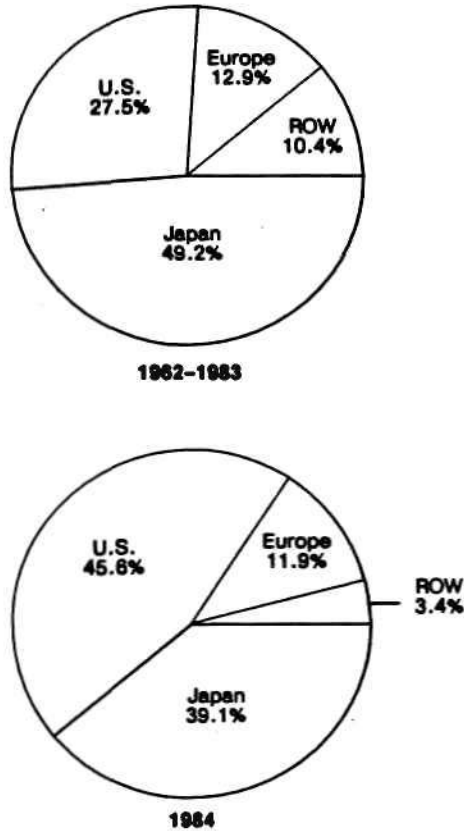
#### FOREIGN DIRECT INVESTMENT BY COUNTRY (Millions of Dollars)

| <u>Total Investment</u>       | <u>United States</u> | <u>Japan</u> | <u>Europe</u> | <u>Others</u> | <u>Total</u> |
|-------------------------------|----------------------|--------------|---------------|---------------|--------------|
| 1962-1984                     | \$662.4              | \$1,007.2    | \$270.9       | \$192.7       | \$2,133.2    |
| 1962-1983                     | \$471.4              | \$ 843.4     | \$221.1       | \$178.3       | \$1,714.2    |
| 1984                          | \$191.0              | \$ 163.8     | \$ 49.8       | \$ 14.4       | \$ 419.0     |
| 1984 as a percent<br>of total | 28.8%                | 16.3%        | 18.3%         | 7.5%          | 19.6%        |

Source: DATAQUEST  
Economic Planning Board

Figure 10

SHARES OF DIRECT INVESTMENT BY COUNTRY  
(Percent)



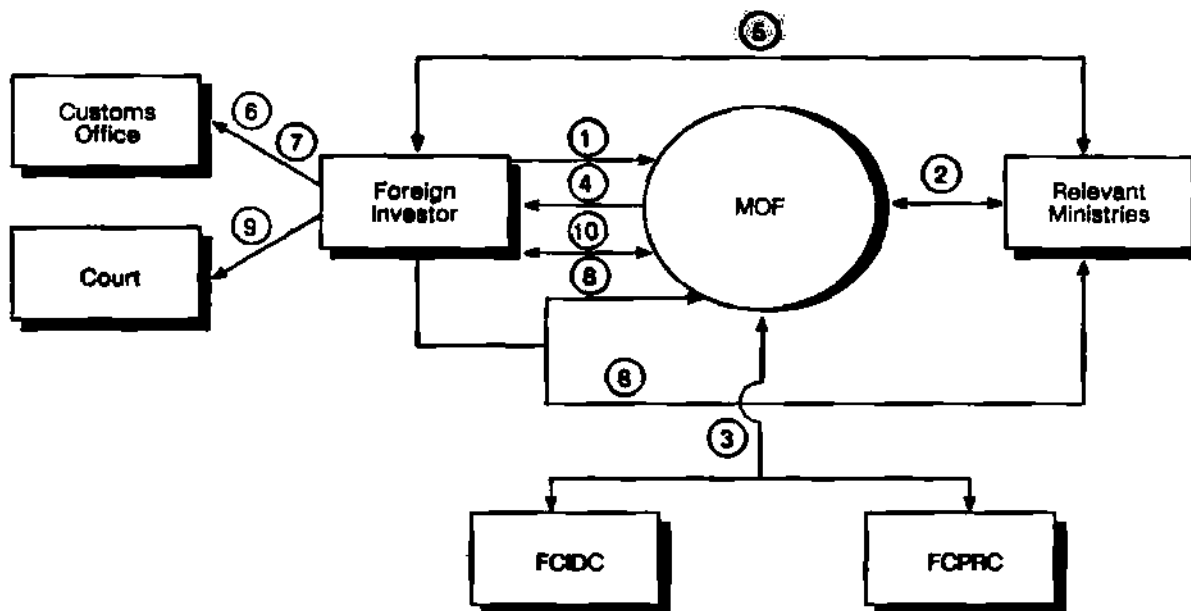
Source: DATAQUEST

The foreign investment application and implementation process, and the offices administering each step, are illustrated in Figure 11. The foreign investor makes initial application to the Ministry of Finance (MOF), which directs the application to the relevant ministry for review. The MOF then directs the proposal to the Foreign Capital Inducement Deliberation Committee (FCIDC), and to the Foreign Capital Project Review Committee (FCPRC) for approval. If everything is in order, the MOF authorizes the project, and the investor then applies to the relevant ministries for confirmation of specification of capital goods. Import declarations as well as applications for exemptions or reduction of custom duties are made to the customs office.

The investor then files a report of foreign capital inducement with the MOF and other relevant ministries, and registers all applications and approvals with the court system and the MOF.

Figure 11

PROCEDURES FOR FOREIGN INVESTMENT PROPOSALS



- |   |  |
|---|--|
| ① Application for authorization   | ⑥ Import declaration   |
| ② Review of application   | ⑦ Application for exemption or reduction of customs duty, etc. |
| ③ Deliberation and approval   | ⑧ Report of foreign capital inducement                         |
| ④ Authorization   | ⑨ Registration   |
| ⑤ Application for confirmation of specification of capital goods and issuing the letter thereof | ⑩ Registration of foreign invested enterprise                  |

Note: Procedures ② and ③ are omitted in the case of projects eligible for automatic approval.

MOF: Ministry of Finance

FCIDC: Foreign Capital Inducement Deliberation Committee  
Advisory body to the Minister of Finance

FCPRC: Foreign Capital Project Review Committee  
Chaired by the Minister of Finance

Source: Ministry of Finance



## WORK FORCE PROFILE

The Economic Planning Board estimates that at the end of December 1984, the number of South Koreans 14 years and older stood at 27.79 million (see Table 7). The economically active population of Korea stood at 14.98 million, or 53.9 percent of the total. The unemployment level steadily declined in 1984, an indicator of the growing economy. During 1982, 4.4 percent of the employable (economically active) population were out of work. By 1984, the level of unemployment had declined to 3.8 percent. Employment in the Mining and Manufacturing sectors is steadily increasing, while employment in the Agro-Forestry and Fishery sectors is steadily decreasing.

Table 7

### **WORK FORCE PROFILE (Millions)**

| <u>Sector</u>                   | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>1986</u> |
|---------------------------------|-------------|-------------|-------------|-------------|-------------|
| Population over 14 Years Old    | 26.53       | 27.13       | 27.79       | 28.52       | 29.20       |
| Economically Active Population* | 15.08       | 15.13       | 14.98       | 15.32       | 16.35       |
| Employment (All Industry)       | 14.42       | 14.52       | 14.42       | 14.71       | 15.72       |
| Agro-Forestry and Fishery       | 4.62        | 4.31        | 3.91        | 3.87        | 3.93        |
| Manufacturing, Mining           | 3.16        | 3.38        | 3.49        | 3.64        | 3.96        |
| Social Overhead, Other Services | 6.64        | 6.82        | 7.02        | 7.20        | 83          |
| Unemployment Level (Percent)    | 4.4%        | 4.2%        | 3.8%        | 4.0%        | 3.8%        |

\*Individuals currently employed plus those actively seeking employment

Source: Economic Planning Board

### Educational Level

Due to a comprehensive educational system, the South Korean rate of literacy exceeds 97.5 percent. Furthermore, well-trained, highly qualified manpower is available in various fields due to a rapid increase in technical and vocational schools.

An estimated 77,000 students graduated from college in 1983, and bilingual graduates are available in most fields. A profile of the educational system and student enrollments as of 1983 is shown in Table 8.

Table 8

## SOUTH KOREAN EDUCATIONAL SYSTEM--1983

| <u>School</u>             | <u>Number of<br/>Schools</u> | <u>Students<br/>Enrollment</u> | <u>Students<br/>Graduated</u> |
|---------------------------|------------------------------|--------------------------------|-------------------------------|
| Vocational High School    | 639                          | 880,797                        | 262,821                       |
| Junior Vocational College | 122                          | 169,080                        | 68,379                        |
| College, University       | 98                           | 772,907                        | 77,272                        |

Source: Ministry of Education

Wages and Fringe Benefits

No minimum wage standards have been established by law in South Korea, although the Labor Standards Law authorizes the Director-General of the Ministry of Labor to set a minimum wage according to the industry. Wages must be paid regularly and in full once or more per month, on a fixed day or days.

Large Korean companies adopt a paternal attitude toward employees, providing many nontaxable benefits such as transportation, lunches, housing at remote sites, or housing loans, as well as cash gifts for weddings and funerals.

All employees are entitled to a physical examination when they begin working and companies with 16 or more employees must pay for annual physicals as well.

The standard workweek is 48 hours--eight hours a day for six days. The working hours may be extended to 60 hours per week by mutual agreement, and an extended workweek has become a common practice in export manufacturing companies. Further extension of overtime hours requires previous approval of the Ministry of Labor. Eight hours of work a day should be accompanied by at least one hour of rest. Anything beyond the standard workweek is considered overtime, and is subject to compensation at 150 percent of the standard hourly rate.

The industrial production workers' average monthly earnings and average number of workdays per month are shown in Table 9.

Table 9

**AVERAGE MONTHLY WAGES AND WORKDAYS  
OF INDUSTRIAL PRODUCTION WORKERS**

|                          | 1982         |             | 1983         |             | 1984         |             |
|--------------------------|--------------|-------------|--------------|-------------|--------------|-------------|
|                          | Per Month    |             | Per Month    |             | Per Month    |             |
|                          | Work         |             | Work         |             | Work         |             |
|                          | <u>Wages</u> | <u>Days</u> | <u>Wages</u> | <u>Days</u> | <u>Wages</u> | <u>Days</u> |
| All Industries           | \$329        | 24.8        | \$343        | 24.8        | \$359        | 24.8        |
| Electrical & Electronics | \$262        | 24.2        | \$281        | 24.6        | \$293        | 24.4        |

Source: Economic Planning Board

## INFRASTRUCTURE

### Transportation

**Highways**--An extensive highway network for shipped goods already exists in South Korea, and all major cities are connected by paved roads. As of the end of 1983, total road mileage was 54,599km, of which 21,279km were paved. By 1986, there will be a total of 1,428km of expressways connecting nearly every district in the country in a "one-day" travel network.

**Railroads**--All major urban areas are connected by railroad. As of the end of 1983, the total railroad mileage was 6,128km. The major ports of Pusan and Ichon are connected to Seoul by double track lines. Lines connecting Seoul with the mining districts in the eastern part of the nation have already been electrified. The subsidized railroad rate structure is extremely attractive for freight service.

**Air Transportation**--Seoul's Kimpo International Airport is served by 13 international carriers. In 1983, the total number of international air passengers was 3.71 million and the number of domestic passengers was 2.36 million. Domestic airline routes have expanded steadily to serve all major cities and industrial estates. At present, 16 major cities are connected to Seoul by daily service.

**Marine Transportation**--Korea has a sizeable merchant fleet with a total gross tonnage of 7.83 million tons. The total cargo handled in the 24 open ports (including the ports of Pusan and Ichon) amounted to 147.7 million tons during 1983. Of this total, 89.9 million tons or 61 percent of the total was import cargo and 29.3 million tons or 20 percent of the total was export cargo. The remaining 28.5 million tons, 19 percent of the total, was domestic traffic among the coastal ports of Korea. Almost 99.8 percent of the total export and import cargo was transported by marine transportation.

### Communications

The number of installed telephones was 5.33 million circuits in 1983, compared with 167,570 circuits in 1962. The First Satellite Station, built in 1970, and the Second Satellite Communication Station, built in 1976, have greatly contributed to international communications with high-quality transpacific telegraph, telephone, and television connections from all member countries of the world. International communications will be remarkably improved by the introduction of the automatic telephone system (3,000 lines), and the satellite communication system will add 470 lines by 1986.

### Electric Power

Electricity is available in all industrial areas and towns. Installed capacity was 13,115MW in 1983, and generation and transmission facilities are being expanded to meet the increasing demand for power for industrial use. Long-term electric power development programs call for an installed capacity of 18,081MW by 1986.

### Industrial Estates

To keep pace with the rapid economic development, the government is actively promoting the establishment of industrial estates. All the industries located in an industrial estate enjoy advantages such as low land costs, adequate power and water supplies, and good road networks, and share various supporting facilities including special administrative support. Most important, however, are the tax concessions granted to foreign-invested enterprises under the Foreign Capital Inducement Act.

Foreign investors may either own or lease land throughout Korea. Foreign nationals are subject to the regulations of the Alien Land Acquisition Law, which requires that foreign-invested firms that hold over 50 percent ownership of stocks or shares in a corporation obtain approval for land ownership from the Ministry of Home Affairs. Bonded warehouses and factories may be established at any point in the industrial estates with the approval of the Office of Customs Administration.

### Free Export Zones

The Masan Free Export Zone was established in 1970 to encourage direct foreign investment and exports. In 1973, another free export zone was established near Iri. These two zones are special administrative tax-free areas having the characteristics of bonded areas where various pertinent laws and regulations have been waived or have been relaxed altogether or in part.

## CHAPTER 8--SOUTH KOREAN SEMICONDUCTOR INDUSTRY

### HISTORICAL OVERVIEW

The South Korean semiconductor industry came into being in 1956 when KOMY Semiconductor, Ltd., started manufacturing and packaging discrete transistors under a joint venture with the KOMG Company of the United States.

The 1960s decade was dominated by manufacturing, assembly, and packaging of discrete devices by foreign firms such as Signetics (1966), Fairchild Semiconductor (1967), Motorola (1967), AMI (KMI, 1970), and Toshiba (Korea Toshiba, 1970). The only native assembly company in operation during this period was Anam Industrial, which diversified into the new business of semiconductor packaging for discrete devices.

The 1970s decade was characterized by integrated circuit manufacturing and packaging. In 1974, Korea Semiconductor Inc. was established under a joint venture between Samsung Electronics Group and South Korean-owned ICII (located in the United States). The joint venture produced metal gate CMOS integrated circuits for the electronic watch. Korea Semiconductor was later acquired by the Samsung Group, and became a part of the Samsung Semiconductor and Telecommunications Company.

In 1977, Taihan Electric Wire established a semiconductor company, Taihan Semiconductor, to supply semiconductor devices for internal use in consumer electronic products. Gold Star Semiconductor was established in 1979. Gold Star Semiconductor entered into a joint venture with AT&T in 1980, and started producing linear ICs and discrete devices for internal consumption in consumer electronic products.

Korea Toshiba was established in 1969 under a joint venture with Toshiba of Japan and Korean investors. Toshiba sold its majority ownership (retaining 10 percent), and the company changed its name to the Korea Electronics Company in 1976. In 1976, the South Korean government established an R&D organization, the Korea Institute of Electronics Technology (KIET), to promote the semiconductor and computer industries.

During the 1980s, South Korea has emerged as a significant participant in the worldwide semiconductor industry. Currently, the South Korean semiconductor industry is heavily supported by the South Korean government and is dominated by four major industrial and financial conglomerates or Chaebol. They are Hyundai, Daewoo, Lucky-Gold Star (referred to here as Gold Star), and Samsung.

In 1983, the South Korean government formed the Semiconductor Industry Fostering Plan, under which it expects to lend the Korean semiconductor industry \$346 million over the period through 1987, in addition to providing a wide range of tax and investment incentives. (These incentives were discussed in Chapter 7, Industry.)

In July 1984, the government announced a joint VLSI research project with the four Chaebol. The project budget is approximately \$91 million. The target for the first phase of the project is to develop a 1-Mbit DRAM. In addition to the government funding, the four conglomerates invested \$586 million in semiconductor production and R&D facilities in 1984, and made estimated expenditures of \$528 million for 1985.

The 1980s period is the beginning of the VLSI era for the South Korean semiconductor industry. In 1981, KIET successfully designed and produced an 8-bit microprocessor and a 2K static RAM. In 1983, after a year of ground work, the leading conglomerate, Hyundai Group, launched an electronics company with a massive investment. It went directly into VLSI technology, establishing ultramodern manufacturing facilities both in Korea and the United States. Hyundai's activity stimulated Samsung and Gold Star to follow with investments in semiconductor programs on an even larger scale. In 1984, Gold Star Semiconductor started producing the 280 microprocessor under a second-source agreement with Zilog.

The fourth largest conglomerate, Daewoo Group, took a different route to enter the electronics business when it acquired the electronics business of Taihan Electronic Wire Company. This 1983 acquisition included Taihan Semiconductor.

A detailed discussion of the recent activities of the top four conglomerates in developing semiconductor technology and manufacturing capability is given in Chapter 9, Native South Korean Semiconductor Manufacturers.

## PRODUCTION

Total South Korean semiconductor industry production (including subcontract work) grew from \$648 million in 1982 to \$1,259 million in 1984, at a cumulative annual growth rate of 39.4 percent (see Table 10). Integrated circuits were the fastest growth product area, increasing from \$490 million in 1982 to \$1,070 million in 1984, at a cumulative annual rate of 47.8 percent.

South Korean semiconductor industry production declined in 1985, dropping from the 1984 level of \$1,259 million to \$994 million. This decline followed the worldwide trend. The cumulative annual growth rate of South Korean production for the years 1982 to 1985 is estimated at 15.3 percent (Table 10), only slightly less than the 16.7 percent worldwide industry growth for the same period (see Table 11).

Table 10

**ESTIMATED SOUTH KOREAN SEMICONDUCTOR INDUSTRY PRODUCTION**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u>      |                  |
|---------------------|-------------|-------------|-------------|-------------|------------------|------------------|
|                     |             |             |             |             | <u>1982-1984</u> | <u>1982-1985</u> |
| Total Semiconductor | \$648.0     | \$850.0     | \$1,259.0   | \$994.0     | 39.4%            | 15.3%            |
| IC                  | 490.0       | 661.0       | 1,070.0     | 844.8       | 47.8%            | 19.9%            |
| Discrete            | 121.0       | 159.0       | 155.2       | 122.5       | 13.3%            | (0.4%)           |
| Optoelectronic      | 37.0        | 30.0        | 33.8        | 26.7        | (4.4%)           | (10.3%)          |

\*Includes related components and assemblies

Source: EIAK  
DATAQUEST

Table 11

**ESTIMATED WORLDWIDE SEMICONDUCTOR PRODUCTION**  
(Billions of Dollars)

|                                 | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u>      |                  |
|---------------------------------|-------------|-------------|-------------|-------------|------------------|------------------|
|                                 |             |             |             |             | <u>1982-1984</u> | <u>1982-1985</u> |
| Total Semiconductor             | \$15.1      | \$19.2      | \$28.9      | \$24.0      | 38.3%            | 16.7%            |
| IC                              | 10.7        | 14.4        | 22.5        | 18.2        | 45.0%            | 19.4%            |
| Discrete and<br>Optoelectronics | 4.4         | 4.8         | 6.4         | 5.8         | 20.6%            | 9.6%             |

Source: DATAQUEST

However, the South Korean semiconductor industry performance from 1982 through 1984 (39.4 percent) was better than the world average (38.3 percent) for the same period. Growth of South Korean IC production for the same period is estimated at 47.8 percent, slightly above the estimated worldwide growth rate of 45.0 percent. This growth reflects the native South Korean manufacturers' successful development of VLSI class production facilities.

## CONSUMPTION

South Korea's economic growth ranks second, behind Japan, among Asian Rim countries. South Korea's rate of real GNP growth in recent years has led the rest by a good margin, registering 9.5 percent in 1983 compared to 1982, and 7.7 percent in 1984 compared to 1983. While future growth depends on political stability, foreign trade, and other factors, South Korea has already attained the momentum, infrastructure, and manufacturing base to make relatively high value-added products, a factor which bodes well for continued healthy growth for the rest of the 1980s.

Because of the rapid growth in the electronics industry after the 1980 worldwide recession, and the recent proliferation of board and system subcontracting by U.S. OEMs, South Korean semiconductor consumption grew at an estimated cumulative annual rate of 40.3 percent, from \$154.4 million in 1982 to \$304.0 million 1984. Reflecting the focus on production of leading-edge components and end equipment, cumulative growth in IC consumption over the same period is estimated to be 71 percent (see Table 12).

South Korean semiconductor consumption is expected to decline in 1985 due to large inventory accumulation and a worldwide decline in end-equipment sales. Cumulative semiconductor consumption in South Korea grew an estimated 18.3 percent from 1982 to 1985 to reach \$255 million.

Table 12

### **ESTIMATED SOUTH KOREAN SEMICONDUCTOR INDUSTRY CONSUMPTION\*** (Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u>      |                  |
|---------------------|-------------|-------------|-------------|-------------|------------------|------------------|
|                     |             |             |             |             | <u>1982-1984</u> | <u>1982-1985</u> |
| Total Semiconductor | \$154.4     | \$226.7     | \$304.0     | \$255.0     | 40.3%            | 18.3%            |
| IC                  | 78.0        | 118.0       | 228.0       | 191.0       | 71.0%            | 34.8%            |
| Discrete            | 73.0        | 105.0       | 68.2        | 57.0        | (3.3%)           | (7.9%)           |
| Optoelectronics     | 3.4         | 3.7         | 7.8         | 7.0         | 51.5%            | 27.2%            |

\*Includes related components and assemblies

Source: EIAK  
DATAQUEST



## MARKET SHARE

Historically, Japanese and U.S. manufacturers have had the largest share of the South Korean semiconductor market, although native South Korean and Rest of World manufacturers have gained share over the period between 1982 and 1985. Regional market share for semiconductors consumed in South Korea is shown in millions of dollars and as a percentage of total in Table 13. These tables summarize the data presented in Appendix B, at the end of this document.

Table 13

**SOUTH KOREAN SEMICONDUCTOR CONSUMPTION  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
REGIONAL SUMMARY\*  
(Millions of Dollars)**

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR<br/>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------|
| Total Semiconductor | \$154       | \$227       | \$304       | \$255       | 18.3                      |
| Japanese            | \$ 76       | \$110       | \$133       | \$112       | 13.8                      |
| U.S.                | \$ 51       | \$ 63       | \$ 88       | \$ 75       | 13.7                      |
| Korean              | \$ 15       | \$ 30       | \$ 47       | \$ 39       | 37.5                      |
| Rest of World       | \$ 12       | \$ 24       | \$ 36       | \$ 30       | 35.7                      |

**(Percent of Total)**

|                     |        |        |        |        |
|---------------------|--------|--------|--------|--------|
| Total Semiconductor | 100.0% | 100.0% | 100.0% | 100.0% |
| Japanese            | 49.4%  | 48.9%  | 43.8%  | 43.9%  |
| U.S.                | 33.3%  | 27.8%  | 28.9%  | 29.4%  |
| Korean              | 9.7%   | 13.3%  | 15.5%  | 15.3%  |
| Rest of World       | 7.8%   | 10.6%  | 11.8%  | 11.8%  |

\*Totals may not add due to rounding.

Source: DATAQUEST

Japanese manufacturers historically have had the largest share of this semiconductor market. Japanese sales of \$76 million in 1982 accounted for 49.4 percent of the local market. Japanese sales grew at 13.8 percent cumulatively over the period, a lower rate of growth than the market, which increased at 18.3 percent over the same period. The Japanese share had declined slightly to 43.8 percent by 1985.

U.S. manufacturers' sales to the South Korean market also grew at a lower rate than the market. U.S. 1982 revenues of \$51 million grew at a cumulative annual rate of 13.7 percent to reach \$75 million in 1985. The U.S. market share, estimated at 33.3 percent in 1982, declined to 27.8 percent in 1983. Over the next two years, U.S. manufacturers began regaining share, although not as high as the 1983 levels, reaching 29.4 percent of the market in 1985.

In 1982, South Korean manufacturers' revenues were approximately \$15 million, or 9.7 percent of the native market. Their revenues have grown at a cumulative annual rate of 37.5 percent, reaching \$39 million dollars in 1985. This growth, nearly double that of the market as a whole, has resulted in an increase in market share to 15.3 percent in 1985.

Revenues of Rest of World manufacturers, notably European companies (see Appendix B at the end of this document) have also shown rapid growth and a slight increase in share of the South Korean market between 1982 and 1985. ROW revenues were approximately \$12 million in 1982, a 7.8 percent share of the market. These revenues grew at a cumulative annual rate of 35.7 percent, to reach \$30 million, or 11.8 percent, in 1985.

#### **SEMICONDUCTOR EQUIPMENT AND MATERIALS SUPPLIERS**

South Korea has no major native semiconductor equipment manufacturers. U.S. manufacturers have supplied 70 percent of the wafer fab equipment required to outfit the more than 2 million square feet of semiconductor capacity that has been added in the last three years and the Japanese have supplied the remaining 30 percent.

In 1984, a few native companies began to produce noncritical processing equipment. But, to date, these new entrants have attained no significant share of the domestic market. The equipment industry is an important part of the semiconductor industry infrastructure, and native manufacture will, therefore, be a candidate for support.

As in the case of equipment, semiconductor production materials are supplied primarily by the United States and Japan. South Korean firms do, however, manufacture lead frames, low-grade chemicals, and some miscellaneous supplies used in the production line. They are working to develop the technological know-how to enter the other materials markets, and are entering into foreign partnerships in pursuit of this goal.

Recently, three Korean companies announced plans to produce polished wafers. One of these, the Hyundai Electronics, has entered into a technology agreement with Ricoh of Japan for production of silicon wafers. Materials suppliers located in South Korea, their products and, where applicable, their partners, are shown in Table 14.

Table 14

MATERIAL SUPPLIERS IN SOUTH KOREA

| <u>Company</u> | <u>Location</u>                                     | <u>Material</u>             | <u>Business Partner</u> |
|----------------|---|-----------------------------|-------------------------|
| Samsung        | 42, Sungju-dong,<br>Changwon City,<br>Kyungnam      | Lead Frame                  | N/A                     |
| Gold Star      | 379, Kasuri, Usan-up,<br>Whasung-kum,<br>Kyungki-do | Lead Frame                  | N/A                     |
| Poong San      | 52, Banyeo 1 Dong,<br>Haewoondae-gu,<br>Pusan       | Lead Frame                  | KAIST (Korea)           |
| Kosil          | Gumi City, Kyongbuk                                 | Polished Wafer              | Monsanto (U.S.)         |
| Lami           | 60-1, Choongmuro 3GA,<br>Chung-gu Seoul             | Polished Wafer              | Epitaxi (U.S.)          |
| Union Carbide  | C.P.O. Box 4302,<br>Seoul                           | Bulk and Specialty<br>Gases | N/A                     |

N/A = Not Applicable

Source: DATAQUEST

## CHAPTER 9--NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS

Native semiconductor manufacturers and their products are listed in Table 15. The Group 1 companies shown in the table are the major forces in South Korea's penetration of the worldwide market. The Group 2 companies participate in the semiconductor business primarily through manufacture of discrete devices, and/or assembly and packaging activities. The discussion in this section focuses on the major Chaebol, as their activities are of primary interest and significance in South Korea's efforts to establish an internationally competitive, indigenous semiconductor industry incorporating leading-edge technology.

Table 15

### NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS

| <u>Company</u>  | <u>Products</u>   |
|---|---|
| <u>Group 1</u>  |   |
| Korea Electronics Co., Ltd.                               | Bipolar linear; audio & video circuits,<br>Transistors, diodes, LEDs  |
| Gold Star Semiconductor, Ltd.                             | Bipolar digital; STTL, LSTTL, modems,<br>telephone ICs<br>Bipolar linear; audio, video, industrial<br>ICs<br>MOS memory; 64K DRAM, 64K SRAM<br>MOS MPU; 28, 280 families<br>Semicustom; CMOS gate arrays<br>Hybrid IC; thick film<br>Transistors; low-power high-speed, medium-<br>power, SCR/TRIAC |
| Samsung Semiconductor and<br>Telecommunications Co., Ltd. | Bipolar linear; audio, video, industrial,<br>telecom and consumer ICs<br>MOS logic; watch and calculator chips,<br>HC/TTL, LS/TTL<br>MOS memory; 64K DRAM, 128K DRAM<br>256K DRAM, 16K SRAM, 64K SRAM, 16K EEPROM<br>MOS MPU; 4- and 8-bit Intel Second source<br>Transistors; S/S, power           |
| Daewoo Electronics Components<br>Co., Ltd.                | Bipolar Linear, audio and video ICs<br>Transistors, diodes  |

(Continued)

Table 15 (Continued)

## NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS

| <u>Company</u>                           | <u>Products</u>   |
|--|---|
| <u>Group 1 (Continued)</u>               |   |
| Hyundai Electronics Industries Co., Ltd. | MOS memory; 16K and 64K SRAM, 128K and 256K ROM, 1K EEPROM, 64K EPROM, 64K DRAM<br>MOS MPU; 8- and 16-bit   |
| KETRI (KIET)                             | Bipolar linear; audio and video circuits;<br>MOS memory; 2K and 4K SRAM, 32K and 64K ROMs<br>MOS MPU; 8-bit |
| <u>Group 2</u>                           |   |
| Dung Sung Moolsan Ind. Co. Ltd.          | Diodes, rectifiers, varistors   |
| Karibong Electronics Corp.               | Diodes, rectifiers, LED display, LED lamps  |
| KOMY Semiconductor, Ltd.                 | ICs and transistors   |
| Korea Optoelectronics Corp.              | Transistors, diodes, solar cells, photo Darlingtons, photo couplers, photo interrupters                     |

Source: DATAQUEST

South Korean semiconductor investment increased dramatically in 1983 when the government launched the Semiconductor Industry Fostering Plan. This plan provides more than \$300 million for loans to domestic firms over the 1984 to 1987 time period. The major beneficiaries of this financial support are Samsung, Gold Star, and Hyundai. Heated competition among these conglomerates pushed investments far more than original plans, and additional funds were obtained from international financial markets. Since the beginning of 1983, these three Chaebol have invested close to \$1 billion in semiconductor technology, and more than 90 percent of the total investments have been financed by external debt.

## REVIEW OF BIG FOUR SEMICONDUCTOR OPERATIONS

### Gold Star

The Lucky-Gold Star Group is an \$8.5 billion company making products ranging from toothpaste to apparel, elevators to microwave ovens, electronic switching systems (ESS) to computers and ICs. The Gold Star Company, a subsidiary of the Group, is the second largest electronics company in South Korea, with 1984 revenues of approximately \$1.2 billion. It is a major producer of color televisions, video cassette recorders, microwave ovens, monitors, and terminals. The company is extending its main products to include "high-tech" areas, and, consequently, it is now manufacturing minicomputers and mainframes. The Gold Star Company has a factory in Huntsville, Alabama, where it makes one million color televisions per year, in addition to microwave ovens and refrigerators, all for the North American market.

The Group's subsidiary Gold Star Semiconductor (GSS) was established in 1980. GSS is 44 percent owned by AT&T, and produces advanced digital switching systems, PCs, and semiconductors. GSS is establishing a design center in its new Sunnyvale, California, offices. To date, there is no wafer fab facility in the United States. GSS has been aggressive in establishing foundry and license agreements with major U.S. companies to obtain electronics technology. The technology licenses GSS holds to date are listed in the Company Profile chapter of this report.

### Samsung

*\$4.2 B 1985 overall electronics exports \$900M (1984) → \$1.2 B (1985)*  
*\$1.9 B 1985*

The Samsung Electronics Company, a subsidiary of the Samsung Group, is the leading South Korean electronics manufacturer with 1984 sales of approximately \$1.5 billion. This company is the electronics arm of the Samsung Group, which is the largest Chaebol in South Korea having sales of over \$10 billion in 1984. Samsung Semiconductor and Telecommunications Company (SST), a subsidiary of the Samsung Electronics Group, was created by the government in 1977 to foster South Korea's electronics industry. Overall, the electronic sector currently accounts for over one-fifth of Samsung's revenues.

SST has a technology license with ITT to make and sell advanced electronic switching systems. SST shares with Gold Star a government mandated oligopoly for digitizing the telephone systems of all Korean cities. In addition, Samsung has joint venture with Hewlett-Packard, General Electric, and Corning Glass Works. They also have many subcontractual agreements with American and European companies.

In semiconductors, SST licensed Micron Technology's 64K and 256K DRAMS, and entered into a joint development pact with EXEL to develop the 2816A 16K EEPROM. Further, SST's recent license from Intel gave SST the right to make and sell microprocessor products in South Korea. All technology agreements are listed in the Company Profiles chapter of this report.

In 1974, SST acquired a fab facility in Buchon that gave the company consumer IC manufacturing capability. Its new \$125 million fab facility in Suwon, south of Seoul, has a capacity of 27,000 4-inch wafers per month with 3-micron feature size. SST added a 6-inch fab with all steppers for VLSI production in 1985.

Samsung Semiconductor Inc., in Santa Clara, California, is SST's U.S. subsidiary. Established in 1983, the Santa Clara facility houses a 5,000-square foot pilot line, with 5-inch, 2-micron capability. The company is SST's U.S. arm for sales, marketing, design, and application engineering. Product definition, development, and process debugging are performed in the Santa Clara facility before the designs are transferred back to South Korea for volume production.

### Hyundai

Hyundai is the second largest Chaebol at approximately \$10 billion in 1984. Hyundai's main lines of business are automobiles, shipbuilding, and construction. Hyundai was the last of the Big 4 to enter electronics in 1982. The company gained electronics assembly experience through its subcontract with Faraday (PC add-on boards), Novatel (cellular telephones), and Hazeltine (terminals).

Hyundai Electronics was established in 1983. In addition to semiconductors, Hyundai will be entering the areas of telecommunications, office automation, and information systems. The company has negotiated second-source agreements with International CMOS Technologies (ICT) for EEPROM technology. Hyundai plans to sample 16K SRAMs, 8-bit MCUs, and 1K EEPROMs in 1986.

Hyundai established a U.S. subsidiary, Hyundai Electrosystems, Inc., (HEI), in Santa Clara, California. HEI originally devoted most of its 100,000-square-foot complex to semiconductors. The facility contains an 11,000-square-foot wafer fab facility designed to run CMOS on 5-inch wafers with 2-micron design rules. HEI's manufacturing operations were shut down during 1985, and the company plans to sell or lease the fab facility. HEI plans to continue with marketing activities in the United States.

### Daewoo

The primary market areas of this \$5 billion conglomerate business are shipbuilding as well as international trade, machinery, construction, automobiles, oil, and consumer electronics. It has a PC subcontract with Corona Systems, a computer license with Burroughs, and a joint venture on customized ICs and communication equipment with Northern Telecom. The Group's subsidiary, Daewoo Telecom, is one of the four Korean companies picked to modernize the Korean rural telephone system.

Daewoo Semiconductor is a division of Daewoo Electronics. It was established in June 1984. Daewoo's U.S. operations are headquartered in Silicon Valley, California, at its subsidiary ID Focus. ID Focus is currently doing market research to develop designs for the electronics and telecommunications divisions of Daewoo. Daewoo does not directly operate a semiconductor facility in the United States, but is working on a mask design process under a technical agreement with Northern Telecom.

#### SEMICONDUCTOR PLANT LOCATIONS

South Korean semiconductor manufacturing is concentrated in two areas, Seoul in the Northwest portion of the country, and Gumi in the Southeast. The locations of the semiconductor production facilities of the top five manufacturers are shown in Figure 12. Plant ownership and products are listed at the top of the figure, along with the identifying code designating their location in South Korea.

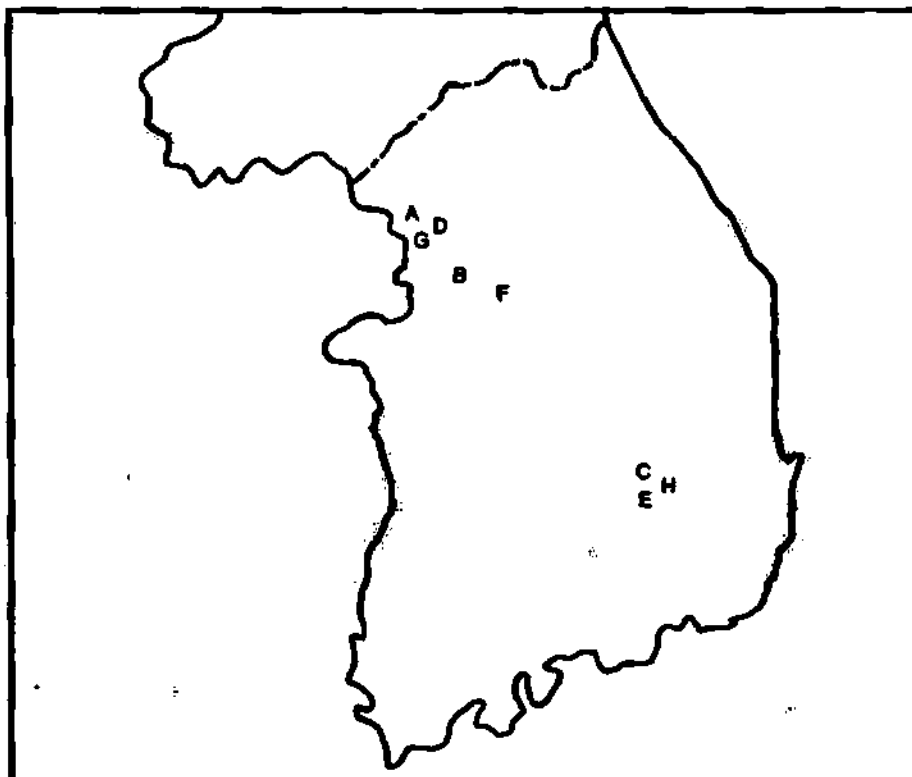
The 1985 wafer production capacity of each of the plants is shown in Table 16. The production capacity controlled by these companies is estimated at 196,000 wafer starts per month, with the majority of the capacity added during the 1980s. The percent of capacity by wafer size is shown in Table 17. Facilities designed to run 3- and 4-inch wafers account for 43.8 percent of total slices. Five-inch wafer fab lines account for 33.2 percent of capacity, while state-of-the-art 6-inch facilities account for 23.0 percent. Further details on facilities are given in the chart presented in Appendix E, Facilities Data.



Figure 12

SEMICONDUCTOR MANUFACTURING LOCATIONS

| Map Code | Location          | Products   |
|----------|-------------------|--|
| A        | Samsung           | Bipolar, MOS<br>Memory                                       |
| B        | Buchon<br>Suwon   |  |
| C        | Gold Star<br>Gumi | Bipolar, MOS Memory,<br>MPU, Gate Array<br>Memory, Custom IC |
| D        | Anyang            |  |
| E        | KEC               | Transistor, Linear IC,<br>Diode, LED<br>MOS Memory, MPU      |
| F        | Hyundai           |  |
| G        | Daewoo            | Linear Bipolar, Discrete                                     |
| H        | ETRI (KIET)       |  |



Source: DATAQUEST

Table 16

## WAFER PRODUCTION CAPACITY OF SELECTED MANUFACTURERS--1985

|                | <u>Plants</u> | <u>Wafer Size</u> | <u>Wafer Starts<br/>Average<br/>Per Month</u> |
|----------------|---------------|-------------------|---|
| SST            | Buchon        | 3-inch            | 15,000  |
|                |               | 4-inch            | 15,000  |
|                |               | 5-inch            | 20,000  |
|                | Suwon         | 4-inch            | 27,000  |
|                |               | 6-inch            | 20,000  |
| GSS            | Gumi          | 4-inch            | 13,000  |
|                |               | 5-inch            | 15,000  |
|                | Anyang        | 5-inch            | 10,000  |
| KEC            | Gumi          | 3-inch            | 5,000   |
|                |               | 5-inch            | 5,000   |
| Hyundai        | Ichon         | 5-inch            | 15,000  |
|                |               | 6-inch            | 25,000  |
| ETRI<br>(KIET) | Gumi Location | 4-inch            | 3,000   |
|                |               | 4-inch            | 2,000   |
| Daewoo         | Goonpo-eup    | 4-inch            | 7,000   |

Table 17

## PRODUCTION CAPACITY BY WAFER SIZE--1985

| <u>Wafer Size</u>                         | <u>3-inch</u> | <u>4-inch</u> | <u>5-inch</u> | <u>6-inch</u> | <u>Total</u> |
|---|---------------|---------------|---------------|---------------|--------------|
| Capacity in Average<br>Wafer Starts/Month | 20,000        | 67,000        | 65,000        | 45,000        | 197,000      |
| Percent of Total                          | 10.2%         | 34.0%         | 33.0%         | 22.8%         | 100%         |

Source: DATAQUEST

## NATIVE SEMICONDUCTOR PRODUCTION

Semiconductor device production estimates for the Korea Electronics Company (KEC), Gold Star, and Samsung, from 1982 through 1985, are shown in the following tables. Estimates of Daewoo and Hyundai device production are not included in the following data. While Daewoo and Hyundai are investing heavily in capacity and technology, as of midyear 1985 they had not yet developed significant production.

Total semiconductor revenues of the three major manufacturers, KEC, Gold Star, and Samsung, are shown in Table 18. Revenues grew at an estimated cumulative annual rate of 96.1 percent, from \$22.8 million in 1982 to \$172 million in 1985. Total IC growth over the period was dramatic at 151.8 percent, as these manufacturers rapidly came on-line with production facilities capable of producing leading-edge circuits. The IC manufacturing base of these companies supported only \$7.2 million of IC production in 1982, but leaped to an estimated \$115 million in 1985.

Table 18

### SEMICONDUCTOR REVENUES OF SAMSUNG, GOLD STAR, AND KEC (Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$22.8      | \$58.7      | \$114.0     | \$172.0     | 96.1%                           |
| IC                  | \$ 7.2      | \$21.7      | \$ 51.0     | \$115.0     | 151.8%                          |
| Bipolar Digital     | 0           | 0           | \$ 1.5      | \$ 4.0      | 166.7%                          |
| MOS                 | \$ 3.2      | \$10.0      | \$ 26.5     | \$ 61.0     | 167.1%                          |
| Linear              | \$ 4.0      | \$11.7      | \$ 23.0     | \$ 50.0     | 132.1%                          |
| Discrete            | \$14.3      | \$34.5      | \$ 60.0     | \$ 55.0     | 56.7%                           |
| Optoelectronics     | \$ 1.3      | \$ 2.5      | \$ 3.0      | \$ 2.0      | 15.4%                           |

Source: DATAQUEST

Semiconductor revenues for the top three manufacturers, by company and product category, are presented in Table 19. Samsung and Gold Star each demonstrated growth rates in excess of 100 percent from 1982 through 1985. These two manufacturers are heavily committed to developing semiconductor manufacturing capability and have invested large amounts of capital to this end. KEC's revenue growth, 41.9 percent, is less than half that of Samsung and Gold Star. KEC has participated at a lower level in the rush to develop capacity; however, as an established device manufacturer, the company had the highest 1982 revenues of \$14.7 million, whereas Samsung and Gold Star both started the period with combined revenues of less than \$10 million. KEC's primary product areas are linear and discrete devices.

Table 19

NATIVE SEMICONDUCTOR REVENUES OF SAMSUNG, GOLD STAR,  
AND KEC BY TECHNOLOGY  
(Millions of Dollars)

|                          | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|--------------------------|-------------|-------------|-------------|-------------|---------------------------------|
| <b>Samsung</b>           |             |             |             |             |                                 |
| Total Semiconductor      | \$ 4.8      | \$25.9      | \$60.0      | \$95.0      | 170.5%                          |
| IC                       | 3.7         | 14.0        | 33.0        | 75.0        | 172.7%                          |
| Bipolar Digital          | 0           | 0           | 0           | 0           | N/A                             |
| MOS                      | 3.2         | 9.9         | 25.0        | 55.0        | 158.1%                          |
| Linear                   | 0.5         | 4.1         | 8.0         | 20.0        | 242.0%                          |
| Discrete                 | 1.1         | 11.9        | 27.0        | 20.0        | 163.0%                          |
| Optoelectronics          | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| <b>Gold Star</b>         |             |             |             |             |                                 |
| Total Semiconductor      | \$ 3.3      | \$ 6.4      | \$16.0      | \$35.0      | 119.7%                          |
| IC                       | 0.8         | 3.9         | 13.0        | 32.0        | 242.0%                          |
| Bipolar Digital          | 0.0         | 0.0         | 1.5         | 4.0         | 166.7%                          |
| MOS                      | 0.0         | 0.1         | 1.5         | 6.0         | 674.6%                          |
| Linear                   | 0.8         | 3.8         | 10.0        | 22.0        | 201.8%                          |
| Discrete                 | 2.5         | 2.5         | 3.0         | 3.0         | 6.3%                            |
| Optoelectronics          | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| <b>Korea Electronics</b> |             |             |             |             |                                 |
| Total Semiconductor      | \$14.7      | \$26.4      | \$38.0      | \$42.0      | 41.9%                           |
| IC                       | 2.7         | 3.8         | 5.0         | 8.0         | 43.6%                           |
| Bipolar Digital          | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| MOS                      | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| Linear                   | 2.7         | 3.8         | 5.0         | 8.0         | 43.6%                           |
| Discrete                 | 10.7        | 20.1        | 30.0        | 32.0        | 44.1%                           |
| Optoelectronics          | 1.3         | 2.5         | 3.0         | 2.0         | 15.4%                           |

N/A = Not Applicable

Source: DATAQUEST

## JOINT VENTURES AND LICENSE AGREEMENTS

Semiconductors are the common denominator in South Korea's efforts to develop high-technology manufacturing. Compared to their American and Japanese counterparts, South Korean companies are playing catch-up from a very late start; however, they are very aggressive and ambitious. The combination of government and industry focus and support is yielding the same dramatic results as have been seen with the Japanese entry into semiconductor production during the 1970s. Further, the South Koreans are trying to accomplish in 5 years what it took the Japanese 20 years to develop, a self-sufficient semiconductor industry. This much reduced timetable would not be feasible without the formation of alliances. Unlike Japan's approach, South Korea welcomes alliances and foreign ownership.

A technology agreement provides a vehicle for South Korean manufacturers to move ahead at a more rapid pace in developing an indigenous semiconductor industry than would be possible through purely internal development. The rapidity with which alliances are being formed is startling. In the span of only two years, from 1983 to 1985, 4 native South Korean semiconductor manufacturers have entered into more than 20 technology and production alliances. A summary of agreements for semiconductor technology is presented in Table 20. The majority of the technology agreements have been made with U.S. manufacturers; very few have been made with Japanese companies.

Table 20

### SEMICONDUCTOR TECHNOLOGY ALLIANCES BY COMPANY

#### Samsung Semiconductor and Telecommunications Co., Ltd.

| <u>Year</u> | <u>Partner</u>           | <u>Agreement*</u> | <u>Products</u>                 |
|-------------|--------------------------|-------------------|---------------------------------|
| 1983        | Exel                     | TTA               | 16K EEPROM                      |
| 1983        | Samsung Semi. (U.S.)     | TTA               | NMOS and CMOS memory            |
| 1983        | DITTI (Germany)          | TTA               | Linear IC, CMOS                 |
| 1983        | Micron Technology (U.S.) | TTA               | 64K DRAM, 256K DRAM             |
| 1983        | Sharp (Japan)            | TTA               | 16K SRAM, 256K ROM              |
| 1984        | DITTI (Germany)          | TTA               | Bipolar IC                      |
| 1984        | Samsung Semi. (U.S.)     | TTA               | 16K EEPROM, 256K DRAM, 64K SRAM |
| 1985        | Intel (U.S.)             | T/C               | MPU, MCU (active)               |
| 1985        | National Semiconductor   | TTA               | Gate array                      |
| 1985        | Zytrex                   | TTA               | H <sub>2</sub> CMOS             |
| 1986        | Ixys                     | TTA               | Smart power (most discrete)     |

(Continued)

Table 20 (Continued)

## SEMICONDUCTOR TECHNOLOGY ALLIANCES BY COMPANY

Gold Star Semiconductor, Ltd. (GSS)

| <u>Year</u> | <u>Partner</u>                | <u>Agreement</u> | <u>Products</u>            |
|-------------|-------------------------------|------------------|----------------------------|
| 1981        | AT&T (U.S.) - owns 44% of GSS | J/V, TTA         | Bipolar process technology |
| 1982        | AT&T (U.S.)                   | TTA              | MOS technology             |
| 1983        | Zilog (U.S.)                  | TTA              | 8-bit microprocessor       |
| 1984        | LSI Logic (U.S.)              | TTA              | Gate array                 |
| 1984        | AMD (U.S.)                    | R/A              | All AMD products in Korea  |
| 1984        | AMD (U.S.)                    | TTA              | 64K DRAM design            |
| 1985        | LSI Logic (U.S.)              | TTA              | Gate array                 |
| 1985        | Fairchild (U.S.)              | TTA              | 64K SRAM (active)          |

Korea Electronics Co., Ltd.

| <u>Year</u> | <u>Partner</u>  | <u>Agreement</u> | <u>Products</u> |
|-------------|-----------------|------------------|-----------------|
| 1978        | Toshiba (Japan) | TTA              | Pellet          |
| 1983        | Toshiba (Japan) | TTA              | Linear IC       |
| 1984        | Toshiba (Japan) | TTA              | MOS technology  |

Hyundai Electronics Industries Co., Ltd.

| <u>Year</u> | <u>Partner</u>                           | <u>Agreement</u> | <u>Products</u>              |
|-------------|--|------------------|------------------------------|
| 1983        | Modern Electrosystems Inc. (U.S.)        | TTA              | NMOS and CMOS memory and MCU |
| 1984        | INMOS (U.S.)                             | TTA              | 256K x 1 DRAM                |
| 1984        | TI (U.S.)                                | TTA              | 64K DRAM                     |
| 1984        | International CMOS Technologies (U.S.)   | T/C              | EPROM, EEPROM                |
| 1985        | Hyundai Electronics America, Inc. (U.S.) | TTA              | 64K SRAM, 64K EEPROM         |

1986 General Instruments (GI)  
TTA: Technology Transfer Agreement (second sourcing) Standard cells 16K 2<sup>2</sup>Proms (active)  
J/V: Joint Venture Agreement  
R/A: Representative Agreement  
T/C: Technology Cooperation Agreement

Daewoo

Source: DATAQUEST

1986 Zymos

RQ

standard cells (active)

## CAPITAL SPENDING

In their efforts to become full-fledged participants in the worldwide semiconductor industry, South Korean manufacturers are investing heavily in development of R&D and semiconductor manufacturing capability. Semiconductor-related capital spending for the top four companies is presented in Table 21.

Table 21

### ESTIMATED SEMICONDUCTOR-RELATED CAPITAL SPENDING (Millions of Dollars)

|                  | <u>1984-87</u> | <u>1984</u> | <u>1985</u> | <u>1986</u> | <u>1987</u> |
|------------------|----------------|-------------|-------------|-------------|-------------|
| Total Investment | \$1534         | \$586       | \$528       | \$215       | \$205       |
| Facilities       | 1360           | \$544       | \$478       | \$179       | \$159       |
| Samsung          | 770            | \$283       | \$268       | \$113       | \$106       |
| Gold Star        | 198            | \$ 96       | \$ 61       | \$ 30       | \$ 11       |
| KEC              | 91             | \$ 34       | \$ 20       | \$ 17       | \$ 20       |
| Hyundai          | 301            | \$131       | \$129       | \$ 19       | \$ 22       |
| R&D              | 174            | \$ 42       | \$ 50       | \$ 36       | \$ 46       |
| Samsung          | 100            | \$ 16       | \$ 29       | \$ 27       | \$ 28       |
| Gold Star        | 31             | \$ 16       | \$ 7        | \$ 4        | \$ 4        |
| KEC              | 14             | \$ 3        | \$ 2        | \$ 3        | \$ 6        |
| Hyundai          | 27             | \$ 7        | \$ 12       | \$ 2        | \$ 8        |

Source: DATAQUEST

Total capital spending in 1984 was \$586 million. Estimated 1985 capital spending declined slightly from 1984 levels, but still represented a very high level of investment at approximately \$528 million. Since most of the factories and R&D programs initiated by the major industry and government push in 1983 came on-stream in 1984 and 1985, investment is expected to taper off in coming years. Total 1986 spending is projected to be \$215 million, while 1987 spending is expected to be \$205 million.

The establishment of production facilities accounted for the major share of 1984 capital spending at \$544 million, or 93 percent of total dollar investment. R&D expenditures as a share of total spending are anticipated to increase from 7 percent in 1984 to 22 percent in 1987.

A description of the R&D facilities established by the Big Four manufacturers is given in Table 22.

Table 22

RESEARCH AND DEVELOPMENT FACILITIES

| <u>Company</u> | <u>Location</u> | <u>Year<br/>Established</u> | <u>Man Power<br/>Employees</u> | <u>Floor<br/>Space (m<sup>2</sup>)</u> | <u>R&amp;D Exp.<br/>(% of Sales)</u> |
|----------------|-----------------|-----------------------------|--------------------------------|--|--------------------------------------|
| SST*           | Buchon          | 1981                        | 421                            | 11,000                                 | 4.7%                                 |
| SST            | Suwon           | 1984                        | N/A                            | N/A                                    | N/A                                  |
| GSS            | Anyang          | 1983                        | 130                            | 66,116                                 | 24.0%                                |
| KEC            | Gumi            | 1984                        | 99                             | 1,300                                  | 2.3%                                 |
| Hyundai        | Ichon           | 1984                        | 58                             | 1,300                                  | 50.0%                                |

N/A = Not Available

Source: DATAQUEST

\*This facility was converted to production in 1985. Currently only Telecom R&D is at Buchon.



## CHAPTER 10--COMPANY PROFILES

In this chapter, DATAQUEST presents information on companies manufacturing semiconductors in South Korea. The content of each profile varies depending on the data available. The most complete information is provided for the major manufacturers discussed in detail in Chapter 9, Native Manufacturers. These manufacturers have made the largest investments in developing advanced semiconductor technology during the 1980s.

The company profiles presented in this chapter are listed below:

- Daewoo Electronic Components Co., Ltd. \$5.1B (1984)
- Gold Star Semiconductor, Ltd. \$8.5B
- Hyundai Electronics Industries Co., Ltd. \$9.2B
- Korea Electronics Co., Ltd. \$84.6 M
- Samsung Semiconductor and Telecommunications Co., Ltd. \$10.0 B
- Electronics and Telecommunications Research Institute (ETRI)
- Dong Sung Moolsan Ind. Co., Ltd.
- Karibong Electronics Corp.
- KOMY Semiconductor, Ltd.
- Korea Diode Co., Ltd.
- Korea Fuji Electronics Ind. Co.
- Korea Optoelectronics Corp.
- Rohm Korea Corp.

**DAEWOO ELECTRONIC COMPONENTS CO., LTD.**

**Parent Company**

The Daewoo Group was founded in 1967 as a trading company. It has grown into a conglomerate of 29 companies that offer products and services such as automobile, shipbuilding, electronics, chemicals, construction, banking, insurance, and financing. Its total 1984 sales were US\$5.1 billion.

Daewoo Electronic Components Co., Ltd.  
541 Namdaemun-ro 5-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-754-0707; Fax: 02-776-6669  
(Millions of Dollars Except Per Share Data)

**Balance Sheet (December 31)**

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | N/A         | \$ 14.3     | \$ 45.3     | \$127.0     | \$ 87.0     |
| Long-Term Liabilities                     | N/A         | \$ 1.4      | \$ 1.3      | \$ 45.3     | \$ 61.6     |
| Shareholders' Equity                      | N/A         | \$ 4.3      | \$ 8.0      | \$ 51.5     | \$ 53.2     |
| After-Tax Return on<br>Average Equity (%) | (50.9)      | (28.2)      | 40.0        | 19.3        | 5.2         |

**Operating Performance (December 31)**

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$ 10.6     | \$ 22.8     | \$ 37.4     | \$215.0     | \$343.2     |
| Cost of Revenue          | N/A         | \$ 22.8     | \$ 33.4     | \$164.7     | \$258.6     |
| SG&A Expense             | N/A         | \$ 1.4      | \$ 1.3      | \$ 30.2     | \$ 62.8     |
| Pretax Income            | N/A         | (\$ 1.4)    | \$ 2.7      | \$ 10.1     | \$ 4.8      |
| Net Income               | (\$ 1.5)    | (\$ 1.4)    | \$ 2.7      | \$ 6.3      | \$ 2.4      |
| Average Shares (Million) | \$ 19.0     | \$ 6.4      | \$ 9.4      | \$ 80.0     | \$ 80.0     |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | ( 59.0)     | ( 156.0)    | 181.0       | 57.0        | 28.0        |
| Dividends                | 0           | 0           | 0           | 50.0        | 50.0        |
| Book Value               | 217.0       | 414.0       | 596.0       | 453.0       | 363.0       |
| Price Average            | N/A         | N/A         | N/A         | N/A         | 651.0       |
| Total Employees          | N/A         | N/A         | 1,356       | 8,020       | 10,822      |
| Exchange Rate (W/\$)     | 659.9       | 700.5       | 748.8       | 795.5       | 827.4       |

N/A = Not Available

Source: Dongsuh Securities Co., Ltd.,  
Annual Report of Listed Companies

### Background

Daewoo Electronic Components was established in 1978 as a subsidiary of the Daewoo Group. In March 1983, Daewoo purchased the consumer electronics business of Tai Han Electric Wire Co., Ltd., and became the third largest consumer electronics company in South Korea.

### Major Products

The company's main products are as follows: electronic components, television subsystems, ATVs, VTRs, cassettes, PCs, refrigerators, washing machines, and air conditioning units.

**Daewoo Electronic Components Co., Ltd.**  
**REVENUE BY BUSINESS ACTIVITY**  
**(Millions of Dollars)**

| <u>Activity</u>     | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---------------------|-------------|-------------|-------------|-------------|-------------|
| Electronic Products | \$10.6      | \$22.8      | \$37.4      | \$128.2     | \$205.5     |
| Electric Products   | 0           | 0           | 0           | \$ 86.8     | \$137.7     |

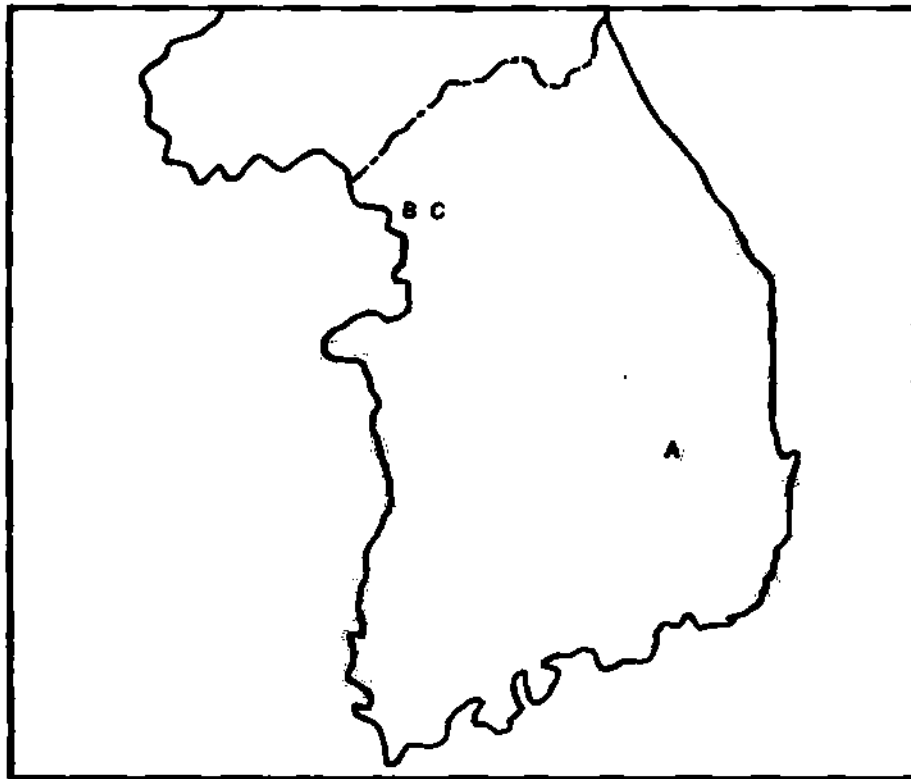
Source: Daewoo Electronic  
Components Co., Ltd.  
Annual Report

Daewoo's manufacturing facilities, their sizes, and products produced are shown in Figure 13.

Figure 13

Daewoo Electronic Components Co., Ltd.  
MANUFACTURING FACILITIES

| <u>Map Code</u> | <u>Location</u> | <u>Products</u>  |
|-----------------|-----------------|--|
| A               | Gumi Plant      | TV, VTR, PC, audio products, bipolar linear and discrete semiconductors                    |
| B               | Inchon Plant    | Refrigerator, washing machine, air conditioner, fan, vacuum cleaner, stove, microwave oven |
| C               | Juan Plant      | VTR, V-Camera, VDP   |



Source: DATAQUEST

### Semiconductor Division

- Director: C.S. Lee
- Products:
  - Linear Bipolar: Audio, video, and ICs
  - Discrete: Transistors and diodes
  - Hybrid ICs

### Semiconductor Production

- Location: 543 Dangjung-ri, Goonpo-eup, Kyungki-do, Korea
  - Manager: H.T. Kwon
  - First production: September 1979
  - Capacity: 4-inch wafers, 7,000/month
  - Capital Investment: Approximately \$10 million

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 17                     |
| Projection aligners           | 4                      |
| Ion implanters                | 1                      |
| Sputtering equipment          | 10                     |
| Etch equipment                | 2                      |
| CVD systems                   | 1                      |
| Design Center                 | In House               |

## GOLD STAR SEMICONDUCTOR, LTD. (GSS)

### Parent Company

The Lucky-Gold Star Group was founded in 1979, when the Lucky Group and Gold Star Group were combined. The Lucky Group was founded in 1947 as the Lucky Chemical Company, and the Gold Star Group was founded in 1958 as the Gold Star Co., an electronics firm.

The Lucky-Gold Star Group has 21 domestic affiliated companies and 7 overseas locally incorporated firms. Its products and services include the areas of chemicals, electronics, energy and resources, construction, insurance and finance, and trading. In 1984, sales were US\$8.5 billion.

Gold Star Semiconductor, Ltd.  
60-1 Chungmu-ro 3-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-273-4151, Telex: GOLDSEC K22767  
(Millions of Dollars Except Per Share Data)

#### Balance Sheet (December 31)

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | N/A         | \$35.7      | \$40.1      | \$44.0      | \$ 55.6     |
| Long-Term Liabilities                     | N/A         | \$22.8      | \$36.1      | \$49.0      | \$ 68.9     |
| Shareholders' Equity                      | N/A         | \$ 7.1      | \$ 8.0      | \$23.9      | \$ 29.0     |
| After-Tax Return on<br>Average Equity (%) | N/A         | N/A         | 3.7         | 9.9         | 17.4        |

#### Operating Performance (December 31)

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$ 1.2      | \$ 5.0      | \$41.4      | \$66.3      | \$130.3     |
| Cost of Revenue          | N/A         | \$ 5.7      | \$29.4      | \$46.5      | \$102.7     |
| SG&A Expense             | N/A         | \$ 2.9      | \$ 2.7      | \$ 3.8      | \$ 8.5      |
| Pretax Income            | N/A         | (\$ 8.6)    | \$ 0.3      | \$ 2.4      | \$ 5.0      |
| Net Income               | N/A         | (\$ 8.6)    | \$ 0.3      | \$ 2.4      | \$ 5.0      |
| Average Shares (Million) | N/A         | 1.3         | 1.4         | 2.5         | 2.5         |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | N/A         | (4,890)     | 169         | 770         | 1,653       |
| Dividends                | 0           | 0           | 0           | 0           | 0           |
| Book Value               | N/A         | (4,007)     | 4,615       | 7,783       | 9,492       |
| Price Average            | N/A         | N/A         | N/A         | N/A         | N/A         |
| Total Employees          | N/A         | N/A         | 1,000       | 1,524       | 2,351       |
| Exchange Rate (W/\$)     | 659.9       | 700.5       | 748.8       | 795.5       | 827.4       |

As of the end of period  
N/A = Not Available

Source: Annual Report of  
Gold Star Semiconductor, Ltd.

### Background

Gold Star Semiconductor was established in 1979; it became a joint venture entity with AT&T in November of 1980 for the manufacture of 1A ESS and semiconductors. AT&T has 44 percent ownership in GSS. The company has three divisions and an R&D laboratory. The three divisions are: semiconductor, computer, and communications. In 1984, GSS saw significant growth in all business areas. The company's total revenue reached \$130 million in 1984, an increase of 96 percent over 1983.

### Major Products

The company's major products are as follows:

- Semiconductor: Transistors, linear ICs, digital ICs, hybrid ICs, 8-bit MPU, 64K SRAM, gates
- Computer: Supermini, mini, micro, PC, workstation, CAD/CAM
- Communication: 1A ESS, SLC-96, RSS, DCT

**Gold Star Semiconductor, Ltd.  
REVENUE BY BUSINESS LINE  
(Millions of Dollars)**

| <u>Activity</u> | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|-----------------|-------------|-------------|-------------|-------------|-------------|
| Semiconductor   | \$1.2       | \$2.1       | \$ 3.3      | \$ 6.4      | \$ 15.0     |
| Computer        | -           | -           | \$ 4.3      | \$ 0.3      | \$ 4.8      |
| ESS             | -           | \$2.9       | \$33.8      | \$59.6      | \$110.2     |

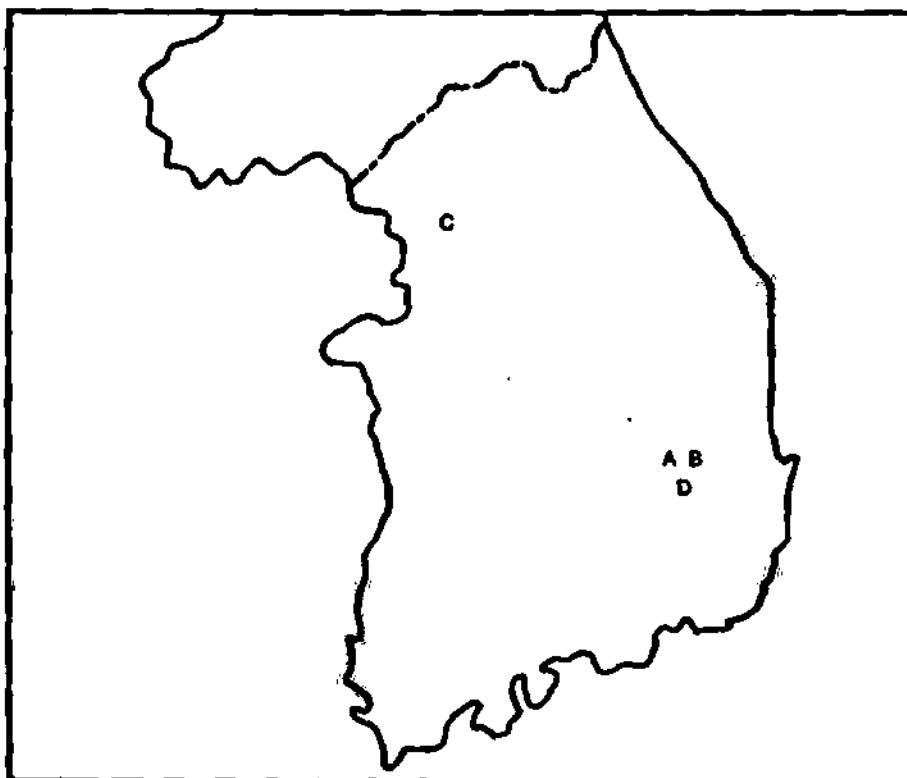
Source: DATAQUEST  
Annual Report of Gold Star  
Semiconductor, Ltd.

GSS's manufacturing facilities, their products, and approximate size are shown in Figure 14.

Figure 14

Gold Star Semiconductor, Ltd.  
MANUFACTURING FACILITIES

| Map Code | Location            | Products                                     |
|----------|---------------------|--|
| A        | Gumi Bipolar Plant  | Transistor, Linear IC, Digital IC, Hybrid IC |
| B        | Gumi MOS-I Plant    | MPU, Memory, Gate Array                      |
| C        | Anyang MOS-II Plant | Memory, Custom IC                            |
| D        | Gumi ESS Plant      | ESS, Computer                                |



Source: DATAQUEST



## Semiconductor Division

- Director: Dr. C.S. Kim
- Brief history of GSS's semiconductor business:
  - 1979: Founded as a member of the Lucky-Gold Star Group
  - 1980: Started packaging business
  - 1980: Started semiconductor fabrication
  - 1981: Established joint venture and technology agreement with AT&T
  - 1982: Technology agreement with AT&T for Digital ESS, superminicomputer, and MOS technology
  - 1983: Second-source agreement for Z80 MPU with Zilog
  - 1984: Started production of Z80 family
  - 1984: Second-source agreement for gate array with LSI Logic
  - 1984: Completed MOS-I plant construction
  - 1984: Second-source agreement for 64K DRAM with AMD
  - 1984: Completed MOS-II plant construction
  - 1985: Second-source agreement for LL-7000 with LSI Logic
- Products:
  - MOS Memory: 64K DRAM, 64K SRAM
  - MOS MPU: Z8, Z80 families
  - Linear Bipolar: Audio, video, and industrial ICs
  - Digital Bipolar: STTL, LSTTL, MODEM, telephone ICs, CDI
  - Semicustom: CMOS gate arrays
  - Hybrid IC: Thin film
  - Transistors: Low-power, high-speed, medium-power, SCR/TRIAC

**Gold Star Semiconductor, Ltd.**  
**WORLDWIDE SEMICONDUCTOR SALES**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985*</u> |
|---------------------|-------------|-------------|-------------|--------------|
| Total Semiconductor | \$ 3.3      | \$ 6.4      | \$15.0      | \$35.0       |
| Total IC            | \$ 0.8      | \$ 3.9      | \$13.0      | \$32.0       |
| Bipolar Digital     | -           | -           | 1.0         | 4.0          |
| MOS                 | -           | 0.1         | 1.0         | 6.0          |
| Memory              | -           | -           | 0.0         | 4.0          |
| MPU/MCU             | -           | 0.1         | 1.0         | 1.0          |
| Logic               | -           | -           | -           | 1.0          |
| Linear              | 0.8         | 3.8         | 10.0        | 22.0         |
| Total Discrete      | \$ 2.5      | \$ 2.5      | \$ 3.0      | \$ 3.0       |

\*Estimated

Source: DATAQUEST  
Annual Reports of  
Gold Star Semiconductor, Ltd.

**Semiconductor Production**

|                             | <u>Bipolar and MOS I</u>                   | <u>MOS II</u>                                      |
|-----------------------------|--|--|
| Location                    | 171 Imsu-dong, Gumi-si,<br>Kyungbuk, Korea | 533 Hogae-dong,<br>Anyang-si,<br>Kyungki-do, Korea |
| Manager                     | D. H. Song                                 | Dr. C.S. Kim                                       |
| Date of First<br>Production | Feb. 1980/Sept. 1984                       | Nov. 1984  |
| Employees (Total)           | 1,200                                      |  |

- Production Capacity
  - Transistor: 75 million units/year
  - Plastic DIP: 100 million units/year
  - Ceramic DIP: 14 million units/year

● Capital Spending (Millions of Dollars)

|            | <u>1983</u> | <u>1984</u> | <u>1985 (est.)</u> |
|------------|-------------|-------------|--------------------|
| All Plants | \$ 40       | \$ 60       | \$100              |

● Average Monthly Wafer Starts

| <u>Plant</u> | <u>Wafer Size</u> | <u>Wafers/Month</u> |
|--------------|-------------------|---------------------|
| Bipolar      | 4-inch            | 13,000              |
| MOS I        | 5-inch            | 15,000              |
| MOS II       | 5-inch            | 10,000              |

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 88                     |
| Wafer Steppers                | 9                      |
| Projection Aligners           | 8                      |
| Ion Implanters                | 7                      |
| Sputtering Equipment          | 5                      |
| Etching Equipment             | 10                     |
| CVD Systems                   | 5                      |
| Epi Reactors                  | 3                      |

● Design Centers

- There are two design groups within GSS. Both design groups are for in-house product development.
  - . One is currently established at the Gumi plant.
  - . The U.S. design center, United Microtek, Inc., is a wholly owned subsidiary of the Lucky-Gold Star Group. It is located at 1130 E. Arques Ave., Sunnyvale, CA 94086 (Telephone: 408-738-8388).
- Equipment: 2 Calma GDS II, 5 workstations

## Joint Ventures/Licensing

### Gold Star Semiconductor, Ltd.

| <u>Partner</u> | <u>Country</u> | <u>Year</u> | <u>Technology</u>                        |
|----------------|----------------|-------------|--|
| AT&T           | United States  | 1980        | Process technology<br>64K DRAM, 16K SRAM |
| Zilog          | United States  | 1983        | 28, 280 MCU, and MPU<br>families         |
| AMD            | United States  | 1984        | 64K, 256K DRAM                           |
| LSI Logic      | United States  | 1984        | CMOS gate array                          |
| Fairchild      | United States  | 1985        | 64K SRAM                                 |

- Contract manufacturing

- Monolithic Memories Inc.: Bipolar linear products (expired)
- Fairchild: 64K SRAM
- LSI Logic: Gate arrays

## HYUNDAI ELECTRONICS INDUSTRIES CO., LTD.

### Parent Company

The Hyundai Group was founded as a construction company in 1947; the firm is now the largest business organization in South Korea. It has worldwide operations in construction, ship-building, steel fabrication, automobile manufacturing, and electronics. Its 32 affiliated companies, including five in the United States, employ more than 150,000 people. Hyundai's total 1984 sales were US\$9.2 billion.

*privately owned by Chun family*

### Background

Hyundai Electronics Industries (HEI) was established in February 1983 by the Hyundai Group. A sister company, Hyundai Electronics America (formerly Modern Electrosystems, Inc.) was founded about the same time, in March of 1983. HEI encompasses six technical divisions; of these, three are related to semiconductor operations, and one is a laboratory. The divisions are Semiconductor I, Semiconductor II, Semiconductor Assembly, Information Systems, Communications, and Industrial Electronics.

### Major Products

The company's major products are semiconductors, computers and peripherals, mobile telephones, communication equipment, automobile electronics, industrial instrumentation, and control systems.

Hyundai's main manufacturing facility is shown in Figure 15.

Planned semiconductor products include:

- Memory: 16K SRAM, 128K ROM, 1K EEPROM, 64K EPROM, 64K DRAM, 256K, 1Ml
- MPU: 8-bit, 16-bit, CMOS

*Intel CMOS Tech.*

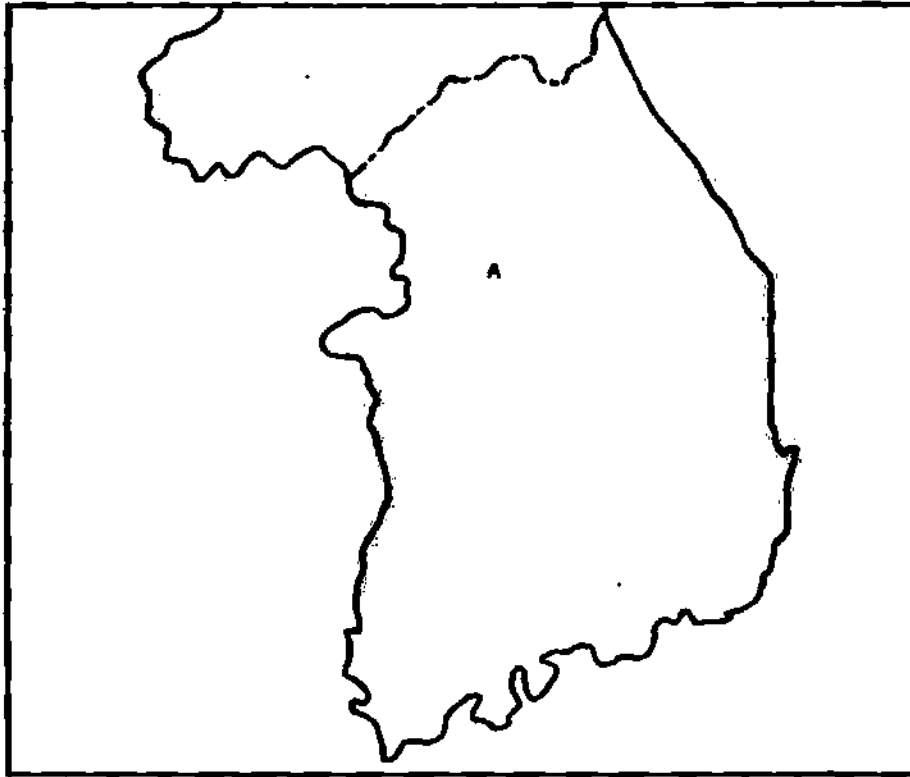
*Inmos*

*Vitellic*

Figure 15

Hyundai Electronics Industries Co., Ltd.  
MANUFACTURING FACILITIES

| <u>Map Code</u> | <u>Location</u> | <u>Products</u>              |
|-----------------|-----------------|------------------------------|
| A               | Ichon Plant     | Memory, Assembly Consignment |



Source: DATAQUEST

### Semiconductor Divisions

- Semiconductor I Division--Director: Dr. D.W. Chun
- Semiconductor II Division--Director: Dr. K.O. Park
- Semiconductor Assembly Division--Director: J.H. Lee

### Semiconductor Production

- All Divisions are Located at the Main Office:

133-2 Ami-ri, Bubal-myun, Ichon-kun  
Kyungki-do, Korea

- First Production

- SC I: December 1984
- SCII: Fourth quarter, 1985
- Assembly: Second quarter, 1985

- Employees: 850

- Capital Spending (Millions of Dollars)

| <u>1983</u> | <u>1984</u> | <u>1985</u> |
|-------------|-------------|-------------|
| \$30        | \$112       | \$140       |

- Average Monthly Wafer Starts: 1985

| <u>Plant</u> | <u>Wafer Size</u> | <u>Wafers/Month</u> |
|--------------|-------------------|---------------------|
| SC I         | 5-inch            | 15,000              |
| SC II        | 6-inch            | 25,000              |

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 72                     |
| Wafer Steppers                | 34                     |
| Projection Aligners           | 6                      |
| Ion Implanters                | 7                      |
| Sputtering Equipment          | 7                      |
| Etching Equipment             | 23                     |
| CVD Systems                   | 14                     |

- **Design Centers**

Originally, Hyundai operated two design groups, one at Ichon, South Korea, and the other at HEA, U.S.A., serving in-house product development needs. In 1985, HEA announced the closing of engineering and manufacturing activities, which included the U.S. design center.

- **Equipment:** 2 Calma GDS II with 4 workstations

### Joint Venture/Licensing

| <u>Partner</u>                | <u>Country</u> | <u>Year</u> | <u>Technology</u>       |
|-------------------------------|----------------|-------------|-------------------------|
| Inmos                         | United States  | 1984        | 64K, 256K CMOS DRAMS    |
| International CMOS Technology | United States  | 1984        | EEPROMs, EPROMs         |
| Texas Instruments             | United States  | 1984        | 64K DRAMS               |
| Western Design Center         | United States  | 1984        | 8-bit, 16-bit, CMOS MPU |

- **Contract Manufacturing**

- Texas Instruments: 64K, 256K DRAMS
- Vitelic: 64K, 256K, 1-megabit CMOS DRAMS

### U.S. Sister Company

Hyundai Electronics America, Inc. (HEA)

- HEA is the product development and marketing arm of HEI, Korea
- Location: 2191 Laurelwood Rd., Santa Clara, CA 95054
- Telephone: (408) 986-9800
- Telex: 278841 HEA UR
- Date established: March 1983
- Chief Operating Officer: C.S. Park



- Employees: 200 (September 1985)
- Investment: \$40 million
- Products: SRAM, ROM, EPROM, EEPROM, MPU
- Capacity: 5-inch Wafers, 4,000/month

In October 1985, HEA closed its product development and manufacturing activities, and announced it will concentrate marketing activities at the current location.

**KOREA ELECTRONICS CO., LTD.**

**Background**

Korea Electronics Co. (KEC) was established in September 1969 under a joint venture with Toshiba Co. of Japan (South Korea, 30 percent; Toshiba, 70 percent). At that time, the company name was Toshiba Korea Co. In 1979, the ownership was changed to 90 percent South Korea, 10 percent Toshiba when the company became public. The current company name was adopted at that time.

Korea Electronics Co., Ltd.  
45 Namdaemun-ro 4-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-757-5700, Fax: 02-756-5800  
(Millions of Dollars Except Per Share Data)

**Balance Sheet (September 31)**

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | \$ N/A      | \$31.3      | \$18.4      | \$ 8.0      | \$26.1      |
| Long-Term Liabilities                     | \$ 7.9      | \$ 8.3      | \$16.3      | \$14.6      | \$19.9      |
| Shareholders' Equity                      | \$ 4.5      | \$11.7      | \$10.8      | \$10.9      | \$14.0      |
| After-Tax Return on<br>Average Equity (%) | 14.7        | 15.8        | 5.1         | 11.9        | 32.9        |

**Operating Performance (September 31)**

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$24.2      | \$50.0      | \$40.1      | \$61.6      | \$84.6      |
| Cost of Revenue          | \$18.2      | \$40.0      | \$33.4      | \$50.3      | \$66.5      |
| SG&A Expense             | \$ 1.5      | \$ 4.3      | \$ 4.0      | \$ 6.3      | \$ 6.0      |
| Pretax Income            | \$ 0.9      | \$ 1.4      | \$ 0.4      | \$ 2.0      | \$ 6.4      |
| Net Income               | \$ 0.6      | \$ 1.3      | \$ 0.4      | \$ 1.3      | \$ 4.0      |
| Average Shares (Million) | 4.0         | 6.4         | 9.0         | 9.0         | 9.0         |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | 108.0       | 152.0       | 51.0        | 111.0       | 371.0       |
| Dividends                | 100.0       | 87.5        | 45.0        | 50.0        | 60.0        |
| Book Value               | 326.0       | 1,188.0     | 1,123.0     | 826.0       | 1,192.0     |
| Price Average            | N/A         | N/A         | N/A         | 1,087.0     | 2,450.0     |
| Total Employees          | N/A         | 1,827       | 1,786       | 2,003       | 2,184       |
| Exchange Rate (W/US\$)   | 659.9       | 700.5       | 748.8       | 795.5       | 827.4       |

N/A = Not Available

Source: Dongsuh Securities Co., Ltd.,  
Annual Report of Listed Companies

### Major Products

The company's major products are black and white and color television sets, monitors, and semiconductors.

**Korea Electronics Co., Ltd.**  
**REVENUE BY BUSINESS LINE**  
**(Millions of Dollars)**

|                  | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|------------------|-------------|-------------|-------------|-------------|
| Semiconductor    | \$27.2      | \$14.7      | \$26.4      | \$38.0      |
| Pellet           | -           | \$ 0.1      | \$ 0.5      | \$ 1.0      |
| Television/Tuner | \$21.4      | \$24.0      | \$33.9      | \$47.1      |

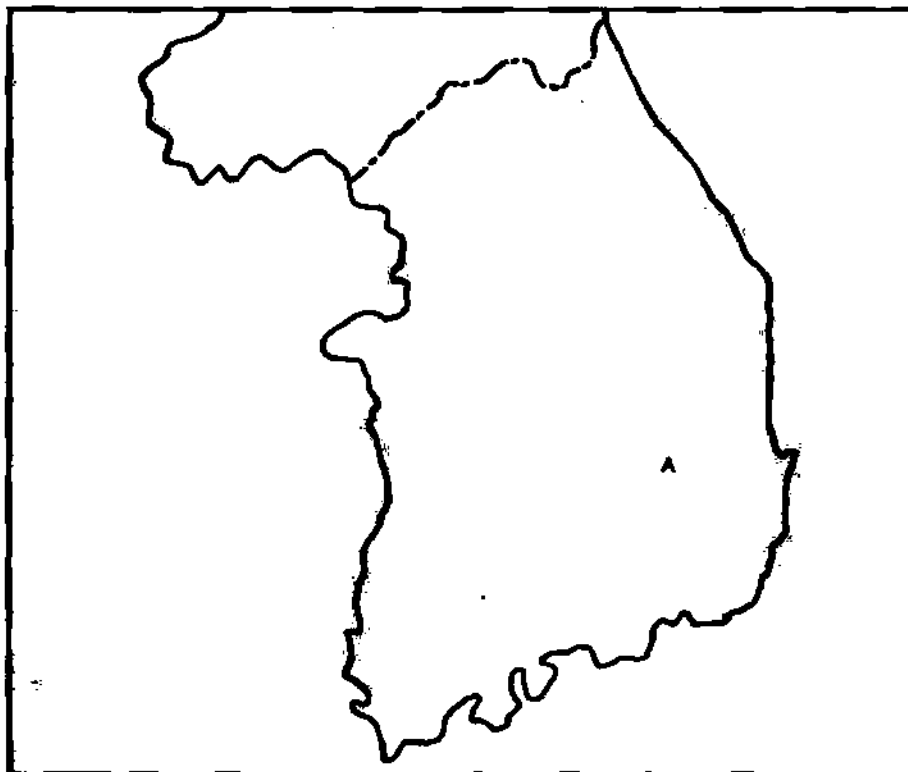
Source: DATAQUEST  
Annual Reports of  
Korea Electronics Co., Ltd.

KEC's major manufacturing facilities and its products are shown in Figure 16.

Figure 16

Korea Electronics Co., Ltd.  
MANUFACTURING FACILITIES

| <u>Map Code</u> | <u>Location</u> | <u>Products</u>   |
|-----------------|-----------------|---|
| A               | Gumi Plant      | Transistors, IC, LED, Diode, Pellet, CTV, FBT, Tuner, Monitor |



Source: DATAQUEST

### Semiconductor Division

The following is a brief history of KEC's semiconductor business:

- Started the business in March 1970 with the production of To-92 type transistors
- Expanded the business to provide more variety of product--from semiconductor components to consumer products
- Had one of the world's largest assembly capacities for To-92 transistors as of the end of 1984

### Major Products

- Linear Bipolar: Audio and video ICs
- Discrete: Transistors, diodes, LEDs

**Korea Electronics Co., Ltd.  
WORLDWIDE SEMICONDUCTOR SALES  
(Millions of Dollars)**

|                       | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|-----------------------|-------------|-------------|-------------|-------------|
| Total Semiconductor   | \$14.7      | \$26.4      | \$38.0      | \$42.0      |
| Total IC              | \$ 2.7      | \$ 3.8      | \$ 5.0      | \$ 8.0      |
| Bipolar Digital       | -           | -           | -           | -           |
| MOS                   | -           | -           | -           | -           |
| Memory                | -           | -           | -           | -           |
| Microprocessor        | -           | -           | -           | -           |
| Logic                 | -           | -           | -           | -           |
| Linear                | 2.7         | 3.8         | 5.0         | 8.0         |
| Total Discrete        | \$10.7      | \$20.1      | \$30.0      | \$32.0      |
| Total Optoelectronics | \$ 1.3      | \$ 2.5      | \$ 3.0      | \$ 2.0      |

Source: DATAQUEST  
Annual Reports of  
Korea Electronics Co., Ltd.

### Semiconductor Production

- Location: 149 Gongdan-dong, Gumi City, Kyungbuk, Korea
- Capital Spending
  - Estimated total investment by 1985: \$40 million
- Average Monthly Wafer Starts
  - 3-inch, 5,000
  - 4-inch, 5,000

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 36                     |
| Projection Aligners           | 10                     |
| Ion Implanters                | 1                      |
| Etching Equipment             | 2                      |
| CVD Systems                   | 3                      |

### Joint Ventures/Licensing

| <u>Partner</u> | <u>Country</u> | <u>Year</u> | <u>Technology</u>  |
|----------------|----------------|-------------|--|
| Toshiba        | Japan          | 1970        | Assembly and process technology, discrete and linear bipolar devices |

SAMSUNG SEMICONDUCTOR AND TELECOMMUNICATIONS CO., LTD.

Parent Company

The Samsung Group was founded in 1938, making it one of the oldest private business enterprises in Korea. Samsung has grown into a conglomerate of 25 affiliated companies with more than 100,000 employees. The products and services it provides include the following areas: food, textile, electronics, heavy industries, construction, hotels, insurance, and trading. The Samsung Group's 1984 sales reached over US\$10 billion.

Samsung Semiconductor and Telecommunications  
150 Taepyung-ro 2-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-771-78, Telex: K24377  
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | N/A         | \$34.3      | \$64.1      | \$104.3     | \$385.5     |
| Long-Term Liabilities                     | \$24.2      | \$25.7      | \$26.7      | \$ 56.6     | \$201.8     |
| Shareholders' Equity                      | \$12.1      | \$14.3      | \$25.4      | \$ 37.7     | \$ 85.8     |
| After-Tax Return on<br>Average Equity (%) | (27.8)      | 22.6        | 14.4        | 8.6         | 12.5        |

Operating Performance (December 31)

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$27.3      | \$68.5      | \$92.1      | \$132.0     | \$216.3     |
| Cost of Revenue          | \$18.2      | \$47.1      | \$68.1      | \$104.3     | \$155.9     |
| SG&A Expense             | \$ 3.0      | \$ 5.7      | \$ 8.0      | \$ 18.9     | \$ 27.8     |
| Pretax Income            | (\$ 4.5)    | \$ 2.9      | \$ 2.7      | \$ 5.0      | \$ 12.1     |
| Net Income               | (\$ 4.5)    | \$ 2.9      | \$ 2.7      | \$ 2.5      | \$ 7.3      |
| Average Shares (Million) | 11.4        | 11.4        | 16.3        | 26.0        | 60.0        |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | (220.0)     | 174.0       | 125.0       | 109.0       | 141.0       |
| Dividends                | 0           | 0           | 0           | 0           | 100.0       |
| Book Value               | 105.0       | 539.0       | 1,091.0     | 1,090.0     | 1,020.0     |
| Price Average            | N/A         | N/A         | N/A         | N/A         | 1,758.0     |
| Total Employees          | N/A         | N/A         | N/A         | N/A         | 6,871       |
| Exchange Rate (W/US\$)   | 659.0       | 700.5       | 748.8       | 795.5       | 827.4       |

N/A = Not Available

Source: Dongsuh Securities Co., Ltd.  
Annual Report of Listed Companies

## Background

The Samsung Group took over the Korea Telecommunications Co. (KTC) in 1980. KTC was a wholly owned government corporation established in 1977 to modernize the South Korean communications network. In 1982, the Samsung Group merged its telecommunications operations with another of its subsidiaries, the Korea Semiconductor Inc., a manufacturer of CMOS watch chips since 1974. The new entity was renamed Samsung Semiconductor and Telecommunications Company (SST).

SST is separated into three divisions: telecommunications, computers, and semiconductors. SST also has a research and development facility, and an affiliated group company, Samsung Semiconductor, Inc. (formerly Tristar Semiconductor), which is located in the United States.

## Major Products

SST's major products include ESS, PAB, telephone sets, key telephones, facsimiles, modems, computers, optical fiber and cables, and semiconductors.

### Samsung Semiconductor and Telecommunications Co., Ltd. REVENUE BY BUSINESS LINE (Millions of Dollars)

|                | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|----------------|-------------|-------------|-------------|-------------|-------------|
| ESS            | \$25.8      | \$56.6      | \$69.7      | \$78.4      | \$114.0     |
| PABX           | \$ 0.9      | \$ 4.0      | \$ 6.0      | \$ 9.1      | \$ 17.3     |
| Telephone      | -           | -           | \$ 0.7      | \$ 5.4      | \$ 12.0     |
| Facsimile      | -           | -           | -           | \$ 1.6      | \$ 3.1      |
| Modem          | -           | -           | -           | \$ 0.1      | \$ 0.4      |
| Minicomputer   | -           | -           | -           | -           | \$ 0.8      |
| Key Telephone  | -           | -           | -           | -           | \$ 0.8      |
| Semiconductors | -           | -           | \$ 4.8      | \$25.9      | \$ 60.0     |

Source: DATAQUEST  
Annual Reports of  
Samsung Semiconductor and  
Telecommunications Co., Ltd.

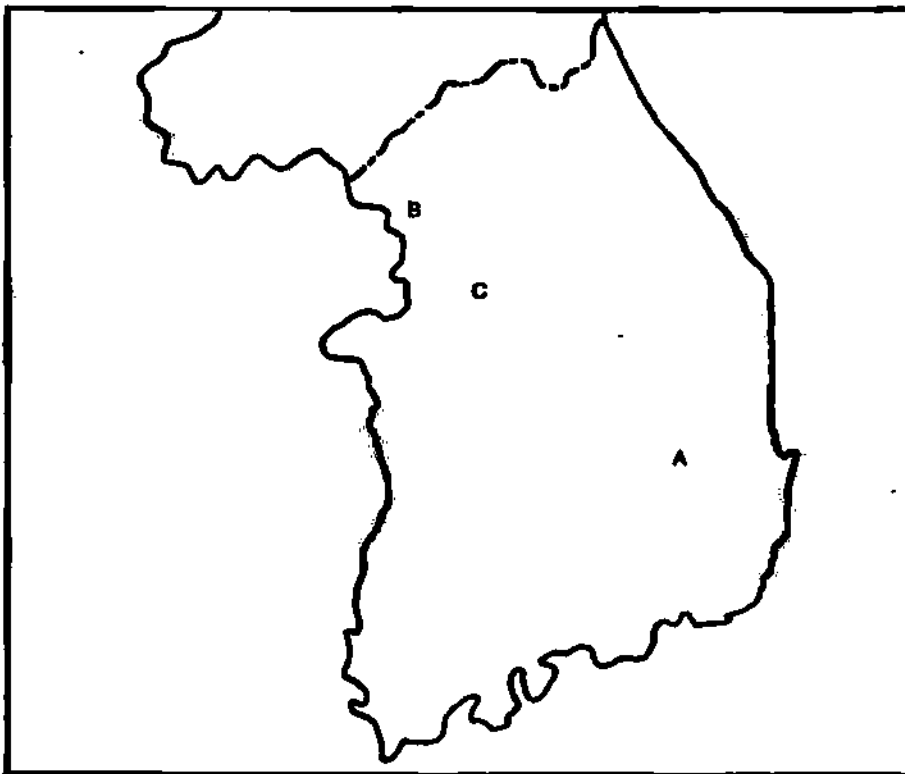
SST's major manufacturing facilities, their size, and the products produced, are shown in Figure 17.



**Figure 17**

**Samsung Semiconductor and Telecommunications Co., Ltd.  
MANUFACTURING FACILITIES**

| <b>Map Code</b> | <b>Location</b>     | <b>Products</b>  |
|-----------------|---------------------|--|
| <b>A</b>        | <b>Gumi Plant</b>   | <b>ESS, Computer, OA Equipment, Telephone, Terminal</b>        |
| <b>B</b>        | <b>Buchon Plant</b> | <b>Transistors, CMOS, Linear IC, Lead Frame, Optical Fiber</b> |
| <b>C</b>        | <b>Suwon Plant</b>  | <b>64K DRAM, 256K DRAM, MPU, MCU, 16K SRAM, 16K EEPROM</b>     |



Source: DATAQUEST

### Semiconductor Division

- Director: K.H. Kim
- Brief history of SST's semiconductor business
  - 1974: Successfully produced LSI for electronic watches
  - 1978: Started producing linear IC
  - 1978: Developed color-signal ICs
  - 1983: Established U.S. subsidiary in Santa Clara, California
  - 1983: Succeeded in pilot production of the 64K DRAM
  - 1984: Completed the construction of the VLSI plant
  - 1984: Developed the 16K EEPROM and 16K SRAM
  - 1984: Developed the 256K DRAM
  - 1985: Shipped 256K DRAM samples
  - 1985: Completed construction of the 256K DRAM facility

### Semiconductor Products

- MOS Logic: Watch chip, calculator chip, HC/TTL, LS/TTL
- MOS Memory: 64K DRAM, 128K DRAM, 256K DRAM, 16K SRAM, 64K SRAM, 16K EEPROM
- MOS MPU: 4-bit, 8-bit, and Intel second source
- Linear IC: Audio, video, industrial, telecom, and consumer ICs
- Transistors: S/S, Power

**Samsung Semiconductor and Telecommunications Co., Ltd.**  
**WORLDWIDE SEMICONDUCTOR SALES**  
(Millions of Dollars)

|                       | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|-----------------------|-------------|-------------|-------------|-------------|
| Total Semiconductor   | \$4.8       | \$25.9      | \$60.0      | \$95.0      |
| Total IC              | \$3.7       | \$14.0      | \$33.0      | \$75.0      |
| Bipolar Digital       | -           | -           | -           | -           |
| MOS                   | 3.2         | 9.9         | 25.0        | 55.0        |
| Memory                | -           | -           | 3.0         | 21.0        |
| Microprocessor        | -           | -           | -           | -           |
| Logic                 | 3.2         | 9.9         | 22.0        | 34.0        |
| Linear                | 0.5         | 4.1         | 8.0         | 20.0        |
| Total Discrete        | \$1.1       | \$11.9      | \$27.0      | \$20.0      |
| Total Optoelectronics | -           | -           | -           | -           |

Source: DATAQUEST  
Annual Reports of  
Samsung Semiconductor and  
Telecommunications Co., Ltd.

**Semiconductor Production**

• Facilities

|                             | <u>Buchon Plant</u>                             | <u>Suwon Plant</u>  |
|-----------------------------|---|---|
| Location                    | 82-3, Dodang-dong, Buchon,<br>Kyunggi-do, Korea | San 24, Nongsuh-ri,<br>Kiheung-myun, Yongin-gun,<br>Kyunggi-do, Korea |
| Manager                     | S.K. Lee  | Y. W. Lee   |
| Date of First<br>Production | Dec. 1974                                       | April 1984  |
| Employees<br>(May 1985)     | 1,900   | 1,600   |

✓ 6-8 months construction period!

● Production Capacity (Thousands of Units)

| <u>Plant</u> | <u>Product</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>Total</u> |
|--------------|----------------|-------------|-------------|-------------|--------------|
| Buchon       | Transistor     | 132,101     | 249,202     | 470,698     | 852,001      |
|              | Linear IC      | 8,718       | 19,964      | 50,504      | 79,186       |
|              | MOS Logic      | 56,576      | 107,309     | 172,068     | 335,952      |
| Suwon        | MOS Memory     |             |             | 18,144      | 18,144       |
| Total        |                | 197,394     | 376,475     | 711,414     | 1,285,283    |

● Capital Spending (Millions of Dollars)

| <u>Plant</u> | <u>1983</u> | <u>1984</u> | (Estimated)<br><u>1985</u> |
|--------------|-------------|-------------|----------------------------|
| Buchon       | \$15        | \$ 40       | \$ 60                      |
| Suwon        | <u>24</u>   | <u>124</u>  | <u>194</u>                 |
| Total        | \$39        | \$164       | \$254                      |

● Average Monthly Wafer Starts (Wafer/Month)

| <u>Plant</u> | <u>Wafer Size</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|--------------|-------------------|-------------|-------------|-------------|-------------|
| Buchon       | 3-inch            | 15,000      | 15,000      | 15,000      | 15,000      |
|              | 4-inch            |             | 15,000      | 15,000      | 15,000      |
|              | 5-inch            |             |             |             | 20,000      |
| Suwon        | 4-inch            |             |             | 27,000      | 27,000      |
|              | 6-inch            |             |             |             | 20,000      |

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 210                    |
| Wafer Steppers                | 19                     |
| Projection Aligners           | 36                     |
| Ion Implanters                | 17                     |
| Sputtering Equipment          | 10                     |
| Etching Equipment             | 43                     |
| CVD Systems                   | 8                      |
| Epi Reactors                  | 4                      |

- U.S. Subsidiary

- Samsung Semiconductor, Inc. (SSI)
  - SSI is the product development and marketing arm of SST, Korea.
- Location: 5150 Great America Parkway, Santa Clara, CA 95054
- Telephone: (408) 980-1630
- Telex: 339544 KORSEM SNTA
- Date established: July 1983
- President: Dr. Sang Joon Lee
- Employees: 150
- Investment: \$60 million (\$30 million-\$40million in facilities)
- Products: DRAM, SRAM, EPROM, EEPROM, Custom, Semicustom
- Capacity: 5-inch Wafers, 4,000/month

- Design Centers

- There are design groups for internal product development both at Buchon plant and SSI (U.S.). In the spring of 1985, SST established a joint venture agreement with National Semiconductor of the United States to open a design center at the Buchon plant. This facility designs gate arrays and other semicustom products for National Semiconductor and for customers in Korea.

- Number of People: Approximately 20
- Equipment: Five Daisy workstations

### Joint Venture/Licensing

| <u>Partner</u>         | <u>Country</u> | <u>Year</u> | <u>Technology</u> |
|------------------------|----------------|-------------|-------------------|
| DITTI                  | Germany        | 1983        | CMOS              |
| Micron Technology      | United States  | 1983        | 64K, 256K DRAM    |
| Sharp (Japan)          | Japan          | 1983        | 4-bit MPU         |
| Exel Microelectronics  | United States  | 1984        | 16K EEPROM        |
| Intel                  | United States  | 1985        | 8-bit MPU, MCU    |
| National Semiconductor | United States  | 1985        | Gate array        |
| Zytrex                 | United States  | 1985        | CMOS logic        |

### Contract Manufacturing

- Wafer Foundry for SGS, Italy, for MPU
- 5,000 Wafers/Month

## KOREA ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE (KETRI)

### Parent Company

This organization was formed in March 1985, when the Korea Institute of Electronics Technology (KIET) was merged with Korea Telecommunications Research Institute. The combined institute will be located at the original telecommunications research institute, Daeduck, about 100 miles south of Seoul, Korea. KIET's semiconductor facility at Gumi City will be sold to Daewoo. The following information refers to this facility.

### Semiconductor Production

- Location: Imsu-dong Gumi-si, Kyungbuk, Korea
- Manager: Y.I. Kang
- Date of First Production: October 1980
- Employees: 150
- Products:
  - Linear Bipolar: Audio, video, and telecommunications
  - MOS Memory: 2K and 4K SRAMs, 32K and 64K ROMs
  - MOS MPU: 8-bit
- Investment
  - \$60 million by 1985
- Average Monthly Wafer Starts
  - Bipolar: 4-inch, 2,000
  - MOS: 4-inch, 2,000

#### Partial Equipment List

#### Number of Units

|                        |    |
|------------------------|----|
| Furnace                | 32 |
| Aligner                | 6  |
| Ion implanter          | 2  |
| Sputter                | 1  |
| Etcher                 | 3  |
| Wafer coater/developer | 6  |
| VCD                    | 2  |

- Design Center
  - In-house design group
  - 1 Applicon CAD
  - 2 Metheus workstations

#### Joint Venture/Licensing

VLSI Technology: (1982) NMOS Process, 32K ROM

#### Contract Manufacturing

VLSI Technology: 32K and 64K ROM (Expired)



**DONG SUNG MOOLSAN IND. CO., LTD.**

President: Dong Hai Kim  
Head Office: Room 703, Sehan Bldg., 27-1, Supyo-dong  
Jongro-ku, Seoul, Korea  
Factory: San 2-2, Karpyung-ri, Majang-myun  
Ichon-kun, Kyunggi-do, Korea  
Seoul Office: Room 305, Daechang Bldg., 182-2, Jangsa-dong  
Jongro-ku, Seoul, Korea  
Telephone: Head Office: 272-5072/3  
Factory: (MAJANG) 20  
Seoul Office: 272-6576/7  
P.O. Box, C.P.O Box 1872, Seoul  
Telex: KOSTAR K26133  
Cable: KOSTAR METAL, Seoul  
Capital: W340 million  
Employees: 240  
Established: 1982  
Annual Production: 1984e--\$3.1 million  
Brand Name: DS  
Main Products: Rectifier diodes, silicon varistors, bridge  
diodes, varistors

**KARIBONG ELECTRONICS CORP.**

President: Ju Sup Shim  
Head Office: 238-104, Karibong-dong, Guro-ku, Seoul, Korea  
Factory: 1st: 238-104, Karibong-dong, Guro-ku, Seoul, Korea  
          2nd: 151-16, Doksan-dong, Guro-ku, Seoul, Korea  
Telephone: Head Office: 855-7101/4  
              Factory: 1st: 856-8427, 853-2331  
                      2nd: 864-7739, 7740, 0554  
P.O. Box: Gurodanji 59, Seoul  
Telex: ROHMKO K23205  
Cable: KARIBONG Seoul  
Capital: W80 million  
Employees: 816  
Established: 1976  
Annual Production: 1984e--\$9.3 million  
Main Products: Silicon diodes, rectifying diodes, LED display,  
                  LED lamps

KOMY SEMICONDUCTOR, LTD.

President: Jin Young Lee  
Head Office and Factory: 316-7, Hyosung-dong, Buk-ku,  
Ichon, Korea  
Seoul Office: Tae Yang Bldg., 44-4, Yoido-dong  
Youngdeungpo-ku, Seoul, Korea  
Telephone: Head Office: 742-4373, 782-9051  
Factory: (032) 92-3983  
P.O. Box: C.P.O Box 1829, Seoul  
Telex: KOMYKOR K24214  
Cable: LEEKOMY Bupyeong  
Capital: W200 million  
Employees: 300  
Established: 1964  
Venture Form: Joint venture with KOMG of the United States;  
KOMG has minority ownership  
Annual Production: 1984e--\$84.0 million  
Overseas Office: KSL Microdevices, Bldg. 38, 3350 Scott Blvd.,  
Santa Clara, CA 94054 U.S.A.  
Brand Name: KSL  
Main Products: Transistors, ICs

KOREA DIODE CO., LTD.

President: Sam Yong Rho

Head Office: Rm. 6f06, Joongang Bldg., 44-26, Yoido-dong,  
Youngdeungpo-ku, Seoul, Korea

Factory: 4-13, Wonmi-dong, Buchon City, Kyunggi-do, Korea

Telephone: Head Office: 783-6141

Factory: (032) 63-8231

P.O. Box: Yoido P.O. Box 653, Seoul

Telex: KODICO K27885

Capital: W120 million

Employees: 40

Established: 1983

Brand Name: KDC

Main Products: Rectifier diodes, fast recovery diodes, zener  
diodes, bridge diodes, varistors, transistors

KOREA FUJI ELECTRONICS IND. CO.

President: Jin Kyu Kim  
Head Office and Factory: 159-17, Doksan-dong, Guro-ku, Seoul,  
Korea  
Telephone: Head Office: 856-6444, 863-4345, 855-0301  
P.O. Box: C.P.O. Box 1604 Seoul  
Telex: WOOINTY K28984  
Cable: SENSITRONIC Seoul  
Capital: W100 million  
Employees: 68  
Established: 1975  
Annual Production: 1984e--\$2.9 million  
Main Products: NTC thermistors, thermistor sensors, silicon  
varistors, SIC varistors, silicon rectifier  
diodes.

**KOREA OPTOELECTRONICS CORP.**

President: Wall Boon Park  
Head Office: 53-10, Kueui-dong, Sungdong-ku  
Seoul, Korea  
Factory: 119, Jungkog-dong, Sungdong-ku, Seoul, Korea  
Telephone: Head Office: 446-0002, 447-3714  
Factory: 446-6960  
Telex: RANDKOP K24673  
Capital: W75 million  
Employees: 200  
Established: 1978  
Annual Production: 1984e--\$1.5 million  
Brand Name: KOC  
Main Products: Photo transistors, transistors, diodes, solar  
cells, photo diodes, photo Darlingtons, photo  
couplers, photo interrupters

ROHM KOREA CORP.

President: Ju Sup Shim  
Head Office and Factory: 371-11, Karibong-dong, Guro-ku,  
Seoul, Korea  
Telephone: Head Office: 855-7101/4  
P.O. Box: Gurodanji, 13 Seoul  
Telex: ROHMKO K23205  
Cable: ROHMKO Seoul  
Capital: W673.1 million  
Employees: 983  
Established: 1972  
Venture Form: Joint venture with Rohm of Japan; Rohm holds  
minority ownership  
Annual Production: 1984e--\$12.0 million  
Main Products: Silicon transistor arrays, silicon diode  
arrays, LED displays, LED lamps, infrared  
LED lamps, photo transistors, LED photo  
sensors, fixed metal film resistors, fixed  
carbon film resistors

## APPENDIX A

### **SOUTH KOREAN SEMICONDUCTOR INDUSTRY PRODUCTION, CONSUMPTION, IMPORTS, AND EXPORTS**

#### INTRODUCTION

Appendix A consists of a set of detailed tables that estimate South Korean semiconductor industry production, consumption, and semiconductor trade for 1982 through 1985. Semiconductor production and trade tables are historical data tables only. Semiconductor consumption tables are divided into historical data tables for 1982 through 1985, and forecast tables for 1985 through 1990.

All historical tables begin with 1982 and end with 1985, while all forecast tables begin with 1985 and end with 1990. A list of Appendix A tables detailing the type of data, years, and units is as follows:

| <u>Table Number</u> | <u>Type of Data</u>  | <u>Calendar<br/>Years</u> | <u>Units</u>   |
|---------------------|----------------------|---------------------------|----------------|
| A-0                 | Exchange Rates       | 1982-1985                 | Won per Dollar |
| A-1                 | Production History   | 1982-1985                 | Dollars        |
| A-2                 | Production History   | 1982-1985                 | Won            |
| A-3                 | Consumption History  | 1982-1985                 | Dollars        |
| A-4                 | Consumption History  | 1982-1985                 | Won            |
| A-5                 | Consumption Forecast | 1985-1990                 | Dollars        |
| A-6                 | Consumption Forecast | 1985-1990                 | Won            |
| A-7                 | Imports              | 1982-1985                 | Dollars        |
| A-8                 | Imports              | 1982-1985                 | Won            |
| A-9                 | Exports              | 1982-1985                 | Dollars        |
| A-10                | Exports              | 1982-1985                 | Won            |

#### DEFINITIONS AND CONVENTIONS

DATAQUEST uses a common manufacturer base for all data tables. This base includes all merchant suppliers to the semiconductor market. It excludes captive suppliers that manufacture devices solely for the benefit of the parent company, such as Burroughs, IBM, and Western Electric. Included, however, are companies that actively market semiconductor devices to the merchant market as well as to other divisions of their own companies. A recent case in point is NCR, previously a captive supplier,



which in 1982 offered products on the merchant market for the first time. For such companies, both external shipments and internal consumption are included. Devices that are used internally are valued at current market prices.

### Production

South Korean semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, since some assembly and packaging revenues are counted as semiconductor production and some are not.

Semiconductor production tables include all semiconductor products manufactured in South Korea, including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging activities. Actual semiconductor device production, excluding related components, by native South Korean manufacturers is given in Chapter 9, Native Korean Semiconductor Manufacturers.

### Consumption

DATAQUEST defines consumption as the purchase of a semiconductor device or devices. This definition must be differentiated from actual use of the device in a final product. According to our definition, devices that are inventoried at the user level are considered consumption.

### FORECAST

Historical data are expressed in current dollars or current won and therefore include the given year's inflation rate and exchange rates. However, the consumption forecasts, which appear in Tables A-5 and A-6, use constant won, dollars, and exchange rates, with no allowance for inflation or exchange rate variations. All estimates for 1985 and beyond are made as if 1985 monetary conditions would continue through 1990 and, therefore, show the absolute year-to-year growth during this period.

Table A-0

EXCHANGE RATE  
KOREAN WON TO U.S. DOLLAR  
(Won per Dollar)

| <u>Year</u> | <u>Won per Dollar</u> |
|-------------|-----------------------|
| 1982        | 749                   |
| 1983        | 796                   |
| 1984        | 827                   |
| 1985E       | 760                   |

Source: Far Eastern  
Economic Review  
DATAQUEST

Table A-1

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR PRODUCTION**  
(Millions of Dollars)

|                      | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|----------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor* | \$648.0     | \$850.0     | \$1,259.0   | \$994.0     | 15.3%                           |
| IC                   | \$490.0     | \$661.0     | \$1,070.0   | \$844.8     | 19.9%                           |
| Discrete             | \$121.0     | \$159.0     | \$ 155.2    | \$122.5     | 0.4%                            |
| Optoelectronics      | \$ 37.0     | \$ 30.0     | \$ 33.8     | \$ 26.7     | (10.3%)                         |

Table A-2

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR PRODUCTION**  
(Billions of Won)

|                      | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|----------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor* | W485.2      | W676.2      | W1,041.7    | W755.4      | 15.9%                           |
| IC                   | W366.9      | W525.8      | W 885.3     | W642.0      | 20.5%                           |
| Discrete             | W 90.6      | W126.5      | W 128.4     | W 93.1      | 0.9%                            |
| Optoelectronics      | W 27.7      | W 23.9      | W 28.0      | W 20.3      | (9.9%)                          |

Source: DATAQUEST

\*Includes not only fab, assembly, and test, by native manufacturers but also contract assembly and test.

Table A-3

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR CONSUMPTION**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$154.4     | \$226.7     | \$304.0     | \$255.0     | 18.2%                           |
| IC                  | \$ 78.0     | \$118.0     | \$228.0     | \$191.0     | 34.8%                           |
| Discrete            | \$ 73.0     | \$105.0     | \$ 68.2     | \$ 57.0     | (7.9%)                          |
| Optoelectronics     | \$ 3.4      | \$ 3.7      | \$ 7.8      | \$ 7.0      | 27.2%                           |

Table A-4

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR CONSUMPTION**  
(Billions of Won)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | W115.6      | W180.6      | W251.5      | W193.8      | 18.8%                           |
| IC                  | W 58.4      | W 93.9      | W188.6      | W145.2      | 35.5%                           |
| Discrete            | W 54.7      | W 83.5      | W 56.4      | W 43.3      | (7.5%)                          |
| Optoelectronics     | W 2.5       | W 2.9       | W 6.5       | W 5.3       | 27.8%                           |

Source: DATAQUEST

Table A-5

**FORECAST SOUTH KOREAN SEMICONDUCTOR CONSUMPTION**  
(Millions of Dollars)

|                     | <u>1985</u> | <u>1986</u> | <u>1987</u> | <u>1988</u> | <u>1989</u> | <u>1990</u> | <u>CAGR</u><br><u>1985-1990</u> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$255.0     | \$306.0     | \$422.3     | \$543.5     | \$576.1     | \$689.2     | 22.0%                           |
| IC                  | \$191.0     | \$232.5     | \$328.9     | \$429.4     | \$456.5     | \$559.9     | 24.0%                           |
| Discrete            | \$ 57.0     | \$ 65.1     | \$ 82.3     | \$100.3     | \$103.4     | \$113.6     | 14.8%                           |
| Optoelectronics     | \$ 7.0      | \$ 8.4      | \$ 11.1     | \$ 13.8     | \$ 16.2     | \$ 15.7     | 17.5%                           |

Table A-6

**FORECAST SOUTH KOREAN SEMICONDUCTOR CONSUMPTION**  
(Billions of Won)

|                     | <u>1985</u> | <u>1986</u> | <u>1987</u> | <u>1988</u> | <u>1989</u> | <u>1990</u> | <u>CAGR</u><br><u>1985-1990</u> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | W193.8      | W232.6      | W320.9      | W413.1      | W437.8      | W523.8      | 22.0%                           |
| IC                  | W145.2      | W176.7      | W250.0      | W326.3      | W346.9      | W425.5      | 24.0%                           |
| Discrete            | W 43.3      | W 49.5      | W 62.5      | W 76.2      | W 78.6      | W 86.3      | 14.8%                           |
| Optoelectronics     | W 5.3       | W 6.4       | W 8.4       | W 10.5      | W 12.3      | W 11.9      | 17.5%                           |

Source: DATAQUEST

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR IMPORTS**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$130.4     | \$233.7     | \$336.0     | \$229.0     | 20.6%                           |
| IC                  | \$ 86.0     | \$160.0     | \$245.0     | \$167.0     | 24.8%                           |
| Discrete            | \$ 44.0     | \$ 73.0     | \$ 86.0     | \$ 58.6     | 10.0%                           |
| Optoelectronics     | \$ 0.4      | \$ 0.7      | \$ 5.0      | \$ 3.4      | 104.2%                          |

Table A-8

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR IMPORTS**  
(Billions of Won)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | W97.6       | W185.9      | W278.0      | W174.0      | 21.3%                           |
| IC                  | W64.4       | W127.3      | W202.7      | W126.9      | 25.4%                           |
| Discrete            | W32.9       | W 58.1      | W 71.2      | W 44.5      | 10.6%                           |
| Optoelectronics     | W 0.3       | W 0.6       | W 4.1       | W 2.6       | 105.3%                          |

Source: DATAQUEST

Table A-9

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR EXPORTS**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$624.0     | \$857.0     | \$1,291.0   | \$968.0     | 15.8%                           |
| IC                  | \$498.0     | \$703.0     | \$1,087.0   | \$815.0     | 17.8%                           |
| Discrete            | \$ 92.0     | \$127.0     | \$ 173.0    | \$129.7     | 12.1%                           |
| Optoelectronics     | \$ 34.0     | \$ 27.0     | \$ 31.0     | \$ 23.2     | (11.9%)                         |

Table A-10

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR EXPORTS**  
(Billions of Won)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | ₩467.3      | ₩681.7      | ₩1,068.2    | ₩735.7      | 16.3%                           |
| IC                  | ₩372.9      | ₩559.2      | ₩ 899.4     | ₩619.4      | 18.4%                           |
| Discrete            | ₩ 68.9      | ₩101.0      | ₩ 143.1     | ₩ 98.6      | 12.7%                           |
| Optoelectronics     | ₩ 25.5      | ₩ 21.5      | ₩ 25.6      | ₩ 17.7      | (11.5%)                         |

Source: DATAQUEST

## APPENDIX B

### SOUTH KOREAN SEMICONDUCTOR MARKET SHARE

#### ESTIMATED MARKET SHARE IN SOUTH KOREA

An integral part of DATAQUEST's South Korean Semiconductor Industry data base is the analysis of semiconductor markets through estimation of market share by manufacturer. This analysis provides insights into semiconductor markets and reinforces estimates of consumption, production, and company revenues that were made using other data. The tables show the South Korean market shares for all major Japanese, U.S., South Korean, and Rest of World semiconductor manufacturers. South Korean semiconductor market share is presented by product line for 1984 and 1985 in the following tables:

| <u>Table Number</u> | <u>Product</u>      | <u>Currency</u> |
|---------------------|---------------------|-----------------|
| B-1                 | Total Semiconductor | Dollars         |
| B-2                 | Total Semiconductor | Won             |
| B-3                 | Integrated Circuit  | Dollars         |
| B-4                 | Integrated Circuit  | Won             |
| B-5                 | Bipolar Digital     | Dollars         |
| B-6                 | Bipolar Digital     | Won             |
| B-7                 | MOS                 | Dollars         |
| B-8                 | MOS                 | Won             |
| B-9                 | Linear              | Dollars         |
| B-10                | Linear              | Won             |
| B-11                | Discrete            | Dollars         |
| B-12                | Discrete            | Won             |
| B-13                | Optoelectronics     | Dollars         |
| B-14                | Optoelectronics     | Won             |

The totals given for the companies reflect the portion of their worldwide production that is sold in the South Korean market.



## DEFINITIONS AND CONVENTIONS

DATAQUEST uses a common manufacturer base for all data tables. This base includes all noncaptive suppliers to the semiconductor market. It excludes totally captive suppliers, such as IBM, that manufacture devices solely for the benefit of the parent company, but it includes companies that actively market their semiconductor devices to the industry at large as well as to other divisions of their own companies. For these companies, both external shipments and internal consumption are included. Devices that are used internally are valued at current market prices.

All estimates given in these tables are presented in U.S. dollars to make the tables useful in comparing companies based in different countries. Each table is also presented in won, in order to provide a more accurate presentation of real growth rates for the South Korean companies.

Construction of the tables involves combining data from many countries, each of which has different and changing exchange rates. DATAQUEST uses International Monetary Fund average exchange rates for each year and, as far as possible, the estimates are prepared in terms of local currencies before conversion to U.S. dollars or won. The won to dollar exchange rates by year are given in Appendix A, Table A-0.

## NEED FOR CAREFUL INTERPRETATION

Despite the care taken in gathering and analyzing the available data and in attempting to categorize those data in a meaningful way, careful attention must be paid to the definitions and assumptions used herein when interpreting the estimates presented in these tables. Various companies, government agencies, and trade associations may use slightly different definitions of product categories and regional groupings, or they may include different companies in their summaries. These differences should be kept in mind when making comparisons between these data and those provided by others.

Table B-1

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY**  
**1984-1985**  
**TOTAL SEMICONDUCTOR\***  
**(Millions of Dollars)**

| <u>Companies</u>     | <u>1984</u>          | <u>1985</u>          |
|----------------------|----------------------|----------------------|
| <b>Total</b>         | <b>\$304.0</b>       | <b>\$255.0</b>       |
| <b>Japanese</b>      | <b>\$132.5</b> 43.6% | <b>\$112.3</b> 44.0% |
| Fujitsu              | \$ 2.3               | \$ 2.2               |
| Hitachi              | \$ 23.3              | \$ 17.1              |
| Matsushita           | \$ 8.5               | \$ 7.5               |
| Mitsubishi           | \$ 6.2               | \$ 4.5               |
| NEC                  | \$ 31.8              | \$ 26.1              |
| Sanyo                | \$ 15.5              | \$ 13.4              |
| Sharp                | \$ 2.3               | \$ 1.5               |
| Toshiba              | \$ 11.6              | \$ 9.7               |
| Others               | \$ 30.9              | \$ 30.2              |
| <b>U.S.</b>          | <b>\$ 88.1</b> 28.9% | <b>\$ 74.5</b> 29.2% |
| AMD                  | \$ 2.3               | \$ 2.2               |
| AMI                  | \$ 0.6               | \$ 0.3               |
| Fairchild            | \$ 2.9               | \$ 1.9               |
| GI                   | \$ 4.7               | \$ 4.5               |
| Intel                | \$ 4.7               | \$ 4.5               |
| MMI                  | \$ 0.1               | \$ 0.7               |
| Mostek               | \$ 3.1               | \$ 1.5               |
| Motorola             | \$ 20.2              | \$ 17.1              |
| NSC                  | \$ 11.6              | \$ 11.0              |
| RCA                  | \$ 2.3               | \$ 2.2               |
| Signetics            | \$ 3.1               | \$ 2.2               |
| TI                   | \$ 21.6              | \$ 16.1              |
| Others               | \$ 10.9              | \$ 10.2              |
| <b>South Korean</b>  | <b>\$ 47.3</b>       | <b>\$ 38.8</b>       |
| Gold Star            | \$ 5.4               | \$ 7.5               |
| KEC                  | \$ 22.5              | \$ 15.7              |
| Samsung              | \$ 17.8              | \$ 14.2              |
| Others               | \$ 1.6               | \$ 1.5               |
| <b>Rest of World</b> | <b>\$ 36.2</b> 11.9% | <b>\$29.5</b> 11.6%  |
| ITT                  | \$ 1.6               | \$ 1.5               |
| Philips              | \$ 2.3               | \$ 2.2               |
| Rifa                 | \$ 1.6               | \$ 0.0               |
| SGS                  | \$ 11.6              | \$ 8.2               |
| Siemens              | \$ 0.8               | \$ 1.5               |
| Thomson              | \$ 13.0              | \$11.0               |
| UMC                  | \$ 1.6               | \$ 0.0               |
| Others               | \$ 3.8               | \$ 5.0               |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-2

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY  
1984-1985  
TOTAL SEMICONDUCTOR\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W251.6      | W193.8      |
| Japanese         | W109.6      | W 85.3      |
| Fujitsu          | W 1.9       | W 1.7       |
| Hitachi          | W 19.2      | W 13.0      |
| Matsushita       | W 7.1       | W 5.7       |
| Mitsubishi       | W 5.1       | W 3.4       |
| NEC              | W 26.3      | W 19.8      |
| Sanyo            | W 12.8      | W 10.2      |
| Sharp            | W 1.9       | W 1.1       |
| Toshiba          | W 9.6       | W 7.4       |
| Others           | W 25.6      | W 23.0      |
| U.S.             | W 72.9      | W 56.6      |
| AMD              | W 1.9       | W 1.7       |
| AMI              | W 0.5       | W 0.2       |
| Fairchild        | W 2.4       | W 1.4       |
| GI               | W 3.8       | W 3.4       |
| Intel            | W 3.8       | W 3.4       |
| MMI              | W 0.1       | W 0.6       |
| Mostek           | W 2.6       | W 1.1       |
| Motorola         | W 16.7      | W 13.0      |
| NSC              | W 9.6       | W 8.4       |
| RCA              | W 1.9       | W 1.7       |
| Signetics        | W 2.6       | W 1.7       |
| TI               | W 17.9      | W 12.2      |
| Others           | W 9.0       | W 7.7       |
| South Korean     | W 39.1      | W 29.5      |
| Gold Star        | W 4.5       | W 5.7       |
| KEC              | W 18.6      | W 11.9      |
| Samsung          | W 14.8      | W 10.8      |
| Others           | W 1.3       | W 1.1       |
| Rest of World    | W 29.9      | W 22.4      |
| ITT              | W 1.3       | W 1.1       |
| Philips          | W 1.9       | W 1.7       |
| Rifa             | W 1.3       | W 0.0       |
| SGS              | W 9.6       | W 6.2       |
| Siemens          | W 0.6       | W 1.1       |
| Thomson          | W 10.8      | W 8.4       |
| UMC              | W 1.3       | W 0.0       |
| Others           | W 3.1       | W 3.8       |

Totals may not add due to rounding

Source: DATAQUEST

Table B-3

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**INTEGRATED CIRCUIT\***  
**(Millions of Dollars)**

| <u>Companies</u>     | <u>1984</u>    | <u>1985</u>    |
|----------------------|----------------|----------------|
| <b>Total</b>         | <b>\$228.6</b> | <b>\$189.7</b> |
| <b>Japanese</b>      | <b>\$106.6</b> | <b>\$ 88.0</b> |
| Fujitsu              | \$ 1.6         | \$ 1.5         |
| Hitachi              | \$ 21.7        | \$ 15.7        |
| Matsushita           | \$ 7.8         | \$ 6.7         |
| Mitsubishi           | \$ 5.4         | \$ 3.7         |
| NEC                  | \$ 26.4        | \$ 20.9        |
| Sanyo                | \$ 10.1        | \$ 8.9         |
| Sharp                | \$ 1.6         | \$ 0.7         |
| Toshiba              | \$ 9.3         | \$ 7.5         |
| Others               | \$ 22.9        | \$ 22.3        |
| <b>U.S.</b>          | <b>\$ 73.3</b> | <b>\$ 62.7</b> |
| AMD                  | \$ 2.3         | \$ 2.2         |
| AMI                  | \$ 0.6         | \$ 0.3         |
| Fairchild            | \$ 2.3         | \$ 1.5         |
| GI                   | \$ 1.6         | \$ 1.5         |
| Intel                | \$ 4.7         | \$ 4.5         |
| MMI                  | \$ 0.1         | \$ 0.7         |
| Mostek               | \$ 3.1         | \$ 1.5         |
| Motorola             | \$ 13.2        | \$ 11.9        |
| NSC                  | \$ 10.6        | \$ 10.2        |
| RCA                  | \$ 2.3         | \$ 2.2         |
| Signetics            | \$ 3.1         | \$ 2.2         |
| TI                   | \$ 21.1        | \$ 15.7        |
| Others               | \$ 8.4         | \$ 8.2         |
| <b>South Korean</b>  | <b>\$ 19.4</b> | <b>\$ 17.9</b> |
| Gold Star            | \$ 3.9         | \$ 6.0         |
| KEC                  | \$ 2.3         | \$ 1.5         |
| Samsung              | \$ 12.4        | \$ 9.7         |
| Others               | \$ 0.8         | \$ 0.7         |
| <b>Rest of World</b> | <b>\$ 29.3</b> | <b>\$ 21.1</b> |
| ITT                  | \$ 0.8         | \$ 0.7         |
| Philips              | \$ 2.3         | \$ 2.2         |
| Rifa                 | \$ 1.6         | \$ 0.0         |
| SGS                  | \$ 9.3         | \$ 5.2         |
| Siemens              | \$ 0.8         | \$ 0.7         |
| Thomson              | \$ 10.5        | \$ 9.0         |
| UMC                  | \$ 1.6         | \$ 0.0         |
| Others               | \$ 2.5         | \$ 3.1         |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-4

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**INTEGRATED CIRCUIT\***  
**(Billions of Won)**

| <u>Companies</u>     | <u>1984</u>   | <u>1985</u>   |
|----------------------|---------------|---------------|
| <b>Total</b>         | <b>W189.2</b> | <b>W144.2</b> |
| <b>Japanese</b>      | <b>W 88.2</b> | <b>W 66.8</b> |
| Fujitsu              | W 1.3         | W 1.1         |
| Hitachi              | W 18.0        | W 11.9        |
| Matsushita           | W 6.4         | W 5.1         |
| Mitsubishi           | W 4.5         | W 2.8         |
| NEC                  | W 21.8        | W 15.9        |
| Sanyo                | W 8.3         | W 6.8         |
| Sharp                | W 1.3         | W 0.6         |
| Toshiba              | W 7.7         | W 5.7         |
| Others               | W 18.9        | W 17.0        |
| <b>U.S.</b>          | <b>W 60.7</b> | <b>W 47.7</b> |
| AMD                  | W 1.9         | W 1.7         |
| AMI                  | W 0.5         | W 0.2         |
| Fairchild            | W 1.9         | W 1.2         |
| GI                   | W 1.3         | W 1.1         |
| Intel                | W 3.8         | W 3.4         |
| MMI                  | W 0.1         | W 0.6         |
| Mostek               | W 2.6         | W 1.1         |
| Motorola             | W 10.9        | W 9.1         |
| NSC                  | W 8.8         | W 7.8         |
| RCA                  | W 1.9         | W 1.7         |
| Signetics            | W 2.6         | W 1.7         |
| TI                   | W 17.5        | W 11.9        |
| Others               | W 6.9         | W 6.2         |
| <b>South Korean</b>  | <b>W 16.0</b> | <b>W 13.6</b> |
| Gold Star            | W 3.2         | W 4.5         |
| KEC                  | W 1.9         | W 1.1         |
| Samsung              | W 10.3        | W 7.4         |
| Others               | W 0.6         | W 0.6         |
| <b>Rest of World</b> | <b>W 24.2</b> | <b>W 16.0</b> |
| ITT                  | W 0.6         | W 0.6         |
| Philips              | W 1.9         | W 1.7         |
| Rifa                 | W 1.3         | W 0.0         |
| SGS                  | W 7.7         | W 4.0         |
| Siemens              | W 0.6         | W 0.6         |
| Thomson              | W 8.7         | W 6.8         |
| UMC                  | W 1.3         | W 0.0         |
| Others               | W 2.1         | W 2.4         |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-5

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
BIPOLAR DIGITAL\*  
(Millions of Dollars)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$29.5      | \$20.0      |
| Japanese         | \$11.4      | \$ 2.7      |
| Hitachi          | \$ 6.2      | \$ 0.7      |
| Mitsubishi       | \$ 2.3      | \$ 0.7      |
| Toshiba          | \$ 0.8      | \$ 0.0      |
| Others           | \$ 2.1      | \$ 1.2      |
| U.S.             | \$14.4      | \$13.5      |
| AMD              | \$ 0.8      | \$ 0.7      |
| Fairchild        | \$ 1.5      | \$ 1.0      |
| MMI              | \$ 0.1      | \$ 0.7      |
| Motorola         | \$ 3.1      | \$ 3.7      |
| NSC              | \$ 2.0      | \$ 1.9      |
| Signetics        | \$ 0.0      | \$ 0.7      |
| TI               | \$ 6.2      | \$ 4.5      |
| Others           | \$ 0.8      | \$ 0.2      |
| South Korean     | \$ 0.8      | \$ 2.2      |
| Gold Star        | \$ 0.8      | \$ 2.2      |
| Rest of World    | \$ 2.9      | \$ 1.5      |
| Philips          | \$ 0.8      | \$ 0.7      |
| SGS              | \$ 1.6      | \$ 0.0      |
| Others           | \$ 0.6      | \$ 0.7      |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-6

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
BIPOLAR DIGITAL\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W24.4       | W15.2       |
| Japanese         | W 9.5       | W 2.1       |
| Hitachi          | W 5.1       | W 0.6       |
| Mitsubishi       | W 1.9       | W 0.6       |
| Toshiba          | W 0.6       | W 0.0       |
| Others           | W 1.8       | W 0.9       |
| U.S.             | W 11.9      | W 10.3      |
| AMD              | W 0.6       | W 0.6       |
| Fairchild        | W 1.2       | W 0.8       |
| MMI              | W 0.1       | W 0.6       |
| Motorola         | W 2.6       | W 2.8       |
| NSC              | W 1.7       | W 1.4       |
| Signetics        | W 0.0       | W 0.6       |
| TI               | W 5.1       | W 3.4       |
| Others           | W 0.6       | W 0.1       |
| South Korean     | W 0.6       | W 1.7       |
| Gold Star        | W 0.6       | W 1.7       |
| Rest of World    | W 2.4       | W 1.1       |
| Philips          | W 0.6       | W 0.6       |
| SGS              | W 1.3       | W 0.0       |
| Others           | W 0.5       | W 0.6       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-7

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**MOS\***  
**(Millions of Dollars)**

| <u>Companies</u>     | <u>1984</u>   | <u>1985</u>   |
|----------------------|---------------|---------------|
| <b>Total</b>         | <b>\$96.3</b> | <b>\$80.7</b> |
| <b>Japanese</b>      | <b>\$44.8</b> | <b>\$36.4</b> |
| Fujitsu              | \$ 1.6        | \$ 1.5        |
| Hitachi              | \$10.9        | \$ 7.5        |
| Matsushita           | \$ 2.3        | \$ 2.2        |
| Mitsubishi           | \$ 0.8        | \$ 0.7        |
| NEC                  | \$17.1        | \$11.9        |
| Sanyo                | \$ 1.6        | \$ 1.5        |
| Sharp                | \$ 1.6        | \$ 0.7        |
| Toshiba              | \$ 2.3        | \$ 2.2        |
| Others               | \$ 6.8        | \$ 8.1        |
| <b>U.S.</b>          | <b>\$35.8</b> | <b>\$32.6</b> |
| AMD                  | \$ 1.6        | \$ 1.5        |
| AMI                  | \$ 0.6        | \$ 0.3        |
| Fairchild            | \$ 0.1        | \$ 0.1        |
| GI                   | \$ 0.8        | \$ 0.7        |
| Intel                | \$ 4.7        | \$ 4.5        |
| Mostek               | \$ 3.1        | \$ 1.5        |
| Motorola             | \$ 5.4        | \$ 5.2        |
| NSC                  | \$ 2.0        | \$ 4.6        |
| RCA                  | \$ 1.6        | \$ 1.5        |
| Signetics            | \$ 0.8        | \$ 0.7        |
| TI                   | \$11.8        | \$ 8.2        |
| Others               | \$ 3.4        | \$ 3.8        |
| <b>South Korean</b>  | <b>\$ 7.0</b> | <b>\$ 5.2</b> |
| Gold Star            | \$ 0.8        | \$ 1.5        |
| Samsung              | \$ 6.2        | \$ 3.7        |
| <b>Rest of World</b> | <b>\$ 8.8</b> | <b>\$ 6.4</b> |
| Philips              | \$ 0.8        | \$ 0.7        |
| SGS                  | \$ 2.3        | \$ 1.5        |
| Thomson              | \$ 3.5        | \$ 3.0        |
| UMC                  | \$ 1.6        | \$ 0.0        |
| Others               | \$ 0.6        | \$ 1.2        |

\*Totals may not add due to rounding

Source: DATAQUEST



Table B-8

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**MOS\***  
**(Billions of Won)**

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W79.7       | W61.3       |
| Japanese         | W37.1       | W27.7       |
| Fujitsu          | W 1.3       | W 1.1       |
| Hitachi          | W 9.0       | W 5.7       |
| Matsushita       | W 1.9       | W 1.7       |
| Mitsubishi       | W 0.6       | W 0.6       |
| NEC              | W14.1       | W 9.1       |
| Sanyo            | W 1.3       | W 1.1       |
| Sharp            | W 1.3       | W 0.6       |
| Toshiba          | W 1.9       | W 1.7       |
| Others           | W 5.6       | W 6.1       |
| U.S.             | W29.6       | W24.8       |
| AMD              | W 1.3       | W 1.1       |
| AMI              | W 0.5       | W 0.2       |
| Fairchild        | W 0.1       | W 0.0       |
| GI               | W 0.6       | W 0.6       |
| Intel            | W 3.8       | W 3.4       |
| Mostek           | W 2.6       | W 1.1       |
| Motorola         | W 4.5       | W 4.0       |
| NSC              | W 1.7       | W 3.5       |
| RCA              | W 1.3       | W 1.1       |
| Signetics        | W 0.6       | W 0.6       |
| TI               | W 9.8       | W 6.2       |
| Others           | W 2.8       | W 2.9       |
| South Korean     | W 5.8       | W 4.0       |
| Gold Star        | W 0.6       | W 1.1       |
| Samsung          | W 5.1       | W 2.8       |
| Rest of World    | W 7.2       | W 4.9       |
| Philips          | W 0.6       | W 0.6       |
| SGS              | W 1.9       | W 1.1       |
| Thomson          | W 2.9       | W 2.3       |
| UMC              | W 1.3       | W 0.0       |
| Others           | W 0.5       | W 0.9       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-9

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
LINEAR\*  
(Millions of Dollar)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$102.8     | \$89.0      |
| Japanese         | \$ 50.4     | \$48.8      |
| Hitachi          | \$ 4.7      | \$ 7.5      |
| Matsushita       | \$ 5.4      | \$ 4.5      |
| Mitsubishi       | \$ 2.3      | \$ 2.2      |
| NEC              | \$ 9.3      | \$ 8.9      |
| Sanyo            | \$ 8.5      | \$ 7.5      |
| Toshiba          | \$ 6.2      | \$ 5.2      |
| Others           | \$ 13.9     | \$13.0      |
| U.S.             | \$ 23.2     | \$16.6      |
| Fairchild        | \$ 0.7      | \$ 0.5      |
| GI               | \$ 0.8      | \$ 0.7      |
| Motorola         | \$ 4.7      | \$ 3.0      |
| NSC              | \$ 6.6      | \$ 3.7      |
| RCA              | \$ 0.8      | \$ 0.7      |
| Signetics        | \$ 2.3      | \$ 0.7      |
| TI               | \$ 3.1      | \$ 3.0      |
| Others           | \$ 4.2      | \$ 4.2      |
| South Korean     | \$ 11.6     | \$10.4      |
| Gold Star        | \$ 2.3      | \$ 2.2      |
| KEC              | \$ 2.3      | \$ 1.5      |
| Samsung          | \$ 6.2      | \$ 6.0      |
| Others           | \$ 0.8      | \$ 0.7      |
| Rest of World    | \$ 17.6     | \$13.2      |
| ITT              | \$ 0.8      | \$ 0.7      |
| Philips          | \$ 0.8      | \$ 0.7      |
| Rifa             | \$ 1.6      | \$ 0.0      |
| SGS              | \$ 5.4      | \$ 3.7      |
| Siemens          | \$ 0.8      | \$ 0.7      |
| Thomson          | \$ 7.0      | \$ 6.0      |
| Others           | \$ 1.3      | \$ 1.2      |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-10

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
LINEAR\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W85.0       | W67.6       |
| Japanese         | W41.7       | W37.1       |
| Hitachi          | W 3.8       | W 5.7       |
| Matsushita       | W 4.5       | W 3.4       |
| Mitsubishi       | W 1.9       | W 1.7       |
| NEC              | W 7.7       | W 6.8       |
| Sanyo            | W 7.1       | W 5.7       |
| Toshiba          | W 5.1       | W 4.0       |
| Others           | W11.5       | W 9.9       |
| U.S.             | W19.2       | W12.6       |
| Fairchild        | W 0.6       | W 0.4       |
| GI               | W 0.6       | W 0.6       |
| Motorola         | W 3.8       | W 2.3       |
| NSC              | W 5.5       | W 2.8       |
| RCA              | W 0.6       | W 0.6       |
| Signetics        | W 1.9       | W 0.6       |
| TI               | W 2.6       | W 2.3       |
| Others           | W 3.5       | W 3.2       |
| South Korean     | W 9.6       | W 7.9       |
| Gold Star        | W 1.9       | W 1.7       |
| KEC              | W 1.9       | W 1.1       |
| Samsung          | W 5.1       | W 4.5       |
| Others           | W 0.6       | W 0.6       |
| Rest of World    | W14.6       | W10.0       |
| ITT              | W 0.6       | W 0.6       |
| Philips          | W 0.6       | W 0.6       |
| Rifa             | W 1.3       | W 0.0       |
| SGS              | W 4.5       | W 2.8       |
| Siemens          | W 0.6       | W 0.6       |
| Thomson          | W 5.8       | W 4.6       |
| Others           | W 1.1       | W 0.9       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-11

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**DISCRETE\***  
**(Millions of Dollars)**

| <u>Companies</u>     | <u>1984</u>   | <u>1985</u>   |
|----------------------|---------------|---------------|
| <b>Total</b>         | <b>\$68.0</b> | <b>\$59.0</b> |
| <b>Japanese</b>      | <b>\$21.2</b> | <b>\$19.8</b> |
| Fujitsu              | \$ 0.8        | \$ 0.7        |
| Hitachi              | \$ 1.6        | \$ 1.5        |
| Matsushita           | \$ 0.8        | \$ 0.7        |
| Mitsubishi           | \$ 0.8        | \$ 0.7        |
| NEC                  | \$ 4.7        | \$ 4.5        |
| Sanyo                | \$ 4.7        | \$ 3.7        |
| Toshiba              | \$ 1.6        | \$ 1.5        |
| Others               | \$ 6.5        | \$ 6.4        |
| <b>U.S.</b>          | <b>\$13.5</b> | <b>\$10.6</b> |
| Fairchild            | \$ 0.6        | \$ 0.4        |
| GI                   | \$ 2.3        | \$ 2.2        |
| Motorola             | \$ 7.0        | \$ 5.2        |
| NSC                  | \$ 1.0        | \$ 0.8        |
| TI                   | \$ 0.5        | \$ 0.4        |
| Others               | \$ 2.1        | \$ 1.6        |
| <b>South Korean</b>  | <b>\$26.4</b> | <b>\$20.1</b> |
| Gold Star            | \$ 1.6        | \$ 1.5        |
| KEC                  | \$18.6        | \$13.4        |
| Samsung              | \$ 5.4        | \$ 4.5        |
| Others               | \$ 0.8        | \$ 0.7        |
| <b>Rest of World</b> | <b>\$ 6.9</b> | <b>\$ 8.4</b> |
| ITT                  | \$ 0.8        | \$ 0.7        |
| SGS                  | \$ 2.3        | \$ 3.0        |
| Siemens              | \$ 0.0        | \$ 0.7        |
| Thomson              | \$ 2.5        | \$ 2.0        |
| Others               | \$ 1.3        | \$ 1.9        |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-12

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
DISCRETE\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W56.2       | W44.8       |
| Japanese         | W17.6       | W15.1       |
| Fujitsu          | W 0.6       | W 0.6       |
| Hitachi          | W 1.3       | W 1.1       |
| Matsushita       | W 0.6       | W 0.6       |
| Mitsubishi       | W 0.6       | W 0.6       |
| NEC              | W 3.8       | W 3.4       |
| Sanyo            | W 3.8       | W 2.8       |
| Toshiba          | W 1.3       | W 1.1       |
| Others           | W 5.4       | W 4.9       |
| U.S.             | W11.2       | W 8.1       |
| Fairchild        | W 0.5       | W 0.3       |
| GI               | W 1.9       | W 1.7       |
| Motorola         | W 5.8       | W 4.0       |
| NSC              | W 0.8       | W 0.6       |
| TI               | W 0.4       | W 0.3       |
| Others           | W 1.7       | W 1.2       |
| South Korean     | W21.8       | W15.3       |
| Gold Star        | W 1.3       | W 1.1       |
| KEC              | W15.4       | W10.2       |
| Samsung          | W 4.5       | W 3.4       |
| Others           | W 0.6       | W 0.6       |
| Rest of World    | W 5.7       | W 6.4       |
| ITT              | W 0.6       | W 0.6       |
| SGS              | W 1.9       | W 2.3       |
| Siemens          | W 0.0       | W 0.6       |
| Thomson          | W 2.1       | W 1.5       |
| Others           | W 1.1       | W 1.4       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-13

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
OPTOELECTRONICS\*  
(Millions of Dollars)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$7.4       | \$6.4       |
| Japanese         | \$4.7       | \$4.5       |
| NEC              | \$0.8       | \$0.7       |
| Sanyo            | \$0.8       | \$0.7       |
| Sharp            | \$0.8       | \$0.7       |
| Toshiba          | \$0.8       | \$0.7       |
| Others           | \$1.6       | \$1.5       |
| U.S.             | \$1.2       | \$1.1       |
| GI               | \$0.8       | \$0.7       |
| Others           | \$0.5       | \$0.4       |
| South Korean     | \$1.6       | \$0.7       |
| KEC              | \$1.6       | \$0.7       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-14

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
OPTOELECTRONICS\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | ₩6.2        | ₩4.8        |
| Japanese         | ₩3.8        | ₩3.4        |
| NEC              | ₩0.6        | ₩0.6        |
| Sanyo            | ₩0.6        | ₩0.6        |
| Sharp            | ₩0.6        | ₩0.6        |
| Toshiba          | ₩0.6        | ₩0.6        |
| Others           | ₩1.3        | ₩1.1        |
| U.S.             | ₩1.0        | ₩0.9        |
| GI               | ₩0.6        | ₩0.6        |
| Others           | ₩0.4        | ₩0.3        |
| South Korean     | ₩1.3        | ₩0.6        |
| KEC              | ₩1.3        | ₩0.6        |

\*Totals may not add due to rounding

Source: DATAQUEST

APPENDIX C

**SOUTH KOREAN ASSEMBLY INDUSTRY**

This Appendix presents available data on the assembly industry in South Korea. Table C-1 presents revenues of companies involved in the assembly business, both native and foreign-owned. The data are followed by assembly company profiles. As in the case of revenues and plant locations, both native and foreign-owned firms are included.

**Table C-1**

**ASSEMBLY REVENUE BY COMPANY  
(Millions of Dollars)**

| <u>Company</u>      | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|---------------------|-------------|-------------|-------------|-------------|
| Anam Industrial     | \$ 44       | \$ 75       | \$105       | \$102       |
| Motorola Korea      | \$140       | \$164       | \$213       | \$215       |
| Signetics Korea     | \$ 86       | \$110       | \$169       | \$150       |
| Fairchild Korea     | \$ 57       | \$ 67       | \$ 85       | \$ 87       |
| Korea Microsystems  | \$ 75       | \$ 69       | \$ 63       | \$ 60       |
| Korea Tokyo Silicon | N/A         | \$ 53       | \$ 52       | \$ 58       |

N/A = Not Available

Source: Company Annual Reports, 1982-1984  
Korea Economic News, 1985



**ANAM INDUSTRIAL Co., LTD.**

Anam Industrial was established in August 1956 as an industrial product manufacturing and service company. In 1966, the company expanded its business into electronic component manufacturing and trading. The diode and transistor packaging business was started in May 1972. In November of the same year, Anam opened a U.S. subsidiary, in Valley Forge, Pennsylvania. Amkor conducts Anam's U.S. sales and marketing activities.

- President: Joo Chai Kim
- Head Office: 151-22 Hwayang-dong, Sungdong-ku, Seoul, Korea
- Telephone: 463-2266
- Factories: 151-22 Hwayang-dong, Sungdong-ku, Seoul,  
Korea  
Telephone: 463-2266  
316-74 Hyosung-dong, Buk-ku, Ichon  
(032) 742-7024
- Telex: ANAMIC K27381
- Employees: 7,000
- Annual Production: 1984e--\$117.2 million
- Investment: US\$300 million by 1987
- Main Products: Plastic DIP packages (8 to 64 leads), ceramic DIP packages, side braze and flat packages, LEDs, electronic watches, electronic wiring devices, liquid nitrogen
- Annual Production Capacity
  - 1985: 1.2 billion units
  - 1987: 2.5 billion units
- U.S. Subsidiary: Amkor Electronics, Inc.,  
Corporate Center, Valley Forge, PA 19482

**FAIRCHILD SEMICONDUCTOR (KOREA) LTD.**

This company was established in October 1967, by Fairchild Camera and Instruments of the United States. It is 100 percent owned by the Fairchild. The company operates exclusively for its U.S. parent company.

- President: Young Il Lee
- Head Office and Factory: 219-6 Karibong-dong, Kuro-ku, Seoul,  
Korea
- Telephone: 855-6751
- Telex: FAIRKOR K23670
- Employees: 1,000
- Main Products: IC and transistor assembly packaging
- Annual Production: 1984e--\$85 million
- Annual Production Capacity: 150 million units

**KOREA MICROSYSTEMS, INC.**

This company was established by American Microsystems, Inc., of the United States in March of 1970. It is is 100 percent owned by AMI. The company provides exclusive assembly and packaging services to AMI.

- President: Man Rip Choi
- Head Office and Factory: 449-2 Jakjeon-dong, Buk-ku, Ichon, Korea
- Telephone: (032) 92-0411
- Telex: MICROS K28484
- Employees: 1,200
- Main Products: MOS LSI assembly and packaging
- Annual Production: 1984e--\$63 million
- Annual Production Capacity: 50 million units
- Equipment: Die attach machines (56), lead bonding machines (161)

**MOTOROLA KOREA LTD.**

The company was established in March of 1967 by Motorola, Inc., of the United States, and is 100 percent owned by Motorola. It started out as the assembly and packaging operation for transistors and ICs, but expanded its activities into manufacturing electronic parts, subsystems, and small products.

- President: Eun Shik Chung
- Head Office and Factory: 445-Kwangjang-dong, Sungdong-ku, Seoul, Korea
- Telephone: 445-7109
- Telex: MOKOR K23284
- Employees: 5,000
- Main Products: Transistor and IC assembly and packaging, mold sets and parts, pagers, walkie-talkies
- Annual Production: 1984e--\$213 million

**SIGNETICS KOREA CO., LTD.**

This company was established in 1966 by the Signetics Corp. of the United States.

- President: Jae Yil Park
- Head Office and Factory: 272 Yumchang-dong, Kangseo-ku, Seoul, Korea
- Telephone: 694-5081
- Telex: SIGKOR K23626
- Employees: 2,600
- Main Products: Plastic and ceramic DIP, plastic chip carriers, small outline packages
- Annual Production: 1984e--\$169 million
- Annual Production Capacity: 600 million units

**KOREA TOKYO SILICON CO., LTD.**

- President: Kingo Ito
- Head Office and Factory: 973-4, Yangduck-dong, Masan City,  
Kyungnam, Korea
- Seoul Office: Rm. 2001, Samjung Bldg., 69-5, 2-ka,  
Taepyung-ro, Chung-ku, Seoul, Korea
- Telephone: Head Office: (0551) 55-0181/5, 55-6851/2  
Seoul Office: 778-2408, 752-9790
- P.O. Box: P.O. Box, 362 Masan
- Telex: SILICON K3352
- Cable: KTSILICON Masan
- Employees: 1,800
- Established: 1972
- Annual Production: 1984e--\$52 million
- Brand Name: SANYO
- Main Products: Silicon transistors, hybrid ICs, monolithic ICs,  
digital quartz modules, digital watches

## APPENDIX D

### SEMICONDUCTOR WAFER FOUNDRY

The following companies are currently engaged in or offering wafer foundry services. Descriptions include technologies, potential capacity for the foundry services, and current customers.

- Samsung Semiconductor & Telecommunications Co., Ltd.
  - Technology: NMOS, CMOS
  - Capacity: 4-inch, 10,000 wafers/month
  - Customer: SGS (5,000 wafers/month)
- Gold Star Semiconductor, Ltd.
  - Technology: NMOS, CMOS
  - Capacity: 5-inch, 20,000 wafers/month
  - Customer: LSI Logic, Fairchild C & I
- Hyundai Electronics Industries, Co., Ltd.
  - Technology: NMOS, CMOS
  - Capacity: 5-inch, 5,000 wafers/month; 6-inch, 20,000 wafers/month
  - Customer: Texas Instruments, Vitelic, International CMOS Technology
- Electronics & Telecommunications Research Institute (ETRI)
  - Technology: NMOS, CMOS, bipolar
  - Capacity: 4-inch, 2,000 wafers/month MOS; 4-inch, 2,000 wafers/month bipolar
  - Customer: None

## APPENDIX B

### FACILITIES DATA

The chart presented here represents a compilation of all available data on semiconductor production and assembly facilities of selected native South Korean manufacturers. The following companies and plants are described in the facilities chart:

- Samsung Semiconductor and Telecommunications
  - Buchon Plant
  - Suwon Plant
  - Samsung Semiconductor (U.S.)
- Gold Star Semiconductor
  - Gumi Plant
  - Anyang R&D Plant
- Hyundai Electronics
  - Semiconductor Plant I
  - Semiconductor Plant II
  - Assembly Plant
- Daewoo Electronic Components
- Korea Electronics Company
- ETRI Semiconductor Operations
- Anam Industrial (assembly)



Appendix E  
Facilities Data

| Company/Plant                                | Start-up of Production Facilities | Name of Representative | Employees | Floor Space (Square Feet) | Product/Technology |          |      |                |               |            |         |           |        |            |       |                 |         | Capacity (Wafers/Month) |         |         | Wafer Size (Inches) |
|--|-----------------------------------|------------------------|-----------|---------------------------|--------------------|----------|------|----------------|---------------|------------|---------|-----------|--------|------------|-------|-----------------|---------|-------------------------|---------|---------|---------------------|
|  |                                   |                        |           |                           | Operations         |          |      | Bipolar Memory | Bipolar Logic | MOS Memory | MOS MPU | MOS Logic | Linear | Transistor | Diode | Optoelectronics | 1983    | 1984                    | 1985    |         |                     |
|  |                                   |                        |           |                           | Fab                | Assembly | Test |                |               |            |         |           |        |            |       |                 |         |                         |         |         |                     |
| Samsung Semiconductor and Telecommunications |                                   |                        |           |                           |                    |          |      |                |               |            |         |           |        |            |       |                 |         |                         |         |         |                     |
| Buchon Plant                                 | Dec. 1974                         | S.K. Lee               | 1,800     | 280,000                   | X                  | X        | X    |                | X             |            | X       | X         | X      | X          | X     |                 | 30,000  | 30,000                  | 50,000  | 3, 4, 5 |                     |
| Suwon Plant                                  | April 1984                        | Y.W. Lee               | 1,600     | 1,000,000                 | X                  | X        | X    |                |               | X          |         |           |        |            |       |                 | N/A     | 27,000                  | 47,000  | 4, 6    |                     |
| Samsung Semiconductor Inc. (U.S.A.)          | July 1983                         | S.J. Lee               | 150       | 100,000                   | X                  |          | X    |                |               | X          | X       | X         |        |            |       |                 | N/A     | 4,000                   | 4,000   | 5       |                     |
| Gold Star Semiconductor                      |                                   |                        |           |                           |                    |          |      |                |               |            |         |           |        |            |       |                 |         |                         |         |         |                     |
| Gumi Plant                                   | Feb. 1980                         | D.H. Song              | 1,200     | 200,000                   | X                  | X        | X    |                | X             | X          | X       | X         | X      | X          | X     |                 | 16,800  | 28,000                  | 28,000  | 4, 5    |                     |
| Anyang R&D Plant                             | Nov. 1984                         | C.S. Kim               |           | 100,000                   | X                  |          | X    |                |               | X          | X       | X         |        |            |       |                 | N/A     | 9,000                   | 10,000  | 5       |                     |
| Hyundai Electronics                          |                                   |                        |           |                           |                    |          |      |                |               |            |         |           |        |            |       |                 |         |                         |         |         |                     |
| Semiconductor I                              | Dec. 1984                         | D.W. Chun              | 850       | 150,000                   | X                  |          | X    |                |               | X          | X       | X         |        |            |       |                 | N/A     | N/A                     | 15,000  | 5       |                     |
| Semiconductor II                             | Dec. 1985                         | K.O. Park              |           | —                         | X                  |          | X    |                |               |            |         |           |        |            |       |                 | N/A     | N/A                     | 25,000  | 6       |                     |
| Assembly Plant                               | April 1985                        | J.H. Lee               |           | 720,000                   |                    | X        | X    |                |               | X          |         |           |        |            |       |                 | N/A     | N/A                     | 240,000 | 4, 5, 6 |                     |
| Daewoo Electronic Components                 | Sept. 1979                        | C.S. Lee               | 1,400     | —                         | X                  | X        | X    |                |               |            |         |           | X      | X          | X     |                 | 4,000   | 5,000                   | 7,000   | 4       |                     |
| Korea Electronics                            | Sept. 1989                        | Y.W. Yoo               | 2,100     | 387,400                   | X                  | X        | X    |                |               |            |         |           | X      | X          | X     | X               | 5,000   | 6,000                   | 10,000  | 3, 4    |                     |
| ETRI Semiconductor Operations                | Oct. 1980                         | Y.I. Kang              | 150       | —                         | X                  | X        | X    |                |               | X          | X       |           | X      |            |       |                 | 4,000   | 4,000                   | 4,000   | 4       |                     |
| Anam Industrial                              | May 1972                          | J.C. Kim               | 7,000     | 280,000                   |                    | X        | X    |                |               |            |         |           |        |            |       |                 | 350,000 | 500,000                 | 800,000 | 3, 4, 5 |                     |

Appendix E  
Facilities Data (Continued)

|   | Average Production<br>(Thousands of<br>Units/Month) |        |         | Capital Spending<br>(Millions of<br>Dollars) |       |       | CAD |             | Wafer Fab |            |          |                     |                    |                   |     |         |             |                | Test                  |                |            | Assembly    |                |               |             |              |   |     |     |     |
|---|---|--------|---------|--|-------|-------|-----|-------------|-----------|------------|----------|---------------------|--------------------|-------------------|-----|---------|-------------|----------------|-----------------------|----------------|------------|-------------|----------------|---------------|-------------|--------------|---|-----|-----|-----|
|   | 1982  | 1983   | 1984    | 1983   | 1984  | 1985  | CPU | Workstation | E-beam    | Projection |          | Contact<br>Aligners | Diffusion<br>Tubes | Ion<br>Implanters | CVD | Epitaxy | Wet<br>Etch | Plasma<br>Etch | Sputtering<br>Systems | Memory<br>Test | IC<br>Test | LSI<br>Test | Wafer<br>Probe | Dicing<br>Saw | Die<br>Bond | Wire<br>Bond |   |     |     |     |
|   |   |        |         |  |       |       |     |             |           | Aligners   | Steppers |                     |                    |                   |     |         |             |                |                       |                |            |             |                |               |             |              |   |     |     |     |
| Samsung Semiconductor<br>and Telecommunications | 16,450  | 31,373 | 57,778  | \$15   | \$ 40 | \$ 80 | 2   | 8           | 0         | 8          | 0        | 20                  | 110                | 8                 | 3   | 4       | 10          | 13             | 4                     | —              | —          | —           | —              | —             | —           | —            |   |     |     |     |
| Buchon Plant                                    | N/A   | N/A    | 2,288   | \$24   | \$124 | \$194 | 1   | 4           | 1         | 18         | 19       | 0                   | 100                | 11                | 5   | 0       | 0           | 30             | 6                     | —              | —          | —           | —              | —             | —           | —            |   |     |     |     |
| Suwon Plant                                     |   |        |         |  |       |       |     |             |           |            |          |                     |                    |                   |     |         |             |                |                       |                |            |             |                |               |             |              |   |     |     |     |
| Samsung Semiconductor<br>Inc. (U.S.A.)          | N/A   | 0      | 0       | N/A  | \$ 50 | \$ 10 | 1   | 2           | 0         | 2          | 2        | 0                   | 30                 | 1                 | 1   | 0       | 0           | 4              | 1                     | —              | —          | —           | N/A            | N/A           | N/A         | N/A          |   |     |     |     |
| Gold Star Semiconductor                         |   |        |         |  |       |       |     |             |           |            |          |                     |                    |                   |     |         |             |                |                       |                |            |             |                |               |             |              |   |     |     |     |
| Gumi Plant                                      | 4,000   | 7,800  | 15,750  | \$40   | \$ 60 | \$100 | 1   | 2           | 0         | 8          | 7        | 5                   | 64                 | 5                 | 5   | 3       | 5           | 5              | 3                     | —              | —          | —           | —              | —             | —           | —            |   |     |     |     |
| Anyang R&D Plant                                | N/A   | N/A    | 4,800   |  |       |       | 1   | 2           | 0         | 2          | 2        | 0                   | 24                 | 2                 | 2   | 0       | 0           | 5              | 1                     | —              | —          | —           | N/A            | N/A           | N/A         | N/A          |   |     |     |     |
| Hyundai Electronics                             |   |        |         |  |       |       |     |             |           |            |          |                     |                    |                   |     |         |             |                |                       |                |            |             |                |               |             |              |   |     |     |     |
| Semiconductor I                                 | N/A   | N/A    | 0       | \$30   | \$112 | \$140 | 2   | 5           | 0         | 0          | 9        | 8                   | 24                 | 3                 | 6   | 0       | 1           | 13             | 2                     | 4              | 0          | 2           | 3              | N/A           | N/A         | N/A          |   |     |     |     |
| Semiconductor II                                | N/A   | N/A    | N/A     |  |       |       |     |             | 0         | 0          | 25       | 0                   | 48                 | 4                 | 8   | 0       | 0           | 10             | 5                     | —              | —          | —           | —              | —             | —           | —            | — | N/A | N/A | N/A |
| Assembly Plant                                  | N/A   | N/A    | 0       |  |       |       |     |             | N/A       | N/A        | N/A      | N/A                 | N/A                | N/A               | N/A | N/A     | N/A         | N/A            | N/A                   | N/A            | N/A        | N/A         | N/A            | —             | —           | —            | — | 21  | 86  | 133 |
| Daewoo Electronic Components                    | 4,000   | 5,000  | 10,000  | \$ 1   | \$ 1  | \$ 10 | 0   | 0           | 0         | 0          | 0        | 4                   | 17                 | 1                 | 1   | 0       | 2           | 0              | 2                     | —              | —          | —           | —              | —             | —           | —            |   |     |     |     |
| Korea Electronics                               | 7,400   | 18,000 | 14,500  | \$ 40  |       |       | 0   | 0           | 0         | 0          | 0        | 10                  | 36                 | 1                 | 3   | 0       | 2           | 0              | 0                     | —              | —          | —           | —              | —             | —           | —            |   |     |     |     |
| ETRI Semiconductor Operations                   | 100   | 200    | 500     | \$ 60  |       |       | 1   | 2           | 0         | 2          | 0        | 4                   | 32                 | 2                 | 2   | 1       | 5           | 3              | 1                     | 1              | 1          | 1           | 2              | —             | —           | —            |   |     |     |     |
| Anam Industrial                                 | 50,000  | 70,000 | 100,000 | \$10   | \$ 20 | \$ 50 | N/A | N/A         | N/A       | N/A        | N/A      | N/A                 | N/A                | N/A               | N/A | N/A     | N/A         | N/A            | N/A                   | N/A            | N/A        | N/A         | 8,000 Units    |               |             |              |   |     |     |     |

N/A = Not Applicable

— = Unavailable

Source: DATAQUEST

## NOTES:

Combined totals may appear if companies do not provide breakouts by individual plants. For example, in the Gold Star Semiconductor listing, one figure is given for employees: 1,200. This indicates that total employment for both the Gumi plant and the Anyang R&D plant equals 1,200. This same format is followed when one capital spending figure is given for all three years. For example, the Korea Electronics listing notes \$60 million in capital spending over the three year period from 1983 through 1985.

Floor space: the square footage given for floor space may include facilities other than those devoted to semiconductor manufacturing. For example, Samsung's Suwon plant listing notes 1,000,000 square feet. This area includes engineering and support facilities.

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- 02 Research
- 
- ☐
- 03 Marketing
- 
- ☐
- 04 Client Care
- 
- ☐
- 05 Conference
- 
- ☐
- 06 Internal
- 
- ☐
- 07 Consulting

## Client Contact

- ☒
- 01 Industry
- 
- ☐
- 02 FSP (Copy Mktg.)
- 
- ☐
- 03 Pru-Bache (Copy PB 3-030)
- 
- ☐
- 04 Other DQ Service
- 
- ☐
- 05 Gov't. Agency

## Non-Client Contact

- ☐
- 06 Prospect (Copy Mktg.)
- 
- ☐
- 07 Press (Copy PR Dept.)
- 
- ☐
- 08 Consultant
- 
- ☐
- 09 Industry Source
- 
- ☐
- 10 Recruiting (Copy Pers)
- 
- ☐
- 11 Other (specify) \_\_\_\_\_

Time Spent: Minutes: ☐ 5 ☐ 10 ☐ 15 ☐ 30 ☐ 45 ☒ 2 HoursDISCUSSION: I had dinner with Richard at ISSCC  
Gave him a copy of ECL RAM N/L. - he will commentHe got the following information from Samsung - ~~the~~  
would like our comment on the information:

- Samsung invested \$500 M in 1985
  - They have an order from IBM for 15 M 256K DRAM
  - They are currently shipping 2M 256Ks/mo.
  - They have built 3 fabs - 1 took 5 months to build  
and staff at class 1 - The other 2 took 6 mo  
and 8 mo.
  - within 3 mo they will introduce ~~a~~ two 1M DRAMs
  - they bought Micron's + Mostek's designs and  
couldn't get them to work so they designed their  $\rightarrow$
- ACTION: Cene, Sheridan, Lane - any comments?

# TOP U.S. DEFENSE ELECTRONICS CONTRACTORS

| RATING  | JSIS clients | COMPANY NAME                                      | DEFENSE<br>SALES<br>(\$MILLIONS) | TOTAL 1983<br>SALES<br>(\$MILLIONS) | DEFENSE<br>ELECTRONICS<br>% of TOTAL |
|---------|--------------|---|----------------------------------|-------------------------------------|--------------------------------------|
| S.C.    | 1            | Hughes Aircraft                                   | \$4,444                          | \$ 4,938                            | 90.0                                 |
| S.C.    | 2            | Lockheed  | \$2,600                          | \$ 6,400                            | 40.6                                 |
| S.C.    | 3            | Raytheon  | \$2,582                          | \$ 5,937                            | 43.5                                 |
| S.C.    | 4            | Litton Industries                                 | \$1,563                          | \$ 4,606                            | 33.9                                 |
| J.R.    | 5            | Honeywell   | \$1,540                          | \$ 5,753                            | 26.8                                 |
| F/D/Dr. | 6            | Rockwell International                            | \$1,540                          | \$ 8,098                            | 18.5                                 |
| T.D.    | 7            | ✓ General Electric                                | \$1,500                          | \$26,797                            | 5.6                                  |
| J.R.    | 8            | Sperry  | \$1,365                          | \$ 4,910                            | 27.8                                 |
| J.R.    | 9            | RCA   | \$1,299                          | \$ 8,977                            | 14.5                                 |
| G.C.    | 10           | Texas Instruments                                 | \$1,236                          | \$ 4,580                            | 27.0                                 |
| S.C.    | 11           | Westinghouse Electric                             | \$1,200                          | \$ 9,500                            | 12.6                                 |
|         | 12           | ✓ IBM   | \$1,176                          | \$40,180                            | 2.9                                  |
| R.D.    | 13           | ITT   | \$ 947                           | \$20,200                            | 4.7                                  |
| S.C.    | 14           | General Dynamics                                  | \$ 850                           | \$ 7,146                            | 11.9                                 |
| S.C.    | 15           | Martin Marietta                                   | \$ 828                           | \$ 3,899                            | 21.2                                 |
| S.C.    | 16           | Ford Motor Co./Ford<br>Aerospace & Communications | \$ 820                           | \$44,000                            | 1.9                                  |
| R.D.    | 17           | McDonnell Douglas                                 | \$ 810                           | \$ 8,300                            | 9.8                                  |
| S.C.    | 18           | Boeing Aerospace                                  | \$ 800                           | \$ 2,000                            | 40.0                                 |
| S.C.    | 19           | Singer  | \$ 800                           | \$ 2,478                            | 32.3                                 |
| S.C.    | 20           | Northrop  | \$ 669                           | \$ 3,200                            | 20.9                                 |
| F.      | 21           | GTE   | \$ 647                           | \$12,944                            | 5.0                                  |
| T.D.    | 22           | Harris  | \$ 630                           | \$ 2,000                            | 31.5                                 |
| C.W.    | 23           | Teledyne  | \$ 610                           | \$ 3,000                            | 20.3                                 |
| S.C.    | 24           | Grumman   | \$ 583                           | \$ 2,254                            | 25.9                                 |
| S.C.    | 25           | LTV   | \$ 550                           | \$ 4,578                            | 12.0                                 |

Source: Defense Electronics

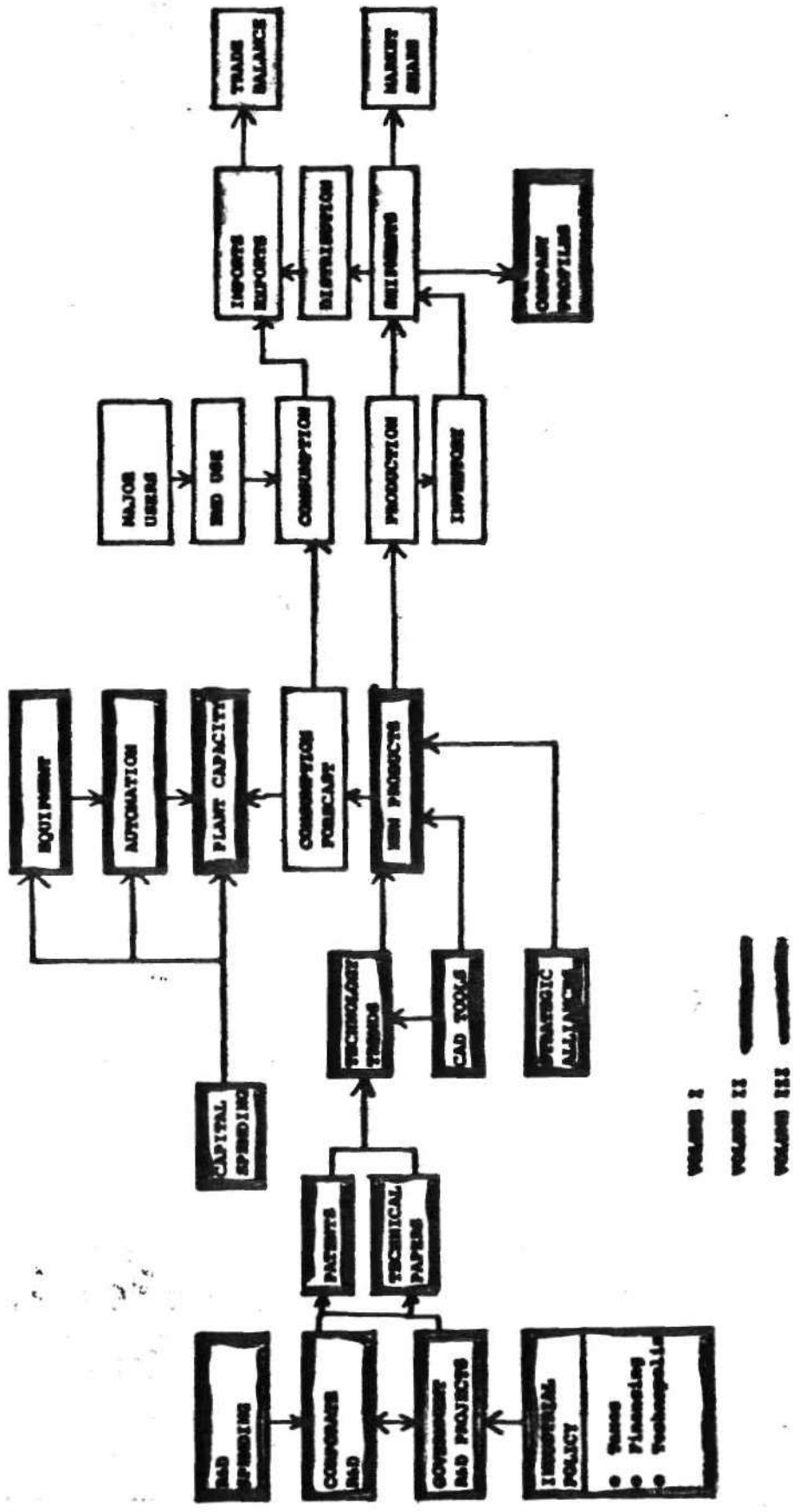
# TOP U.S. DEFENSE ELECTRONICS CONTRACTORS

|      |    | DEFENSE<br>SALES<br>(\$MILLIONS)         | TOTAL 1983<br>SALES<br>(\$MILLIONS) | DEFENSE<br>ELECTRONICS<br>% of TOTAL |      |
|------|----|--|-------------------------------------|--------------------------------------|------|
|      | 26 | Sanders Associates                       | \$ 497                              | \$ 746                               | 66.6 |
|      | 27 | ✓ Motorola                               | \$ 490                              | \$ 4,328                             | 11.3 |
|      | 28 | Eaton                                    | \$ 480                              | \$ 2,674                             | 18.0 |
|      | 29 | Burroughs                                | \$ 465                              | \$ 4,400                             | 11.0 |
|      | 30 | North American Phillips                  | \$ 450                              | \$ 3,800                             | 10.8 |
| S.C. | 31 | E-Systems                                | \$ 418                              | \$ 827                               | 50.4 |
|      | 32 | Allied/Bendix Aerospace                  | \$ 384                              | \$10,220                             | 3.8  |
| S.C. | 33 | Loral                                    | \$ 357                              | \$ 418                               | 85.0 |
|      | 34 | ✓ United Technologies/<br>Norden Systems | \$ 350                              | \$14,670                             | 2.4  |
|      | 35 | Gould                                    | \$ 348                              | \$ 1,325                             | 26.0 |
|      | 36 | Control Data Corp.(CDC)                  | \$ 325                              | \$ 4,600                             | 7.0  |
|      | 37 | AVCO                                     | \$ 285                              | \$ 2,800                             | 10.1 |
|      | 38 | Western Electric(AT&T)                   | \$ 277                              | \$13,838                             | 2.0  |
|      | 39 | Computer Sciences Corp.(CSC)             | \$ 235                              | \$ 712                               | 33.0 |
|      | 40 | Varian Associates                        | \$ 228                              | \$ 760                               | 30.0 |
|      | 41 | ✓ Perkin-Elmer                           | \$ 205                              | \$ 1,182                             | 17.3 |
|      | 42 | Hewlett-Packard                          | \$ 188                              | \$ 4,710                             | 4.0  |
|      | 43 | ✓ Fairchild Industries                   | \$ 154                              | \$ 950                               | 16.2 |
|      | 44 | Hazeltine                                | \$ 140                              | \$ 143                               | 98.2 |
|      | 45 | Goodyear Aerospace                       | \$ 126                              | \$ 618                               | 20.5 |
|      | 46 | AAI                                      | \$ 113                              | \$ 188                               | 60.0 |
|      | 47 | Logicon                                  | \$ 110                              | \$ 128                               | 85.9 |
|      | 48 | Watkins-Johnson                          | \$ 106                              | \$ 186                               | 57.0 |
|      | 49 | Interstate Electronics                   | \$ 100                              | \$ 688                               | 14.5 |
|      | 50 | Bell Aerospace Textron                   | \$ 92                               | \$ 2,980                             | 3.1  |

Source: Defense Electronics

# J S I S.

JAPANESE SEMICONDUCTOR INDUSTRY ANALYSIS



VOLUME I

VOLUME II

VOLUME III

PRODUCT  
CONCEPT



MARKET  
PENETRATION

EVOLUTION



## Korea

ROK's  
Semiconductor  
Exports Jump

The Republic of Korea's semiconductor exports have increased sharply. Exports between January and April this year compared with the same period last year are:

|          | Value<br>(\$M) | Percent Change<br>vs. Same Month<br>of Previous Year |
|----------|----------------|--|
| January  | \$ 82.270      | (12.4%)  |
| February | 88.740         | 17.2%  |
| March    | 101.678        | 19.2%  |
| April    | 109.886        | 26.5%  |
| Total    | \$382.574      | 11.9%  |

Source: Dataquest  
July 1986

May exports are expected to reach \$120 million, up 30 percent over the year before. Transistor exports between January and April showed a remarkable increase of 233.7 percent to \$46.751 million. IC exports in April totaled \$1.477 million, up 648 percent over the year before. Dataquest expects the increase in IC exports to remain higher than transistors in the future.

ROK Introduces  
126 Electronic  
and Electrical  
Technologies

In 1985, Korean companies licensed 126 electronic and electrical technologies from foreign companies. Introductions by company included the following:

- GoldStar Co., Ltd.
  - Nine items, including workstation manufacturing
- Samsung Electronics Co., Ltd.
  - Eight items, including MSX PC manufacturing
- Daewoo Electronics Co., Ltd.
  - Seven items, including MSX FDD manufacturing
- Samsung Semiconductor & Telecommunications Co., Ltd.
  - Six items, including microcontroller and microprocessor manufacturing
- Hyundai Electronics Co., Ltd.
  - Five items, including semiconductor manufacturing
- Daewoo Telecom Co., Ltd.
  - Four items, including 16-bit PC manufacturing
- GoldStar Semiconductor, Ltd.
  - Four items, including semiconductor manufacturing

Most of the high-technology products such as semiconductors, computers, and telecommunications equipment, are dependent on technology licensed from foreign countries. The following table lists foreign technology introduced in 1985 in Korea.

# Technology Transfer To The Republic Of Korea In 1985

| Company                                       | Technology Supplier                          | Technology  | Contents of Technology   |
|---|--|---|--|
| Hyundai Electronics                           | Chun Dongwo<br>Park Kwangwoo<br>(U.S.A.)     | Semiconductor<br>Manufacturing  | Technology Information<br>Materials<br>Technology Services                     |
| Korea Electronic<br>Materials                 | A.C.T. Corp.<br>(U.S.A.)                     | Silicon Single-<br>Crystal and Wafer<br>Manufacturing                   | Technology Information<br>Materials<br>Technology Services                     |
| Samsung Semiconductor &<br>Telecommunications | Zytex (U.S.A.)                               | High-Speed<br>CMOS Logic IC<br>Manufacturing                            | Technology Information<br>Materials<br>Technology Services                     |
| Hyundai Electronics                           | Park Kwangwoo<br>(U.S.A.)                    | Semiconductor<br>Manufacturing  | Technology Information<br>Patent License<br>Materials<br>Technology Services   |
| Samsung Semiconductor &<br>Telecommunications | SGS-ATES<br>(Italy)                          | Semiconductor<br>Manufacturing  | Technology Information<br>Materials<br>Technology Services                     |
| Hyundai Electronics                           | HEA (U.S.A.)                                 | Clean Room<br>Technology for<br>64K Devices                             | Technology Information<br>Technology Services                                  |
| Hyundai Electronics                           | Vitellic Corp.<br>(U.S.A.)                   | 1Mb DRAM;<br>256K SRAM,<br>256K Video RAM<br>Manufacturing              | Technology Information<br>Materials<br>Technology Services                     |
| GoldStar Semiconductor                        | United<br>Microtek Inc.<br>(U.S.A.)          | MOS 74HC TTL<br>Series<br>Manufacturing                                 | Technology Information<br>Materials<br>Technology Services                     |
| Lucky Industrial Materials                    | Siltec Corp.<br>(U.S.A.)                     | Silicon Wafer<br>Manufacturing  | Technology Information<br>Trademark Rights<br>Materials<br>Technology Services |
| Samsung Semiconductor &<br>Telecommunications | Samsung<br>Semiconductor<br>(U.S.A.)         | Semiconductor<br>Manufacturing<br>Including<br>1Mb DRAM                 | Technology Information<br>Patent License<br>Technology Services                |
| Varian Korea                                  | Varian Associates<br>Inc. (U.S.A.)           | Semiconductor<br>Manufacturing<br>Equipment<br>Installation<br>Services | Technology Information<br>Trademark Rights<br>Technology Services              |
| Samsung Semiconductor &<br>Telecommunications | Intel Corp.<br>(U.S.A.)                      | Microcontroller,<br>Microprocessor,<br>Peripheral<br>Devices            | Technology Information<br>Patent License<br>Materials<br>Technology Services   |
| GoldStar Semiconductor                        | Fairchild Camera &<br>Instrument<br>(U.S.A.) | 64K SRAM<br>Manufacturing<br>Materials<br>Technology Services           | Technology Information<br>Patent License                                       |
| GoldStar Semiconductor                        | Barvon Research<br>(U.S.A.)                  | Custom<br>Semiconductor<br>Manufacturing                                | Technology Information<br>Materials<br>Technology Services                     |
| Samsung Precision<br>Industry                 | Vanguard West Inc.<br>(U.S.A.)               | Lead Frame<br>Manufacturing<br>Technology Services                      | Technology Information<br>Materials  |

(Continued)

**Technology Transfer To  
The Republic Of Korea In 1985 (Continued)**

| Company                                    | Technology Supplier                       | Costs  | Period of Contract |
|--|---|--|--------------------|
| Hyundai Electronics                        | Chun Dongwo<br>Park Kwangwoo<br>(U.S.A.)  | US\$320,000  | 2 years            |
| Korea Electronic Materials                 | A.C.T. Corp.<br>(U.S.A.)                  | US\$62,000<br>Technology Fee:<br>3.5%                      | 13 years           |
| Samsung Semiconductor & Telecommunications | Zytex (U.S.A.)                            | US\$725,000<br>Technology Fee:<br>3%                       | 3 years            |
| Hyundai Electronics                        | Park Kwangwoo<br>(U.S.A.)                 | US\$160,000  | 2 years            |
| Samsung Semiconductor & Telecommunications | SGS-ATES<br>(Italy)                       | US\$85,000<br>Technology Fee:<br>3%                        | 5 years            |
| Hyundai Electronics                        | HEA (U.S.A.)                              | US\$4 million  | 5 years            |
| Hyundai Electronics                        | Vitellic Corp.<br>(U.S.A.)                | US\$11 million<br>Technology Fee:<br>3%                    | 3 years            |
| GoldStar Semiconductor                     | United<br>Microtek Inc.<br>(U.S.A.)       | US\$960,000  | 3 years            |
| Lucky Industrial Materials                 | Siltec Corp.<br>(U.S.A.)                  | US\$4 million<br>Technology Fee:<br>4%                     | 7 years            |
| Samsung Semiconductor & Telecommunications | Samsung<br>Semiconductor<br>(U.S.A.)      | US\$29.3 million   | 5 years            |
| Varian Korea Inc. (U.S.A.)                 | Varian Associates                         | Technology Fee:<br>5%                                      | 10 years           |
| Samsung Semiconductor & Telecommunications | Intel Corp.<br>(U.S.A.)                   | 10% of Net<br>Profits                                      | 1 year             |
| GoldStar Semiconductor                     | Fairchild Camera & Instrument<br>(U.S.A.) | Technology Fee:<br>3.5%                                    | 10 years           |
| GoldStar Semiconductor                     | Barvon Research<br>(U.S.A.)               | US\$200,000  | 3 years            |
| Samsung Precision Industry                 | Vanguard West Inc.<br>(U.S.A.)            | US\$65,000 and<br>Training Fee<br>(US\$7,000 per<br>month) | 5 years            |

Source: The Electronic Times  
(Korea)

## Taiwan

**Korean-made  
Memories Capture  
Large Market  
in Taiwan**

According to a Taiwan report, memories made in the Republic of Korea have captured 50 percent of the Taiwan market. The steep increase in Korean-made memories on the market is due to the recent depreciation of the U.S. dollar. So far, Samsung, GoldStar, and Hyundai have developed into the Taiwan memory market. Their memories have been sold at lower prices than Japanese- and U.S.-made models.



JSIS Code: Newsletters 1985-1986, JSIA  
1986-32

## DOING HIGH-TECHNOLOGY BUSINESS IN KOREA

### SUMMARY

This newsletter is the second to supplement the Korean Semiconductor Industry Analysis (KSIA) that was published in March 1986. (For more information on the 150-page, in-depth analysis, please contact Maureen Davies at (408) 971-9000, extension 481.)

As described briefly in Chapter 7 of KSIA, the Korean government selected nine strategic industries and placed special emphasis on developing approximately 600 technologies essential to them. The semiconductor industry is one of these; the other industries are computer materials, biochemicals, bioengineering, precision machinery, plant engineering, textiles, and energy resources. For these strategic industries, the government offers financial and technological support to individuals, companies, and venture groups seeking to establish new technology-intensive businesses using up-to-date technology.

Dataquest has prepared the following summary of "what-to-do" and "how-to-do-it" if one desires to enter or participate in the fast-growing high-technology industries in Korea.

### INITIAL PHASE

It is very important to assess the basic business strategy of your company before entering the market in Korea. The following steps will guide you in planning the initial phase.

#### Type of Business

##### Trading: Import/Export

Without Your Own Product: Pure Trading - Check the list of products banned from Korea. (This list is available from the Korean Ministry of Electronics.) In general, if a high-technology product is

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available from a Korean manufacturer it is banned from import. This is the government's attempt to protect high-technology start-up industries from foreign competition.

With Your Own Product - If a product is not made in Korea, then import authorization will usually be given. Even if a product is on the banned list, it may be manufactured and marketed in Korea if it is not on the Negative List. (See the following sections for a description of products on this list.)

#### Where to Get More Information

● **Korean diplomatic missions in major cities:**

- Addresses and telephone numbers are listed in the white pages of telephone directories.
- The mission will provide a broad range of information on government policies, investment guidelines, etc. If you want more specific information, they will guide you to the proper organization.

● **Korean Traders' Association (KTA)**

- A nonprofit, nongovernmental economic organization, KTA has more than 5,000 member companies comprising all licensed exporters and importers in Korea. KTA provides foreign businessmen with up-to-date and comprehensive information about the Korean economy and export products. KTA also recommends suitable domestic exporters, importers, or manufacturers.
- Main office: 17th Fl., World Trade Center,  
Seoul, Korea  
Mailing Address: CPO Box 1117, Seoul, Korea  
Telephone: 771-41  
Telex: K24265 KOTRASO  
Tokyo Office: Tel: (03) 438-2761  
Telex: 27464 KOTRASO J  
New York Office: Tel: (212) 421-8804  
Telex: 425572 KTANY  
Washington Office: Tel: (202) 682-1550  
Telex: 757427 KTAWSH  
Hong Kong Office: Tel: 5-432234  
Telex: 74386 KOCEK HX  
Dusseldorf Office: Tel: (0211) 498930  
Telex: 8584754 KTAD

● **Foreign Investment Information Center, Ministry of Finance**

- Address: 108-4 Susong-dong, Chongro-ku, Seoul, Korea  
Tel: 720-2757, 723-1681
- This office is a one-stop information center for investing in Korea.

### Manufacturing

As described briefly above, it is possible to manufacture and market a product in Korea. Extra incentives will be given to products that are exported in order to stimulate the growth of foreign exchange. (Refer to the following sections.)

### Products or Services

Once you have decided upon the product or service to be introduced to Korea, it is necessary to see if the product is on the Negative List. The List may be obtained from the Korean diplomatic missions or Ministry of Finance. In general, almost all high-technology-related products and services are not included in this List. But even if a product or service is on the Negative List, it will still be permitted as long as the manufactured product or service provided is 100 percent exported.

## BUSINESS FORMATION: DEFINITIONS AND GUIDELINES

### Branch Office of a Foreign Company

A foreign company may open a branch office in Korea by reporting to the Bank of Korea and registering the business. Registered branches conduct business for profit and must pay taxes. Branches are granted export-import licenses; however, branch offices cannot manufacture products and cannot own shares in Korean companies.

### Trading Agents

Official trading agents must be registered with the Korea Traders' Association (KTA). Only these agents are allowed to issue quotations or trading orders that are recognized by the government or by banks authorized to deal in foreign exchange. (See the KTA described in the previous section.)

### Corporate Entity

The Commercial Code recognizes four types of corporations: the partnership, the limited partnership, the limited company, and the stock company. The foreign investor may choose any of these four types; however, the stock corporation is the most common among foreign investors. To establish a stock corporation, articles of incorporation must be drawn up and notarized. Seven or more individuals or promoters are required for incorporation, none of whom needs to be a Korean national. Under the Civil Code, their status as "promoters" lasts only until the corporation is registered, when the board of directors assumes control of the company.

A stock corporation can be set up under either the Foreign Exchange Control Act or the Foreign Capital Inducement Act (FCIA). In practice, most foreign investors choose to establish a corporation under the FCIA, which offers tax benefits, guaranteed repatriation of profits, and other incentives (see below). The FCIA was described in a previous newsletter, entitled "Korean Taxation."

## INVESTMENT

### Basic Policy and Governing Laws

In recent years, the government has pursued an open-door policy for foreign investment. The basic position is clearly stated in the FCIA as follows: "The purpose of this law shall be to effectively induce and protect foreign capital conducive to the sound development of the national economy . . . ."

The FCIA is the primary governing law that regulates foreign equity investment, foreign loans, and technology inducement. It further stipulates conditions and procedures for licensing, tax incentives, and repatriation of capital as well as remittance of dividends. Other laws relating to foreign investment are the Foreign Exchange Control Act, the Alien Land Acquisition Act, the Customs Law, the Commercial Code, and various tax laws.

FCIA provides that foreign investors and enterprises are treated the same as Korean nationals in the course of performing business in Korea.

### Eligible and Noneligible Projects

Industrial areas in which foreign investment is prohibited or restricted are described on the Negative List. A foreign investment in a product or service not appearing on the Negative List may be allowed with the approval of the Minister of Finance.

#### ● Noneligible Projects (on the Negative List)

- Public projects conducted by the government or public organizations
- Projects that cause harm to the health and sanitation of Korean nationals and the maintenance of the environment
- Projects that are clearly contrary to good morals and traditions
- Other projects prescribed by the Enforcement Decree of FCIA

- Restricted Projects

These are projects that will be permitted after certain developments in the national economy.

- Projects that are being supported by the government on a special basis
- Projects that consume energy excessively or use imported raw materials at an overly high rate
- Highly pollution-prone projects
- Projects that cause luxurious consumption or extravagance
- Projects that endanger the livelihoods of farmers and fishermen
- Projects belonging to infant industries that need temporary protection

#### Minimum Foreign Investment Ratio

The minimum allowable amount or value of foreign equity investment is US\$100,000, and this investment must be less than 50 percent of the total investment.

The form of equity investment may be as follows:

- Cash
- Capital goods
- Profits accruing from stocks or shares acquired in accordance with the FCIA
- Industrial property rights, or any other technology equivalent thereto or any right to use it

This foreign investment ratio is set forth in an official agreement between the foreign investor and his Korean partner, as outlined in the articles of incorporation. Foreign investment with a ratio less than 50 percent may be approved immediately if the following conditions are met:

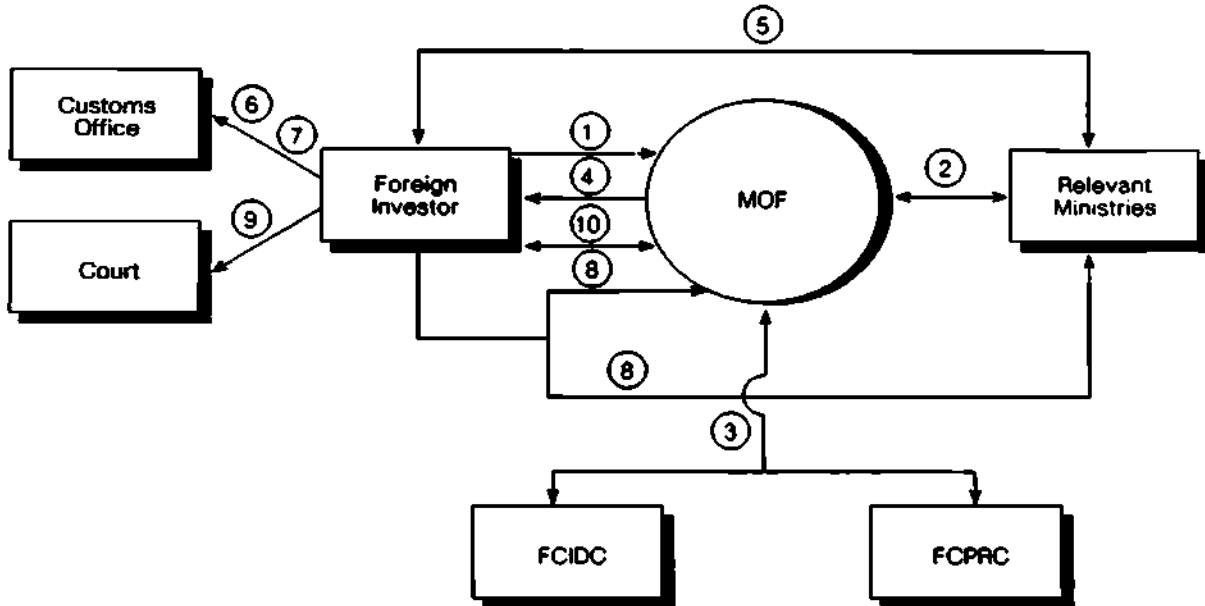
- The minimum foreign investment ratio is less than 50 percent
- The project is not on the Negative List
- The amount of foreign investment is equivalent to US\$1 million or less
- A foreign investor does not apply for tax exemption or reduction

## Investment Procedure

Figure 1 portrays the procedures of the foreign investment application and implementation process and the offices administering each step.

Figure 1

### PROCEDURES FOR FOREIGN INVESTMENT PROPOSALS



- |   |  |
|---|--|
| ① Application for authorization   | ⑥ Import declaration   |
| ② Review of application   | ⑦ Application for exemption or reduction of customs duty, etc. |
| ③ Deliberation and approval   | ⑧ Report of foreign capital inducement                         |
| ④ Authorization   | ⑨ Registration   |
| ⑤ Application for confirmation of specification of capital goods and issuing the letter thereof | ⑩ Registration of foreign invested enterprise                  |

Note: Procedures ② and ③ are omitted in the case of projects eligible for automatic approval.

MOF: Ministry of Finance  
FCIDC: Foreign Capital Inducement Deliberation Committee  
Advisory body to the Minister of Finance  
FCPRC: Foreign Capital Project Review Committee  
Chaired by the Minister of Finance

Source: Ministry of Finance

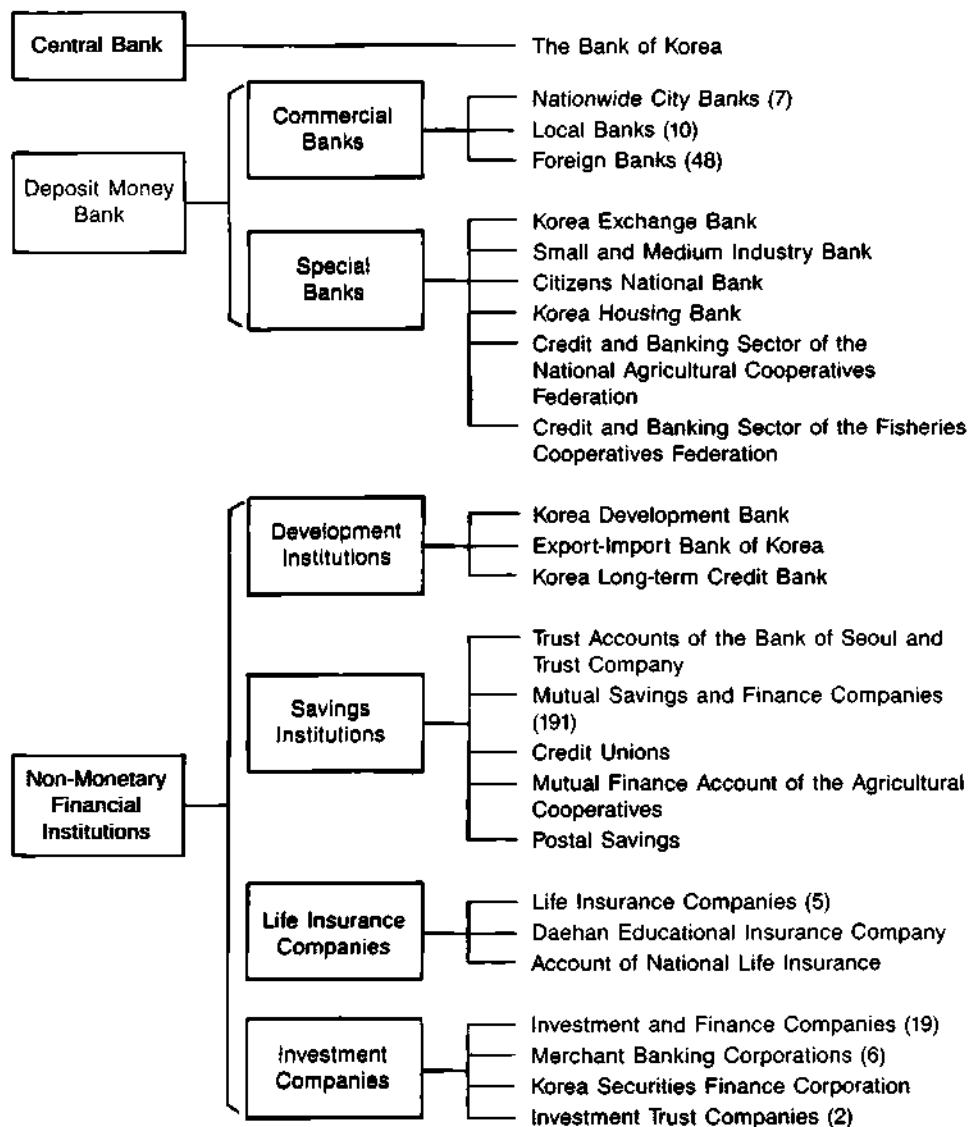
## BANKING AND FINANCE IN KOREA

### Financial Sector

The financial sector of Korea includes a diversified commercial banking system, a wide range of secondary financial institutions, and a securities market (see Figure 2). There is no discrimination between foreign-invested and domestic business firms in acquiring financial credits from banking institutions.

Figure 2

#### KOREAN FINANCIAL INSTITUTIONS



Note: Figures in parentheses denote the number of institutions as of the end of 1983

Source: Bank of Korea

## Small and Medium-Size Industry Support Organizations

In addition to the financial sector, there are many government and private institutions and organizations that support small and medium-size companies in every aspect of business, including start-up financing and the funding of new product development. Listed below are some of the most commonly used institutions for supporting small and medium-size companies:

- Banking Institutions

- The Korea Exchange Bank  
Address: 181 2-ka, Ulchi-ro, Choong-ku, Seoul, Korea  
Tel: 771-46

This is the largest commercial bank in Korea specializing in foreign exchange transactions, trade financing, and all areas of international banking. It maintains an international network of 38 branches, subsidiaries, and representatives.

- The Small and Medium Industry Bank  
Address: 26-1 2-ka, Ulchi-ro, Choong-ku, Seoul, Korea  
Tel: 771-50

This bank supports all phases of banking needs for small and medium-size industries, including start-up financing.

- The Citizen's National Bank  
Address: 9-1 2-ka, Namdaemoon-ro, Choong-ku, Seoul, Korea  
Tel: 771-40

This bank provides general banking with short-term loans to individuals and small companies. It gives special assistance to start-up companies with new products or technologies by providing long-term loans or equity investments.

- The Korea Long-term Credit Bank  
Address: 15-22 Yoido-dong, Youngdungpo-ku, Seoul, Korea  
Tel: 783-4431

This bank supports the commercialization of new technologies by providing long-term loans or equity investments.

- Venture Capital Companies

There are four private venture capital companies in Korea. However, they are heavily subsidized by the government and their objective is not primarily a high return to their investors. Their profits are mainly put into a revolving fund to support further investments with nominal dividends provided to the investors, who are usually public and private institutions. In addition to financial support, all of these venture capital companies provide services such as arranging private investment,



preparing business proposals, handling all of the procedures of business formation, and giving advice on managing the business. These venture capital companies can be of great assistance to foreign investors who wish to do business under a joint ventureship.

- Korea Technology Development Corporation (KTDC)  
Address: 9th Fl., FKI Building  
28-1 Yoido-dong, Youngdungpo-ku, Seoul, Korea  
Tel: 783-7601, 783-7851

KTDC was established in 1977 under the "Korea Technology Development Act" that provides government support with autonomous, private management. It provides funds to business enterprises at favorable terms, including equity investments needed for developing technology. In most cases it provides up to \$1 million a year to a large number of companies.

- Korea Development Investment Corporation (KDIC)  
Address: 12th Fl., Private School Endowment Building  
27-2 Yoido-dong, Youngdungpo-ku, Seoul, Korea  
Tel: 783-9574

KDIC was established in 1982 by domestic and international investment companies. It is very selective, but provides large amounts of money, depending on the project. It is similar in character to U.S. venture firms. Its primary investment is in new inventions or technologies either from domestic or foreign businesses manufacturing in Korea.

- Korea Technology Financing Corporation (KTFC)  
Address: Industrial Bank Building  
10-2 Kwanchul-dong, Chongro-ku, Seoul, Korea  
Tel: 744-5411

KTIC is sponsored by domestic private financial institutions. It is similar to the KTDC.

- Korea Technology Advancement Corporation (K-TAC)  
Address: c/o KAIST  
39-1 Hawolgok-dong, Sungbook-ku, Seoul, Korea  
Tel: 962-8197

K-TAC was established by seven government R&D organizations to commercialize their technological developments. In addition, several domestic banking and investment organizations support the venture. The company also provides funds to those with technologies from sources other than their member R&D firms.

### THE BOTTOM LINE

The FCIA guarantees the overseas remittance of profit dividends accruing from the stock or shares acquired by a foreign investor, sales proceeds from stock or shares, principal, interest and fees to be paid under a loan contract or a public loan agreement, and royalties to be paid under a technology inducement contract. When a foreign investor wants to remit abroad, one must file an application with the president of the Foreign Exchange Bank (such as the Korea Exchange Bank) for approval. The president of the bank will approve the application after reviewing the legitimacy of the repatriation.

Should a foreign investor want to invest profit dividends accruing from the stock or shares acquired in accordance with the FCIA in an enterprise in Korea, the investor must report to the Minister of Finance and first obtain approval. Then all properties of foreign-invested enterprise are guaranteed and protected from requisition or expropriation under pertinent laws and decrees.

### CONCLUSIONS

It is Dataquest's opinion that there will be many new joint venture companies formed between U.S. and Korean investors in the next five years. Specifically, we see the semiconductor industry growing at a compound annual growth rate of a minimum of 22 percent over the next five years, and with this high rate, local companies will be funded to support its growth.

Gene Norrett  
Dr. Mike Bae

October 1985

## **Dataquest Announces Korean Semiconductor Industry Analysis**

DATAQUEST proudly announces a major expansion of its semiconductor research with the introduction of the Korean Semiconductor Industry Analysis. This new research will be available on December 1, 1985. Features include:

- Data gathered and analyzed by research professionals in Seoul, Tokyo, and San Jose
- The most current information on Korean companies, factories, products, investments, technology developments, statistics, and joint ventures
- The low-cost contract manufacturing companies' investments, manufacturing capabilities, and other support services such as engineering, design, and maskmaking
- The significant increase in electronic system investment in Korea and the companies that are manufacturing in Korea

The Korean Semiconductor Industry Analysis will include an annual update of the entire report, newsletters, and clarification inquiries. It will sell for \$1,900 to Japanese Semiconductor Industry Service (JSIS) subscribers and \$2,500 to non-JSIS subscribers.

***For more information, please contact Gene Norrett, Vice President and Director of JSIS, or John Jackson, National Sales Manager, at Dataquest, (408) 971-9000.***

JSIS 85-5

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Sheridan Tatsuno

October 3, 1986

*Sheridan*

# KOREAN STRATEGIC ALLIANCES

## GOLD STAR

|                |         |                                  |
|----------------|---------|----------------------------------|
| 1981 AT&T      | JV, 2nd | Bipolar process                  |
| 1982 AT&T      | 2nd     | MOS process                      |
| 1983 AT&T      | 2nd     | 64K DRAM, 3B computer system     |
| 1983 Zilog     | 2nd     | Z80 (8-bit), sell Zilog products |
| 1984 LSI Logic | 2nd     | CMOS gate arrays (7000 series)   |
| 1984 AMD       | Rep     | All AMD products in Korea        |
| 1984 AMD       | 2nd     | 64K DRAM design; 256K CMOS DRAM  |
| 1984 TI        | 2nd     | 64K DRAM                         |
| 1985 MMI       | 2nd     | Programmable logic array license |
| 1985 Fairchild | 2nd     | CMOS 64K SRAM                    |

## HYUNDAI

|                 |            |                                       |
|-----------------|------------|---------------------------------------|
| 1983 Modern El. | 2nd        | NMOS & CMOS memory and MCU            |
| 1984 Inmos      | 2nd        | 256K DRAM                             |
| 1984 Int'l      | Tech. agr. | 1K CMOS joint development & marketing |
| CMOS Tech       |            |                                       |
| 1984 Western    | 2nd        | CMOS 8-/16-bit 6502 MPUs              |
| Design Center   |            |                                       |
| 1984 TI         | 2nd        | 64K DRAMs                             |
| 1985 HEA        | 2nd        | 64K SRAMs, 64K EEPROM                 |
| 1986 Vitelic    | 2nd, mfg.  | 16K CMOS SRAM, 64/256/1Mb CMOS DRAM   |
| 1986 GI         | Mfg.       | Standard cells, 16K EEPROM            |

## SAMSUNG

|                  |            |                               |
|------------------|------------|-------------------------------|
| 1983 Exel        | 2nd        | 16K EEPROM                    |
| 1983 Samsung/US  | 2nd        | NMOS & CMOS memory            |
| 1983 DITTI (Ger) | 2nd        | Linear ICs, CMOS              |
| 1983 Micron      | 2nd        | 64K & 256K DRAM               |
| 1983 Sharp       | 2nd        | 16K SRAM, 256K ROM            |
| 1984 Sharp       | 2nd        | 4-bit, single-chip MCU        |
| 1985 Intel       | Tech. Agr. | 8048, 8049 MCUs; MPR          |
| 1985 National    | 2nd        | Gate arrays                   |
| 1985 Zytex       | Financing  | 2.0 micron CMOS process       |
| 1986 Ixys        | TTA        | Smart power (CMOS & discrete) |

## DAEWOO

|            |           |                          |
|------------|-----------|--------------------------|
| 1986 Zymos | 1/2 stock | Standard cell technology |
|------------|-----------|--------------------------|

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J.H. Sohn  
(ex-goldstar.) 7/87  
DQ rep.

MEMORY ALLIANCE

|          | MTI                               | SHARP                 | INTEL                      |           |          |
|----------|-----------------------------------|-----------------------|----------------------------|-----------|----------|
| SAMSUNG  | 64K DRAM<br>256K DRAM             | 16K SRAM<br>256K ROM  | EPROM<br>(64K, 128K, 256K) |           |          |
|          | AMD                               | FAIRCHILD             | AT&T                       |           |          |
| GOLDSTAR | 64K DRAM                          | 64K SRAM              | 256K DRAM                  |           |          |
|          | INMOS                             | VITELIC               | GI                         | ICT       | TI       |
| HYUNDAI  | 16K SRAM<br>64K SRAM<br>256K DRAM | 16K DRAM<br>256K DRAM | 512K ROM<br>16K EEPROM     | 64K EPROM | 128K ROM |

## MEMORY STATUS

|             | COMPANY  | SPEED(ns) | SAMPLE OUT | MASS PROD. | CAPA(yr) | PRICE    |
|-------------|----------|-----------|------------|------------|----------|----------|
| 1M DRAM     | SAMSUNG  | 120/150   | 87.3       | 88.1       | 72M PCS  | N/A      |
|             | GOLDSTAR | 100/150   | 87.9       | 88.7       | 24M PCS  | N/A      |
|             | HYUNDAI  | 100/150   | 87.12      | 88.10      | 24M PCS  | N/A      |
| 4M DRAM     | SAMSUNG  | 100/150   | 88.7       | 89.7       | N/A      | N/A      |
|             | GOLDSTAR | 100/150   | 88.7       | 89.7       | N/A      | N/A      |
|             | HYUNDAI  | 100/150   | 88.7       | 89.7       | N/A      | N/A      |
| 64K SRAM    | SAMSUNG  | 60/75/85  | 86.9       | 87.1       | 6M PCS   | \$ 3.00  |
|             | GOLDSTAR | 45/55/75  | 85.6       | 86.3       | 12M PCS  | \$ 4.50  |
|             | HYUNDAI  | 45/55/75  | 85.9       | 86.7       | 24M PCS  | \$ 3.00  |
| 256K SRAM   | SAMSUNG  | 100/150   | 87.7       | 87.10      | N/A      | N/A      |
|             | HYUNDAI  | 55/70/90  | 87.12      | 88.7       | N/A      | N/A      |
| 512K 1M ROM | GOLDSTAR | 30/45/55  | 85.11      | 86.3       | 6M PCS   | \$ 3.00  |
| 64K EPROM   | GOLDSTAR | 25/35/45  | 87.3       | 87.7       | 3M PCS   | \$ 20.00 |
|             | HYUNDAI  | 150/300   | 86.1       | 87.7       | 6M PCS   | N/A      |
| 16K EEPROM  | SAMSUNG  | 250       | 86.9       | 87.1       | 3M PCS   | N/A      |
| 64K EEPROM  | SAMSUNG  | 200       | 86.9       | 87.1       | 3M PCS   | N/A      |

# DATAQUEST MEMO

TO: Gene Norrett  
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\$12K clients

\$2K/country report ~~6~~

FROM: Tom Wang *TW*

SUBJ: ASETS' Schedule Review

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Tom Wang

1/19/87

1/19 1/26 2/2 2/9 2/16 2/23 3/2 3/9

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Final Editing ----->2/16

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~~Brochure~~ ----->2/16

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Camera Rdy 2/23 *OK*

All Ready 2/27

News Release 3/5

Sales Training 2/16

*Hot NLs (trade balance/albumen)  
SMT in Taiwan; PC clones; offshore mfg. electronics*

\* The next ASETS' review meeting will be held on Jan. 26th at 2:00 pm, in SIG conference room. Thank you for attending.

*"brainstorming" session w/ DQ researchers & managers → Jewel Peyton  
→ reproduce NL in each service.*

# Status of ASETS

Tom Wang

1/19/87

## Vol I PRODUCTS & MARKETS

| Tabs                      | Overall | Korea | Taiwan | HK  | China | Sing | Pgs |
|---------------------------|---------|-------|--------|-----|-------|------|-----|
| Intro to the Service      | 8       | ----- |        |     |       |      | 8   |
| Table of Contents         | 3       | ----- |        |     |       |      | 3   |
| History of Semi Industry  | 20      | x     | x      | x   | x     | x    | 20  |
| Electronics Industry      | 125     | x     | x      | x   | (25)  | x    | 100 |
| Semiconductor End Use     | 10      | (2)   | (2)    | (2) | (2)   | (2)  |     |
| Major Semiconductor Users | 25      | (5)   | (5)    | (5) | (5)   | (5)  |     |
| Consumption/Production    | 40      | x     | x      | x   | (8)   | (8)  | 24  |
| Market Share              | 60      | x     | x      | x   | (12)  | (12) | 36  |
| Imports/Exports           | 25      | x     | x      | x   | (5)   | (5)  | 15  |
| Distribution              | 25      | (5)   | x      | x   | (5)   | (5)  | 10  |
| Design Centers            | 10      | (2)   | x      | x   | (2)   | x    | 6   |
| Assembly Industry         | 40      | x     | x      | x   | ---   | (10) | 30  |
| -----                     |         |       |        |     |       |      |     |
| Total                     | 391     | (14)  | (7)    | (7) | (64)  | (47) | 252 |



## Vol II Government & Technology

|                         | Overall    | Korea       | Taiwan      | HK         | China       | Sing        | Pgs        |
|-------------------------|------------|-------------|-------------|------------|-------------|-------------|------------|
| Intro to the Service    | 8          | -----       |             |            |             |             | 8          |
| Table of Contents       | 3          | -----       |             |            |             |             | 3          |
| <b>GOVERNMENT:</b>      |            |             |             |            |             |             |            |
| Demography & Economy    | 50         | x           | x           | x          | (10)        | (10)        | 30         |
| Government & Politics   | 40         | x           | x           | x          | (8)         | (8)         | 24         |
| Industrial Policy       | 40         | x           | x           | x          | (8)         | (8)         | 24         |
| Government R&D Projects | 15         | (3)         | x           | (3)        | (3)         | (3)         | 3          |
| High-Tech Zones         | 30         | (8)         | x           | (3)        | (8)         | (3)         | 8          |
| <b>TECHNOLOGY:</b>      |            |             |             |            |             |             |            |
| Corporate R&D           | 40         | x           | x           | x          | (5)         | (5)         | 30         |
| Strategic Alliances     | 7          | x           | x           | (1)        | (1)         | (1)         | 4          |
| Technology Trends       | 30         | (10)        | (10)        | (2)        | (6)         | (2)         |            |
| Equipment & Materials   | 10         | x           | x           | x          | (2)         | (2)         | 6          |
| Fab/Foundry Database    | 30         | x           | x           | x          | x           | x           | 30         |
| <b>Total</b>            | <b>303</b> | <b>(21)</b> | <b>(10)</b> | <b>(9)</b> | <b>(51)</b> | <b>(42)</b> | <b>170</b> |

## Vol III Company Profiles

|                      | Overall | Korea | Taiwan | HK | China | Sing | Pgs |
|----------------------|---------|-------|--------|----|-------|------|-----|
| Intro to the Service | 8       | ----- |        |    |       |      | 8   |
| Table of Contents    | 3       | ----- |        |    |       |      | 3   |
| Native Companies     | 150     | x     | x      | x  | (20)  | (20) | 110 |

|                   |    |      |     |     |       |      |    |
|-------------------|----|------|-----|-----|-------|------|----|
| Foreign Companies | 80 | (20) | (8) | (8) | ----- | (20) | 24 |
|-------------------|----|------|-----|-----|-------|------|----|

---

|       |     |      |     |     |      |      |     |
|-------|-----|------|-----|-----|------|------|-----|
| Total | 241 | (20) | (8) | (8) | (20) | (20) | 145 |
|-------|-----|------|-----|-----|------|------|-----|

*Editing 26-20 pp/day*

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*45*

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KOREAN  
SEMICONDUCTOR  
INDUSTRY  
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345

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# Korean Semiconductor Industry Analysis

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# TABLE OF CONTENTS

| <u>Title</u>                                   | <u>Page</u> |
|--|-------------|
| INTRODUCTION                                   | 1           |
| CHAPTER 1--GEOGRAPHY AND DEMOGRAPHICS          | 3           |
| Geography                                      | 3           |
| Climate  | 4           |
| Population                                     | 5           |
| Language                                       | 6           |
| CHAPTER 2--HISTORICAL OVERVIEW                 | 9           |
| CHAPTER 3--KOREA AND THE UNITED STATES         | 11          |
| CHAPTER 4--CURRENT POLITICAL PERSPECTIVE       | 14          |
| CHAPTER 5--GOVERNMENT                          | 16          |
| Structure                                      | 16          |
| Ministries                                     | 17          |
| Financial Structure                            | 21          |
| Taxation                                       | 23          |
| CHAPTER 6--ECONOMY                             | 25          |
| Overview                                       | 25          |
| Current Five-Year Plan                         | 25          |
| Economic Analysis                              | 26          |
| CHAPTER 7--INDUSTRY                            | 31          |
| Overview                                       | 31          |
| Strategy for Industrial Development            | 31          |
| Foreign Investment                             | 33          |
| Work Force Profile                             | 37          |
| Infrastructure                                 | 39          |
| CHAPTER 8--SOUTH KOREAN SEMICONDUCTOR INDUSTRY | 41          |
| Historical Overview                            | 41          |
| Production                                     | 42          |
| Consumption                                    | 44          |
| Market Share                                   | 45          |
| Semiconductor Equipment and Materials Supplies | 46          |

## TABLE OF CONTENTS (Continued)

| <u>Title</u>   | <u>Page</u>  |
|--|--|
| CHAPTER 9--NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS | 49   |
| Review of Big Four Semiconductor Operations                | 51   |
| Semiconductor Plant Locations                              | 53   |
| Native Semiconductor Production                            | 56   |
| Joint Ventures and License Agreements                      | 58   |
| Capital Spending   | 60   |
| CHAPTER 10--COMPANY PROFILES                               | 63   |
| Daewoo   | 64   |
| Gold Star  | 68   |
| Hyundai  | 75   |
| Korea Electronics  | 80   |
| Samsung  | 85   |
| KETRI  | 93   |
| Dong Sung Moolsan  | 95   |
| Karibong Electronics                                       | 96   |
| KOMY Semiconductor   | 97   |
| Korea Diode  | 98   |
| Korea Fuji Electronics                                     | 99   |
| Korea Optoelectronics                                      | 100  |
| Rohm Korea   | 101  |
| APPENDIX A   | South Korean Semiconductor Industry Production,<br>Consumption, Imports, and Exports |
| APPENDIX B   | South Korean Semiconductor Market Share  |
| APPENDIX C   | South Korean Assembly Industry<br>Assembly Revenue by Company<br>Company Profiles    |
| APPENDIX D   | Semiconductor Wafer Foundry  |
| APPENDIX E   | Facilities Data  |

# LIST OF TABLES

| <u>Table</u> | <u>Title</u>  | <u>Page</u> |
|--------------|---|-------------|
| Table 1      | Climate Data--Seoul Area  | 5           |
| Table 2      | South Korean Population Statistics  | 6           |
| Table 3      | Population Density--1984  | 6           |
| Table 4      | Major Economic Indicators, History and Forecast   | 27          |
| Table 5      | Import/Export/Balance of Trade, History and Forecast  | 29          |
| Table 6      | Foreign Direct Investment by Country  | 34          |
| Table 7      | Work Force Profile  | 37          |
| Table 8      | South Korean Educational System--1983   | 38          |
| Table 9      | Average Monthly Wages and Workdays of<br>Industrial Production Workers                                  | 39          |
| Table 10     | Estimated South Korean Semiconductor Industry<br>Production   | 43          |
| Table 11     | Estimated Worldwide Semiconductor Industry<br>Production  | 43          |
| Table 12     | Estimated South Korean Semiconductor Industry<br>Consumption  | 44          |
| Table 13     | South Korean Semiconductor Consumption, Estimated<br>Share of Worldwide Manufacturers, Regional Summary | 45          |
| Table 14     | Materials Suppliers in South Korea  | 47          |
| Table 15     | Native South Korean Semiconductor Manufacturers   | 49          |
| Table 16     | Wafer Production Capacity of Selected Manufacturers--<br>1985   | 55          |
| Table 17     | Production Capacity by Wafer Size--1985   | 55          |
| Table 18     | Semiconductor Revenues of Samsung, Gold Star,<br>and KEC  | 56          |
| Table 19     | Native Semiconductor Revenues of Samsung, Gold Star,<br>and KEC by Technology                           | 57          |



**LIST OF TABLES (Continued)**

| <u>Table</u> | <u>Title</u>                                     | <u>Page</u> |
|--------------|--|-------------|
| Table 20     | Semiconductor Technology Alliances by Company    | 58          |
| Table 21     | Estimated Semiconductor-Related Capital Spending | 60          |
| Table 22     | Research and Development Facilities              | 61          |

## LIST OF FIGURES

|           | <u>Title</u>   | <u>Page</u> |
|-----------|--|-------------|
| Figure 1  | Location of Korea  | 3           |
| Figure 2  | South Korea  | 4           |
| Figure 3  | Korean Alphabet  | 7           |
| Figure 4  | Economic Planning Board  | 18          |
| Figure 5  | Ministry of Trade and Industry   | 19          |
| Figure 6  | Ministry of Science and Technology   | 20          |
| Figure 7  | South Korean Financial Institutions  | 22          |
| Figure 8  | GNP and GNP/Capita   | 28          |
| Figure 9  | Balance of Trade, History and Forecast   | 28          |
| Figure 10 | Share of Direct Investment by Country  | 35          |
| Figure 11 | Procedures for Foreign Investment Proposals                                      | 36          |
| Figure 12 | Semiconductor Manufacturing Locations  | 54          |
| Figure 13 | Daewoo Electronic Components Co., Ltd.--Manufacturing Facilities                 | 66          |
| Figure 14 | Gold Star Semiconductor, Ltd.--Manufacturing Facilities                          | 70          |
| Figure 15 | Hyundai Electronics Industries Co., Ltd.--Manufacturing Facilities               | 76          |
| Figure 16 | Korea Electronics Co., Ltd.--Manufacturing Facilities                            | 82          |
| Figure 17 | Samsung Semiconductor and Telecommunications Co., Ltd.--Manufacturing Facilities | 87          |

## INTRODUCTION

South Korea's rapid entry into the international semiconductor marketplace will have a measurable effect on the development of the worldwide semiconductor industry throughout the 1980s.

The course of South Korea's industrial growth has been, in the words of the World Bank, ". . . one of the outstanding success stories of international development." Beginning from a position near the bottom of the international income scale, and without the benefit of principal natural resources, South Korea launched itself into a series of economic development programs. In only two decades, these five-year programs have transformed the country from a marginally subsistent agricultural economy into one of Asia's major industrial nations.

As semiconductors become more important to the economic and defense strategies of all nations, governments are becoming increasingly concerned about establishing an indigenous semiconductor industry. South Korea is no exception. Only five years ago, South Korea's participation in the semiconductor industry was limited to discrete device production and circuit assembly. Now, it is taking the necessary steps to develop VLSI capability and become a major semiconductor supplier.

Reports in the business and electronics press represent South Korea as a threat to the current market leaders in the international semiconductor industry. The country's approach to the industry has been likened to that of Japan, with major government support and the involvement of powerful multibillion-dollar conglomerates. With the help of low labor costs and government financing, South Korea is working to achieve a position of world dominance in semiconductor production, similar to that it has already achieved in ship building, construction textiles, and steel. Together, industry and government are investing more than \$1 billion in production capacity and R&D activities. DATAQUEST estimates that South Korean semiconductor industry production (includes components and assemblies produced by native and foreign-owned manufacturers) grew at a 30 percent CAGR, from \$648 million in 1982, to \$1,259 million in 1984.

A significant difference between the South Korean strategy and the approach to developing a native semiconductor industry followed by Japan in the 1970s, is the South Korean willingness to form partnerships and alliances with foreign firms. With virtually no background in VLSI technology, the South Koreans are receiving technology licenses from foreign firms to help acquire state-of-the-art knowledge and techniques for producing high-end integrated circuits such as memories, microprocessors, and semicustom circuits.

South Korea's drive to acquire technology has been represented as a major aspect of the South Korean threat. It has been reported that Japan has in the past held back from transferring technology to South Korea for fear it will be used against Japan in the competition for world markets.

However, in spite of these negative reports, the large number of alliances already in effect between South Korean and foreign electronics manufacturers serves to underline the fact that alliances are playing an ever-growing role in the international electronic production business. South Korean firms have more than 200 technology agreements with Japanese companies. Samsung is manufacturing a 16-bit microcomputer under license to NEC. Daewoo is assembling an IBM PC-compatible with a high ratio of components from Japan; the computer is shipped to a U.S. manufacturer for sale. Further, South Korea has entered into more than 15 alliances and technology agreements with U.S. semiconductor manufacturers since 1981.

Currently, the native South Korean companies are suffering very badly as a result of the world recession in semiconductors. It is unfortunate that they entered the industry in a big way at its peak in 1984 and then suffered huge financial losses in 1985. South Korean companies now have the manufacturing expertise, the technology licenses, and the people in place to produce the product, but no market. DATAQUEST believes that lack of marketing in the United States and Europe is the principal weakness of the major South Korean semiconductor manufacturers. They are now being forced not only to be subcontractors for assembly and test but, through joint venture agreements, also to become foundries for major U.S. and European manufacturers and, to a lesser extent, for second-tier Japanese companies. However, DATAQUEST expects the Korean companies to design, fabricate, and market their own products in the West during the next business cycle.

South Korea's emergence as an internationally competitive semiconductor supplier provides a situation in which both threat and opportunity are present. DATAQUEST's Korean Semiconductor Industry Analysis provides detailed information on the South Korean semiconductor market and the native manufacturers' activities in developing semiconductor technology and production capacity. The report also describes the country's economy, government structure, and industrial policies as they relate to the semiconductor industry participants.

## CHAPTER 1--GEOGRAPHY AND DEMOGRAPHICS

### GEOGRAPHY

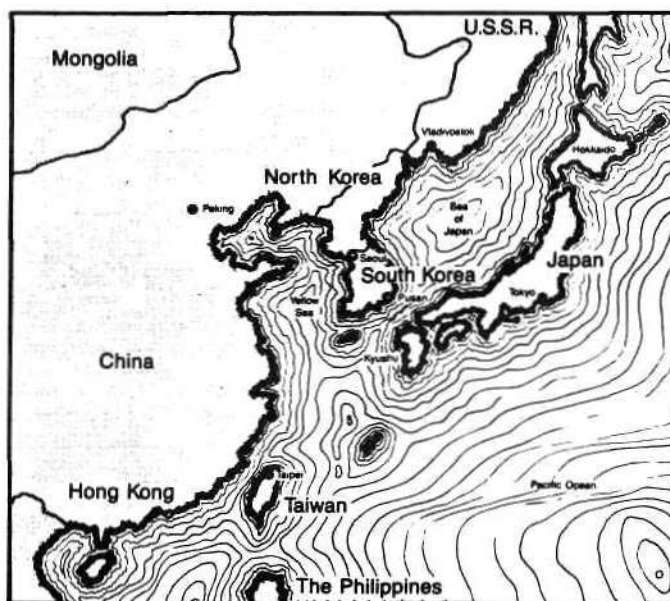
The Korean peninsula resembles Italy on the European continent. Its location relative to Asia and Japan is shown in Figure 1. The peninsula extends south from Manchuria, pointing toward Kyushu in southern Japan. The Korean peninsula is flanked by two oceans, the Sea of Japan on the east and the Yellow Sea on the west. Japan lies 125 miles off the southern tip of the peninsula.

The Korean peninsula was a single nation from the time the Silla Dynasty took power in 676 A.D., until World War II and the Korean War resulted in the politically separate North and South Korean nations. (For further details, see Chapter 3, Korea and the United States.) Bordered by China and Russia in the north, the Democratic People's Republic of Korea (North Korea) occupies the mountainous peninsula's upper half, while the Republic of Korea (South Korea) occupies the lower half and includes 3,579 contiguous islands.

The total area of the Korean peninsula is about 86,328 square miles. From north to south, the longest distance in the peninsula is 600 miles, and from west to east, the average distance is 170 miles. The Korean peninsula is comparable in size to the British Isles or New Zealand.

Figure 1

#### LOCATION OF KOREA



Source: DATAQUEST

South Korea comprises only 38,672 square miles. Its average width is 130 miles, and its length is approximately 300 miles from the demilitarized zone forming the boundary with North Korea at the 42nd parallel, to the southern tip of the peninsula. South Korea is shown in Figure 2.

Figure 2

**SOUTH KOREA**



Source: DATAQUEST

**CLIMATE**

South Korea lies in the northern temperate zone with a climate that has four distinct seasons. Influenced by monsoons, the latitudinal position and terrains of the country, and the currents running along its coasts, the climate shows wide variations and differences. The country spans nine latitudes and the elevation of terrain is greater in the north than in the south. Due to these geographical factors, the nearer the northern frontier, the lower the average temperature. The average temperature throughout the year is 13 degrees C along the southern coast and drops as low as 10 degrees C over the central and northern zones of Korea. The average monthly temperature, humidity, and precipitation in the Seoul area are shown in Table 1.

Table 1

## CLIMATE DATA--SEOUL AREA

| <u>Month</u> | <u>Temperature</u><br><u>(Degrees C)</u> | <u>Humidity</u> | <u>Precipitation</u><br><u>(mm)</u> |
|--------------|--|-----------------|-------------------------------------|
| January      | -3.7                                     | 64%             | 28.0                                |
| February     | -3.2                                     | 64%             | 5.0                                 |
| March        | 5.2                                      | 63%             | 32.8                                |
| April        | 10.1                                     | 65%             | 216.7                               |
| May          | 16.5                                     | 65%             | 90.3                                |
| June         | 21.6                                     | 76%             | 118.8                               |
| July         | 22.7                                     | 80%             | 259.2                               |
| August       | 22.8                                     | 76%             | 331.5                               |
| September    | 19.6                                     | 66%             | 58.3                                |
| October      | 13.0                                     | 62%             | 44.9                                |
| November     | 8.6                                      | 65%             | 10.6                                |
| December     | -3.8                                     | 64%             | 46.3                                |

Source: Central Meteorological  
Office of Korea

POPULATION

According to the census completed on November 1, 1980, South Korea's total population stood at 37,436,315, an increase of 2,729,695 or 7.9 percent over the 1975 population estimate. This population growth rate of 7.9 percent represents the lowest for the country since 1960, and was 2.5 percentage points lower than the 10.4 percent growth rate reported during the 1970 through 1975 period. The population growth has continued to slow during the 1980s. The average yearly increase from 1980 to 1984 was less than 2 percent per year. Population statistics and projections for the years 1982 through 1986 are given in Table 2.

Prior to 1930, only 6 percent of the South Korean population lived in cities. Now, 60 percent of the population lives in cities and towns. Seoul, the capital of South Korea, is one of the world's largest cities, with a population approaching 10 million. The second largest city is Pusan, the country's principal port on the southeastern end of the peninsula.

South Korea has a total land area of 38,672 square miles inhabited by more than 40 million people. This equals an average population density of 1,038 people per square mile. South Korea is compared with Japan and Taiwan in Table 3. South Korea's 1984 population density of 1,038 people per square mile is higher than Japan's at 827 people per square mile, and lower than Taiwan's at 1,400 people per square mile.

Table 2

SOUTH KOREAN POPULATION STATISTICS  
(Thousands)

|                        | <u>1982</u>   | <u>1983</u>   | <u>1984</u>   | <u>1985*</u>  | <u>1986*</u>  |
|------------------------|---------------|---------------|---------------|---------------|---------------|
| Men                    | 19,847        | 20,162        | 20,479        | 20,798        | 21,116        |
| Women                  | <u>19,484</u> | <u>19,789</u> | <u>20,099</u> | <u>20,411</u> | <u>20,723</u> |
| Total                  | 39,331        | 39,951        | 40,578        | 41,209        | 41,839        |
| Birth Rate<br>Increase | 1.57%         | 1.57%         | 1.57%         | 1.56%         | 1.56%         |

\*Estimated

Source: Korean Census Bureau

Table 3

POPULATION DENSITY--1984

| <u>Country</u> | Area<br>(Thousands of<br><u>Sq. Miles</u> ) | Population<br>( <u>Millions</u> ) | People/<br><u>Square Mile</u> |
|----------------|---|-----------------------------------|-------------------------------|
| Japan          | 146   | 120.8                             | 827                           |
| South Korea    | 39  | 40.5                              | 1,038                         |
| Taiwan         | 14  | 19.6                              | 1,400                         |

Source: DATAQUEST  
Asian Economic Journal, 1985

LANGUAGE

The origin of the Korean language has not been established definitely, but because the Korean people are primarily of Mongolian origin, it is believed that the Korean language is somewhat related to Manchu or Mongolian. However, the Korean and Mongolian languages are much further apart, both in vocabulary and syntax, than are English and German, or English and French.



The generally accepted theory indicates that the archetype of the Korean language was developed in the southern part of the peninsula among agrarian tribes. Another language developed among the hunting tribes in northern Korea. Although it is certain that the Chinese language and letters greatly influenced the language, Korean grammar is entirely different from Chinese grammar.

Koreans wrote exclusively in Chinese characters until the fifteenth century. In 1443, King Sejong of the Yi Dynasty, with the aid of several scholars, invented a phonetic alphabet called Hangul, which has been in use ever since.

The Korean alphabet is illustrated in Figure 3. It consists of 24 letters, of which 10 are vowels and 14 are consonants.

Figure 3

#### KOREAN ALPHABET

##### Consonants:

|   |   |   |   |   |   |   |    |   |    |   |   |   |   |
|---|---|---|---|---|---|---|----|---|----|---|---|---|---|
| ㄱ | ㄴ | ㄷ | ㄹ | ㅁ | ㅂ | ㅅ | ㅇ  | ㅈ | ㅊ  | ㅋ | ㅌ | ㅍ | ㅎ |
| G | N | D | R | M | B | S | NG | J | CH | K | T | P | H |

##### Compound Consonants (Hard Sounds):

|    |    |    |    |    |
|----|----|----|----|----|
| ㄱㄱ | ㄷㄷ | ㅂㅂ | ㅅㅅ | ㅈㅈ |
| GG | DD | BB | SS | JJ |

##### Vowels:

|      |    |      |         |   |    |   |    |    |   |
|------|----|------|---------|---|----|---|----|----|---|
| ㅏ    | ㅑ  | ㅓ    | ㅕ       | ㅗ | ㅛ  | ㅜ | ㅠ  | ㅡ  | ㅣ |
| A(h) | YA | U(p) | You(ng) | O | YO | U | YU | EU | I |

\*EU is to indicate the silent vowel as in chick(e)n.

##### Compound Vowels:

|      |       |      |       |       |       |     |     |
|------|-------|------|-------|-------|-------|-----|-----|
| ㅏㅓ   | ㅑㅓ    | ㅓㅕ   | ㅕㅕ    | ㅗㅕ    | ㅛㅕ    | ㅜㅕ  | ㅡㅕ  |
| A(i) | Ye(i) | E(h) | Ye(s) | Oe(h) | We(t) | Uwi | Eui |

## CHAPTER 2--HISTORICAL OVERVIEW

Koreans are generally considered descendants of two strains--the nomadic tribes from Mongolia and the Aryan migrants from central and western Asia. Koreans are predominantly Mongoloid, but they have both Occidental and Oriental characteristics. They are a homogeneous race and are somewhat taller and hardier than the Chinese and Japanese.

Archaeologists believe that the original Koreans migrated from Manchuria during the Neolithic Age. Because of its situation as a land bridge between Asia and Japan, the Korean peninsula has been the site of power struggles and occupation forces throughout its history.

The Korean peninsula was ruled by three warring kingdoms between 57 B.C. and 676 A.D., when with the aid of China, the Silla Dynasty took power. During the next 200 years, Chinese cultural influence passed through Korea to Japan. In 918, the Silla Dynasty fell to the Koryo Dynasty, which gave Korea its present name. Korea was invaded by Mongol and Tartar armies in the eleventh century, and fell under the rule of Kublai Khan in 1213. The Mongols occupied Korea for the next 130 years. The Yi Dynasty brought the peninsula back under Korean rule in the late thirteenth century.

Korea was invaded by Japan in 1592 during its attack on China, and by Manchuria at the time of the Ming and Manchu power struggle in China. Korea withdrew from all foreign contact for the next 250 years, earning the name the "Hermit Kingdom." It did not again initiate contact with the outside world until the 1870s, when it opened its ports to Japanese ships, and signed treaties with the United States and several European countries.

Japan annexed Korea in 1910 during a power struggle with China and Russia, and ruled the peninsula until 1945. After Japan's defeat in World War II, Korea fell under the joint occupation of Russian and American troops, Russian in the north and American in the south. North Korean troops attacked and captured South Korea in June of 1950, and were pushed back by United Nations and South Korean forces several months later. The Korean War technically ended in June of 1953, and the Korean peninsula has remained divided into the two separate nations of North and South Korea.

### CHAPTER 3--KOREA AND THE UNITED STATES

Official relations between the independent nation of Korea and the United States opened on May 22, 1882 with the signing of a Treaty of Peace, Amity, Commerce and Navigation. The treaty, which marked the opening of Korea, signaled the end of Korea's preferred status as an isolationist nation, the so-called Hermit Kingdom.

The earliest contacts between Americans and Koreans came almost immediately after the signing of the treaty when American educators and medical missionaries journeyed to Korea and began the process of modernizing the Kingdom. American businessmen also arrived. Many took part in the process of laying down the first modern infrastructure of the country, such as railroads, electric generating plants, and other key enterprises.

Official U.S. interest in Korea was, however, overshadowed by U.S. concern with the rising power of Japan, especially as a naval presence in the Pacific. Japan's desire for Korea were of long standing, and when Japan formally annexed Korea as a colony in 1910, the United States raised no objection since its major objective was to secure the Philippines as its chief Asiatic outpost with the concurrence of the Japanese.

U.S.-Korean trade, which had initially been fairly significant, fell off markedly. The American diplomatic presence in Korea had already been ended in deference to Japanese desires, and contact between the two countries was largely carried on by the American Christian missions in Korea.

Many of these early Americans in Korea supported and encouraged the Koreans who were determined to regain Korea's independence and freedom from Japan. Many also encouraged Koreans who were dedicated to the establishment of a modern democracy on the peninsula.

At the Yalta and Potsdam meetings in 1945, detailed planning for the post-World War II future of Korea took place. It was agreed that there should be two separate Soviet and U.S. occupation zones on the peninsula to make it possible to accept the Japanese surrender, disarm Japanese troops, and evacuate them to Japan. For a variety of reasons, these two temporary occupation zones became permanent and in 1948, after an election sponsored by the United Nations, the Republic of Korea (South Korea) was established and the U.S. occupation was terminated. In the north, the Soviets refused to countenance elections and the Communist North Korean regime came into being with its leader, Kim Il-sung, installed by Joseph Stalin.

The North Korean communist regime attacked South Korea in 1950. The Truman administration saw this invasion as a threat not only to South Korea but to Japan as well, and the possible harbinger of a general

Soviet advance into non-communist Asia. American policy was reversed. The United States led the way in the formation of a United Nations military force to repulse the invasion and, after three years of fighting, the war ended in an armistice in 1953.

The United States entered into a treaty of mutual defense with South Korea three months after the armistice and restationed American military forces on the peninsula. The American government also entered into a program of economic and military aid to the Republic of Korea. This program assisted Korea's rapid economic development and, after 30 years of effort, culminated in South Korea's emergence as a major economic power in Asia.

Because there is a high degree of congruence in the foreign policy and domestic aims of both the U.S. and South Korean governments, relations between them are characterized by a sense of common purpose and a mutual desire for cooperation and partnership.

The U.S. and South Korean views on Northeast Asian defense and security are virtually identical. On the U.S. side, this has meant a continued significant American troop presence in South Korea at a high state of readiness and a steady upgrading of its arms and materials. On the South Korean side, it has meant a commitment of 600,000 men and women of the Korean armed forces to deter a renewed attack by Communist North Korea.

This degree of cooperative effort has taken institutional form in the creation of a Combined Forces Command. It has resulted in annual joint U.S.-South Korean defense preparedness exercises such as Team Spirit, which maintain a high state of readiness.

The two economies are complementary. Both nations are dedicated to the free enterprise capitalist system and the principles of free trade. This has made possible a high level of trade between the two countries, as significant American equity investment in South Korea, and growing Korean investment in the United States with its accompanying contributions to job creation and mutual economic gain. American lending institutions have also made possible advances in South Korean economic development.

Trade relations between the two countries have not been without friction, however. More than 46 percent of South Korean exports to the United States face nontariff barriers of one form or another. Anti-dumping actions have proved burdensome to Korean exporters, and losses have been high even when such dumping actions have been disallowed. More recently, the United States has moved to negotiate voluntary limits on Korean steel exports to America.

These problems have, however, been solved in the cooperative spirit that characterizes the overall relationship, and the basic friendship between the two countries has not been affected. The United States is clearly striving to keep its markets open to South Korean exports, which

are vital to the country's economic growth. The Generalized System of Preferences, although somewhat modified, has been extended to the continuing benefit of South Korea.

For its part, South Korea has made strong efforts to ensure that U.S. exporters have even greater access to its markets. Under its present Import Liberalization Program, the process is continuing. Revisions to its foreign investment law resulted in a major surge in U.S. investment in South Korea during 1984.

In an effort to reduce the U.S. trade deficit with South Korea, a South Korean purchasing mission visited the United States in February and March of 1984. The mission concluded well over \$2 billion in American purchases to help lower the deficit.

The United States has actively supported the Republic of Korea as South Korea has sought to attain its foreign policy goals. Among other forms of support, the United States has endorsed proposals from South Korea to open a dialogue with North Korea aimed at bringing about the peaceful unification of the Korean peninsula.

Looking to the future, it seems clear that the spirit of partnership and friendship will increase, and that new and more fruitful forms of economic cooperation will evolve, especially in the Pacific Basin area.

#### CHAPTER 4---CURRENT POLITICAL PERSPECTIVE

Within the foreseeable future, significant changes in the strategic environment surrounding Korea are unlikely. The powers surrounding the peninsula--the U.S.S.R., the People's Republic of China (PRC), and Japan--are not likely to undergo drastic changes either in terms of the direction of their political policies or in the balance of power among the nations.

The role of the United States in the security of South Korea will remain essentially unchanged as will the requirements placed upon it for the fulfillment of this role. As the country's economy grows and trade and economic relations between the United States and South Korea expand, so does America's and the West's stake in continued Northeast Asian security.

The Soviet interest in the Korean peninsula is linked to its global competition with the United States. The growth of South Korea's strength with a steady U.S. commitment is not likely to tempt the Soviets into risky initiatives. Prudential Bache notes that moves by South Korea to re-establish relations with the Soviet Union is a positive factor. Recently the Soviet Union announced it would participate in the 1988 Olympic Games in Seoul. Furthermore, North Korea is unlikely to make a move on its own without the Kremlin's backing, considering its almost total dependence on the Soviet Union for petroleum supplies (only three-day reserve in stock) and military equipment.

Prudential Bache also notes that recently both North and South Korea have started to seek mutual gains in the economic arena instead of the political arena. They are talking about exchanging their commodities and a possibility of co-managing the 1988 Seoul Olympic Games. Also, they agreed in principle, that families separated by the Korean War can meet each other in either country.

Although the PRC's interest in the Korean peninsula is more direct than the U.S.S.R.'s, its resources are more limited. The growth of a more liberal Chinese economic policy would highlight the already significant differences between the PRC and North Korea, as would a successful "non-Communist" change of power in the north. Despite these problems, the PRC's interest in keeping North Korea from siding with the U.S.S.R. are high. Thus the demands on the PRC for continuing present policies toward the peninsula also remain high.

South Korea's economy is expected to continue to grow at an annual rate exceeding 5 percent. By the end of this century, it is plausible to assume that the Republic will reach the present per capita income levels of West European nations. Korean economic planning will continue to be pragmatic, market oriented, and adaptive.

## CHAPTER 5--GOVERNMENT

### STRUCTURE

The Republic of Korea (South Korea) is a constitutional democracy. It is committed to democratic and peaceful pursuit of its domestic and international policies, renounces aggressive war, and abides by all international treaties and agreements.

The president of South Korea, as chief executive of the administration, represents the state vis-a-vis foreign states.

The legislative power is exercised by a unicameral National Assembly, whose members are elected by popular and secret vote under the party system.

The judiciary is independent and carries out its duties without outside interference. The judiciary functions on three levels: the Supreme Court, appellate courts, and district courts. The Supreme Court is empowered to rule on the constitutionality of a law or administrative decree. It also hears all final appeals from the courts and courts-martial.

Administratively, the country is divided into nine provinces and four special cities, Seoul, Pusan, Taegu, and Ichon, which enjoy provincial status. The president appoints the heads of all local governments either directly or indirectly.

### Executive Branch

Presidential Office: The Blue House  
1 Sejong-ro, Chongro-gu, Seoul

Office of Prime Minister: 77 Sejong-ro, Chongro-gu, Seoul

18 Ministries and 2 Boards

### Legislative Branch

National Assembly: 1 Youido-dong, Yongdungpo-gu, Seoul

15 standing committees  
National Assembly Secretariat  
National Assembly Library

## Judicial Branch

Supreme Court: 37 Sosomun-dong, Chung-gu, Seoul

3 appellate courts  
13 district courts  
1 family court

## MINISTRIES

The executive branch of the government is composed of presidential agencies and the cabinet. The cabinet has within its jurisdiction the state council, the Economic Planning Board, the National Unification Board, and 18 ministries. The ministries are listed below:

|                           |                           |
|---------------------------|---------------------------|
| Agriculture and Fisheries | Health and Social Affairs |
| Communications            | Home Affairs              |
| Construction              | Justice                   |
| Culture and Information   | Labor                     |
| Education                 | National Defense          |
| Energy and Resources      | Science and Technology    |
| Finance                   | Sports                    |
| Foreign Affairs           | Trade and Industry        |
| Government Administration | Transportation            |

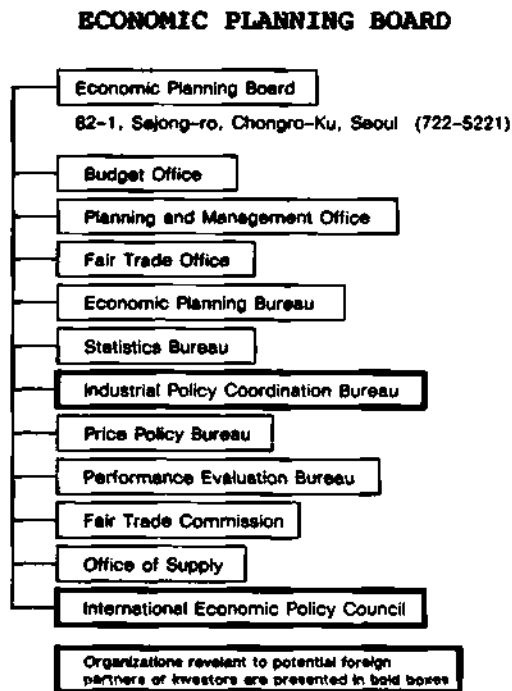
The ministries of primary interest to foreign investors are described in the following paragraphs.

### Economic Planning Board (EPB)

This board takes charge of matters related to overall planning for development of the national economy, formulation and execution of the government budget, overall coordination of plans for mobilization of resources, investment, technical development, and economic cooperation with foreign countries and international organizations. The Minister of Economic Planning is concurrently a Deputy Prime Minister, and coordinates business related to economy and finance among the ministries. The EPB has Offices of Budget, Planning and Management, and Fair Trade, and Bureaus of Economic Planning, Statistics, Industrial Policy Coordination, Price Policy, and Performance Evaluation. The EPB also has under its control and supervision the Fair Trade Commission, the Office of Supply, and the International Economic Policy Council. The agencies under the jurisdiction of the EPB are illustrated in Figure 4.



Figure 4



Source: Ministry of Finance

#### Ministry of Foreign Affairs (MFA)

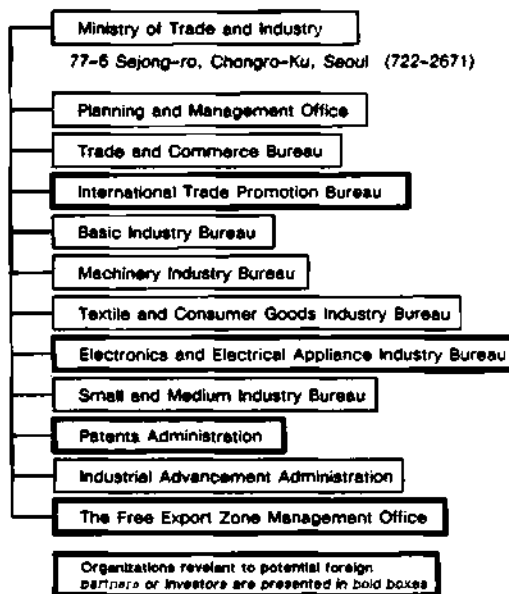
This ministry has jurisdiction over matters concerning diplomacy, trade and treaties with foreign countries, other international agreements, protection and guidance of South Korean nationals abroad, and international organization. The MFA Offices of Planning and Management, and Bureaus of Asian Affairs, European Affairs, African Affairs, Middle Eastern Affairs, American Affairs, Economic Affairs, Consular and Overseas Residents Affairs, Information and Cultural Affairs, and International Organizations and Treaties. It maintains the Foreign Affairs and National Security Institute, which trains diplomatic service officials. The MFA coordinates foreign investment activities. A further discussion of the procedures to be followed by foreign manufacturers in establishing local facilities is given in Chapter 7, Industry.

#### Ministry of Trade and Industry (MTI)

The structure of the MTI is shown in Figure 5. This ministry handles matters related to commerce, foreign trade, industry, patents, and standards of mineral and manufactured products. This ministry has the Office of Planning and Management, and the bureaus of Trade and Commerce, International Trade Promotion, Basic Industry, Machinery Industry, Textile and Consumer Goods Industry, Electronics and International Appliance Industry, and Small and Medium Industry. The ministry also controls such separate agencies as Patents Administration, the Industrial Advancement Administration, and the Free Export Zone Management Office.

Figure 5

**MINISTRY OF TRADE AND INDUSTRY**



Source: Ministry of Finance

**Ministry of Energy and Resources (MER)**

This ministry is in charge of development, production, import, and all other matters related to energy and other resources. It comprises the Offices of Planning and Management, and of Resources Policy, and the Bureaus of Electric Power, Mine, and Resources Development. It controls the Mines Registration Office and the Mines Safety Office.

**Ministry of Communications (MOC)**

This ministry controls postal affairs, telecommunications, postal exchange, postal savings, postal pension, and national life insurances. It comprises the Office of Planning and Management, and the Bureaus of Postal Service, Telecommunications Administration, Radio Regulation, and Postal Savings, Insurance, and Finance. The MOC has under its control the Local Communications Office, Postal Service Research Institute, Postal Giro and Money Order Center, Electronics and Telecommunications Research Institute, Central Radio Monitoring Office, and Communications Officials Training Institute.

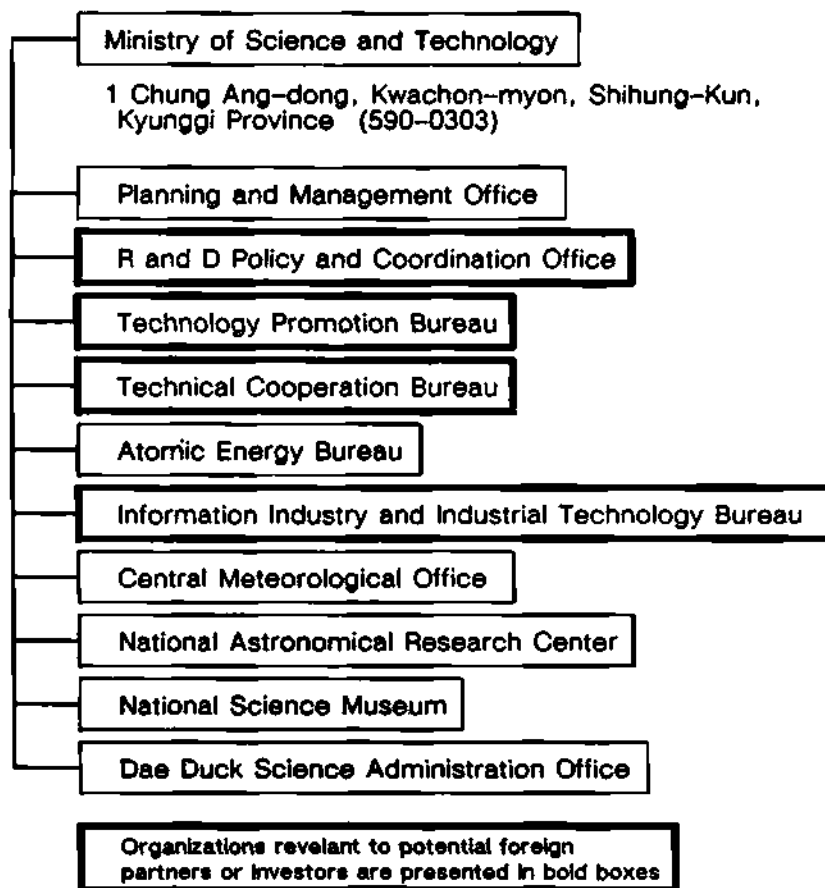
**Ministry of Science and Technology (MST)**

The structure of the MST is shown in Figure 6. The ministry handles matters related to the development and application of science and technology and the management of industrial and technical manpower. It

comprises the offices of Planning and Management and of R&D Policy and Coordination, and the bureaus of Technology Promotion, Technical Cooperation, Atomic Energy, and Information Industry and Industrial Technology. The Central Meteorological Service, National Astronomical Research Center, the National Science Museum, and the Dae Duck Science Administration Office are under its control.

Figure 6

MINISTRY OF SCIENCE AND TECHNOLOGY



Source: Ministry of Finance

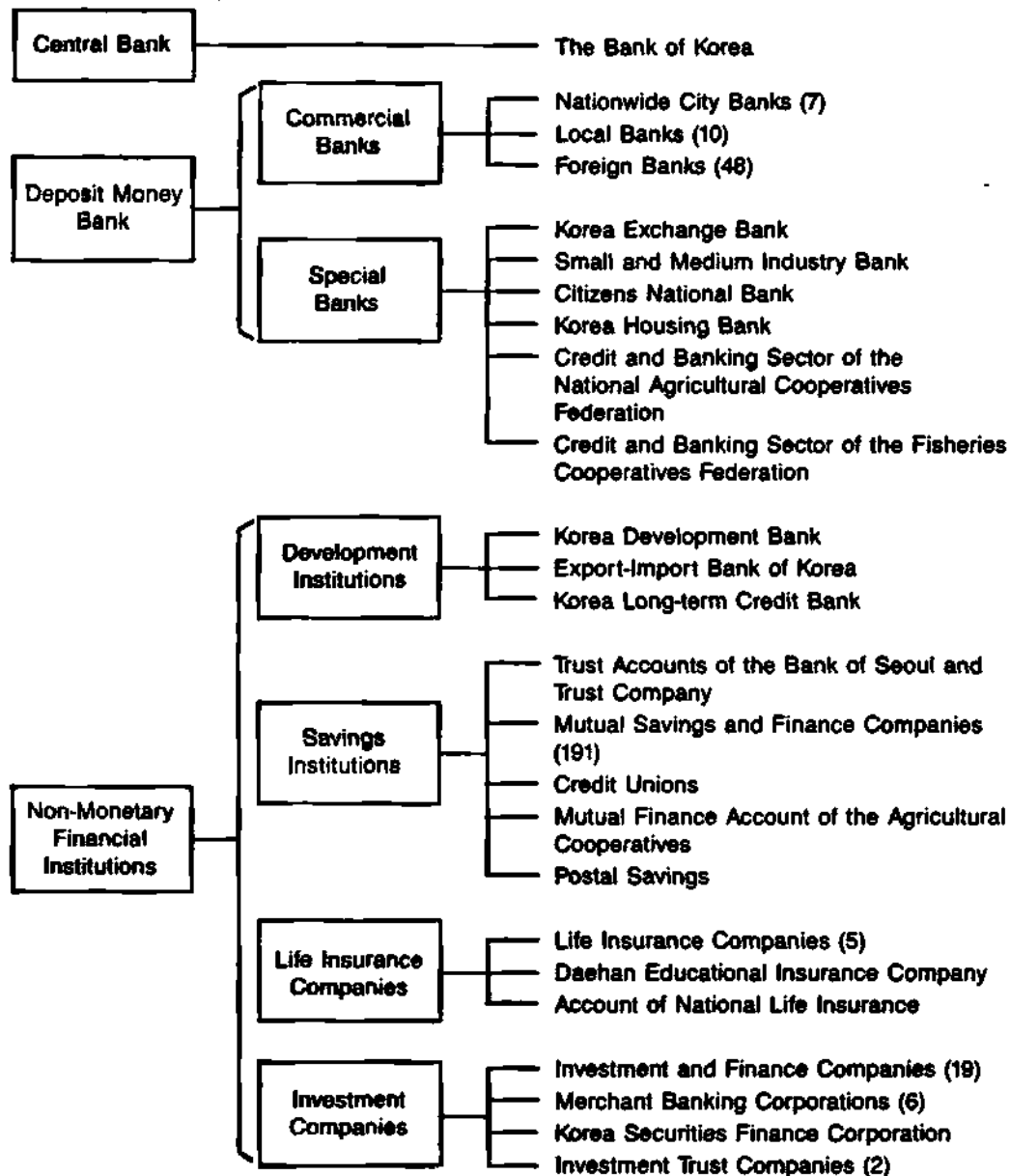
## FINANCIAL STRUCTURE

South Korea's financial sector includes a diversified commercial banking system, a wide range of secondary financial institutions, and a securities market. The development of the financial sector, particularly the banks, has not kept pace with the rest of the economy because it has been closely controlled. The government plans to turn over its share of national commercial banks to private interests while relying on the market mechanism and indirect means of control, such as reserve requirements, to regulate the industry. The securities, which permitted indirect foreign investment through unit trusts in 1981, will be further opened to foreign investors.

South Korea's financial institutions are as shown in Figure 7. They can be divided into two main categories: monetary institutions and other financial institutions. The former category includes the Bank of Korea and the deposit money banks, which, in turn, can be classified into the commercial banks and special banks according to their government economic goals.

Figure 7

SOUTH KOREAN FINANCIAL INSTITUTIONS



Note: Figures in parentheses denote the number of institutions as of the end of 1983

Source: Bank of Korea

## TAXATION

### Enactment of Tax Legislation

Under the South Korean constitution, tax legislation is enacted by the National Assembly. Proposed tax legislation is drafted by the related ministries (e.g., national taxes by the Ministry of Finance and local taxes by the Ministry of Home Affairs) and submitted to the National Assembly through a resolution by the State Council. Such proposals may also be submitted by members of the National Assembly. After passage by the National Assembly, the new tax laws are transmitted to the Administration for promulgation by the president. The law takes effect 20 days after promulgation, unless otherwise provided.

Generally, changes in South Korean tax laws become effective on the first day of January of the following year.

### Tax Systems

The Korean tax system comprises both national and local taxes. National taxes are divided into internal taxes, customs duties, defense taxes, and education taxes. The latter two are temporary taxes with revenues for a specific purpose; they are due to expire at the end of 1985 and 1986, respectively. Internal taxes that are presently in force consist of five direct and six indirect taxes. Dividends received are taxable. Dividends paid to nonresident foreign shareholders are subject to withholding taxes at the source.

## CHAPTER 6--ECONOMY

### OVERVIEW

In the early 1960s, the South Korean government introduced a system of five-year economic plans to provide a framework for economic development. These plans were drawn up by the government in consultation with other relevant bodies. In the years following the introduction of the first plan in 1962, South Korea achieved remarkable growth, with the gross national product increasing 4.5-fold in real terms to US\$57.4 billion in 1980.

During this period, South Korea's development was led by a variety of government incentives and an emphasis on exports, which reached US\$29.2 billion in 1984, compared to only US\$55 million in 1962. Expansion was also supported by successfully raising the share of domestic savings as a percent of GNP from 2.9 to 21.6 percent.

### CURRENT FIVE-YEAR PLAN

The rapid development during the 1960s and 1970s resulted in great changes in the economic environment in Korea. There was a marked shift in employment from agriculture to the manufacturing industry, and labor-intensive production gradually gave way to more technology and capital-intensive manufacturing processes. Inevitably, the speed of these changes led to a number of structural imbalances that became more and more problematic as the seventies drew to a close.

The current five-year plan (for the period from 1982 through 1987) was formulated to settle such problems as high inflation, the uneven distribution of financial assets, and many environmental problems.

Although high growth of about 7 to 8 percent a year was still envisaged, the emphasis shifted from the previous plans toward measures designed to promote stability, enhance efficiency, and balance future development. Great attention was also given to the question of social welfare and equity, in recognition of the public's growing concern over these matters.

The highest priority of the plan was to achieve economic stability, which was considered essential to strengthening industrial competitiveness and improving the balance of payments. The government expected the trade deficit to decline from US\$4.4 billion in 1980 to US\$2.4 billion in 1982, due to more rapid growth in exports than imports.

However, the international economic recession of 1980 through 1982 led to a vastly different outcome during the first two years of the plan's implementation than the government expected. While the average

GNP growth was fairly close to projections, the world recession was deeper and longer than expected, and export growth did not begin to reach the planned levels until the middle of 1983. On the other hand, the decline in crude oil prices and some other raw materials, together with very successful harvests and appropriate monetary and fiscal policies, allowed the fight against inflation to succeed far beyond expectations. Lower costs also reduced the value of imports, despite the gradual liberalization of import restrictions, and the 1983 trade deficit was only about a third of that experienced in 1981. The balance of trade improved more over the two-year period than was originally planned for the whole five-year period.

In 1984, the plan was revised to reflect the impact of the worldwide recession of 1980 through 1982. As well as updating the macroeconomic forecasts, the revised five-year plan further stresses the importance of linking the benefits of future economic growth to the enhancement of the people's general quality of life. The policies to be emphasized in the remaining three years of the plan period include reducing pollution, further improving the transportation system, encouraging more balanced regional development, and expanding public health facilities.

As originally drafted, the 1982 through 1987 five-year plan concentrated on solving the structural problems that had developed over the previous two decades of rapid growth and absorbing the effects of the second oil shock. The revised plan, seeks to deal with only those structural problems remaining after the successful adjustment to a low-inflation environment in 1982 and 1983, and is set against a different international environment.

#### ECONOMIC ANALYSIS

The year 1983 was a period of regaining the growth momentum following the recession of the 1970s. South Korea's 1983 real GNP grew 9.5 percent over 1982. Consumer prices rose only 2.4 percent, wholesale price inflation was essentially flat, and the current account deficit declined 40 percent (see Table 4). In addition, the growth of external debt slowed substantially. For example, every year from 1978 to 1982, about US\$5.6 billion was added to South Korea's foreign debt. But in 1983, the increase was only US\$3.3 billion. South Korea's exports increased by US\$2.6 billion, reaching US\$24.4 billion in 1983, an 11.9 percent increase over 1982.

The year 1984 was another good period for the South Korean economy. GNP growth was robust at 7.7 percent, prices were stable, and the international balance of payments improved. In addition, government policies continued to make structural improvements to enhance efficiency and promote fairer competition in many areas of the economy.



Table 4

**MAJOR ECONOMIC INDICATORS  
HISTORY AND FORECAST  
(U.S. Dollars)**

|                                | <u>1962</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985*</u> | <u>1986*</u> |
|--------------------------------|-------------|-------------|-------------|-------------|--------------|--------------|
| GNP (Millions)                 | 2,315       | 68,743      | 75,280      | 81,073      | 88,000       | 97,300       |
| Percent Growth                 | 2.2%        | 5.6%        | 9.5%        | 7.7%        | 8.5%         | 10.6%        |
| Per Capita GNP                 | 87          | 1,800       | 1,884       | 1,998       | 2,135        | 2,331        |
| Revenue (Billions of Won)      | N/A         | 10,858      | 11,075      | 13,721      | 13,275       | N/F          |
| Expenditure (Billions of Won)  | N/A         | 11,125      | 11,424      | 13,346      | 12,934       | N/F          |
| Exchange Rate (Won/US\$)       | 257         | 749         | 796         | 827         | 760          | 760          |
| WPI** (100 at 1980)            | N/A         | 126.0       | 126.3       | 127.2       | 129.5        | 130.3        |
| CPI <sup>†</sup> (100 at 1980) | N/A         | 130.1       | 134.5       | 137.6       | 141.5        | 144.9        |
| National Savings Ratio         | N/A         | 22.4%       | 24.4%       | 26.7%       | 28.1%        | 29.3%        |
| Total Investment to GNP        | N/A         | 27.0%       | 27.6%       | 28.7%       | 29.1%        | 29.5%        |
| Debt (Millions of Dollars)     | 89          | 37,200      | 40,500      | 43,100      | N/A          | N/A          |
| Debt to GNP                    | 3.8%        | 52.5%       | 53.8%       | 53.2%       | N/A          | N/A          |

\*Estimated

\*\*WPI = Wholesale Price Inflation

<sup>†</sup>CPI = Consumer Price Index

N/F = Not Forecast

N/A = Not Available

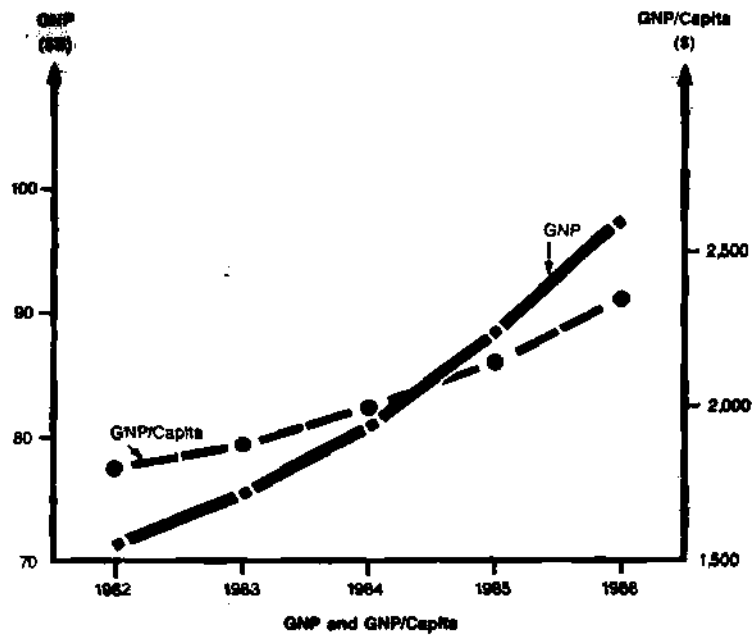
Source: South Korean Economic  
Planning Board

Because the 1983 South Korean economy surpassed virtually all principal goals under the old plan, GNP is now forecast to reach US\$97.3 billion by 1986, as opposed to US\$90 billion, while per capita GNP is expected to reach US\$2,331. Figure 8 illustrates the historical and forecast growth in GNP and the concurrent growth in per capita GNP for the years 1982 through 1986. The higher GNP should be sufficient to reduce unemployment to 3.8 percent from the 4.0 percent expected under the old plan.

Most striking in the revised economic plan's projections are the substantially lower inflation forecasts. The GNP deflator, widely regarded as the most important inflation indicator, is now expected to be rising at an annual rate of 2.0 percent at the end of 1986, as opposed to the 9.5 percent increase envisaged in the original plan.

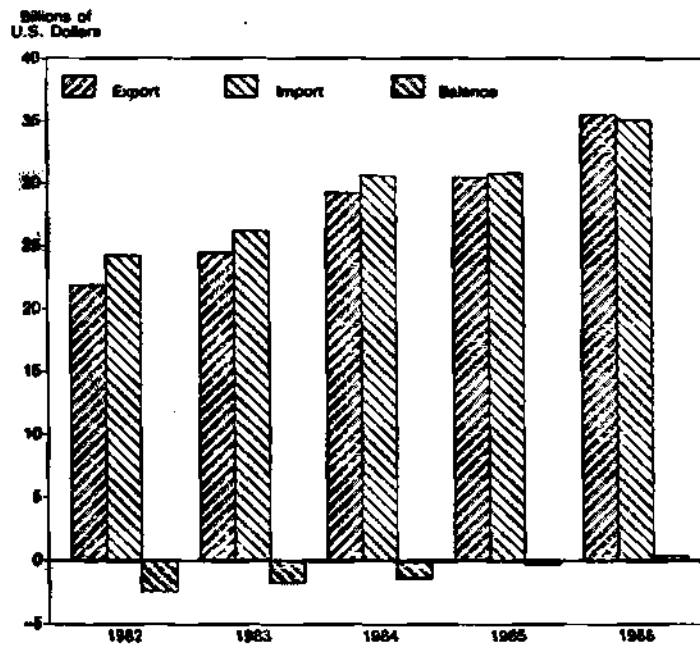
Another major feature of the plan is the recognition that South Korea's dependence on external trade will have to fall, given the continued rise in protectionism evidenced by the country's trading partners. The projection for 1986 merchandise exports has been decreased from US\$53.0 billion to US\$35.5 billion. The domestic market will continue to give impetus to growth, as it has done in the past two years, when export growth has been relatively sluggish. South Korea's balance of trade for the years 1982 through 1986 is illustrated in Figure 9.

**Figure 8**  
**GNP AND GNP/CAPITA**



Source: South Korean Economic Planning Board

**Figure 9**  
**BALANCE OF TRADE**  
**HISTORY AND FORECAST**



Source: Economic Planning Board  
Projection 1965-1966

Table 5 shows South Korean imports and exports by its major trading partners. South Korea is a net exporter to the United States, and increased its exports to the United States from \$6.2 billion in 1982 to \$10.5 billion in 1984. Imports from the United States have been held at a much lower growth, increasing only slightly from \$6.0 billion in 1982 to \$6.9 billion in 1984.

Table 5  
IMPORT/EXPORT/BALANCE OF TRADE  
HISTORY AND FORECAST  
(Millions of U.S. Dollars)

| Geographic Segment | 1982    | 1983    | 1984    | 1985*  | 1986*  |
|--------------------|---------|---------|---------|--------|--------|
| United States      |         |         |         |        |        |
| Export             | 6,243   | 8,245   | 10,479  | N/F    | N/F    |
| Import             | 5,956   | 6,274   | 6,876   | N/F    | N/F    |
| Balance            | 287     | 1,971   | 3,604   | N/F    | N/F    |
| Japan              |         |         |         |        |        |
| Export             | 3,388   | 3,404   | 4,602   | N/F    | N/F    |
| Import             | 5,305   | 6,238   | 7,640   | N/F    | N/F    |
| Balance            | (1,917) | (2,834) | (3,038) | N/F    | N/F    |
| Asia**             |         |         |         |        |        |
| Export             | 4,856   | 5,690   | 5,906   | N/F    | N/F    |
| Import             | 6,693   | 6,535   | 6,940   | N/F    | N/F    |
| Balance            | (1,837) | (845)   | (1,034) | N/F    | N/F    |
| Europe             |         |         |         |        |        |
| Export             | 3,741   | 3,803   | 4,048   | N/F    | N/F    |
| Import             | 2,126   | 2,740   | 3,535   | N/F    | N/F    |
| Balance            | 1,615   | 1,063   | 513     | N/F    | N/F    |
| ROW                |         |         |         |        |        |
| Export             | 3,625   | 3,303   | 4,210   | N/F    | N/F    |
| Import             | 4,171   | 4,405   | 5,641   | N/F    | N/F    |
| Balance            | (546)   | (1,102) | (1,431) | N/F    | N/F    |
| Total              |         |         |         |        |        |
| Export             | 21,853  | 24,445  | 29,245  | 30,500 | 35,500 |
| Import             | 24,251  | 26,192  | 30,631  | 30,800 | 35,100 |
| Balance            | (2,398) | (1,747) | (1,386) | (300)  | 400    |

\*Estimated

\*\*Excluding Japan

N/F = Not Forecast

Source: Economic Planning Board  
Projection, 1985-1986

South Korea has been a net importer from Japan, importing \$5.3 billion of goods in 1982 and exporting only \$3.4 billion. This negative balance of trade with Japan has intensified over the last two years as imports from Japan have risen faster than exports to Japan. The negative balance of trade of \$1.9 billion in 1982 rose to \$3.0 billion in 1984.

The Asian category of trading partners includes Taiwan, Hong Kong, Malaysia, the Philippines, Singapore, and India. The Asian group represents a larger block of trade with South Korea than does Japan and has lower trade deficit. Europe represented a larger export market for South Korean products in 1982 and 1983 than Japan. In 1984, South Korean exports to Japan exceeded those to Europe by an estimated \$554 million.

Increased South Korean interaction with U.S. markets over this period have placed the United States at the top of South Korea's major export market at \$10.5 billion in 1984. During 1984, the United States and Europe represented the only positive balance of trade partners for South Korea among the five regional trading partners.

## CHAPTER 7--INDUSTRY

### OVERVIEW

During the last two decades, South Korea has made remarkable economic progress and the rapidly expanding economy has provided increased markets for domestic products. Although the oil and resources crises have created difficulties for the economy, South Korea has maintained a rising GNP during the 1980s. The 1982 GNP was 5.6 percent over the previous year, and 1984 was 7.7 percent higher than 1983. The government will continue its long-term economic development plan without significant deviation from its original objectives. As a growing economy with room for development, South Korea currently offers substantial investment opportunities, particularly in the electronics and semiconductors areas.

While the country has no significant natural physical resources, its abundant labor force provides one of the country's most important assets. This well-educated labor force has proven to be easily trainable, productive, highly motivated, and dedicated to work. The tax incentives offered to assist targeted industries are considered more advantageous than those offered by other developing countries, and the government gives strong tax and banking incentives for export promotion. In addition, repatriation of capital and profit remittances are legally guaranteed, and the property of foreign investors is protected by law. Adequate electricity, transportation, communication, industrial water, and industrial estate infrastructural facilities have been developed for high-technology manufacturing industries.

The following section describes the South Korean government's strategy for attracting and supporting industrial development, including the financial incentives offered to non-Korean investors and the project application process. Foreign direct investment in South Korea is described, as is the work force and the industrial infrastructure.

### STRATEGY FOR INDUSTRIAL DEVELOPMENT

Quality has become increasingly important in the international electronics marketplace. Strengthening the industrial infrastructure and raising the level of technology is essential to achieve this. Major aspects of South Korean industrial policy reflect these goals, and include free market competition, increased levels of research and development, support for the small and medium industrial companies, and selection of industrial winners. The South Korean government is supporting a range of programs designed to speed the country's transition into a significant participant in the worldwide high-technology marketplace. The following sections describe the programs and policies that are most relevant to the South Korean electronics industry.

### Science and Technology Investment

Under the current five-year economic plan, the ratio of the government's science and technology investments against its GNP will rise from 0.89 percent in 1981 to 2 percent by 1986. South Korea's level of investment as a percent of GNP is approaching that of the world's industrial leaders. West Germany tops the list with a ratio of 2.7 percent, followed by the United States at 2.6 percent and Japan at 2.4 percent. South Korea's industrial development strategy calls for raising a "special technology development fund." The value of this fund is estimated at \$380 million, and is earmarked to finance specified science and technology projects over the five-year period of the current economic plan (1982 through 1987).

The Ministry of Science and Technology developed a list of target industries, and has asked private businesses and government research institutions to place emphasis on developing 635 technologies essential to promote the target industries. The target industries are:

- Semiconductor
- Computer
- Biochemical
- Precision machinery
- Bioengineering
- Materials
- Textiles
- Energy and resources
- Plant engineering industries

The government also offers financial and technological support to venture groups seeking to establish new, technology-intensive businesses that use newly developed technological know-how.

### Tax Incentives

South Korean tax law grants a variety of tax incentives, including reduced corporate and individual income taxes, five-year tax holidays, and additional first-year depreciation or special depreciation allowances designed to encourage certain capital expenditures. Exporting firms are allowed special reserves for the development of overseas markets. These firms are also allowed certain deductions from revenues received from foreign transactions.

Further temporary tax incentives are granted under the Foreign Capital Inducement Act (FCIA) of 1982. This law states that a foreign investment company is fully exempt from income taxes on the portion of taxable income attributable to the foreign investment for a period of five years. After five years, the exemption is reduced to 50 percent for the next three years.

Under the FCIA, a foreign investment company is also exempt from property taxes and sales acquisition taxes in the same manner as stated above. A foreign shareholder is exempt from taxes on income from investments in South Korea at 100 percent for the first five years, and 50 percent for the succeeding three years. Interest and related income from foreign-currency loans are tax exempt.

Further, the FCIA states that royalties to foreigners are fully exempt from income taxes for five years from the date of government approval and are 50 percent exempt for the succeeding three years.

#### FOREIGN INVESTMENT

As clearly stated in the FCIA, the government's fundamental policy regarding foreign capital is ". . . to effectively induce and protect foreign capital conducive to the sound development of the national economy and the improvement of the international balance of payments, and to properly manage such foreign capital."

Based on this policy, the South Korean government has developed policies designed to attract and protect the foreign investment that is vital to the economy. Government policy contributes not only to the promotion of economic cooperation with foreign countries, but also strengthens the international competitiveness of the nation's industries, and fosters development of advanced technology.

In addition, the government has revised the FCIA, introducing an automatic approval system and a negative list system that was devised to more clearly define desirable projects. These revisions effectively simplify the authorization procedure for some projects. Further, by stating those projects not eligible for support, the negative list system has substantially widened the range of projects that may be considered.

### Foreign Direct Investment

The level of foreign direct investment in South Korea is increasing. As shown in Table 6, total foreign direct investment for the 22-year period from 1962 through 1984 was \$2.1 billion. Yet the amount of foreign investment in 1984 alone consisted of nearly 20 percent of the total investment for the previous 22-year period.

The major foreign investor over the 1962 through 1983 period was Japan, which accounted for 49.5 percent of the total dollars. However, U.S. participation is increasing. As shown in Figure 10, the United States was the largest investor in South Korea in 1984, accounting for 45.6 percent of total investment dollars in that year.

Table 6

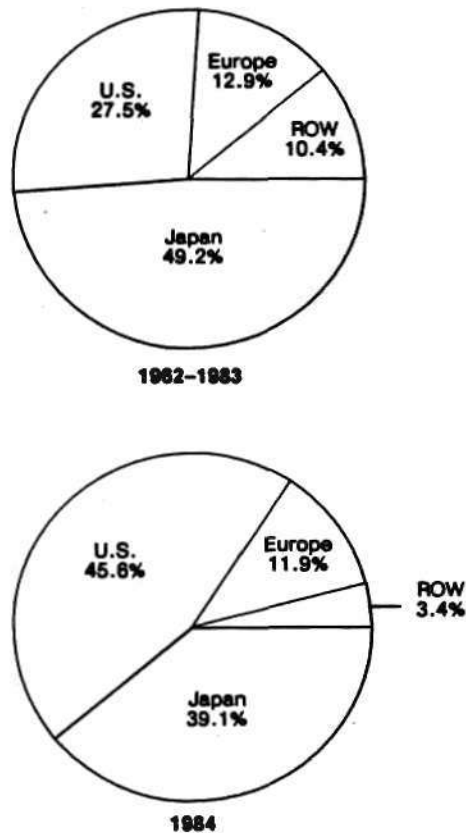
#### FOREIGN DIRECT INVESTMENT BY COUNTRY (Millions of Dollars)

| <u>Total Investment</u>       | <u>United States</u> | <u>Japan</u> | <u>Europe</u> | <u>Others</u> | <u>Total</u> |
|-------------------------------|----------------------|--------------|---------------|---------------|--------------|
| 1962-1984                     | \$662.4              | \$1,007.2    | \$270.9       | \$192.7       | \$2,133.2    |
| 1962-1983                     | \$471.4              | \$ 843.4     | \$221.1       | \$178.3       | \$1,714.2    |
| 1984                          | \$191.0              | \$ 163.8     | \$ 49.8       | \$ 14.4       | \$ 419.0     |
| 1984 as a percent<br>of total | 28.8%                | 16.3%        | 18.3%         | 7.5%          | 19.6%        |

Source: DATAQUEST  
Economic Planning Board



**Figure 10**  
**SHARES OF DIRECT INVESTMENT BY COUNTRY**  
**(Percent)**



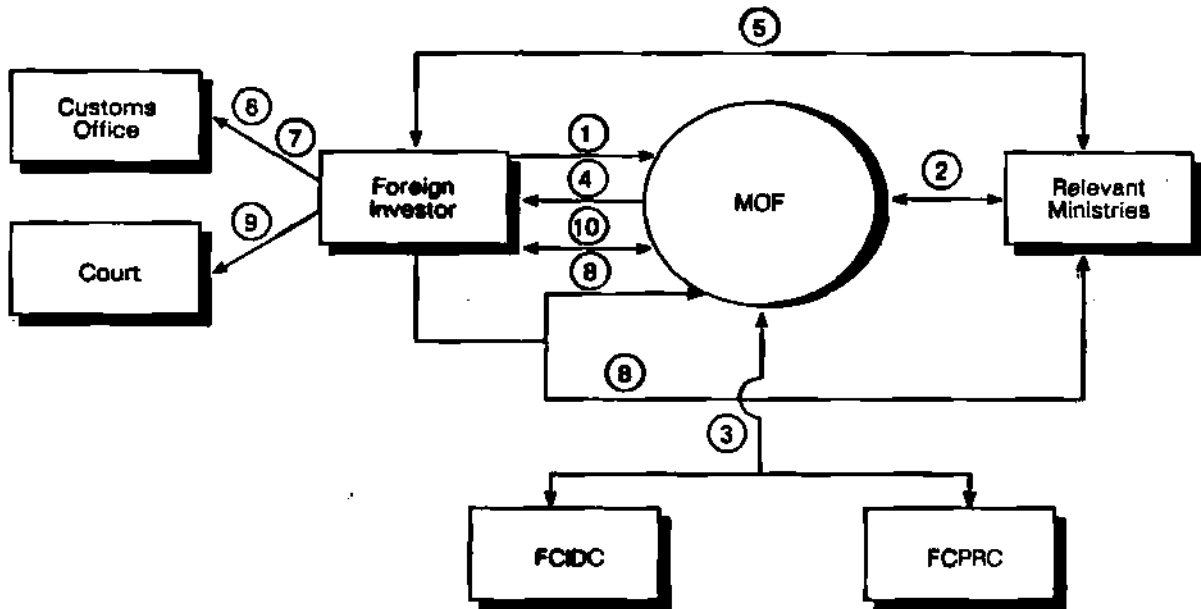
*Source: DATAQUEST*

The foreign investment application and implementation process, and the offices administering each step, are illustrated in Figure 11. The foreign investor makes initial application to the Ministry of Finance (MOF), which directs the application to the relevant ministry for review. The MOF then directs the proposal to the Foreign Capital Inducement Deliberation Committee (FCIDC), and to the Foreign Capital Project Review Committee (FCPRC) for approval. If everything is in order, the MOF authorizes the project, and the investor then applies to the relevant ministries for confirmation of specification of capital goods. Import declarations as well as applications for exemptions or reduction of custom duties are made to the customs office.

The investor then files a report of foreign capital inducement with the MOF and other relevant ministries, and registers all applications and approvals with the court system and the MOF.

Figure 11

PROCEDURES FOR FOREIGN INVESTMENT PROPOSALS



- |   |  |
|---|--|
| ① Application for authorization   | ⑥ Import declaration   |
| ② Review of application   | ⑦ Application for exemption or reduction of customs duty, etc. |
| ③ Deliberation and approval   | ⑧ Report of foreign capital inducement                         |
| ④ Authorization   | ⑨ Registration   |
| ⑤ Application for confirmation of specification of capital goods and issuing the letter thereof | ⑩ Registration of foreign invested enterprise                  |

Note: Procedures ② and ③ are omitted in the case of projects eligible for automatic approval.

MOF: Ministry of Finance

FCIDC: Foreign Capital Inducement Deliberation Committee  
Advisory body to the Minister of Finance

FCPRC: Foreign Capital Project Review Committee  
Chaired by the Minister of Finance

Source: Ministry of Finance

## WORK FORCE PROFILE

The Economic Planning Board estimates that at the end of December 1984, the number of South Koreans 14 years and older stood at 27.79 million (see Table 7). The economically active population of Korea stood at 14.98 million, or 53.9 percent of the total. The unemployment level steadily declined in 1984, an indicator of the growing economy. During 1982, 4.4 percent of the employable (economically active) population were out of work. By 1984, the level of unemployment had declined to 3.8 percent. Employment in the Mining and Manufacturing sectors is steadily increasing, while employment in the Agro-Forestry and Fishery sectors is steadily decreasing.

Table 7

### **WORK FORCE PROFILE (Millions)**

| <u>Sector</u>                   | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>1986</u> |
|---------------------------------|-------------|-------------|-------------|-------------|-------------|
| Population over 14 Years Old    | 26.53       | 27.13       | 27.79       | 28.52       | 29.20       |
| Economically Active Population* | 15.08       | 15.13       | 14.98       | 15.32       | 16.35       |
| Employment (All Industry)       | 14.42       | 14.52       | 14.42       | 14.71       | 15.72       |
| Agro-Forestry and Fishery       | 4.62        | 4.31        | 3.91        | 3.87        | 3.93        |
| Manufacturing, Mining           | 3.16        | 3.38        | 3.49        | 3.64        | 3.96        |
| Social Overhead, Other Services | 6.64        | 6.82        | 7.02        | 7.20        | 83          |
| Unemployment Level (Percent)    | 4.4%        | 4.2%        | 3.8%        | 4.0%        | 3.8%        |

\*Individuals currently employed plus those actively seeking employment

Source: Economic Planning Board

### Educational Level

Due to a comprehensive educational system, the South Korean rate of literacy exceeds 97.5 percent. Furthermore, well-trained, highly qualified manpower is available in various fields due to a rapid increase in technical and vocational schools.

An estimated 77,000 students graduated from college in 1983, and bilingual graduates are available in most fields. A profile of the educational system and student enrollments as of 1983 is shown in Table 8.

Table 8

## SOUTH KOREAN EDUCATIONAL SYSTEM--1983

| <u>School</u>             | <u>Number of<br/>Schools</u> | <u>Students<br/>Enrollment</u> | <u>Students<br/>Graduated</u> |
|---------------------------|------------------------------|--------------------------------|-------------------------------|
| Vocational High School    | 639                          | 880,797                        | 262,821                       |
| Junior Vocational College | 122                          | 169,080                        | 68,379                        |
| College, University       | 98                           | 772,907                        | 77,272                        |

Source: Ministry of Education

Wages and Fringe Benefits

No minimum wage standards have been established by law in South Korea, although the Labor Standards Law authorizes the Director-General of the Ministry of Labor to set a minimum wage according to the industry. Wages must be paid regularly and in full once or more per month, on a fixed day or days.

Large Korean companies adopt a paternal attitude toward employees, providing many nontaxable benefits such as transportation, lunches, housing at remote sites, or housing loans, as well as cash gifts for weddings and funerals.

All employees are entitled to a physical examination when they begin working and companies with 16 or more employees must pay for annual physicals as well.

The standard workweek is 48 hours--eight hours a day for six days. The working hours may be extended to 60 hours per week by mutual agreement, and an extended workweek has become a common practice in export manufacturing companies. Further extension of overtime hours requires previous approval of the Ministry of Labor. Eight hours of work a day should be accompanied by at least one hour of rest. Anything beyond the standard workweek is considered overtime, and is subject to compensation at 150 percent of the standard hourly rate.

The industrial production workers' average monthly earnings and average number of workdays per month are shown in Table 9.

Table 9

**AVERAGE MONTHLY WAGES AND WORKDAYS  
OF INDUSTRIAL PRODUCTION WORKERS**

|                          | 1982      |           | 1983      |           | 1984      |           |
|--------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                          | Per Month |           | Per Month |           | Per Month |           |
|                          | Wages     | Work Days | Wages     | Work Days | Wages     | Work Days |
| All Industries           | \$329     | 24.8      | \$343     | 24.8      | \$359     | 24.8      |
| Electrical & Electronics | \$262     | 24.2      | \$281     | 24.6      | \$293     | 24.4      |

Source: Economic Planning Board

## INFRASTRUCTURE

### Transportation

**Highways**--An extensive highway network for shipped goods already exists in South Korea, and all major cities are connected by paved roads. As of the end of 1983, total road mileage was 54,599km, of which 21,279km were paved. By 1986, there will be a total of 1,428km of expressways connecting nearly every district in the country in a "one-day" travel network.

**Railroads**--All major urban areas are connected by railroad. As of the end of 1983, the total railroad mileage was 6,128km. The major ports of Pusan and Ichon are connected to Seoul by double track lines. Lines connecting Seoul with the mining districts in the eastern part of the nation have already been electrified. The subsidized railroad rate structure is extremely attractive for freight service.

**Air Transportation**--Seoul's Kimpo International Airport is served by 13 international carriers. In 1983, the total number of international air passengers was 3.71 million and the number of domestic passengers was 2.36 million. Domestic airline routes have expanded steadily to serve all major cities and industrial estates. At present, 16 major cities are connected to Seoul by daily service.

**Marine Transportation**--Korea has a sizeable merchant fleet with a total gross tonnage of 7.83 million tons. The total cargo handled in the 24 open ports (including the ports of Pusan and Ichon) amounted to 147.7 million tons during 1983. Of this total, 89.9 million tons or 61 percent of the total was import cargo and 29.3 million tons or 20 percent of the total was export cargo. The remaining 28.5 million tons, 19 percent of the total, was domestic traffic among the coastal ports of Korea. Almost 99.8 percent of the total export and import cargo was transported by marine transportation.

### Communications

The number of installed telephones was 5.33 million circuits in 1983, compared with 167,570 circuits in 1962. The First Satellite Station, built in 1970, and the Second Satellite Communication Station, built in 1976, have greatly contributed to international communications with high-quality transpacific telegraph, telephone, and television connections from all member countries of the world. International communications will be remarkably improved by the introduction of the automatic telephone system (3,000 lines), and the satellite communication system will add 470 lines by 1986.

### Electric Power

Electricity is available in all industrial areas and towns. Installed capacity was 13,115MW in 1983, and generation and transmission facilities are being expanded to meet the increasing demand for power for industrial use. Long-term electric power development programs call for an installed capacity of 18,081MW by 1986.

### Industrial Estates

To keep pace with the rapid economic development, the government is actively promoting the establishment of industrial estates. All the industries located in an industrial estate enjoy advantages such as low land costs, adequate power and water supplies, and good road networks, and share various supporting facilities including special administrative support. Most important, however, are the tax concessions granted to foreign-invested enterprises under the Foreign Capital Inducement Act.

Foreign investors may either own or lease land throughout Korea. Foreign nationals are subject to the regulations of the Alien Land Acquisition Law, which requires that foreign-invested firms that hold over 50 percent ownership of stocks or shares in a corporation obtain approval for land ownership from the Ministry of Home Affairs. Bonded warehouses and factories may be established at any point in the industrial estates with the approval of the Office of Customs Administration.

### Free Export Zones

The Masan Free Export Zone was established in 1970 to encourage direct foreign investment and exports. In 1973, another free export zone was established near Iri. These two zones are special administrative tax-free areas having the characteristics of bonded areas where various pertinent laws and regulations have been waived or have been relaxed altogether or in part.

## CHAPTER 8--SOUTH KOREAN SEMICONDUCTOR INDUSTRY

### HISTORICAL OVERVIEW

The South Korean semiconductor industry came into being in 1956 when KOMY Semiconductor, Ltd., started manufacturing and packaging discrete transistors under a joint venture with the KOMG Company of the United States.

The 1960s decade was dominated by manufacturing, assembly, and packaging of discrete devices by foreign firms such as Signetics (1966), Fairchild Semiconductor (1967), Motorola (1967), AMI (KMI, 1970), and Toshiba (Korea Toshiba, 1970). The only native assembly company in operation during this period was Anam Industrial, which diversified into the new business of semiconductor packaging for discrete devices.

The 1970s decade was characterized by integrated circuit manufacturing and packaging. In 1974, Korea Semiconductor Inc. was established under a joint venture between Samsung Electronics Group and South Korean-owned ICII (located in the United States). The joint venture produced metal gate CMOS integrated circuits for the electronic watch. Korea Semiconductor was later acquired by the Samsung Group, and became a part of the Samsung Semiconductor and Telecommunications Company.

In 1977, Taihan Electric Wire established a semiconductor company, Taihan Semiconductor, to supply semiconductor devices for internal use in consumer electronic products. Gold Star Semiconductor was established in 1979. Gold Star Semiconductor entered into a joint venture with AT&T in 1980, and started producing linear ICs and discrete devices for internal consumption in consumer electronic products.

Korea Toshiba was established in 1969 under a joint venture with Toshiba of Japan and Korean investors. Toshiba sold its majority ownership (retaining 10 percent), and the company changed its name to the Korea Electronics Company in 1976. In 1976, the South Korean government established an R&D organization, the Korea Institute of Electronics Technology (KIET), to promote the semiconductor and computer industries.

During the 1980s, South Korea has emerged as a significant participant in the worldwide semiconductor industry. Currently, the South Korean semiconductor industry is heavily supported by the South Korean government and is dominated by four major industrial and financial conglomerates or Chaebol. They are Hyundai, Daewoo, Lucky-Gold Star (referred to here as Gold Star), and Samsung.

In 1983, the South Korean government formed the Semiconductor Industry Fostering Plan, under which it expects to lend the Korean semiconductor industry \$346 million over the period through 1987, in addition to providing a wide range of tax and investment incentives. (These incentives were discussed in Chapter 7, Industry.)

In July 1984, the government announced a joint VLSI research project with the four Chaebol. The project budget is approximately \$91 million. The target for the first phase of the project is to develop a 1-Mbit DRAM. In addition to the government funding, the four conglomerates invested \$586 million in semiconductor production and R&D facilities in 1984, and made estimated expenditures of \$528 million for 1985.

The 1980s period is the beginning of the VLSI era for the South Korean semiconductor industry. In 1981, KIET successfully designed and produced an 8-bit microprocessor and a 2K static RAM. In 1983, after a year of ground work, the leading conglomerate, Hyundai Group, launched an electronics company with a massive investment. It went directly into VLSI technology, establishing ultramodern manufacturing facilities both in Korea and the United States. Hyundai's activity stimulated Samsung and Gold Star to follow with investments in semiconductor programs on an even larger scale. In 1984, Gold Star Semiconductor started producing the 280 microprocessor under a second-source agreement with Zilog.

The fourth largest conglomerate, Daewoo Group, took a different route to enter the electronics business when it acquired the electronics business of Taihan Electronic Wire Company. This 1983 acquisition included Taihan Semiconductor.

A detailed discussion of the recent activities of the top four conglomerates in developing semiconductor technology and manufacturing capability is given in Chapter 9, Native South Korean Semiconductor Manufacturers.

## PRODUCTION

Total South Korean semiconductor industry production (including subcontract work) grew from \$648 million in 1982 to \$1,259 million in 1984, at a cumulative annual growth rate of 39.4 percent (see Table 10). Integrated circuits were the fastest growth product area, increasing from \$490 million in 1982 to \$1,070 million in 1984, at a cumulative annual rate of 47.8 percent.

South Korean semiconductor industry production declined in 1985, dropping from the 1984 level of \$1,259 million to \$994 million. This decline followed the worldwide trend. The cumulative annual growth rate of South Korean production for the years 1982 to 1985 is estimated at 15.3 percent (Table 10), only slightly less than the 16.7 percent worldwide industry growth for the same period (see Table 11).



Table 10

ESTIMATED SOUTH KOREAN SEMICONDUCTOR INDUSTRY PRODUCTION  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u>      |                  |
|---------------------|-------------|-------------|-------------|-------------|------------------|------------------|
|                     |             |             |             |             | <u>1982-1984</u> | <u>1982-1985</u> |
| Total Semiconductor | \$648.0     | \$850.0     | \$1,259.0   | \$994.0     | 39.4%            | 15.3%            |
| IC                  | 490.0       | 661.0       | 1,070.0     | 844.8       | 47.8%            | 19.9%            |
| Discrete            | 121.0       | 159.0       | 155.2       | 122.5       | 13.3%            | (0.4%)           |
| Optoelectronic      | 37.0        | 30.0        | 33.8        | 26.7        | (4.4%)           | (10.3%)          |

\*Includes related components and assemblies

Source: EIAK  
DATAQUEST

Table 11

ESTIMATED WORLDWIDE SEMICONDUCTOR PRODUCTION  
(Billions of Dollars)

|                                 | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u>      |                  |
|---------------------------------|-------------|-------------|-------------|-------------|------------------|------------------|
|                                 |             |             |             |             | <u>1982-1984</u> | <u>1982-1985</u> |
| Total Semiconductor             | \$15.1      | \$19.2      | \$28.9      | \$24.0      | 38.3%            | 16.7%            |
| IC                              | 10.7        | 14.4        | 22.5        | 18.2        | 45.0%            | 19.4%            |
| Discrete and<br>Optoelectronics | 4.4         | 4.8         | 6.4         | 5.8         | 20.6%            | 9.6%             |

Source: DATAQUEST

However, the South Korean semiconductor industry performance from 1982 through 1984 (39.4 percent) was better than the world average (38.3 percent) for the same period. Growth of South Korean IC production for the same period is estimated at 47.8 percent, slightly above the estimated worldwide growth rate of 45.0 percent. This growth reflects the native South Korean manufacturers' successful development of VLSI class production facilities.

## CONSUMPTION

South Korea's economic growth ranks second, behind Japan, among Asian Rim countries. South Korea's rate of real GNP growth in recent years has led the rest by a good margin, registering 9.5 percent in 1983 compared to 1982, and 7.7 percent in 1984 compared to 1983. While future growth depends on political stability, foreign trade, and other factors, South Korea has already attained the momentum, infrastructure, and manufacturing base to make relatively high value-added products, a factor which bodes well for continued healthy growth for the rest of the 1980s.

Because of the rapid growth in the electronics industry after the 1980 worldwide recession, and the recent proliferation of board and system subcontracting by U.S. OEMs, South Korean semiconductor consumption grew at an estimated cumulative annual rate of 40.3 percent, from \$154.4 million in 1982 to \$304.0 million 1984. Reflecting the focus on production of leading-edge components and end equipment, cumulative growth in IC consumption over the same period is estimated to be 71 percent (see Table 12).

South Korean semiconductor consumption is expected to decline in 1985 due to large inventory accumulation and a worldwide decline in end-equipment sales. Cumulative semiconductor consumption in South Korea grew an estimated 18.3 percent from 1982 to 1985 to reach \$255 million.

Table 12

### ESTIMATED SOUTH KOREAN SEMICONDUCTOR INDUSTRY CONSUMPTION\* (Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u>      |                  |
|---------------------|-------------|-------------|-------------|-------------|------------------|------------------|
|                     |             |             |             |             | <u>1982-1984</u> | <u>1982-1985</u> |
| Total Semiconductor | \$154.4     | \$226.7     | \$304.0     | \$255.0     | 40.3%            | 18.3%            |
| IC                  | 78.0        | 118.0       | 228.0       | 191.0       | 71.0%            | 34.8%            |
| Discrete            | 73.0        | 105.0       | 68.2        | 57.0        | (3.3%)           | (7.9%)           |
| Optoelectronics     | 3.4         | 3.7         | 7.8         | 7.0         | 51.5%            | 27.2%            |

\*Includes related components and assemblies

Source: EIAK  
DATAQUEST

## MARKET SHARE

Historically, Japanese and U.S. manufacturers have had the largest share of the South Korean semiconductor market, although native South Korean and Rest of World manufacturers have gained share over the period between 1982 and 1985. Regional market share for semiconductors consumed in South Korea is shown in millions of dollars and as a percentage of total in Table 13. These tables summarize the data presented in Appendix B, at the end of this document.

Table 13

**SOUTH KOREAN SEMICONDUCTOR CONSUMPTION  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
REGIONAL SUMMARY\*  
(Millions of Dollars)**

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$154       | \$227       | \$304       | \$255       | 18.3                            |
| Japanese            | \$ 76       | \$110       | \$133       | \$112       | 13.8                            |
| U.S.                | \$ 51       | \$ 63       | \$ 88       | \$ 75       | 13.7                            |
| Korean              | \$ 15       | \$ 30       | \$ 47       | \$ 39       | 37.5                            |
| Rest of World       | \$ 12       | \$ 24       | \$ 36       | \$ 30       | 35.7                            |

**(Percent of Total)**

|                     |        |        |        |        |
|---------------------|--------|--------|--------|--------|
| Total Semiconductor | 100.0% | 100.0% | 100.0% | 100.0% |
| Japanese            | 49.4%  | 48.9%  | 43.8%  | 43.9%  |
| U.S.                | 33.3%  | 27.8%  | 28.9%  | 29.4%  |
| Korean              | 9.7%   | 13.3%  | 15.5%  | 15.3%  |
| Rest of World       | 7.8%   | 10.6%  | 11.8%  | 11.8%  |

\*Totals may not add due to rounding.

Source: DATAQUEST

Japanese manufacturers historically have had the largest share of this semiconductor market. Japanese sales of \$76 million in 1982 accounted for 49.4 percent of the local market. Japanese sales grew at 13.8 percent cumulatively over the period, a lower rate of growth than the market, which increased at 18.3 percent over the same period. The Japanese share had declined slightly to 43.8 percent by 1985.

U.S. manufacturers' sales to the South Korean market also grew at a lower rate than the market. U.S. 1982 revenues of \$51 million grew at a cumulative annual rate of 13.7 percent to reach \$75 million in 1985. The U.S. market share, estimated at 33.3 percent in 1982, declined to 27.8 percent in 1983. Over the next two years, U.S. manufacturers began regaining share, although not as high as the 1983 levels, reaching 29.4 percent of the market in 1985.

In 1982, South Korean manufacturers' revenues were approximately \$15 million, or 9.7 percent of the native market. Their revenues have grown at a cumulative annual rate of 37.5 percent, reaching \$39 million dollars in 1985. This growth, nearly double that of the market as a whole, has resulted in an increase in market share to 15.3 percent in 1985.

Revenues of Rest of World manufacturers, notably European companies (see Appendix B at the end of this document) have also shown rapid growth and a slight increase in share of the South Korean market between 1982 and 1985. ROW revenues were approximately \$12 million in 1982, a 7.8 percent share of the market. These revenues grew at a cumulative annual rate of 35.7 percent, to reach \$30 million, or 11.8 percent, in 1985.

#### SEMICONDUCTOR EQUIPMENT AND MATERIALS SUPPLIERS

South Korea has no major native semiconductor equipment manufacturers. U.S. manufacturers have supplied 70 percent of the wafer fab equipment required to outfit the more than 2 million square feet of semiconductor capacity that has been added in the last three years and the Japanese have supplied the remaining 30 percent.

In 1984, a few native companies began to produce noncritical processing equipment. But, to date, these new entrants have attained no significant share of the domestic market. The equipment industry is an important part of the semiconductor industry infrastructure, and native manufacture will, therefore, be a candidate for support.

As in the case of equipment, semiconductor production materials are supplied primarily by the United States and Japan. South Korean firms do, however, manufacture lead frames, low-grade chemicals, and some miscellaneous supplies used in the production line. They are working to develop the technological know-how to enter the other materials markets, and are entering into foreign partnerships in pursuit of this goal.

Recently, three Korean companies announced plans to produce polished wafers. One of these, the Hyundai Electronics, has entered into a technology agreement with Ricoh of Japan for production of silicon wafers. Materials suppliers located in South Korea, their products and, where applicable, their partners, are shown in Table 14.

**Table 14**

**MATERIAL SUPPLIERS IN SOUTH KOREA**

| <u>Company</u> | <u>Location</u>                                     | <u>Material</u>             | <u>Business Partner</u> |
|----------------|---|-----------------------------|-------------------------|
| Samsung        | 42, Sungju-dong,<br>Changwon City,<br>Kyungnam      | Lead Frame                  | N/A                     |
| Gold Star      | 379, Kasuri, Usan-up,<br>Whasung-kum,<br>Kyungki-do | Lead Frame                  | N/A                     |
| Poong San      | 52, Banyeo 1 Dong,<br>Haewoondae-gu,<br>Pusan       | Lead Frame                  | KAIST (Korea)           |
| Kosil          | Gumi City, Kyongbuk                                 | Polished Wafer              | Monsanto (U.S.)         |
| Lami           | 60-1, Choongmuro 3GA,<br>Chung-gu Seoul             | Polished Wafer              | Epitaxi (U.S.)          |
| Union Carbide  | C.P.O. Box 4302,<br>Seoul                           | Bulk and Specialty<br>Gases | N/A                     |

N/A = Not Applicable

Source: DATAQUEST

## CHAPTER 9--NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS

Native semiconductor manufacturers and their products are listed in Table 15. The Group 1 companies shown in the table are the major forces in South Korea's penetration of the worldwide market. The Group 2 companies participate in the semiconductor business primarily through manufacture of discrete devices, and/or assembly and packaging activities. The discussion in this section focuses on the major Chaebol, as their activities are of primary interest and significance in South Korea's efforts to establish an internationally competitive, indigenous semiconductor industry incorporating leading-edge technology.

Table 15

### NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS

| <u>Company</u>  | <u>Products</u>   |
|---|---|
| <u>Group 1</u>  |   |
| Korea Electronics Co., Ltd.                               | Bipolar linear; audio & video circuits,<br>Transistors, diodes, LEDs  |
| Gold Star Semiconductor, Ltd.                             | Bipolar digital; STTL, LSTTL, modems,<br>telephone ICs<br>Bipolar linear; audio, video, industrial<br>ICs<br>MOS memory; 64K DRAM, 64K SRAM<br>MOS MPU; 28, 280 families<br>Semicustom; CMOS gate arrays<br>Hybrid IC; thick film<br>Transistors; low-power high-speed, medium-<br>power, SCR/TRIAC |
| Samsung Semiconductor and<br>Telecommunications Co., Ltd. | Bipolar linear; audio, video, industrial,<br>telecom and consumer ICs<br>MOS logic; watch and calculator chips,<br>HC/TTL, LS/TTL<br>MOS memory; 64K DRAM, 128K DRAM<br>256K DRAM, 16K SRAM, 64K SRAM, 16K EEPROM<br>MOS MPU; 4- and 8-bit Intel Second source<br>Transistors; S/S, power           |
| Daewoo Electronics Components<br>Co., Ltd.                | Bipolar Linear, audio and video ICs<br>Transistors, diodes  |

(Continued)

Table 15 (Continued)

## NATIVE SOUTH KOREAN SEMICONDUCTOR MANUFACTURERS

| <u>Company</u>                           | <u>Products</u>   |
|--|---|
| <u>Group 1</u> (Continued)               |   |
| Hyundai Electronics Industries Co., Ltd. | MOS memory; 16K and 64K SRAM, 128K and 256K ROM, 1K EEPROM, 64K EPROM, 64K DRAM<br>MOS MPU; 8- and 16-bit   |
| KETRI (KIET)                             | Bipolar linear; audio and video circuits;<br>MOS memory; 2K and 4K SRAM, 32K and 64K ROMs<br>MOS MPU; 8-bit |
| <u>Group 2</u>                           |   |
| Dung Sung Moolsan Ind. Co. Ltd.          | Diodes, rectifiers, varistors   |
| Karibong Electronics Corp.               | Diodes, rectifiers, LED display, LED lamps  |
| KOMY Semiconductor, Ltd.                 | ICs and transistors   |
| Korea Optoelectronics Corp.              | Transistors, diodes, solar cells, photo Darlingtons, photo couplers, photo interrupters                     |

Source: DATAQUEST

South Korean semiconductor investment increased dramatically in 1983 when the government launched the Semiconductor Industry Fostering Plan. This plan provides more than \$300 million for loans to domestic firms over the 1984 to 1987 time period. The major beneficiaries of this financial support are Samsung, Gold Star, and Hyundai. Heated competition among these conglomerates pushed investments far more than original plans, and additional funds were obtained from international financial markets. Since the beginning of 1983, these three Chaebol have invested close to \$1 billion in semiconductor technology, and more than 90 percent of the total investments have been financed by external debt.

## REVIEW OF BIG FOUR SEMICONDUCTOR OPERATIONS

### Gold Star

The Lucky-Gold Star Group is an \$8.5 billion company making products ranging from toothpaste to apparel, elevators to microwave ovens, electronic switching systems (ESS) to computers and ICs. The Gold Star Company, a subsidiary of the Group, is the second largest electronics company in South Korea, with 1984 revenues of approximately \$1.2 billion. It is a major producer of color televisions, video cassette recorders, microwave ovens, monitors, and terminals. The company is extending its main products to include "high-tech" areas, and, consequently, it is now manufacturing minicomputers and mainframes. The Gold Star Company has a factory in Huntsville, Alabama, where it makes one million color televisions per year, in addition to microwave ovens and refrigerators, all for the North American market.

The Group's subsidiary Gold Star Semiconductor (GSS) was established in 1980. GSS is 44 percent owned by AT&T, and produces advanced digital switching systems, PCs, and semiconductors. GSS is establishing a design center in its new Sunnyvale, California, offices. To date, there is no wafer fab facility in the United States. GSS has been aggressive in establishing foundry and license agreements with major U.S. companies to obtain electronics technology. The technology licenses GSS holds to date are listed in the Company Profile chapter of this report.

### Samsung

The Samsung Electronics Company, a subsidiary of the Samsung Group, is the leading South Korean electronics manufacturer with 1984 sales of approximately \$1.5 billion. This company is the electronics arm of the Samsung Group, which is the largest Chaebol in South Korea having sales of over \$10 billion in 1984. Samsung Semiconductor and Telecommunications Company (SST), a subsidiary of the Samsung Electronics Group, was created by the government in 1977 to foster South Korea's electronics industry. Overall, the electronic sector currently accounts for over one-fifth of Samsung's revenues.

SST has a technology license with ITT to make and sell advanced electronic switching systems. SST shares with Gold Star a government mandated oligopoly for digitizing the telephone systems of all Korean cities. In addition, Samsung has joint venture with Hewlett-Packard, General Electric, and Corning Glass Works. They also have many subcontractual agreements with American and European companies.

In semiconductors, SST licensed Micron Technology's 64K and 256K DRAMs, and entered into a joint development pact with EXEL to develop the 2816A 16K EEPROM. Further, SST's recent license from Intel gave SST the right to make and sell microprocessor products in South Korea. All technology agreements are listed in the Company Profiles chapter of this report.



In 1974, SST acquired a fab facility in Buchon that gave the company consumer IC manufacturing capability. Its new \$125 million fab facility in Suwon, south of Seoul, has a capacity of 27,000 4-inch wafers per month with 3-micron feature size. SST added a 6-inch fab with all steppers for VLSI production in 1985.

Samsung Semiconductor Inc., in Santa Clara, California, is SST's U.S. subsidiary. Established in 1983, the Santa Clara facility houses a 5,000-square foot pilot line, with 5-inch, 2-micron capability. The company is SST's U.S. arm for sales, marketing, design, and application engineering. Product definition, development, and process debugging are performed in the Santa Clara facility before the designs are transferred back to South Korea for volume production.

### Hyundai

Hyundai is the second largest Chaebol at approximately \$10 billion in 1984. Hyundai's main lines of business are automobiles, shipbuilding, and construction. Hyundai was the last of the Big 4 to enter electronics in 1982. The company gained electronics assembly experience through its subcontract with Faraday (PC add-on boards), Novatel (cellular telephones), and Hazeltine (terminals).

Hyundai Electronics was established in 1983. In addition to semiconductors, Hyundai will be entering the areas of telecommunications, office automation, and information systems. The company has negotiated second-source agreements with International CMOS Technologies (ICT) for EEPROM technology. Hyundai plans to sample 16K SRAMs, 8-bit MCUs, and 1K EEPROMs in 1986.

Hyundai established a U.S. subsidiary, Hyundai Electrosystems, Inc., (HEI), in Santa Clara, California. HEI originally devoted most of its 100,000-square-foot complex to semiconductors. The facility contains an 11,000-square-foot wafer fab facility designed to run CMOS on 5-inch wafers with 2-micron design rules. HEI's manufacturing operations were shut down during 1985, and the company plans to sell or lease the fab facility. HEI plans to continue with marketing activities in the United States.

### Daewoo

The primary market areas of this \$5 billion conglomerate business are shipbuilding as well as international trade, machinery, construction, automobiles, oil, and consumer electronics. It has a PC subcontract with Corona Systems, a computer license with Burroughs, and a joint venture on customized ICs and communication equipment with Northern Telecom. The Group's subsidiary, Daewoo Telecom, is one of the four Korean companies picked to modernize the Korean rural telephone system.

Daewoo Semiconductor is a division of Daewoo Electronics. It was established in June 1984. Daewoo's U.S. operations are headquartered in Silicon Valley, California, at its subsidiary ID Focus. ID Focus is currently doing market research to develop designs for the electronics and telecommunications divisions of Daewoo. Daewoo does not directly operate a semiconductor facility in the United States, but is working on a mask design process under a technical agreement with Northern Telecom.

#### SEMICONDUCTOR PLANT LOCATIONS

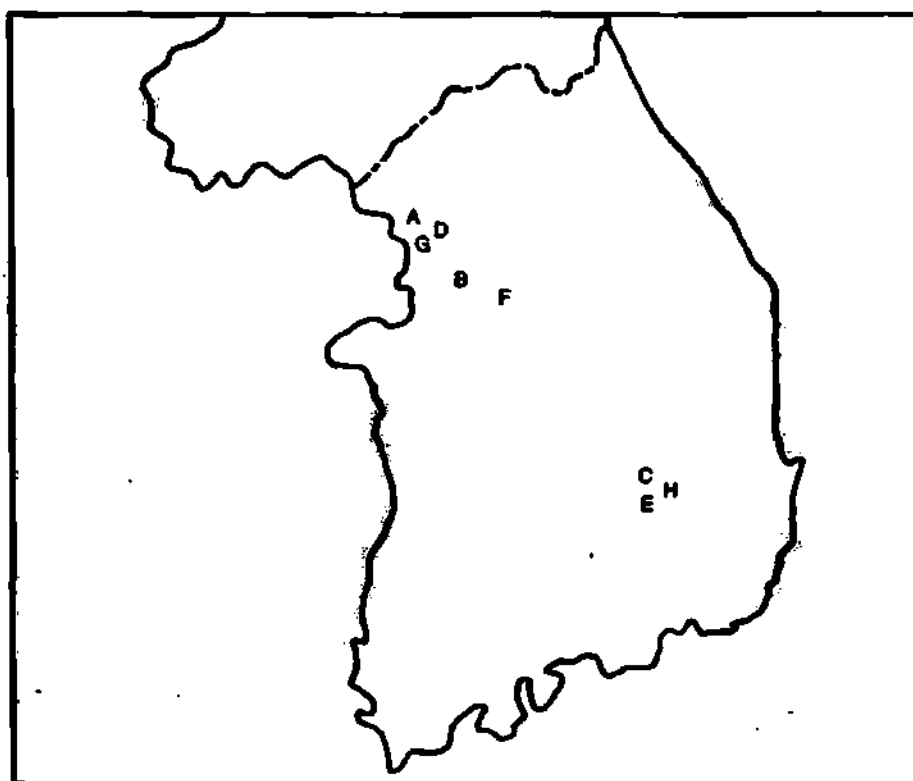
South Korean semiconductor manufacturing is concentrated in two areas, Seoul in the Northwest portion of the country, and Gumi in the Southeast. The locations of the semiconductor production facilities of the top five manufacturers are shown in Figure 12. Plant ownership and products are listed at the top of the figure, along with the identifying code designating their location in South Korea.

The 1985 wafer production capacity of each of the plants is shown in Table 16. The production capacity controlled by these companies is estimated at 196,000 wafer starts per month, with the majority of the capacity added during the 1980s. The percent of capacity by wafer size is shown in Table 17. Facilities designed to run 3- and 4-inch wafers account for 43.8 percent of total slices. Five-inch wafer fab lines account for 33.2 percent of capacity, while state-of-the-art 6-inch facilities account for 23.0 percent. Further details on facilities are given in the chart presented in Appendix E, Facilities Data.

**Figure 12**

**SEMICONDUCTOR MANUFACTURING LOCATIONS**

| <u>Map Code</u> | <u>Location</u> | <u>Products</u>          |
|-----------------|-----------------|--------------------------|
| A               | Samsung         | Bipolar, MOS             |
| B               | Buchon          | Memory                   |
|                 | Suwon           |                          |
| C               | Gold Star       | Bipolar, MOS Memory,     |
|                 | Gumi            | MPU, Gate Array          |
| D               | Anyang          | Memory, Custom IC        |
| E               | KEC             | Transistor, Linear IC,   |
|                 |                 | Diode, LED               |
| F               | Hyundai         | MOS Memory, MPU          |
| G               | Daewoo          | Linear Bipolar, Discrete |
| H               | ETRI (KIET)     | Bipolar, MOS             |



Source: DATAQUEST

Table 16

## WAFER PRODUCTION CAPACITY OF SELECTED MANUFACTURERS--1985

|                | <u>Plants</u> | <u>Wafer Size</u> | <u>Wafer Starts<br/>Average<br/>Per Month</u> |
|----------------|---------------|-------------------|---|
| SST            | Buchon        | 3-inch            | 15,000  |
|                |               | 4-inch            | 15,000  |
|                |               | 5-inch            | 20,000  |
|                | Suwon         | 4-inch            | 27,000  |
|                |               | 6-inch            | 20,000  |
| GSS            | Gumi          | 4-inch            | 13,000  |
|                |               | 5-inch            | 15,000  |
|                | Anyang        | 5-inch            | 10,000  |
| KEC            | Gumi          | 3-inch            | 5,000   |
|                |               | 5-inch            | 5,000   |
| Hyundai        | Ichon         | 5-inch            | 15,000  |
|                |               | 6-inch            | 25,000  |
| ETRI<br>(KIET) | Gumi Location | 4-inch            | 3,000   |
|                |               | 4-inch            | 2,000   |
| Daewoo         | Goonpo-eup    | 4-inch            | 7,000   |

Table 17

## PRODUCTION CAPACITY BY WAFER SIZE--1985

| <u>Wafer Size</u>                         | <u>3-inch</u> | <u>4-inch</u> | <u>5-inch</u> | <u>6-inch</u> | <u>Total</u> |
|---|---------------|---------------|---------------|---------------|--------------|
| Capacity in Average<br>Wafer Starts/Month | 20,000        | 67,000        | 65,000        | 45,000        | 197,000      |
| Percent of Total                          | 10.2%         | 34.0%         | 33.0%         | 22.8%         | 100%         |

Source: DATAQUEST

## NATIVE SEMICONDUCTOR PRODUCTION

Semiconductor device production estimates for the Korea Electronics Company (KEC), Gold Star, and Samsung, from 1982 through 1985, are shown in the following tables. Estimates of Daewoo and Hyundai device production are not included in the following data. While Daewoo and Hyundai are investing heavily in capacity and technology, as of midyear 1985 they had not yet developed significant production.

Total semiconductor revenues of the three major manufacturers, KEC, Gold Star, and Samsung, are shown in Table 18. Revenues grew at an estimated cumulative annual rate of 96.1 percent, from \$22.8 million in 1982 to \$172 million in 1985. Total IC growth over the period was dramatic at 151.8 percent, as these manufacturers rapidly came on-line with production facilities capable of producing leading-edge circuits. The IC manufacturing base of these companies supported only \$7.2 million of IC production in 1982, but leaped to an estimated \$115 million in 1985.

Table 18

### SEMICONDUCTOR REVENUES OF SAMSUNG, GOLD STAR, AND KEC (Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$22.8      | \$58.7      | \$114.0     | \$172.0     | 96.1%                           |
| IC                  | \$ 7.2      | \$21.7      | \$ 51.0     | \$115.0     | 151.8%                          |
| Bipolar Digital     | 0           | 0           | \$ 1.5      | \$ 4.0      | 166.7%                          |
| MOS                 | \$ 3.2      | \$10.0      | \$ 26.5     | \$ 61.0     | 167.1%                          |
| Linear              | \$ 4.0      | \$11.7      | \$ 23.0     | \$ 50.0     | 132.1%                          |
| Discrete            | \$14.3      | \$34.5      | \$ 60.0     | \$ 55.0     | 56.7%                           |
| Optoelectronics     | \$ 1.3      | \$ 2.5      | \$ 3.0      | \$ 2.0      | 15.4%                           |

Source: DATAQUEST

Semiconductor revenues for the top three manufacturers, by company and product category, are presented in Table 19. Samsung and Gold Star each demonstrated growth rates in excess of 100 percent from 1982 through 1985. These two manufacturers are heavily committed to developing semiconductor manufacturing capability and have invested large amounts of capital to this end. KEC's revenue growth, 41.9 percent, is less than half that of Samsung and Gold Star. KEC has participated at a lower level in the rush to develop capacity; however, as an established device manufacturer, the company had the highest 1982 revenues of \$14.7 million, whereas Samsung and Gold Star both started the period with combined revenues of less than \$10 million. KEC's primary product areas are linear and discrete devices.

Table 19

**NATIVE SEMICONDUCTOR REVENUES OF SAMSUNG, GOLD STAR,  
AND KEC BY TECHNOLOGY  
(Millions of Dollars)**

|                          | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|--------------------------|-------------|-------------|-------------|-------------|---------------------------------|
| <b>Samsung</b>           |             |             |             |             |                                 |
| Total Semiconductor      | \$ 4.8      | \$25.9      | \$60.0      | \$95.0      | 170.5%                          |
| IC                       | 3.7         | 14.0        | 33.0        | 75.0        | 172.7%                          |
| Bipolar Digital          | 0           | 0           | 0           | 0           | N/A                             |
| MOS                      | 3.2         | 9.9         | 25.0        | 55.0        | 158.1%                          |
| Linear                   | 0.5         | 4.1         | 8.0         | 20.0        | 242.0%                          |
| Discrete                 | 1.1         | 11.9        | 27.0        | 20.0        | 163.0%                          |
| Optoelectronics          | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| <b>Gold Star</b>         |             |             |             |             |                                 |
| Total Semiconductor      | \$ 3.3      | \$ 6.4      | \$16.0      | \$35.0      | 119.7%                          |
| IC                       | 0.8         | 3.9         | 13.0        | 32.0        | 242.0%                          |
| Bipolar Digital          | 0.0         | 0.0         | 1.5         | 4.0         | 166.7%                          |
| MOS                      | 0.0         | 0.1         | 1.5         | 6.0         | 674.6%                          |
| Linear                   | 0.8         | 3.8         | 10.0        | 22.0        | 201.8%                          |
| Discrete                 | 2.5         | 2.5         | 3.0         | 3.0         | 6.3%                            |
| Optoelectronics          | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| <b>Korea Electronics</b> |             |             |             |             |                                 |
| Total Semiconductor      | \$14.7      | \$26.4      | \$38.0      | \$42.0      | 41.9%                           |
| IC                       | 2.7         | 3.8         | 5.0         | 8.0         | 43.6%                           |
| Bipolar Digital          | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| MOS                      | 0.0         | 0.0         | 0.0         | 0.0         | N/A                             |
| Linear                   | 2.7         | 3.8         | 5.0         | 8.0         | 43.6%                           |
| Discrete                 | 10.7        | 20.1        | 30.0        | 32.0        | 44.1%                           |
| Optoelectronics          | 1.3         | 2.5         | 3.0         | 2.0         | 15.4%                           |

N/A = Not Applicable

Source: DATAQUEST

## JOINT VENTURES AND LICENSE AGREEMENTS

Semiconductors are the common denominator in South Korea's efforts to develop high-technology manufacturing. Compared to their American and Japanese counterparts, South Korean companies are playing catch-up from a very late start; however, they are very aggressive and ambitious. The combination of government and industry focus and support is yielding the same dramatic results as have been seen with the Japanese entry into semiconductor production during the 1970s. Further, the South Koreans are trying to accomplish in 5 years what it took the Japanese 20 years to develop, a self-sufficient semiconductor industry. This much reduced timetable would not be feasible without the formation of alliances. Unlike Japan's approach, South Korea welcomes alliances and foreign ownership.

A technology agreement provides a vehicle for South Korean manufacturers to move ahead at a more rapid pace in developing an indigenous semiconductor industry than would be possible through purely internal development. The rapidity with which alliances are being formed is startling. In the span of only two years, from 1983 to 1985, 4 native South Korean semiconductor manufacturers have entered into more than 20 technology and production alliances. A summary of agreements for semiconductor technology is presented in Table 20. The majority of the technology agreements have been made with U.S. manufacturers; very few have been made with Japanese companies.

Table 20

### SEMICONDUCTOR TECHNOLOGY ALLIANCES BY COMPANY

#### Samsung Semiconductor and Telecommunications Co., Ltd.

| <u>Year</u> | <u>Partner</u>           | <u>Agreement*</u> | <u>Products</u>                    |
|-------------|--------------------------|-------------------|------------------------------------|
| 1983        | Exel                     | TTA               | 16K EEPROM                         |
| 1983        | Samsung Semi. (U.S.)     | TTA               | NMOS and CMOS memory               |
| 1983        | DITTI (Germany)          | TTA               | Linear IC, CMOS                    |
| 1983        | Micron Technology (U.S.) | TTA               | 64K DRAM, 256K DRAM                |
| 1983        | Sharp (Japan)            | TTA               | 16K SRAM, 256K ROM                 |
| 1984        | DITTI (Germany)          | TTA               | Bipolar IC                         |
| 1984        | Samsung Semi. (U.S.)     | TTA               | 16K EEPROM, 256K DRAM,<br>64K SRAM |
| 1985        | Intel (U.S.)             | T/C               | MPU, MCU                           |
| 1985        | National Semiconductor   | TTA               | Gate array                         |

(Continued)

Table 20 (Continued)

## SEMICONDUCTOR TECHNOLOGY ALLIANCES BY COMPANY

Gold Star Semiconductor, Ltd.

| <u>Year</u> | <u>Partner</u>   | <u>Agreement</u> | <u>Products</u>            |
|-------------|------------------|------------------|----------------------------|
| 1981        | AT&T (U.S.)      | J/V, TTA         | Bipolar process technology |
| 1982        | AT&T (U.S.)      | TTA              | MOS technology             |
| 1983        | Zilog (U.S.)     | TTA              | 8-bit microprocessor       |
| 1984        | LSI Logic (U.S.) | TTA              | Gate array                 |
| 1984        | AMD (U.S.)       | R/A              | All AMD products in Korea  |
| 1984        | AMD (U.S.)       | TTA              | 64K DRAM design            |
| 1985        | LSI Logic (U.S.) | TTA              | Gate array                 |
| 1985        | Fairchild (U.S.) | TTA              | 64K SRAM                   |

Korea Electronics Co., Ltd.

| <u>Year</u> | <u>Partner</u>  | <u>Agreement</u> | <u>Products</u> |
|-------------|-----------------|------------------|-----------------|
| 1978        | Toshiba (Japan) | TTA              | Pellet          |
| 1983        | Toshiba (Japan) | TTA              | Linear IC       |
| 1984        | Toshiba (Japan) | TTA              | MOS technology  |

Hyundai Electronics Industries Co., Ltd.

| <u>Year</u> | <u>Partner</u>                           | <u>Agreement</u> | <u>Products</u>              |
|-------------|--|------------------|------------------------------|
| 1983        | Modern Electrosystems Inc. (U.S.)        | TTA              | NMOS and CMOS memory and MCU |
| 1984        | INMOS (U.S.)                             | TTA              | 256K x 1 DRAM                |
| 1984        | TI (U.S.)                                | TTA              | 64K DRAM                     |
| 1984        | International CMOS Technologies (U.S.)   | T/C              | EPROM, EEPROM                |
| 1985        | Hyundai Electronics America, Inc. (U.S.) | TTA              | 64K SRAM, 64K EEPROM         |

TTA: Technology Transfer Agreement (second sourcing)

J/V: Joint Venture Agreement

R/A: Representative Agreement

T/C: Technology Cooperation Agreement

Source: DATAQUEST



## CAPITAL SPENDING

In their efforts to become full-fledged participants in the worldwide semiconductor industry, South Korean manufacturers are investing heavily in development of R&D and semiconductor manufacturing capability. Semiconductor-related capital spending for the top four companies is presented in Table 21.

Table 21

### ESTIMATED SEMICONDUCTOR-RELATED CAPITAL SPENDING (Millions of Dollars)

|                  | <u>1984</u> | <u>1985</u> | <u>1986</u> | <u>1987</u> |
|------------------|-------------|-------------|-------------|-------------|
| Total Investment | \$586       | \$528       | \$215       | \$205       |
| Facilities       | \$544       | \$478       | \$179       | \$159       |
| Samsung          | \$283       | \$268       | \$113       | \$106       |
| Gold Star        | \$ 96       | \$ 61       | \$ 30       | \$ 11       |
| KEC              | \$ 34       | \$ 20       | \$ 17       | \$ 20       |
| Hyundai          | \$131       | \$129       | \$ 19       | \$ 22       |
| R&D              | \$ 42       | \$ 50       | \$ 36       | \$ 46       |
| Samsung          | \$ 16       | \$ 29       | \$ 27       | \$ 28       |
| Gold Star        | \$ 16       | \$ 7        | \$ 4        | \$ 4        |
| KEC              | \$ 3        | \$ 2        | \$ 3        | \$ 6        |
| Hyundai          | \$ 7        | \$ 12       | \$ 2        | \$ 8        |

Source: DATAQUEST

Total capital spending in 1984 was \$586 million. Estimated 1985 capital spending declined slightly from 1984 levels, but still represented a very high level of investment at approximately \$528 million. Since most of the factories and R&D programs initiated by the major industry and government push in 1983 came on-stream in 1984 and 1985, investment is expected to taper off in coming years. Total 1986 spending is projected to be \$215 million, while 1987 spending is expected to be \$205 million.

The establishment of production facilities accounted for the major share of 1984 capital spending at \$544 million, or 93 percent of total dollar investment. R&D expenditures as a share of total spending are anticipated to increase from 7 percent in 1984 to 22 percent in 1987.

A description of the R&D facilities established by the Big Four manufacturers is given in Table 22.

Table 22

RESEARCH AND DEVELOPMENT FACILITIES

| <u>Company</u> | <u>Location</u> | <u>Year<br/>Established</u> | <u>Man Power<br/>Employees</u> | <u>Floor<br/>Space (m<sup>2</sup>)</u> | <u>R&amp;D Exp.<br/>(% of Sales)</u> |
|----------------|-----------------|-----------------------------|--------------------------------|--|--------------------------------------|
| SST*           | Buchon          | 1981                        | 421                            | 11,000                                 | 4.7%                                 |
| SST            | Suwon           | 1984                        | N/A                            | N/A                                    | N/A                                  |
| GSS            | Anyang          | 1983                        | 130                            | 66,116                                 | 24.0%                                |
| KEC            | Gumi            | 1984                        | 99                             | 1,300                                  | 2.3%                                 |
| Hyundai        | Ichon           | 1984                        | 58                             | 1,300                                  | 50.0%                                |

N/A = Not Available

Source: DATAQUEST

\*This facility was converted to production in 1985. Currently only Telecom R&D is at Buchon.

## CHAPTER 10--COMPANY PROFILES

In this chapter, DATAQUEST presents information on companies manufacturing semiconductors in South Korea. The content of each profile varies depending on the data available. The most complete information is provided for the major manufacturers discussed in detail in Chapter 9, Native Manufacturers. These manufacturers have made the largest investments in developing advanced semiconductor technology during the 1980s.

The company profiles presented in this chapter are listed below:

- Daewoo Electronic Components Co., Ltd.
- Gold Star Semiconductor, Ltd.
- Hyundai Electronics Industries Co., Ltd.
- Korea Electronics Co., Ltd.
- Samsung Semiconductor and Telecommunications Co., Ltd.
- Electronics and Telecommunications Research Institute (ETRI)
- Dong Sung Moolsan Ind. Co., Ltd.
- Karibong Electronics Corp.
- KOMY Semiconductor, Ltd.
- Korea Diode Co., Ltd.
- Korea Fuji Electronics Ind. Co.
- Korea Optoelectronics Corp.
- Rohm Korea Corp.

DAEWOO ELECTRONIC COMPONENTS CO., LTD.

Parent Company

The Daewoo Group was founded in 1967 as a trading company. It has grown into a conglomerate of 29 companies that offer products and services such as automobile, shipbuilding, electronics, chemicals, construction, banking, insurance, and financing. Its total 1984 sales were US\$5.1 billion.

Daewoo Electronic Components Co., Ltd.  
541 Namdaemun-ro 5-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-754-0707; Fax: 02-776-6669  
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | N/A         | \$ 14.3     | \$ 45.3     | \$127.0     | \$ 87.0     |
| Long-Term Liabilities                     | N/A         | \$ 1.4      | \$ 1.3      | \$ 45.3     | \$ 61.6     |
| Shareholders' Equity                      | N/A         | \$ 4.3      | \$ 8.0      | \$ 51.5     | \$ 53.2     |
| After-Tax Return on<br>Average Equity (%) | (50.9)      | (28.2)      | 40.0        | 19.3        | 5.2         |

Operating Performance (December 31)

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$ 10.6     | \$ 22.8     | \$ 37.4     | \$215.0     | \$343.2     |
| Cost of Revenue          | N/A         | \$ 22.8     | \$ 33.4     | \$164.7     | \$258.6     |
| SG&A Expense             | N/A         | \$ 1.4      | \$ 1.3      | \$ 30.2     | \$ 62.8     |
| Pretax Income            | N/A         | (\$ 1.4)    | \$ 2.7      | \$ 10.1     | \$ 4.8      |
| Net Income               | (\$ 1.5)    | (\$ 1.4)    | \$ 2.7      | \$ 6.3      | \$ 2.4      |
| Average Shares (Million) | \$ 19.0     | \$ 6.4      | \$ 9.4      | \$ 80.0     | \$ 80.0     |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | ( 59.0)     | ( 156.0)    | 181.0       | 57.0        | 28.0        |
| Dividends                | 0           | 0           | 0           | 50.0        | 50.0        |
| Book Value               | 217.0       | 414.0       | 596.0       | 453.0       | 363.0       |
| Price Average            | N/A         | N/A         | N/A         | N/A         | 651.0       |
| Total Employees          | N/A         | N/A         | 1,356       | 8,020       | 10,822      |
| Exchange Rate (W/\$)     | 659.9       | 700.5       | 748.8       | 795.5       | 827.4       |

N/A = Not Available

Source: Dongsuh Securities Co., Ltd.,  
Annual Report of Listed Companies

### Background

Daewoo Electronic Components was established in 1978 as a subsidiary of the Daewoo Group. In March 1983, Daewoo purchased the consumer electronics business of Tai Han Electric Wire Co., Ltd., and became the third largest consumer electronics company in South Korea.

### Major Products

The company's main products are as follows: electronic components, television subsystems, ATVs, VTRs, cassettes, PCs, refrigerators, washing machines, and air conditioning units.

**Daewoo Electronic Components Co., Ltd.  
REVENUE BY BUSINESS ACTIVITY  
(Millions of Dollars)**

| <u>Activity</u>     | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---------------------|-------------|-------------|-------------|-------------|-------------|
| Electronic Products | \$10.6      | \$22.8      | \$37.4      | \$128.2     | \$205.5     |
| Electric Products   | 0           | 0           | 0           | \$ 86.8     | \$137.7     |

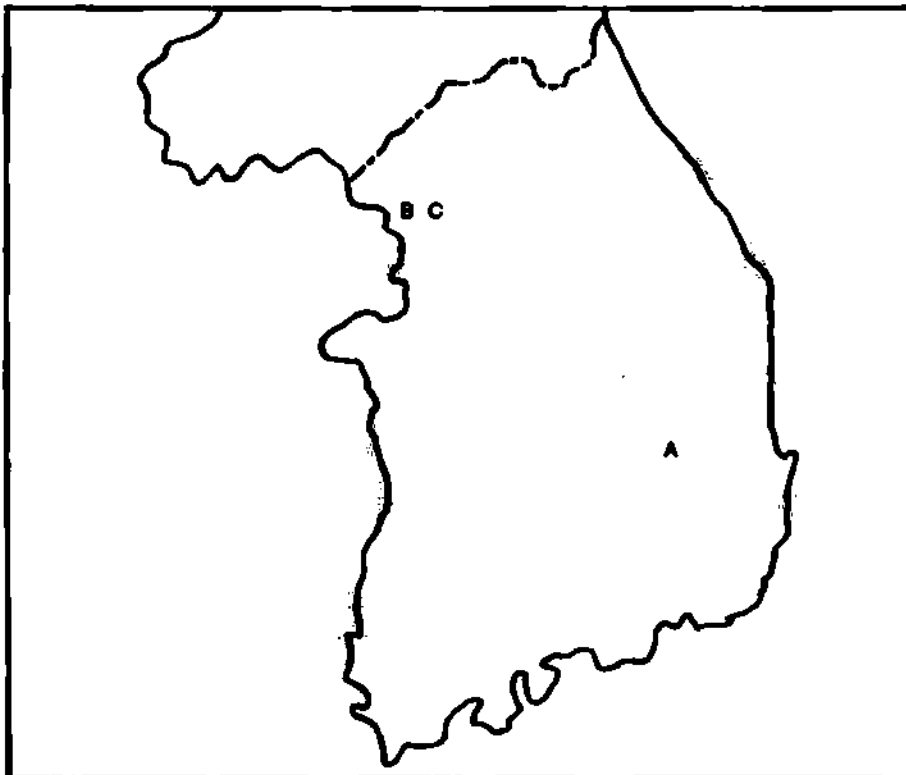
Source: Daewoo Electronic  
Components Co., Ltd.  
Annual Report

Daewoo's manufacturing facilities, their sizes, and products produced are shown in Figure 13.

Figure 13

Daewoo Electronic Components Co., Ltd.  
MANUFACTURING FACILITIES

| <u>Map Code</u> | <u>Location</u> | <u>Products</u>  |
|-----------------|-----------------|--|
| A               | Gumi Plant      | TV, VTR, PC, audio products, bipolar linear and discrete semiconductors                    |
| B               | Inchon Plant    | Refrigerator, washing machine, air conditioner, fan, vacuum cleaner, stove, microwave oven |
| C               | Juan Plant      | VTR, V-Camera, VDP   |



Source: DATAQUEST

### Semiconductor Division

- Director: C.S. Lee
- Products:
  - Linear Bipolar: Audio, video, and ICs
  - Discrete: Transistors and diodes
  - Hybrid ICs

### Semiconductor Production

- Location: 543 Dangjung-ri, Goonpo-eup, Kyungki-do, Korea
  - Manager: H.T. Kwon
  - First production: September 1979
  - Capacity: 4-inch wafers, 7,000/month
  - Capital Investment: Approximately \$10 million

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 17                     |
| Projection aligners           | 4                      |
| Ion implanters                | 1                      |
| Sputtering equipment          | 10                     |
| Etch equipment                | 2                      |
| CVD systems                   | 1                      |
| Design Center                 | In House               |

## GOLD STAR SEMICONDUCTOR, LTD. (GSS)

### Parent Company

The Lucky-Gold Star Group was founded in 1979, when the Lucky Group and Gold Star Group were combined. The Lucky Group was founded in 1947 as the Lucky Chemical Company, and the Gold Star Group was founded in 1958 as the Gold Star Co., an electronics firm.

The Lucky-Gold Star Group has 21 domestic affiliated companies and 7 overseas locally incorporated firms. Its products and services include the areas of chemicals, electronics, energy and resources, construction, insurance and finance, and trading. In 1984, sales were US\$8.5 billion.

Gold Star Semiconductor, Ltd.  
60-1 Chungmu-ro 3-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-273-4151, Telex: GOLDSEC K22767  
(Millions of Dollars Except Per Share Data)

#### Balance Sheet (December 31)

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | N/A         | \$35.7      | \$40.1      | \$44.0      | \$ 55.6     |
| Long-Term Liabilities                     | N/A         | \$22.8      | \$36.1      | \$49.0      | \$ 68.9     |
| Shareholders' Equity                      | N/A         | \$ 7.1      | \$ 8.0      | \$23.9      | \$ 29.0     |
| After-Tax Return on<br>Average Equity (%) | N/A         | N/A         | 3.7         | 9.9         | 17.4        |

#### Operating Performance (December 31)

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$ 1.2      | \$ 5.0      | \$41.4      | \$66.3      | \$130.3     |
| Cost of Revenue          | N/A         | \$ 5.7      | \$29.4      | \$46.5      | \$102.7     |
| SG&A Expense             | N/A         | \$ 2.9      | \$ 2.7      | \$ 3.8      | \$ 8.5      |
| Pretax Income            | N/A         | (\$ 8.6)    | \$ 0.3      | \$ 2.4      | \$ 5.0      |
| Net Income               | N/A         | (\$ 8.6)    | \$ 0.3      | \$ 2.4      | \$ 5.0      |
| Average Shares (Million) | N/A         | 1.3         | 1.4         | 2.5         | 2.5         |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | N/A         | (4,890)     | 169         | 770         | 1,653       |
| Dividends                | 0           | 0           | 0           | 0           | 0           |
| Book Value               | N/A         | (4,007)     | 4,615       | 7,783       | 9,492       |
| Price Average            | N/A         | N/A         | N/A         | N/A         | N/A         |
| Total Employees          | N/A         | N/A         | 1,000       | 1,524       | 2,351       |
| Exchange Rate (W/\$)     | 659.9       | 700.5       | 748.8       | 795.5       | 827.4       |

As of the end of period

N/A = Not Available

Source: Annual Report of  
Gold Star Semiconductor, Ltd.



## Background

Gold Star Semiconductor was established in 1979; it became a joint venture entity with AT&T in November of 1980 for the manufacture of 1A ESS and semiconductors. AT&T has 44 percent ownership in GSS. The company has three divisions and an R&D laboratory. The three divisions are: semiconductor, computer, and communications. In 1984, GSS saw significant growth in all business areas. The company's total revenue reached \$130 million in 1984, an increase of 96 percent over 1983.

## Major Products

The company's major products are as follows:

- Semiconductor: Transistors, linear ICs, digital ICs, hybrid ICs, 8-bit MPU, 64K SRAM, gates
- Computer: Supermini, mini, micro, PC, workstation, CAD/CAM
- Communication: 1A ESS, SLC-96, RSS, DCT

**Gold Star Semiconductor, Ltd.  
REVENUE BY BUSINESS LINE  
(Millions of Dollars)**

| <u>Activity</u> | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|-----------------|-------------|-------------|-------------|-------------|-------------|
| Semiconductor   | \$1.2       | \$2.1       | \$ 3.3      | \$ 6.4      | \$ 15.0     |
| Computer        | -           | -           | \$ 4.3      | \$ 0.3      | \$ 4.8      |
| ESS             | -           | \$2.9       | \$33.8      | \$59.6      | \$110.2     |

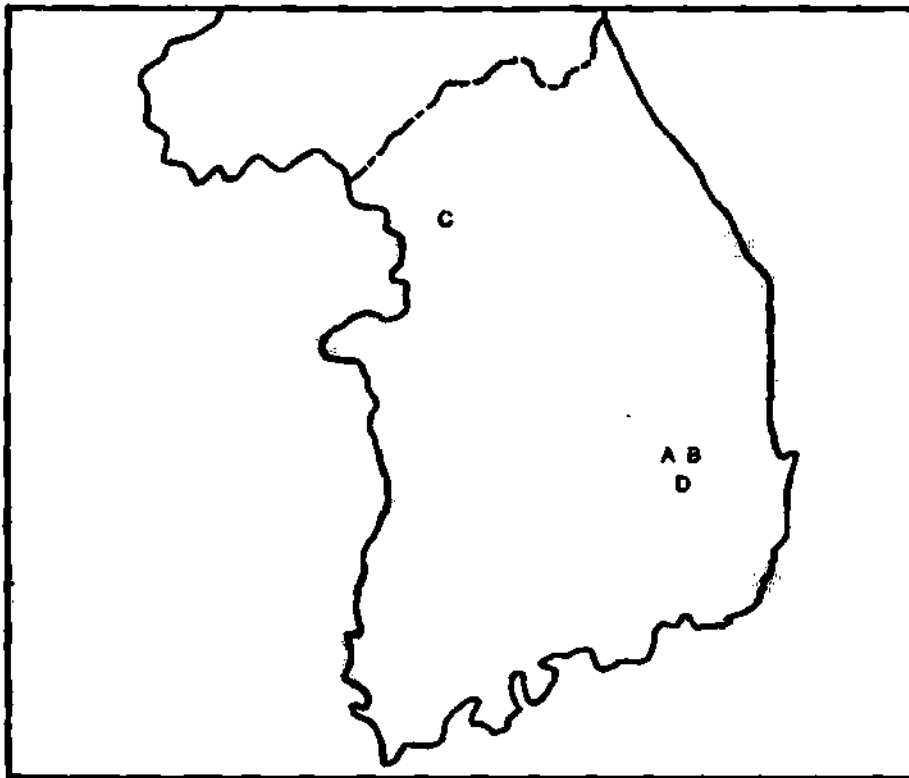
Source: DATAQUEST  
Annual Report of Gold Star  
Semiconductor, Ltd.

GSS's manufacturing facilities, their products, and approximate size are shown in Figure 14.

**Figure 14**

**Gold Star Semiconductor, Ltd.  
MANUFACTURING FACILITIES**

| <u>Map Code</u> | <u>Location</u>     | <u>Products</u>                              |
|-----------------|---------------------|--|
| A               | Gumi Bipolar Plant  | Transistor, Linear IC, Digital IC, Hybrid IC |
| B               | Gumi MOS-I Plant    | MPU, Memory, Gate Array                      |
| C               | Anyang MOS-II Plant | Memory, Custom IC                            |
| D               | Gumi ESS Plant      | ESS, Computer                                |



Source: DATAQUEST

## Semiconductor Division

- Director: Dr. C.S. Kim
- Brief history of GSS's semiconductor business:
  - 1979: Founded as a member of the Lucky-Gold Star Group
  - 1980: Started packaging business
  - 1980: Started semiconductor fabrication
  - 1981: Established joint venture and technology agreement with AT&T
  - 1982: Technology agreement with AT&T for Digital ESS, superminicomputer, and MOS technology
  - 1983: Second-source agreement for Z80 MPU with Zilog
  - 1984: Started production of Z80 family
  - 1984: Second-source agreement for gate array with LSI Logic
  - 1984: Completed MOS-I plant construction
  - 1984: Second-source agreement for 64K DRAM with AMD
  - 1984: Completed MOS-II plant construction
  - 1985: Second-source agreement for LL-7000 with LSI Logic
- Products:
  - MOS Memory: 64K DRAM, 64K SRAM
  - MOS MPU: Z8, Z80 families
  - Linear Bipolar: Audio, video, and industrial ICs
  - Digital Bipolar: STTL, LSTTL, MODEM, telephone ICs, CDI
  - Semicustom: CMOS gate arrays
  - Hybrid IC: Thin film
  - Transistors: Low-power, high-speed, medium-power, SCR/TRIAC

**Gold Star Semiconductor, Ltd.**  
**WORLDWIDE SEMICONDUCTOR SALES**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985*</u> |
|---------------------|-------------|-------------|-------------|--------------|
| Total Semiconductor | \$ 3.3      | \$ 6.4      | \$15.0      | \$35.0       |
| Total IC            | \$ 0.8      | \$ 3.9      | \$13.0      | \$32.0       |
| Bipolar Digital     | -           | -           | 1.0         | 4.0          |
| MOS                 | -           | 0.1         | 1.0         | 6.0          |
| Memory              | -           | -           | 0.0         | 4.0          |
| MPU/MCU             | -           | 0.1         | 1.0         | 1.0          |
| Logic               | -           | -           | -           | 1.0          |
| Linear              | 0.8         | 3.8         | 10.0        | 22.0         |
| Total Discrete      | \$ 2.5      | \$ 2.5      | \$ 3.0      | \$ 3.0       |

\*Estimated

Source: DATAQUEST  
Annual Reports of  
Gold Star Semiconductor, Ltd.

Semiconductor Production

|                             | <u>Bipolar and MOS I</u>                   | <u>MOS II</u>                                      |
|-----------------------------|--|--|
| Location                    | 171 Imsu-dong, Gumi-si,<br>Kyungbuk, Korea | 533 Hogae-dong,<br>Anyang-si,<br>Kyungki-do, Korea |
| Manager                     | D. H. Song                                 | Dr. C.S. Kim                                       |
| Date of First<br>Production | Feb. 1980/Sept. 1984                       | Nov. 1984  |
| Employees (Total)           | 1,200                                      |  |

● Production Capacity

- Transistor: 75 million units/year
- Plastic DIP: 100 million units/year
- Ceramic DIP: 14 million units/year

● Capital Spending (Millions of Dollars)

|            | <u>1983</u> | <u>1984</u> | <u>1985 (est.)</u> |
|------------|-------------|-------------|--------------------|
| All Plants | \$ 40       | \$ 60       | \$100              |

● Average Monthly Wafer Starts

| <u>Plant</u> | <u>Wafer Size</u> | <u>Wafers/Month</u> |
|--------------|-------------------|---------------------|
| Bipolar      | 4-inch            | 13,000              |
| MOS I        | 5-inch            | 15,000              |
| MOS II       | 5-inch            | 10,000              |

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 88                     |
| Wafer Steppers                | 9                      |
| Projection Aligners           | 8                      |
| Ion Implanters                | 7                      |
| Sputtering Equipment          | 5                      |
| Etching Equipment             | 10                     |
| CVD Systems                   | 5                      |
| Epi Reactors                  | 3                      |

● Design Centers

- There are two design groups within GSS. Both design groups are for in-house product development.
  - . One is currently established at the Gumi plant.
  - . The U.S. design center, United Microtek, Inc., is a wholly owned subsidiary of the Lucky-Gold Star Group. It is located at 1130 E. Arques Ave., Sunnyvale, CA 94086 (Telephone: 408-738-8388).
- Equipment: 2 Calma GDS II, 5 workstations

## Joint Ventures/Licensing

### Gold Star Semiconductor, Ltd.

| <u>Partner</u> | <u>Country</u> | <u>Year</u> | <u>Technology</u>                        |
|----------------|----------------|-------------|--|
| AT&T           | United States  | 1980        | Process technology<br>64K DRAM, 16K SRAM |
| Zilog          | United States  | 1983        | 28, 280 MCU, and MPU<br>families         |
| AMD            | United States  | 1984        | 64K, 256K DRAM                           |
| LSI Logic      | United States  | 1984        | CMOS gate array                          |
| Fairchild      | United States  | 1985        | 64K SRAM                                 |

- Contract manufacturing

- Monolithic Memories Inc.: Bipolar linear products (expired)
- Fairchild: 64K SRAM
- LSI Logic: Gate arrays

## HYUNDAI ELECTRONICS INDUSTRIES CO., LTD.

### Parent Company

The Hyundai Group was founded as a construction company in 1947; the firm is now the largest business organization in South Korea. It has worldwide operations in construction, ship-building, steel fabrication, automobile manufacturing, and electronics. Its 32 affiliated companies, including five in the United States, employ more than 150,000 people. Hyundai's total 1984 sales were US\$9.2 billion.

### Background

Hyundai Electronics Industries (HEI) was established in February 1983 by the Hyundai Group. A sister company, Hyundai Electronics America (formerly Modern Electrosystems, Inc.) was founded about the same time, in March of 1983. HEI encompasses six technical divisions; of these, three are related to semiconductor operations, and one is a laboratory. The divisions are Semiconductor I, Semiconductor II, Semiconductor Assembly, Information Systems, Communications, and Industrial Electronics.

### Major Products

The company's major products are semiconductors, computers and peripherals, mobile telephones, communication equipment, automobile electronics, industrial instrumentation, and control systems.

Hyundai's main manufacturing facility is shown in Figure 15.

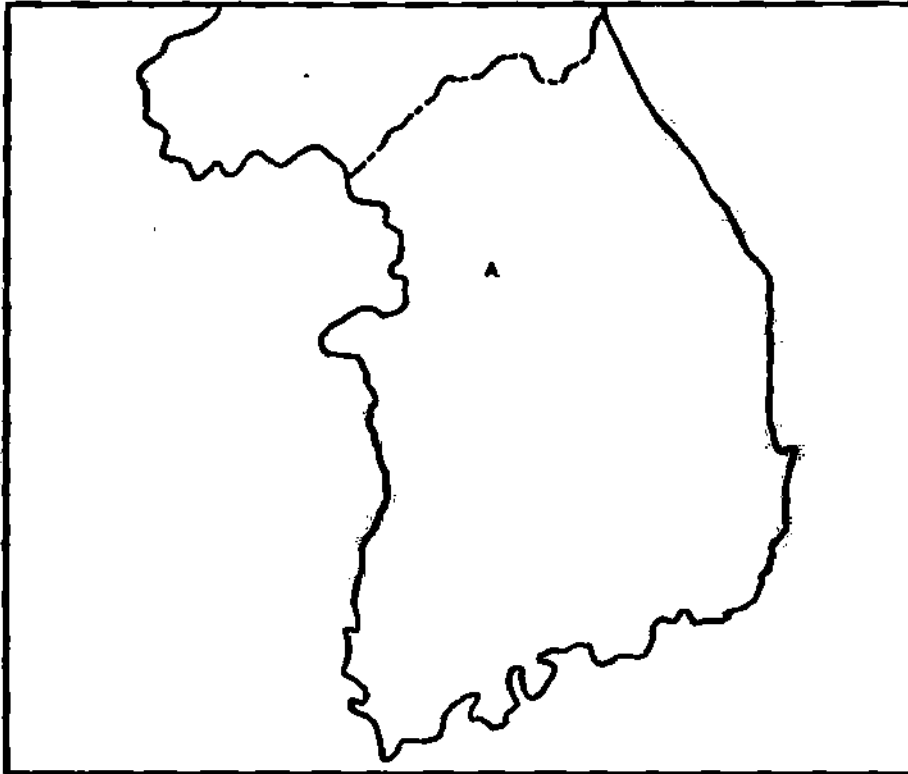
Planned semiconductor products include:

- Memory: 16K SRAM, 128K ROM, 1K EEPROM, 64K EPROM, 64K DRAM
- MPU: 8-bit, 16-bit, CMOS

Figure 15

Hyundai Electronics Industries Co., Ltd.  
MANUFACTURING FACILITIES

| <u>Map Code</u> | <u>Location</u> | <u>Products</u>              |
|-----------------|-----------------|------------------------------|
| A               | Ichon Plant     | Memory, Assembly Consignment |



Source: DATAQUEST



### Semiconductor Divisions

- Semiconductor I Division--Director: Dr. D.W. Chun
- Semiconductor II Division--Director: Dr. K.O. Park
- Semiconductor Assembly Division--Director: J.H. Lee

### Semiconductor Production

- All Divisions are Located at the Main Office:

133-2 Ami-ri, Bubal-myun, Ichon-kun  
Kyungki-do, Korea

- First Production

- SC I: December 1984
- SCII: Fourth quarter, 1985
- Assembly: Second quarter, 1985

- Employees: 850

- Capital Spending (Millions of Dollars)

| <u>1983</u> | <u>1984</u> | <u>1985</u> |
|-------------|-------------|-------------|
| \$30        | \$112       | \$140       |

- Average Monthly Wafer Starts: 1985

| <u>Plant</u> | <u>Wafer Size</u> | <u>Wafers/Month</u> |
|--------------|-------------------|---------------------|
| SC I         | 5-inch            | 15,000              |
| SC II        | 6-inch            | 25,000              |

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 72                     |
| Wafer Steppers                | 34                     |
| Projection Aligners           | 6                      |
| Ion Implanters                | 7                      |
| Sputtering Equipment          | 7                      |
| Etching Equipment             | 23                     |
| CVD Systems                   | 14                     |

- Design Centers

Originally, Hyundai operated two design groups, one at Ichon, South Korea, and the other at HEA, U.S.A., serving in-house product development needs. In 1985, HEA announced the closing of engineering and manufacturing activities, which included the U.S. design center.

- Equipment: 2 Calma GDS II with 4 workstations

### Joint Venture/Licensing

| <u>Partner</u>                | <u>Country</u> | <u>Year</u> | <u>Technology</u>       |
|-------------------------------|----------------|-------------|-------------------------|
| Inmos                         | United States  | 1984        | 64K, 256K CMOS DRAMS    |
| International CMOS Technology | United States  | 1984        | EEPROMs, EPROMs         |
| Texas Instruments             | United States  | 1984        | 64K DRAMS               |
| Western Design Center         | United States  | 1984        | 8-bit, 16-bit, CMOS MPU |

- Contract Manufacturing
  - Texas Instruments: 64K, 256K DRAMS
  - Vitelic: 64K, 256K, 1-megabit CMOS DRAMS

### U.S. Sister Company

Hyundai Electronics America, Inc. (HEA)

- HEA is the product development and marketing arm of HEI, Korea
- Location: 2191 Laurelwood Rd., Santa Clara, CA 95054
- Telephone: (408) 986-9800
- Telex: 278841 HEA UR
- Date established: March 1983
- Chief Operating Officer: C.S. Park

- Employees: 200 (September 1985)
- Investment: \$40 million
- Products: SRAM, ROM, EPROM, EEPROM, MPU
- Capacity: 5-inch Wafers, 4,000/month

In October 1985, HEA closed its product development and manufacturing activities, and announced it will concentrate marketing activities at the current location.

## KORRA ELECTRONICS CO., LTD.

### Background

Korea Electronics Co. (KEC) was established in September 1969 under a joint venture with Toshiba Co. of Japan (South Korea, 30 percent; Toshiba, 70 percent). At that time, the company name was Toshiba Korea Co. In 1979, the ownership was changed to 90 percent South Korea, 10 percent Toshiba when the company became public. The current company name was adopted at that time.

Korea Electronics Co., Ltd.  
45 Namdaemun-ro 4-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-757-5700, Fax: 02-756-5800  
(Millions of Dollars Except Per Share Data)

### Balance Sheet (September 31)

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | \$ N/A      | \$31.3      | \$18.4      | \$ 8.0      | \$26.1      |
| Long-Term Liabilities                     | \$ 7.9      | \$ 8.3      | \$16.3      | \$14.6      | \$19.9      |
| Shareholders' Equity                      | \$ 4.5      | \$11.7      | \$10.8      | \$10.9      | \$14.0      |
| After-Tax Return on<br>Average Equity (%) | 14.7        | 15.8        | 5.1         | 11.9        | 32.9        |

### Operating Performance (September 31)

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$24.2      | \$50.0      | \$40.1      | \$61.6      | \$84.6      |
| Cost of Revenue          | \$18.2      | \$40.0      | \$33.4      | \$50.3      | \$66.5      |
| SG&A Expense             | \$ 1.5      | \$ 4.3      | \$ 4.0      | \$ 6.3      | \$ 6.0      |
| Pretax Income            | \$ 0.9      | \$ 1.4      | \$ 0.4      | \$ 2.0      | \$ 6.4      |
| Net Income               | \$ 0.6      | \$ 1.3      | \$ 0.4      | \$ 1.3      | \$ 4.0      |
| Average Shares (Million) | 4.0         | 6.4         | 9.0         | 9.0         | 9.0         |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | 108.0       | 152.0       | 51.0        | 111.0       | 371.0       |
| Dividends                | 100.0       | 87.5        | 45.0        | 50.0        | 60.0        |
| Book Value               | 326.0       | 1,188.0     | 1,123.0     | 826.0       | 1,192.0     |
| Price Average            | N/A         | N/A         | N/A         | 1,087.0     | 2,450.0     |
| Total Employees          | N/A         | 1,827       | 1,786       | 2,003       | 2,184       |
| Exchange Rate (W/US\$)   | 659.9       | 700.5       | 748.8       | 795.5       | 827.4       |

N/A = Not Available

Source: Dongsuh Securities Co., Ltd.,  
Annual Report of Listed Companies

### Major Products

The company's major products are black and white and color television sets, monitors, and semiconductors.

**Korea Electronics Co., Ltd.**  
**REVENUE BY BUSINESS LINE**  
**(Millions of Dollars)**

|                  | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|------------------|-------------|-------------|-------------|-------------|
| Semiconductor    | \$27.2      | \$14.7      | \$26.4      | \$38.0      |
| Pellet           | -           | \$ 0.1      | \$ 0.5      | \$ 1.0      |
| Television/Tuner | \$21.4      | \$24.0      | \$33.9      | \$47.1      |

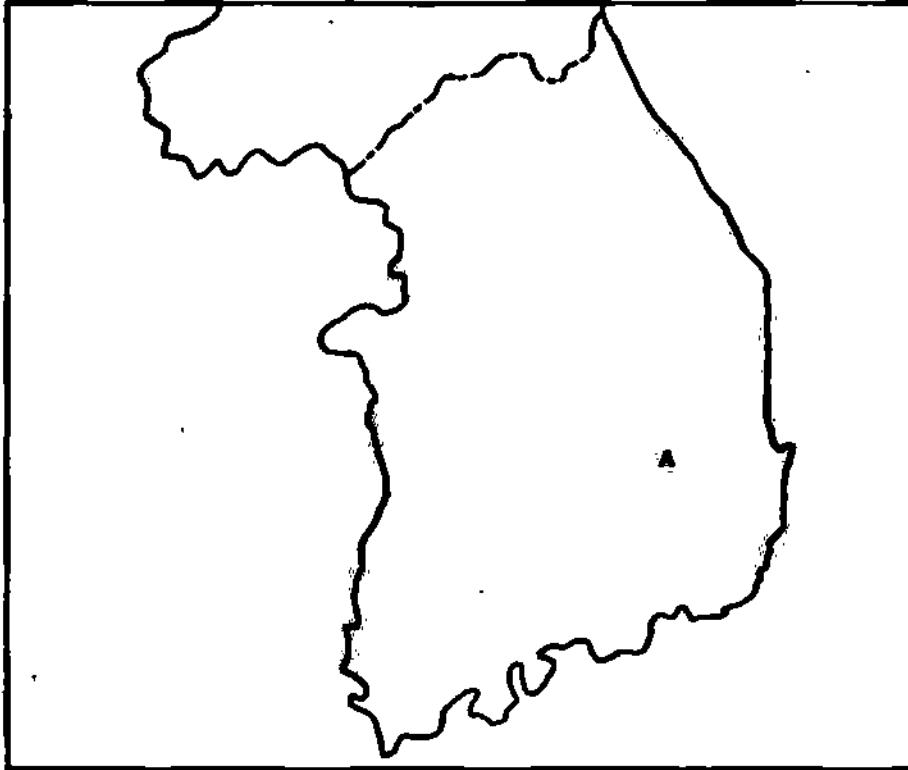
Source: DATAQUEST  
Annual Reports of  
Korea Electronics Co., Ltd.

KEC's major manufacturing facilities and its products are shown in Figure 16.

Figure 16

Korea Electronics Co., Ltd.  
MANUFACTURING FACILITIES

| <u>Map Code</u> | <u>Location</u> | <u>Products</u>   |
|-----------------|-----------------|---|
| A               | Gumi Plant      | Transistors, IC, LED, Diode, Pellet, CTV, FBT, Tuner, Monitor |



Source: DATAQUEST

### Semiconductor Division

The following is a brief history of KEC's semiconductor business:

- Started the business in March 1970 with the production of To-92 type transistors
- Expanded the business to provide more variety of product--from semiconductor components to consumer products
- Had one of the world's largest assembly capacities for To-92 transistors as of the end of 1984

### Major Products

- Linear Bipolar: Audio and video ICs
- Discrete: Transistors, diodes, LEDs

**Korea Electronics Co., Ltd.  
WORLDWIDE SEMICONDUCTOR SALES  
(Millions of Dollars)**

|                       | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|-----------------------|-------------|-------------|-------------|-------------|
| Total Semiconductor   | \$14.7      | \$26.4      | \$38.0      | \$42.0      |
| Total IC              | \$ 2.7      | \$ 3.8      | \$ 5.0      | \$ 8.0      |
| Bipolar Digital       | -           | -           | -           | -           |
| MOS                   | -           | -           | -           | -           |
| Memory                | -           | -           | -           | -           |
| Microprocessor        | -           | -           | -           | -           |
| Logic                 | -           | -           | -           | -           |
| Linear                | 2.7         | 3.8         | 5.0         | 8.0         |
| Total Discrete        | \$10.7      | \$20.1      | \$30.0      | \$32.0      |
| Total Optoelectronics | \$ 1.3      | \$ 2.5      | \$ 3.0      | \$ 2.0      |

Source: DATAQUEST  
Annual Reports of  
Korea Electronics Co., Ltd.

### Semiconductor Production

- Location: 149 Gongdan-dong, Gumi City, Kyungbuk, Korea
- Capital Spending
  - Estimated total investment by 1985: \$40 million
- Average Monthly Wafer Starts
  - 3-inch, 5,000
  - 4-inch, 5,000

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 36                     |
| Projection Aligners           | 10                     |
| Ion Implanters                | 1                      |
| Etching Equipment             | 2                      |
| CVD Systems                   | 3                      |

### Joint Ventures/Licensing

| <u>Partner</u> | <u>Country</u> | <u>Year</u> | <u>Technology</u>  |
|----------------|----------------|-------------|--|
| Toshiba        | Japan          | 1970        | Assembly and process technology,<br>discrete and linear bipolar<br>devices |



**SAMSUNG SEMICONDUCTOR AND TELECOMMUNICATIONS CO., LTD.**

**Parent Company**

The Samsung Group was founded in 1938, making it one of the oldest private business enterprises in Korea. Samsung has grown into a conglomerate of 25 affiliated companies with more than 100,000 employees. The products and services it provides include the following areas: food, textile, electronics, heavy industries, construction, hotels, insurance, and trading. The Samsung Group's 1984 sales reached over US\$10 billion.

Samsung Semiconductor and Telecommunications  
150 Taepyung-ro 2-ga,  
Jung-gu, Seoul 100, Korea  
Telephone: 02-771-78, Telex: K24377  
(Millions of Dollars Except Per Share Data)

**Balance Sheet (December 31)**

|   | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|---|-------------|-------------|-------------|-------------|-------------|
| Financial Resources                       | N/A         | \$34.3      | \$64.1      | \$104.3     | \$385.5     |
| Long-Term Liabilities                     | \$24.2      | \$25.7      | \$26.7      | \$ 56.6     | \$201.8     |
| Shareholders' Equity                      | \$12.1      | \$14.3      | \$25.4      | \$ 37.7     | \$ 85.8     |
| After-Tax Return on<br>Average Equity (%) | (27.8)      | 22.6        | 14.4        | 8.6         | 12.5        |

**Operating Performance (December 31)**

|                          | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| Revenue                  | \$27.3      | \$68.5      | \$92.1      | \$132.0     | \$216.3     |
| Cost of Revenue          | \$18.2      | \$47.1      | \$68.1      | \$104.3     | \$155.9     |
| SG&A Expense             | \$ 3.0      | \$ 5.7      | \$ 8.0      | \$ 18.9     | \$ 27.8     |
| Pretax Income            | (\$ 4.5)    | \$ 2.9      | \$ 2.7      | \$ 5.0      | \$ 12.1     |
| Net Income               | (\$ 4.5)    | \$ 2.9      | \$ 2.7      | \$ 2.5      | \$ 7.3      |
| Average Shares (Million) | 11.4        | 11.4        | 16.3        | 26.0        | 60.0        |
| Per Share (Won)          |             |             |             |             |             |
| Earnings                 | (220.0)     | 174.0       | 125.0       | 109.0       | 141.0       |
| Dividends                | 0           | 0           | 0           | 0           | 100.0       |
| Book Value               | 105.0       | 539.0       | 1,091.0     | 1,090.0     | 1,020.0     |
| Price Average            | N/A         | N/A         | N/A         | N/A         | 1,758.0     |
| Total Employees          | N/A         | N/A         | N/A         | N/A         | 6,871       |
| Exchange Rate (W/US\$)   | 659.0       | 700.5       | 748.8       | 795.5       | 827.4       |

N/A = Not Available

Source: Dongsuh Securities Co., Ltd.  
Annual Report of Listed Companies

## Background

The Samsung Group took over the Korea Telecommunications Co. (KTC) in 1980. KTC was a wholly owned government corporation established in 1977 to modernize the South Korean communications network. In 1982, the Samsung Group merged its telecommunications operations with another of its subsidiaries, the Korea Semiconductor Inc., a manufacturer of CMOS watch chips since 1974. The new entity was renamed Samsung Semiconductor and Telecommunications Company (SST).

SST is separated into three divisions: telecommunications, computers, and semiconductors. SST also has a research and development facility, and an affiliated group company, Samsung Semiconductor, Inc. (formerly Tristar Semiconductor), which is located in the United States.

## Major Products

SST's major products include ESS, PAB, telephone sets, key telephones, facsimiles, modems, computers, optical fiber and cables, and semiconductors.

### Samsung Semiconductor and Telecommunications Co., Ltd. REVENUE BY BUSINESS LINE (Millions of Dollars)

|                | <u>1980</u> | <u>1981</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> |
|----------------|-------------|-------------|-------------|-------------|-------------|
| ESS            | \$25.8      | \$56.6      | \$69.7      | \$78.4      | \$114.0     |
| PABX           | \$ 0.9      | \$ 4.0      | \$ 6.0      | \$ 9.1      | \$ 17.3     |
| Telephone      | -           | -           | \$ 0.7      | \$ 5.4      | \$ 12.0     |
| Facsimile      | -           | -           | -           | \$ 1.6      | \$ 3.1      |
| Modem          | -           | -           | -           | \$ 0.1      | \$ 0.4      |
| Minicomputer   | -           | -           | -           | -           | \$ 0.8      |
| Key Telephone  | -           | -           | -           | -           | \$ 0.8      |
| Semiconductors | -           | -           | \$ 4.8      | \$25.9      | \$ 60.0     |

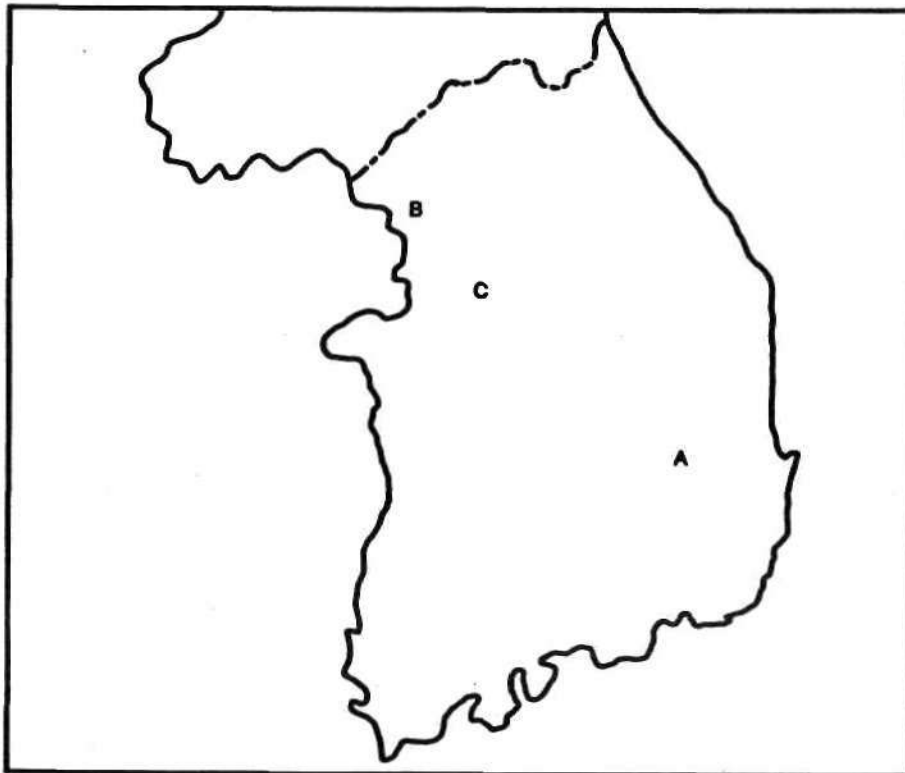
Source: DATAQUEST  
Annual Reports of  
Samsung Semiconductor and  
Telecommunications Co., Ltd.

SST's major manufacturing facilities, their size, and the products produced, are shown in Figure 17.

**Figure 17**

**Samsung Semiconductor and Telecommunications Co., Ltd.  
MANUFACTURING FACILITIES**

| <b>Map Code</b> | <b>Location</b>     | <b>Products</b>  |
|-----------------|---------------------|--|
| <b>A</b>        | <b>Gumi Plant</b>   | <b>ESS, Computer, OA Equipment, Telephone, Terminal</b>        |
| <b>B</b>        | <b>Buchon Plant</b> | <b>Transistors, CMOS, Linear IC, Lead Frame, Optical Fiber</b> |
| <b>C</b>        | <b>Suwon Plant</b>  | <b>64K DRAM, 256K DRAM, MPU, MCU, 16K SRAM, 16K EEPROM</b>     |



Source: DATAQUEST

### Semiconductor Division

- Director: K.H. Kim
- Brief history of SST's semiconductor business
  - 1974: Successfully produced LSI for electronic watches
  - 1978: Started producing linear IC
  - 1978: Developed color-signal ICs
  - 1983: Established U.S. subsidiary in Santa Clara, California
  - 1983: Succeeded in pilot production of the 64K DRAM
  - 1984: Completed the construction of the VLSI plant
  - 1984: Developed the 16K EEPROM and 16K SRAM
  - 1984: Developed the 256K DRAM
  - 1985: Shipped 256K DRAM samples
  - 1985: Completed construction of the 256K DRAM facility

### Semiconductor Products

- MOS Logic: Watch chip, calculator chip, HC/TTL, LS/TTL
- MOS Memory: 64K DRAM, 128K DRAM, 256K DRAM, 16K SRAM, 64K SRAM, 16K EEPROM
- MOS MPU: 4-bit, 8-bit, and Intel second source
- Linear IC: Audio, video, industrial, telecom, and consumer ICs
- Transistors: S/S, Power

**Samsung Semiconductor and Telecommunications Co., Ltd.**  
**WORLDWIDE SEMICONDUCTOR SALES**  
(Millions of Dollars)

|                       | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|-----------------------|-------------|-------------|-------------|-------------|
| Total Semiconductor   | \$4.8       | \$25.9      | \$60.0      | \$95.0      |
| Total IC              | \$3.7       | \$14.0      | \$33.0      | \$75.0      |
| Bipolar Digital       | -           | -           | -           | -           |
| MOS                   | 3.2         | 9.9         | 25.0        | 55.0        |
| Memory                | -           | -           | 3.0         | 21.0        |
| Microprocessor        | -           | -           | -           | -           |
| Logic                 | 3.2         | 9.9         | 22.0        | 34.0        |
| Linear                | 0.5         | 4.1         | 8.0         | 20.0        |
| Total Discrete        | \$1.1       | \$11.9      | \$27.0      | \$20.0      |
| Total Optoelectronics | -           | -           | -           | -           |

Source: DATAQUEST  
Annual Reports of  
Samsung Semiconductor and  
Telecommunications Co., Ltd.

**Semiconductor Production**

● Facilities

|                             | <u>Buchon Plant</u>                             | <u>Suwon Plant</u>  |
|-----------------------------|---|---|
| Location                    | 82-3, Dodang-dong, Buchon,<br>Kyunggi-do, Korea | San 24, Nongsuh-ri,<br>Kiheung-myun, Yongin-gun,<br>Kyunggi-do, Korea |
| Manager                     | S.K. Lee  | Y. W. Lee   |
| Date of First<br>Production | Dec. 1974                                       | April 1984  |
| Employees<br>(May 1985)     | 1,900   | 1,600   |

● Production Capacity (Thousands of Units)

| <u>Plant</u> | <u>Product</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>Total</u> |
|--------------|----------------|-------------|-------------|-------------|--------------|
| Buchon       | Transistor     | 132,101     | 249,202     | 470,698     | 852,001      |
|              | Linear IC      | 8,718       | 19,964      | 50,504      | 79,186       |
|              | MOS Logic      | 56,576      | 107,309     | 172,068     | 335,952      |
| Suwon        | MOS Memory     |             |             | 18,144      | 18,144       |
| Total        |                | 197,394     | 376,475     | 711,414     | 1,285,283    |

● Capital Spending (Millions of Dollars)

| <u>Plant</u> | <u>1983</u> | <u>1984</u> | (Estimated)<br><u>1985</u> |
|--------------|-------------|-------------|----------------------------|
| Buchon       | \$15        | \$ 40       | \$ 60                      |
| Suwon        | <u>24</u>   | <u>124</u>  | <u>194</u>                 |
| Total        | \$39        | \$164       | \$254                      |

● Average Monthly Wafer Starts (Wafer/Month)

| <u>Plant</u> | <u>Wafer Size</u> | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|--------------|-------------------|-------------|-------------|-------------|-------------|
| Buchon       | 3-inch            | 15,000      | 15,000      | 15,000      | 15,000      |
|              | 4-inch            |             | 15,000      | 15,000      | 15,000      |
|              | 5-inch            |             |             |             | 20,000      |
| Suwon        | 4-inch            |             |             | 27,000      | 27,000      |
|              | 6-inch            |             |             |             | 20,000      |

| <u>Partial Equipment List</u> | <u>Number of Units</u> |
|-------------------------------|------------------------|
| Furnaces                      | 210                    |
| Wafer Steppers                | 19                     |
| Projection Aligners           | 36                     |
| Ion Implanters                | 17                     |
| Sputtering Equipment          | 10                     |
| Etching Equipment             | 43                     |
| CVD Systems                   | 8                      |
| Epi Reactors                  | 4                      |

- U.S. Subsidiary

- Samsung Semiconductor, Inc. (SSI)

- SSI is the product development and marketing arm of SST, Korea.

- Location: 5150 Great America Parkway, Santa Clara, CA 95054

- Telephone: (408) 980-1630

- Telex: 339544 KORSEM SNTA

- Date established: July 1983

- President: Dr. Sang Joon Lee

- Employees: 150

- Investment: \$60 million (\$30 million-\$40million in facilities)

- Products: DRAM, SRAM, EPROM, EEPROM, Custom, Semicustom

- Capacity: 5-inch Wafers, 4,000/month

- Design Centers

- There are design groups for internal product development both at Buchon plant and SSI (U.S.). In the spring of 1985, SST established a joint venture agreement with National Semiconductor of the United States to open a design center at the Buchon plant. This facility designs gate arrays and other semicustom products for National Semiconductor and for customers in Korea.

- Number of People: Approximately 20

- Equipment: Five Daisy workstations

### Joint Venture/Licensing

| <u>Partner</u>         | <u>Country</u> | <u>Year</u> | <u>Technology</u> |
|------------------------|----------------|-------------|-------------------|
| DITTI                  | Germany        | 1983        | CMOS              |
| Micron Technology      | United States  | 1983        | 64K, 256K DRAM    |
| Sharp (Japan)          | Japan          | 1983        | 4-bit MPU         |
| Exel Microelectronics  | United States  | 1984        | 16K EEPROM        |
| Intel                  | United States  | 1985        | 8-bit MPU, MCU    |
| National Semiconductor | United States  | 1985        | Gate array        |
| Zytrex                 | United States  | 1985        | CMOS logic        |

### Contract Manufacturing

- Wafer Foundry for SGS, Italy, for MPU
- 5,000 Wafers/Month



## KOREA ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE (KETRI)

### Parent Company

This organization was formed in March 1985, when the Korea Institute of Electronics Technology (KIET) was merged with Korea Telecommunications Research Institute. The combined institute will be located at the original telecommunications research institute, Daeduck, about 100 miles south of Seoul, Korea. KIET's semiconductor facility at Gumi City will be sold to Daewoo. The following information refers to this facility.

### Semiconductor Production

- Location: Imsu-dong Gumi-si, Kyungbuk, Korea
- Manager: Y.I. Kang
- Date of First Production: October 1980
- Employees: 150
- Products:
  - Linear Bipolar: Audio, video, and telecommunications
  - MOS Memory: 2K and 4K SRAMs, 32K and 64K ROMs
  - MOS MPU: 8-bit
- Investment
  - \$60 million by 1985
- Average Monthly Wafer Starts
  - Bipolar: 4-inch, 2,000
  - MOS: 4-inch, 2,000

### Partial Equipment List

### Number of Units

|                        |    |
|------------------------|----|
| Furnace                | 32 |
| Aligner                | 6  |
| Ion implanter          | 2  |
| Sputter                | 1  |
| Etcher                 | 3  |
| Wafer coater/developer | 6  |
| VCD                    | 2  |

- Design Center
  - In-house design group
  - 1 Applicon CAD
  - 2 Metheus workstations

**Joint Venture/Licensing**

VLSI Technology: (1982) NMOS Process, 32K ROM

**Contract Manufacturing**

VLSI Technology: 32K and 64K ROM (Expired)

**DONG SUNG MOOLSAN IND. CO., LTD.**

President: Dong Hai Kim  
Head Office: Room 703, Sehan Bldg., 27-1, Supyo-dong  
Jongro-ku, Seoul, Korea  
Factory: San 2-2, Karpung-ri, Majang-myun  
Ichon-kun, Kyunggi-do, Korea  
Seoul Office: Room 305, Daechang Bldg., 182-2, Jangsa-dong  
Jongro-ku, Seoul, Korea  
Telephone: Head Office: 272-5072/3  
Factory: (MAJANG) 20  
Seoul Office: 272-6576/7  
P.O. Box, C.P.O Box 1872, Seoul  
Telex: KOSTAR K26133  
Cable: KOSTAR METAL, Seoul  
Capital: W340 million  
Employees: 240  
Established: 1982  
Annual Production: 1984e--\$3.1 million  
Brand Name: DS  
Main Products: Rectifier diodes, silicon varistors, bridge  
diodes, varistors

KARIBONG ELECTRONICS CORP.

President: Ju Sup Shim

Head Office: 238-104, Karibong-dong, Guro-ku, Seoul, Korea

Factory: 1st: 238-104, Karibong-dong, Guro-ku, Seoul, Korea

2nd: 151-16, Doksan-dong, Guro-ku, Seoul, Korea

Telephone: Head Office: 855-7101/4

Factory: 1st: 856-8427, 853-2331

2nd: 864-7739, 7740, 0554

P.O. Box: Gurodanji 59, Seoul

Telex: ROHMKO K23205

Cable: KARIBONG Seoul

Capital: W80 million

Employees: 816

Established: 1976

Annual Production: 1984e--\$9.3 million

Main Products: Silicon diodes, rectifying diodes, LED display,  
LED lamps

**KOMY SEMICONDUCTOR, LTD.**

President: Jin Young Lee  
Head Office and Factory: 316-7, Hyosung-dong, Buk-ku,  
Ichon, Korea  
Seoul Office: Tae Yang Bldg., 44-4, Yoido-dong  
Youngdeungpo-ku, Seoul, Korea  
Telephone: Head Office: 742-4373, 782-9051  
Factory: (032) 92-3983  
P.O. Box: C.P.O Box 1829, Seoul  
Telex: KOMYKOR K24214  
Cable: LEEKOMY Bupyeong  
Capital: W200 million  
Employees: 300  
Established: 1964  
Venture Form: Joint venture with KOMG of the United States;  
KOMG has minority ownership  
Annual Production: 1984e--\$84.0 million  
Overseas Office: KSL Microdevices, Bldg. 38, 3350 Scott Blvd.,  
Santa Clara, CA 94054 U.S.A.  
Brand Name: KSL  
Main Products: Transistors, ICs

**KOREA DIODE CO., LTD.**

President: Sam Yong Rho

Head Office: Rm. 6f06, Joongang Bldg., 44-26, Yoido-dong,  
Youngdeungpo-ku, Seoul, Korea

Factory: 4-13, Wonmi-dong, Buchon City, Kyunggi-do, Korea

Telephone: Head Office: 783-6141

Factory: (032) 63-8231

P.O. Box: Yoido P.O. Box 653, Seoul

Telex: KODICO K27885

Capital: W120 million

Employees: 40

Established: 1983

Brand Name: KDC

Main Products: Rectifier diodes, fast recovery diodes, zener  
diodes, bridge diodes, varistors, transistors

**KOREA FUJI ELECTRONICS IND. CO.**

**President: Jin Kyu Kim**

**Head Office and Factory: 159-17, Doksan-dong, Guro-ku, Seoul,  
Korea**

**Telephone: Head Office: 856-6444, 863-4345, 855-0301**

**P.O. Box: C.P.O. Box 1604 Seoul**

**Telex: WOOINTY K28984**

**Cable: SENSITRONIC Seoul**

**Capital: W100 million**

**Employees: 68**

**Established: 1975**

**Annual Production: 1984e--\$2.9 million**

**Main Products: NTC thermistors, thermistor sensors, silicon  
varistors, SIC varistors, silicon rectifier  
diodes.**

**KOREA OPTOELECTRONICS CORP.**

President: Wall Boon Park  
Head Office: 53-10, Kueui-dong, Sungdong-ku  
Seoul, Korea  
Factory: 119, Jungkog-dong, Sungdong-ku, Seoul, Korea  
Telephone: Head Office: 446-0002, 447-3714  
Factory: 446-6960  
Telex: KANDKOP K24673  
Capital: W75 million  
Employees: 200  
Established: 1978  
Annual Production: 1984e--\$1.5 million  
Brand Name: KOC  
Main Products: Photo transistors, transistors, diodes, solar  
cells, photo diodes, photo Darlingtons, photo  
couplers, photo interrupters



**ROHM KOREA CORP.**

President: Ju Sup Shim  
Head Office and Factory: 371-11, Karibong-dong, Guro-ku,  
Seoul, Korea  
Telephone: Head Office: 855-7101/4  
P.O. Box: Gurodanji, 13 Seoul  
Telex: ROHMKO K23205  
Cable: ROHMKO Seoul  
Capital: W673.1 million  
Employees: 983  
Established: 1972  
Venture Form: Joint venture with Rohm of Japan; Rohm holds  
minority ownership  
Annual Production: 1984e--\$12.0 million  
Main Products: Silicon transistor arrays, silicon diode  
arrays, LED displays, LED lamps, infrared  
LED lamps, photo transistors, LED photo  
sensors, fixed metal film resistors, fixed  
carbon film resistors

## APPENDIX A

### **SOUTH KOREAN SEMICONDUCTOR INDUSTRY PRODUCTION, CONSUMPTION, IMPORTS, AND EXPORTS**

#### INTRODUCTION

Appendix A consists of a set of detailed tables that estimate South Korean semiconductor industry production, consumption, and semiconductor trade for 1982 through 1985. Semiconductor production and trade tables are historical data tables only. Semiconductor consumption tables are divided into historical data tables for 1982 through 1985, and forecast tables for 1985 through 1990.

All historical tables begin with 1982 and end with 1985, while all forecast tables begin with 1985 and end with 1990. A list of Appendix A tables detailing the type of data, years, and units is as follows:

| <u>Table Number</u> | <u>Type of Data</u>  | <u>Calendar<br/>Years</u> | <u>Units</u>   |
|---------------------|----------------------|---------------------------|----------------|
| A-0                 | Exchange Rates       | 1982-1985                 | Won per Dollar |
| A-1                 | Production History   | 1982-1985                 | Dollars        |
| A-2                 | Production History   | 1982-1985                 | Won            |
| A-3                 | Consumption History  | 1982-1985                 | Dollars        |
| A-4                 | Consumption History  | 1982-1985                 | Won            |
| A-5                 | Consumption Forecast | 1985-1990                 | Dollars        |
| A-6                 | Consumption Forecast | 1985-1990                 | Won            |
| A-7                 | Imports              | 1982-1985                 | Dollars        |
| A-8                 | Imports              | 1982-1985                 | Won            |
| A-9                 | Exports              | 1982-1985                 | Dollars        |
| A-10                | Exports              | 1982-1985                 | Won            |

#### DEFINITIONS AND CONVENTIONS

DATAQUEST uses a common manufacturer base for all data tables. This base includes all merchant suppliers to the semiconductor market. It excludes captive suppliers that manufacture devices solely for the benefit of the parent company, such as Burroughs, IBM, and Western Electric. Included, however, are companies that actively market semiconductor devices to the merchant market as well as to other divisions of their own companies. A recent case in point is NCR, previously a captive supplier,

which in 1982 offered products on the merchant market for the first time. For such companies, both external shipments and internal consumption are included. Devices that are used internally are valued at current market prices.

### Production

South Korean semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, since some assembly and packaging revenues are counted as semiconductor production and some are not.

Semiconductor production tables include all semiconductor products manufactured in South Korea, including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging activities. Actual semiconductor device production, excluding related components, by native South Korean manufacturers is given in Chapter 9, Native Korean Semiconductor Manufacturers.

### Consumption

DATAQUEST defines consumption as the purchase of a semiconductor device or devices. This definition must be differentiated from actual use of the device in a final product. According to our definition, devices that are inventoried at the user level are considered consumption.

### FORECAST

Historical data are expressed in current dollars or current won and therefore include the given year's inflation rate and exchange rates. However, the consumption forecasts, which appear in Tables A-5 and A-6, use constant won, dollars, and exchange rates, with no allowance for inflation or exchange rate variations. All estimates for 1985 and beyond are made as if 1985 monetary conditions would continue through 1990 and, therefore, show the absolute year-to-year growth during this period.

Table A-0

EXCHANGE RATE  
KOREAN WON TO U.S. DOLLAR  
(Won per Dollar)

| <u>Year</u> | <u>Won per Dollar</u> |
|-------------|-----------------------|
| 1982        | 749                   |
| 1983        | 796                   |
| 1984        | 827                   |
| 1985E       | 760                   |

Source: Far Eastern  
Economic Review  
DATAQUEST

Table A-1

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR PRODUCTION**  
(Millions of Dollars)

|                      | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|----------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor* | \$648.0     | \$850.0     | \$1,259.0   | \$994.0     | 15.3%                           |
| IC                   | \$490.0     | \$661.0     | \$1,070.0   | \$844.8     | 19.9%                           |
| Discrete             | \$121.0     | \$159.0     | \$ 155.2    | \$122.5     | 0.4%                            |
| Optoelectronics      | \$ 37.0     | \$ 30.0     | \$ 33.8     | \$ 26.7     | (10.3%)                         |

Table A-2

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR PRODUCTION**  
(Billions of Won)

|                      | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|----------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor* | W485.2      | W676.2      | W1,041.7    | W755.4      | 15.9%                           |
| IC                   | W366.9      | W525.8      | W 885.3     | W642.0      | 20.5%                           |
| Discrete             | W 90.6      | W126.5      | W 128.4     | W 93.1      | 0.9%                            |
| Optoelectronics      | W 27.7      | W 23.9      | W 28.0      | W 20.3      | (9.9%)                          |

Source: DATAQUEST

\*Includes not only fab, assembly, and test, by native manufacturers but also contract assembly and test.

Table A-3

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR CONSUMPTION**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$154.4     | \$226.7     | \$304.0     | \$255.0     | 18.2%                           |
| IC                  | \$ 78.0     | \$118.0     | \$228.0     | \$191.0     | 34.8%                           |
| Discrete            | \$ 73.0     | \$105.0     | \$ 68.2     | \$ 57.0     | (7.9%)                          |
| Optoelectronics     | \$ 3.4      | \$ 3.7      | \$ 7.8      | \$ 7.0      | 27.2%                           |

Table A-4

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR CONSUMPTION**  
(Billions of Won)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | W115.6      | W180.6      | W251.5      | W193.8      | 18.8%                           |
| IC                  | W 58.4      | W 93.9      | W188.6      | W145.2      | 35.5%                           |
| Discrete            | W 54.7      | W 83.5      | W 56.4      | W 43.3      | (7.5%)                          |
| Optoelectronics     | W 2.5       | W 2.9       | W 6.5       | W 5.3       | 27.8%                           |

Source: DATAQUEST

Table A-5

FORECAST SOUTH KOREAN SEMICONDUCTOR CONSUMPTION  
(Millions of Dollars)

|                     | <u>1985</u> | <u>1986</u> | <u>1987</u> | <u>1988</u> | <u>1989</u> | <u>1990</u> | <u>CAGR</u><br><u>1985-1990</u> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$255.0     | \$306.0     | \$422.3     | \$543.5     | \$576.1     | \$689.2     | 22.0%                           |
| IC                  | \$191.0     | \$232.5     | \$328.9     | \$429.4     | \$456.5     | \$559.9     | 24.0%                           |
| Discrete            | \$ 57.0     | \$ 65.1     | \$ 82.3     | \$100.3     | \$103.4     | \$113.6     | 14.8%                           |
| Optoelectronics     | \$ 7.0      | \$ 8.4      | \$ 11.1     | \$ 13.8     | \$ 16.2     | \$ 15.7     | 17.5%                           |

Table A-6

FORECAST SOUTH KOREAN SEMICONDUCTOR CONSUMPTION  
(Billions of Won)

|                     | <u>1985</u> | <u>1986</u> | <u>1987</u> | <u>1988</u> | <u>1989</u> | <u>1990</u> | <u>CAGR</u><br><u>1985-1990</u> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | W193.8      | W232.6      | W320.9      | W413.1      | W437.8      | W523.8      | 22.0%                           |
| IC                  | W145.2      | W176.7      | W250.0      | W326.3      | W346.9      | W425.5      | 24.0%                           |
| Discrete            | W 43.3      | W 49.5      | W 62.5      | W 76.2      | W 78.6      | W 86.3      | 14.8%                           |
| Optoelectronics     | W 5.3       | W 6.4       | W 8.4       | W 10.5      | W 12.3      | W 11.9      | 17.5%                           |

Source: DATAQUEST

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR IMPORTS**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$130.4     | \$233.7     | \$336.0     | \$229.0     | 20.6%                           |
| IC                  | \$ 86.0     | \$160.0     | \$245.0     | \$167.0     | 24.8%                           |
| Discrete            | \$ 44.0     | \$ 73.0     | \$ 86.0     | \$ 58.6     | 10.0%                           |
| Optoelectronics     | \$ 0.4      | \$ 0.7      | \$ 5.0      | \$ 3.4      | 104.2%                          |

Table A-8

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR IMPORTS**  
(Billions of Won)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | W97.6       | W185.9      | W278.0      | W174.0      | 21.3%                           |
| IC                  | W64.4       | W127.3      | W202.7      | W126.9      | 25.4%                           |
| Discrete            | W32.9       | W 58.1      | W 71.2      | W 44.5      | 10.6%                           |
| Optoelectronics     | W 0.3       | W 0.6       | W 4.1       | W 2.6       | 105.3%                          |

Source: DATAQUEST



Table A-9

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR EXPORTS**  
(Millions of Dollars)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | \$624.0     | \$857.0     | \$1,291.0   | \$968.0     | 15.8%                           |
| IC                  | \$498.0     | \$703.0     | \$1,087.0   | \$815.0     | 17.8%                           |
| Discrete            | \$ 92.0     | \$127.0     | \$ 173.0    | \$129.7     | 12.1%                           |
| Optoelectronics     | \$ 34.0     | \$ 27.0     | \$ 31.0     | \$ 23.2     | (11.9%)                         |

Table A-10

**HISTORICAL SOUTH KOREAN SEMICONDUCTOR EXPORTS**  
(Billions of Won)

|                     | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> | <u>CAGR</u><br><u>1982-1985</u> |
|---------------------|-------------|-------------|-------------|-------------|---------------------------------|
| Total Semiconductor | W467.3      | W681.7      | W1,068.2    | W735.7      | 16.3%                           |
| IC                  | W372.9      | W559.2      | W 899.4     | W619.4      | 18.4%                           |
| Discrete            | W 68.9      | W101.0      | W 143.1     | W 98.6      | 12.7%                           |
| Optoelectronics     | W 25.5      | W 21.5      | W 25.6      | W 17.7      | (11.5%)                         |

Source: DATAQUEST

## APPENDIX B

### **SOUTH KOREAN SEMICONDUCTOR MARKET SHARE**

#### ESTIMATED MARKET SHARE IN SOUTH KOREA

An integral part of DATAQUEST's South Korean Semiconductor Industry data base is the analysis of semiconductor markets through estimation of market share by manufacturer. This analysis provides insights into semiconductor markets and reinforces estimates of consumption, production, and company revenues that were made using other data. The tables show the South Korean market shares for all major Japanese, U.S., South Korean, and Rest of World semiconductor manufacturers. South Korean semiconductor market share is presented by product line for 1984 and 1985 in the following tables:

| <u>Table Number</u> | <u>Product</u>      | <u>Currency</u> |
|---------------------|---------------------|-----------------|
| B-1                 | Total Semiconductor | Dollars         |
| B-2                 | Total Semiconductor | Won             |
| B-3                 | Integrated Circuit  | Dollars         |
| B-4                 | Integrated Circuit  | Won             |
| B-5                 | Bipolar Digital     | Dollars         |
| B-6                 | Bipolar Digital     | Won             |
| B-7                 | MOS                 | Dollars         |
| B-8                 | MOS                 | Won             |
| B-9                 | Linear              | Dollars         |
| B-10                | Linear              | Won             |
| B-11                | Discrete            | Dollars         |
| B-12                | Discrete            | Won             |
| B-13                | Optoelectronics     | Dollars         |
| B-14                | Optoelectronics     | Won             |

The totals given for the companies reflect the portion of their worldwide production that is sold in the South Korean market.

## **DEFINITIONS AND CONVENTIONS**

DATAQUEST uses a common manufacturer base for all data tables. This base includes all noncaptive suppliers to the semiconductor market. It excludes totally captive suppliers, such as IBM, that manufacture devices solely for the benefit of the parent company, but it includes companies that actively market their semiconductor devices to the industry at large as well as to other divisions of their own companies. For these companies, both external shipments and internal consumption are included. Devices that are used internally are valued at current market prices.

All estimates given in these tables are presented in U.S. dollars to make the tables useful in comparing companies based in different countries. Each table is also presented in won, in order to provide a more accurate presentation of real growth rates for the South Korean companies.

Construction of the tables involves combining data from many countries, each of which has different and changing exchange rates. DATAQUEST uses International Monetary Fund average exchange rates for each year and, as far as possible, the estimates are prepared in terms of local currencies before conversion to U.S. dollars or won. The won to dollar exchange rates by year are given in Appendix A, Table A-0.

## **NEED FOR CAREFUL INTERPRETATION**

Despite the care taken in gathering and analyzing the available data and in attempting to categorize those data in a meaningful way, careful attention must be paid to the definitions and assumptions used herein when interpreting the estimates presented in these tables. Various companies, government agencies, and trade associations may use slightly different definitions of product categories and regional groupings, or they may include different companies in their summaries. These differences should be kept in mind when making comparisons between these data and those provided by others.

Table B-1

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY**  
**1984-1985**  
**TOTAL SEMICONDUCTOR\***  
**(Millions of Dollars)**

| <u>Companies</u>     | <u>1984</u>    | <u>1985</u>    |
|----------------------|----------------|----------------|
| <b>Total</b>         | <b>\$304.0</b> | <b>\$255.0</b> |
| <b>Japanese</b>      | <b>\$132.5</b> | <b>\$112.3</b> |
| Fujitsu              | \$ 2.3         | \$ 2.2         |
| Hitachi              | \$ 23.3        | \$ 17.1        |
| Matsushita           | \$ 8.5         | \$ 7.5         |
| Mitsubishi           | \$ 6.2         | \$ 4.5         |
| NEC                  | \$ 31.8        | \$ 26.1        |
| Sanyo                | \$ 15.5        | \$ 13.4        |
| Sharp                | \$ 2.3         | \$ 1.5         |
| Toshiba              | \$ 11.6        | \$ 9.7         |
| Others               | \$ 30.9        | \$ 30.2        |
| <b>U.S.</b>          | <b>\$ 88.1</b> | <b>\$ 74.5</b> |
| AMD                  | \$ 2.3         | \$ 2.2         |
| AMI                  | \$ 0.6         | \$ 0.3         |
| Fairchild            | \$ 2.9         | \$ 1.9         |
| GI                   | \$ 4.7         | \$ 4.5         |
| Intel                | \$ 4.7         | \$ 4.5         |
| MMI                  | \$ 0.1         | \$ 0.7         |
| Mostek               | \$ 3.1         | \$ 1.5         |
| Motorola             | \$ 20.2        | \$ 17.1        |
| NSC                  | \$ 11.6        | \$ 11.0        |
| RCA                  | \$ 2.3         | \$ 2.2         |
| Signetics            | \$ 3.1         | \$ 2.2         |
| TI                   | \$ 21.6        | \$ 16.1        |
| Others               | \$ 10.9        | \$ 10.2        |
| <b>South Korean</b>  | <b>\$ 47.3</b> | <b>\$ 38.8</b> |
| Gold Star            | \$ 5.4         | \$ 7.5         |
| KEC                  | \$ 22.5        | \$ 15.7        |
| Samsung              | \$ 17.8        | \$ 14.2        |
| Others               | \$ 1.6         | \$ 1.5         |
| <b>Rest of World</b> | <b>\$ 36.2</b> | <b>\$29.5</b>  |
| ITT                  | \$ 1.6         | \$ 1.5         |
| Philips              | \$ 2.3         | \$ 2.2         |
| Rifa                 | \$ 1.6         | \$ 0.0         |
| SGS                  | \$ 11.6        | \$ 8.2         |
| Siemens              | \$ 0.8         | \$ 1.5         |
| Thomson              | \$ 13.0        | \$11.0         |
| UMC                  | \$ 1.6         | \$ 0.0         |
| Others               | \$ 3.8         | \$ 5.0         |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-2

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY**  
**1984-1985**  
**TOTAL SEMICONDUCTOR\***  
**(Billions of Won)**

| <u>Companies</u>     | <u>1984</u>   | <u>1985</u>   |
|----------------------|---------------|---------------|
| <b>Total</b>         | <b>₩251.6</b> | <b>₩193.8</b> |
| <b>Japanese</b>      | <b>₩109.6</b> | <b>₩ 85.3</b> |
| Fujitsu              | ₩ 1.9         | ₩ 1.7         |
| Hitachi              | ₩ 19.2        | ₩ 13.0        |
| Matsushita           | ₩ 7.1         | ₩ 5.7         |
| Mitsubishi           | ₩ 5.1         | ₩ 3.4         |
| NEC                  | ₩ 26.3        | ₩ 19.8        |
| Sanyo                | ₩ 12.8        | ₩ 10.2        |
| Sharp                | ₩ 1.9         | ₩ 1.1         |
| Toshiba              | ₩ 9.6         | ₩ 7.4         |
| Others               | ₩ 25.6        | ₩ 23.0        |
| <b>U.S.</b>          | <b>₩ 72.9</b> | <b>₩ 56.6</b> |
| AMD                  | ₩ 1.9         | ₩ 1.7         |
| AMI                  | ₩ 0.5         | ₩ 0.2         |
| Fairchild            | ₩ 2.4         | ₩ 1.4         |
| GI                   | ₩ 3.8         | ₩ 3.4         |
| Intel                | ₩ 3.8         | ₩ 3.4         |
| MMI                  | ₩ 0.1         | ₩ 0.6         |
| Mostek               | ₩ 2.6         | ₩ 1.1         |
| Motorola             | ₩ 16.7        | ₩ 13.0        |
| NSC                  | ₩ 9.6         | ₩ 8.4         |
| RCA                  | ₩ 1.9         | ₩ 1.7         |
| Signetics            | ₩ 2.6         | ₩ 1.7         |
| TI                   | ₩ 17.9        | ₩ 12.2        |
| Others               | ₩ 9.0         | ₩ 7.7         |
| <b>South Korean</b>  | <b>₩ 39.1</b> | <b>₩ 29.5</b> |
| Gold Star            | ₩ 4.5         | ₩ 5.7         |
| KEC                  | ₩ 18.6        | ₩ 11.9        |
| Samsung              | ₩ 14.8        | ₩ 10.8        |
| Others               | ₩ 1.3         | ₩ 1.1         |
| <b>Rest of World</b> | <b>₩ 29.9</b> | <b>₩ 22.4</b> |
| ITT                  | ₩ 1.3         | ₩ 1.1         |
| Philips              | ₩ 1.9         | ₩ 1.7         |
| Rifa                 | ₩ 1.3         | ₩ 0.0         |
| SGS                  | ₩ 9.6         | ₩ 6.2         |
| Siemens              | ₩ 0.6         | ₩ 1.1         |
| Thomson              | ₩ 10.8        | ₩ 8.4         |
| UMC                  | ₩ 1.3         | ₩ 0.0         |
| Others               | ₩ 3.1         | ₩ 3.8         |

Totals may not add due to rounding

Source: DATAQUEST

Table B-3

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
INTEGRATED CIRCUIT\*  
(Millions of Dollars)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$228.6     | \$189.7     |
| Japanese         | \$106.6     | \$ 88.0     |
| Fujitsu          | \$ 1.6      | \$ 1.5      |
| Hitachi          | \$ 21.7     | \$ 15.7     |
| Matsushita       | \$ 7.8      | \$ 6.7      |
| Mitsubishi       | \$ 5.4      | \$ 3.7      |
| NEC              | \$ 26.4     | \$ 20.9     |
| Sanyo            | \$ 10.1     | \$ 8.9      |
| Sharp            | \$ 1.6      | \$ 0.7      |
| Toshiba          | \$ 9.3      | \$ 7.5      |
| Others           | \$ 22.9     | \$ 22.3     |
| U.S.             | \$ 73.3     | \$ 62.7     |
| AMD              | \$ 2.3      | \$ 2.2      |
| AMI              | \$ 0.6      | \$ 0.3      |
| Fairchild        | \$ 2.3      | \$ 1.5      |
| GI               | \$ 1.6      | \$ 1.5      |
| Intel            | \$ 4.7      | \$ 4.5      |
| MMI              | \$ 0.1      | \$ 0.7      |
| Mostek           | \$ 3.1      | \$ 1.5      |
| Motorola         | \$ 13.2     | \$ 11.9     |
| NSC              | \$ 10.6     | \$ 10.2     |
| RCA              | \$ 2.3      | \$ 2.2      |
| Signetics        | \$ 3.1      | \$ 2.2      |
| TI               | \$ 21.1     | \$ 15.7     |
| Others           | \$ 8.4      | \$ 8.2      |
| South Korean     | \$ 19.4     | \$ 17.9     |
| Gold Star        | \$ 3.9      | \$ 6.0      |
| KBC              | \$ 2.3      | \$ 1.5      |
| Samsung          | \$ 12.4     | \$ 9.7      |
| Others           | \$ 0.8      | \$ 0.7      |
| Rest of World    | \$ 29.3     | \$ 21.1     |
| ITT              | \$ 0.8      | \$ 0.7      |
| Philips          | \$ 2.3      | \$ 2.2      |
| Rifa             | \$ 1.6      | \$ 0.0      |
| SGS              | \$ 9.3      | \$ 5.2      |
| Siemens          | \$ 0.8      | \$ 0.7      |
| Thomson          | \$ 10.5     | \$ 9.0      |
| UMC              | \$ 1.6      | \$ 0.0      |
| Others           | \$ 2.5      | \$ 3.1      |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-4

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**INTEGRATED CIRCUIT\***  
**(Billions of Won)**

| <u>Companies</u>     | <u>1984</u>   | <u>1985</u>   |
|----------------------|---------------|---------------|
| <b>Total</b>         | <b>W189.2</b> | <b>W144.2</b> |
| <b>Japanese</b>      | <b>W 88.2</b> | <b>W 66.8</b> |
| Fujitsu              | W 1.3         | W 1.1         |
| Hitachi              | W 18.0        | W 11.9        |
| Matsushita           | W 6.4         | W 5.1         |
| Mitsubishi           | W 4.5         | W 2.8         |
| NEC                  | W 21.8        | W 15.9        |
| Sanyo                | W 8.3         | W 6.8         |
| Sharp                | W 1.3         | W 0.6         |
| Toshiba              | W 7.7         | W 5.7         |
| Others               | W 18.9        | W 17.0        |
| <b>U.S.</b>          | <b>W 60.7</b> | <b>W 47.7</b> |
| AMD                  | W 1.9         | W 1.7         |
| AMI                  | W 0.5         | W 0.2         |
| Fairchild            | W 1.9         | W 1.2         |
| GI                   | W 1.3         | W 1.1         |
| Intel                | W 3.8         | W 3.4         |
| MMI                  | W 0.1         | W 0.6         |
| Mostek               | W 2.6         | W 1.1         |
| Motorola             | W 10.9        | W 9.1         |
| NSC                  | W 8.8         | W 7.8         |
| RCA                  | W 1.9         | W 1.7         |
| Signetics            | W 2.6         | W 1.7         |
| TI                   | W 17.5        | W 11.9        |
| Others               | W 6.9         | W 6.2         |
| <b>South Korean</b>  | <b>W 16.0</b> | <b>W 13.6</b> |
| Gold Star            | W 3.2         | W 4.5         |
| KEC                  | W 1.9         | W 1.1         |
| Samsung              | W 10.3        | W 7.4         |
| Others               | W 0.6         | W 0.6         |
| <b>Rest of World</b> | <b>W 24.2</b> | <b>W 16.0</b> |
| ITT                  | W 0.6         | W 0.6         |
| Philips              | W 1.9         | W 1.7         |
| Rifa                 | W 1.3         | W 0.0         |
| SGS                  | W 7.7         | W 4.0         |
| Siemens              | W 0.6         | W 0.6         |
| Thomson              | W 8.7         | W 6.8         |
| UMC                  | W 1.3         | W 0.0         |
| Others               | W 2.1         | W 2.4         |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-5

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
BIPOLAR DIGITAL\*  
(Millions of Dollars)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$29.5      | \$20.0      |
| Japanese         | \$11.4      | \$ 2.7      |
| Hitachi          | \$ 6.2      | \$ 0.7      |
| Mitsubishi       | \$ 2.3      | \$ 0.7      |
| Toshiba          | \$ 0.8      | \$ 0.0      |
| Others           | \$ 2.1      | \$ 1.2      |
| U.S.             | \$14.4      | \$13.5      |
| AMD              | \$ 0.8      | \$ 0.7      |
| Fairchild        | \$ 1.5      | \$ 1.0      |
| MMI              | \$ 0.1      | \$ 0.7      |
| Motorola         | \$ 3.1      | \$ 3.7      |
| NSC              | \$ 2.0      | \$ 1.9      |
| Signetics        | \$ 0.0      | \$ 0.7      |
| TI               | \$ 6.2      | \$ 4.5      |
| Others           | \$ 0.8      | \$ 0.2      |
| South Korean     | \$ 0.8      | \$ 2.2      |
| Gold Star        | \$ 0.8      | \$ 2.2      |
| Rest of World    | \$ 2.9      | \$ 1.5      |
| Philips          | \$ 0.8      | \$ 0.7      |
| SGS              | \$ 1.6      | \$ 0.0      |
| Others           | \$ 0.6      | \$ 0.7      |

\*Totals may not add due to rounding

Source: DATAQUEST



Table B-6

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**BIPOLAR DIGITAL\***  
**(Billions of Won)**

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W24.4       | W15.2       |
| Japanese         | W 9.5       | W 2.1       |
| Hitachi          | W 5.1       | W 0.6       |
| Mitsubishi       | W 1.9       | W 0.6       |
| Toshiba          | W 0.6       | W 0.0       |
| Others           | W 1.8       | W 0.9       |
| U.S.             | W 11.9      | W 10.3      |
| AMD              | W 0.6       | W 0.6       |
| Fairchild        | W 1.2       | W 0.8       |
| MMI              | W 0.1       | W 0.6       |
| Motorola         | W 2.6       | W 2.8       |
| NSC              | W 1.7       | W 1.4       |
| Signetics        | W 0.0       | W 0.6       |
| TI               | W 5.1       | W 3.4       |
| Others           | W 0.6       | W 0.1       |
| South Korean     | W 0.6       | W 1.7       |
| Gold Star        | W 0.6       | W 1.7       |
| Rest of World    | W 2.4       | W 1.1       |
| Philips          | W 0.6       | W 0.6       |
| SGS              | W 1.3       | W 0.0       |
| Others           | W 0.5       | W 0.6       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-7

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**MOS\***  
**(Millions of Dollars)**

| <u>Companies</u>     | <u>1984</u>   | <u>1985</u>   |
|----------------------|---------------|---------------|
| <b>Total</b>         | <b>\$96.3</b> | <b>\$80.7</b> |
| <b>Japanese</b>      | <b>\$44.8</b> | <b>\$36.4</b> |
| Fujitsu              | \$ 1.6        | \$ 1.5        |
| Hitachi              | \$10.9        | \$ 7.5        |
| Matsushita           | \$ 2.3        | \$ 2.2        |
| Mitsubishi           | \$ 0.8        | \$ 0.7        |
| NEC                  | \$17.1        | \$11.9        |
| Sanyo                | \$ 1.6        | \$ 1.5        |
| Sharp                | \$ 1.6        | \$ 0.7        |
| Toshiba              | \$ 2.3        | \$ 2.2        |
| Others               | \$ 6.8        | \$ 8.1        |
| <b>U.S.</b>          | <b>\$35.8</b> | <b>\$32.6</b> |
| AMD                  | \$ 1.6        | \$ 1.5        |
| AMI                  | \$ 0.6        | \$ 0.3        |
| Fairchild            | \$ 0.1        | \$ 0.1        |
| GI                   | \$ 0.8        | \$ 0.7        |
| Intel                | \$ 4.7        | \$ 4.5        |
| Mostek               | \$ 3.1        | \$ 1.5        |
| Motorola             | \$ 5.4        | \$ 5.2        |
| NSC                  | \$ 2.0        | \$ 4.6        |
| RCA                  | \$ 1.6        | \$ 1.5        |
| Signetics            | \$ 0.8        | \$ 0.7        |
| TI                   | \$11.8        | \$ 8.2        |
| Others               | \$ 3.4        | \$ 3.8        |
| <b>South Korean</b>  | <b>\$ 7.0</b> | <b>\$ 5.2</b> |
| Gold Star            | \$ 0.8        | \$ 1.5        |
| Samsung              | \$ 6.2        | \$ 3.7        |
| <b>Rest of World</b> | <b>\$ 8.8</b> | <b>\$ 6.4</b> |
| Philips              | \$ 0.8        | \$ 0.7        |
| SGS                  | \$ 2.3        | \$ 1.5        |
| Thomson              | \$ 3.5        | \$ 3.0        |
| UMC                  | \$ 1.6        | \$ 0.0        |
| Others               | \$ 0.6        | \$ 1.2        |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-8

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**MOS\***  
**(Billions of Won)**

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W79.7       | W61.3       |
| Japanese         | W37.1       | W27.7       |
| Fujitsu          | W 1.3       | W 1.1       |
| Hitachi          | W 9.0       | W 5.7       |
| Matsushita       | W 1.9       | W 1.7       |
| Mitsubishi       | W 0.6       | W 0.6       |
| NEC              | W14.1       | W 9.1       |
| Sanyo            | W 1.3       | W 1.1       |
| Sharp            | W 1.3       | W 0.6       |
| Toshiba          | W 1.9       | W 1.7       |
| Others           | W 5.6       | W 6.1       |
| U.S.             | W29.6       | W24.8       |
| AMD              | W 1.3       | W 1.1       |
| AMI              | W 0.5       | W 0.2       |
| Fairchild        | W 0.1       | W 0.0       |
| GI               | W 0.6       | W 0.6       |
| Intel            | W 3.8       | W 3.4       |
| Mostek           | W 2.6       | W 1.1       |
| Motorola         | W 4.5       | W 4.0       |
| NSC              | W 1.7       | W 3.5       |
| RCA              | W 1.3       | W 1.1       |
| Signetics        | W 0.6       | W 0.6       |
| TI               | W 9.8       | W 6.2       |
| Others           | W 2.8       | W 2.9       |
| South Korean     | W 5.8       | W 4.0       |
| Gold Star        | W 0.6       | W 1.1       |
| Samsung          | W 5.1       | W 2.8       |
| Rest of World    | W 7.2       | W 4.9       |
| Philips          | W 0.6       | W 0.6       |
| SGS              | W 1.9       | W 1.1       |
| Thomson          | W 2.9       | W 2.3       |
| UMC              | W 1.3       | W 0.0       |
| Others           | W 0.5       | W 0.9       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-9

**KOREAN SEMICONDUCTOR MARKET**  
**ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS**  
**BY COMPANY 1984-1985**  
**LINEAR\***  
**(Millions of Dollar)**

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$102.8     | \$89.0      |
| Japanese         | \$ 50.4     | \$48.8      |
| Hitachi          | \$ 4.7      | \$ 7.5      |
| Matsushita       | \$ 5.4      | \$ 4.5      |
| Mitsubishi       | \$ 2.3      | \$ 2.2      |
| NEC              | \$ 9.3      | \$ 8.9      |
| Sanyo            | \$ 8.5      | \$ 7.5      |
| Toshiba          | \$ 6.2      | \$ 5.2      |
| Others           | \$ 13.9     | \$13.0      |
| U.S.             | \$ 23.2     | \$16.6      |
| Fairchild        | \$ 0.7      | \$ 0.5      |
| GI               | \$ 0.8      | \$ 0.7      |
| Motorola         | \$ 4.7      | \$ 3.0      |
| NSC              | \$ 6.6      | \$ 3.7      |
| RCA              | \$ 0.8      | \$ 0.7      |
| Signetics        | \$ 2.3      | \$ 0.7      |
| TI               | \$ 3.1      | \$ 3.0      |
| Others           | \$ 4.2      | \$ 4.2      |
| South Korean     | \$ 11.6     | \$10.4      |
| Gold Star        | \$ 2.3      | \$ 2.2      |
| KEC              | \$ 2.3      | \$ 1.5      |
| Samsung          | \$ 6.2      | \$ 6.0      |
| Others           | \$ 0.8      | \$ 0.7      |
| Rest of World    | \$ 17.6     | \$13.2      |
| ITT              | \$ 0.8      | \$ 0.7      |
| Philips          | \$ 0.8      | \$ 0.7      |
| Rifa             | \$ 1.6      | \$ 0.0      |
| SGS              | \$ 5.4      | \$ 3.7      |
| Siemens          | \$ 0.8      | \$ 0.7      |
| Thomson          | \$ 7.0      | \$ 6.0      |
| Others           | \$ 1.3      | \$ 1.2      |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-10

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
LINEAR\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W85.0       | W67.6       |
| Japanese         | W41.7       | W37.1       |
| Hitachi          | W 3.8       | W 5.7       |
| Matsushita       | W 4.5       | W 3.4       |
| Mitsubishi       | W 1.9       | W 1.7       |
| NEC              | W 7.7       | W 6.8       |
| Sanyo            | W 7.1       | W 5.7       |
| Toshiba          | W 5.1       | W 4.0       |
| Others           | W11.5       | W 9.9       |
| U.S.             | W19.2       | W12.6       |
| Fairchild        | W 0.6       | W 0.4       |
| GI               | W 0.6       | W 0.6       |
| Motorola         | W 3.8       | W 2.3       |
| NSC              | W 5.5       | W 2.8       |
| RCA              | W 0.6       | W 0.6       |
| Signetics        | W 1.9       | W 0.6       |
| TI               | W 2.6       | W 2.3       |
| Others           | W 3.5       | W 3.2       |
| South Korean     | W 9.6       | W 7.9       |
| Gold Star        | W 1.9       | W 1.7       |
| KEC              | W 1.9       | W 1.1       |
| Samsung          | W 5.1       | W 4.5       |
| Others           | W 0.6       | W 0.6       |
| Rest of World    | W14.6       | W10.0       |
| ITT              | W 0.6       | W 0.6       |
| Philips          | W 0.6       | W 0.6       |
| Rifa             | W 1.3       | W 0.0       |
| SGS              | W 4.5       | W 2.8       |
| Siemens          | W 0.6       | W 0.6       |
| Thomson          | W 5.8       | W 4.6       |
| Others           | W 1.1       | W 0.9       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-11

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
DISCRETE\*  
(Millions of Dollars)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$68.0      | \$59.0      |
| Japanese         | \$21.2      | \$19.8      |
| Fujitsu          | \$ 0.8      | \$ 0.7      |
| Hitachi          | \$ 1.6      | \$ 1.5      |
| Matsushita       | \$ 0.8      | \$ 0.7      |
| Mitsubishi       | \$ 0.8      | \$ 0.7      |
| NEC              | \$ 4.7      | \$ 4.5      |
| Sanyo            | \$ 4.7      | \$ 3.7      |
| Toshiba          | \$ 1.6      | \$ 1.5      |
| Others           | \$ 6.5      | \$ 6.4      |
| U.S.             | \$13.5      | \$10.6      |
| Fairchild        | \$ 0.6      | \$ 0.4      |
| GI               | \$ 2.3      | \$ 2.2      |
| Motorola         | \$ 7.0      | \$ 5.2      |
| NSC              | \$ 1.0      | \$ 0.8      |
| TI               | \$ 0.5      | \$ 0.4      |
| Others           | \$ 2.1      | \$ 1.6      |
| South Korean     | \$26.4      | \$20.1      |
| Gold Star        | \$ 1.6      | \$ 1.5      |
| KEC              | \$18.6      | \$13.4      |
| Samsung          | \$ 5.4      | \$ 4.5      |
| Others           | \$ 0.8      | \$ 0.7      |
| Rest of World    | \$ 6.9      | \$ 8.4      |
| ITT              | \$ 0.8      | \$ 0.7      |
| SGS              | \$ 2.3      | \$ 3.0      |
| Siemens          | \$ 0.0      | \$ 0.7      |
| Thomson          | \$ 2.5      | \$ 2.0      |
| Others           | \$ 1.3      | \$ 1.9      |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-12

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
DISCRETE\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W56.2       | W44.8       |
| Japanese         | W17.6       | W15.1       |
| Fujitsu          | W 0.6       | W 0.6       |
| Hitachi          | W 1.3       | W 1.1       |
| Matsushita       | W 0.6       | W 0.6       |
| Mitsubishi       | W 0.6       | W 0.6       |
| NEC              | W 3.8       | W 3.4       |
| Sanyo            | W 3.8       | W 2.8       |
| Toshiba          | W 1.3       | W 1.1       |
| Others           | W 5.4       | W 4.9       |
| U.S.             | W11.2       | W 8.1       |
| Fairchild        | W 0.5       | W 0.3       |
| GI               | W 1.9       | W 1.7       |
| Motorola         | W 5.8       | W 4.0       |
| NSC              | W 0.8       | W 0.6       |
| TI               | W 0.4       | W 0.3       |
| Others           | W 1.7       | W 1.2       |
| South Korean     | W21.8       | W15.3       |
| Gold Star        | W 1.3       | W 1.1       |
| KEC              | W15.4       | W10.2       |
| Samsung          | W 4.5       | W 3.4       |
| Others           | W 0.6       | W 0.6       |
| Rest of World    | W 5.7       | W 6.4       |
| ITT              | W 0.6       | W 0.6       |
| SGS              | W 1.9       | W 2.3       |
| Siemens          | W 0.0       | W 0.6       |
| Thomson          | W 2.1       | W 1.5       |
| Others           | W 1.1       | W 1.4       |

\*Totals may not add due to rounding

Source: DATAQUEST

Table B-13

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
OPTOELECTRONICS\*  
(Millions of Dollars)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | \$7.4       | \$6.4       |
| Japanese         | \$4.7       | \$4.5       |
| NEC              | \$0.8       | \$0.7       |
| Sanyo            | \$0.8       | \$0.7       |
| Sharp            | \$0.8       | \$0.7       |
| Toshiba          | \$0.8       | \$0.7       |
| Others           | \$1.6       | \$1.5       |
| U.S.             | \$1.2       | \$1.1       |
| GI               | \$0.8       | \$0.7       |
| Others           | \$0.5       | \$0.4       |
| South Korean     | \$1.6       | \$0.7       |
| KEC              | \$1.6       | \$0.7       |

\*Totals may not add due to rounding

Source: DATAQUEST



Table B-14

KOREAN SEMICONDUCTOR MARKET  
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS  
BY COMPANY 1984-1985  
OPTOELECTRONICS\*  
(Billions of Won)

| <u>Companies</u> | <u>1984</u> | <u>1985</u> |
|------------------|-------------|-------------|
| Total            | W6.2        | W4.8        |
| Japanese         | W3.8        | W3.4        |
| NEC              | W0.6        | W0.6        |
| Sanyo            | W0.6        | W0.6        |
| Sharp            | W0.6        | W0.6        |
| Toshiba          | W0.6        | W0.6        |
| Others           | W1.3        | W1.1        |
| U.S.             | W1.0        | W0.9        |
| GI               | W0.6        | W0.6        |
| Others           | W0.4        | W0.3        |
| South Korean     | W1.3        | W0.6        |
| KEC              | W1.3        | W0.6        |

\*Totals may not add due to rounding

Source: DATAQUEST

## APPENDIX C

### **SOUTH KOREAN ASSEMBLY INDUSTRY**

This Appendix presents available data on the assembly industry in South Korea. Table C-1 presents revenues of companies involved in the assembly business, both native and foreign-owned. The data are followed by assembly company profiles. As in the case of revenues and plant locations, both native and foreign-owned firms are included.

**Table C-1**

#### **ASSEMBLY REVENUE BY COMPANY (Millions of Dollars)**

| <u>Company</u>      | <u>1982</u> | <u>1983</u> | <u>1984</u> | <u>1985</u> |
|---------------------|-------------|-------------|-------------|-------------|
| Anam Industrial     | \$ 44       | \$ 75       | \$105       | \$102       |
| Motorola Korea      | \$140       | \$164       | \$213       | \$215       |
| Signetics Korea     | \$ 86       | \$110       | \$169       | \$150       |
| Fairchild Korea     | \$ 57       | \$ 67       | \$ 85       | \$ 87       |
| Korea Microsystems  | \$ 75       | \$ 69       | \$ 63       | \$ 60       |
| Korea Tokyo Silicon | N/A         | \$ 53       | \$ 52       | \$ 58       |

N/A = Not Available

Source: Company Annual Reports, 1982-1984  
Korea Economic News, 1985

**ANAM INDUSTRIAL Co., LTD.**

Anam Industrial was established in August 1956 as an industrial product manufacturing and service company. In 1966, the company expanded its business into electronic component manufacturing and trading. The diode and transistor packaging business was started in May 1972. In November of the same year, Anam opened a U.S. subsidiary, in Valley Forge, Pennsylvania. Amkor conducts Anam's U.S. sales and marketing activities.

- President: Joo Chai Kim
- Head Office: 151-22 Hwayang-dong, Sungdong-ku, Seoul, Korea
- Telephone: 463-2266
- Factories: 151-22 Hwayang-dong, Sungdong-ku, Seoul, Korea  
Telephone: 463-2266  
316-74 Hyosung-dong, Buk-ku, Ichon  
(032) 742-7024
- Telex: ANAMIC K27381
- Employees: 7,000
- Annual Production: 1984e--\$117.2 million
- Investment: US\$300 million by 1987
- Main Products: Plastic DIP packages (8 to 64 leads), ceramic DIP packages, side braze and flat packages, LEDs, electronic watches, electronic wiring devices, liquid nitrogen
- Annual Production Capacity
  - 1985: 1.2 billion units
  - 1987: 2.5 billion units
- U.S. Subsidiary: Amkor Electronics, Inc.,  
Corporate Center, Valley Forge, PA 19482

**FAIRCHILD SEMICONDUCTOR (KOREA) LTD.**

This company was established in October 1967, by Fairchild Camera and Instruments of the United States. It is 100 percent owned by the Fairchild. The company operates exclusively for its U.S. parent company.

- President: Young Il Lee
- Head Office and Factory: 219-6 Karibong-dong, Kuro-ku, Seoul, Korea
- Telephone: 855-6751
- Telex: FAIRKOR K23670
- Employees: 1,000
- Main Products: IC and transistor assembly packaging
- Annual Production: 1984e--\$85 million
- Annual Production Capacity: 150 million units

**KOREA MICROSYSTEMS, INC.**

This company was established by American Microsystems, Inc., of the United States in March of 1970. It is 100 percent owned by AMI. The company provides exclusive assembly and packaging services to AMI.

- President: Man Rip Choi
- Head Office and Factory: 449-2 Jakjeon-dong, Buk-ku, Ichon, Korea
- Telephone: (032) 92-0411
- Telex: MICROS K28484
- Employees: 1,200
- Main Products: MOS LSI assembly and packaging
- Annual Production: 1984e--\$63 million
- Annual Production Capacity: 50 million units
- Equipment: Die attach machines (56), lead bonding machines (161)

**MOTOROLA KOREA LTD.**

The company was established in March of 1967 by Motorola, Inc., of the United States, and is 100 percent owned by Motorola. It started out as the assembly and packaging operation for transistors and ICs, but expanded its activities into manufacturing electronic parts, subsystems, and small products.

- President: Eun Shik Chung
- Head Office and Factory: 445-Kwangjang-dong, Sungdong-ku, Seoul, Korea
- Telephone: 445-7109
- Telex: MOROR K23284
- Employees: 5,000
- Main Products: Transistor and IC assembly and packaging, mold sets and parts, pagers, walkie-talkies
- Annual Production: 1984e--\$213 million

**SIGNETICS KOREA CO., LTD.**

This company was established in 1966 by the Signetics Corp. of the United States.

- President: Jae Yil Park
- Head Office and Factory: 272 Yumchang-dong, Kangseo-ku, Seoul, Korea
- Telephone: 694-5081
- Telex: SIGKOR K23626
- Employees: 2,600
- Main Products: Plastic and ceramic DIP, plastic chip carriers, small outline packages
- Annual Production: 1984e--\$169 million
- Annual Production Capacity: 600 million units

KORBA TOKYO SILICON CO., LTD.

- President: Kingo Ito
- Head Office and Factory: 973-4, Yangduck-dong, Masan City,  
Kyungnam, Korea
- Seoul Office: Rm. 2001, Samjung Bldg., 69-5, 2-ka,  
Taepyung-ro, Chung-ku, Seoul, Korea
- Telephone: Head Office: (0551) 55-0181/5, 55-6851/2  
Seoul Office: 778-2408, 752-9790
- P.O. Box: P.O. Box, 362 Masan
- Telex: SILICON K3352
- Cable: KTSILICON Masan
- Employees: 1,800
- Established: 1972
- Annual Production: 1984e--\$52 million
- Brand Name: SANYO
- Main Products: Silicon transistors, hybrid ICs, monolithic ICS,  
digital quartz modules, digital watches



## APPENDIX D

### SEMICONDUCTOR WAFER FOUNDRY

The following companies are currently engaged in or offering wafer foundry services. Descriptions include technologies, potential capacity for the foundry services, and current customers.

- Samsung Semiconductor & Telecommunications Co., Ltd.
  - Technology: NMOS, CMOS
  - Capacity: 4-inch, 10,000 wafers/month
  - Customer: SGS (5,000 wafers/month)
- Gold Star Semiconductor, Ltd.
  - Technology: NMOS, CMOS
  - Capacity: 5-inch, 20,000 wafers/month
  - Customer: LSI Logic, Fairchild C & I
- Hyundai Electronics Industries, Co., Ltd.
  - Technology: NMOS, CMOS
  - Capacity: 5-inch, 5,000 wafers/month; 6-inch, 20,000 wafers/month
  - Customer: Texas Instruments, Vitelic, International CMOS Technology
- Electronics & Telecommunications Research Institute (ETRI)
  - Technology: NMOS, CMOS, bipolar
  - Capacity: 4-inch, 2,000 wafers/month MOS; 4-inch, 2,000 wafers/month bipolar
  - Customer: None

## APPENDIX E

### FACILITIES DATA

The chart presented here represents a compilation of all available data on semiconductor production and assembly facilities of selected native South Korean manufacturers. The following companies and plants are described in the facilities chart:

- Samsung Semiconductor and Telecommunications
  - Buchon Plant
  - Suwon Plant
  - Samsung Semiconductor (U.S.)
- Gold Star Semiconductor
  - Gumi Plant
  - Anyang R&D Plant
- Hyundai Electronics
  - Semiconductor Plant I
  - Semiconductor Plant II
  - Assembly Plant
- Daewoo Electronic Components
- Korea Electronics Company
- ETRI Semiconductor Operations
- Anam Industrial (assembly)

### Appendix E Facilities Data

| Company/Plant                                | Start-up of Production Facilities | Name of Representative | Employees | Floor Space (Square Feet) | Operations |          |      | Product/Technology |               |            |         |           |        |            |       | Capacity (Wafers/Month) |         |         | Wafer Size (Inches) |         |
|--|-----------------------------------|------------------------|-----------|---------------------------|------------|----------|------|--------------------|---------------|------------|---------|-----------|--------|------------|-------|-------------------------|---------|---------|---------------------|---------|
|  |                                   |                        |           |                           | Fab        | Assembly | Test | Bipolar Memory     | Bipolar Logic | MOS Memory | MOS MPU | MOS Logic | Linear | Transistor | Diode | Optoelectronics         | 1983    | 1984    |                     | 1985    |
| Samsung Semiconductor and Telecommunications |                                   |                        |           |                           |            |          |      |                    |               |            |         |           |        |            |       |                         |         |         |                     |         |
| Buchon Plant                                 | Dec. 1974                         | S.K. Lee               | 1,900     | 260,000                   | X          | X        | X    |                    | X             |            | X       | X         | X      | X          | X     |                         | 30,000  | 30,000  | 50,000              | 3, 4, 5 |
| Suwon Plant                                  | April 1984                        | Y.W. Lee               | 1,800     | 1,000,000                 | X          | X        | X    |                    |               | X          |         |           |        |            |       |                         | N/A     | 27,000  | 47,000              | 4, 8    |
| Samsung Semiconductor Inc. (U.S.A.)          | July 1983                         | S.J. Lee               | 150       | 100,000                   | X          |          | X    |                    |               | X          | X       | X         |        |            |       |                         | N/A     | 4,000   | 4,000               | 5       |
| Gold Star Semiconductor                      |                                   |                        |           |                           |            |          |      |                    |               |            |         |           |        |            |       |                         |         |         |                     |         |
| Gumi Plant                                   | Feb. 1980                         | D.H. Song              | 1,200     | 200,000                   | X          | X        | X    |                    | X             | X          | X       | X         | X      | X          | X     |                         | 16,800  | 28,000  | 28,000              | 4, 5    |
| Anyang R&D Plant                             | Nov. 1984                         | C.S. Kim               |           | 100,000                   | X          |          | X    |                    |               | X          | X       | X         |        |            |       |                         | N/A     | 9,000   | 10,000              | 5       |
| Hyundai Electronics                          |                                   |                        |           |                           |            |          |      |                    |               |            |         |           |        |            |       |                         |         |         |                     |         |
| Semiconductor I                              | Dec. 1984                         | D.W. Chun              | 850       | 150,000                   | X          |          | X    |                    |               | X          | X       | X         |        |            |       |                         | N/A     | N/A     | 15,000              | 5       |
| Semiconductor II                             | Dec. 1985                         | K.O. Park              |           | —                         | X          |          | X    |                    |               | X          |         |           |        |            |       |                         | N/A     | N/A     | 25,000              | 6       |
| Assembly Plant                               | April 1985                        | J.H. Lee               |           | 720,000                   |            | X        | X    |                    |               |            |         |           |        |            |       |                         | N/A     | N/A     | 240,000             | 4, 5, 6 |
| Daewoo Electronic Components                 | Sept. 1979                        | C.S. Lee               | 1,400     | —                         | X          | X        | X    |                    |               |            |         |           | X      | X          | X     |                         | 4,000   | 5,000   | 7,000               | 4       |
| Korea Electronics                            | Sept. 1989                        | Y.W. Yoo               | 2,100     | 387,400                   | X          | X        | X    |                    |               |            |         |           | X      | X          | X     | X                       | 5,000   | 6,000   | 10,000              | 3, 4    |
| ETRI Semiconductor Operations                | Oct. 1980                         | Y.I. Kang              | 150       | —                         | X          | X        | X    |                    |               | X          | X       |           | X      |            |       |                         | 4,000   | 4,000   | 4,000               | 4       |
| Anam Industrial                              | May 1972                          | J.C. Kim               | 7,000     | 280,000                   |            | X        | X    |                    |               |            |         |           |        |            |       |                         | 350,000 | 500,000 | 800,000             | 3, 4, 5 |

### Appendix E Facilities Data (Continued)

| Company/Plant                                | Average Production (Thousands of Units/Month) |        |         | Capital Spending (Millions of Dollars) |       |       | CAD |             | Wafer Fab |            |          |           |       |            |         |          |             |            | Test        |         |          | Assembly    |             |          |           |
|--|---|--------|---------|--|-------|-------|-----|-------------|-----------|------------|----------|-----------|-------|------------|---------|----------|-------------|------------|-------------|---------|----------|-------------|-------------|----------|-----------|
|  | 1982  | 1983   | 1984    | 1983                                   | 1984  | 1985  | CPU | Workstation | E-beam    | Projection | Contact  | Diffusion | Ion   | CVD        | Epitaxy | Wet Etch | Plasma Etch | Sputtering | Memory Test | IC Test | LSI Test | Wafer Probe | Dicing Saw  | Die Bond | Wire Bond |
|  | 1982  | 1983   | 1984    | 1983                                   | 1984  | 1985  |     |             |           | Aligners   | Steppers | Aligners  | Tubes | Implanters |         |          |             |            |             |         |          |             |             |          |           |
| Samsung Semiconductor and Telecommunications |   |        |         |  |       |       |     |             |           |            |          |           |       |            |         |          |             |            |             |         |          |             |             |          |           |
| Buchon Plant                                 | 16,450  | 31,373 | 57,778  | \$15                                   | \$40  | \$80  | 2   | 8           | 0         | 8          | 0        | 20        | 110   | 6          | 3       | 4        | 10          | 13         | 4           | —       | —        | —           | —           | —        | —         |
| Suwon Plant                                  | N/A   | N/A    | 2,268   | \$24                                   | \$124 | \$194 | 1   | 4           | 1         | 18         | 19       | 0         | 100   | 11         | 5       | 0        | 0           | 30         | 6           | —       | —        | —           | —           | —        | —         |
| Samsung Semiconductor Inc. (U.S.A.)          | N/A   | 0      | 0       | N/A                                    | \$50  | \$10  | 1   | 2           | 0         | 2          | 2        | 0         | 30    | 1          | 1       | 0        | 0           | 4          | 1           | —       | —        | N/A         | N/A         | N/A      | N/A       |
| Gold Star Semiconductor                      |   |        |         |  |       |       |     |             |           |            |          |           |       |            |         |          |             |            |             |         |          |             |             |          |           |
| Gumi Plant                                   | 4,000   | 7,800  | 15,750  | \$40                                   | \$80  | \$100 | 1   | 2           | 0         | 6          | 7        | 5         | 64    | 5          | 5       | 3        | 5           | 5          | 3           | —       | —        | —           | —           | —        | —         |
| Anyang R&D Plant                             | N/A   | N/A    | 4,800   |  |       |       | 1   | 2           | 0         | 2          | 2        | 0         | 24    | 2          | 2       | 0        | 5           | 1          | 1           | —       | —        | N/A         | N/A         | N/A      | N/A       |
| Hyundai Electronics                          |   |        |         |  |       |       |     |             |           |            |          |           |       |            |         |          |             |            |             |         |          |             |             |          |           |
| Semiconductor I                              | N/A   | N/A    | 0       | \$30                                   | \$112 | \$140 | 2   | 5           | 0         | 0          | 9        | 8         | 24    | 3          | 6       | 0        | 1           | 13         | 2           | 4       | 0        | 2           | 3           | N/A      | N/A       |
| Semiconductor II                             | N/A   | N/A    | N/A     |  |       |       |     |             | 0         | 0          | 25       | 0         | 48    | 4          | 8       | 0        | 0           | 10         | 5           | —       | —        | —           | —           | N/A      | N/A       |
| Assembly Plant                               | N/A   | N/A    | 0       |  |       |       |     |             | N/A       | N/A        | N/A      | N/A       | N/A   | N/A        | N/A     | N/A      | N/A         | N/A        | —           | —       | —        | —           | 21          | 66       | 133       |
| Daewoo Electronic Components                 | 4,000   | 5,000  | 10,000  | \$1                                    | \$1   | \$10  | 0   | 0           | 0         | 0          | 0        | 4         | 17    | 1          | 1       | 0        | 2           | 0          | 2           | —       | —        | —           | —           | —        | —         |
| Korea Electronics                            | 7,400   | 18,000 | 14,500  | \$40                                   |       |       | 0   | 0           | 0         | 0          | 10       | 36        | 1     | 3          | 0       | 2        | 0           | 0          | —           | —       | —        | —           | —           | —        | —         |
| ETRI Semiconductor Operations                | 100   | 200    | 500     | \$60                                   |       |       | 1   | 2           | 0         | 2          | 0        | 4         | 32    | 2          | 2       | 1        | 5           | 3          | 1           | 1       | 1        | 1           | 2           | —        | —         |
| Anam Industrial                              | 50,000  | 70,000 | 100,000 | \$10                                   | \$20  | \$50  | N/A | N/A         | N/A       | N/A        | N/A      | N/A       | N/A   | N/A        | N/A     | N/A      | N/A         | N/A        | N/A         | N/A     | N/A      | N/A         | 8,000 Units |          |           |

N/A = Not Applicable

— = Unavailable

Source: DATAQUEST

#### NOTES:

Combined totals may appear if companies do not provide breakdowns by individual plants. For example, in the Gold Star Semiconductor listing, one figure is given for employees: 1,200. This indicates that total employment for both the Gumi plant and the Anyang R&D plant equals 1,200. This same format is followed when one capital spending figure is given for all three years. For example, the Korea Electronics listing notes \$60 million in capital spending over the three year period from 1983 through 1985.

Floor space: the square footage given for floor space may include facilities other than those devoted to semiconductor manufacturing. For example, Samsung's Suwon plant listing notes 1,000,000 square feet. This area includes engineering and support facilities.

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