
Asian Semiconductor and Electronics Technology Service

Products, Markets, and Technology

Dataquest

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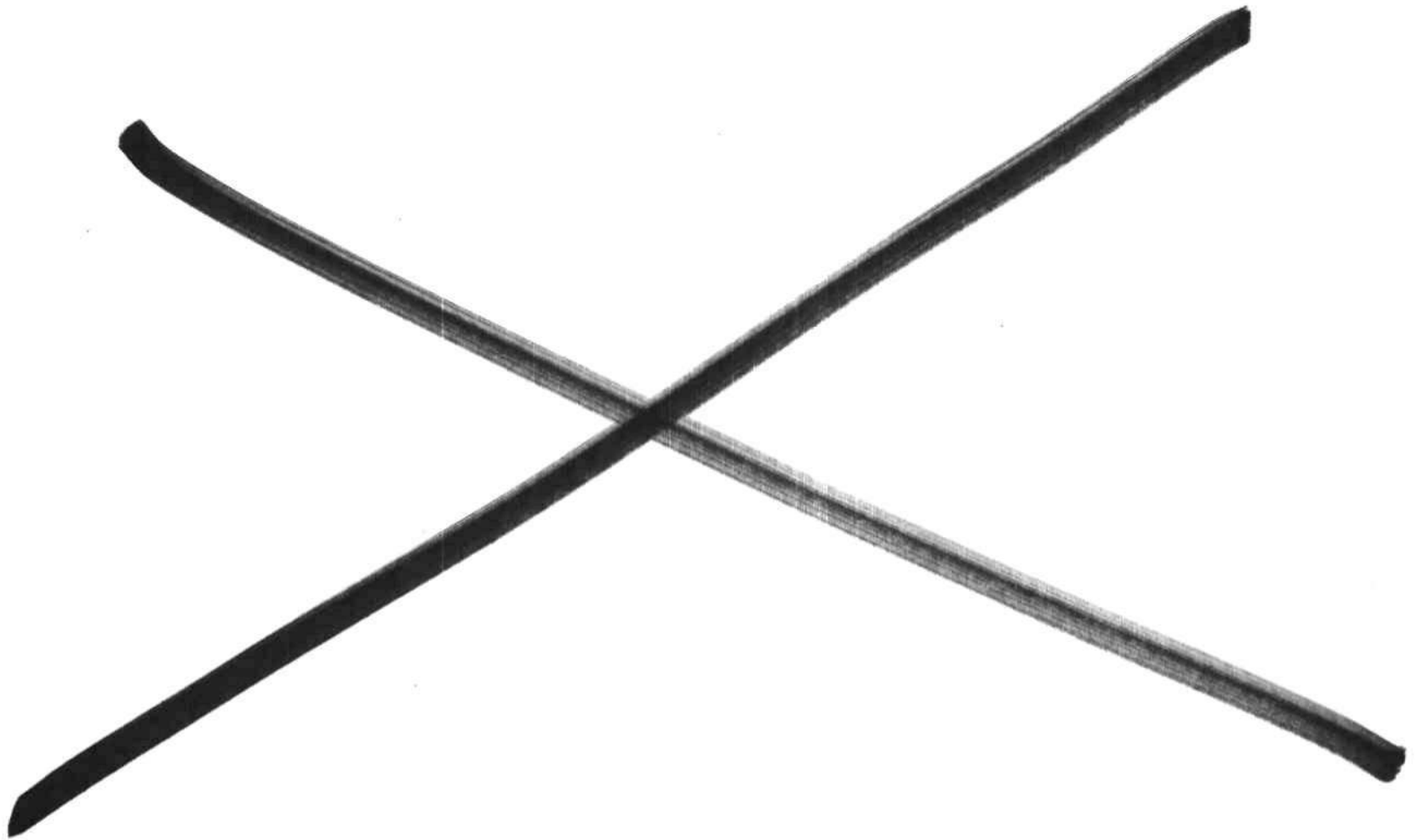


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¹Titles in capital letters signify tabs.

Introduction to the Service

The Asian Semiconductor and Electronics Technology Service (ASETS) documents, analyzes, and interprets all important aspects of the Asian semiconductor and electronics industries, as well as the Asian manufacturers that participate in the worldwide markets. The service comprises the following:

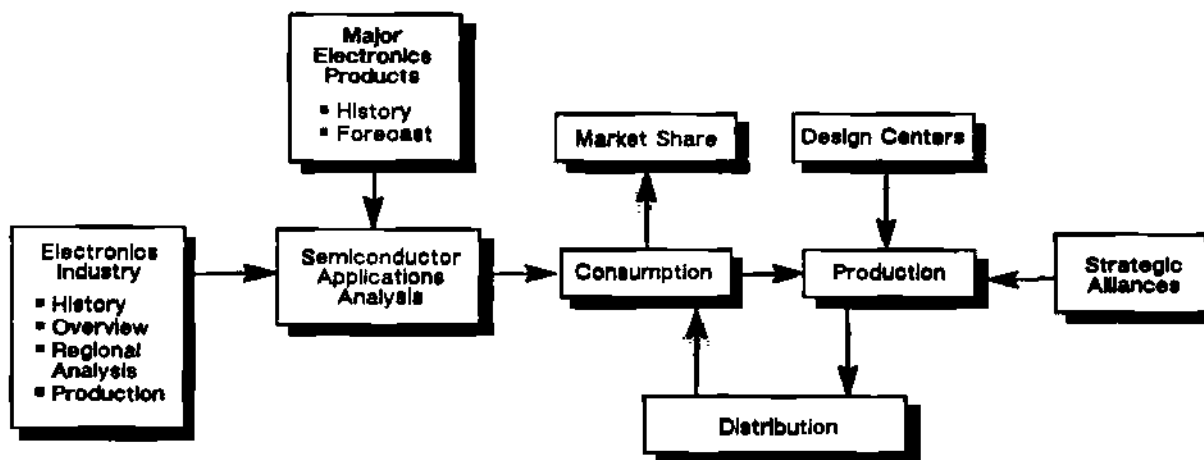
- Two loose-leaf database binders containing sections that are continually revised and updated as developments occur or as additional information becomes available
- Timely newsletters analyzing significant industry developments—with additional binders provided for these newsletters
- Tactical industry updates every two weeks to keep you apprised of these dynamic markets
- Direct access to research staff in Seoul, Taipei, and San Jose for background information and for questions regarding the information contained in each volume

The service analyzes, interprets, and reports on the products, markets, and strategies of the major Asian companies in the semiconductor and electronics industries, with a specific focus on the Asian market. The service also provides valuable information on the government, economy, and industrial policy of each Asian country. ASETS provides data with which to make strategic decisions. We perform the following functions:

- Monitoring Asian semiconductor R&D projects and corporate spending
- Analyzing semiconductor technology trends on a quarterly basis
- Evaluating plant capacity expansion and design center activity
- Analyzing trends in strategic alliances
- Tracking Asian semiconductor production, inventory, shipments, pricing, and consumption for the major products
- Forecasting five-year consumption and quarterly figures for all semiconductor categories
- Examining and analyzing the electronics equipment and end-user markets
- Profiling the major Asian semiconductor companies, emphasizing their products and strategies
- Analyzing the forces affecting the Asian semiconductor markets

Dataquest monitors the Asian semiconductor and electronics industry using the system shown in Figure 1.

Figure 1
Products and Markets
(Volume I)



Source: Dataquest (August 1990)

NEED FOR THE SERVICE

Since 1975, Dataquest's Semiconductor Industry Service (SIS) has offered comprehensive worldwide market research to semiconductor manufacturers, semiconductor users, and suppliers of semiconductor manufacturing equipment and materials. As individual geographic markets expanded, it became obvious that each of these areas was developing its own unique characteristics. This is especially true of Asia, because it is becoming an integrated marketplace and important industrial power.

Much has been written about Asia, but there is no other single detailed, comprehensive, continually updated, and unbiased analytical service in the semiconductor market. With the movement of both finished and unfinished semiconductor products across geographic borders, available industry statistics sources have become less useful. Hence, there is a growing need for the type of information that Dataquest provides through its continuous industry coverage, updated database, and analyses of observed trends.

SERVICE ORGANIZATION

Volume I—Products and Markets

Volume I contains specifics of the semiconductor and electronics industries in Asia. It is divided into the following sections:

- **History of the Industry**—Discusses the background of the industry in Asia and gives an overview of the current industry situation

- **Electronics Industry**—Provides an overview of the increasing part that the electronics industry plays in Asia; includes in-depth discussion of the Asian consumer and PC industries
- **Semiconductor Applications**—Analyzes the major semiconductor products that are used in the consumer and industrial markets and the major subsections of those markets
- **Consumption/Production**—Contains Asian semiconductor shipments, production, and consumption history and forecasts
- **Market Share**—Contains worldwide shares for the major Asian manufacturers and market shares in Asia for the major Asian, US, European, and Rest of World (ROW) manufacturers
- **Distribution**—Describes the role played by agents and distributors in Asian semiconductor sales through distribution; lists the major distributors
- **Electronic Products**—Analyzes the major Asian electronics product markets with respect to consumption, production, imports and exports, and technology trends
- **Strategic Alliances**—Analyzes joint venture, licensing, and second-sourcing agreements entered into by Asian semiconductor device and systems manufacturers
- **Capital Spending**—Contains Asian capital expenditure history and forecasts
- **Design Centers**—Contains information about high-technology design centers in selected markets

Volume II—Company Profiles

The second volume comprises profiles of major Asian merchant semiconductor companies, including analyses of sales channels, financial structures, and product portfolios. It also examines factory locations, their technologies, and their organizational structures. Semiconductor revenue for most companies is split by geographic region. The companies covered include the following:

- | | | |
|-------------|----------------|-----------|
| • AMPI | • HMC | • TSMC |
| • Chartered | • Hyundai | • UMC |
| • Daewoo | • KEC | • Winbond |
| • Elcap | • Samsung | • WUXI |
| • Goldstar | • SGS-Thomson | |
| • Hua-Ko | • Shanghai #14 | |

SERVICE FEATURES AND PROCEDURES

The date of publication is noted on the bottom of each page of a document. Sections are updated regularly, and filing instructions are sent with the new versions. The table of contents also is updated regularly to enable subscribers to verify that their binders are current and complete.

Newsletters are published monthly and should be filed in the *Newsletters* binder. The newsletters are devoted to current topics of specific Asian interest and to international industry developments.

The inquiry privilege permits the binderholder to contact Dataquest by mail, fax, telegram, telephone, telex, or in person to request copies of printed material, data, or opinions on topics covered by ASETS. The principal information collections are maintained at our San Jose, California, headquarters and, with the exception of confidential or proprietary material, are available to all our subscribers. We also have research staffs in Seoul and Taipei that maintain pertinent information on the material contained in the ASETS database.

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ASETS STAFF

The ASETS staff has a continuing, long-term commitment to the semiconductor and related electronics industries. The expertise and experience of the worldwide Semiconductor Industry Service staff and access to the resources of other Dataquest high-technology industry groups further enhance the quality of our service.

Members of Dataquest's professional staff are frequent speakers at industry seminars and symposia. We participate in the leading professional societies related to the electronics industry. We maintain contact with a large user base through sophisticated sampling and interviewing techniques. Our staff regularly reviews all important publications related to the semiconductor industry and associated user industries.

SUBSCRIPTION TERMS

Basic Terms

The service begins on the date of the first billing. At that time, the binderholder receives four service binders containing complete, up-to-date material and copies of all recent newsletters. For the duration of the subscription, the binderholder receives a copy of each additional or replacement section of the notebook and each newsletter published. Direct access to the service staff may be used for questions related to ASETS.

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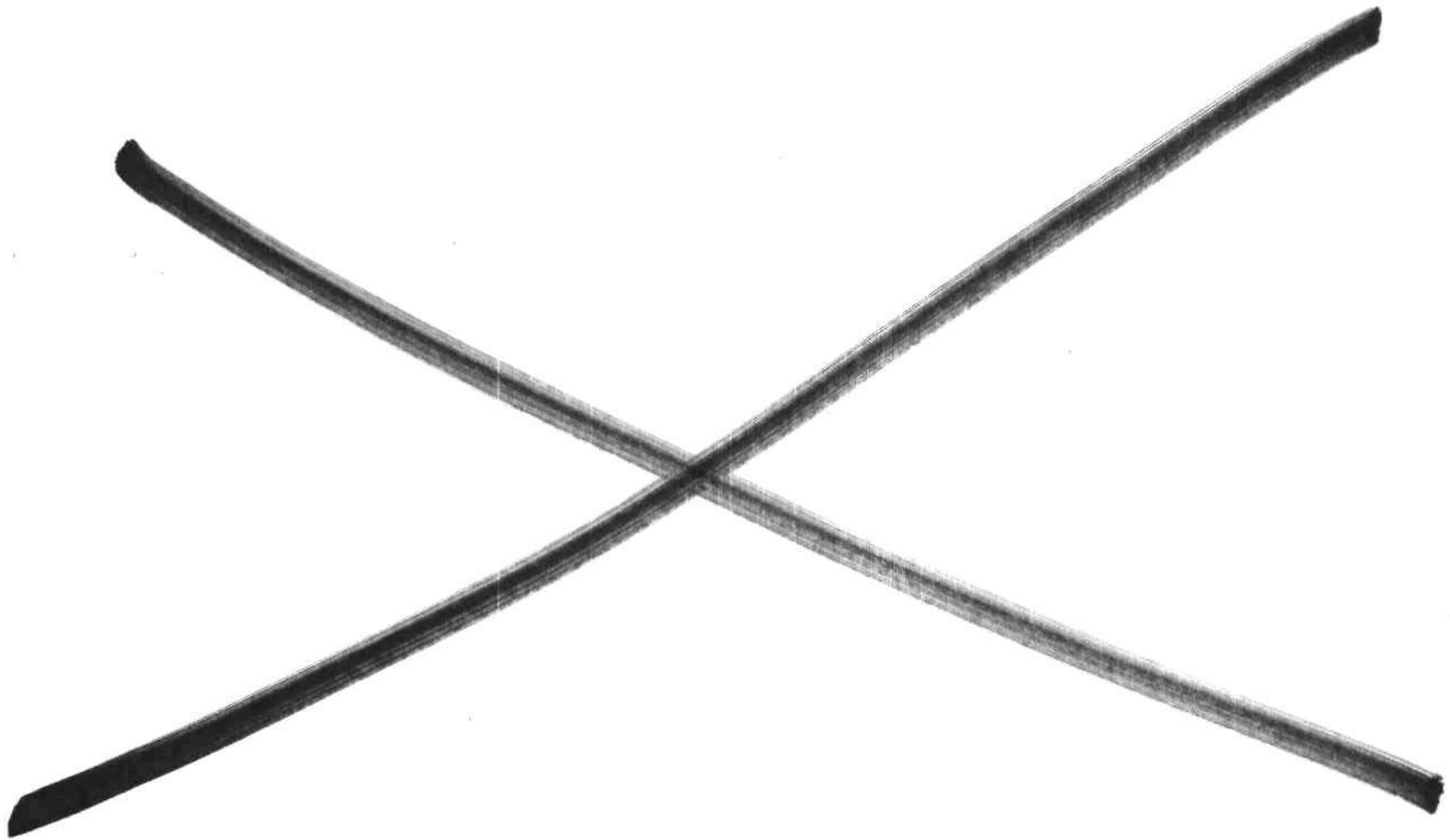
Subsidiaries, divisions, regional offices, majority-owned affiliates, and parent companies of the subscribing organization are eligible for add-on subscriptions at a fraction of the base price for each additional subscription.

Relationship to Dataquest's Semiconductor Industry Service

ASETS is intended to complement SIS. Topics of general interest (such as discussions of technological advances) will be covered only to the extent that they specifically affect Asia. These companion services are offered separately as components of Dataquest's international semiconductor industry program.

Base Price and Payment Terms

Industrial clients will be billed annually for the full price of the service. Dataquest reserves the right to raise its subscription prices to reflect broadened scope or increased costs. Subscribers will be notified in advance of any such price increase.



History of the Semiconductor Industry—China

BACKGROUND

Integrated circuit technology in the People's Republic of China (hereafter called China) began in 1963 when China developed its first integrated circuit (IC). Although production quantity increased rapidly, the physical quality and the reliability of many of these products were unsatisfactory. Major efforts to improve technology did not begin until 1978. By 1986, market-oriented products were developed to help satisfy some of China's unleashed consumer demand. Between 1963 and 1987, China invested US\$270 million in its IC industry. During that period, the country imported more than 30 front- and back-end IC lines.

Improvements in technology resulted in the construction of some high-standard clean rooms as well as the use of production lines and appropriate IC manufacturing equipment so that factories could put out prescribed amounts of high-quality products. Additionally, the relative techniques of micromanufacturing, sputtering, diffusion, ion implementation, and isoplanar isolation were organized together to ensure progress. By 1986, the mainland Chinese knew how to produce VLSI having 5- to 7-micron linewidths and 10,000-component integration.

China's Department of Electronics Industry played a key role in the development of the country's semiconductor industry, largely as a result of its focus on the consumer products in the 1980s. The agency set national standards, encouraged cooperation with foreign partners, prioritized and financed large projects, established research institutes, and funded universities to increase China's pool of young engineers.

At this stage of development, China's semiconductor industry was not prepared for the sudden demand for televisions, radios, watches, tractors, washing machines, and other items from its newly rich farmers and urban workers beginning in 1983. China had not yet developed the family of circuits required to manufacture these products and had to import them. The eventual large quantity of imports caused a huge drain on the country's hard currency and added to its spiraling inflation. China needed to increase the output of its factories. Particle contamination, chemical impurities, incomplete process procedures, and fluctuating power supplies were just a few of the problems the country faced.

China introduced the concept of a joint venture to its electronics industry in an attempt to narrow the growing gaps in the manufacturing cycle. Major Chinese government departments such as the Ministry of Electronic Industry (MEI) sought foreign partnerships to decrease development delays and at the same time open up huge untapped markets for these multinationals. By 1986, China was mass-producing 5-micron chips and successfully producing 3-micron samples of 64K DRAM and 16K SRAM. Unfortunately, production stalled in 1987 because only 5 of more than 20 major lines remained in operation.

Today, there are six key joint ventures in various stages of development or operation in the semiconductor industry in China:

- Toshiba with Wuxi Microelectronics
- Motorola with the City of Tianjin
- Philips with Shanghai Device Factories, Numbers 5 and 7
- NEC with Beijing Central Steel & Yangtong Device Factory

- Siemens with Wuxi Microelectronics
- Belgium Telephone with Shanghai Number 14, now called Shanghai Belling

With the basic component technology transferred by international members of these joint ventures, China is enabled to manufacture a wide variety of top-quality electronics equipment (see the *ASETS Prod., Mkt., & Tech.* section entitled “History of the Electronics Industry—China”). The Ministry of Machinery and Electronics Industries (formerly MEI) under the leadership of Minister Zou Jiahua remains committed to building up the current three IC bases in China—Beijing, Shanghai, and Wuxi. Dataquest estimates that approximately 50 percent of China’s IC products meet international standards. China’s stated task for 1990 through 1995 is to support key industries and create economies of scale.

HIGHLIGHTS

The 1980s

Highlights of the major developments within China’s semiconductor industry in the 1980s include the following:

- LTX Company, a world leader in analog IC test systems, transferred television device test technology to Beijing Electronic Tube Factory. The hardware and software included in the test package were used to test two chips for the in Sanyo and Toshiba televisions. COCOM restrictions had made such technology transfers very difficult in the past.
- Oregon’s Integrated Measurement Systems Inc. (IMS) won a contract from the Chinese Ministry of Aerospace in Xian, China, to purchase IMS’ Logic Master HS. The provincial ministry, under China’s Aviation Administration, used the Logic Master for design verification and characterization of custom ICs. Chinese engineers performed limited production testing on electronic equipment designed for China’s aviation industry.
- “Semiconductor China 1989” was one of Shanghai’s first major exhibitions of semiconductor fabrication and processing technology. The April 1989 exhibition lured equipment buyers from all over China. Dataquest estimated that China had approximately 4,200 production facilities, 200 service-related organizations in electronics, and 150 research institutes in 1989. China had a work force of 1.6 million, including 150,000 engineers and technicians.
- Motorola adopted a “wait-and-see” approach to its negotiations with mainland Chinese officials to construct a fully owned US\$300 million semiconductor facility designed to have a 25,000-square-foot clean room for the production of ICs, transistors, and two-way radio products to be sold in China and abroad. China’s electronics industry produced more than US\$10 billion in electronics products, most of which are consumer-related goods.
- The joint venture between Shenzhen-based Daming Semiconductor and California-based GSP Company reported strong production of diodes, ICs, and button cell batteries, which are marketed exclusively in China. The agreement granted 30 percent ownership to GSP, which supplied almost all of Daming’s operating equipment. Daming was able to gain access to international marketing channels through GSP. Last year, only one year after operations began, the joint venture reported US\$267,000 in profits.

The 1990s

Highlights of Chinese semiconductor industry developments in the 1990s include the following:

- 1990
 - As China experienced deeper economic adversity under its austerity program initiated in late 1988, the Chinese Academy of Sciences and its affiliate research institutes made efforts to develop China's communications infrastructure.
 - The Shanghai Metallurgical Institute developed a "very high speed" GaAs IC, the 120-gate gate array. The internal gate speed was not available, but this low-technology product helped to satisfy a need in China's burdened communications network.
 - China's microelectronics industry recentralized and promoted large-scale, capital-intensive projects. The policy focused on long-term infrastructure needs rather than short-term demand for consumer electronic products, which was blamed for draining the nation's precious capital.
 - The city government of Shanghai and officials at Caohejing High-Tech Park decided to permit foreign investors to lease land in order to boost long-term investment in the park.
 - Caohejing has 17 joint ventures at present, accounting for US\$210 million in total investment. Major foreign investors that established wholly owned businesses in the park include 3M Corporation, Foxboro, and Philips.
 - Government statistics report that there were 9 joint ventures in the park in 1989, totaling US\$60 million. Export value of products shipped from Caohejing were reported to be worth US\$32 million.
 - The Suzhou Semiconductor General Plant in Jiangsu Province opened an integrated circuit (IC) production line to manufacture devices for China's consumer IC market.
 - The annual capacity of the fab was estimated to be 1 million pieces, mostly consumer chips used in cameras; the facility was capable of manufacturing 3-inch wafers.
 - According to sources in China, over 90 percent of the plant equipment was bought from domestic equipment suppliers.
 - At least four of China's major semiconductor facilities result from joint venture agreements with international semiconductor companies. Li-shan and Suzhou, however, are China's two major wafer fabs almost entirely independent of foreign cooperation.
 - Officials of Helionetics Inc. of Irvine, California, and the North Computer Application and Development Corp. (NCAD) of Shenyang, China, signed an agreement to form a new, jointly owned company called Shenyang Shenlong Computer Systems Ltd. Helionetics and NCAD shared the US\$1 million start-up costs.
 - The company was formed to manufacture and market a personal computer based on Sun Microsystems' SPARC technology. The product actually will be both a PC and a workstation, as it will run both on MS-DOS and SUN OS operating systems, thanks to Helionetic's 33-MHz SP-II add-on board.

- The venture combines the sophistication of Helionetic's hardware with the software talents of North Computers; its market potential is estimated to be US\$200 million during the next five years.
- The company planned to bring its first product to market by early 1991. In addition to selling the computers in China, it planned to export them to Europe, the United States, and other locations.
- NEC and Shoudu Iron & Steel signed a joint venture agreement reportedly as equal partners, to manufacture semiconductors in China.
 - The total investment for a fab in Beijing could reach \$200 million by 1993.
 - The fab would reportedly produce 50 million ICs a year, including microcontrollers, ASICs, and memory products for domestic consumption.

History of the Semiconductor Industry—Hong Kong

BACKGROUND

The Hong Kong semiconductor industry started inconspicuously in 1963 when Fairchild Semiconductor (H.K.), Ltd., began manufacturing and packaging discrete transistors in Kwun Tong. The companion electronics industry had started on a limited scale four years earlier, assembling portable single-band transistor radios with imported electronic components. However, official statistics did not list any factories until 1961, when three factories employing slightly more than 100 operators and exporting HK\$13 million worth of transistor radios were recorded. (Unless otherwise specified, in-text currency references are to U.S. dollars.)

In the 1960s, the Hong Kong semiconductor industry was dominated by manufacturing, assembly, testing, and packaging of integrated circuits (ICs) and discrete devices by foreign companies. The only locally owned company, Micro Electronics, assembled rectifiers, transistors, and LED lamps and displays. National Semiconductor and Fairchild stopped their semiconductor assembly work in 1983 and 1984, respectively.

In the early 1980s, three local semiconductor companies started VLSI fabrication. Since then, the local IC industry has consistently moved at a fast pace in an attempt to fulfill the demands of Hong Kong's own electronic manufacturers and to compete with its long-established U.S. and Japanese competitors.

The rapid improvement of the business and manufacturing climate in mainland China in the late 1980s positively affected Hong Kong's semiconductor industry when the territory became a stepping stone for electronics companies seeking penetration of the People's Republic of China's vast market. In response to growing demand for semiconductors in Hong Kong and China, Motorola began constructing a 7.2-acre facility in the Tai Po Industrial Estate next to Tolo Harbor. The first phase of the project was budgeted to cost several hundred million Hong Kong dollars (HK\$7.803/US\$1 on 9/12/88).

HIGHLIGHTS

Highlights of the major events in Hong Kong's semiconductor industry between 1960 and the present are summarized in the following paragraphs.

1960 to 1969

Between 1960 and 1969, foreign semiconductor companies looked to Hong Kong to set up assembly, testing, and packaging facilities in the territories. The company names, ownership, and starting dates are listed in Table 1.

1970 to 1988

Many new semiconductor companies were established in Hong Kong from 1969 and 1988. Three wafer-fabrication facilities (RCL Semiconductor, Elcap Electronics, and Hua Ko Electronics) are independent of each other and believed to be closely linked to the People's Republic of China (PRC). These companies use 3- to 2-micron technology and produce mainly gate arrays, high-speed CMOS, ROM, and custom ICs. Each company's total sales reached between \$10 million and \$15 million in 1985, and their total investment in semiconductor production and R&D facilities is estimated to have been more than \$400 million that year. The semiconductor companies from this second phase (1969 to 1988) are listed in Table 2.

Table 1

**First Phase of Semiconductor Companies in Hong Kong
(1960-1969)**

Company	Ownership	Start Date
Fairchild Semiconductor (H.K.), Ltd.	U.S. subsidiary	1962
Micro Electronics, Ltd.	Local	1964
Teledyne Semiconductor	U.S. subsidiary	1965
Motorola Semiconductor (H.K.), Ltd.	U.S. subsidiary	1967
National Semiconductor (H.K.), Ltd.	U.S. subsidiary	1969

Source: Dataquest (February 1991)

Table 2

**Second Phase of Semiconductor Companies in Hong Kong
(1969-1988)**

Company	Ownership	Start Date
Semicon Devices, Ltd.	Local	1969
Electronic Devices, Ltd.	Local	1969
Siliconix (H.K.), Ltd.	U.S. subsidiary	1974
RCL Semiconductors, Ltd.	Local	1979
Sprague	U.S. subsidiary	1981
Elcap Electronics, Ltd.	Local	1982
Hua Ko Electronics Co., Ltd.	Local	1983
Swire Technologies, Ltd.	Local	1986
Bel Fuse Ltd.	U.S. subsidiary	1987

Dataquest (February 1991)

As the Hong Kong government began to support various R&D projects during this period, the Industry Development Board, established in 1983, began advising the government on all industrial matters other than labor and textiles. A total of more than HK\$2 million was allocated to the R&D projects at various universities in Hong Kong. Table 3 presents details of some of these projects.

As a result of foreign investment, government support, and expanding electronics markets, Hong Kong's semiconductor industry was flourishing by 1986. The major end-use markets in Hong Kong were consumer products such as telephones, clocks, and toys. Because of Hong Kong's growing local use of semiconductors, companies such as Motorola and Texas Instruments had established design centers there. The trend continued in 1987, as indicated by the following:

- VLSI Technology, Inc., announced in September 1987 that it had chosen Hong Kong as the headquarters for its East Asian/Pacific Rim operations. The centerpiece of the new facility would be an ASIC design center providing customers with cell-based designs using CMOS or HMOS technologies and 1.5-micron design rules. (The center opened in January 1988.)

Table 3

Projects Supported by Hong Kong's Industry Development Board

Project	Start Date	Responsible Group
Fabrication and analysis of integrated circuits	April 1982	University of Hong Kong
Computer-aided design of electronic systems and VLSI	January 1983	Hong Kong Polytechnic
Integrated circuit technology and semiconductor devices	August 1983	Chinese University of Hong Kong
CAD/CAM system for Hong Kong manufacturing industries	July 1985	University of Hong Kong
Surface-mount technology laboratory	1988	Hong Kong Productivity Council

Source: Dataquest (February 1991)

- Motorola Semiconductors Hong Kong Ltd. reentered the DRAM field after suspending production in 1986 because prices had dropped below cost. Motorola's profits had improved, and it had recently released new 256K and 1Mb DRAM products.
- Motorola announced plans to build "Silicon Harbour," a new 29,000-square-meter electronics plant on a 7.2-acre site in the high-technology zone of the Tai Po Industrial Estate on the waterfront next to Tolo Harbor.
 - Motorola planned to design, manufacture, and test semiconductors there using CAD/CAM/CIM technologies. Construction was to be completed in 1990.
 - The project should help the local electronics industry to move into the current generation of modern circuitry and product miniaturization. The plant will accommodate Motorola's Asia/Pacific Division Headquarters, its regional computer center, and its design and manufacturing center for ASIC, bipolar/MOS LSI semiconductors.

1989

In 1989, the uncertainty of Hong Kong's future as it faces Britain's planned changeover to the People's Republic of China in 1997 was heightened by the military suppression of China's prodemocracy movement in June. Investments in manufacturing in southern China slowed considerably in the second half of 1989 as many Hong Kong investors looked to the newly emerging economies of Thailand, Malaysia, the Philippines, and Indonesia. Dataquest believes that the business climate in Hong Kong will continue to be highly sensitive to the political events in Beijing.

Hong Kong will remain Asia's second-largest financial center after Tokyo for some time. Its vibrant laissez-faire economy, proximity to China and Taiwan, and western cultural orientation will continue to allow Hong Kong to serve as the West's gateway to the East. The Hong Kong government is slowly realizing that it must play an active role in developing a semiconductor industry, and it has taken steps to work with industry and universities to set up technical research centers and make training available to more people.

Major events that affected Hong Kong's fledgling semiconductor business in 1989 include the following:

- Motorola continued to increase its ASIC manufacturing capabilities in Asia at its Hong Kong facilities, expanding its IMS verification system XL-60 to handle large-scale ASICs. The facility operates on a 24-hour basis.
- Engineers from Elcap, Hua Ko, Motorola, National Semiconductor, and other local semiconductor companies were hired by ATC of Hong Kong and Hong Kong University to provide hands-on training in the use of software, IC fabrication, and device verification on IMS ASIC verification systems.
- AT&T's new Hong Kong test facility began testing PCBs and discrete electronic components for its subsidiaries as part of its quality management services. At the time, the company operated a test facility in Taiwan to test monitors and one in Singapore to test LEDs and data storage devices, particularly disk drives. AT&T's Asia/Pacific strategy had been to reduce the long lead times hampering its regional suppliers. The subsidiary moved into testing diodes and transistors and is developing software to automate the company's offshore testing facilities.

THE 1990s

Highlights of Hong Kong's semiconductor industry developments in the 1990s include the following:

- 1990
 - Government, university, and industry leaders in Hong Kong successfully established the territory's first ASIC design center. It represented Hong Kong's major attempt to develop a long-term semiconductor industry strategy in 1990. The government of Hong Kong agreed to contribute US\$1.3 million for the purchase of equipment and software and another US\$513,000 for the design center's first year of operating expenses. The private sector was not asked to contribute funds; however, companies that benefit from the center in the future will likely be required to contribute in some way.
 - The center's administrative office is located in the Vocational Training Institute, and instruction will be at Hong Kong's four higher-learning institutions. About 250 students will be enrolled each year.
 - With electronics as Hong Kong's second-largest export earner, the government began to adopt a more proactive approach to the region's fastest-growing industry in 1990.
 - Siemens, a leading German electronics company, officially opened a Hong Kong-based purchasing office. Officials from the company's headquarters expect the office to buy US\$115 million worth of products in two years.

History of the Semiconductor Industry—Singapore

BACKGROUND

The Singapore semiconductor industry began in 1969 when several multinational companies headquartered in the United States set up labor-intensive, export-oriented plants in Singapore to assemble semiconductor components. By the mid-1980s, the semiconductor industry there had reached US\$1,329 million, employing approximately 14,000 Singaporeans. After 1987, SGS-Thomson built an IC design center and Hewlett-Packard constructed a \$50 million fabrication plant to manufacture gallium arsenide phosphide wafers that are used in light-display panels on products such as stereo sets and computer terminals. Currently, there are two front-end wafer fabrication plants in Singapore—those of SGS-Thomson and Chartered Semiconductor (see the ASETS binder entitled *Company Profiles*).

HIGHLIGHTS

The Late 1980s

Developments in the Singapore semiconductor industry in the late 1980s are plentiful. Highlights include the following:

- Fujitsu initiated the construction of its first software development centers in Singapore and Malaysia to make use of the region's pool of trainable engineers. Fujitsu was concurrently working to set up similar facilities in China and South Korea.
- Singapore joined Japan as one of the world's leading users of surface-mount technology (SMT). Overall, Singapore ranked second only to Japan in the amount invested to develop SMT.
- SCI Singapore, one of the world's largest contract SMT assemblers and manufacturers of electronic components, sold 85 percent of its total output to Singaporean companies producing disk drives and other electronic products. Sales in Singapore totaled US\$64.0 million in 1988, an astonishing increase from the US\$2.5 million sold in 1985.
- Europe's largest electronics company, Siemens, announced a five-year, \$70 million investment in its Singapore IC assembly and test facilities. By 1995, Siemens Components' fixed investments in Singapore should have more than doubled from its previous 18 years, totaling \$150 million. Siemens' announced strategy was to increase its nondomestic sales 60 percent by the 1990s.
- On July 27, 1989, Chartered Semiconductor Pte. Ltd. and Singapore's Ministry of Finance formally celebrated the opening of Chartered's new wafer fabrication facility.
- Texas Instruments expanded its assembly and test capacity in Singapore to meet the rising demand for its 4Mb samples in the region. The plant expansion's total cost was estimated at \$24 million, with an additional \$330 million in new production equipment to be purchased by the subsidiary over the course of three years.

The 1990s

Highlights of Singapore's semiconductor industry developments in the 1990s include the following:

- 1990
 - In an effort to automate Singapore's computerized traffic management system, electronic banking machines, and hospitals, the Singapore government accepted a bid from France to set up a laboratory at the French-Singapore Institute (FSI) to develop new applications for smart cards. The FSI and the French Embassy negotiated the financing of the laboratory. Several fully automated manufacturing companies in France had expressed interest in selling equipment to the FSI.
 - Singapore's national telecommunications authority announced the completion of a nationwide Integrated Services Digital Network (ISDN). Digitalization of the country's telephone network is still in progress and is expected to be completed by 1995.
 - Toshiba announced that it established a new company called Toshiba Electronics Asia (Singapore) Pte. Ltd. (TEA) in Singapore to supervise the company's components business in Southeast Asia, Australia, and New Zealand. According to the plan, TEA would eventually supervise all business activities of its branches and offices throughout Southeast and East Asia.
 - Harris Semiconductor (Singapore) issued a statement in June 1990 that its Singapore operations will not be relocated to Malaysia. The statement followed an announcement by officials at Harris Corporation that the company would relocate its California, Taiwan, and Singapore operations to Malaysia.
 - The second announcement clarified the future of Harris' Singapore operations, where approximately 1,000 workers are employed. Officials said that only two product lines would be moved to Malaysia as part of the corporation's US\$200 million expansion plans.
 - As a result of Harris Semiconductor's Taiwan plant closure, optoelectronics and high-end integrated circuit operations were shifted to Singapore.
 - Harris Semiconductor began its operations in 1988 when Harris Corporation bought General Electric's worldwide operations, including GE's two semiconductor plants in Singapore. Its investment in Singapore totals US\$40 million so far.
 - According to foreign press reports, SGS-Thomson in Singapore anticipated record sales of \$564 million in 1990. The company hopes to double wafer fabrication capacity to 100,000 units per month by 1992.

- Seagate Technology International, the second-largest private sector employer in Singapore in 1990, invested more than \$20 million to install two automated PCB assembly lines at its Senoko plant.
 - The heart of the two new lines is the latest ultrahigh-speed surface-mount placement machine from Philips—the MCM VII.
 - Representatives of the company said that its Senoko plant is one of the finest PCB surface-mount technology facilities in the world and provides vital support to Seagate's worldwide disk-drive operations.
- Press reports from Asia said National Semiconductor laid off more than 300 workers in Singapore. Combined with two layoffs totaling more than 400 workers and attrition, National's Singapore work force fell from 3,500 in January 1989 to 2,100 in 1990.

History of the Semiconductor Industry—South Korea

BACKGROUND

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 14 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 ULSI capability and to 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 the one it has already achieved in shipbuilding, 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 (including components and assemblies produced by native- and foreign-owned manufacturers) grew at a 25.2 percent compound annual growth rate (CAGR), from \$850 million in 1987 to \$2,087 million in 1989. (Unless otherwise specified, in-text currency references are to U.S. dollars.)

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 companies 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.

HIGHLIGHTS

South Korea's rapid entry into the international semiconductor marketplace had 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 a World Bank spokesperson, "... 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.

The 1960s

The South Korean semiconductor industry came into being in 1965 when KOMY Semiconductor, Ltd., started manufacturing and packaging discrete transistors under a joint venture with the KOMG Company of the United States.

The 1960s were 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

The 1970s were 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 electronic watches. Korea Semiconductor was later acquired by the Samsung Group and it 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. Two years later, it was sold by the Lucky-Goldstar Group and changed the name to Goldstar Semiconductor, Ltd., in 1979. It 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. That year, the South Korean government established an R&D organization, the Korea Institute of Electronics Technology (KIET), to promote the semiconductor and computer industries.

The 1980s

During the 1980s, South Korea 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*: Hyundai, Daewoo, Lucky-Goldstar, and Samsung.

The fourth largest conglomerate, Daewoo, took a different route to enter the electronics field when it acquired the electronics business of Taihan Electronic Wire Company. This 1983 acquisition included the semiconductor line in its research and development lab.

A detailed discussion of the recent activities of the top four conglomerates in developing semiconductor technology and manufacturing capability is given in Volume III Company Profiles entitled "Native South Korean Semiconductor Manufacturers."

The 1980s were 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 groundwork, 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 South Korea and the United States. Hyundai's activity stimulated Samsung and Lucky-Goldstar to follow with investments in semiconductor programs on an even larger scale. In 1984, Lucky-Goldstar started producing the Z80 microprocessor under a second-source agreement with Zilog.

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

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 1Mb DRAM. In addition to the government funding, the four conglomerates invested \$463 million in semiconductor production and R&D facilities in 1984 and made additional expenditures of \$490 million for 1985.

In 1985, the native South Korean companies were suffering very badly as a result of the world recession in semiconductors. By contrast, 1986 proved to be a boom year for the South Korean semiconductor industry. Revenue from native South Korean companies' total output of semiconductor products skyrocketed from 1985's \$175 million to \$300 million in 1986, reinforcing South Korea's emergence as an internationally competitive semiconductor supplier.

1989

South Korean companies' total worldwide shipments increased 39 percent from US\$1,262 million in 1988 to US\$1,757 million in 1989. After increasing its semiconductor sales by 42 percent, Samsung became the twelfth largest semiconductor company in the world in 1989. Samsung's 38 percent growth in the Asia/Pacific and rest of world (ROW) regions enabled it to reach 8.6 percent of the Asia/Pacific-ROW semiconductor market, which brought it to within \$47 million of Toshiba's total semiconductor revenue in the region.

Developments in the South Korean semiconductor industry from the beginning of 1989 to the present are very numerous and significant. Key events are highlighted as follows:

- The Korean Semiconductor Research Association invested US\$340 million in 1989 to develop 13 semiconductor projects throughout South Korea. This investment increase represented a 700 percent expansion compared with 1988. Participant companies provided 60 percent of the total investment, and the remaining 40 percent came from the Korean government's special R&D project.
- Samsung Electronics Inc. and IBM Korea, Inc., agreed to exchange patents for the design and manufacture of semiconductor products, marking the first time a Korean manufacturer has released high-technology patents to IBM. The cross-licensing pact indicated an opening of the exchange of high-technology patents between U.S. and South Korean companies.
- The Hanil Group of Korea completed construction of a GaAs plant in Siheung late in 1989, and the US\$77 million plant was scheduled to begin pilot testing early in 1990 and start full operation in the second half of 1990. The plant occupies 140,000 square feet of floor space at Hanil's newly purchased 780,000-square-foot site. Hanil invested approximately US\$31 million in the project in 1989.

- Hyundai Electronics Industry Co., Ltd., announced plans to expand 1Mb DRAM production in 1989. Hyundai's ambitious plan sought to increase production of 1Mb DRAMs from 5,000 to 250,000 pieces per month by early 1990.
- Samsung announced that it has successfully developed a 4Mb mask ROM with a 150-nanosecond access time. The entire project took 11 months from its inception in June 1988.
- Samsung exhibited its 0.9-micron 4Mb DRAM at an electronic materials and equipment show in Seoul during the fourth quarter.
- The government reported that 16 foreign semiconductor equipment manufacturers had moved to South Korea in the past two to three years to get a piece of the estimated \$1.5 billion 1990 domestic equipment market. Presently, there are 64 semiconductor equipment manufacturers in South Korea.
- The Korean Patent Bureau recorded 4,270 semiconductor patents in 1988; 30 percent of these were from Korean-owned companies, and 70 percent were from foreign-owned firms. Only 10 percent of the semiconductor patents went to South Korean companies in 1984, which shows that South Korean companies have dramatically increased their share despite the international competition.
- Lucky-Goldstar Group merged the semiconductor business of Goldstar Company and Goldstar Semiconductor Ltd. into a new company, Goldstar Electron. Goldstar Electron began operations on August 1, 1989.
- The government-assisted 4Mb DRAM project, which was completed in April 1989, reported a 20 percent yield in 0.8-micron technology and 115 consequential semiconductor patents.
- Zilog agreed to transfer its MCU technology to Samsung, which has the right to design, manufacture, and market Zilog's 8-bit MCU.
- Goldstar contracted a 1Mb DRAM technology transfer agreement with Hitachi. According to the agreement, Goldstar produced 1Mb DRAMs both under its own brand name and by OEM arrangement with Hitachi.
- Samsung started producing high-speed 1Mb DRAMs. The chip operated at a 70ns speed and used CMOS technology, which allowed for lower power consumption at such high speeds.
- Samsung and Lucky-Goldstar began to develop their GaAs R&D through their respective electronic systems and chemicals subsidiary companies. Samsung Corning, Goldstar Cable & Electrochemicals, and Lucky Metal Company took the lead in GaAs research in South Korea with heavy financial assistance from their parent companies.
- The current diode market in South Korea was dominated by foreign suppliers; these suppliers controlled 70 percent of the total domestic market.
- The Korea Electronics Co. (KEC) increased its production capacity after investing an additional US\$22.4 million in an existing plant. Consequently, KEC bolstered capacity from 80,000 4-inch wafers to 200,000 5-inch wafers annually.
- The South Korean government has marked microelectronics to have top priority in a technology development program valued at \$39 billion that will affect a wide range of high-technology industries.

- In August 1989, a similar Ministry of Trade and Industry (MITI) program dedicated 40 projects, valued at US\$35 million, to electronics-related technology research, included DRAM research.
- After this latest package was implemented, the government made available funds for R&D in the fields of new materials, precision chemistry, aeronautics, mechatronics, biology, and mining.
- Texas Instruments (TI) South Korea completed construction of a US\$9 million component plant in Jinchun and began production, positioning itself to penetrate the automobile industry in South Korea.
 - The plant produced components for motor control units in automobiles, connectors for semiconductors, and other automobile-related electronic components.
 - Texas Instruments had left open an option to expand the facility's capabilities into the field of semiconductor design and test.
- Samsung Electronics began using its VLSI line, which will be used for R&D in the areas of 16Mb and 64Mb DRAMs. The line operates in a Class 1 clean room environment and handles 0.1u resolution.
- Kukje announced that it would manufacture gallium arsenide (GaAs) products by early 1990, becoming the first South Korean company to manufacture such products. Samsung announced that it would invest about \$15 million (\$US1 = 674.6 won) to produce 1 million units of laser diodes per year.
 - For Kukje, the investment in GaAs totaled \$74 million in 1989, about five times more than Samsung plans to invest.
 - Other local companies followed the lead taken by Kukje and Samsung. Goldstar, KEC, and Sammi had plans to participate in the business. Sammi Group intended to invest \$6.8 million in the production of microwave devices in early 1990; Goldstar and KEC planned to develop laser diodes and high-density LEDs.

The 1990s

Key events in the South Korean semiconductor industry in the 1990s include the following:

- 1990
 - South Korea's Ministry of Trade and Industry (MTI) announced an extensive, four-year high-definition television (HDTV) national development strategy. According to the plan, MTI would construct facilities for research and development, sponsor university-level research, and provide financial incentives to privately owned component and systems companies involved in any significant HDTV technologies. MTI said it would commit US\$145 million (W100 billion) over a three-year period in an attempt to achieve mass-quantity HDTV production by 1994.
 - Samsung Electronics Company Limited announced plans to invest approximately US\$438 million (W300 billion) for the construction of a large-scale IC assembly plant near the Gulf of Asam in Chungnam Province, South Korea. According to Samsung's plan, the plant would handle the assembly of DRAM and SRAM ICs. This facility would occupy approximately 4.3 million square feet of land.

- Du Pont Korea Photomask Limited completed a new photomask facility in Ichun, South Korea, in 1990. The company had invested approximately US\$30 million in the plant initially and had plans to install two e-beam systems. Du Pont Korea Photomask was first established in 1987 by Du Pont Company and Korea-based Hanryo Development Company. In December 1990, Du Pont held 66 percent of the company's total shares.
- South Korea's exports of electronics equipment to North America entered an extended slowdown during the second quarter of 1990. The data processing and telecommunication segments of electronic equipment exports were initially hit the hardest.
- South Korea's leading electronics companies—Samsung Electronics Co., Ltd.; Goldstar Co., Ltd.; and Daewoo Electronics Co., Ltd.—reported their 1989 sales revenue (see Table 1).
 - The sales revenue in local currency of these three companies grew an average of 12.2 percent in 1989 over the previous year. However, total exports of electronic equipment and semiconductors decreased by 18 percent.
 - The increase in domestic consumption of data processing and consumer equipment along with total domination of that market by these suppliers led to an average increase of 40 percent in domestic sales.
 - Foreign governments continued to pressure South Korea to lower its high import tariffs on a variety of popular electronics products, particularly if the domestic market continues to grow significantly. One very sensitive trade topic was telecommunications.
- An unexpected increase in personal computer production in South Korea led to increased demand for 256K DRAMs and 1Mb DRAMs during the first quarter. Semiconductor prices in South Korea began to increase in May. In the case of 1Mb DRAM, the average price was \$6.75 in February and \$6.88 in March. The 256K DRAM price had risen significantly from \$1.78 in February to \$2.20 in March. Most semiconductor companies attribute this recovery to 386 PC manufacturing, laptop, and notebook personal computers.

Table 1

Samsung, Goldstar, and Daewoo's Electronics Equipment Sales

Company	Sales Revenue (WB)		CAGR (%)
	1988	1989	1988-1989
Samsung Electronics Co., Ltd.	3,028	4,007	32.3
Goldstar Co., Ltd.	2,826	2,605	-7.8
Daewoo Electronics Co., Ltd.	1,110	1,201	8.2
Exchange Rate (US\$1 to Won)	719.85	673.68	-6.4

Source: Company Literature, Dataquest (February 1991)

- South Korea's personal computer production increased rapidly from 32,000 in Q1/1989 to 105,000 in Q1/1990. This 328 percent output increase was attributed to high-volume shipments of IBM PC-compatible AT machines, which reached 70,000; XT machines, 13,000; and 16-bit machines, 23,000.
- Samsung and Hewlett-Packard (HP) signed an agreement in which Hewlett-Packard transfers HP RISC chip and workstation technology to Samsung.
 - According to press announcements, the agreement allowed for transfer of various technologies ranging from processor architecture development to actual workstation manufacturing.
 - Other low-end products currently manufactured by Hewlett-Packard are expected to be produced by Samsung.
- Chunan and Songtan in Chunan Province were chosen as sites for South Korea's first two semiconductor manufacturing equipment estates. The Chunan Estate, which is scheduled to begin production of semiconductor equipment in 1992, has 26 companies scheduled to participate.
- Daeryung Precision Industrial Inc. (DPI) purchased the semiconductor packaging plant of Fairchild Semiconductor Korea (FSK) in Guro, which had been closed since 1988, for an undisclosed price. National Semiconductor took over FSK operations in 1987 but was unable to turn the operations around and totally abandoned the plant in 1989. Officials from DPI were reported as saying that the company has no interest in restarting the facility and will begin to sell off all remaining FSK facilities.
- Pohang Steel Company (POSCO); Samsung Electronics Co., Ltd.; and MEMC agreed to establish a new joint venture company in South Korea to manufacture semiconductors. The new company began constructing a front-end wafer fabrication facility in 1990, and production of 6-inch wafers is scheduled to begin in 1991.
- South Korean industry sources reported that a government-sponsored HDTV project would begin technology research in August 1990. A preliminary agreement between South Korea's MTI and PTRI (Production Technology Research Institute) was to be finalized by the end of July. Specific fields of research include receiver, industrial application, broadcasting, and transmission. The two government agencies will invest approximately US\$200 million by 1992.
- Samsung Electronics Company announced on July 3 that it had successfully pilot-produced and would soon begin mass-producing a 32-bit RISC microprocessor named "Clipper." Samsung was able to develop the chip in part by licensing design technology from Intergraph in December 1990; then it developed its own process technology.
- Tension between SGS-Thomson and Hyundai diminished when the two companies reached a cross-licensing agreement on July 3, 1990, covering DRAM and SRAM products. The previous patents in question are fundamental semiconductor patents acquired by SGS-Thomson in its acquisition of Mostek Corporation. In conjunction with the agreement, SGS-Thomson dropped two lawsuits filed against Hyundai and filed a motion to terminate the investigation instituted by the International Trade Commission (ITC). The ITC complaint sought a permanent exclusion order that would have barred the importation of infringing DRAMs and SRAMs by Hyundai.

- Press reports indicated that Samsung began sampling 16Mb DRAMs to its key customers. The company began shipping its 4Mb part shortly before this announcement was made. Samsung was the only Korean company sampling 16Mb devices at the time.
- Korean press reports indicated that Hyundai has developed a Sea-of-Gates type gate array with a 45ps speed implemented in a 1.2-micron CMOS process.
- The Korean press also reported that Kumyoung Trading Company established a joint venture with Japan Plasma Systems and Japan Oxygen to produce semiconductor equipment. The new company, named PKS, produced the semiconductor equipment that uses plasma technology.
- Samsung and Applied Materials signed a joint development agreement covering advanced plasma etch process development and production support using Applied Materials' Precision 5000 Etch system.
 - The agreement followed an earlier joint development program between the two companies, announced in May 1990, involving CVD process development.
 - The latter agreement covers virtually all of Applied Materials' etch technologies, including single-crystal silicon, polysilicon, tungsten silicide, and silicon oxide etching applications. Under the agreement, Samsung sent process engineers to Applied Materials' Santa Clara, California, facilities for advanced oxide and polysilicon process development and training on the Precision 5000 Etch system.
 - In addition to the Santa Clara facility, Applied Materials Japan was involved in development of hardware and software provided to Samsung.
- Korean press reports indicated that Samsung began construction of its third semiconductor plant in Asan in Chungnam Province. The plant will have 1.2 million square feet of manufacturing space and will house assembly and test operations upon its opening in May 1991.
- Goldstar started volume shipments of 80ns 1Mb DRAMS. The company was reportedly shipping 1 million units per month.
- Goldstar recorded an 18 percent increase in sales for the first half of 1990. Net income for the first half was \$34.9 million, compared with a net loss of \$15.8 million during the first half of 1989. The company reported that domestic demand for consumer electronics increased by 35 percent during the period on a year-to-year basis.
- Texas Instruments (TI) announced its conclusion of a five-year, broad-based patent cross-license agreement with Samsung. This agreement replaced one signed by TI and the Korean supplier five years ago. The terms of the agreement, which were approved by the government of Korea, remain confidential. TI has stated, however, that its royalty payments under the renewed cross-license "are expected to greatly exceed the amounts received by TI under the agreement expired at the end of 1990."

History of the Semiconductor Industry—Taiwan

BACKGROUND

Taiwan, or the Republic of China (ROC), has been involved in the semiconductor industry for more than 25 years. Its first basic local transistor technology was developed by a native Chinese. Dr. T.Y. Chang started the first Taiwanese semiconductor factory with technology he developed at the Cheng Kung University. It was not until years later that foreign technology for passive components was first brought to Taiwan by the Japanese. The largest foreign transfer of technology started in September 1965. General Instrument established the first 100 percent foreign-invested electronics factory to fabricate germanium alloy transistors in Taiwan at that time and thus began the explosion of a vast network of discrete semiconductor manufacturers, which in 1985 produced 60 percent of the world market in diodes exported out of Taiwan.

The years from 1972 to 1976 were busy ones for Taiwan's own Fine Products Corporation. It not only mass-produced a small-signal transistor in a TO-105/106 package, started IC assembly in hermetic ceramic and metal can packages, and started producing commercially accepted silicon bipolar transistors in TO-92 packages, but it also began fabrication of planar type GaAsP/GaAs red dot LEDs and monolithic seven-segment digit display chips.

Fine Products was not the only productive group during this time. The Electronic Research and Service Organization of Industrial Technology Research Institute (ERSO/ITRI) established and engaged in the development of ICs and got 5-micron MOS technology transferred from RCA in the United States. International Rectifier started diode assembly, Taiwan Microdevices started transistor fabrication, and Taiwan Litton started LED assembly using technology from Texas Instruments.

In 1976, Tokyo Sanyo started transistor and diode assembly, Tong-Hsing started to fabricate alumina substrate for hybrid ICs, and Universal Scientific Industrial started thick-film hybrid-module fabrication, with its R&D and pilot-run facilities in the United States. Also making its contribution to Taiwan's growth as a technological force was Tatung Corporation, which set up a floating-zone silicon crystal growth facility with technical assistance from Siemens of West Germany.

HIGHLIGHTS

Developments from 1977 to the present are so plentiful that the highlights for each year are spotlighted by year below and on the following pages.

The 1970s

Highlights of Taiwan's semiconductor industry developments in the 1970s include the following:

- 1977
 - Rectron started diode/rectifier production, using GI technology.
 - Transistor, solar-cell, and ceramic-package IC assembly operations were set up by Hitachi, Opto Electronics, and United Semiconductor, respectively.
 - ERSO/ITRI completed its first IC production plant and started wafer fabrication of CMOS products.

- 1978
 - ERSO/ITRI completed its first custom IC design and cooperated with Telecommunication Labs to develop bipolar ICs.
- 1979
 - Fine Products developed silicon phototransistors, infrared-emitting diodes, and solar cell fabrication. Its small-signal transistor got a license from Fairchild Camera and Instruments of the United States.
 - ERSO/ITRI produced its first bipolar IC, using RCA technology.
 - United Microelectronics Company (UMC) was established and received an intensive technological transfer arrangement from ERSO/ITRI.

Highlights of the Taiwanese semiconductor industry in the 1980s include the following:

- 1980
 - President Enterprises established an electronic division and started bipolar power transistor fabrication with technological assistance from EE Tech of the United States.
 - Advanced Device Technology (ADT) was established to fabricate MOS power transistors.
 - Photonics started rectifier/diode, GaAsP-LED, and solar-cell fabrication.
- 1981
 - Sino-American started silicon crystal growth based on the Cz-pulling method.
 - ERSO/ITRI began a semicustom design service and developed an N-channel silicon-gate MOS process and a 4-bit single-chip microprocessor.
- 1982
 - Fine Products developed a Mesa-type GaAsP/GaAs, GaP/GaP red and green LED; a high-speed PIN photo diode, and a custom-design silicon optical encoder.
 - ERSO/ITRI transferred IC design to start Syntek Company, and ERSO/ITRI and UMC jointly developed a ROM IC.
 - The National Science Council (NSC) initiated a silane development and application project.
- 1983
 - Fine Products started GaAsP/GaP/GaP orange and yellow LED and N-channel junction FET fabrication.
 - ERSO/ITRI started a five-year VLSI technology development project with a budget of \$70 million; with NSC, it organized the 1983 “International VLSI Symposium.” (Unless otherwise specified, in-text currency references are to U.S. dollars.)
- 1984
 - UMC signed a technical assistance contract with AMI of the United States to produce telephone-switching ICs; Syntek signed a contract with Synertek to get a standard cell design.

- Symbol, Promax, Frontier, and Dionix were established to fabricate diodes.
 - Hi-Sincerity started small-signal transistor fabrication; Optotek, LED chip production; President, TO-3P power transistor package development; ADT, DIMOS power transistor production; and ASE, Talent, and CET started plastic package IC assembly.
 - ERSO/ITRI started VLSI lab construction; developed an 8-bit single-chip microprocessor, a 4-bit AD/DA converter; and developed jointly with Vitelic a CMOS 64K dynamic RAM (DRAM).
 - UMC went public; established a U.S. subsidiary, Unicorn, that engaged in IC design; and developed jointly with MOSel a 16K SRAM. UMC also was authorized by Synertek to second-source microcontroller and peripheral ICs.
 - A science-based industrial park, Hsin-Chu, approved the VLSI operations of Vitelic, Quasel, and MOSel, all founded by veteran engineers from the United States.
 - The IC industry annual output exceeded 1.3 billion ICs, valued at \$465 million. Imported ICs, mostly from the United States and Japan, were valued at \$481 million.
 - The semiconductor industry consisted of 57 companies and organizations, 13 of them in ICs, 44 in discrete and optoelectronics.
- 1985
 - Fine Products developed a new generation of red and infrared LEDs based on GaAlAs/GaAs materials; UMC developed a 64K EPROM jointly with MOSel.
 - Advanced Technology Corporation was established and obtained a technology transfer from Material Research Laboratories (MRL/ITRI) on compound semiconductor crystal growth and epitaxial processes.
 - ERSO/ITRI developed a CMOS 256K DRAM jointly with Vitelic, signed a cooperation contract with Philips to build a Philips IC design center, and promoted IC common design service for the entire Taiwan electronic industry.
 - Taiwan produced a total of 1.1 billion ICs, valued at \$392 million.
 - 1986
 - A \$250 million VLSI facility was proposed and got approval from the Taiwanese government and private investors. Six-inch wafers were used for IC production.
 - UMC produced CMOS devices for Inova Microelectronics.
 - Philips (27.5 percent share) invested in Taiwan Semiconductor Manufacturing Company (TSMC).
 - Quasel formed a new management and tightened its link with the Bank of Communication.
 - Chino Excel began bipolar IC production.
 - Morris Chang assumed leadership of a technology unit, Industry Technology Research Institute (ITRI).

- TSMC finalized share subscriptions: Taiwan government (48.3 percent), Philips (27.5 percent) Formosa Plastics Corp. (5.0 percent), China American Petrochemical Co. (5.0 percent), Central Holding Investment Co. (4.2 percent), China General Plastics Corp. (3.0 percent), USI Far East Corp. (2.0 percent), Yao Hua Glass Co. (1.0 percent), and Tai Yuen Textile Co. (1.0 percent).
- 1987
 - TSMC was established as a foundry service and leased ERSO's 6-inch fab.
 - UMC announced plans for a second fab (6 inch) by 1988.
 - The Taiwanese government suggested joint ventures for 26 products.
 - Three new Taiwanese semiconductor companies were established: Hualon Microelectronics Co. (HMC), Winbond, and UTIC.
 - Taiwan had 40 design houses.
 - Rectron moved its assembly to Malaysia, the first Taiwanese semiconductor company to move offshore.
- 1988
 - UMC planned to finish construction of its 6-inch fab by November.
 - HMC finished its 5-inch fab and began IC production in May.
 - Winbond's new \$36.7 million 5-inch fab, capable of handling 15,000 wafers per month using 1.5- to 5.0-micron CMOS and NMOS processes, was to be finished by September 1988.
 - TSMC began operations at its leased 6-inch fab.
 - In April, TSMC began construction of a \$200 million fab in Hsinchu, with completion targeted for late 1989 and monthly production of 30,000 wafers. Long-term purchase commitments were secured from Intel, Motorola, and other foreign companies.
 - Taiwan's Industrial Development Bureau and the Taipei Computer Association urged TSMC to produce 256K DRAMs to meet estimated local demand of 1 million units per month
 - AMPI, a subsidiary of AMPI USA in Sunnyvale, California, made plans to build a fab in the Hsinchu Industrial Park to manufacture power MOSFETs.
 - Acer delayed its PS/2 chip set.
 - ERSO/ITRI led Taiwan's submicron project, along with HMC, MOSel, UMC, and Winbond. The first stage (1988-1989) would build 4Mb SRAMs using 0.8-micron technology. The second stage (1990-1996) will develop 0.5-micron technology.
 - The Taiwanese data processing industry was threatened by the shortage of Japanese DRAMs; some PC makers halted production entirely.
 - Taiwan's Industrial Development Bureau of the Ministry of Economic Affairs announced plans for a second high-technology industrial park like the Hsinchu Science-based Industrial Park, to be located in Chang Hua County.

- ERSO transferred CMOS VLSI technology to Winbond and authorized Winbond to produce and sell telecommunications and consumer ICs designed by ERSO.
- Hambrecht & Quist Taiwan Ltd. has invested NT\$10 million (US\$333,000) in Winbond.
- Texas Instruments (TI) subcontracted TSMC to manufacture logic ICs.
- HMC announced production of 256K DRAMs by the end of 1988.
- 1989
 - The Acer Group and TI agreed to build a \$250 million DRAM plant in Taiwan with TI bearing most of the cost. According to the agreement, Acer owned 74 percent of the new company, while TI held 26 percent and had the option to increase its portion to 51 percent. The fab project was TI's first memory chip facility outside Japan.
 - UMC announced plans to build a VLSI manufacturing plant. The estimated project cost was set at \$217 million. The company's 1988 profits totaled \$21 million.
 - Taiwan's Ministry of Economic Affairs (MOEA) and Philips Electronics Industries (Taiwan) Ltd. agreed to jointly manufacture the ICs used in high-resolution color television sets.
 - HMC, a subsidiary of Hualon Corporation, announced the test production of 80 to 120ns, 256K memory chips in April for domestic and foreign markets. HMC planned to upgrade its product line of 64K SRAMs, consumer ICs, and telephone dialers.
 - Motorola Inc. and ACC Microelectronics Corporation of Taiwan agreed to jointly develop, manufacture, and market control chips used in computer floppy disk drives.
 - Taiwan's ERSO convinced six major semiconductor manufacturers to invest jointly in a \$57 million research laboratory to be completed in four years. ERSO supplied fixed capital related to land and production. HMC TSMC, UMC, VLSI Taiwan Corp., Winbond Electronics Corporation, and an unknown 60 other companies paid the remainder of the costs.
 - Motorola agreed to second-source key ACC products to build future products for the IBM-compatible PC market. The second-sourced products will include the following:
 - 82020 16/20-MHz turbo-AT chip set (286/386SX)
 - 82300 20/25-MHz 386-AT chip set
 - 3201, 3202, and 3203 floppy disk drive controllers
 - 16C451, 16C461, and 5500 multifunction I/O controllers
 - 2330 cache controller
 - 2335 tag RAM controller
 - NCR Corporation (Dayton, Ohio) designated Taiwan's Winbond Electronics Corporation as its microelectronics design center to service the needs of the Southeast Asian market.

- Walsin Lihwan Electric Wire and Cable Corporation (Taiwan) combined two existing capital ventures with Winbond Electronics Corporation and MOSel Corporation (United States) in a plan to double IC productivity in five years.
- TSMC began limited production of 256K DRAM chips as a step toward large-scale production after TSMC's second plant began full operation. TSMC used its own process technology for the plant.
- Walsin Lihwa Wire and Cable Inc. purchased \$4 million in shares of Fine Products Microelectronics Corp., one of Taiwan's major optical semiconductor manufacturers.
 - The move was part of Walsin Lihwa's corporate expansion into optoelectronic parts, digital electronic parts, computer components, and digital telecommunications products.
 - Walsin Lihwa held a 47.9 percent stake in Winbond, a producer of data processing, telecommunication, and consumer ICs, and a 40.0 percent stake in MOSel, a U.S.-based company with IC design capabilities.
- HMC started trial production of its 80, 100, and 120ns 256K DRAMs and announced that its \$118.7 million plant would turn out 20,000 6-inch wafers per month by 1990.
- Taiwan's ERSO announced that it would design high-frequency circuit technology necessary for cellular mobile telephones (CMTs) at a frequency range from 800 to 999 MHz.
 - ERSO transferred technology to domestic makers of the design technology and introduced the concepts of application-specific IC design into CMT manufacturing.
 - ERSO also set up a plan to introduce standards and specifications for CMTs in Taiwan.
- Taiwan's MOEA agreed to support ERSO's proposal for a six-company, submicron IC experimental plant in the Hsinchu Science-Based Industrial Park.
 - The project, scheduled to be completed in 1994 and at a cost of approximately \$240 million, signified the first major government-aided IC cooperative organized in Taiwan.
 - Participants in the cooperative project included AMPI, HMC, TSMC, UMC, Vitelic, and Winbond.
- Philips Taiwan, Ltd., announced the adoption of an Asian focus strategy necessary to compete with Japan and South Korea. Philips Taiwan's sales into the Asia/Pacific region accounted for only 7 percent of its worldwide sales in 1989, 25 percent of which are to U.S. companies and 55 percent to European ones.
- Philips Taiwan, Ltd., exercised its right to purchase more than one-half of TSMC's shareholdings.
- Vitelic Taiwan successfully completed its test production of 512K DRAMs and provided samples of its V53C864 fast-page mode and V53C866 static-column mode 64Kx8 high-speed DRAMs.
 - The company claimed that its 64Kx8 DRAMs are designed for use in PCs, which require bandwidths for high resolution and advanced graphics.

- The V53C864 chip cut chip count in VGA by one-half.
- Features of the 64Kx8 included 160-MHz bandwidth, 300-mil, 24-pin DIPs, or 24- and 26-pin SOJs.
- Vitelic's Taiwan operation sold 50 percent of its total output into Taiwan in 1989.

The 1990s

Highlights of Taiwan's semiconductor industry developments in the 1990s include the following:

- 1990
 - The administrative bureau of the Hsinchu Science-based Industrial Park (SIPA) registered US\$215 million (NT\$5.59 billion) in total sales revenue during 1989 for 85 of the companies located in the park. Sales in 1989 decreased 15 percent compared with performance in 1988, according to the SIPA report.
 - The large group of semiconductors and electronic systems companies located in SIPA grew 88 percent in 1988 and are now feeling the effects of a worldwide industry downturn.
 - The general consensus is that 1990 will be at the same level as 1989. Included in the 1989 figures were the sales revenue of SIPA's top four companies, which are the following PC manufacturers:
 - Acer Incorporated ranked number one with US\$500 million (NT\$13 billion) in sales.
 - Wyse Technology (Taiwan) Co., Ltd., ranked a distant number two with \$307 million (NT\$8 billion) in sales.
 - Mitac International Corporation was positioned third, with sales totaling US\$172 million (NT\$4.5 billion).
 - AST Taiwan Co., Ltd., placed fourth with US\$138 million (NT\$3.6 billion) in annual sales.
 - The head office of Harris Corporation in Melbourne, Florida, announced that it would close its assembly and test operations in Taiwan, which is the smallest of its three Asian facilities. An estimated 300 jobs were lost in Taiwan as a result of the pullout.
 - Harris said that it would consolidate semiconductor production in Singapore and Kuala Lumpur by the end of 1990. A spokesperson for the company said that its Malaysia and Singapore plants have compatible processes and ample test and assembly capacity to absorb the functions performed in Taiwan.
- The Hualon Group, parent owner of Taiwan's second-largest semiconductor company, HMC, recently acquired Hugin Sweda, Inc., with an investment of US\$50 million.

- Hugin Sweda is a wholly owned U.S. subsidiary of Britain's Hugin Sweda plc. The group's purchase of the British company will leverage international retail point-of-sale (POS) computer systems and terminals capability. According to the agreement, Hualon can use Hugin Sweda's distribution network and rights to its brand name throughout Asia as well as in North and South America. Currently, Hugin Sweda's U.S. operation is based in Dallas, Texas, with 1,000 employees and approximately US\$100 million in annual sales revenue.
- Microtek International Inc. announced a joint venture agreement with C-Cube Microsystems (United States), Winbond Electronics Corporation, and Hambrecht & Quist Ventures (United States) in March.
 - According to the terms of the agreement, overall investment in C-Cube would reach US\$5 million. C-Cube was a leading developer of digital image technology used in multimedia applications such as color desktop publishing, digital photography, and digital video systems. The new company is based in Taiwan's SIPA.
 - In February, C-Cube announced its first product, the CL550 Image Coprocessor, which incorporates a complete range of functions for high-quality image compression, including still images and real-time videos.
- The Taiwanese government's Institute for Information Industry outlined primary goals for the next generation of information technology development in Taiwan. Institute officials recommended that Taiwan develop strong service and software industries if it wishes to become the world's third largest information products maker by 1996.
- TSMC dedicated its second wafer-processing facility in SIPA in Hsinchu, Taiwan. TSMC's plans to build a fab from the ground up with standard mechanical interface (SMIF) have been known in the industry since 1989.
 - SMIF is the use of enclosed clean-air modules surrounding each piece of equipment, known as the "clean island" concept, as an alternative to the clean room. SMIF technology is expected to offer significant cost savings in both construction and fab operation (see ASETS research bulletin 1990-06 entitled "TSMC's New Fab Built for SMIF Opens").
 - The TSMC experiment represented the first full-fledged attempt by a SMIF semiconductor manufacturer to commit an entire high-volume manufacturing facility to SMIF.
 - Although this concept has been considered a viable manufacturing method since 1988, companies hesitated to use it because there was not an industry-proven test case of the SMIF method.
- Taiwan's Institute for Information Industry made a formal recommendation to PC companies to focus their attention on workstations, minisupercomputers, optical peripherals, software servicing, and other items that ensure high value-added prices in the 1990s. Although Taiwan manufactures 10 percent of the world's PCs, 30 percent of its monitors, and 60 percent of its motherboards, officials commented that the information industry in Taiwan could become one of the largest in the world.

- In May, Intel and TSMC announced an agreement whereby TSMC will manufacture DRAMs for distribution through Intel's sales channels.
 - TSMC completed and started operating one-half of its 7,000-square-meter clean room space Module-A at its new wafer fabrication facility, which uses SMIF technology. After Module-B is fully ramped in the fourth quarter of 1991, TSMC's Fab-II will have an output capacity of 40,000 6-inch CMOS wafers (see ASETS newsletter 1990-06, "TSMC's New Fab Built for SMIF Opens").
 - According to this latest announcement, 256K DRAMs will be the first devices manufactured in July 1990, followed by 1Mb DRAMs.
 - Taiwan's heavy reliance on foreign DRAM suppliers has been a concern for some time, but attempts by local suppliers to satisfy local consumption have been slow. TSMC and Intel apparently will be able to provide Taiwanese computer manufacturers with a steady source of DRAMs from a local supplier.
- The emergence of laptop and notebook fever in Asia ignited concern over how Taiwan will be able to supply liquid crystal display (LCD) products necessary to manufacture these products. UMC, Lite-On, and a number of other electronics manufacturers in Taiwan are expected to establish a consortium to enter the LCD business. Currently, Taiwanese companies are working to license certain LCD technologies from Japan to serve as the backbone for the consortium.
- The NSC reported that domestic companies increased investment in LCD technology. The council encouraged such activity as necessary to support the expect high growth in demand because of Taiwan's move to manufacture portable computers. Taiwan was capable of making only small monochrome displays in 1990. The NSC encouraged a cooperative effort among Taiwanese companies to develop large LCDs.
- SIPA in Hsinchu, Taiwan, announced that it would halt applications for new plants in the park. The park director explained that there was difficulty in obtaining additional property from neighboring landowners because of the extremely inflated land prices.
- Nonvolatile memory manufacturer SEEQ Technology and HMC of Taiwan signed an agreement that includes an equity investment that gives Hualon a 10 percent stake in SEEQ. Under the terms of the eight-year agreement, Hualon will provide foundry services to SEEQ. The two companies also plan to jointly develop semiconductor products. Hualon purchased 1.62 million shares of SEEQ common stock at \$3.25 per share, giving the Taiwanese company its stake in SEEQ.
- Acer Inc. of Taiwan, Asia's largest manufacturer of IBM-compatible PCs, moved toward making Malaysia its major operations support base. Acer invested \$13 million in its new Penang factory. The factory, which produces high-resolution VGA color monitors, employs 40 administration and engineering workers and operators.
- Taiwanese press reports indicated that three Taiwan-based semiconductor manufacturers would begin making 1Mb DRAMs in 1990. The three companies were HMC, TSMC Ltd., and Vitelic Taiwan Corp.
 - Acer, Taiwan's biggest manufacturer and exporter of PCs, announced that second-quarter earnings fell 52.7 percent from first-quarter levels. According to the Chinese-language newspaper *Economic Daily News*, the worldwide computer industry recession and the large number of investment projects recently undertaken by the company contributed to the decline in earnings.

- Matsushita of Japan and Taiwan Matsushita Corp. announced that they will jointly invest approximately \$3.4 million in the production of 32-bit PCs, semiconductors, and other high-tech products in Taiwan. The Japanese company agreed to provide 80 percent of the capital with the Taiwan partner providing 20 percent.
- In October 1990 Panasonic Computer (Taiwan) Co. was established to handle manufacturing and exporting. Its computers mostly were exported initially on an OEM basis, with hopes of own-brand products appearing in 1993.
- Applied Materials announced that it signed a joint-development agreement with Taiwan's ERSO to develop and qualify a number of etch and CVD processes for ERSO's semiconductor requirements.
 - ERSO was conducting a Submicron Process Technology Development Program similar to SEMATECH's efforts. Contributing members of this project include AMPI, Macronix, MOSel, TSMC, UMC, Vitelic, and Winbond.
 - As part of Taiwan's ITRI, ERSO develops and transfers electronic technology and provides technical services to Taiwan's fast-growing semiconductor industry. ERSO announced plans to construct a \$250 million fab line, which is scheduled to open in 1992.
 - The etch processes under development in this joint effort will include polysilicon and metal etch, and CVD processes will include interlayer and intermetal dielectrics. The project will use Applied Materials' Precision 5000-line of CVD and etch systems as the basis for process development.
 - In a related announcement, Applied Materials reported the opening of an office in Taipei that is dedicated to serving its Taiwanese customers.
- The Taiwanese press reported that UMC completed a successful pilot production run in July of its new 1Mb SRAM. The initial run produced single-lot yields of 20 percent, a figure that is expected to increase to 50 percent once the new product reaches volume production. The new chip was fabricated using a 0.8-micron process and reportedly began production in UMC's ULSI plant in the fourth quarter of 1990. UMC was reportedly developing the chip in cooperation with ISSI, a Sunnyvale, California, start-up.
- Wyse Technology announced that it closed its Hong Kong plant in order to concentrate on production in Taiwan. In December 1989, Wyse was purchased by Channel International Corporation, a Taiwan investor group. Wyse's Taiwan plant expanded its output in order to compensate for lost supply.
- The sales revenue of all companies operating in the SIPA reached \$1.1 billion during the first half of 1990, up over 16 percent compared with the same period in 1989. Semiconductor manufacturers recorded sales of \$227.2 million for the first half of the year.
- HMC of Taiwan completed the purchase of 1.63 million newly issued shares of SEEQ common stock at \$3.25 per share. The purchase of stock is the result of an alliance announced in July, which includes a manufacturing and technology agreement. Under the terms of the agreement, HMC will provide foundry services to SEEQ, and both companies will jointly develop and market future semiconductor products. As part of the agreement, HMC was to acquire an interest in SEEQ by purchasing SEEQ common stock.

- The Taiwan Council for Economic Planning and Development reported that during the first seven months of 1990 machinery, electronics, and information products accounted for 33 percent of all exports from the ROC, up 4.1 percent from 1989. The Council reported that this evidence shows Taiwan's progress in upgrading its manufacturing industry.
- According to Taiwanese press reports, an official of the Ministry of Economic Affairs stated that economic growth for the ROC would probably fall below 5 percent this year. Taiwan's unemployment rate jumped to 1.96 percent in July from 1.67 percent in June, the highest level in 33 months. A government report said this higher level of unemployment reflects sagging exports and an economic slowdown on the island.
- The Taiwan Ministry of Economics invested \$40 million through the ITRI to develop second-generation intelligent robots. According to a Taiwanese press report, the ITRI said that the development project is scheduled for completion in 1994.
- The dollar value of PC sales to the Taiwanese market in 1990 exceeded the 1989 figure, despite a decline in unit sales. According to the Institute for Information Industry, PC unit sales in Taiwan might decline 3.7 percent, while stronger sales of high value-added models would probably increase the dollar value of sales by 1.4 percent.
- The ITRI Computer and Communications Research Laboratories (CCL) organized a Notebook Consortium in an attempt to reposition Taiwan's desktop clone makers for the growth of the worldwide notebook computer market. Currently, the consortium has 46 members, including ADI Corp., Jamicon, Mitac International, Proton, Sinoca Enterprises, Sun Moon Star, and Tatung. At the fall 1990 COMDEX Show in Las Vegas, Nevada, more than 40 Taiwanese companies exhibited notebook computers.
- According to Taiwanese press reports, Philips Taiwan Ltd. decided to discontinue its consumer laser diode packaging production in Taiwan at the end of 1990.



Worldwide Electronic Equipment Production Forecast

This section and the four that follow explain key electronics manufacturing activity in terms of factory revenue and unit shipments for the world, Asia/Pacific, South Korea, Taiwan, Hong Kong, and Singapore. The Asian semiconductor application market database provides a demand-side analysis of future semiconductor consumption trends throughout Asia. The Asia/Pacific-ROW (Rest of World) region's relative strength in electronic equipment manufacturing and certain application segments is illustrated in Tables 1, 2, and 3 of this first section, Worldwide Electronic Equipment Production Forecast.

Table 1

Worldwide Electronic Equipment Production Forecast by Region (Millions of US Dollars)

	1989	1990	1991	1992	1993	1994	1995	CAGR 1989-1990	CAGR 1990-1995
North America	255,960	268,325	286,867	304,326	321,001	338,711	359,075	4.8%	6.0%
Japan	199,170	187,540	192,865	205,906	219,759	225,017	236,431	(5.8%)	4.7%
Europe	163,270	174,596	195,274	221,609	256,690	272,020	294,749	6.9%	11.0%
A/P-ROW	58,619	66,830	77,791	92,236	108,225	124,047	137,513	14.0%	15.5%
Total	677,018	697,291	752,796	824,077	905,675	959,795	1,027,768	3.0%	8.1%

Note: Columns may not add to totals shown because of rounding.
Source: Dataquest (October 1990)

Table 2

Worldwide Electronic Equipment Production Forecast by Application Segment (Millions of US Dollars)

	1989	1990	1991	1992	1993	1994	1995	CAGR 1989-1990	CAGR 1990-1995
Data Processing	224,541	236,998	263,608	294,426	328,133	352,275	382,838	5.5%	10.1%
Communications	88,110	90,573	98,113	108,942	122,046	131,478	144,384	2.8%	9.8%
Industrial	111,758	114,777	123,919	135,888	148,749	155,922	164,996	2.7%	7.5%
Consumer	141,050	140,692	148,644	160,110	173,833	182,907	192,340	(0.3%)	6.5%
Military	78,441	80,026	81,856	84,085	87,301	88,763	91,382	2.0%	2.7%
Transportation	33,118	34,226	36,657	40,625	45,614	48,450	51,828	3.3%	8.7%
Total	677,018	697,291	752,796	824,077	905,675	959,795	1,027,768	3.0%	8.1%

Note: Columns may not add to totals shown because of rounding.
Source: Dataquest (October 1990)

Table 3

**Asia/Pacific-ROW Electronic Equipment Production Forecast
by Application Segment
(Millions of US Dollars)**

	1989	1990	1991	1992	1993	1994	1995	CAGR 1989-1990	CAGR 1990-1995
Data Processing	18,650	21,298	25,068	29,855	35,467	40,822	45,721	14.2%	16.5%
Communications	7,035	8,189	9,573	11,746	14,059	16,126	18,222	16.4%	17.3%
Industrial	3,178	3,499	4,084	4,874	5,525	5,955	6,259	10.1%	12.3%
Consumer	25,677	29,256	33,877	39,839	46,412	53,698	59,175	13.9%	15.1%
Military	2,681	2,915	3,170	3,446	3,742	4,061	4,406	8.8%	8.6%
Transportation	1,398	1,673	2,019	2,476	3,020	3,385	3,730	19.7%	17.4%
Total	58,619	66,830	77,791	92,236	108,225	124,047	137,513	14.0%	15.5%

Note: Columns may not add to totals shown because of rounding.
Source: Dataquest (October 1990)

Asia/Pacific-ROW Electronic Equipment Production Forecast

This section and the four that follow explain key electronics manufacturing activity in terms of factory revenue for Asia/Pacific, South Korea, Taiwan, Hong Kong, and Singapore. The Asian semiconductor application market database provides a demand-side analysis of future semiconductor consumption trends throughout Asia. The Asia/Pacific-ROW (Rest of World) region's relative strength in electronic equipment manufacturing and certain application segments is illustrated in Tables 1 and 2 of this first section, Asia/Pacific-ROW Electronic Equipment Production Forecast.

Table 1

**Total Asia/Pacific-ROW Electronic Equipment Production Forecast
by Application Segment
(Millions of U.S. Dollars)**

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1988-1990
Data Processing	22,707	24,954	27,356	31,049	36,835	42,863	47,867	53,205	9.8	14.2
Communication	8,230	8,944	10,455	12,342	14,140	16,221	18,055	20,489	12.7	14.4
Industrial	2,214	2,433	2,920	3,369	3,855	4,313	4,800	5,236	14.8	12.4
Consumer	21,743	23,893	27,773	29,239	35,960	40,357	44,746	49,854	13.0	12.4
Military/Aerospace	3,134	3,281	3,583	3,907	4,318	5,000	5,507	5,989	6.9	10.8
Transportation	1,392	1,625	1,852	2,124	2,451	2,856	3,296	3,780	15.3	15.3
Total	59,420	65,130	73,939	82,030	97,559	111,610	124,271	138,553	11.6	13.4

Source: Dataquest (November 1991)

Table 2
Total Asia/Pacific-ROW Electronic Equipment Production Forecast
by Application Segment
(Growth Rate Percentage)

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
Data Processing	9.9	9.6	13.5	18.6	16.4	11.7	11.2	9.8	14.2
Communication	8.7	16.9	18.0	14.6	14.7	11.3	13.5	12.7	14.4
Industrial	9.9	20.0	15.4	14.4	11.9	11.3	9.1	14.8	12.4
Consumer	9.9	16.2	5.3	23.0	12.2	10.9	11.4	13.0	12.4
Military/Aerospace	4.7	9.2	9.0	10.5	15.8	10.1	8.8	6.9	10.8
Transportation	16.7	14.0	14.7	15.4	16.5	15.4	14.7	15.3	15.3
Total	9.6	13.5	10.9	18.9	14.4	11.3	11.5	11.6	13.4

Source: Dataquest (November 1991)

Key Electronic Equipment Production—South Korea

Table 1 explains South Korea's key electronic equipment production in millions of U.S. dollars for 1988 through 1990.

Table 1

Key Electronic Equipment Production—South Korea (Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Telephone Sets	231.1	383.9	324.5	18.5
Telephone Switchboard and Exchanges	425.7	786.7	654.1	24.0
Carrier Line System Total	82.8	154.7	84.5	1.0
Modems	33.6	39.3	35.4	2.6
Teleprinters	6.1	4.4	2.6	-34.7
Facsimile Machines	83.2	145.3	235.7	68.3
Image Telegraphic Apparatus	0.5	0.1	0.6	9.5
Other Telephone Equipment (Wire)	143.5	186.3	14.2	-68.5
Telephone Answering Machines	130.6	77.5	60.1	-32.2
Keyphone Apparatus	193.7	77.5	62.5	-43.2
Interphones	17.8	16.9	45.4	59.7
Cordless Telephones	81.9	137.2	133.9	27.9
Mobile Phones	34.7	51.6	78.4	50.3
Other Wireless Telephones	28.9	29.9	28.5	-0.7
Other Transmitters-Receivers	0	0	30.4	NA
Radio Broadcasting Apparatus	32.2	35.1	29.0	-5.1
TV Broadcasting Apparatus	8.7	2.1	7.8	-5.3
CB Transceivers	84.6	78.6	76.9	-4.7
Other Broadcast and Studio	38.5	20.7	8.0	-54.4
Printing Telegraphic Apparatus	2.8	0.4	0.1	-81.1
Walkie-Talkies	36.5	26.2	22.3	-21.8
Television Cameras	9.6	28.0	40.8	106.2
Receiving Apparatus	112.6	108.8	202.4	34.1
Other Communications Equipment	53.4	56.9	53.1	-0.3
Alarm Systems	53.4	87.3	74.9	18.4
Office Automation	154.3	142.8	314.7	42.8
Automatic Vending Machines	24.2	34.9	54.7	50.3
Electrocardiographs	0.5	0.3	0	-100.0
Electrotonographs	6.4	4.7	8.0	11.8
Other Medical Instruments/Equipment	4.0	4.2	29.3	170.6

(Continued)

Table 1 (Continued)

Key Electronic Equipment Production—South Korea
(Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Computed Tono-Scanners	6.2	5.5	8.1	14.3
X-Ray Radiography/Radiotherapy	5.7	8.6	14.1	57.3
Other Electronic Measuring Instruments	0.4	65.2	263.8	2,468.1
Other Industrial	21.2	39.2	252.3	245.0
Other Microcomputers	161.4	1,029.4	814.4	124.6
Microcomputer 64-Bit CPUs	0	0.2	4.9	NA
Microcomputer 32-Bit CPUs	19.8	7.0	7.2	-39.7
Microcomputer 16-Bit CPUs	989.7	702.8	814.4	-9.3
Other Data Processing Machines	0.6	0.3	0.2	-42.3
Main Storage Units	0.4	15.2	59.8	1,122.7
Floppy Disk Drives	24.1	21.1	21.1	-6.4
Rigid Disk Drives	26.6	63.2	76.2	69.3
Other Disk Drives	10.3	3.7	2.7	-48.8
Laser Printers	2.7	5.1	11.6	107.3
Line Printers	2.9	2.5	2.5	-7.2
Dot Printers	124.3	193.9	232.7	36.8
CRT Terminals	192.6	53.7	37.9	-55.6
Color Monitors (CRT)	495.9	568.9	874.9	32.8
Monochrome Monitors (CRT)	297.0	389.1	323.7	4.4
Keyboard (Key Entry System)	28.3	42.0	57.6	42.7
Other Terminals Systems	1.1	59.7	75.5	728.5
Other Peripherals	48.5	63.0	100.9	44.2
Electronic Calculators	48.6	65.2	55.5	6.9
Electronic/Electric Measurement/Test	99.6	82.8	90.8	-4.5
Loudspeaker Devices	231.5	263.3	233.4	0.4
Microphone Apparatus	5.3	10.6	9.6	34.6
Color Televisions	1,724.5	1,742.9	2,005.5	7.8
Monochrome Televisions	26.8	191.1	148.1	135.1
Videotape Recorders	1,565.3	1,796.2	1,550.1	-0.5
Radios	52.1	50.2	33.6	-19.7
Car Radio-Cassettes	702.5	710.0	756.0	3.7
Radio-Cassette Players	883.9	1,582.6	1,696.0	38.5
Cassette Tape Recorders	883.9	118.0	142.7	-59.8
Tape Decks	233.0	103.2	64.1	-47.5
Stereo System Components (General)	217.3	294.1	399.0	35.5
Record Players	327.6	291.3	205.6	-20.8
Wrist Watches—Digital (LED/LCD)	222.9	364.1	193.2	-6.9

(Continued)

Table 1 (Continued)

Key Electronic Equipment Production—South Korea
(Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Electronic TV Games	0.8	0.8	25.4	463.5
Refrigerators	860.7	784.4	1,034.6	9.6
Washing Machines	441.4	623.0	770.9	32.2
Rotating Appliances	177.4	73.7	942.6	130.5
Heating Appliances	202.4	218.4	263.0	14.0
Microwave Ovens	1,010.8	1,014.1	679.6	-18.0

NA = Not available

Source: Dataquest (November 1991)

Key Electronic Equipment Production—Taiwan

Table 1 explains Taiwan's key electronic equipment production in millions of U.S. dollars for 1988 through 1990.

Table 1

Key Electronic Equipment Production—Taiwan (Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Sewing Machines	227.6	231.8	250.6	4.9
Wall Air Conditioners	93.5	133.9	99	2.9
Automobile Air Conditioners	28.3	56.8	64.2	50.6
Refrigerators	37.2	35	33.5	-5.1
Heating Appliances	36.1	6.2	NA	NA
Washing Machines	31.7	28	26	-9.4
Microcomputers (PC)	1,073.7	1,119.2	1,308.9	10.4
Disk Drives (Magnetic Disk Devices)	0	11.8	5.3	NA
Monitors	716.9	687.7	800.5	5.7
Computer Terminals	339.4	293.8	307.1	-4.9
Printers	16.8	16	6.4	-38.3
Keyboards	36.3	42.9	80.5	48.9
Calculators	341.4	343.3	246.6	-15.0
Color Televisions	374.4	371.3	293.8	-11.4
Monochrome Televisions	51.6	NA	NA	NA
Videotape Recorders	178.4	146.3	157	-6.2
Electronic Video Games	84	35	28.9	-41.3
Radio Receivers	167.2	118.5	NA	NA
Radio-Cassette Players	237.2	209.7	NA	NA
Record Players	154.4	109.5	NA	NA
Car Radio-Cassette Players	63.6	54.1	NA	NA
Cassette Tape Recorders	30.3	189.5	NA	NA
Loudspeaker Devices	5	4.8	NA	NA
Integrated Circuits	2.1	2.3	2.7	13.4
Transistors	0.1	0.1	0.1	0
Telephone Sets	916.3	826.1	769.6	-8.4
Telephone Switchboard and Exchanges	79.9	167.6	257.3	79.5
Cameras for Ordinary Use	450.9	445.1	646.9	19.8
Electronic Wrist Watches	44.9	50.1	56.3	12.0
Electronic/Electric Clocks	118.8	114.3	119.4	0.3

NA = Not available
Source: Dataquest (November 1991)

Key Electronic Equipment Production—Hong Kong

Table 1 explains Hong Kong's key electronic equipment production in millions of U.S. dollars for 1988 through 1990.

Table 1

Key Electronic Equipment Production—Hong Kong (Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Word Processors and Electronic Typewriters	2.2	0.7	0.1	-78.7
Electronic Calculators	189.8	126.8	111	-23.5
Cash Registers	2.4	4.6	8.1	83.7
Copy Machines	180.6	247.9	231.6	13.2
Computers	1,453.6	1,638.2	1,815.5	11.8
Color Televisions	352.3	285.9	378.5	3.7
Monochrome Televisions	196.2	128.8	184.4	-3.1
Car Radio-Cassette Players	28	27.9	22.5	-10.4
Car Radio Receivers	1.2	0.1	1.1	-4.3
Radio-Cassette Players	187.4	92.5	51.8	-47.4
Portable Radios Receivers	103.9	48.3	36.5	-40.7
Other Radio-Broadcast Receivers	322.1	419	451.8	18.4
Radio and Radio Combinations (Tape, etc.)	38.9	40.1	39.3	0.5
Other Radios	1.3	0.9	7.8	144.9
Record Players	136.6	171.7	175.2	13.3
Videotape Recorders	17.7	85.8	99.7	137.3
Cassette Tape Recorders	112.1	67.6	46.2	-35.8
Dictation Machines	0.1	0.5	11.7	981.7
Other Telephonic Apparatus	391.8	356.9	329.3	-8.3
Microphone Devices	1.2	0.4	2	29.1
Loudspeaker Devices	10.4	8	11.2	3.8
Amplifiers	7.5	4.7	2.9	-37.8
Headphone/Earphone Apparatus	27.6	24.5	29	2.5
Walkie-Talkies	17.9	10.9	8.2	-32.3
Paging Apparatus	0.4	0.3	0.1	-50.0
Telephonic/Telegraphic Radio Receivers	28.5	13.6	7.1	-50.1
Radio Telephone Equipment Total	219.7	277.7	252.1	7.1
Television Cameras	0.8	2.8	0.1	-64.6
Navigational Aids (Civil)	14.1	14.2	7.4	-27.6
Telecommunications Equipment	38	56.9	75.4	40.9

(Continued)

Table 1 (Continued)

Key Electronic Equipment Production—Hong Kong
(Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Other Communications Equipment	10.2	12.7	14.2	18.0
Microwave Ovens	2.6	0.1	0.3	-66.0
Alarms—Fire and Smoke Detectors	22.7	9	5.1	-52.6
Alarms—Burglar	36	47.7	47.3	14.6
Electronic Automatic Regulators	13.2	15.2	10.5	-10.8
Electronic Measuring Instruments	6.2	10.1	11.3	35.0
Camera Flash Equipment	21.2	17.3	15.2	-15.3
Wrist Watches—Digital (LED/LCD)	216.2	153.1	154.2	-15.5
Wrist Watches—Nondigital	1,333.1	1,375.3	1,599.8	9.5
Instrument Panel Clocks	0.8	0.3	0.1	-64.6
Electronic/Electric Clocks	68	40.5	31.6	-31.8
Electronic Toys	22	16.5	4.5	-54.8
Electronic TV Games	3.8	1.1	4.5	8.8
Electronic Hand-Held Games	172.8	101.4	40.6	-51.5
Electromagnetic Electrostatic Instruments	7.7	6.1	1	-64.0
Components	1,060.1	1,221.9	1,505.2	19.2

Source: Dataquest (November 1991)

Key Electronic Equipment Production—Singapore

Table 1 explains Singapore's key electronic production in millions of U.S. dollars for 1988 through 1990.

Table 1

Key Electronic Equipment Production—Singapore (Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Sewing Machines (Household)	0	0.20	0.2	NA
Sewing Machines (Commercial)	0.6	1.1	1.6	63.3
Wall Air Conditioners	96.6	82	80.5	-8.7
Automobile Air Conditioners	0.5	0	0.1	-55.3
Other Air-Conditioning Machines	0	3.6	2.6	NA
Word Processors and Electronic Typewriters	9.5	26.8	2.3	-50.8
Typewriters	125	173.6	194.6	24.8
Calculators Total	77.1	41.4	49.8	-19.6
Cash Registers	0	0	9.9	NA
Other Office Equipment	0.2	0.4	1.31	55.0
Other Data Processing Equipment	108.1	0.1	0.2	-95.7
Mainframe Computers	0.5	1.3	16	465.7
Minicomputers	0.1	2.7	18.8	1,271.1
Microcomputers (Complete Digital CPU)	249.2	415.8	490.6	40.3
Other Microcomputers	0	53.6	131	NA
Mainframe CPUs	0	0.2	0	NA
Minicomputer CPUs	0	0.4	3.1	NA
Disk Drives	2,820.6	2,929.6	4,179.1	21.7
Tape Drives	156.8	203.1	239.5	23.6
Printers	152	226.8	275.7	34.7
Terminals (Including Monitors)	89.5	65.2	88	-0.8
Keyboards	0	63.4	42.6	NA
Digital Central Storage Units	25.4	52.5	25.7	0.6
Control Units	26.6	22.2	38.9	20.9
Other Peripherals	263.2	568.4	786	72.8
Optical Reader/Document Scanners	0	0.3	0.9	NA
Off-Line DP Equipment	0.6	3.2	28.1	584.3
Color Televisions	710.3	690.4	809.7	6.8
Monochrome Televisions	3.2	0.3	0.1	-82.3

(Continued)

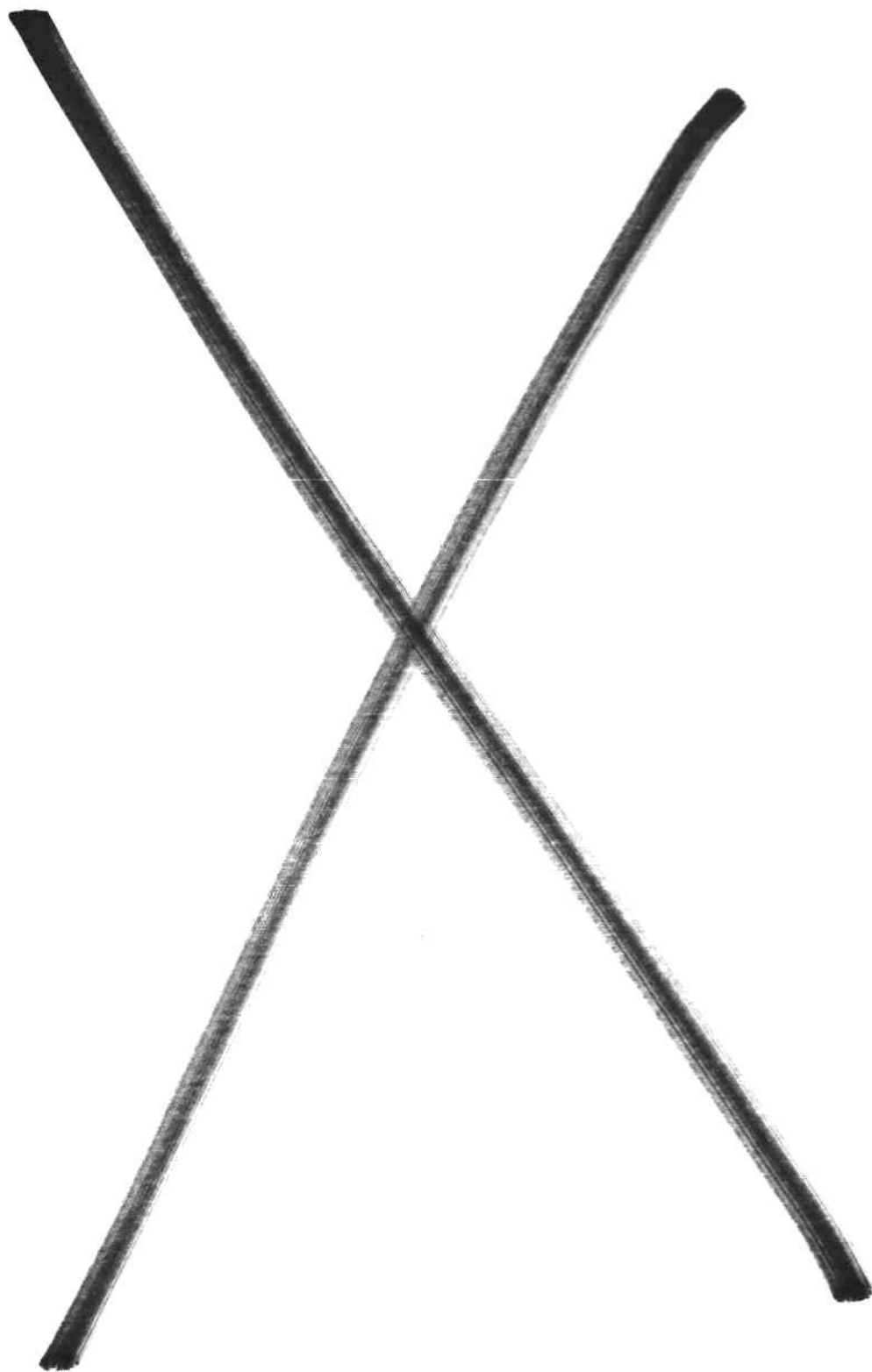
Table 1 (Continued)

Key Electronic Equipment Production—Singapore
(Millions of U.S. Dollars)

	1988	1989	1990	CAGR (%) 1988-1990
Car Radios	160.2	162.4	163.2	0.9
Radio-Cassette Players	650.2	608.9	627.2	-1.8
Portable Radio Receivers	21.3	11.8	9.1	-34.6
Other Radio-Broadcast Receivers	320.4	310	328.6	1.3
Record Players	31.8	18.3	31.8	0
Videotape Recorders	0	118.4	177.8	NA
Cassette Tape Recorders	94.9	42.7	42.6	-33.0
Other Tape Recorders	38.6	1.1	9.8	-49.6
Dictation Machines	162.3	239.9	207.3	13.0
Telephone Sets	191.1	119.3	91.3	-30.9
Telephone Switchboard and Exchanges	0.3	1.1	2.2	170.8
Modems	13.7	5.6	24.4	33.5
Facsimile Machines	35.3	39.6	24.4	-16.9
Telex Machines	0	0	0.1	NA
Other Line Telephonic or Telegraphic	0.3	10.6	10.3	485.9
Microphone Devices	6.5	5.9	7.7	8.8
Loudspeaker Devices	9.7	51.3	57.1	7.2
Headphone/Earphone Apparatus	0	4.6	2.9	NA
Amplifiers	19.6	4.3	65.9	83.4
Radio Transmitter-Receivers	72.8	69.4	234.5	79.5
Radio-Telephonic or Telegraphic Receivers	97.6	13.3	55.4	-24.7
Television Cameras	0.1	0.7	1.2	246.4
Navigational Instruments (Aerospace)	1.3	17.7	27.4	359.1
Electronic Medical Apparatus	10.8	1.4	3.1	-46.4
X-Ray Radiography/Radiotherapy Apparatus	0.1	0.9	1.5	287.3
Washing Machines	2.6	10.1	17.8	18.9
Refrigerators	19	10.2	11.3	-22.9
Heating Appliances	21.4	137.6	170.9	-12.1
Other Rotating Appliances	21.9	27.8	33.5	23.7
Industrial Floor Vacuum/Polishers	22.1	20	20.7	-3.2
Microwave Ovens	0	67	43.4	NA
Rice Cookers	0	0	0.4	NA
Integrated Circuits	2,011.3	2,005.8	2,231.8	5.3
Transistors	72.8	69.4	234.5	79.5

NA = Not available

Source: Dataquest (November 1991)



Semiconductor End Use

INTRODUCTION

The Semiconductor End-Use Analysis is a fundamental part of Dataquest's Asian Semiconductor and Electronics Technology Service (ASETS).

ASETS has developed a method and an information data base that provides a thorough analysis of semiconductor consumption in the electronic and electric equipment markets in Asia.

METHOD

Dataquest analyzes 50 types of major electronic/electric products (or product groups) that consume semiconductors and uses this analysis to support our consumption analysis by product. Dataquest's Semiconductor Industry Group (SIG) has segmented the market according to the most widely recognized application areas. The major categories are as follows:

- Data processing
- Communications
- Military
- Industrial
- Consumer
- Transportation

ASETS uses these same market segmentations in order to facilitate a consumption comparison of each country and area. ASETS excludes the military section from its segmentation, however, because there is no significant military market in Asia (which is similar to Japan but different from the United States and Europe). Transportation and industrial categories are likewise excluded because of their relative unimportance. These three segments are, however, included in the category, "Other."

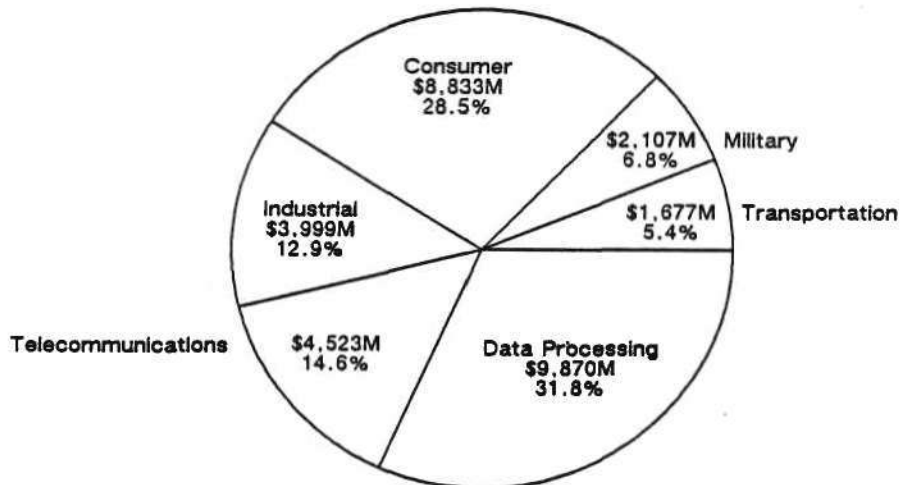
ASIAN SEMICONDUCTOR CONSUMPTION

Figures 1 and 2 show 1986 worldwide and Asian semiconductor end use, respectively. The Asian semiconductor market (defined as South Korea, Taiwan, Hong Kong, Singapore, and China) represents about 8.4 percent of the total world semiconductor market. Data processing and consumer electronics combined represent 87 percent of the Asian market compared with 60.3 percent worldwide (and 45.6 percent and 76.8 percent for North America and Japan, respectively).

Semiconductor End Use

Figure 1

1986 Worldwide Semiconductor End Use (Millions of U.S. Dollars)

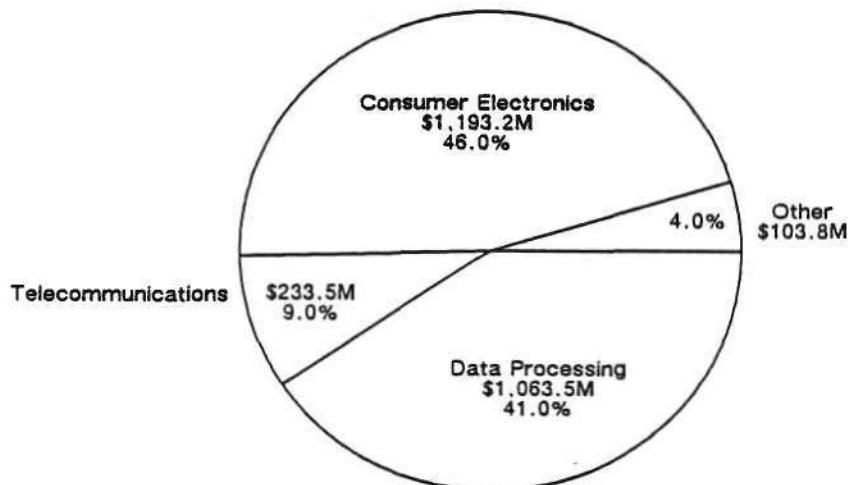


Total Semiconductor Consumption: \$30,009 Million

Source: Dataquest
April 1988

Figure 2

1986 Asian Semiconductor End Use (Millions of U.S. Dollars)



Total Semiconductor Consumption: \$2,594 Million

Source: Dataquest
April 1988

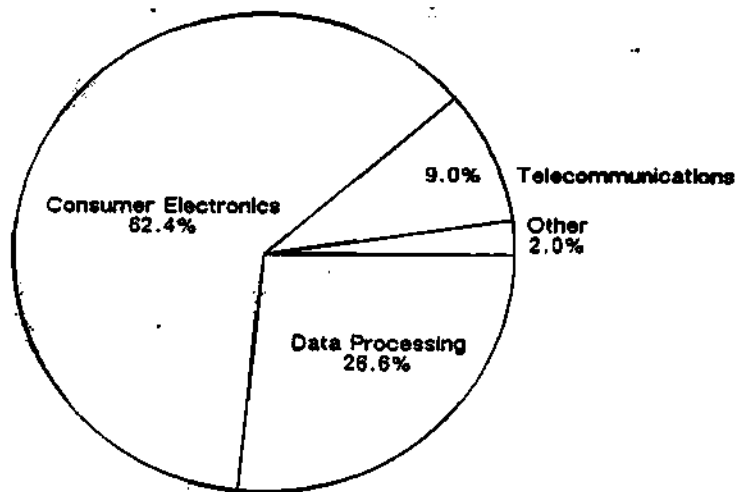
Semiconductor End Use

The rapid growth in home-video electronics production accounts for the dominant role that consumer electronics plays in Asia. In fact, Figure 3 shows that 62.4 percent of South Korea's semiconductor consumption in 1986 was due to consumer electronics, the bulk represented by home audio-video equipment.

Likewise, the emergence of Asian-produced IBM-compatible personal computers accounts for the disproportionate share of data processing-bound semiconductors. Indeed, as shown in Figure 4, Taiwan was the 1986 Asian leader in this consumption segment at 68.4 percent.

Figure 3

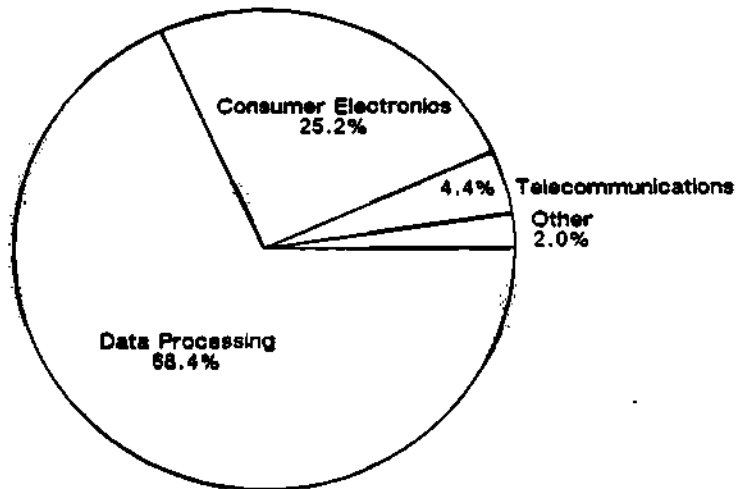
1986 South Korean Total Semiconductor Consumption



Source: Dataquest
April 1988

Semiconductor End Use

Figure 4
1986 Taiwanese Semiconductor Consumption



Source: Dataquest
April 1988

INDIAN SEMICONDUCTOR CONSUMPTION

Figure 5 shows Indian semiconductor consumption by end-use segment for the 1986–1987 fiscal year. Total semiconductor consumption amounted to US\$71 million, or 1.8 percent of total semiconductor shipments to and within the Asia-Pacific/Rest of World region.

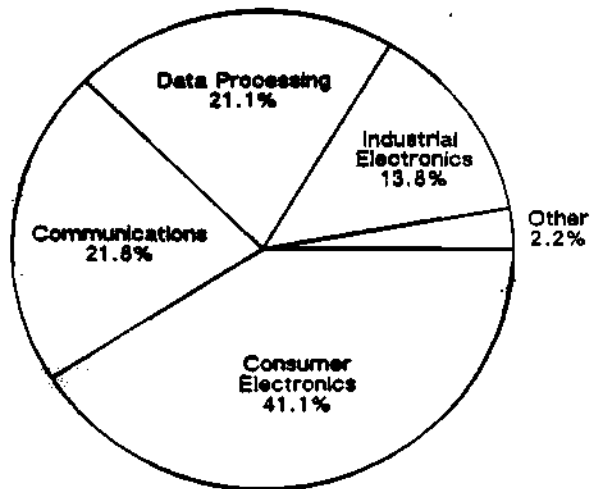
India's semiconductor end-use pattern is similar to the Asian semiconductor end-use pattern in general in that the consumer electronics segment ranks first in consumption. Television production accounts for 72.6 percent of consumption in this segment.

In contrast, the data processing segment represents a much smaller share, 21.1 percent, of total semiconductor consumption; and the communications and industrial electronics segments represent relatively larger shares—21.8 percent and 13.8 percent, respectively—of total consumption. Production of IBM PC-compatible computers is almost exclusively responsible for semiconductor consumption in the data processing segment. Production of telecommunications equipment accounts for 90.0 percent of semiconductor consumption in the communications segment. Given that India's telecommunications infrastructure is considerably underdeveloped and its enhancement is a major high-technology development goal of the government, this end-use segment probably represents one of India's most lucrative high-technology markets to foreign investors.

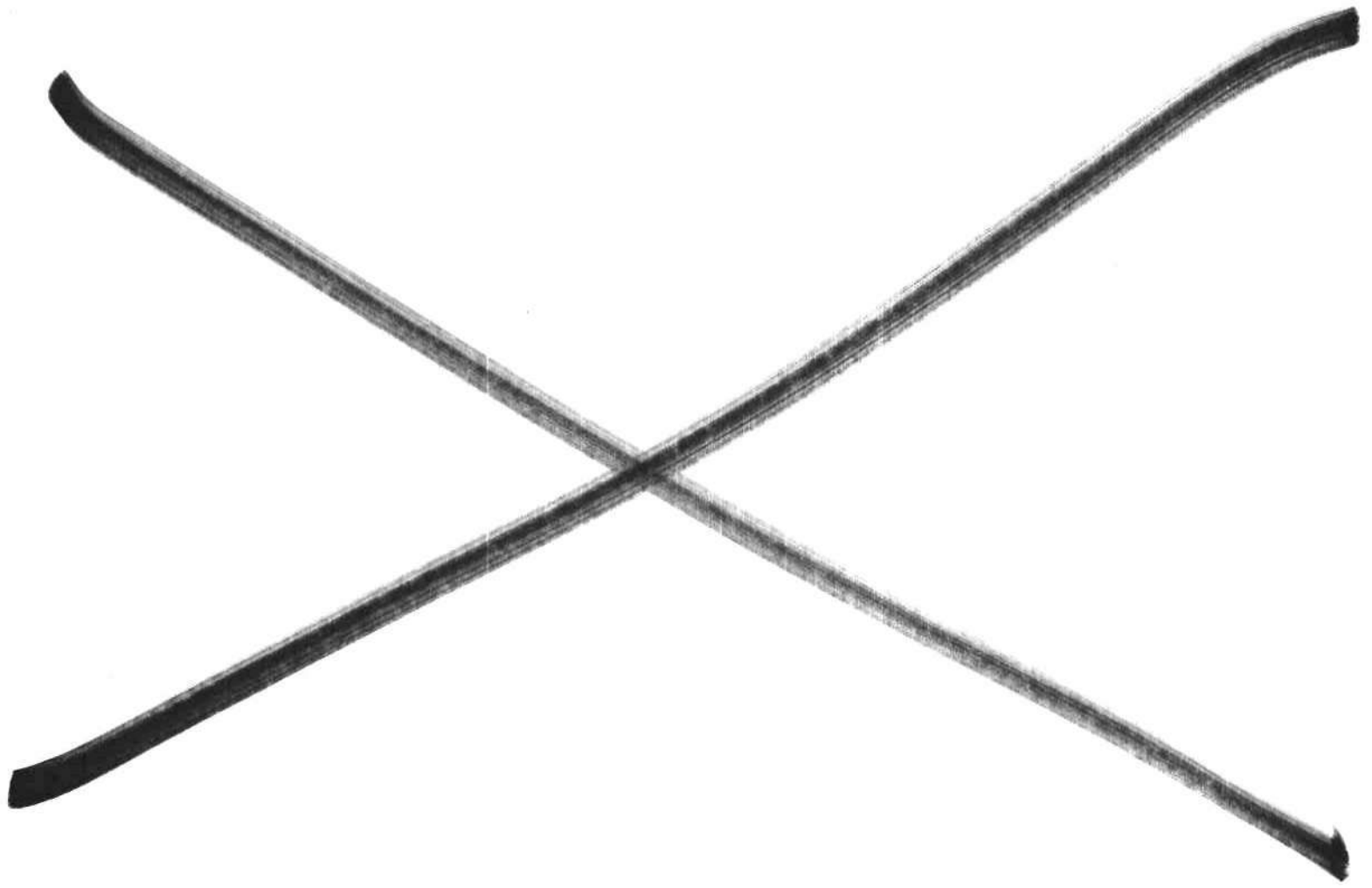
Semiconductor End Use

Figure 5

Fiscal 1986-1987 Indian Total Semiconductor Consumption



Source: Dataquest
April 1988



Electronics Industry--Taiwan

INTRODUCTION

In 1987, electronic production in Taiwan reached \$16.2 billion, up 51.9 percent from 1986, as shown in Table 1. Overseas sales of electronic testing and measuring equipment registered the largest increase, 140 percent more than 1986 figures. (Exports of electronic computing machines were second, with an export growth rate of 122 percent.) Telecommunication products followed with a growth rate of 47 percent.

Taiwan still does not have the capability to produce sophisticated electronic components, advanced testing and measuring instruments, or sophisticated computer and telecommunications equipment. The development of Taiwan's electronics industry will continue to provide many opportunities for future imports of sophisticated U.S. electronic components. Economic authorities are actively seeking foreign investors in the electronics industry who can transfer technology and management know-how. Taiwan wants to boost the sophistication level of its locally manufactured components. Dataquest predicts that the electronics industry will grow 25.2 percent in 1988, at which time annual production value for the industry should reach \$20.3 billion. Taiwan anticipates that most future exports will be audio and video products and computer and telecommunications systems.

At the end of 1986, 2,568 registered electronics companies, with a total registered capital of \$1,859.5 million, engaged in electronics production in Taiwan. In addition to locally invested firms (2,388), the electronics industry included 74 foreign-owned subsidiaries, 86 joint venture companies, and 20 overseas Chinese-invested companies. The foreign-invested firms accounted for 16.5 percent of registered capital and 25 percent of total employees.

The vast majority of locally invested firms are small-scale and labor-intensive. These firms produce diverse but related products in small lots according to orders received. They do not generally produce for inventory, simply ceasing production when orders lag. The large number of competitors in low-end production has kept profits low and price-cutting rampant. Smaller firms, therefore, generally do not invest in R&D and cannot keep up with advances in the electronics industry. Economic authorities have begun to address this problem with such incentives as low-interest loans and tax holidays to assist small firms. They also encourage firms to consolidate and cooperate in an effort to raise their profit levels. These companies are then expected to increase R&D expenditures and to move into high-technology production.

The electronics industry employed 273,345 people at the end of 1986, or about 13.54 percent of all local manufacturing employees. Electronic finished-product companies had the most employees, with 109,010 at the end of 1986, followed by electronic components and parts companies with 64,502. Average monthly earnings of electronics employees as of December 1986 were NT\$15,554 (US\$432.06 at US\$1=NT\$36). Worker productivity in electronics has increased 10 to 15 percent annually since 1982. Annual labor turnover is approximately 4 percent.

Electronics Industry--Taiwan

Table 1 cites 1983-1987 electronics industry production in Taiwan by product area. Tables 2 through 3 list electronic product imports and exports by item. Tables 4 through 8 cite information industry figures, as well as imports and exports. Table 9 lists electronic products included in Taiwan's Strategic Industry Act.

Table 1
Electronics Industry Production--Taiwan
(Millions of U.S. Dollars)

<u>Item</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Household Electrical Apparatus	\$ 726.3	\$ 884.3	\$ 800.7	\$ 911.1	\$ 1,029.5
Electronic Products	2,598.3	3,651.1	3,104.3	4,448.4	7,439.9
Electronic Components and Parts	3,295.6	4,239.6	3,862.6	4,456.6	6,769.4
Other	<u>652.4</u>	<u>1,006.3</u>	<u>673.1</u>	<u>850.6</u>	<u>961.2</u>
Total	\$7,272.6	\$9,781.3	\$8,440.7	\$10,666.7	\$16,200.0

Source: Ministry of Economic Affairs
Dataquest
October 1988

Electronic Products--Taiwan

The monetary units used in this service section are U.S. dollars.

PERSONAL COMPUTERS (PCs)

Shipment Summary

Table 1 gives an overview of Taiwan's PC market history and forecast.

Total PCs

Taiwan's 1987 PC unit shipments are estimated at 1.9 million, or 56 percent growth over 1986. This figure is expected to grow to 2.6 million units in 1988, or 35 percent growth over 1987. In addition:

- The 1987 value of these shipments is estimated at \$796 million, or 72 percent growth over 1986, and is forecast to grow significantly and steadily to \$1.04 billion in 1988.
- The compound annual growth rate (CAGR) of unit shipments from 1987 to 1991 is 25 percent, and the shipment value CAGR is 23 percent, again, significant and steady growth.

Less Than \$1,000 Segment

PC unit shipments in the less than \$1,000 segment reached an estimated 1 million units in 1987, 47 percent growth over 1986. These units were manufactured by leading worldwide PC companies, such as Amstrad, Atari, Commodore, and Sinclair. Also:

- PC shipment value has been growing at a 91 percent rate and is estimated at \$208 million for 1987.
- CAGRs for units shipped and their value are both lower than the CAGR of total PC shipments.

Table 2 gives an overview of the market history and forecast for Taiwanese PCs priced at less than \$1,000.

\$1,000 to \$5,000 Segment

Shipments of PC units priced from \$1,000 to \$5,000 were estimated at 871,000 in 1987, representing growth of 69 percent over 1986 and accounting for approximately 46 percent of Taiwan's total PC shipments (see Table 3). Almost all the shipments in this segment are IBM PC-compatible products, which shows that Taiwanese-manufactured PCs have significant worldwide market share. This category includes all IBM PC-, XT-, and AT-compatible products and 32-bit PCs. In addition:

- 1987 shipments for this segment were valued at an estimated \$592 million, or 74 percent of Taiwan's total PC shipments.

Electronic Products--Taiwan

- CAGRs of both units shipped and shipment value are slightly higher than that of total shipments. This is because of the Taiwanese tendency to develop high-value-added PCs.

Export Trends

Most PCs manufactured in Taiwan are exported. Table 4 shows the percentage of PCs exported in each of the three price segments.

Domestic Market

Less Than \$1,000 Segment

No domestic demand exists for PCs in the less than \$1,000 price range. Although video game computers (such as Nintendowich, which is extremely popular in the Taiwanese market) are in this price range, they are not included in our PC definition.

Because IBM-compatible PCs are very popular in the domestic market, most individuals and households prefer compatible PCs to home computers (such as Atari and Commodore).

\$1,000 to \$5,000 Segment

The \$1,000 to \$5,000 price segment represents the total domestic market. The number of units sold domestically in 1987 was 180,000, a growth of 73 percent over 1986. The 1987 market value was \$156 million, or 56 percent growth over 1986.

Import Trends

As Table 5 shows, domestic shipments are the major supply channel for the domestic market; imports are considerably less important. However, imports constitute most of the high-value-added product market.

Distribution Channels

Table 6 shows the distribution channels for Taiwanese PC shipments.

OEM Exports

The OEM export channel is Taiwan's second most important channel. OEM exports are expected to maintain a stable status from 1988 through 1991.

Electronic Products--Taiwan

Foreign Brand Exports

The foreign brand export channel is the most important distribution channel for the Taiwanese PC industry, especially for the less than \$1,000 segment. In 1987, it represented 45 percent of total shipments.

Native Brand Exports

Native manufacturers exporting under their own brand names experience rapid shipment growth from 1984 to 1987. In 1987, this channel represented 25 percent of total shipments. This figure is forecast to increase slightly from 1987 to 1991.

Domestic Shipments

In 1987, 13 percent of total shipments were domestic. This percentage should increase from 1988 to 1991 as the domestic market expands.

Major Manufacturers

Taiwan has 11 major PC manufacturers, which account for 68 percent of the total PC shipment value. Table 7 show the major PC manufacturers, and Table 8 introduces the OEM partnerships and technical relationships, all of which are middle- or long-term relationships. Further facts of interest pertaining to Taiwan's major PC manufacturers are:

- Six are offshore; the remaining five are local.
- Atari and Commodore are the only two manufacturers that produce home PCs (i.e., the less than \$1,000 segment).
- Atari, Avnet, Commodore, and Wang manufacture non-IBM PCs.
- The other manufacturers (e.g., Lopan, Mitac, Multitech, Tatung, Wyse, and Zenith) produce IBM-compatible XT, AT, and 386 PCs.

Native Manufacturers

Table 9 is a list of Taiwanese PC manufacturers and their products.

Electronic Products--Taiwan

Table 1a

Taiwanese PC Industry History
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	720	906	1,209	1,889
Growth Rate	-	26%	33%	56%
Value (\$M)	\$ 188	\$ 272	\$ 465	\$ 796
Growth Rate	-	43%	72%	72%
Unit Price (\$)	\$ 263	\$ 299	\$ 385	\$ 424
Growth Rate	-	14%	29%	10%
Exports				
Units (K)	684	860	1,113	1,720
Growth Rate	-	26%	29%	55%
Value (\$M)	\$ 152	\$ 240	\$ 393	\$ 700
Growth Rate	-	58%	64%	78%
Unit Price (\$)	\$ 222	\$ 279	\$ 353	\$ 407
Growth Rate	-	26%	27%	15%
Domestic Market				
Units (K)	40	52	104	180
Growth Rate	-	30%	100%	73%
Value (\$M)	\$ 46	\$ 58	\$ 108	\$ 156
Growth Rate	-	26%	86%	44%
Unit Price (\$)	\$1,150	\$1,115	\$1,038	\$ 867
Growth Rate	-	(3%)	(7%)	(17%)
Imports				
Units (K)	4	6	8	11
Growth Rate	-	50%	33%	38%
Value (\$M)	\$ 9	\$ 27	\$ 35	\$ 56
Growth Rate	-	200%	30%	60%
Unit Price (\$)	\$2,250	\$4,500	\$4,375	\$5,091
Growth Rate	-	100%	(3%)	16%
Domestic Shipments				
Units (K)	36	46	96	169
Growth Rate	-	28%	109%	76%
Value (\$M)	\$ 37	\$ 31	\$ 73	\$ 100
Growth Rate	-	(16%)	135%	37%
Unit Price (\$)	\$1,028	\$ 674	\$ 760	\$ 592
Growth Rate	-	(34%)	13%	(22%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 1b

Taiwanese PC Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	2,559	3,180	3,918	4,682	25%
Growth Rate	35%	24%	23%	19%	
Value (\$M)	\$1,035	\$1,304	\$1,544	\$1,839	23%
Growth Rate	30%	25%	19%	19%	
Unit Price (\$)	\$ 406	\$ 409	\$ 395	\$ 393	(2%)
Growth Rate	(4%)	1%	(3%)	0	
Exports					
Units (K)	2,322	2,861	3,502	4,154	25%
Growth Rate	35%	23%	22%	19%	
Value (\$M)	\$ 889	\$1,101	\$1,287	\$1,510	21%
Growth Rate	27%	24%	17%	17%	
Unit Price (\$)	\$ 383	\$ 385	\$ 368	\$ 364	(3%)
Growth Rate	(6%)	1%	(5%)	(1%)	
Domestic Market					
Units (K)	252	340	442	560	33%
Growth Rate	40%	35%	30%	27%	
Value (\$M)	\$ 221	\$ 294	\$ 376	\$ 470	32%
Growth Rate	42%	33%	28%	25%	
Unit Price (\$)	\$ 877	\$ 865	\$ 851	\$ 839	1%
Growth Rate	1%	(1%)	(2%)	(1%)	
Imports					
Units (K)	15	21	26	32	31%
Growth Rate	36%	40%	24%	23%	
Value (\$M)	\$ 70	\$ 95	\$ 116	\$ 140	26%
Growth Rate	25%	36%	22%	21%	
Unit Price (\$)	\$4,667	\$4,524	\$4,462	\$4,375	(4%)
Growth Rate	-	100%	(3%)	16%	
Domestic Shipments					
Units (K)	237	319	416	528	33%
Growth Rate	40%	35%	30%	27%	
Value (\$M)	\$ 151	\$ 199	\$ 260	\$ 330	35%
Growth Rate	51%	32%	31%	27%	
Unit Price (\$)	\$ 637	\$ 624	\$ 625	\$ 625	1%
Growth Rate	8%	(2%)	0	0	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 2a

Taiwanese PCs Less than \$1,000 Industry History
(Estimated Total Shipments and Exports,)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	612	680	693	1,018
Growth Rate	-	11%	2%	47%
Value (\$M)	\$ 71	\$ 72	\$109	\$208
Growth Rate	-	1%	51%	91%
Unit Price (\$)	\$116	\$106	\$157	\$204
Growth Rate	-	(9%)	49%	30%
Exports				
Units (K)	612	680	693	1,018
Growth Rate	-	11%	2%	47%
Value (\$M)	\$ 71	\$ 72	\$109	\$208
Growth Rate	-	1%	51%	91%
Unit Price (\$)	\$116	\$106	\$157	\$204
Growth Rate	-	(9%)	49%	30%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 2b

**Taiwanese PCs Less Than \$1,000 Industry Forecast
(Estimated Total Shipments and Exports)**

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR 1987-1991</u>
Total Shipments					
Units (K)	1,382	1,680	2,053	2,318	23%
Growth Rate	36%	22%	22%	13%	
Value (\$M)	\$247	\$294	\$325	\$369	15%
Growth Rate	19%	19%	11%	14%	
Unit Price (\$)	\$179	\$175	\$158	\$159	(6%)
Growth Rate	(13%)	(2%)	(10%)	1%	
Exports					
Units (K)	1,382	1,680	2,053	2,318	23%
Growth Rate	36%	22%	22%	13%	
Value (\$M)	\$247	\$294	\$325	\$369	15%
Growth Rate	19%	19%	11%	14%	
Unit Price (\$)	\$179	\$175	\$158	\$159	(6%)
Growth Rate	(13%)	(2%)	(10%)	1%	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 3a

Taiwanese PCs \$1,000 to \$5,000 Industry History
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	108	226	516	871
Growth Rate	-	109%	128%	69%
Value (\$M)	\$ 118	\$ 199	\$ 357	\$ 592
Growth Rate	-	69%	79%	66%
Unit Price (\$)	\$1,093	\$ 881	\$ 692	\$ 680
Growth Rate	-	(19%)	(21%)	(2%)
Exports				
Units (K)	72	180	420	702
Growth Rate	-	150%	133%	67%
Value (\$M)	\$ 81	\$ 168	\$ 284	\$ 492
Growth Rate	-	107%	69%	73%
Unit Price (\$)	\$1,125	\$ 933	\$ 676	\$ 701
Growth Rate	-	(17%)	(28%)	4%
Domestic Market				
Units (K)	40	52	104	180
Growth Rate	-	30%	100%	73%
Value (\$M)	\$ 46	\$ 58	\$ 108	\$ 156
Growth Rate	-	26%	86%	44%
Unit Price (\$)	\$1,150	\$1,115	\$1,038	\$ 867
Growth Rate	-	(3%)	(7%)	(17%)
Imports				
Units (K)	4	6	8	11
Growth Rate	-	50%	33%	38%
Value (\$M)	\$ 9	\$ 27	\$ 35	\$ 56
Growth Rate	-	200%	30%	60%
Unit Price (\$)	\$2,250	\$4,500	\$4,375	\$5,091
Growth Rate	-	100%	(3%)	16%
Domestic Shipments				
Units (K)	36	46	96	169
Growth Rate	-	28%	109%	76%
Value (\$M)	\$ 37	\$ 31	\$ 73	\$ 100
Growth Rate	-	(16%)	135%	37%
Unit Price (\$)	\$1,028	\$ 674	\$ 760	\$ 592
Growth Rate	-	(34%)	13%	(22%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 3b

Taiwanese PCs \$1,000 to \$5,000 Industry Forecast
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	1,177	1,500	1,865	2,364	28%
Growth Rate	35%	27%	24%	27%	
Value (\$M)	\$ 793	\$1,006	\$1,222	\$1,471	26%
Growth Rate	34%	27%	21%	20%	
Unit Price (\$)	\$ 674	\$ 671	\$ 655	\$ 622	(2%)
Growth Rate	(1%)	0	(2%)	(5%)	
Exports					
Units (K)	940	1,181	1,449	1,836	27%
Growth Rate	34%	26%	23%	27%	
Value (\$M)	\$ 642	\$ 807	\$ 962	\$1,141	23%
Growth Rate	30%	26%	19%	19%	
Unit Price (\$)	\$ 683	\$ 683	\$ 664	\$ 621	(3%)
Growth Rate	(3%)	0	(3%)	(6%)	
Domestic Market					
Units (K)	252	340	442	560	33%
Growth Rate	40%	35%	30%	27%	
Value (\$M)	\$ 221	\$ 294	\$ 376	\$ 470	32%
Growth Rate	42%	33%	28%	25%	
Unit Price (\$)	\$ 877	\$ 865	\$ 851	\$ 839	1%
Growth Rate	1%	(1%)	(2%)	(1%)	
Imports					
Units (K)	15	21	26	32	31%
Growth Rate	36%	40%	24%	23%	
Value (\$M)	\$ 70	\$ 95	\$ 116	\$ 140	26%
Growth Rate	25%	36%	22%	21%	
Unit Price (\$)	\$4,667	\$4,524	\$4,462	\$4,375	(4%)
Growth Rate	(8%)	(3%)	(1%)	(2%)	
Domestic Shipments					
Units (K)	237	319	416	528	33%
Growth Rate	40%	35%	30%	27%	
Value (\$M)	\$ 151	\$ 199	\$ 260	\$ 330	35%
Growth Rate	51%	32%	31%	27%	
Unit Price (\$)	\$ 637	\$ 624	\$ 625	\$ 625	1%
Growth Rate	8%	(2%)	0	0	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 4

Percentage of Taiwanese PCs Exported

	<u>1984</u>	<u>1987</u>	<u>1991</u>
PCs Less Than \$1,000*			
Export Unit Share	100%	100%	100%
Export Value Share	100%	100%	100%
PCs \$1,000 to \$5,000			
Export Unit Share	67%	81%	78%
Export Value Share	69%	83%	78%
PCs \$0 to \$5,000			
Export Unit Share	95%	91%	89%
Export Value Share	80%	88%	82%

*This segment comprises the home PC market. Since Taiwan's home PCs used in business are 100 percent manufactured offshore by foreign companies, home PCs are all sold back to the parent companies; therefore, PCs in this price segment are all for export.

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 5

**Taiwanese PC Import Market
(PCs from \$1,000 to \$5,000)**

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Import Unit Share	10.0%	6.1%	5.7%
Import Value Share	19.6%	36.0%	30.0%

Note: According to our PC definition, no market demand exists for PCs less than \$1,000.

Source: Dataquest
September 1988

Electronic Products---Taiwan

Table 6a

Taiwanese PC Distribution Channel History
(Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$188	\$272	\$465	\$796
OEM Export Value	\$ 45	\$ 65	\$ 84	\$136
(Percentage of Total Shipments)	24%	24%	18%	17%
Foreign Brand Export Value	\$102	\$154	\$196	\$360
(Percentage of Total Shipments)	54%	57%	42%	45%
Native Brand Export Value	\$ 4	\$ 22	\$112	\$200
(Percentage of Total Shipments)	2%	8%	24%	25%
Domestic Shipment Value	\$ 37	\$ 31	\$ 73	\$100
(Percentage of Total Shipments)	20%	11%	16%	13%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 6b

Taiwanese PC Distribution Channel Forecast (Millions of U.S. Dollars)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$1,040	\$1,300	\$1,547	\$1,840
OEM Export Value (Percentage of Total Shipments)	\$ 177 17%	\$ 221 17%	\$ 263 17%	\$ 294 16%
Foreign Brand Export Value (Percentage of Total Shipments)	\$ 447 43%	\$ 520 40%	\$ 572 37%	\$ 681 37%
Native Brand Export Value (Percentage of Total Shipments)	\$ 260 25%	\$ 364 28%	\$ 449 29%	\$ 534 29%
Domestic Shipment Value (Percentage of Total Shipments)	\$ 151 15%	\$ 199 15%	\$ 260 17%	\$ 330 18%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 7

Major Taiwanese PC Manufacturers*

<u>1987 Ranking</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Specifications</u>
1	Acer (Multitech) (Continental)	MPF-700 MPF-900 MPF-1100, 1600 PC-1900	PC XT-compatible PC AT-compatible 32-bit PC
2	Atari	1040 ST 520 STM 520 STM 260 ST PC-10	Home PC Home PC Home PC Non-IBM
3	Wyse	WY-1400 WY-2200	PC XT PC AT
4	Mitac	MPC-160T MPC-2000	PC XT PC AT
5	Avnet	1040 ST 520 ST	Non-IBM Non-IBM
6	Copam	PC-401 PC-501	PC XT PC AT
7	Wang	4230 A PC-S3	Workstation Non-IBM
8	Commodore	PC-10 PC-20 PC-S3	Home PC (non-IBM)
9	Tatung	TCS-6000 TCS-7000 80286	PC XT PC AT
10	Zenith	Easy-PC	PC XT

*Manufacturers with more than 1 percent of the total PC shipment value in Taiwan

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 8

Major PC Manufacturers' Partnerships/Alliances--Taiwan

<u>Manufacturer</u>	<u>OEM Partner</u>	<u>Technical Partner</u>
Multitech, Continental	ITT, Adds, NBI, Damco, McDonnell, Tadiran	Counterpoint, Sertek
Atari	-	-
Wyse	MAPC	-
Mitac	ITT	Shugart, ITT, Computervision
Avnet	Sinclair, Curry's, Dixon's	-
Copam	AVR, ITD, TCCM, Ultima Electronic Corp., Elonex, IMP-Data, Stak	ERSO, AVR, ITD
Tatung	IBM, Wang, Data General, Zenith, AT&T, Paxus, TSTI	ERSO, Zebec
Zenith (Taiwan)	IBM, Data General, Compaq	Zenith (mother corporation)
Li-Cheng	Inves, Peacock, Borsu, M.D.F., Contel, AI	Microsoft

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 9

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Acetek System Inc. Room 502, Fu Hsin S. Rd. Sec., 1, Taipei, 10587 Taiwan	Main boards, add-on cards, peripherals
A-Dart Technology Inc. FL. 2, No. 9 Kuang Fu N. Road Taipei, Taiwan	Add-on cards, power supplies
Advanced Datum Info. Corp. (ADP) 15/F, 126, Section 4 Nanking East Road Taipei, Taiwan	Brain 16, XT compatible terminals, monitors, add-on cards
Alltek Computer Co., Ltd. 3/F-1, No. 63, Lane 122 Jen-ai Road, Section 4 Taipei, Taiwan	IBM PC compatible
AMI Computer Mfgr. Inc. P.O. Box 99 Taipei, Taiwan	KC-2, AT compatible
Aquarius Systems Inc. 6F, North 394 Keelung Road Section 1 P.O. Box 48-29 Taipei, Taiwan	ASI-2000, AT compatible ASI-100, XT compatible ASI-500, XT compatible
Auto Computer Co., Ltd. 3/F-2, No. 271, Section 3 Roosevelt Road Taipei, Taiwan	Autocomputer PC, AT compatible Add-on cards Autocomputer XT, XT compatible
Bison Science Technique Co. Ltd. 16, Section 1 Chung Shan North Road Taipei, Taiwan	Bit-Plus, XT compatible

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Dataven Enterprises Co., Ltd. 41F, North 25, Alley 12, Lane 91 Section 1, Nei Hu Road Taipei, Taiwan	DVE-1000, XT compatible motherboards
Dennison Industrial Co., Ltd. 6th Floor, Fu-Hsing Commercial Building 331 Fu-Hsing North Road Taipei, Taiwan	Amigo 16-M, XT compatible peripherals, keyboards
Digitek Co., Ltd. CANDID International Corp. P.O. Box 4-4, Nankang 4 Taipei, Taiwan	XT turbo, AT, XT compatible
Expert Electronic Co., Ltd. Floor 4th, Number 568, Kuang Fu South Road, Taipei, Taiwan R.O.C.	AT, XT main boards, add-on cards, adapters
First International Computer Inc. (FIC) 201, Tung Hwa North Road Taipei, Taiwan	Leo AT/XT, XT compatible
Flytech Technology Co., Ltd. P.O. Box 23-169 Taipei, Taiwan	AT, XT compatibles turbo board multiuser systems
Flying Triumph Co., Ltd. Office: Room 1, 5F, Number 145 Section 1, Keelung Road Taipei, Taiwan	XT compatible add-on card Apple II, IIe cards Fox-16XT, XT compatible
Fullink Enterprise Co., Ltd. 5/Floor, Number 145, Section 1 Chung Shan North Road Taipei, Taiwan	AT, XT add-on cards

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
BITCOM International Co., Ltd. 9th Floor, Number 56 Nanking East Road, Section 4 Taipei, Taiwan	AT, XT add-on cards
Bright Up Industries Co., Ltd. 12-F, Number 142, Section 4 Chung Hsiao East Road Taipei, Taiwan	SPC 8816, XT compatible monitors
BURDA Enterprises Inc. 5/F, 26, Section 3 Jen-ai Road Taipei, Taiwan	AT, XT compatible Apple II, IIe
Cartolia Computer Co., Ltd. 2/F, Number 567, Chung Hsiai East Road, Section 7 Taipei, Taiwan	AT, XT compatible Apple II, IIe
C & D Technology, Inc. P.O. Box 5-250 Taipei, Taiwan U.S.-Britronics Inc. 14730 E. Firestone Boulevard Suite 302 La Mirada, CA 90638)	Mandax Multi PC AT Add-on cards, peripherals
Central Pillar Co., (Taiwan) Ltd. Room 4-3, 4/F., Number 2 Fu Hsing N. Road Taipei (104), Taiwan	CPC-1000, PC compatible, add-on cards
Chung Yu Electronics, Ltd. P.O. Box 30-535 Taipei, Taiwan	AT, XT compatible power supplies

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Galaxy Microcraft Systems Co., Ltd. P.O. Box 24-543 Taipei, Taiwan	GX-2000, XT compatible add-on cards, modems
GIT Co., Ltd. Hou & Hou Co., Ltd. P.O. Box 47-157 Taipei, Taiwan	AT-1200, AT compatible DM-3600, XT compatible Motherboards, cards, keyboards
Goodworld Industrial Co., Ltd. Third Floor 122-2 Section 1 Shin-Sheng S. Road Taipei 10622, Taiwan	Xetac/XT, XT compatible Xetac/AT, AT compatible Xetac/IIf, IIf compatible
Horn Computer Electronic Co., Ltd. 6/Floor, Number 1-4, Section 5 Chung Hsiao East Road Taipei, Taiwan	PC/XT/AT compatibles Add-on cards
Hwa Hsin Electronic Co., Ltd. 1/Floor, Number 1, Alley 29 Lane 283, Roosevelt Road Section 3, Taipei Taiwan	AT, XT cards
Inter-Orient & World Corp. P.O. Box 48 243 Taipei, Taiwan R.O.C.	Dynamic PC/XT, XT compatible Shuttle PC/XT, XT compatible Geniskhan, AT compatible Prince, Jr. compatible Portcom, XT compatible Add-on cards, keyboards
Jepssen Enterprise Co., Ltd. Room 1105, North 415 Hsin-Yi Road, Section 4 Taipei, Taiwan	AT, XT compatible

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Joytech Computer Co., Ltd. 10/Floor, North 86 Fuhsing North Road Taipei, Taiwan	Excel-Turbo, XT compatible, add-on cards
K.S. Brotherbox Co., Ltd. P.O. Box 32-62 Taipei, Taiwan	AT, XT portable compatible
Kun Ying Enterprise Co., Ltd. Room 1311, North 41, Section 1 Chung Hsiao West Road Taipei, Taiwan	SU-640C, PC/XT compatible SU-101E, Apple IIe compatible KY-640C, AT compatible
Long Redart Co., Ltd. P.O. Box 68 1257 Taipei, Taiwan	PC/AT enhanced, AT compatible PC/XT enhanced, XT compatible Apple IIe motherboard
Lyi-Cheng Enterprise Co., Ltd. P.O. Box 78-105 Taipei, Taiwan	Minta MT-320, AT compatible
Mitac Inc. 9F1, Number 585 Ming-Sheng E. Road Taipei, Taiwan	Portable Viso, PC compatible Mitac 286, AT compatible MPC-160, XT compatible Add-on boards
Modern Computer Corp. 41F, North 8, Section 1 Kien Kwo S. Road Taipei, Taiwan	PTC-900, AT, XT compatible AT-2000, AT compatible Add-on cards
Monterey International Corp. Office: 5/F, Number 40 Deh Hwei Street Taipei, Taiwan	Staff-2 AT, AT compatible XT compatible

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Mortec Electronic Ind., Co. Ltd. 2nd Floor, North 10, Lane 575 Tun Hwa South Road Taipei, Taiwan	Tech-5000, XT compatible Tech-1, Apple II compatible Main boards, add-on cards
Multitech 15th Floor, 135 Chien-Ku N. Road Section 2, Taipei 10479 Taiwan	Popular 500, PC compatible Plus 700, XT compatible Advance 900, AT compatible
Nippon Binary K.K.	COPAM PC-501AT, AT compatible
Northern International Inc. Office: 6/F.-5, Number 333 Fu Hsing N. Road Taipei, Taiwan	PC/XT/AT add-on boards
P&C Shiten Enterprise Co., Ltd. Room 7, 8th Floor Number 100 Roosevelt Road Section 3 Taipei, Taiwan	IP-640, XT compatible Add-on cards, XT, AT
Peripherals Enterprise Co., Ltd. 7th Floor, Number 349 Min Sheng East Road Taipei, Taiwan	AT, XT add-on cards
Plus & Plus Co., Ltd. 2/F, Number 126 Roosevelt Road Section 3 Taipei, Taiwan	ARC turbo, PC/XT compatible
POFA Technology Corp. P.O. Box 43-442 432, Keelung Road, Sec. 1, Rm. 703 Taipei, Taiwan	Model P, PC compatible Model P+, XT compatible

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Sailing Strong Intern Co., Ltd. Number 179, Fu-Shing N. Road Taipei, Taiwan	51-8000 PC AT compatible add-on boards
SPL Taiwan Ltd. 2/F, Morrison Plaza 25-4, Jen-ai Road, Section 4 Taipei, Taiwan	AT, XT compatible add-on cards, peripherals
Spring Circle Computer Inc. Office: 3/F., Number 126 Roosevelt, Section 3 Taipei, Taiwan	Add-on cards, XT/AT
Starrise Computer Co., Ltd. Office: Number 63, Hsin Ming Road Neihu Zone Taipei, Taiwan	PC XT final assembly cases and keyboards
Supertron Electronic Co., Ltd. Office: 7/F, Chung San Building Number 486, Fu-Hsin North Road Taipei, Taiwan	AT, XT compatibles, add-on boards
Surwave Electronic Ltd. Office: Number 187, Section 1 Ta-An Road Taipei, Taiwan	Amigo-MX5, Apple IIe compatible Amigo-16/PT, PC compatible
Taiwan Hannox International Inc. Office: 4/F, Number 100 Nanking E. Road, Section 4 Taipei, Taiwan	AT XT add-on card compatible
Taiwan Hwan Hong Enterprise Co. 6th Floor, Number 163 Han-Sheng East Road Panchiao, Taipei Hsein Taiwan	TH316XT-M, XT compatible Add-on cards, modems, drives AT compatible Apple IIe compatible

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Taiwan Tomorrowland Inc. 2F-1, North 13, Lane 190 Fu Hsing North Road Taipei, Taiwan	Cleveland 186, XT compatible
Tatung Co. 22, Chungshan North Road 3rd Section Taipei, Taiwan	TCS-7000, AT compatible monitors, terminals
Tralite Enterprise Co., Ltd. 11 Floor 185 Section 2 Chung Shan North Road Taipei, Taiwan	Add-on cards, keyboards, cases, storage
Trun Sole Enterprise Co., Ltd. P.O. Box 55-506 Taipei, Taiwan	AT XT compatible boards
Turn-Point Science Tech. Co., Ltd. 11 Floor-5, Number 80, Section 1 Ho Ping West Road Taipei, Taiwan	
Unitron Inc. Factory: 5th Floor, Number 3 Lane 521, Chung Cheng Road 23138 Hsin Tein Taipei, Taiwan	U-2900T, XT compatible U-3900, AT compatible Add-on cards
Wugo Co., Ltd. Number 16, Lane 134, Section 2 Chung Hsiao East Road Taipei, Taiwan	Phoenix PC II, XT compatible
Winfortune Enterprise Co., Ltd. 3/F-3, Number 125, Section 3 Taipei, Taiwan	Winton turbo, XT compatible add-on boards

(Continued)

Electronic Products--Taiwan

Table 9 (Continued)

Taiwanese PC Manufacturers

<u>Manufacturer</u>	<u>Products</u>
Yih Lung Enterprise Co., Ltd. Number 112, Chungking N. Road Section 4 Taipei, Taiwan	AT XT compatible add-on cards
Youth Keep Enterprise Co., Ltd. Office: 1/F, Number 7, Lane 92 Section 2, Jen-ai Road Taipei, Taiwan	AT compatible boards
Yutional Enterprise Co., Ltd. 3 Floor, Number 337, Section 4 Shin I Road Taipei, Taiwan	Apple IIe compatible add-on cards

Source: Dataquest
September 1988

Electronic Products--Taiwan

MONITORS

Shipment Summary

For an overview of the Taiwanese monitor market history and forecast, see Tables 10 through 12.

Total Monitors

Shipments of monitors from Taiwan have grown quickly during the past several years because of the large volume of OEM procurements by almost all the leading worldwide PC manufacturers, such as Apple, Commodore, Compaq, and IBM. In addition:

- Taiwanese monitor unit shipments of in 1987 reached an estimated 5.8 million units, or 37 percent growth over 1986, and are forecast to reach 6.2 million units in 1988.
- The 1987 monitor shipment value was estimated at \$913.0 million and is forecast to reach \$1.1 billion in 1988. The CAGR from 1987 to 1991 is forecast to be 16 percent.

Monochrome Monitors

Monochrome monitor units shipped have had a CAGR of 21 percent, reaching 3.7 million in 1987, a value of \$337 million.

Both shipment value and units shipped will decrease from 1988 through 1991. The key factors behind the expected decrease are the appreciation of the Taiwanese dollar and the upgrade in the Taiwanese monitor industry—i.e., Taiwan will move into higher-end monitor product areas, while lower-end monitors will lose their competitive advantage against these manufactured in other developing countries.

Color Monitors

Currently, color monitors are major products in Taiwan's monitor industry, and their shipment value represents 65 percent of total monitor shipments. We believe that this percentage will increase during the next four years.

Color monitor unit shipments had the extremely high growth rate of 78 percent in 1987 and reached 2.1 million units. Shipment value grew at an even higher rate—93 percent—in 1987. We believe that the Taiwanese color monitor industry will continue to grow from 1988 through 1991. However, as the industry becomes more mature, the growth rate will increase more slowly.

Export Trends

Table 13 shows the percentage of monitors exported in each product segment.

Electronic Products--Taiwan

Domestic Market

Total Industry

In 1987, monitors had a domestic consumption of 351,000 units, or \$82.6 million, in Taiwan. Unit shipments grew 67 percent, and shipment value grew 91 percent, over 1986. From 1987 through 1991, the respective CAGRs are forecast at 22 percent and 18 percent.

Monochrome Monitors

Domestic consumption of monochrome monitors will maintain stable growth from 1988 through 1991. As Taiwanese PC manufacturers procure more monitors domestically, the domestic market will continue to grow.

Color Monitors

The color monitor situation is the same as that of monochrome monitors. It will grow steadily during the 1988 through 1991 time frame. The color monitor market value in 1987 was \$66.5 million, or 96 percent growth over 1986, and the number of units shipped was 211,000, or 67 percent growth over 1986.

Import Trends

Imports comprised only 2 percent of Taiwan's domestic monitor consumption value in 1987. This figure is forecast at 3 percent in 1991.

Distribution Channels

Table 14 shows the distribution channels for Taiwanese monitor shipments.

OEM Exports

From 1984 through 1987, the OEM export channel was Taiwan's most important monitor distribution outlet, consisting of 34 percent of the total distribution channels. However, this figure will decrease slightly in the future as the Taiwanese dollar appreciates.

Foreign Brand Exports

In 1987, foreign brand exports caught up with OEM exports by capturing 34 percent of total distribution channels. This channel will become Taiwan's most important distribution channel from 1988 through 1991.

Electronic Products--Taiwan

Native Brand Exports

Constituting 20 percent of total channels in 1987, native manufacturers' exports under their own brand names will become even more important as the industry becomes more mature.

Domestic Shipments

The proportion of domestic shipments should continue to increase during the next four years.

Major Manufacturers

Taiwan has 11 major monitor manufacturers, which account for 28 percent of Taiwan's total monitor shipment value (see Tables 15 and 16). Also of note:

- Six are offshore; the other five are local
- Most Taiwanese manufacturers make both monochrome and color monitors.

Electronic Products--Taiwan

Table 10a

Taiwanese Monitor Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	2,950	3,216	4,267	5,841
Growth Rate	-	9%	33%	37%
Value (\$M)	\$ 331	\$ 326	\$ 558	\$ 913
Growth Rate	-	(2%)	71%	64%
Unit Price (\$)	\$ 112	\$ 101	\$ 131	\$ 156
Growth Rate	-	(10%)	29%	20%
Exports				
Units (K)	2,881	3,085	3,972	5,339
Growth Rate	-	7%	29%	34%
Value (\$M)	\$ 319	\$ 303	\$ 500	\$ 800
Growth Rate	-	(5%)	65%	60%
Unit Price (\$)	\$ 111	\$ 98	\$ 126	\$ 150
Growth Rate	-	(11%)	28%	19%
Domestic Market*				
Units (K)	37	90	210	351
Growth Rate	-	143%	133%	67%
Value (\$M)	\$ 7	\$ 16	\$ 43	\$ 83
Growth Rate	-	144%	168%	91%
Unit Price (\$)	\$ 178	\$ 179	\$ 206	\$ 235
Growth Rate	-	0	15%	14%
Imports				
Units (K)	2.2	6.2	6.0	13.4
Growth Rate	-	182%	(3%)	123%
Value (\$M)	\$ 0.4	\$ 1.2	\$ 1.2	\$ 3.0
Growth Rate	-	200%	0	150%
Unit Price (\$)	\$ 182	\$ 194	\$ 200	\$ 224
Growth Rate	-	6%	3%	12%
Domestic Shipments				
Units (K)	69	131	295	502
Growth Rate	-	90%	125%	70%
Value (\$M)	\$12.0	\$22.6	\$58.4	\$113.0
Growth Rate	-	88%	158%	93%
Unit Price (\$)	\$ 174	\$ 173	\$ 198	\$ 225
Growth Rate	-	(1%)	15%	14%

*Domestic market includes monitors as subsystems of PCs manufactured for export.

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 10b

Taiwanese Monitor Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	1988	1989	1990	1991	CAGR 1987-1991
Total Shipments					
Units (K)	6,173	6,478	6,772	7,002	50%
Growth Rate	6%	5%	5%	3%	
Value (\$M)	\$1,109	\$1,305	\$1,482	\$1,641	16%
Growth Rate	21%	18%	14%	11%	
Unit Price (\$)	\$ 180	\$ 201	\$ 219	\$ 234	11%
Growth Rate	15%	12%	9%	7%	
Exports					
Units (K)	5,491	5,603	5,710	5,755	2%
Growth Rate	3%	2%	2%	1%	
Value (\$M)	\$ 960	\$1,123	\$1,269	\$1,396	15%
Growth Rate	20%	17%	13%	10%	
Unit Price (\$)	\$ 175	\$ 200	\$ 222	\$ 243	13%
Growth Rate	17%	15%	11%	9%	
Domestic Market*					
Units (K)	470	589	689	772	22%
Growth Rate	34%	25%	17%	12%	
Value (\$M)	\$ 107	\$ 129	\$ 146	\$ 160	18%
Growth Rate	29%	21%	13%	10%	
Unit Price (\$)	\$ 227	\$ 219	\$ 212	\$ 208	(3%)
Growth Rate	(3%)	(4%)	(3%)	(2%)	
Imports					
Units (K)	20.4	29.4	39.6	52.7	41%
Growth Rate	52%	44%	35%	33%	
Value (\$M)	\$ 4.8	\$ 6.7	\$ 8.7	\$ 10.9	38%
Growth Rate	60%	40%	30%	25%	
Unit Price (\$)	\$ 235	\$ 228	\$ 220	\$ 207	(2%)
Growth Rate	5%	(3%)	(4%)	(6%)	
Domestic Shipments					
Units (K)	682	875	1,062	1,247	26%
Growth Rate	36%	28%	21%	17%	
Value (\$M)	\$ 48.5	\$181.6	\$213.4	\$245.0	21%
Growth Rate	31%	22%	18%	15%	
Unit Price (\$)	\$ 218	\$ 208	\$ 201	\$ 196	(3%)
Growth Rate	(3%)	(5%)	(3%)	(2%)	

*Domestic market includes monitors as subsystems of PCs manufactured for export.

Source: Dataquest
September 1988

Electronic Products—Taiwan

Table 11a

Taiwanese Monochrome Monitor Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	2,634	2,547	3,072	3,714
Growth Rate	-	(3%)	21%	21%
Value (\$M)	\$265	\$191	\$ 259	\$ 337
Growth Rate	-	(28%)	36%	30%
Unit Price (\$)	\$101	\$ 75	\$ 84	\$ 91
Growth Rate	-	(25%)	12%	8%
Exports				
Units (K)	2,600	2,487	2,937	3,483
Growth Rate	-	(4%)	18%	19%
Value (\$M)	\$261	\$185	\$ 244	\$ 310
Growth Rate	-	(29%)	32%	27%
Unit Price (\$)	\$100	\$ 74	\$ 83	\$ 89
Growth Rate	-	(26%)	12%	7%
Domestic Market*				
Units (K)	15.0	36.0	84.0	140.0
Growth Rate	-	140%	133%	67%
Value (\$M)	\$1.8	\$3.4	\$ 9.2	\$16.1
Growth Rate	-	89%	171%	75%
Unit Price (\$)	\$120	\$ 94	\$ 110	\$115
Growth Rate	-	(21%)	16%	5%
Imports				
Units (K)	1.4	3.3	3.7	7.1
Growth Rate	-	131%	12%	93%
Value (\$M)	\$0.2	\$0.4	\$ 0.5	\$ 1.0
Growth Rate	-	100%	25%	100%
Unit Price (\$)	\$143	\$121	\$ 135	\$ 141
Growth Rate	-	(15%)	12%	4%
Domestic Shipments				
Units (K)	34.0	60.0	135.0	231.0
Growth Rate	-	76%	125%	71%
Value (\$M)	\$4.3	\$5.8	\$15.0	\$27.2
Growth Rate	-	35%	159%	81%
Unit Price (\$)	\$126	\$ 97	\$ 111	\$ 118
Growth Rate	-	(24%)	15%	6%

*Domestic market includes monitors as subsystems of PCs manufactured for export.

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 11b

Taiwanese Monochrome Monitor Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	1988	1989	1990	1991	CAGR 1987-1991
Total Shipments					
Units (K)	3,348	2,996	2,683	2,413	(10%)
Growth Rate	(10%)	(11%)	(10%)	(10%)	
Value (\$M)	\$ 315	\$ 290	\$ 261	\$ 235	(9%)
Growth Rate	(7%)	(8%)	(10%)	(10%)	
Unit Price (\$)	\$ 94	\$ 97	\$ 97	\$ 97	2%
Growth Rate	4%	3%	0	0	
Exports					
Units (K)	3,033	2,589	2,177	1,804	(15%)
Growth Rate	(13%)	(15%)	(16%)	(17%)	
Value (\$M)	\$ 279	\$ 246	\$ 209	\$ 175	(13%)
Growth Rate	(10%)	(12%)	(15%)	(16%)	
Unit Price (\$)	\$ 92	\$ 95	\$ 96	\$ 97	2%
Growth Rate	3%	3%	1%	1%	
Domestic Market*					
Units (K)	188	235	282	324	23%
Growth Rate	34%	25%	20%	15%	
Value (\$M)	\$20.9	\$24.7	\$28.9	\$31.2	18%
Growth Rate	30%	18%	17%	8%	
Unit Price (\$)	\$ 111	\$ 105	\$ 102	\$ 96	(4%)
Growth Rate	(3%)	(5%)	(2%)	(6%)	
Imports					
Units (K)	11.2	17.6	25.8	38.3	52%
Growth Rate	57%	57%	47%	48%	
Value (\$M)	\$ 1.5	\$ 2.4	\$ 3.4	\$ 4.9	49%
Growth Rate	54%	54%	43%	44%	
Unit Price (\$)	\$ 134	\$ 136	\$ 132	\$ 128	(2%)
Growth Rate	(5%)	1%	(3%)	(3%)	
Domestic Shipments					
Units (K)	315	407	506	609	27%
Growth Rate	36%	29%	24%	20%	
Value (\$M)	\$35.5	\$43.6	\$52.4	\$60.0	22%
Growth Rate	31%	23%	20%	15%	
Unit Price (\$)	\$ 113	\$ 107	\$ 104	\$ 99	(4%)
Growth Rate	(4%)	(5%)	(3%)	(5%)	

*Domestic market includes monitors as subsystems of PCs manufactured for export.

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 12a

Taiwanese Color Monitor Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	1984	1985	1986	1987
Total Shipments				
Units (K)	316	669	1,195	2,127
Growth Rate	-	112%	79%	78%
Value (\$M)	\$ 66	\$ 135	\$ 299	\$ 576
Growth Rate	-	105%	121%	93%
Unit Price (\$)	\$ 209	\$ 202	\$ 250	\$ 271
Growth Rate	-	(3%)	24%	8%
Exports				
Units (K)	281	598	1,035	1,856
Growth Rate	-	113%	73%	79%
Value (\$M)	\$ 58	\$ 118	\$ 256	\$ 490
Growth Rate	-	103%	117%	91%
Unit Price (\$)	\$ 206	\$ 197	\$ 247	\$ 264
Growth Rate	-	(4%)	25%	7%
Domestic Market*				
Units (K)	22	54	126	211
Growth Rate	-	145%	133%	67%
Value (\$M)	\$ 4.8	\$12.7	\$34.0	\$66.5
Growth Rate	-	165%	168%	96%
Unit Price (\$)	\$ 218	\$ 235	\$ 270	\$ 315
Growth Rate	-	8%	15%	17%
Imports				
Units (K)	0.78	2.92	2.31	6.27
Growth Rate	-	274%	(21%)	171%
Value (\$M)	\$0.20	\$0.80	\$0.70	\$2.00
Growth Rate	-	300%	(13%)	186%
Unit Price (\$)	\$ 256	\$ 274	\$ 303	\$ 319
Growth Rate	-	7%	11%	5%
Domestic Shipments				
Units (K)	35	71	160	271
Growth Rate	-	103%	125%	69%
Value (\$M)	\$ 7.7	\$16.8	\$43.4	\$85.8
Growth Rate	-	118%	158%	98%
Unit Price (\$)	\$ 220	\$ 237	\$ 271	\$ 317
Growth Rate	-	8%	15%	17%

*Domestic market includes monitors as subsystems of PCs manufactured for export.

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 12b

Taiwanese Color Monitor Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	1988	1989	1990	1991	CAGR 1987-1991
Total Shipments					
Units (K)	2,825	3,482	4,089	4,589	(21%)
Growth Rate	33%	23%	17%	12%	
Value (\$M)	\$ 794	\$1,015	\$1,221	\$1,406	25%
Growth Rate	38%	28%	20%	15%	
Unit Price (\$)	\$ 281	\$ 291	\$ 299	\$ 306	3%
Growth Rate	4%	3%	2%	3%	
Exports					
Units (K)	2,458	3,014	3,533	3,951	21%
Growth Rate	32%	23%	17%	12%	
Value (\$M)	\$ 681	\$ 877	\$1,060	\$1,221	26%
Growth Rate	39%	29%	21%	15%	
Unit Price (\$)	\$ 277	\$ 291	\$ 300	\$ 309	4%
Growth Rate	5%	5%	3%	3%	
Domestic Market*					
Units (K)	282	354	407	448	21%
Growth Rate	34%	26%	15%	10%	
Value (\$M)	\$ 86.0	\$104.4	\$117.0	\$129.0	18%
Growth Rate	29%	21%	12%	10%	
Unit Price (\$)	\$ 305	\$ 295	\$ 287	\$ 288	(2%)
Growth Rate	(3%)	(3%)	(3%)	0	
Imports					
Units (K)	9.20	11.84	13.80	14.40	23%
Growth Rate	47%	29%	17%	4%	
Value (\$M)	\$ 3.26	\$ 4.33	\$ 5.30	\$ 6.00	32%
Growth Rate	63%	33%	22%	13%	
Unit Price (\$)	\$ 354	\$ 366	\$ 384	\$ 417	7%
Growth Rate	11%	3%	5%	8%	
Domestic Shipments					
Units (K)	367	468	556	638	23%
Growth Rate	35%	28%	19%	15%	
Value (\$M)	\$113.0	\$138.0	\$161.0	\$185.0	21%
Growth Rate	32%	22%	17%	15%	
Unit Price (\$)	\$ 308	\$ 295	\$ 290	\$ 290	(2%)
Growth Rate	(3%)	(4%)	(2%)	0	

*Domestic market includes monitors as subsystems of PCs manufactured for export.

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 13

Percentage of Taiwanese Monitors Exported

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Monochrome Monitor			
Export Unit Share	98.7%	93.8%	74.8%
Export Value Share	98.5%	92.0%	74.5%
Color Monitor			
Export Unit Share	88.9%	87.3%	86.1%
Export Value Share	87.9%	85.1%	86.8%
Total Monitors			
Export Unit Share	97.7%	91.4%	82.2%
Export Value Share	96.4%	87.6%	85.1%

Source: Dataquest
September 1988

Electronic Products--Taiwan

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Electronic Products--Taiwan

Table 14a

**Taiwanese Monitor Distribution Channel History
(Millions of U.S. Dollars)**

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$331	\$326	\$558	\$913
OEM Export Value	\$189	\$170	\$206	\$310
(Percentage of Total Shipments)	57%	52%	37%	34%
Foreign Brand Export Value	\$119	\$121	\$212	\$310
(Percentage of Total Shipments)	36%	37%	38%	34%
Native Brand Export Value	\$ 10	\$ 13	\$ 84	\$183
(Percentage of Total Shipments)	3%	4%	15%	20%
Domestic Shipment Value	\$ 12	\$ 23	\$ 58	\$113
(Percentage of Total Shipments)	4%	7%	10%	12%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 14b

**Taiwanese PC Distribution Channel Forecast
(Millions of U.S. Dollars)**

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$1,109	\$1,305	\$1,482	\$1,641
OEM Export Value	\$ 333	\$ 378	\$ 385	\$ 377
(Percentage of Total Shipments)	30%	29%	26%	23%
Foreign Brand Export Value	\$ 388	\$ 444	\$ 445	\$ 492
(Percentage of Total Shipments)	35%	34%	30%	30%
Native Brand Export Value	\$ 244	\$ 300	\$ 445	\$ 525
(Percentage of Total Shipments)	22%	23%	30%	32%
Domestic Shipment Value	\$ 149	\$ 182	\$ 213	\$ 246
(Percentage of Total Shipments)	13%	14%	14%	15%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 15

Major Taiwanese Monitor Manufacturers*

<u>1987 Ranking</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Specifications</u>
1	Tatung	MM-1525D, 1529D, 1422D CM-1380D, VM-12C	Monochrome, color, high, middle resolution
2	Philips	7513, 75xx, 76xx, CM-8562, 8830	Monochrome: middle, high resolution Color: middle, high resolution
3	Zenith	ZVM-1220A, 1230A, 1390A, 1240E	Monochrome, color: middle resolution
4	Sampo	KDS-1302, 1332, 1220, 1401, 1322	Monochrome: middle resolution Color: middle resolution
5	Orion Electronic Taiwan Co., Ltd.		Color monitor
6	Pan Overseas/ Advanced Datum	PM-14 PX-22	Monochrome: middle resolution Color: middle resolution
7	Hitachi		
8	Capetronic Kaohsiung	(OEM order)	Monochrome, color: middle, high resolution
9	Wyse		Monochrome, color
10	Teco	TM 1575, IBM-90 TM 1416, 1460	Monochrome Color
11	Chuntex Electronics Corp.	MD-7F	Color: middle resolution

*Manufacturers with more than 1 percent of the total monitor shipment value in Taiwan

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 16

Major Monitor Manufacturers' Partnerships/Alliances--Taiwan

<u>Manufacturer</u>	<u>OEM Partner</u>
Tatung	Zenith, IBM, Raleigh
Philips	Unisys, Commodore, Sperry,
Zenith	Compaq, Data General, Telex, IBM, Unisys, Apricot, Research
Sampo	Amdek, Sysdyne, ISC, Texas Instruments, Siemens, Xerox, NCR, Taxan
Orion	Amstrad
Pan Overseas/Advanced Datum	Victor, Memorex, Tandon, Prime, QSI, ADI, Quimax, Lee Data
Hitachi	Apple, Amdek, HSC
Capetronic Kaohsiung	Compaq, Lynk, Burroughs, Memorex, Unisys, DDCC, AT&T, Wyse, Amdek, Convergent
Wyse	Amdek, NCR
Teco	LDC
Chuntex Electronics Corp.	CEM Corp., Xerox

Source: Dataquest
September 1988

Electronic Products--Taiwan

TERMINALS

Shipment Summary

Tables 17 through 19 present an overview of the Taiwanese terminal industry and market.

The total number of Taiwanese terminal units shipped in 1987 is estimated at 1.7 million, 28 percent growth over 1986. The total shipment value was \$406.5 million, coincidentally also 28 percent growth over 1986. Taiwan's terminal industry is forecast to maintain an 11 percent shipment value CAGR from 1987 to 1991.

EBCDIC Terminals

In 1987, EBCDIC terminals contributed 5 percent in units and 10 percent in shipment value to total terminals. These figures are forecast to grow at a higher rate than total terminal industry shipments.

ASCII Terminals

ASCII terminals are the mainstay of Taiwan's terminal industry. Their unit shipments in 1987 were 1.6 million, or 28 percent growth over 1986, and their shipment value was \$367.2 million, 26 percent growth over 1986.

Export Trends

Almost 98 percent of Taiwan's total terminal shipments are for export. Taiwanese export trends parallel its shipment trends.

Domestic Market

Total Industry

The Taiwanese domestic terminal market is still very small. In 1987, the total of units sold was 159,000, or 24 percent growth over 1986; the market value was \$11 million, 22 percent growth over 1986. The terminal industry domestic market is the smallest among the five Taiwanese computer-related industries.

EBCDIC Terminals

The EBCDIC terminal domestic market represented approximately 43 percent of both the total market value and units sold. It will have a 17 percent CAGR in value from 1987 to 1991.

Electronic Products--Taiwan

ASCII Terminals

In 1987, the ASCII terminal market value was \$6.3 million, or 24 percent growth over 1986; the number of units sold was 9,100, 25 percent growth over 1986. The forecast CAGR is about the same as for EBCDIC terminals.

Import Trends

Most domestically used terminals are imported (see Table 20).

Distribution Channels

The four distribution channels used by Taiwan's terminal industry are introduced in Table 21.

OEM Exports

OEM exports constituted 22 percent of Taiwan's distribution channels in 1987. These exports are the second biggest terminal industry distribution channel.

Foreign Brand Exports

Taiwan's most important distribution channel, foreign brand exports, accounted for 71 percent of the total Taiwanese terminal distribution in 1987.

Manufacturer's Brand Exports

The export of manufacturers' own brands will continue its growth trend during the 1988 to 1991 period. This channel's export share was 7 percent in 1987.

Domestic Shipments

Domestic shipments of terminals are so inconsequential that they are not discussed here.

Major Manufacturers

Taiwan's 11 major terminal manufacturers account for 93 percent of the total terminal shipment value (see Tables 22 and 23). Also of note:

- Five are local manufacturers; the remaining six are offshore.
- Most Taiwanese manufacturers produce ASCII terminals.

Electronic Products--Taiwan

Table 17a

Taiwanese Terminal Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	753.3	895.0	1,321.0	1,689.0
Growth Rate	-	19%	48%	28%
Value (\$M)	\$207.4	\$225.5	\$318.8	\$406.5
Growth Rate	-	9%	41%	28%
Unit Price (\$)	\$ 275	\$ 252	\$ 241	\$ 241
Growth Rate	-	(8%)	(4%)	0
Exports				
Units (K)	752.0	893.0	1,318.0	1,687.0
Growth Rate	-	19%	48%	28%
Value (\$M)	\$207.0	\$225.0	\$318.0	\$406.0
Growth Rate	-	9%	41%	28%
Unit Price (\$)	\$ 275	\$ 252	\$ 241	\$ 241
Growth Rate	-	(8%)	(4%)	0
Domestic Market				
Units (K)	9.0	10.0	12.8	15.9
Growth Rate	-	11%	28%	24%
Value (\$M)	\$ 6.0	\$ 6.5	\$ 9.0	\$ 11.0
Growth Rate	-	8%	38%	22%
Unit Price (\$)	\$ 667	\$ 650	\$ 703	\$ 692
Growth Rate	-	(8%)	8%	(2%)
Imports				
Units (K)	7.7	8.0	9.8	13.9
Growth Rate	-	4%	23%	42%
Value (\$M)	\$ 5.6	\$ 6.0	\$ 8.2	\$ 10.5
Growth Rate	-	7%	37%	28%
Unit Price (\$)	\$ 727	\$ 750	\$ 837	\$ 755
Growth Rate	-	3%	12%	(10%)
Domestic Shipments				
Units (K)	1.3	2.0	3.0	2.0
Growth Rate	-	54%	50%	(33%)
Value (\$M)	\$ 0.4	\$ 0.5	\$ 0.8	\$ 0.5
Growth Rate	-	25%	60%	(38%)
Unit Price (\$)	\$ 308	\$ 250	\$ 267	\$ 250
Growth Rate	-	(19%)	7%	(6%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 17b

Taiwanese Terminal Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	2,027.0	2,310.0	2,587.0	2,820.0	14%
Growth Rate	20%	14%	12%	9%	
Value (\$M)	\$471.7	\$518.7	\$570.7	\$615.9	11%
Growth Rate	16%	10%	10%	8%	
Unit Price (\$)	\$ 233	\$ 225	\$ 221	\$ 218	(2%)
Growth Rate	(3%)	(4%)	(2%)	(1%)	
Exports					
Units (K)	2,024.0	2,307.0	2,584.0	2,816.0	14%
Growth Rate	20%	14%	12%	9%	
Value (\$M)	\$471.0	\$518.0	\$570.0	\$615.0	11%
Growth Rate	16%	10%	10%	8%	
Unit Price (\$)	\$ 233	\$ 225	\$ 221	\$ 218	2%
Growth Rate	(3%)	(4%)	(2%)	(1%)	
Domestic Market					
Units (K)	18.3	21.9	25.7	29.5	17%
Growth Rate	15%	20%	17%	15%	
Value (\$M)	\$ 13.0	\$ 16.0	\$ 19.0	\$ 21.0	18%
Growth Rate	18%	23%	19%	11%	
Unit Price (\$)	\$ 710	\$ 731	\$ 739	\$ 712	1%
Growth Rate	3%	3%	1%	(4%)	
Imports					
Units (K)	15.3	18.9	22.7	25.5	16%
Growth Rate	10%	24%	20%	12%	
Value (\$M)	\$ 12.3	\$ 15.3	\$ 18.3	\$ 20.1	18%
Growth Rate	17%	24%	20%	10%	
Unit Price (\$)	\$ 804	\$ 810	\$ 806	\$ 788	1%
Growth Rate	6%	1%	0	(2%)	
Domestic Shipments					
Units (K)	3.0	3.0	3.0	4.0	19%
Growth Rate	50%	0	0	33%	
Value (\$M)	\$ 0.7	\$ 0.7	\$ 0.7	\$ 0.9	16%
Growth Rate	40%	0	0	29%	
Unit Price (\$)	\$ 233	\$ 233	\$ 233	\$ 225	(3%)
Growth Rate	(7%)	0	0	(4%)	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 18a

Taiwanese EBCDIC Terminal Industry History
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	23.7	36.5	67.5	85.0
Growth Rate	-	54%	85%	26%
Value (\$M)	\$10.2	\$15.2	\$28.4	\$39.3
Growth Rate	-	49%	87%	38%
Unit Price (\$)	\$ 430	\$ 416	\$ 421	\$ 462
Growth Rate	-	(3%)	1%	10%
Exports				
Units (K)	23.0	36.0	66.0	84.0
Growth Rate	-	57%	83%	27%
Value (\$M)	\$10.0	\$15.0	\$28.0	\$39.0
Growth Rate	-	50%	87%	39%
Unit Price (\$)	\$ 435	\$ 417	\$ 424	\$ 464
Growth Rate	-	(4%)	2%	9%
Domestic Market				
Units (K)	3.9	4.3	5.5	6.8
Growth Rate	-	10%	28%	24%
Value (\$M)	\$ 2.6	\$ 2.8	\$ 3.9	\$ 4.7
Growth Rate	-	8%	39%	21%
Unit Price (\$)	\$ 667	\$ 651	\$ 709	\$ 691
Growth Rate	-	(8%)	9%	(3%)
Imports				
Units (K)	3.2	3.8	4.0	5.8
Growth Rate	-	19%	5%	45%
Value (\$M)	\$ 2.4	\$ 2.6	\$ 3.5	\$ 4.4
Growth Rate	-	8%	35%	26%
Unit Price (\$)	\$ 750	\$ 684	\$ 875	\$ 759
Growth Rate	-	(9%)	28%	(13%)
Domestic Shipments				
Units (K)	0.7	0.5	1.5	1.0
Growth Rate	-	(29%)	200%	(33%)
Value (\$M)	\$ 0.2	\$ 0.2	\$ 0.4	\$ 0.3
Growth Rate	-	0	100%	(25%)
Unit Price (\$)	\$ 286	\$ 400	\$ 267	\$ 300
Growth Rate	-	40%	(33%)	12%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 18b

Taiwanese EBCDIC Terminal Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	122.5	162.5	199.5	255.0	32%
Growth Rate	44%	33%	23%	28%	
Value (\$M)	\$41.4	\$50.4	\$61.4	\$77.5	19%
Growth Rate	5%	22%	22%	26%	
Unit Price (\$)	\$ 338	\$ 310	\$ 308	\$ 304	(10%)
Growth Rate	(27%)	(8%)	(1%)	(1%)	
Exports					
Units (K)	121.0	161.0	198.0	253.0	32%
Growth Rate	44%	33%	23%	28%	
Value (\$M)	\$41.0	\$50.0	\$61.0	\$77.0	19%
Growth Rate	5%	22%	22%	26%	
Unit Price (\$)	\$ 339	\$ 311	\$ 308	\$ 304	(10%)
Growth Rate	(27%)	(8%)	(1%)	(1%)	
Domestic Market					
Units (K)	7.9	9.4	11.1	12.7	17%
Growth Rate	16%	19%	18%	14%	
Value (\$M)	\$ 5.6	\$ 6.9	\$ 8.2	\$ 9.1	18%
Growth Rate	19%	23%	19%	11%	
Unit Price (\$)	\$ 709	\$ 734	\$ 739	\$ 717	1%
Growth Rate	3%	4%	1%	(3%)	
Imports					
Units (K)	6.4	7.9	9.6	10.7	17%
Growth Rate	10%	23%	22%	11%	
Value (\$M)	\$ 5.2	\$ 6.5	\$ 7.8	\$ 8.6	18%
Growth Rate	18%	25%	20%	10%	
Unit Price (\$)	\$ 813	\$ 823	\$ 813	\$ 804	1%
Growth Rate	7%	1%	(1%)	(1%)	
Domestic Shipments					
Units (K)	1.5	1.5	1.5	2.0	19%
Growth Rate	50%	0	0	33%	
Value (\$M)	\$ 0.4	\$ 0.4	\$ 0.4	\$ 0.5	14%
Growth Rate	33%	0	0	25%	
Unit Price (\$)	\$ 267	\$ 267	\$ 267	\$ 250	(4%)
Growth Rate	(11%)	0	0	(6%)	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 19a

Taiwanese ASCII Terminal Industry History
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	729.6	858.5	1,253.5	1,604.0
Growth Rate	-	18%	46%	28%
Value (\$M)	\$197.2	\$210.3	\$290.4	\$367.2
Growth Rate	-	7%	38%	26%
Unit Price (\$)	\$ 270	\$ 245	\$ 232	\$ 229
Growth Rate	-	(9%)	(5%)	(1%)
Exports				
Units (K)	729.0	857.0	1,252.0	1,603.0
Growth Rate	-	18%	46%	28%
Value (\$M)	\$197.0	\$210.0	\$290.0	\$367.0
Growth Rate	-	7%	38%	27%
Unit Price (\$)	\$ 270	\$ 245	\$ 232	\$ 229
Growth Rate	-	(9%)	(5%)	(1%)
Domestic Market				
Units (K)	5.1	5.7	7.3	9.1
Growth Rate	-	12%	28%	25%
Value (\$M)	\$ 3.4	\$ 3.7	\$ 5.1	\$ 6.3
Growth Rate	-	9%	38%	24%
Unit Price (\$)	\$ 667	\$ 649	\$ 699	\$ 692
Growth Rate	-	(8%)	8%	(1%)
Imports				
Units (K)	4.5	4.2	5.8	8.1
Growth Rate	-	(7%)	38%	40%
Value (\$M)	\$ 3.2	\$ 3.4	\$ 4.7	\$ 6.1
Growth Rate	-	6%	38%	30%
Unit Price (\$)	\$ 711	\$ 810	\$ 810	\$ 753
Growth Rate	-	14%	0	(7%)
Domestic Shipments				
Units (K)	0.6	1.5	1.5	1.0
Growth Rate	-	150%	0	(33%)
Value (\$M)	\$ 0.2	\$ 0.3	\$ 0.4	\$ 0.2
Growth Rate	-	50%	33%	(50%)
Unit Price (\$)	\$ 333	\$ 200	\$ 267	\$ 200
Growth Rate	-	(40%)	33%	(25%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 19b

Taiwanese ASCII Terminal Industry Forecast
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	1,904.5	2,147.5	2,378.5	2,565.0	12%
Growth Rate	19%	13%	11%	8%	
Value (\$M)	\$430.3	\$468.3	\$509.3	\$538.4	10%
Growth Rate	17%	9%	9%	6%	
Unit Price (\$)	\$ 226	\$ 218	\$ 214	\$ 210	(2%)
Growth Rate	(1%)	(3%)	(2%)	(2%)	
Exports					
Units (K)	1,903.0	2,146.0	2,377.0	2,563.0	12%
Growth Rate	19%	13%	11%	8%	
Value (\$M)	\$430.0	\$468.0	\$509.0	\$538.0	10%
Growth Rate	17%	9%	9%	6%	
Unit Price (\$)	\$ 226	\$ 218	\$ 214	\$ 210	(2%)
Growth Rate	(1%)	(3%)	(2%)	(2%)	
Domestic Market					
Units (K)	10.4	12.5	14.6	16.8	17%
Growth Rate	14%	20%	17%	15%	
Value (\$M)	\$ 7.4	\$ 9.1	\$ 10.8	\$ 11.9	17%
Growth Rate	17%	23%	19%	10%	
Unit Price (\$)	\$ 712	\$ 728	\$ 740	\$ 708	1%
Growth Rate	3%	2%	2%	(4%)	
Imports					
Units (K)	8.9	11.0	13.1	14.8	16%
Growth Rate	10%	24%	19%	13%	
Value (\$M)	\$ 7.1	\$ 8.8	\$ 10.5	\$ 11.5	17%
Growth Rate	16%	24%	19%	10%	
Unit Price (\$)	\$ 798	\$ 800	\$ 802	\$ 777	1%
Growth Rate	6%	0	0	(3%)	
Domestic Shipments					
Units (K)	1.5	1.5	1.5	2.0	19%
Growth Rate	50%	0	0	33%	
Value (\$M)	\$ 0.3	\$ 0.3	\$ 0.3	\$ 0.4	19%
Growth Rate	50%	0	0	33%	
Unit Price (\$)	\$ 200	\$ 200	\$ 200	\$ 200	0
Growth Rate	0	0	0	0	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 20

Taiwanese Terminal Import Market

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Import Unit Share	86%	87%	86%
Import Value Share	93%	95%	96%

Source: Dataquest
September 1988

Electronic Products--Taiwan

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Electronic Products--Taiwan

Table 21a

Taiwanese Terminal Distribution Channel History
(Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$207.4	\$225.5	\$318.8	\$406.5
OEM Export Value (Percentage of Total Shipments)	\$ 83 40%	\$ 79 35%	\$ 77 24%	\$ 89 22%
Foreign Brand Export Value (Percentage of Total Shipments)	\$ 122 59%	\$ 142 63%	\$ 220 69%	\$ 289 71%
Native Brand Export Value (Percentage of Total Shipments)	\$ 2 1%	\$ 5 2%	\$ 22 7%	\$ 28 7%
Domestic Shipment Value (Percentage of Total Shipments)	\$ 0.4 0	\$ 0.5 0	\$ 0.8 0	\$ 0.5 0

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 21b

Taiwanese Terminal Distribution Channel Forecast (Millions of U.S. Dollars)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$471.7	\$518.7	\$570.7	\$615.9
OEM Export Value (Percentage of Total Shipments)	\$ 94 20%	\$ 99 19%	\$ 103 18%	\$ 105 17%
Foreign Brand Export Value (Percentage of Total Shipments)	\$ 340 72%	\$ 373 72%	\$ 411 72%	\$ 450 73%
Native Brand Export Value (Percentage of Total Shipments)	\$ 38 8%	\$ 47 9%	\$ 57 10%	\$ 62 10%
Domestic Shipment Value (Percentage of Total Shipments)	\$ 0.7 0	\$ 0.7 0	\$ 0.7 0	\$ 0.9 0

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 22

Major Taiwanese Terminal Manufacturers*

<u>1987 Ranking</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Specifications</u>
1	Digital Equipment Taiwan Ltd.	VT-220, PANDA MPF-900	ASCII, monochrome, color
2	Wang Laboratories Taiwan Ltd.	PM-004	ASCII, monochrome
3	Wyse	VY-50, 70	ASCII, monochrome
4	Ampex	ORION series Dialogue 80	ASCII, monochrome
5	CAL-Comp & Compal	OVT series, T9 series	ASCII, 3270, monochrome
6	Advanced Datum	OPUS II, DT3178	ASCII, 3270, monochrome
7	Capetronic Kaohsiung	(OEM order)	ASCII, monochrome
8	Teco	TM 1575, TM 1416	ASCII, monochrome, color
9	Kuo Feng Corporation	(OEM order)	ASCII, monochrome, color
10	Tatung	7261, 7263, 7225 7235	ASCII, monochrome
11	Zenith	DPT6, 12, 14 DP21, 22, 30 14 RST1	ASCII workstation

*Manufacturers with more than 1 percent of the total PC shipment value in Taiwan

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 23

Major Terminal Manufacturers' Partnerships/Alliances--Taiwan

<u>Manufacturer</u>	<u>OEM Partner</u>
Digital Equipment	TTL
Ampex	-
CalComp & Compal	Qume, ITT, Everex, Evervision, SFENA
Capetronic Kaohsiung	Falco, Unisys, AT&T, Prime
Teco	Visual, Honeywell, Beehive, MOS TAC, BHI, Lamia, IBM, REI
Kuo Feng Corp.	Adds, NCR, CCI, TTX, NCR, C&W
Tatung	C.S.S., SBL, CMC

Source: Dataquest
September 1988

Electronic Products--Taiwan

DISK DRIVES

Shipment Summary

Tables 24 through 26 present an overview of Taiwan's disk drive industry and market.

Taiwanese 1987 disk drive unit shipments totaled 0.2 million, 42 percent growth over 1986. Their value was \$138 million, or 75 percent growth over 1986. Disk drive shipments and their value are forecast to have CAGRs of 27 percent and 39 percent, respectively.

Floppy Disk Drive Industry

The floppy disk drive industry accounted for 85 percent of the total units shipped and 64 percent of the total shipment value in 1987. By 1991, hard disks are forecast to replace floppies to a large extent.

Hard Disk Drive Industry

Taiwanese hard disk drive unit shipments in 1987 totaled 174,000, or 544 percent growth over 1986; shipment value was \$49 million, a 44.4 percent growth over 1986. For 1988, we forecast that the hard disk drive industry will continue its remarkable growth rate. By 1991, hard disk drives will replace the floppy disks drive's position as the mainstay of the industry.

Export Trends

Table 27 shows the share of disk drive exports to total shipments in each product segment.

Domestic Market

In 1987, disk drives had domestic consumption of 1.1 million units, valued at \$152 million, 82 percent and 95 percent growth over 1986, respectively. Most of the disk drive shipments are for PCs manufactured for export. Domestic consumption, however, also includes imported disk drives for PC shipments, so it is sometimes greater than the total of the disk drives shipped.

Floppy Disk Drives

In 1987, floppy disk drives constituted 77 percent of the total domestic disk drive consumption in units and 53 percent in value. The CAGR for floppy disks will be 20 percent from 1987 through 1991.

Electronic Products—Taiwan

Hard Disk Drives

Domestic hard disk drive consumption will have a 71 percent CAGR measured in units, and 76 percent measured in value, from 1987 to 1991, a very strong increase in domestic consumption.

Import Trends

Imports, a very important aspect of the Taiwanese disk drive industry, are mainly for end users and for subsystems of PCs to be shipped. Taiwan's 1987 disk drive imports were valued at \$163 million, 99 percent growth over 1986; import quantity was 1.8 million, 82 percent growth over 1986. In 1988, the import growth rate is forecast to continue the high growth level, but this should fall slightly from 1989 through 1991. The 1987 through 1991 CAGR measured in value is forecast at 55 percent.

Floppy Disk Drives

Floppy disk drives comprised 83 percent of the total disk drive import quantity and 56 percent of the import value. Their CAGR is forecast at 25 percent in value and 21 percent in units for the 1988 through 1991 time frame.

Hard Disk Drives

Hard disk drive imports increased dramatically in 1987, having a 200 percent unit growth rate and an 84 percent value growth rate. The high growth rate will continue during 1988. As Taiwan's domestic markets open up further, the disk drive imports will flourish even more. We forecast that the CAGR for shipment value will be 78 percent from 1988 through 1991.

Distribution Channels

Taiwan's four disk drive industry distribution channels are introduced in Table 28.

OEM Exports

OEM exports constituted 26 percent of Taiwan's total disk drive distribution channels in 1987, making it the second biggest channel in the disk drive industry.

Foreign Brand Exports

The main distribution channel for Taiwan's disk drive industry is foreign brand exports. It comprised 49 percent of total distribution in 1987, because foreign brand manufacturers reduced production that year.

Electronic Products--Taiwan

Native Brand Exports

As domestic Taiwanese manufacturers join to produce disk drives, OEM exports will increase in the short run, but native brand exports will increase in the long run.

Domestic Shipments

Domestic shipments are discussed above.

Major Manufacturers

Taiwan's seven major disk drive manufacturers account for about 76 percent of the total disk drive shipment value. (See Tables 29 and 30). Also of note:

- Two manufacturers are offshore; the others are domestic.
- Except for Atari and Commodore, manufacturers produce IBM series disk drives.
- The most popular disk drive sizes in Taiwan are 5 1/4-inch and 3 1/2-inch for both floppy and hard disk drives.

Electronic Products--Taiwan

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Electronic Products—Taiwan

Table 24a

Taiwanese Disk Drive Industry History
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	979	610	821	1,168
Growth Rate	-	(38%)	35%	42%
Value (\$M)	\$ 91	\$ 51	\$ 79	\$138
Growth Rate	-	(44%)	55%	75%
Unit Price (\$)	\$ 93	\$ 84	\$ 96	\$118
Growth Rate	-	(10%)	15%	23%
Exports				
Units (K)	901	549	715	960
Growth Rate	-	(39%)	30%	34%
Value (\$M)	\$ 86	\$ 46	\$ 71	\$119
Growth Rate	-	(47%)	54%	68%
Unit Price (\$)	\$ 95	\$ 84	\$ 99	\$124
Growth Rate	-	(12%)	19%	25%
Domestic Market				
Units (K)	322	483	611	1,115
Growth Rate	-	50%	27%	82%
Value (\$M)	\$ 43	\$ 56	\$ 78	\$152
Growth Rate	-	30%	39%	95%
Unit Price (\$)	\$134	\$116	\$128	\$136
Growth Rate	-	(8%)	10%	7%
Imports				
Units (K)	410	543	648	1,177
Growth Rate	-	32%	19%	82%
Value (\$M)	\$ 50	\$ 60	\$ 82	\$163
Growth Rate	-	20%	37%	99%
Unit Price (\$)	\$122	\$110	\$127	\$138
Growth Rate	-	9%	15%	9%
Domestic Shipments				
Units (K)	78	61	106	208
Growth Rate	-	(22%)	74%	96%
Value (\$M)	\$ 5	\$ 5	\$ 8	\$ 19
Growth Rate	-	0	60%	138%
Unit Price (\$)	\$ 64	\$ 82	\$ 75	\$ 91
Growth Rate	-	28%	8%	21%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 24b

Taiwanese Disk Drive Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	1,719	2,215	2,676	3,046	27%
Growth Rate	47%	29%	21%	14%	
Value (\$M)	\$249	\$345	\$434	\$511	39%
Growth Rate	80%	39%	26%	18%	
Unit Price (\$)	\$145	\$156	\$162	\$168	9%
Growth Rate	23%	8%	4%	3%	
Exports					
Units (K)	1,410	1,790	2,194	2,506	27%
Growth Rate	47%	27%	23%	14%	
Value (\$M)	\$211	\$279	\$355	\$415	37%
Growth Rate	77%	32%	27%	17%	
Unit Price (\$)	\$150	\$156	\$162	\$166	8%
Growth Rate	21%	4%	4%	2%	
Domestic Market					
Units (K)	1,939	2,465	3,128	3,845	36%
Growth Rate	74%	27%	27%	23%	
Value (\$M)	\$374	\$573	\$676	\$845	54%
Growth Rate	146%	53%	18%	25%	
Unit Price (\$)	\$193	\$232	\$216	\$220	13%
Growth Rate	41%	21%	(7%)	2%	
Imports					
Units (K)	2,121	2,707	3,549	4,413	39%
Growth Rate	80%	28%	31%	24%	
Value (\$M)	\$412	\$637	\$767	\$936	55%
Growth Rate	153%	55%	20%	22%	
Unit Price (\$)	\$194	\$235	\$216	\$212	11%
Growth Rate	40%	21%	(8%)	(2%)	
Domestic Shipments					
Units (K)	309	425	482	540	27%
Growth Rate	49%	38%	13%	12%	
Value (\$M)	\$ 38	\$ 66	\$ 79	\$ 96	50%
Growth Rate	100%	74%	20%	22%	
Unit Price (\$)	\$123	\$155	\$164	\$178	18%
Growth Rate	35%	26%	6%	8%	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 25a

Taiwanese Floppy Disk Drive Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	1984	1985	1986	1987
Total Shipments				
Units (K)	979	599	794	994
Growth Rate	-	(39%)	33%	25%
Value (\$M)	\$ 91	\$48	\$70	\$89
Growth Rate	-	(47%)	46%	27%
Unit Price (\$)	\$ 93	\$80	\$88	\$90
Growth Rate	-	(14%)	10%	2%
Exports				
Units (K)	901	539	689	790
Growth Rate	-	(40%)	28%	15%
Value (\$M)	\$ 86	\$44	\$63	\$71
Growth Rate	-	(49%)	43%	13%
Unit Price (\$)	\$ 95	\$82	\$91	\$90
Growth Rate	-	(14%)	12%	(2%)
Domestic Market				
Units (K)	238	401	526	879
Growth Rate	-	68%	31%	67%
Value (\$M)	\$ 22	\$33	\$49	\$81
Growth Rate	-	50%	48%	65%
Unit Price (\$)	\$ 92	\$82	\$93	\$92
Growth Rate	-	(11%)	13%	(1%)
Imports				
Units (K)	364	476	581	976
Growth Rate	-	31%	22%	68%
Value (\$M)	\$ 37	\$42	\$57	\$92
Growth Rate	-	14%	36%	61%
Unit Price (\$)	\$102	\$88	\$98	\$94
Growth Rate	-	(13%)	11%	(4%)
Domestic Shipments				
Units (K)	78	60	105	204
Growth Rate	-	(23%)	75%	94%
Value (\$M)	\$ 5	\$ 4	\$ 7	\$18
Growth Rate	-	(20%)	75%	157%
Unit Price (\$)	\$ 64	\$67	\$67	\$88
Growth Rate	-	4%	0	32%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 25b

Taiwanese Floppy Disk Drive Industry Forecast
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	1988	1989	1990	1991	CAGR 1987-1991
Total Shipments					
Units (K)	1,170	1,337	1,498	1,620	13%
Growth Rate	18%	14%	12%	8%	
Value (\$M)	\$100	\$114	\$126	\$139	12%
Growth Rate	12%	14%	11%	10%	
Unit Price (\$)	\$ 85	\$ 85	\$ 84	\$ 86	(1%)
Growth Rate	(5%)	0	(1%)	2%	
Exports					
Units (K)	943	1,087	1,251	1,394	15%
Growth Rate	19%	15%	15%	11%	
Value (\$M)	\$ 84	\$ 94	\$109	\$125	15%
Growth Rate	18%	12%	16%	15%	
Unit Price (\$)	\$ 89	\$ 86	\$ 87	\$ 90	0
Growth Rate	1%	(3%)	1%	3%	
Domestic Market					
Units (K)	1,241	1,257	1,501	1,807	20%
Growth Rate	41%	1%	19%	20%	
Value (\$M)	\$108	\$108	\$131	\$163	19%
Growth Rate	33%	0	21%	24%	
Unit Price (\$)	\$ 87	\$ 86	\$ 87	\$ 90	(1%)
Growth Rate	(6%)	1%	2%	3%	
Imports					
Units (K)	1,338	1,552	1,833	2,087	21%
Growth Rate	37%	16%	18%	14%	
Value (\$M)	\$133	\$158	\$193	\$226	25%
Growth Rate	45%	19%	22%	17%	
Unit Price (\$)	\$ 99	\$102	\$105	\$108	4%
Growth Rate	5%	2%	3%	3%	
Domestic Shipments					
Units (K)	227	250	247	226	3%
Growth Rate	11%	10%	(1%)	(9%)	
Value (\$M)	\$ 16	\$ 20	\$ 17	\$ 14	(6%)
Growth Rate	(11%)	25%	(15%)	(18%)	
Unit Price (\$)	\$ 70	\$ 80	\$ 69	\$ 62	(8%)
Growth Rate	(20%)	14%	(14%)	(10%)	

Source: Dataquest
September 1988

Electronic Products—Taiwan

Table 26a

Taiwanese Hard Disk Drive Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	-	11	27	174
Growth Rate	-	-	145%	544%
Value (\$M)	-	\$ 3	\$ 9	\$ 49
Growth Rate	-	-	200%	444%
Unit Price (\$)	-	\$ 273	\$ 333	\$282
Growth Rate	-	-	22%	(16%)
Exports				
Units (K)	-	10	26	170
Growth Rate	-	-	160%	554%
Value (\$M)	-	\$ 2	\$ 8	\$ 48
Growth Rate	-	-	300%	500%
Unit Price (\$)	-	\$ 200	\$ 308	\$282
Growth Rate	-	-	54%	(8%)
Domestic Market				
Units (K)	84	82	85	236
Growth Rate	-	(2%)	4%	178%
Value (\$M)	\$ 21	\$ 23	\$ 29	\$ 71
Growth Rate	-	10%	26%	145%
Unit Price (\$)	\$250	\$ 280	\$ 341	\$301
Growth Rate	-	12%	22%	12%
Imports				
Units (K)	46	67	67	201
Growth Rate	-	46%	0	200%
Value (\$M)	\$ 13	\$ 18	\$ 25	\$ 71
Growth Rate	-	38%	39%	184%
Unit Price (\$)	\$280	\$ 269	\$ 373	\$353
Growth Rate	-	(4%)	39%	(5%)
Domestic Shipments				
Units (K)	-	1	1	4
Growth Rate	-	-	0	300%
Value (\$M)	-	\$ 1	\$ 1	\$ 1
Growth Rate	-	-	0	0
Unit Price (\$)	-	\$1,000	\$1,000	\$250
Growth Rate	-	-	0	(75%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 26b

Taiwanese Hard Disk Drive Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	1988	1989	1990	1991	CAGR 1987-1991
Total Shipments					
Units (K)	549	878	1,178	1,426	69%
Growth Rate	216%	60%	34%	21%	
Value (\$M)	\$149	\$231	\$308	\$372	66%
Growth Rate	204%	55%	33%	21%	
Unit Price (\$)	\$271	\$263	\$261	\$261	(2%)
Growth Rate	(4%)	(3%)	(1%)	0	
Exports					
Units (K)	467	703	943	1,112	60%
Growth Rate	175%	51%	34%	18%	
Value (\$M)	\$127	\$185	\$246	\$290	58%
Growth Rate	165%	46%	33%	18%	
Unit Price (\$)	\$272	\$263	\$261	\$261	(2%)
Growth Rate	(4%)	(3%)	1%	0	
Domestic Market					
Units (K)	608	1,208	1,627	2,038	71%
Growth Rate	196%	73%	35%	25%	
Value (\$M)	\$266	\$465	\$545	\$682	76%
Growth Rate	276%	75%	17%	25%	
Unit Price (\$)	\$381	\$385	\$335	\$335	3%
Growth Rate	27%	1%	(13%)	0	
Imports					
Units (K)	847	1,156	1,716	2,326	84%
Growth Rate	321%	36%	49%	36%	
Value (\$M)	\$279	\$479	\$574	\$710	78%
Growth Rate	203%	72%	20%	24%	
Unit Price (\$)	\$329	\$415	\$334	\$305	(4%)
Growth Rate	(7%)	26%	(19%)	9%	
Domestic Shipments					
Units (K)	82	175	235	314	198%
Growth Rate	1,950%	113%	34%	34%	
Value (\$M)	\$ 22	\$ 46	\$ 62	\$ 82	201%
Growth Rate	2,100%	109%	35%	32%	
Unit Price (\$)	\$268	\$263	\$264	\$261	1%
Growth Rate	7%	(2%)	0	(1%)	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 27

Percentage of Taiwanese Disk Drives Exported

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Floppy Disks			
Export Unit Share	92%	79%	86%
Export Value Share	95%	80%	90%
Hard Disks			
Export Unit Share	*	98%	78%
Export Value Share	*	98%	78%
Total			
Export Unit Share	92%	82%	82%
Export Value Share	95%	86%	81%

*Taiwan began to manufacture hard disks in 1985.

Source: Dataquest
September 1988

Electronic Products--Taiwan

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Electronic Products--Taiwan

Table 28a

Taiwanese Disk Drive Distribution Channel History
(Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$979	\$610	\$821	\$1,168
OEM Export Value	\$235	\$159	\$ 57	\$ 304
(Percentage of Total Shipments)	24%	26%	7.0%	26.0%
Foreign Brand Export Value	\$627	\$360	\$657	\$ 572
(Percentage of Total Shipments)	64%	59.0%	80.0%	49.0%
Native Brand Export Value	\$ 39	\$ 31	0	\$ 82
(Percentage of Total Shipments)	4%	5.0%	0	7.0%
Domestic Shipment Value	\$ 78	\$ 61	\$106	\$ 208
(Percentage of Total Shipments)	8%	10%	13%	18%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 28b

Taiwanese Disk Drive Distribution Channel Forecast (Millions of U.S. Dollars)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$1,719	\$2,215	\$2,676	\$3,046
OEM Export Value	\$ 499	\$ 642	\$ 803	\$ 914
(Percentage of Total Shipments)	29.0%	29.0%	30.0%	30.0%
Foreign Brand Export Value	\$ 774	\$ 930	\$1,097	\$1,188
(Percentage of Total Shipments)	45.0%	42.0%	41.0%	39.0%
Native Brand Export Value	\$ 138	\$ 222	\$ 294	\$ 396
(Percentage of Total Shipments)	8.0%	10.0%	11.0%	13.0%
Domestic Shipment Value	\$ 309	\$ 425	\$ 482	\$ 540
(Percentage of Total Shipments)	18%	19%	18%	18%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 29

Major Taiwanese Disk Drive Manufacturers*

<u>1987 Ranking</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Specifications</u>
1	Commodore	1541, 1571 MPF-900	Commodore series, 5 1/4-inch floppy
2	Atari	SF354, 314 SH204, 205	Floppy, 3 1/2-inch 5 1/4-inch Hard, 5 1/4-inch, 3 1/2-inch, 20M
3	Tatung	OWL-8000	IBM series, 5 1/4-inch hard, 10M, 20M, 30M
4	Oceanic Electronics Corp.	OB-1 OH-2 OC-118	IBM series, 360K, 5 1/4-inch Apple series, 360K, 5 1/4-inch Commodore series, 360K, 5 1/4-inch
5	Tecmate	NPH-502	IBM series, FDD, 5 1/4-inch, 360K
6	Ho Shin	HD-550	IBM series, 5 1/4-inch 360K
7	Multitech and Continental	HH1050 Miniscribe 3050	IBM series, 5 1/4-inch hard, floppy

*Manufacturers with more than 1 percent of the total PC shipment value in Taiwan

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 30

Major Disk Drive Manufacturers' Partnerships/Alliances--Taiwan

<u>Manufacturer</u>	<u>OEM Partner</u>
Commodore	Add, Westchester
Atari	ASADD
Tatung	Xebec
Oceanic Electronics Corp.	ICPC
Tecmate	NPH, Jupiter
Ho Hsin	H.S.
Multitech and Continental	Meco, Arabian, Special, TI, Systel, Frontace, Novitronic, Zema, Wyse, NBI, Mesco, Sharjah, Nicosia, WBI, Mecos, Enka Croser, ITT, Zelco

Source: Dataquest
September 1988

Electronic Products--Taiwan

PRINTERS

Tables 31 through 33 provide an overview of Taiwan's printer industry and market.

Shipment Summary

Total Printers

Taiwan's 1987 printer unit shipments are estimated at 79,000. This figure is expected to grow to 85,000 in 1988, an 8 percent growth rate.

The shipment value estimated at \$44 million, which is forecast to be \$45 million in 1988. The CAGR from 1987 through 1991 is forecast at 2 percent.

Dot Matrix Printers

Dot matrix printer unit shipments decreased 2 percent in 1987, down to 76,600 units. The shipment value, however, grew 17 percent in 1987, indicative of higher unit prices that year.

CAGRs of unit shipments and shipment values are predicted to be 7 percent and 2 percent, respectively, through 1991, a very slow growth rate. Dot matrix printers are the mainstay of Taiwan's printer industry.

Daisywheel Printers

Unit shipments of daisywheel printers decreased 73 percent in 1987, to 2,400 units. Shipment value also decreased 72 percent, to \$1.6 million.

Although 1987 was a bad year, we have an optimistic forecast for 1988 through 1991. CAGRs for unit shipments and their shipment value are forecast at 16 percent and 14 percent, respectively.

Export Trends

Table 34 shows the proportion of printers exported to total printers shipped by product segment. Because most Taiwanese-manufactured printers are exported, the export trend in the printer industry is almost the same as the shipment trend.

Domestic Market

In 1987, 41,000 printer units shipped at a domestic market value of \$25 million. We forecast that domestic markets will have a 38 percent unit growth rate and 28 percent value growth rate from 1987 through 1991.

Electronic Products—Taiwan

Dot Matrix Printers

About 85 percent of total printers sold on the domestic market in 1987 were dot matrix printers. Domestically, 34,900 units sold, representing \$20.9 million. CAGRs for dot matrix printers are forecast to be about the same as those of the total printer industry.

Daisywheel Printers

The domestic market for daisywheel printers is still very small.

Import Trends

Imports are the major source of printers on the domestic market (see Table 35).

Distribution Channels

Tables 36 shows the four distribution channels for printers manufactured in Taiwan.

OEM Exports

In 1987, OEM exports represented only 3.8 percent of Taiwan's total distribution channels, but this should increase to 8.3 percent by 1991.

Foreign Brand Exports

Taiwan's most important printer industry distribution channel is foreign brand exports. In 1987, it comprised about 91 percent of total exports, but it will slowly decrease in importance during the next four years.

Native Brand Exports

Almost no Taiwanese manufacturers produce printers bearing their own labels. Most domestic manufacturers are not yet mature enough to manufacture under their own brand names.

Major Manufacturers

The six major printer manufacturers in Taiwan produce 94.3 percent of the total shipment value. Only two are domestic manufacturers; the other four are offshore (see Tables 37 and 38).

Electronic Products--Taiwan

Table 31a

Taiwanese Printer Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	85.0	100.0	87.0	79.0
Growth Rate	-	18%	(13%)	9%
Value (\$M)	\$24.0	\$46.0	\$42.0	\$44.0
Growth Rate	-	92%	(9%)	5%
Unit Price (\$)	\$ 282	\$ 460	\$ 483	\$ 557
Growth Rate	-	63%	5%	15%
Exports				
Units (K)	83.0	98.0	84.0	77.0
Growth Rate	-	18%	(14%)	(8%)
Value (\$M)	\$23.0	\$45.0	\$41.0	\$43.0
Growth Rate	-	96%	(9%)	5%
Unit Price (\$)	\$ 277	\$ 459	\$ 488	\$ 558
Growth Rate	-	66%	6%	14%
Domestic Market				
Units (K)	20.0	24.0	31.0	41.0
Growth Rate	-	20%	29%	32%
Value (\$M)	\$12.0	\$14.0	\$18.0	\$25.0
Growth Rate	-	17%	29%	39%
Unit Price (\$)	\$ 600	\$ 583	\$ 581	\$ 610
Growth Rate	-	(8%)	0	5%
Imports				
Units (K)	18.0	22.0	28.0	39.0
Growth Rate	-	22%	27%	39%
Value (\$M)	\$11.0	\$13.0	\$17.0	\$24.0
Growth Rate	-	18%	31%	41%
Unit Price (\$)	\$ 611	\$ 591	\$ 607	\$ 615
Growth Rate	-	(3%)	3%	1%
Domestic Shipments				
Units (K)	2.0	2.0	3.0	2.0
Growth Rate	-	0	50%	(33%)
Value (\$M)	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0
Growth Rate	-	0	0	0
Unit Price (\$)	\$ 500	\$ 500	\$ 333	\$ 500
Growth Rate	-	0	(33%)	50%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 31b

Taiwanese Printer Industry Forecast
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	85.0	92.0	98.0	104.0	7%
Growth Rate	8%	8%	7%	6%	
Value (\$M)	\$45.0	\$46.0	\$47.0	\$48.0	2%
Growth Rate	2%	2%	2%	2%	
Unit Price (\$)	\$ 529	\$ 500	\$ 480	\$ 462	(6%)
Growth Rate	(5%)	(6%)	(4%)	(4%)	
Exports					
Units (K)	83.0	89.0	94.0	100.0	7%
Growth Rate	8%	7%	6%	6%	
Value (\$M)	\$44.0	\$44.0	\$45.0	\$46.0	2%
Growth Rate	2%	0	2%	2%	
Unit Price (\$)	\$ 530	\$ 494	\$ 479	\$ 460	(5%)
Growth Rate	(5%)	(7%)	(3%)	(4%)	
Domestic Market					
Units (K)	57.0	83.0	108.0	150.0	38%
Growth Rate	39%	46%	30%	39%	
Value (\$M)	\$34.0	\$45.0	\$53.0	\$68.0	28%
Growth Rate	36%	32%	18%	28%	
Unit Price (\$)	\$ 596	\$ 542	\$ 491	\$ 453	(7%)
Growth Rate	(2%)	9%	(9%)	(8%)	
Imports					
Units (K)	55.0	80.0	104.0	146.0	39%
Growth Rate	41%	45%	30%	40%	
Value (\$M)	\$33.0	\$43.0	\$51.0	\$66.0	29%
Growth Rate	38%	30%	19%	29%	
Unit Price (\$)	\$ 600	\$ 538	\$ 490	\$ 452	(7%)
Growth Rate	(2%)	(10%)	(9%)	(8%)	
Domestic Shipments					
Units (K)	2.0	3.0	4.0	4.0	19%
Growth Rate	0	50%	33%	0	
Value (\$M)	\$ 1.0	\$ 2.0	\$ 2.0	\$ 2.0	19%
Growth Rate	0	100%	0	0	
Unit Price (\$)	\$ 500	\$ 667	\$ 500	\$ 500	0
Growth Rate	0	33%	(25%)	0	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 32a

Taiwanese Dot Matrix Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	81.8	94.4	78.2	76.6
Growth Rate	-	15%	(17%)	(2%)
Value (\$M)	\$21.5	\$41.9	\$36.2	\$42.4
Growth Rate	-	95%	(14%)	17%
Unit Price (\$)	\$ 263	\$ 444	\$ 463	\$ 554
Growth Rate	-	69%	4%	20%
Exports				
Units (K)	83.0	93.0	77.0	75.3
Growth Rate	-	16%	(17%)	(2%)
Value (\$M)	\$20.7	\$41.4	\$36.0	\$41.9
Growth Rate	-	100%	(13%)	16%
Unit Price (\$)	\$ 259	\$ 445	\$ 468	\$ 556
Growth Rate	-	72%	5%	19%
Domestic Market				
Units (K)	17.0	20.4	26.3	34.9
Growth Rate	-	20%	29%	33%
Value (\$M)	\$ 9.7	\$11.4	\$14.6	\$20.9
Growth Rate	-	18%	28%	43%
Unit Price (\$)	\$ 571	\$ 559	\$ 555	\$ 599
Growth Rate	-	(8%)	(1%)	8%
Imports				
Units (K)	15.2	19.0	25.1	33.6
Growth Rate	-	25%	32%	34%
Value (\$M)	\$ 8.9	\$10.9	\$14.4	\$20.4
Growth Rate	-	22%	32%	42%
Unit Price (\$)	\$ 586	\$ 574	\$ 574	\$ 607
Growth Rate	-	(2%)	0	6%
Domestic Shipments				
Units (K)	1.8	1.4	1.2	1.3
Growth Rate	-	(22%)	(14%)	8%
Value (\$M)	\$ 0.8	\$ 0.5	\$ 0.2	\$ 0.5
Growth Rate	-	(38%)	(60%)	150%
Unit Price (\$)	\$ 444	\$ 357	\$ 167	\$ 385
Growth Rate	-	(20%)	(53%)	131%
Unit Price (\$)	\$ 500	\$ 500	\$ 333	\$ 500
Growth Rate	-	0	(33%)	50%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 32b

Taiwanese Dot Matrix Industry Forecast
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	81.4	88.1	93.9	99.7	7%
Growth Rate	6%	8%	7%	6%	
Value (\$M)	\$42.8	\$43.6	\$44.4	\$45.3	2%
Growth Rate	1%	2%	2%	2%	
Unit Price (\$)	\$ 526	\$ 495	\$ 473	\$ 454	(5%)
Growth Rate	(5%)	(6%)	(4%)	(4%)	
Exports					
Units (K)	80.5	86.3	91.1	97.0	7%
Growth Rate	7%	7%	6%	6%	
Value (\$M)	\$42.5	\$42.4	\$43.3	\$44.2	1%
Growth Rate	1%	0	2%	2%	
Unit Price (\$)	\$ 528	\$ 491	\$ 475	\$ 456	(5%)
Growth Rate	(5%)	(7%)	(3%)	(4%)	
Domestic Market					
Units (K)	48.5	70.5	91.8	127.5	38%
Growth Rate	39%	45%	30%	39%	
Value (\$M)	\$28.6	\$37.3	\$43.3	\$54.3	27%
Growth Rate	37%	30%	16%	25%	
Unit Price (\$)	\$ 590	\$ 529	\$ 472	\$ 426	(8%)
Growth Rate	(2%)	(10%)	(11%)	(10%)	
Imports					
Units (K)	47.6	68.7	89.0	124.8	39%
Growth Rate	42%	44%	30%	40%	
Value (\$M)	\$28.3	\$36.1	\$42.2	\$53.2	27%
Growth Rate	39%	28%	17%	26%	
Unit Price (\$)	\$ 595	\$ 525	\$ 474	\$ 426	(8%)
Growth Rate	(2%)	(12%)	(10%)	(10%)	
Domestic Shipments					
Units (K)	0.9	1.8	2.8	2.7	20%
Growth Rate	(31%)	100%	56%	(4%)	
Value (\$M)	\$ 0.3	\$ 1.2	\$ 1.1	\$ 1.1	22%
Growth Rate	(40%)	300%	(8%)	0	
Unit Price (\$)	\$ 333	\$ 667	\$ 393	\$ 407	1%
Growth Rate	(13%)	100%	(41%)	4%	
Unit Price (\$)	\$ 500	\$ 667	\$ 500	\$ 500	0
Growth Rate	0	33%	(25%)	0	

Source: Dataquest
September 1988

Electronic Products—Taiwan

Table 33a

Taiwanese Daisywheel Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	3.2	5.6	8.8	2.4
Growth Rate	-	75%	57%	(73%)
Value (\$M)	\$ 2.5	\$4.1	\$5.8	\$1.6
Growth Rate	-	64%	41%	(72%)
Unit Price (\$)	\$ 781	\$732	\$659	\$667
Growth Rate	-	(6%)	(10%)	1%
Exports				
Units (K)	3.0	5.0	7.0	1.7
Growth Rate	-	67%	40%	(76%)
Value (\$M)	\$ 2.3	\$3.6	\$5.0	\$1.1
Growth Rate	-	57%	39%	(78%)
Unit Price (\$)	\$ 767	\$720	\$714	\$647
Growth Rate	-	(6%)	(1%)	(9%)
Domestic Market				
Units (K)	3.0	3.6	4.7	6.1
Growth Rate	-	20%	31%	30%
Value (\$M)	\$ 2.3	\$2.6	\$3.4	\$4.1
Growth Rate	-	13%	31%	21%
Unit Price (\$)	\$ 767	\$722	\$723	\$672
Growth Rate	-	(8%)	0	(7%)
Imports				
Units (K)	2.8	3.0	2.9	5.4
Growth Rate	-	7%	(3%)	86%
Value (\$M)	\$ 2.1	\$2.1	\$2.6	\$3.6
Growth Rate	-	0	24%	38%
Unit Price (\$)	\$ 750	\$700	\$897	\$667
Growth Rate	-	(7%)	28%	(26%)
Domestic Shipments				
Units (K)	0.2	0.6	1.8	0.7
Growth Rate	-	200%	200%	(61%)
Value (\$M)	\$ 0.2	\$0.5	\$0.8	\$0.5
Growth Rate	-	150%	60%	(37%)
Unit Price (\$)	\$1,000	\$833	\$444	\$714
Growth Rate	-	(17%)	(47%)	61%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 33b

Taiwanese Daisywheel Industry Forecast
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
Total Shipments					
Units (K)	3.6	3.9	4.1	4.3	16%
Growth Rate	50%	8%	5%	5%	
Value (\$M)	\$2.2	\$2.4	\$2.6	\$ 2.7	14%
Growth Rate	38%	9%	8%	4%	
Unit Price (\$)	\$611	\$615	\$634	\$ 628	(1%)
Growth Rate	(8%)	1%	3%	(1%)	
Exports					
Units (K)	2.5	2.7	2.9	3.0	15%
Growth Rate	47%	8%	7%	3%	
Value (\$M)	\$1.5	\$1.6	\$1.7	\$ 1.8	13%
Growth Rate	36%	7%	6%	6%	
Unit Price (\$)	\$600	\$593	\$586	\$ 600	(2%)
Growth Rate	(7%)	(1%)	(1%)	2%	
Domestic Market					
Units (K)	8.5	12.5	16.2	22.5	39%
Growth Rate	39%	47%	30%	39%	
Value (\$M)	\$5.4	\$7.7	\$9.7	\$13.7	35%
Growth Rate	32%	43%	26%	41%	
Unit Price (\$)	\$635	\$616	\$599	\$ 609	(2%)
Growth Rate	(5%)	(3%)	(3%)	2%	
Imports					
Units (K)	7.4	11.3	15.0	21.2	41%
Growth Rate	37%	53%	33%	41%	
Value (\$M)	\$4.7	\$6.9	\$8.8	\$12.8	37%
Growth Rate	31%	47%	28%	45%	
Unit Price (\$)	\$635	\$611	\$587	\$ 604	(2%)
Growth Rate	(5%)	(4%)	(4%)	(3%)	
Domestic Shipments					
Units (K)	1.1	1.2	1.2	1.3	17%
Growth Rate	(57%)	9%	0	8%	
Value (\$M)	\$0.7	\$0.8	\$0.9	\$ 0.9	16%
Growth Rate	40%	14%	13%	0	
Unit Price (\$)	\$636	\$667	\$750	\$ 692	(1%)
Growth Rate	(11%)	5%	13%	(8%)	

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 34

Percentage of Taiwanese Printers Exported

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Dot Matrix Printers			
Export Unit Share	98%	98%	97%
Export Value Share	96%	99%	98%
Daisywheel Printers			
Export Unit Share	94%	71%	70%
Export Value Share	92%	69%	67%
Total			
Export Unit Share	98%	97%	96%
Export Value Share	96%	98%	96%

Source: Dataquest
September 1988

Table 35

Taiwanese Printer Import Market

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Total Market	100%	100%	100%
Import Unit Share	90%	95%	97%
Import Value Share	92%	96%	97%

Source: Dataquest
September 1988

Electronic Products--Taiwan

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Electronic Products--Taiwan

Table 36a

Taiwanese Printer Distribution Channel History (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$24	\$46	\$42	\$44
OEM Export Value	\$ 2	\$ 4	\$ 1	\$ 2
(Percentage of Total Shipments)	10.0%	9.0%	2.0%	3.8%
Foreign Brand Export Value	\$20	\$40	\$38	\$40
(Percentage of Total Shipments)	82.0%	86.5%	91.0%	91.2%
Native Brand Export Value	0	0	0	0
(Percentage of Total Shipments)	0	0.5%	0	0
Domestic Shipment Value	\$ 2	\$ 2	\$ 3	\$ 2
(Percentage of Total Shipments)	8%	4%	7%	5%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 36b

**Taiwanese Printer Distribution Channel Forecast
(Millions of U.S. Dollars)**

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$45	\$46	\$47	\$48
OEM Export Value	\$ 3	\$ 3	\$ 3	\$ 4
(Percentage of Total Shipments)	5.8%	7.4%	7.3%	8.3%
Foreign Brand Export Value	\$41	\$39	\$38	\$39
(Percentage of Total Shipments)	90.2%	84.6%	81.9%	81.9%
Native Brand Export Value	\$ 0	\$ 0	\$ 1	\$ 1
(Percentage of Total Shipments)	0	1.0%	1.8%	1.8%
Domestic Shipment Value	\$ 2	\$ 3	\$ 4	\$ 4
(Percentage of Total Shipments)	4%	7%	9%	8%

Source: Dataquest
September 1988

Electronic Products—Taiwan

Table 37

Major Taiwanese Printer Manufacturers*

<u>1987 Ranking</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Specifications</u>
1	Digital Equipment Taiwan Ltd.	LA 210	Dot matrix, 9-pin
2	Qume Cooperation Taiwan	Sprint-II	Daisywheel 40-90 cps
3	Multitech Industrial Corp. & Continental System Inc.	LP-75, 76	Laser printer
4	Teco Electronic & Machinery Co., Ltd.	VP 1814	Dot matrix, 24-pin
5	Primages Inc.	P-90	Daisywheel
6	Wang Laboratories Taiwan Ltd.	ILP-20, YD-4400, LASERTOP32 PS/P7, M1724	

*Manufacturers with more than 1 percent of the total PC shipment value in Taiwan

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 38

Major Printer Manufacturers' Partnerships/Alliances--Taiwan

<u>Manufacturer</u>	<u>OEM Partner</u>
Digital	TA
Qume	Honeywell
Multitech & Continental	Damco, MEI, Imagineering, Russet
Teco	TE, Actebis
Primages	Skid

Source: Dataquest
September 1988

Electronic Products--Taiwan

TELEVISIONS

Tables 39 through 41 provide an overview of the Taiwanese television industry and market.

Shipment Summary

Taiwanese unit shipments of televisions in 1987 were estimated at 5.3 million units, 17 percent growth over 1986; this is expected to grow to 5.8 million units in 1988. Also:

- The shipment value of televisions for 1987 is estimated at \$816 million. Its growth rate will decrease to 5 percent in 1988; the shipment value is expected to reach \$857 million.
- The 1987 to 1991 CAGR for units shipped is predicted to be approximately 8 percent.

Color Television Parts

Color television unit shipments grew 23 percent, to an estimated 4.3 million in 1987. Color television shipment value grew 15 percent, to \$761 million, that year. In addition:

- Taiwanese unit shipment CAGR will maintain a two-digit level, but its shipment value CAGR will drop down to single-digit numbers.
- The color television shipment value comprises more than 90 percent of Taiwan's total television shipment value.

Black-and-White Television Parts

In 1983, monochrome televisions had a negative growth of approximately 6 percent in both units shipped and their value. Since monochrome television has less value added, its position in the television industry will decline.

Export Trends

Most television sets manufactured in Taiwan are for export. Table 42 shows the share of television exports to total shipments in terms of color televisions and monochrome televisions.

Domestic Shipments

Domestic shipments constitute approximately 4 percent of Taiwan's total shipments. Taiwan's domestic market is supplied mainly by local manufacturers.

Electronic Products--Taiwan

Domestic Market

Since televisions are a mature product in Taiwan, the television market has entered the low-growth stage and is expected to have a 3 to 4 percent growth rate in the coming years.

Import Trends

Imports are not a major contributor to Taiwan's domestic market consumption (see Table 43), but their proportional contribution to the domestic market should be on the upswing during the 1988 to 1991 time frame.

Distribution Channels

Table 44 summarizes Taiwan's distribution channels for the television industry.

OEM Exports

OEM exports amount for approximately one-fourth of Taiwan's total shipment value, but this will decrease in the coming years.

Foreign Brand Exports

Foreign brand exports play the major role in Taiwan's television export distribution channels. This channel will grow a small amount during the next two years.

Native Brand Exports

Although the native brand export channel is the least significant one at present, it will become increasingly important during the next few years.

Domestic Shipments

Domestic shipments constituted the second most important television distribution channel in 1986. In 1987, this channel's importance has been decreasing, but during the next four years it is expected to grow a small amount.

Major Manufacturers

Figure 41 shows the major Taiwanese color television manufacturers. In addition:

- Five companies are offshore (Capetronic, Funai Taiwan, Orion, RCA, and Shirasuna). These accounted for about 40 percent of the total color television shipments in 1987.
- Major manufacturers' OEM partnerships and technology alliances are summarized in Table 45.

Electronic Products--Taiwan

Table 39a

Taiwanese Television Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	5,117	3,627	4,581	5,347
Growth Rate	-	(29%)	26%	17%
Value (\$M)	\$694	\$574	\$719	\$816
Growth Rate	-	(17%)	25%	13%
Unit Price (\$)	\$136	\$158	\$157	\$153
Growth Rate	-	17%	(1%)	(3%)
Exports				
Units (K)	4,576	3,102	3,982	4,781
Growth Rate	-	(32%)	28%	20%
Value (\$M)	\$434	\$346	\$472	\$549
Growth Rate	-	(20%)	36%	16%
Unit Price (\$)	\$ 95	\$112	\$119	\$115
Growth Rate	-	18%	6%	(3%)
Domestic Market				
Units (K)	534	623	640	695
Growth Rate	-	17%	3%	9%
Value (\$M)	\$218	\$237	\$244	\$226
Growth Rate	-	9%	3%	(7%)
Unit Price (\$)	\$408	\$380	\$381	\$325
Growth Rate	-	(7%)	0	(15%)
Imports				
Units (K)	20	15	36	75
Growth Rate	-	(25%)	140%	108%
Value (\$M)	\$ 7	\$ 6	\$ 13	\$ 23
Growth Rate	-	(14%)	117%	77%
Unit Price (\$)	\$350	\$400	\$361	\$307
Growth Rate	-	14%	(10%)	(15%)
Domestic Shipments				
Units (K)	541	525	599	566
Growth Rate	-	(3%)	14%	(6%)
Value (\$M)	\$264	\$234	\$236	\$192
Growth Rate	-	(11%)	1%	(19%)
Unit Price (\$)	\$488	\$446	\$394	\$339
Growth Rate	-	(9%)	(12%)	(14%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 39b

Taiwanese Television Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipments				
Units (K)	5,791	6,228	6,859	7,410
Growth Rate	8%	8%	10%	8%
Value (\$M)	\$857	\$893	\$1,465	\$1,108
Growth Rate	5%	4%	64%	(24%)
Unit Price (\$)	\$148	\$143	\$ 214	\$ 150
Growth Rate	(3%)	(3%)	49%	(30%)
Exports				
Units (K)	5,076	5,396	5,885	6,258
Growth Rate	6%	6%	9%	6%
Value (\$M)	\$578	\$599	\$ 659	\$ 695
Growth Rate	5%	4%	10%	5%
Unit Price (\$)	\$114	\$111	\$ 112	\$ 111
Growth Rate	(1%)	(3%)	1%	(1%)
Domestic Market				
Units (K)	715	743	760	792
Growth Rate	3%	4%	2%	4%
Value (\$M)	\$223	\$231	\$ 238	\$ 239
Growth Rate	(1%)	4%	3%	0
Unit Price (\$)	\$312	\$311	\$ 313	\$ 302
Growth Rate	(4%)	0	1%	(4%)
Imports				
Units (K)	95	119	148	181
Growth Rate	27%	25%	24%	22%
Value (\$M)	\$ 29	\$ 34	\$ 41	\$ 48
Growth Rate	26%	17%	21%	17%
Unit Price (\$)	\$305	\$286	\$ 277	\$ 265
Growth Rate	0	(6%)	(3%)	(4%)
Domestic Shipments				
Units (K)	645	837	970	1,152
Growth Rate	14%	30%	16%	19%
Value (\$M)	\$204	\$267	\$ 292	\$ 341
Growth Rate	6%	31%	9%	17%
Unit Price (\$)	\$316	\$319	\$ 301	\$ 296
Growth Rate	(7%)	1%	(6%)	(2%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 40a

Taiwanese Color Television Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	2,271	2,334	3,521	4,347
Growth Rate	-	3%	51%	23%
Value (\$M)	\$549	\$507	\$661	\$761
Growth Rate	-	(8%)	30%	15%
Unit Price (\$)	\$242	\$217	\$188	\$175
Growth Rate	-	(10%)	(14%)	(7%)
Exports				
Units (K)	1,822	1,917	3,021	3,874
Growth Rate	-	5%	58%	28%
Value (\$M)	\$291	\$281	\$431	\$503
Growth Rate	-	4%	53%	17%
Unit Price (\$)	\$160	\$146	\$143	\$130
Growth Rate	-	(8%)	(3%)	(9%)
Domestic Market				
Units (K)	441	515	540	600
Growth Rate	-	17%	5%	11%
Value (\$M)	\$213	\$231	\$238	\$220
Growth Rate	-	8%	3%	(8%)
Unit Price (\$)	\$483	\$449	\$441	\$367
Growth Rate	-	(7%)	(2%)	(17%)
Imports				
Units (K)	19	15	35	71
Growth Rate	-	(21%)	133%	103%
Value (\$M)	\$ 7	\$ 6	\$ 13	\$ 23
Growth Rate	-	(17%)	119%	81%
Unit Price (\$)	\$366	\$387	\$364	\$324
Growth Rate	-	6%	(6%)	(11%)
Domestic Shipments				
Units (K)	449	417	500	473
Growth Rate	-	(7%)	20%	(5%)
Value (\$M)	\$258	\$227	\$230	\$185
Growth Rate	-	(12%)	2%	(20%)
Unit Price (\$)	\$575	\$543	\$460	\$391
Growth Rate	-	(6%)	(15%)	(15%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 40b

Taiwanese Color Television Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipments				
Units (K)	4,841	5,325	5,911	6,443
Growth Rate	11%	10%	11%	9%
Value (\$M)	\$804	\$841	\$952	\$1,057
Growth Rate	6%	5%	13%	11%
Unit Price (\$)	\$166	\$158	\$161	\$ 164
Growth Rate	(5%)	(5%)	2%	2%
Exports				
Units (K)	4,222	4,562	5,016	5,372
Growth Rate	9%	8%	10%	7%
Value (\$M)	\$532	\$552	\$612	\$ 650
Growth Rate	6%	4%	11%	6%
Unit Price (\$)	\$126	\$121	\$122	\$ 121
Growth Rate	(3%)	(4%)	1%	(1%)
Domestic Market				
Units (K)	624	655	675	709
Growth Rate	4%	5%	3%	5%
Value (\$M)	\$217	\$225	\$232	\$ 233
Growth Rate	(1%)	4%	3%	0
Unit Price (\$)	\$348	\$344	\$344	\$ 329
Growth Rate	(5%)	(1%)	0	(4%)
Imports				
Units (K)	92	115	143	175
Growth Rate	30%	25%	24%	22%
Value (\$M)	\$ 29	\$ 34	\$ 41	\$ 48
Growth Rate	26%	17%	21%	17%
Unit Price (\$)	\$311	\$296	\$284	\$ 274
Growth Rate	(4%)	(5%)	(4%)	(3%)
Domestic Shipments				
Units (K)	545	765	890	1,075
Growth Rate	16%	40%	16%	21%
Value (\$M)	\$197	\$262	\$286	\$ 335
Growth Rate	6%	33%	9%	17%
Unit Price (\$)	\$359	\$342	\$321	\$ 312
Growth Rate	(8%)	(5%)	(6%)	(3%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 41a

Taiwanese Black and White Television Industry History
(Estimated Total Shipments, Exports, Domestic Market, Imports,
and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	2,846	1,293	1,060	1,000
Growth Rate	-	(55%)	(18%)	(6%)
Value (\$M)	\$145	\$67	\$58	\$55
Growth Rate	-	(54%)	(13%)	(5%)
Unit Price (\$)	\$ 51	\$52	\$55	\$55
Growth Rate	-	2%	6%	1%
Exports				
Units (K)	2,754	1,185	961	907
Growth Rate	-	(57%)	(19%)	(6%)
Value (\$M)	\$143	\$65	\$41	\$46
Growth Rate	-	(55%)	(37%)	12%
Unit Price (\$)	\$ 52	\$55	\$43	\$51
Growth Rate	-	6%	(22%)	19%
Domestic Market				
Units (K)	93	108	100	95
Growth Rate	-	16%	(7%)	(5%)
Value (\$M)	\$ 5	\$ 6	\$ 6	\$ 6
Growth Rate	-	12%	(5%)	12%
Unit Price (\$)	\$ 56	\$54	\$56	\$66
Growth Rate	-	(3%)	3%	18%
Imports				
Units (K)	1	0	1	2
Growth Rate	-	(67%)	367%	36%
Value (\$M)	0	0	0	0
Growth Rate	-	(54%)	226%	33%
Unit Price (\$)	\$ 56	\$77	\$54	\$53
Growth Rate	-	38%	(30%)	(2%)
Domestic Shipments				
Units (K)	92	108	99	93
Growth Rate	-	17%	(8%)	(6%)
Value (\$M)	\$ 6	\$ 7	\$ 6	\$ 7
Growth Rate	-	17%	(14%)	17%
Unit Price (\$)	\$ 65	\$65	\$61	\$75
Growth Rate	-	(1%)	(6%)	24%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 41b

Taiwanese Black and White Television Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipments				
Units (K)	950	903	948	967
Growth Rate	(5%)	(5%)	5%	2%
Value (\$M)	\$53	\$52	\$53	\$51
Growth Rate	(3%)	(2%)	1%	(3%)
Unit Price (\$)	\$56	\$58	\$56	\$53
Growth Rate	2%	4%	(3%)	(5%)
Exports				
Units (K)	853	836	868	890
Growth Rate	(6%)	(2%)	4%	3%
Value (\$M)	\$46	\$47	\$47	\$45
Growth Rate	0	2%	0	(3%)
Unit Price (\$)	\$52	\$54	\$55	\$56
Growth Rate	2%	5%	2%	1%
Domestic Market				
Units (K)	91	88	85	83
Growth Rate	(4%)	(3%)	(3%)	(3%)
Value (\$M)	\$ 6	\$ 6	\$ 6	\$ 6
Growth Rate	(6%)	6%	(6%)	(6%)
Unit Price (\$)	\$65	\$71	\$69	\$67
Growth Rate	(2%)	9%	(3%)	(3%)
Imports				
Units (K)	3	4	5	6
Growth Rate	50%	33%	31%	25%
Value (\$M)	0	0	0	0
Growth Rate	60%	50%	33%	36%
Unit Price (\$)	\$56	\$63	\$65	\$70
Growth Rate	7%	13%	2%	9%
Domestic Shipments				
Units (K)	97	72	80	77
Growth Rate	4%	(26%)	11%	(4%)
Value (\$M)	\$ 7	\$ 5	\$ 6	\$ 6
Growth Rate	3%	(25%)	13%	(8%)
Unit Price (\$)	\$74	\$75	\$76	\$73
Growth Rate	(1%)	1%	2%	(4%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 42

Percentage of Taiwanese Televisions Exported

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Color Televisions			
Export Unit Share	80%	89%	83%
Export Value Share	53%	66%	61%
Monochrome Televisions			
Export Unit Share	97%	91%	92%
Export Value Share	99%	84%	88%
Total			
Export Unit Share	89%	89%	84%
Export Value Share	63%	67%	63%

Source: Dataquest
September 1988

Table 43

Taiwanese Television Import Market

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Total Market	100%	100%	100%
Import Unit Share	40%	11%	23%
Import Value Share	3%	10%	20%

Source: Dataquest
September 1988

Electronic Products--Taiwan

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Electronic Products--Taiwan

Table 44a

Taiwanese Color Television Distribution Channel History
(Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$549	\$507	\$661	\$761
OEM Export Value	\$ 77	\$ 51	\$139	\$213
(Percentage of Total Shipments)	14%	10%	21%	28%
Foreign Brand Export Value	\$187	\$208	\$245	\$282
(Percentage of Total Shipments)	34%	41%	37%	37%
Native Brand Export Value	\$ 27	\$ 20	\$ 46	\$ 76
(Percentage of Total Shipments)	5%	4%	7%	10%
Domestic Shipment Value	\$ 37	\$ 31	\$ 73	\$100
(Percentage of Total Shipments)	47%	45%	35%	25%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 44b

Taiwanese Color Television Distribution Channel Forecast (Millions of U.S. Dollars)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$804	\$841	\$952	\$1,057
OEM Export Value	\$217	\$177	\$209	\$ 222
(Percentage of Total Shipments)	27%	21%	22%	21%
Foreign Brand Export Value	\$314	\$345	\$381	\$ 423
(Percentage of Total Shipments)	39%	41%	40%	40%
Native Brand Export Value	\$ 72	\$ 59	\$ 76	\$ 74
(Percentage of Total Shipments)	9%	7%	8%	7%
Domestic Shipment Value	\$151	\$199	\$ 260	\$ 330
(Percentage of Total Shipments)	25%	31%	30%	32%

Source: Dataquest
September 1988

Electronic Products—Taiwan

Table 45

Major Color Television Manufacturers' Partnerships/Alliances—Taiwan

<u>Manufacturer</u>	<u>OEM</u>	
	<u>Partner</u>	<u>Alliance</u>
AOC	-	Samsung (Korea)
Taiwan Prince	Hitachi (United States)	Hitachi (Japan)
Kuang Yuan Co.	JVC (United States)	JVC
Tatung	Toshiba (United States)	Toshiba

Source: Dataquest
September 1988

Electronic Products--Taiwan

VIDEO CASSETTE RECORDERS (VCRs)

Shipment Summary

Taiwanese unit shipments of VCRs were estimated at 1.1 million units in 1987, with a 131 percent growth rate in 1986. Unit shipments are expected to grow to 1.6 million in 1988. Taiwanese shipment values of VCRs in 1987 were estimated to be \$291 million (with an 85 percent growth over 1986). Shipment value is expected to grow to \$380 million in 1988, as Table 46 shows. In addition:

- Most domestic manufacturers are allied to the Japanese companies. Due to contractual restrictions, these domestic manufacturers can produce only a limited number of VCRs.
- Foreign manufacturers are the main contributors to Taiwanese VCR export shipments. Therefore, the growth of Taiwanese VCRs exported is based on increased shipments by foreign companies.
- The unit shipment CAGR from 1987 through 1991 is predicted to be more than 10 percent.

Export Trends

Foreign manufacturers are the main contributors to Taiwanese VCR exports; i.e., the number of Taiwanese VCR exports depends on their growth. See Table 47 for the unit and value shares of VCR exports.

Domestic Market

Since VCRs are still a growing product in Taiwan, the VCR market is still in a high-growth stage, with a two-digit growth rate expected for 1988 and 1989.

Import Trends

Because Taiwan's VCR industry is still developing some key technologies, VCRs produced there are not very competitive. For this reason, Taiwanese VCR imports can maintain a high growth rate (see Table 48).

Distribution Channels

Table 49 summarizes Taiwan's VCR industry distribution channels.

Electronic Products--Taiwan

OEM Exports

The OEM export channel provides less than 10 percent of the Taiwanese total VCR shipment value.

Foreign Brand Exports

Foreign brand exports play the second most important role in VCR export distribution channels. This channel's growth rate will be lower during the next several years.

Native Brand Exports

The native brand export channel accounts for only about 1 to 2 percent of total VCR shipments.

Domestic Shipments

Domestic shipments are the major VCR distribution channel in Taiwan, which implies that total shipment increase depends basically on the domestic market growth.

Major Manufacturers

Figure 42 shows the top nine manufacturers of Taiwan's VCR industry, which includes three offshore companies (Orion, Funai Electric of Taichung, and Funai Electric of Taiwan). Also of note:

- Orion accounted for a quarter of total VCR shipments in 1987.
- We summarize those major manufacturers' OEM partnerships and technology alliances in Table 50.

Electronic Products--Taiwan

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Electronic Products--Taiwan

Table 46a

Taiwanese VCR Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipments				
Units (K)	172	298	454	1,051
Growth Rate	-	73%	52%	131%
Value (\$M)	\$ 101	\$134	\$157	\$291
Growth Rate	-	32%	18%	85%
Unit Price (\$)	\$ 587	\$448	\$347	\$277
Growth Rate	-	(24%)	(23%)	(20%)
Exports				
Units (K)	32	35	203	580
Growth Rate	-	9%	480%	186%
Value (\$M)	\$ 2	\$ 4	\$ 37	\$138
Growth Rate	-	187%	746%	273%
Unit Price (\$)	\$ 48	\$125	\$182	\$238
Growth Rate	-	162%	46%	31%
Domestic Market				
Units (K)	140	243	286	500
Growth Rate	-	74%	18%	75%
Value (\$M)	\$ 100	\$130	\$123	\$157
Growth Rate	-	30%	(6%)	28%
Unit Price (\$)	\$ 716	\$537	\$430	\$314
Growth Rate	-	(25%)	(20%)	(27%)
Imports				
Units (K)	0	2	15	100
Growth Rate	-	800%	733%	567%
Value (\$M)	\$ 1	\$ 1	\$ 8	\$ 33
Growth Rate	-	104%	564%	323%
Unit Price (\$)	\$2,875	\$653	\$520	\$330
Growth Rate	-	77%	(20%)	(37%)
Domestic Shipments				
Units (K)	140	263	251	471
Growth Rate	-	87%	(5%)	88%
Value (\$M)	\$ 100	\$129	\$111	\$153
Growth Rate	-	30%	(14%)	38%
Unit Price (\$)	\$ 710	\$491	\$442	\$325
Growth Rate	-	(31%)	(10%)	(27%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 46b

Taiwanese VCR Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipments				
Units (K)	1,566	1,958	2,153	2,369
Growth Rate	49%	25%	10%	10%
Value (\$M)	\$380	\$451	\$447	\$467
Growth Rate	31%	19%	(1%)	9%
Unit Price (\$)	\$243	\$231	\$208	\$197
Growth Rate	(12%)	(5%)	(10%)	(5%)
Exports				
Units (K)	1,041	1,409	1,565	1,742
Growth Rate	79%	35%	11%	11%
Value (\$M)	\$260	\$345	\$365	\$385
Growth Rate	89%	33%	6%	6%
Unit Price (\$)	\$250	\$245	\$233	\$221
Growth Rate	5%	(2%)	(5%)	(5%)
Domestic Market				
Units (K)	650	715	750	788
Growth Rate	30%	10%	5%	5%
Value (\$M)	\$184	\$197	\$196	\$199
Growth Rate	17%	7%	0	2
Unit Price (\$)	\$283	\$275	\$261	\$253
Growth Rate	(10%)	(3%)	(5%)	(3%)
Imports				
Units (K)	155	186	219	252
Growth Rate	55%	20%	18%	15%
Value (\$M)	\$ 52	\$ 57	\$ 69	\$ 82
Growth Rate	58%	10%	21%	19%
Unit Price (\$)	\$333	\$308	\$315	\$324
Growth Rate	1%	(8%)	2%	3%
Domestic Shipments				
Units (K)	585	600	630	649
Growth Rate	24%	3%	5%	3%
Value (\$M)	\$150	\$148	\$156	\$153
Growth Rate	(2%)	(1%)	5%	(2%)
Unit Price (\$)	\$256	\$247	\$248	\$236
Growth Rate	(21%)	(4%)	0	(5%)

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 47

Percentage of Taiwanese VCRs Exported

	<u>1984</u>	<u>1987</u>	<u>1991</u>
VCR			
Export Unit Share	19%	55%	74%
Export Value Share	2%	47%	82%

Source: Dataquest
September 1988

Table 48

Taiwanese VCR Import Market

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Import Unit Share	0	20%	32%
Import Value Share	1%	21%	41%

Source: Dataquest
September 1988

Electronic Products--Taiwan

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Electronic Products--Taiwan

Table 49a

Taiwanese VCR Distribution Channel History (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$101	\$134	\$157	\$210
OEM Export Value	0	\$ 1	\$ 9	\$ 13
(Percentage of Total Shipments)	0	1%	6%	6%
Foreign Brand Export Value	\$ 1	\$ 4	\$ 35	\$ 57
(Percentage of Total Shipments)	1%	3%	22%	27%
Native Brand Export Value	0	0	\$ 2	\$ 2
(Percentage of Total Shipments)	0	0	1%	1%
Domestic Shipment Value	\$ 37	\$ 31	\$ 73	\$100
(Percentage of Total Shipments)	99%	96%	71%	66%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 49b

Taiwanese VCR Distribution Channel Forecast (Millions of U.S. Dollars)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$212	\$213	\$205	\$207
OEM Export Value	\$ 15	\$ 17	\$ 16	\$ 17
(Percentage of Total Shipments)	7%	8%	8%	8%
Foreign Brand Export Value	\$ 45	\$ 47	\$ 31	\$ 33
(Percentage of Total Shipments)	21%	22%	15%	16%
Native Brand Export Value	\$ 2	\$ 2	\$ 2	\$ 4
(Percentage of Total Shipments)	1%	1%	1%	2%
Domestic Shipment Value	\$151	\$199	\$260	\$330
(Percentage of Total Shipments)	71%	69%	76%	74%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 50

Major VCR Manufacturers' Partnerships/Alliances--Taiwan

<u>Manufacturer</u>	<u>OEM</u>	
	<u>Partner</u>	<u>Alliance</u>
Dahsen	Mitsubishi (Japan)	Mitsubishi (Japan)
Taiwan Sony	Sony (Japan)	Sony (Japan)
Tatung	Kolin	Toshiba (Japan)
Sampo	-	Sharp (Japan)
Taiwan Sanyo	-	Sanyo (Japan)
Taiwan Prince	Hitachi (United States)	Hitachi (Japan)

Source: Dataquest
September 1988

Electronic Products--Taiwan

CASSETTE RECORDERS

Table 51 provides an overview of the Taiwanese cassette recorder industry.

Shipment Summary

Taiwanese unit shipments of cassette recorders in 1987 were estimated at 17.8 million units, or 10 percent growth over 1986. This number was expected to grow to reach 19.3 million units in 1988, or 8 percent growth over 1987. In addition:

- Cassette recorders are mature products, so they possess mature product characteristics, such as low growth, many manufacturers, etc.
- The shipment values of cassette recorders in 1987 is estimated to be \$844 million, 42 percent growth over 1986. Shipment value is expected to reach \$939 million in 1988.
- The unit shipment CAGR from 1987 through 1991 is forecast to be about 5 percent.

Export Trends

At least 95 percent of Taiwan's total cassette recorder unit shipments are for export (see Table 52).

Domestic Market

Taiwan's domestic market is predicted to maintain a stable growth rate in the near future.

Import Trends

Imports are the main source of supply for Taiwan's domestic cassette recorder market consumption.

Distribution Channels

The individual distribution channels for Taiwanese-manufactured cassette recorders is summarized in Table 53.

Electronic Products--Taiwan

OEM Exports

The most important of all Taiwanese distribution channels is the OEM export channel, whose shipments represent approximately 70 percent of the total shipment value.

Foreign Brand Exports

The foreign brand export channel's percentage of total exports is not large, about 10 percent.

Native Brand Exports

Native brand exports account for more of total shipments than offshore, at about 17 percent.

Domestic Shipments

The domestic shipment distribution channel comprises only about 1 percent of Taiwan's total cassette recorder shipments.

Major Manufacturers

Figure 43 shows the top nine Taiwanese cassette recorder manufacturers. Three of these are offshore companies (Funai, Shirashna, and Toyo). Out of a very large field, the top nine companies account for only a quarter of the total cassette recorder shipments.

Electronic Products--Taiwan

Table 51a

Taiwanese Cassette Recorder Industry History (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	1984	1985	1986	1987
Total Shipments				
Units (K)	19,633	16,128	16,218	17,831
Growth Rate	-	18%	1%	10%
Value (\$M)	\$694	\$559	\$594	\$844
Growth Rate	-	(20%)	6%	42%
Unit Price (\$)	\$ 35	\$ 35	\$ 37	\$ 47
Growth Rate	-	(2%)	6%	29%
Exports				
Units (K)	19,491	16,052	16,172	17,372
Growth Rate	-	(18%)	1%	7%
Value (\$M)	\$604	\$417	\$403	\$556
Growth Rate	-	(31%)	(3%)	38%
Unit Price (\$)	\$ 31	\$ 26	\$ 25	\$ 32
Growth Rate	-	16%	(4%)	28%
Domestic Market				
Units (K)	149	181	223	819
Growth Rate	-	21%	23%	267%
Value (\$M)	\$ 6	\$ 7	\$ 8	\$ 34
Growth Rate	-	16%	22%	330%
Unit Price (\$)	\$ 38	\$ 37	\$ 35	\$ 42
Growth Rate	-	(4%)	(1%)	17%
Imports				
Units (K)	7	105	177	360
Growth Rate	-	1,491%	69%	103%
Value (\$M)	\$ 1	\$ 4	\$ 6	\$ 13
Growth Rate	-	333%	42%	119%
Unit Price (\$)	\$150	\$ 41	\$ 34	\$ 37
Growth Rate	-	(73%)	(16%)	(8%)
Domestic Shipments				
Units (K)	142	76	46	159
Growth Rate	-	(46%)	(39%)	246%
Value (\$M)	\$ 5	\$ 3	\$ 2	\$ 7
Growth Rate	-	(50%)	(41%)	319%
Unit Price (\$)	\$ 38	\$ 36	\$ 35	\$ 42
Growth Rate	-	(7%)	(2%)	21%

Source: Dataquest
September 1988

Electronic Products--Taiwan

Table 51b

Taiwanese Cassette Recorder Industry Forecast (Estimated Total Shipments, Exports, Domestic Market, Imports, and Domestic Shipments)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipments				
Units (K)	19,257	20,220	21,231	22,293
Growth Rate	8%	5%	5%	5%
Value (\$M)	\$939	\$1,015	\$1,067	\$1,153
Growth Rate	11%	8%	5%	8%
Unit Price (\$)	\$ 49	\$ 50	\$ 50	\$ 52
Growth Rate	3%	3%	0	3%
Exports				
Units (K)	18,762	19,700	20,685	21,719
Growth Rate	8%	5%	5%	5%
Value (\$M)	\$640	\$ 703	\$ 761	\$ 823
Growth Rate	15%	10%	8%	8%
Unit Price (\$)	\$ 34	\$ 36	\$ 37	\$ 38
Growth Rate	7%	5%	3%	3%
Domestic Market				
Units (K)	963	1,105	1,201	1,275
Growth Rate	18%	15%	9%	6%
Value (\$M)	\$ 44	\$ 54	\$ 60	\$ 66
Growth Rate	31%	20%	12%	10%
Unit Price (\$)	\$ 46	\$ 49	\$ 50	\$ 52
Growth Rate	11%	5%	3%	4%
Imports				
Units (K)	468	585	655	701
Growth Rate	30%	25%	12%	7%
Value (\$M)	\$ 18	\$ 23	\$ 26	\$ 29
Growth Rate	36%	28%	13%	12%
Unit Price (\$)	\$ 39	\$ 40	\$ 40	\$ 41
Growth Rate	4%	3%	2%	2%
Domestic Shipments				
Units (K)	195	270	326	384
Growth Rate	23%	38%	21%	18%
Value (\$M)	\$ 9	\$ 13	\$ 16	\$ 20
Growth Rate	34%	44%	25%	23%
Unit Price (\$)	\$ 46	\$ 48	\$ 50	\$ 52
Growth Rate	10%	4%	4%	4%

Source: Dataquest
September 1988

Electronic Products—Taiwan

Table 52

Percentage of Taiwanese Cassettes Exported

	<u>1984</u>	<u>1987</u>	<u>1991</u>
Export Unit Share	99%	97%	97%
Export Value Share	87%	66%	71%

Source: Dataquest
September 1988

Electronic Products--Taiwan

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Electronic Products—Taiwan

Table 53a

Taiwanese Cassette Recorder Distribution Channel History
(Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Shipment Value	\$694	\$559	\$594	\$844
OEM Export Value (Percentage of Total Shipments)	\$486 70%	\$380 68%	\$416 70%	\$608 72%
Foreign Brand Export Value (Percentage of Total Shipments)	\$ 69 10%	\$ 61 11%	\$ 71 12%	\$ 84 10%
Native Brand Export Value (Percentage of Total Shipments)	\$132 19%	\$112 20%	\$107 18%	\$143 17%
Domestic Shipment Value (Percentage of Total Shipments)	\$ 37 1%	\$ 31 1%	\$ 73 0	\$100 1%

Source: Dataquest
September 1988

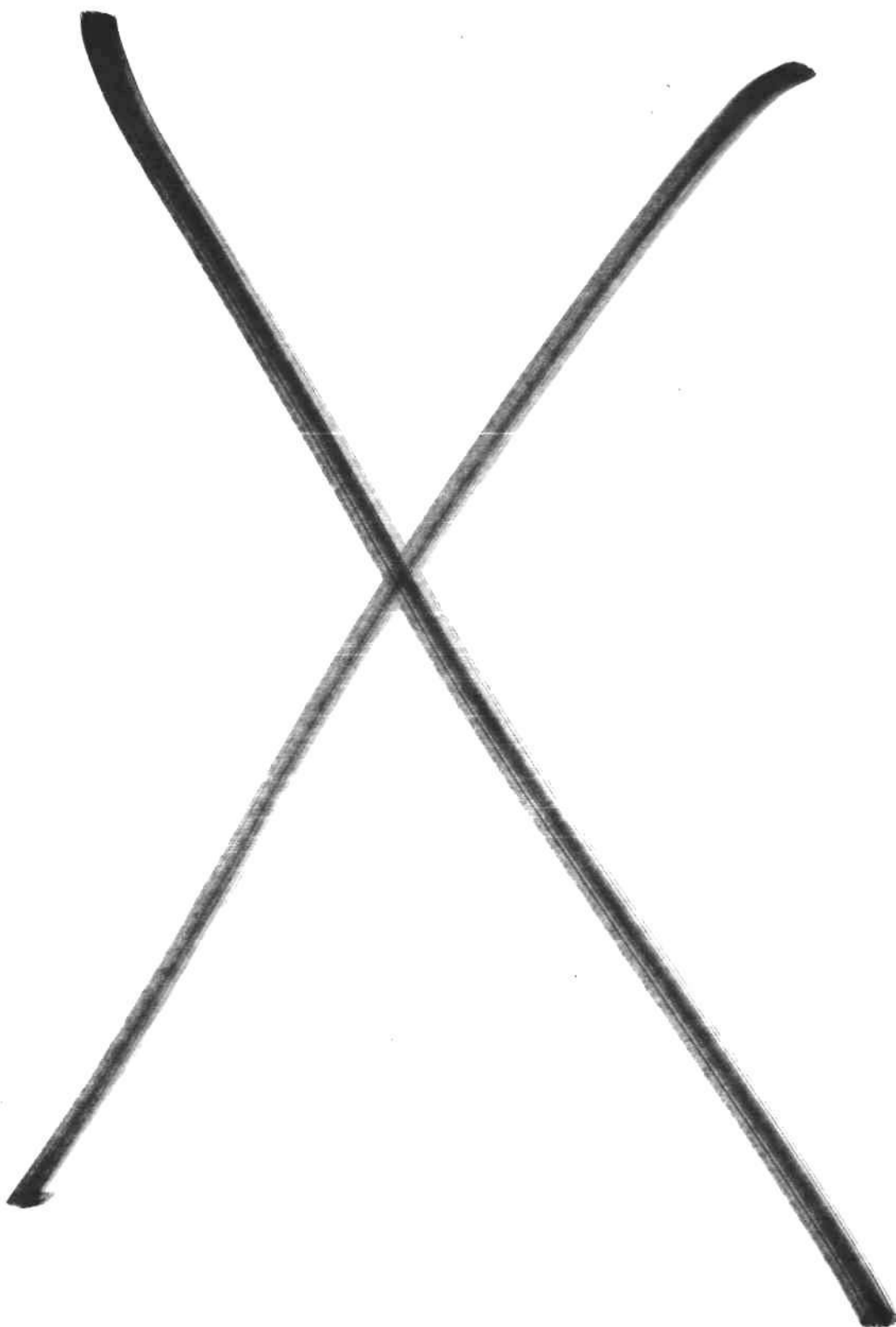
Electronic Products--Taiwan

Table 53b

**Taiwanese Cassette Recorder Distribution Channel Forecast
(Millions of U.S. Dollars)**

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Total Shipment Value	\$939	\$1,015	\$1,067	\$1,153
OEM Export Value	\$648	\$ 711	\$ 758	\$ 807
(Percentage of Total Shipments)	69%	70%	71%	70%
Foreign Brand Export Value	\$113	\$ 112	\$ 139	\$ 115
(Percentage of Total Shipments)	12%	11%	13%	10%
Native Brand Export Value	\$169	\$ 183	\$ 160	\$ 208
(Percentage of Total Shipments)	18%	18%	15%	18%
Domestic Shipment Value	\$151	\$ 199	\$ 260	\$ 330
(Percentage of Total Shipments)	1%	1%	1%	2%

Source: Dataquest
September 1988



Consumption/Production: Overview

Table 1

ROW Semiconductor Consumption (Billions of U.S. Dollars)

Country	1988	1989	1990	1991	1992	1993	CAGR 1988-1993
South Korea	\$ 1.8	\$ 2.4	\$ 2.6	\$ 3.3	\$ 4.2	\$ 4.7	21.2%
Taiwan	1.6	1.9	2.0	2.4	2.9	3.8	18.9%
Hong Kong	0.8	1.0	1.0	1.2	1.4	1.5	13.4%
Singapore	0.7	0.8	0.9	1.1	1.4	1.8	20.8%
China	0.7	0.9	1.0	1.2	1.4	2.0	23.4%
Other	0.2	0.3	0.3	0.5	0.7	1.0	38.0%
ROW Total	\$ 5.8	\$ 7.3	\$ 7.8	\$ 9.7	\$12.0	\$ 14.8	20.6%
Worldwide Total	\$50.9	\$56.4	\$57.3	\$65.9	\$79.4	\$104.3	
ROW/Worldwide, Percentage	11.4%	12.9%	13.6%	14.7%	15.1%	14.2%	15.4%

Source: Dataquest
December 1989

Table 2

Asia/Pacific-ROW Semiconductor Production: History (Millions of U.S. Dollars)

Country	1984	1985	1986	1987	1988	CAGR 1984-1988
South Korea	\$1,259	\$1,140	\$1,429	\$2,083	\$2,800	22.1%
Taiwan	659	522	689	825	1,050	12.4%
Hong Kong	142	136	169	184	200	9.0%
China	140	163	142	205	288	19.8%
Total	\$2,200	\$1,961	\$2,429	\$3,297	\$4,339	18.5%

Note: Includes fab, foundry, assembly, and test by local manufacturers, and also contract assembly and test.

Source: Dataquest
December 1989

Table 3

Asia/Pacific-ROW Semiconductor Production: Forecast
(Millions of U.S. Dollars)

Country	1989	1990	1991	1992	1993	CAGR 1989-1993
South Korea	\$ 2.1	\$ 2.7	\$ 3.6	\$ 4.5	\$ 6.0	30.0%
Taiwan	0.4	0.6	1.0	1.3	1.8	45.6%
China	0.3	0.3	0.4	0.6	1.0	35.1%
Other	0.1	0.2	0.2	0.3	0.4	41.4%
AP/ROW Total	\$ 2.9	\$ 3.8	\$ 5.2	\$ 6.7	\$ 9.2	33.5%
Worldwide Total	\$56.4	\$57.3	\$65.9	\$79.4	\$104.0	16.5%
ROW/Worldwide (%)	5.1%	6.6%	7.9%	8.4%	8.8%	

Note: Includes foundry business but not assembly and test revenue.

Source: Dataquest
December 1989

Consumption/Production--South Korea

INTRODUCTION

The following set of detailed tables estimates South Korean semiconductor industry production, consumption, and semiconductor trade for 1984 through 1989. Semiconductor production and trade tables are historical data tables only. Semiconductor consumption tables are divided into historical data tables for 1984 through 1989 and forecast tables for 1988 through 1992. All historical tables begin with 1984 and end with 1989, while all forecast tables begin with 1988 and end with 1992.

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 AT&T. 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.

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.

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 revenue is counted as semiconductor production and some is 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.

Consumption/Production--South Korea

FORECAST

Table 1 is an exchange rate table for 1982 through 1988. Historical data (Tables 2, 3, 4, and 5) are expressed in current U.S. dollars or current South Korean won. Therefore, data include the given year's inflation rate and exchange rates. However, the consumption forecasts (Tables 6 and 7) use constant won, dollars, and exchange rates, with no allowance for inflation or exchange rate variations. All estimates for 1989 and beyond are made as if 1989 monetary conditions would continue through 1992. Therefore, these estimates show the absolute year-to-year growth during this period.

Table 1
Exchange Rate--South Korea
(Won to U.S. Dollar)

<u>Year</u>	<u>Year-End</u>	<u>Average</u>
1982	748.8	731.08
1983	795.5	775.75
1984	827.4	805.98
1985	890.2	870.02
1986	861.4	881.45
1987	792.3	822.41
1988	684.1	731.46
1989	-	-

Source: Bank of Korea
EIA Korea
Dataquest
September 1989

Consumption/Production--South Korea

Table 2

Historical Semiconductor Consumption--South Korea (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989*</u>	<u>CAGR</u> <u>1984-1989</u>
Total Semiconductor	\$304	\$432	\$794	\$1,256	\$1,783	\$2,373	55.6%
IC	176	319	582	968	1,351	1,849	83.9%
Discrete	121	98	190	264	381	463	38.0%
Optoelectronic	7	15	22	24	51	61	92.7%

*Estimation

Source: Dataquest
September 1989

Table 3

Historical Semiconductor Consumption--South Korea (Billions of Won)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989*</u>	<u>CAGR</u> <u>1984-1989</u>
Total Semiconductor	W245	W376	W700	W1,032	W1,304	W1,736	51.9%
IC	142	278	514	796	988	1,352	62.4%
Discrete	98	85	166	216	279	338	29.9%
Optoelectronic	6	14	20	20	37	45	57.6%

*Estimation

Source: Dataquest
September 1989

Consumption/Production--South Korea

Table 4

Historical Semiconductor Production—South Korea (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>CAGR</u> <u>1984-1989</u>
Total Semiconductor*	\$1,259	\$1,140	\$1,429	\$2,078	\$2,923	\$3,819	23.4%
IC	1,018	941	1,169	1,782	2,503	3,336	25.2%
Discrete	208	168	225	264	360	419	14.3%
Optoelectronic	33	31	35	32	60	63	16.1%

*Includes fab, assembly, and test by native manufacturers, and also contract assembly and test

Source: Dataquest
September 1989

Table 5

Historical Semiconductor Production—South Korea (Billions of Won)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>CAGR</u> <u>1984-1989</u>
Total Semiconductor*	W1,014	W992	W1,259	W1,709	W2,136	W2,792	20.5%
IC	820	819	1,030	1,406	1,830	2,440	22.2%
Discrete	167	146	198	217	263	306	12.0%
Optoelectronic	27	27	37	26	43	46	12.3%

*Includes fab, assembly, and test by native manufacturers, and also contract assembly and test

Source: Dataquest
September 1989

Consumption/Production--South Korea

Table 6

Forecast Semiconductor Consumption--South Korea (Millions of U.S. Dollars)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>CAGR</u> <u>1988-1992</u>
Total Semiconductor	\$1,783	\$2,373	\$2,599	\$3,267	\$4,238	24.2%
IC	1,351	1,849	1,997	2,556	3,399	25.9%
Discrete	381	463	532	628	741	18.1%
Optoelectronic	51	61	70	83	98	17.7%

Source: Dataquest
September 1989

Table 7

Forecast Semiconductor Consumption--South Korea (Billions of Won)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>CAGR</u> <u>1988-1992</u>
Total Semiconductor	W1,304	W1,736	W1,901	W2,389	W3,100	24.2%
IC	988	1,352	1,461	1,869	2,486	25.9%
Discrete	279	338	389	459	542	18.1%
Optoelectronics	37	45	52	61	72	18.1%

*Applied stable exchange rates (1988-1992): 731.46 Won/\$

Source: Dataquest
September 1989

Consumption/Production--Taiwan

INTRODUCTION

The following set of detailed tables contains figures that quantify Taiwan's semiconductor industry production and consumption in U.S. and Taiwanese currencies for 1984 through 1993. Semiconductor production tables are historical data tables only. Semiconductor consumption tables are divided into historical data tables for 1984 through 1988, and forecast tables for 1989 through 1993. All historical tables begin with 1984 and end with 1988, while all forecast tables begin with 1989 and end with 1993.

DEFINITIONS AND CONVENTIONS

Dataquest uses a common manufacturer base for all data tables. This data 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.

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.

Production

Taiwan semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, because some assembly and packaging revenue is counted as semiconductor production and some is not.

Semiconductor production tables include all semiconductor products manufactured in Taiwan, including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging.

Consumption/Production--Taiwan

FORECAST

Table 1 is an exchange rate table for 1984-1989. Historical data (see Tables 2, 3, 4, and 5) are expressed in current U.S. dollars or current NT dollars and therefore include the given year's inflation rate and exchange rates. However, the consumption forecasts (see Tables 6 and 7) use constant NT dollars, U.S. dollars, and exchange rates, with no allowance for inflation or exchange rate variations. All estimates for 1989 and beyond are made as if 1989 monetary conditions would continue through 1993. Therefore, these estimates show the absolute year-to-year growth during this period.

Table 1

Exchange Rate—Taiwan
(NT Dollar to U.S. Dollar)

<u>Year</u>	<u>NT\$/US\$</u>
1984	40.00
1985	40.00
1986	36.00
1987	31.76
1988	28.68
1989*	25.70

*Estimated

Source: Dataquest
June 1989

Consumption/Production--Taiwan

Table 2

Historical Semiconductor Consumption--Taiwan (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$560	\$496	\$694	\$1,055	\$1,836	34.5%
IC	\$431	\$394	\$560	\$ 866	\$1,575	38.3%
Memory	N/A	N/A	N/A	225	472	N/A
ASIC	N/A	N/A	N/A	80	123	N/A
Other	N/A	N/A	N/A	561	980	N/A
Discrete	\$106	\$ 87	\$112	\$ 156	\$ 212	18.9%
Optoelectronic	\$ 23	\$ 15	\$ 22	\$ 33	\$ 49	20.4%

N/A = Not Available

Source: Dataquest
June 1989

Table 3

Historical Semiconductor Consumption--Taiwan (Millions of NT Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$22,412	\$19,840	\$24,984	\$33,494	\$52,656	23.8%
IC	\$17,240	\$15,752	\$20,171	\$27,501	\$45,171	27.2%
Memory	N/A	N/A	N/A	7,146	13,537	N/A
ASIC	N/A	N/A	N/A	2,541	3,528	N/A
Other	N/A	N/A	N/A	17,814	28,106	N/A
Discrete	\$ 4,240	\$ 3,496	\$ 4,032	\$ 4,961	\$ 6,080	9.4%
Optoelectronic	\$ 932	\$ 592	\$ 781	\$ 1,032	\$ 1,405	10.8%

Source: Dataquest
June 1989

Consumption/Production--Taiwan

Table 4

Historical Semiconductor Production--Taiwan (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$659	\$522	\$689	\$825	\$1,050	12.4%
IC	\$474	\$395	\$522	\$625	\$ 795	13.8%
Discrete	\$146	\$ 94	\$124	\$148	\$ 188	6.5%
Diode	106	56	74	88	112	1.4%
Transistor	40	38	50	60	76	17.5%
Optoelectronic	\$ 38	\$ 33	\$ 44	\$ 52	\$ 67	14.8%

Note: Production numbers include assembly and test.
Columns may not add to totals shown because of rounding.

Source: Dataquest
June 1989

Table 5

Historic Semiconductor Production--Taiwan (Millions of NT Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$26,344	\$20,884	\$24,800	\$26,202	\$30,114	3.4%
IC	\$18,960	\$15,804	\$18,774	\$19,835	\$22,796	4.7%
Discrete	\$ 5,848	\$ 3,752	\$ 4,450	\$ 4,701	\$ 5,403	(2.0%)
Diode	4,248	2,232	2,650	2,799	3,217	(6.7%)
Transistor	1,600	1,520	1,800	1,902	2,186	8.1%
Optoelectronic	\$ 1,536	\$ 1,328	\$ 1,577	\$ 1,666	\$ 1,915	5.7%

Note: Production numbers include assembly and test.

Source: Dataquest
June 1989

Consumption/Production--Taiwan

Table 6

Forecast Semiconductor Consumption--Taiwan (Millions of U.S. Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>CAGR</u> <u>1989-1993</u>
Total Semiconductor	\$1,906	\$2,006	\$2,370	\$2,899	\$3,825	19.0%
IC	\$1,542	\$1,650	\$1,949	\$2,384	\$3,145	19.5%
Memory	619	672	806	986	1,301	20.4%
ASIC	174	212	310	379	500	30.2%
Other	749	766	833	1,019	1,344	15.7%
Discrete	\$ 305	\$ 298	\$ 352	\$ 431	\$ 569	16.9%
Optoelectric	\$ 59	\$ 58	\$ 69	\$ 84	\$ 111	17.0%

Source: Dataquest
June 1989

Table 7

Forecast Semiconductor Consumption--Taiwan (Millions of NT Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>CAGR</u> <u>1989-1993</u>
Total Semiconductor	\$48,984	\$51,554	\$60,909	\$74,507	\$98,297	12.7%
IC	\$39,629	\$42,405	\$50,100	\$61,269	\$80,827	12.7%
Memory	15,908	17,270	20,714	25,340	33,436	13.6%
ASIC	4,472	5,448	7,967	9,740	12,850	37.7%
Other	19,249	19,686	21,418	26,188	34,541	16.4%
Discrete	\$ 7,828	\$ 7,646	\$ 9,039	\$11,069	\$14,621	12.7%
Optoelectronic	\$ 1,521	\$ 1,496	\$ 1,760	\$ 2,169	\$ 2,850	12.7%

Source: Dataquest
June 1989

Consumption/Production--Hong Kong

INTRODUCTION

The following set of detailed tables quantifies Hong Kong's semiconductor industry production and consumption for 1984 through 1993. Semiconductor production tables are historical data tables only. Semiconductor consumption tables are divided into historical data tables for 1984 through 1988, and forecast tables for 1989 through 1993. All historical tables begin with 1984 and end with 1988, while all forecast tables begin with 1989 and end with 1993.

DEFINITIONS AND CONVENTIONS

Dataquest uses a common manufacturer base for all data tables. This data 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.

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.

Production

Hong Kong semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, because some assembly and packaging revenue is counted as semiconductor production and some is not.

Semiconductor production tables include all semiconductor products manufactured in Hong Kong, including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging.

Consumption/Production--Hong Kong

FORECAST

Table 1 is an exchange rate table for 1984-1989. Historical data (see Tables 2, 3, 4, and 5) are expressed in current U.S. dollars or current H.K. dollars. Therefore, data include the given year's inflation rate and exchange rates. However, the consumption forecasts (see Tables 6 and 7) use constant H.K. dollars, U.S. dollars, and exchange rates, with no allowance for inflation or exchange rate variations. All estimates for 1986 and beyond are made as if 1986 monetary conditions would continue through 1990. Therefore, these estimates show the absolute year-to-year growth during this period.

Table 1

Exchange Rate—Hong Kong
(H.K. Dollar to U.S. Dollar)

<u>Year</u>	<u>HK\$/US\$</u>
1984	7.79
1985	7.79
1986	7.80
1987	7.80
1988	7.81
1989*	7.81

*Estimated

Source: Dataquest
June 1989

Consumption/Production--Hong Kong

Table 2

Historical Semiconductor Consumption--Hong Kong (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$456	\$334	\$478	\$593	\$790	14.7%
IC	\$380	\$281	\$406	\$504	\$671	15.3%
Memory	N/A	N/A	N/A	40	120	N/A
ASIC	N/A	N/A	N/A	3	8	N/A
Other	N/A	N/A	N/A	461	543	N/A
Discrete	\$ 66	\$ 44	\$ 59	\$ 73	\$ 98	10.2%
Optoelectronic	\$ 10	\$ 9	\$ 13	\$ 16	\$ 21	21.1%

N/A = Not Available

Source: Dataquest
June 1989

Table 3

Historical Semiconductor Consumption--Hong Kong (Millions of H.K. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$3,552	\$2,598	\$3,728	\$4,625	\$6,170	14.8%
IC	\$2,960	\$2,185	\$3,167	\$3,929	\$5,241	15.3%
Memory	N/A	N/A	N/A	312	937	N/A
ASIC	N/A	N/A	N/A	23	62	N/A
Other	N/A	N/A	N/A	3,593	4,241	N/A
Discrete	\$ 514	\$ 343	\$ 460	\$ 571	\$ 762	10.3%
Optoelectronic	\$ 78	\$ 70	\$ 101	\$ 126	\$ 168	21.1%

N/A = Not Available

Source: Dataquest
June 1989

Consumption/Production--Hong Kong

Table 4

Historical Semiconductor Production--Hong Kong (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$142	\$136	\$169	\$184	\$200	9.0%
IC	114	109	136	148	161	9.2%
Discrete	21	20	26	28	30	9.2%
Optoelectronic	7	7	8	9	10	8.2%

Note: Production numbers include assembly and test.
Columns may not add to totals shown because of rounding.

Source: Dataquest
June 1989

Table 5

Historical Semiconductor Production--Hong Kong (Millions of H.K. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>CAGR</u> <u>1984-1988</u>
Total Semiconductor	\$1,106	\$1,057	\$1,316	\$1,435	\$1,565	9.1%
IC	885	847	1,059	1,155	1,260	9.2%
Discrete	166	159	199	217	237	9.3%
Optoelectronic	55	51	64	70	76	8.3%

Note: Production numbers include assembly and test.

Source: Dataquest
June 1989

Consumption/Production--Hong Kong

Table 6

Forecast Semiconductor Consumption--Hong Kong (Millions of U.S. Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>CAGR</u> <u>1989-1993</u>
Total Semiconductor	\$958	\$960	\$1,150	\$1,350	\$1,543	12.7%
IC	\$814	\$815	\$ 977	\$1,147	\$1,311	12.7%
Memory	150	170	200	250	250	13.6%
ASIC	15	21	35	54	54	37.7%
Other	549	624	742	843	1,007	16.4%
Discrete	\$118	\$118	\$ 142	\$ 167	\$ 190	12.7%
Optoelectronic	\$ 26	\$ 26	\$ 31	\$ 37	\$ 42	12.7%

Source: Dataquest
June 1989

Table 7

Forecast Semiconductor Consumption--Hong Kong (Millions of H.K. Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>CAGR</u> <u>1989-1993</u>
Total Semiconductor	\$7,482	\$7,498	\$8,982	\$10,544	\$12,051	12.7%
IC	\$6,355	\$6,368	\$7,629	\$ 8,955	\$10,236	12.7%
Memory	1,172	1,328	1,562	1,953	1,953	13.6%
ASIC	117	164	273	422	422	37.7%
Other	4,288	4,877	5,793	6,581	7,861	16.4%
Discrete	\$ 924	\$ 925	\$1,109	\$ 1,301	\$ 1,487	12.7%
Optoelectronic	\$ 203	\$ 204	\$ 244	\$ 287	\$ 328	12.7%

Source: Dataquest
June 1989

Consumption/Production--China

INTRODUCTION

The following set of detailed tables estimates China's semiconductor industry production and consumption for 1984 through 1988. Semiconductor production tables are historical data tables only. Semiconductor consumption tables are divided into historical data tables for 1984 through 1988, and forecast tables for 1989 through 1993. All historical tables begin with 1984 and end with 1988, while all forecast tables begin with 1989 and end with 1993.

FORECAST

Table 1 is an exchange rate table for 1984-1988. Historical data (Tables 2, 3, 4, and 5) are expressed in current U.S. dollars or current China RMB. Therefore, data include the given year's inflation rate and exchange rates. However, the consumption forecasts (Tables 6 and 7) use constant China RMB, U.S. dollars, and exchange rates, with no allowance for inflation or exchange rate variations. All estimates for 1989 and beyond were made as if 1989 monetary conditions would continue through 1993. Therefore, these estimates show the absolute year-to-year growth during this period.

Table 1
Exchange Rate—China
(RMB to U.S. Dollar)

<u>Year</u>	<u>RMB per US\$</u>
1984	2.32
1985	2.94
1986	3.45
1987	3.72
1988	3.72

Source: Dataquest
November 1989

Consumption/Production--China

Table 2

Historical Semiconductor Consumption--China (Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	CAGR <u>1984-1988</u>
Total Semiconductor	\$250	\$339	\$448	\$610	\$750	31.6%
IC	129	167	288	362	449	36.6%
Discrete	116	164	150	235	285	25.2%
Optoelectronic	5	8	10	13	16	33.7%

Source: Dataquest
November 1989

Table 3

Historical Semiconductor Consumption--China (Millions of China RMB)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	CAGR <u>1984-1988</u>
Total Semiconductor	\$580	\$997	\$1,546	\$2,269	\$2,790	48.1%
IC	299	491	994	1,347	1,670	53.7%
Discrete	269	482	517	874	1,060	40.9%
Optoelectronic	12	24	35	48	60	49.5%

Source: Dataquest
November 1989

Consumption/Production--China

Table 4

Historical Semiconductor Production—China (Millions of U.S. Dollars)

	1984	1985	1986	1987	1988	CAGR 1984-1988
Total Semiconductor	\$140.0	\$163.1	\$141.9	\$204.8	\$288.1	19.8%
IC	43.2	55.8	49.8	90.5	128.4	31.3%
Discrete	94.8	104.3	89.1	110.3	155.7	13.2%
Optoelectronic	2.0	3.0	3.0	4.0	4.0	18.9%

Source: MMEI China
Dataquest
November 1989

Table 5

Historical Semiconductor Production—China (Millions of China RMB)

	1984	1985	1986	1987	1988	CAGR 1984-1988
Total Semiconductor	\$325	\$480	\$490	\$762	\$1,072	43.8%
IC	100	164	172	337	478	47.9%
Discrete	220	307	308	410	579	27.4%
Optoelectronic	5	9	10	15	15	31.6%

Source: MMEI China
Dataquest
November 1989

Consumption/Production--China

Table 6

**Forecast Semiconductor Consumption—China
(Millions of U.S. Dollars)**

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>CAGR</u> <u>1989-1993</u>
Total Semiconductor	\$900	\$1,062	\$1,372	\$1,785	\$2,498	29.1%
IC	548	658	870	1,170	1,667	32.1%
Discrete	333	383	476	583	787	24.0%
Optoelectronic	19	21	26	32	44	23.4%

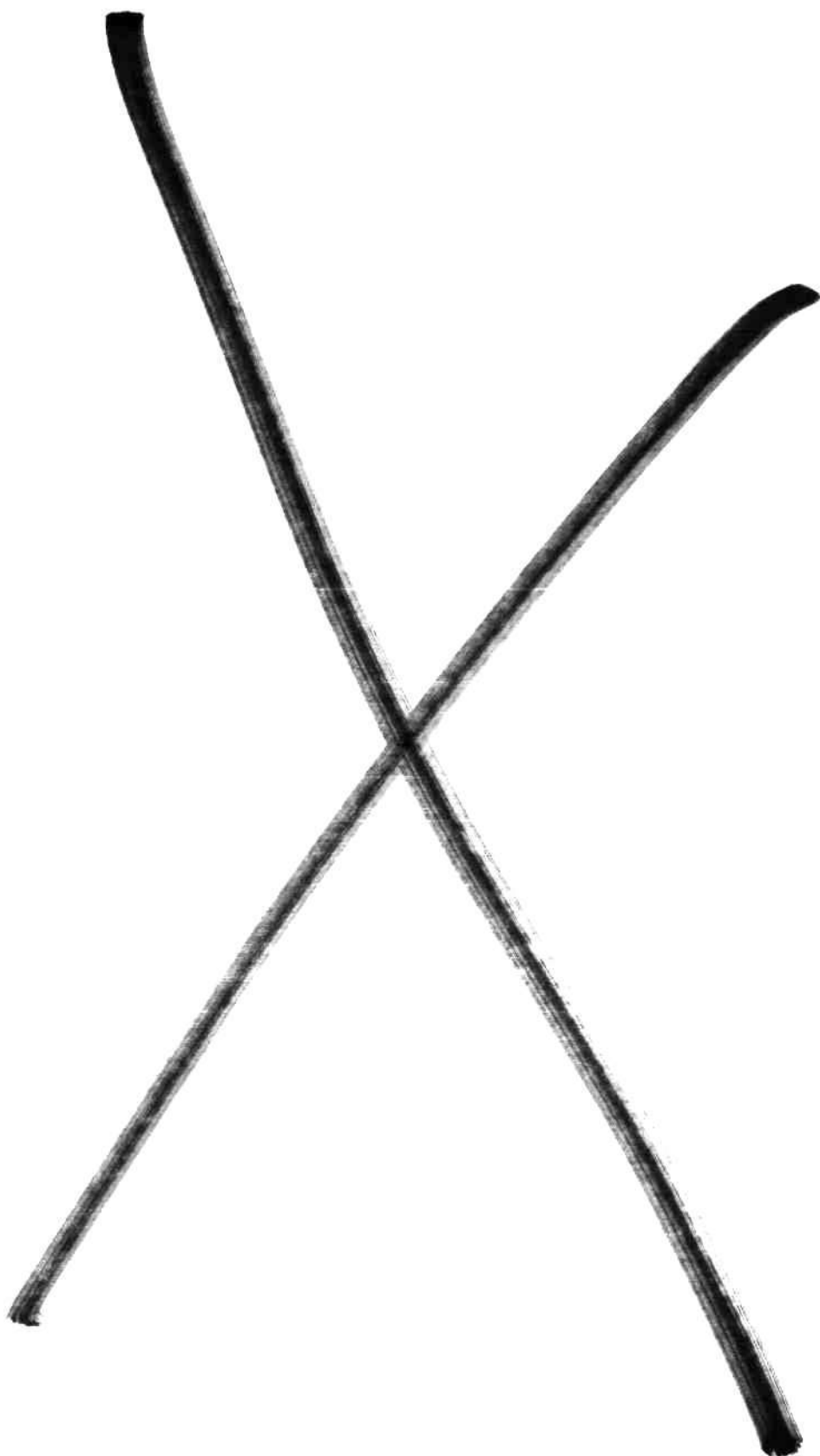
Source: Dataquest
November 1989

Table 7

**Forecast Semiconductor Consumption—China
(Millions of China RMB)**

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>CAGR</u> <u>1989-1993</u>
Total Semiconductor	\$3,348	\$3,951	\$5,104	\$6,640	\$9,293	29.1%
IC	2,039	2,448	3,236	4,352	6,201	32.1%
Discrete	1,239	1,425	1,771	2,169	2,928	24.0%
Optoelectronic	70	78	97	119	164	23.4%

Source: Dataquest
November 1989



Semiconductor Production—South Korea

INTRODUCTION

The following set of detailed tables contains figures that quantify South Korea's semiconductor industry production in US and Korean currencies for 1984 through 1987. Semiconductor production tables are historical data tables with an estimation of the current year, 1990. Please note that after 1987, revenue does not include assembly and test.

Production

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

Tables 1 and 2 include all semiconductor products manufactured in South Korea, including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging between 1984 and 1987. The ASETS database tracks production from 1988 to 1990 of front-end, nonpackaging revenue.

Table 1

Semiconductor Production—South Korea (Millions of US Dollars)

	1984	1985	1986	1987	1988	1989	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	1,259	1,140	1,429	2,078	1,527	2,126	2,551	18.2%	29.3%
Total Integrated Circuit	1,018	941	1,169	1,782	1,401	1,966	2,359	20.5%	29.8%
Total Discrete	208	168	225	264	121	153	184	8.3%	23.3%
Total Optoelectronic	33	31	35	32	5	7	8	(1.0%)	26.5%

Notes: Figures for 1984 through 1987 include foundry, assembly, and test revenue.

Figures for 1988 through 1990 do not include assembly and test revenue.

*Estimated

Source: Dataquest (August 1990)

Table 2

Semiconductor Production—South Korea
(Billions of South Korean Won)

	1984	1985	1986	1987	1988	1989	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	1,015	992	1,260	1,716	1,099	1,433	1,606	19.1%	20.9%
Total Integrated Circuit	820	819	1,030	1,472	1,009	1,325	1,485	21.5%	21.4%
Total Discrete	168	146	198	218	87	103	116	9.1%	15.3%
Total Optoelectronic	27	27	31	26	4	5	5	(0.2%)	18.3%

Notes: Figures for 1984 through 1987 include foundry, assembly, and test revenue.

Figures for 1988 through 1990 do not include assembly and test revenue.

*Estimated

Source: Dataquest (August 1990)

Semiconductor Production—Taiwan

The following set of detailed tables contains figures that quantify Taiwan's semiconductor industry production in US and Taiwanese currencies for 1984 through 1990. Semiconductor production tables are historical data tables with an estimation of the current year, 1990. Please note that after 1988, revenue does not include assembly and test of revenue.

Taiwan semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, because some assembly and packaging revenue is counted as semiconductor production and some is not.

Semiconductor production Tables 1 and 2 include all semiconductor products manufactured in Taiwan, including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging, between 1984 and 1987.

The ASETS database tracks production from 1988 to 1990 of front-end, nonpackaging revenue.

Table 1
Semiconductor Production—Taiwan
(Millions of US Dollars)

	1984	1985	1986	1987	1988*	1989*	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	659	522	689	825	212	350	525	7.8%	57.4%
Total Integrated Circuit	474	395	522	625	100	226	395	9.6%	98.7%
Total Discrete	146	94	124	148	40	42	40	0.5%	0
Total Optoelectronic	38	33	44	52	67	82	90	11.0%	15.9%

Note: 1984 to 1987 figures include foundry, assembly, and test revenue.

*Figures do not include assembly and test revenue.

Source: Dataquest (July 1990)

Table 2
Semiconductor Production—Taiwan
(Millions of New Taiwan Dollars)

	1984	1985	1986	1987	1988*	1989*	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	26,360	20,880	24,804	26,202	6,080	9,300	13,949	(0.2%)	51.5%
Total Integrated Circuit	18,960	15,800	18,792	19,850	2,868	6,005	10,495	1.5%	91.3%
Total Discrete	5,840	3,760	4,464	4,700	1,147	1,116	1,063	(7.0%)	(3.7%)
Total Optoelectronic	1,520	1,320	1,584	1,652	1,922	2,179	2,391	2.8%	11.6%

Note: 1984 to 1987 figures include foundry, assembly, and test revenue.

*Figures do not include assembly and test revenue.

Source: Dataquest (July 1990)

Semiconductor Production—Hong Kong

INTRODUCTION

The following set of detailed tables contains figures that quantify Hong Kong's semiconductor industry production in US and Hong Kong currencies for 1984 through 1990. Semiconductor production tables are historical data tables with an estimation of the current year, 1990. Please note that after 1988, revenue does not include assembly and test of revenue.

Hong Kong semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, because some assembly and packaging revenue is counted as semiconductor production and some is not.

Semiconductor production Tables 1 and 2 include all semiconductor products manufactured in Hong Kong—including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging—between 1984 and 1987.

The ASETS database tracks production from 1988 to 1990 of front-end, nonpackaging revenue.

Table 1
Semiconductor Production—Hong Kong
(Millions of US Dollars)

	1984	1985	1986	1987	1988	1989	1990*	CAGR 1984- 1987	CAGR 1988- 1990*
Total Semiconductor	142	136	169	184	35	45	60	9.0%	30.9%
Total Integrated Circuit	114	109	136	148	25	30	40	9.1%	26.5%
Total Discrete	21	20	26	28	10	15	20	10.1%	41.4%
Total Optoelectronic	7	7	8	9	0	0	0	8.7%	0

Note: Figures for 1984 through 1987 include foundry, assembly, and test revenue. Figures for 1988 through 1990 do not include assembly and test revenue.

*Estimated

Source: Dataquest (August 1990)

Table 2
Semiconductor Production—Hong Kong
(Millions of Hong Kong Dollars)

	1984	1985	1986	1987	1988	1989	1990*	CAGR 1984- 1987	CAGR 1988- 1990*
Total Semiconductor	1,106	1,057	1,316	1,435	273	351	469	9.1%	31.0%
Total Integrated Circuit	885	847	1,059	1,155	195	234	313	9.3%	26.6%
Total Discrete	166	159	199	217	78	117	156	9.3%	41.5%
Total Optoelectronic	55	51	64	70	0	0	0	8.4%	0

Note: Figures for 1984 through 1987 include foundry, assembly, and test revenue. Figures for 1988 through 1990 do not include assembly and test revenue.

*Estimated

Source: Dataquest (August 1990)

Semiconductor Production—China

INTRODUCTION

The following set of detailed tables contains figures that quantify China's semiconductor industry production in US and Korean currencies for 1984 through 1990. Semiconductor production tables are historical data tables with an estimation of the current year, 1990.

Production

China semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, because some assembly and packaging revenue is counted as semiconductor production and some is not.

Semiconductor production Tables 1 and 2 do not include all semiconductor products manufactured in China, including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging between 1984 and 1990. The ASETS database tracks production from 1984 to 1990 of front-end, nonpackaging revenue.

Table 1

Semiconductor Production—China (Millions of US Dollars)

	1984	1985	1986	1987	1988	1989	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	140	163	142	205	288	316	320	13.5%	5.4%
Total Integrated Circuit	43	56	50	91	128	111	125	27.9%	(1.3%)
Total Discrete	95	104	89	110	156	167	190	5.2%	10.5%
Total Optoelectronic	2	3	3	4	4	4	5	26.0%	11.8%

Note: Figures for 1984 to 1990 do not include foundry, assembly, and test revenue.

*Estimated

Source: Dataquest (August 1990)

Table 2

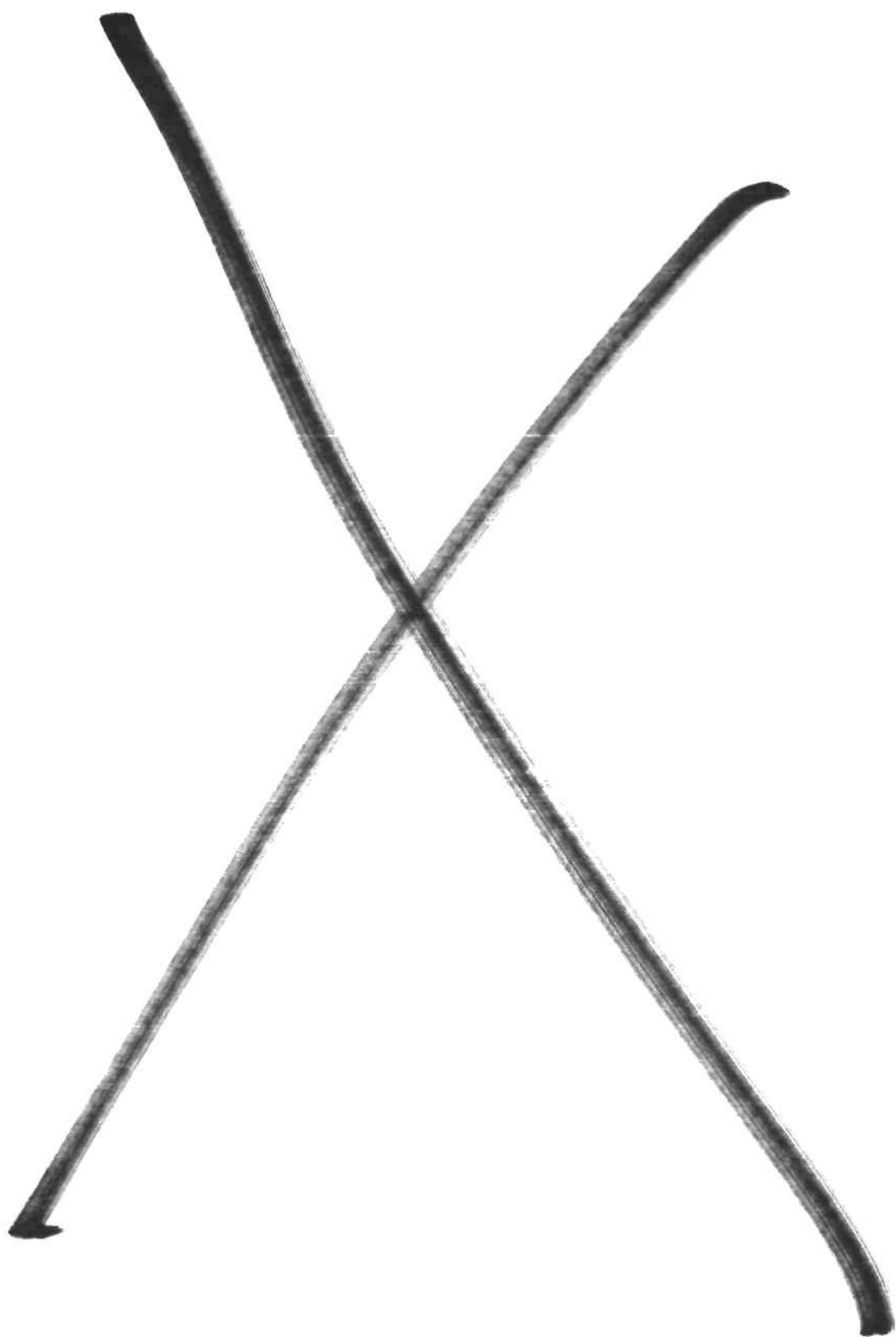
Semiconductor Production—China
(Millions of Chinese Renminbi)

	1984	1985	1986	1987	1988	1989	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	325	480	490	762	1,072	1,177	1,510	32.8%	18.7%
Total Integrated Circuit	100	164	172	337	478	413	590	49.7%	11.1%
Total Discrete	220	307	307	410	579	620	897	23.1%	24.4%
Total Optoelectronic	5	9	10	15	15	15	24	47.4%	25.9%

Note: Figures for 1984 to 1987 do not include foundry, assembly, and test revenue.

*Estimated

Source: Dataquest (August 1990)



Asia/Pacific Semiconductor Consumption—Overview

INTRODUCTION

Tables 1 through 5 quantify Asia/Pacific's total electronics equipment production and semiconductor, integrated circuit, MOS function, and analog consumption for 1988 through 1995 by country. The tables present an overview comparison of Asia/Pacific's major semiconductor-consuming regions. The sections that follow this overview provide in-depth semiconductor device consumption forecasts for each of the newly industrialized economies (NIEs).

Table 1
Total Electronics Equipment Production Forecast by Country
(Millions of U.S. Dollars)

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
South Korea	13,733	16,015	16,822	17,987	19,643	22,216	24,615	27,797	10.7	10.6
Taiwan	9,570	9,245	9,943	10,810	12,033	13,267	14,450	16,349	1.9	10.5
Hong Kong	5,368	5,598	6,341	6,149	6,782	7,454	8,331	9,241	8.7	7.8
Singapore	6,782	7,351	7,754	8,184	9,371	10,526	11,631	13,240	6.9	11.3
Total	35,453	38,209	40,860	43,130	47,829	53,463	59,027	66,627	7.4	10.3

Source: Dataquest (November 1991)

Table 2

Total Semiconductor Consumption Forecast by Country
(Millions of U.S. Dollars)

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
South Korea	1,782	2,014	2,163	2,446	2,792	3,202	3,545	3,847	10.2	12.2
Taiwan	1,563	1,836	2,031	2,332	2,700	3,182	3,496	3,836	14.0	13.6
Hong Kong	830	903	928	998	1,139	1,316	1,458	1,591	5.8	11.4
Singapore	690	871	946	1,070	1,246	1,487	1,757	2,061	17.2	16.8
Total	4,864	5,624	6,069	6,846	7,877	9,186	10,255	11,334	11.7	13.3

Source: Dataquest (November 1991)

Table 3

Total Integrated Circuit Consumption Forecast by Country
(Millions of U.S. Dollars)

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
South Korea	1,350	1,559	1,668	1,883	2,168	2,512	2,807	3,077	11.1	13.0
Taiwan	1,282	1,524	1,708	1,937	2,213	2,580	2,811	3,078	15.4	12.5
Hong Kong	716	739	756	817	945	1,101	1,221	1,341	2.8	12.2
Singapore	599	718	773	876	1,032	1,245	1,483	1,729	13.6	17.5
Total	3,947	4,539	4,905	5,513	6,359	7,438	8,321	9,225	11.5	13.5

Source: Dataquest (November 1991)

Table 4

Total MOS Function Consumption by Country
(Millions of U.S. Dollars)

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
South Korea	675	885	989	1,163	1,405	1,705	1,944	2,162	21.0	16.9
Taiwan	857	1,034	1,190	1,335	1,515	1,727	1,919	2,092	17.8	11.9
Hong Kong	481	499	510	543	637	739	811	901	3.0	12.0
Singapore	385	486	506	578	694	842	1,026	1,180	14.6	18.5
Total	2,399	2,904	3,195	3,619	4,252	5,012	5,699	6,334	15.4	14.7

Source: Dataquest (November 1991)

Table 5

Total Analog Consumption Forecast by Country
(Millions of U.S. Dollars)

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
South Korea	513	526	544	590	640	691	757	818	2.9	8.5
Taiwan	310	373	405	494	596	759	803	905	14.4	17.4
Hong Kong	190	195	205	237	276	333	384	417	4.1	15.2
Singapore	141	169	205	239	286	353	412	507	20.7	19.8
Total	1,153	1,262	1,360	1,560	1,797	2,136	2,356	2,646	8.6	14.2

Source: Dataquest (November 1991)

Asia/Pacific Semiconductor Consumption—South Korea

INTRODUCTION

Tables 1 and 2 contain figures that quantify South Korea's semiconductor industry consumption in U.S. dollars for 1988 through 1995.

DEFINITIONS AND CONVENTIONS

Dataquest uses a common manufacturer base for all data tables. This database 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 Digital Equipment Corporation, IBM, and Unisys. Included, however, are companies that actively market semiconductor devices to the merchant market as well as other divisions of their own companies.

A current case in point is AT&T, previously a captive supplier, which recently 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.

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.

Table 1

**Estimated South Korean Semiconductor Consumption—Total Electronics
(Millions of U.S. Dollars)**

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
Equipment	13,733	16,015	16,822	17,987	19,643	22,216	24,615	27,797	10.7	10.6
Total Semi.	1,781.6	2,014.4	2,163.2	2,446.2	2,792.4	3,201.8	3,545.1	3,847.0	10.2	12.2
Total IC	1,350.4	1,558.8	1,668.0	1,882.8	2,168.3	2,512.3	2,806.8	3,077.2	11.1	13.0
Bipolar	161.7	148.3	135.1	130.0	123.5	116	105.6	97.6	-8.6	-6.3
Bip. Memory	10.9	9.4	8.4	6.5	5.4	4.2	2.0	0.9	-12.3	-36.0
Bip. Logic	150.8	138.9	126.7	123.5	118.1	111.8	103.6	96.7	-8.3	-5.3
MOS Digital	675.4	884.9	989	1,162.7	1,405.2	1,705.2	1,943.7	2,161.8	21.0	16.9
MOS Memory	240.7	319.8	347.6	398.7	515.2	631.3	735.3	823.3	20.2	18.8
MOS Micro.	215.6	284.3	326.4	392.5	455.7	559.8	645.3	721	23.0	17.2
MOS Logic	219.1	280.8	315	371.5	434.2	514.2	563.1	617.4	19.9	14.4
Analog	513.3	525.7	544	590.1	639.6	691.1	757.4	817.8	2.9	8.5
Discrete	381.2	401.8	433.2	484.4	530.4	581.6	616.8	636.2	6.6	8.0
Total Opto.	50.0	53.7	62.0	79.0	93.7	107.9	121.5	133.6	11.4	16.6

Source: Dataquest (November 1991).

Table 2

**Estimated South Korean Semiconductor Consumption—Total Electronics
(Growth Rate—Percentage)**

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Total Semi.	13.1	7.4	13.1	14.1	14.7	10.7	8.5	12.2
Total IC	15.4	7.0	12.9	15.2	15.9	11.7	9.6	13.0
Bipolar	-8.3	-8.9	-3.8	-5.0	-6.1	-8.9	-7.6	-6.3
Bip. Memory	-14.3	-10.4	-23.0	-16.1	-23.0	-52.1	-54.8	-36.0
Bip. Logic	-7.9	-8.8	-2.5	-4.4	-5.3	-7.3	-6.7	-5.3
MOS Digital	31.0	11.8	17.6	20.9	21.4	14.0	11.2	16.9
MOS Memory	32.9	8.7	14.7	29.2	22.5	16.5	12.0	18.8
MOS Micro.	31.8	14.8	20.3	16.1	22.8	15.3	11.7	17.2
MOS Logic	28.2	12.2	17.9	16.9	18.4	9.5	9.6	14.4
Analog	2.4	3.5	8.5	8.4	8.0	9.6	8.0	8.5
Discrete	5.4	7.8	11.8	9.5	9.6	6.1	3.1	8.0
Total Opto.	7.6	15.4	27.4	18.6	15.2	12.5	10.0	16.6

Source: Dataquest (November 1991)

Asia/Pacific Semiconductor Consumption—Taiwan

INTRODUCTION

Tables 1 and 2 contain figures that quantify Taiwan's semiconductor industry consumption in U.S. dollars for 1988 through 1995.

DEFINITIONS AND CONVENTIONS

Dataquest uses a common manufacturer base for all data tables. This database 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 Digital Equipment Corporation, IBM, and Unisys. Included, however, are companies that actively market semiconductor devices to the merchant market as well as other divisions of their own companies.

A current case in point is AT&T, previously a captive supplier, which recently 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.

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.

Table 1

**Estimated Taiwanese Semiconductor Consumption—Total Electronics
(Millions of U.S. Dollars)**

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
Equipment	9,570	9,245	9,943.0	10,810	12,033	13,267	14,450	16,349	1.9	10.5
Total Semi.	1,562.7	1,835.5	2,030.5	2,332.1	2,699.9	3,181.8	3,495.6	3,835.7	14.0	13.6
Total IC	1,282.1	1,523.9	1,707.5	1,937.3	2,213.2	2,580.0	2,810.5	3,078.1	15.4	12.5
Bipolar	114.7	117.6	112.2	107.8	102.3	95.0	87.9	81.1	-1.1	-6.3
Bip. Memory	20.0	22.9	20.5	19.7	19.0	17.9	17.0	15.8	1.2	-5.1
Bip. Logic	94.7	94.7	91.6	88.2	83.4	77.2	70.9	65.3	-1.6	-6.5
MOS Digital	857.4	1,033.8	1,190.1	1,335.1	1,515.3	1,726.6	1,919.3	2,092.3	17.8	11.9
MOS Memory	471.7	489.9	540.1	601.6	695.3	798.6	894.2	990.7	7.0	12.9
MOS Micro.	185.3	263.5	357.7	399.3	459.4	529	589.8	634.4	38.9	12.1
MOS Logic	200.4	280.5	292.3	334.2	360.6	399	435.2	467.2	20.8	9.8
Analog	309.9	372.5	405.3	494.3	595.5	758.5	803.3	904.7	14.3	17.4
Discrete	229.3	254.7	261.8	328.2	402.1	495.5	558.7	617.0	6.8	18.7
Total Opto.	51.2	56.9	61.2	66.6	84.6	106.2	126.4	140.6	9.3	18.1

Source: Dataquest (November 1991)

Table 2

Estimated Taiwanese Semiconductor Consumption—Total Electronics
(Growth Rate—Percentage)

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Total Semi.	17.5	10.6	14.9	15.8	17.8	9.9	9.7	13.6
Total IC	18.9	12.0	13.5	14.2	16.6	8.9	9.5	12.5
Bipolar	2.5	-4.6	-3.9	-5.1	-7.2	-7.5	-7.7	-6.3
Bip. Memory	14.3	-10.4	-4.2	-3.6	-5.8	-4.5	-7.5	-5.1
Bip. Logic	0	-3.2	-3.8	-5.4	-7.5	-8.2	-7.8	-6.5
MOS Digital	20.6	15.1	12.2	13.5	13.9	11.2	9.0	11.9
MOS Memory	3.9	10.2	11.4	15.6	14.9	12.0	10.8	12.9
MOS Micro.	42.2	35.8	11.6	15.1	15.1	11.5	7.6	12.1
MOS Logic	39.9	4.2	14.3	7.9	10.6	9.1	7.3	9.8
Analog	20.2	8.8	22.0	20.5	27.4	5.9	12.6	17.4
Discrete	11.1	2.8	25.4	22.5	23.2	12.8	10.4	18.7
Total Opto.	11.0	7.5	8.9	27.0	25.6	19.0	11.2	18.1

Source: Dataquest (November 1991)

Asia/Pacific Semiconductor Consumption—Hong Kong

INTRODUCTION

Tables 1 and 2 contain figures that quantify Hong Kong's semiconductor industry consumption in U.S. dollars for 1988 through 1995.

DEFINITIONS AND CONVENTIONS

Dataquest uses a common manufacturer base for all data tables. This database 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 Digital Equipment Corporation, IBM, and Unisys. Included, however, are companies that actively market semiconductor devices to the merchant market as well as other divisions of their own companies.

A current case in point is AT&T, previously a captive supplier, which recently 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.

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.

Table 1

Estimated Hong Kong Semiconductor Consumption—Total Electronics
(Millions of U.S. Dollars)

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
Equipment	5,368.0	5,598.2	6,340.9	6,149.0	6,782.0	7,454.0	8,331.0	9,241.0	8.7	7.8
Total Semi.	829.8	903.1	928.4	997.8	1,138.8	1,315.7	1,457.9	1,590.5	5.8	11.4
Total IC	715.8	738.7	755.8	817.1	945.2	1,101.2	1,221.2	1,341.1	2.8	12.2
Bipolar	45.1	44.8	40.0	37.1	32.3	29.7	26.8	23.7	-5.8	-9.9
Bip. Memory	7.9	6.9	6.5	5.7	4.7	4.1	3.3	2.4	-9.5	-17.8
Bip. Logic	37.2	37.9	33.5	31.4	27.6	25.7	23.5	21.3	-5.1	-8.7
MOS Digital	481.2	498.6	510.4	543.3	637.2	738.5	810.5	900.6	3.0	12.0
MOS Memory	186.3	194.6	201.2	237.6	280.0	335.1	360.6	407.8	3.9	15.2
MOS Micro.	147.4	153.5	155.1	181.0	213.9	229.7	258.7	278.7	2.6	12.4
MOS Logic	147.5	150.5	154.1	124.6	143.3	173.7	191.2	214.1	2.2	6.8
Analog	189.5	195.2	205.4	236.7	275.7	332.9	384.0	416.8	4.1	15.2
Discrete	98.1	138.0	145.5	152.4	160.9	177.8	194.8	205.3	21.8	7.1
Total Opto.	15.9	26.5	27.1	28.3	32.7	36.8	41.9	44.1	30.5	10.2

Source: Dataquest (November 1991)

Table 2

Estimated Hong Kong Semiconductor Consumption—Total Electronics
(Growth Rate—Percentage)

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Total Semi.	8.8	2.8	7.5	14.1	15.5	10.8	9.1	11.4
Total IC	3.2	2.3	8.1	15.7	16.5	10.9	9.8	12.2
Bipolar	-0.7	-10.7	-7.3	-12.8	-8.0	-9.8	-11.6	-9.9
Bip. Memory	-12.9	-5.9	-12.7	-17.1	-13.7	-18.3	-26.3	-17.8
Bip. Logic	2.0	-11.6	-6.3	-12.0	-7.1	-8.5	-9.5	-8.7
MOS Digital	3.6	2.4	6.4	17.3	15.9	9.7	11.1	12.0
MOS Memory	4.5	3.4	18.1	17.8	19.7	7.6	13.1	15.2
MOS Micro.	4.1	1.0	16.7	18.2	7.4	12.6	7.7	12.4
MOS Logic	2.1	2.4	-19.1	15.0	21.2	10.0	12.0	6.8
Analog	3.0	5.2	15.3	16.4	20.8	15.3	8.5	15.2
Discrete	40.7	5.4	4.8	5.6	10.4	9.6	5.4	7.1
Total Opto.	66.1	2.6	4.1	15.7	12.6	13.9	5.3	10.2

Source: Dataquest (November 1991)

Asia/Pacific Semiconductor Consumption—Singapore

INTRODUCTION

Tables 1 and 2 contain figures that quantify Singapore's semiconductor industry consumption in U.S. dollars for 1988 through 1995.

DEFINITIONS AND CONVENTIONS

Dataquest uses a common manufacturer base for all data tables. This database 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 Digital Equipment Corporation, IBM, and Unisys. Included, however, are companies that actively market semiconductor devices to the merchant market as well as to other divisions of their own companies.

A current case in point is AT&T, previously a captive supplier, which recently 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.

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.

Table 1

Estimated Singaporean Semiconductor Consumption—Total Electronics
(Millions of U.S. Dollars)

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1988-1990	CAGR (%) 1990-1995
Equipment	6,782	7,351	7,754	8,184	9,371	10,526	11,631	13,240	6.9	11.3
Total Semi.	689.5	870.8	946.4	1,070.3	1,245.5	1,487.0	1,756.6	2,061.0	17.2	16.8
Total IC	599.1	717.6	773.2	876.2	1,032.2	1,244.7	1,482.5	1,728.7	13.6	17.5
Bipolar	73.4	62.4	62.7	59.0	52.6	49.5	45.4	42.8	-7.5	-7.4
Bip. Memory	2.8	2.0	4.9	4.4	3.8	3.2	2.5	2.4	33.4	-13.2
Bip. Logic	70.6	60.3	57.8	54.6	48.8	46.3	43.0	40.3	-9.5	-6.9
MOS Digital	385.1	486.2	505.6	578.1	694	842	1,025.5	1,179.5	14.6	18.5
MOS Memory	170.6	220.9	224.8	253.2	309.2	362.3	442.3	501.7	14.8	17.4
MOS Micro.	100.2	133.2	145.7	173.1	210.3	269.7	325.8	367.1	20.6	20.3
MOS Logic	114.4	132.1	135.1	151.8	174.5	210.0	257.4	310.6	8.7	18.1
Analog	140.6	169.0	204.9	239.1	285.7	353.2	411.5	506.5	20.7	19.8
Discrete	74.1	133.7	150.7	168.8	185.7	210.2	235.2	286.6	42.6	13.7
Total Opto.	16.4	19.5	22.4	25.2	27.6	32.1	39.0	45.7	17.1	15.3

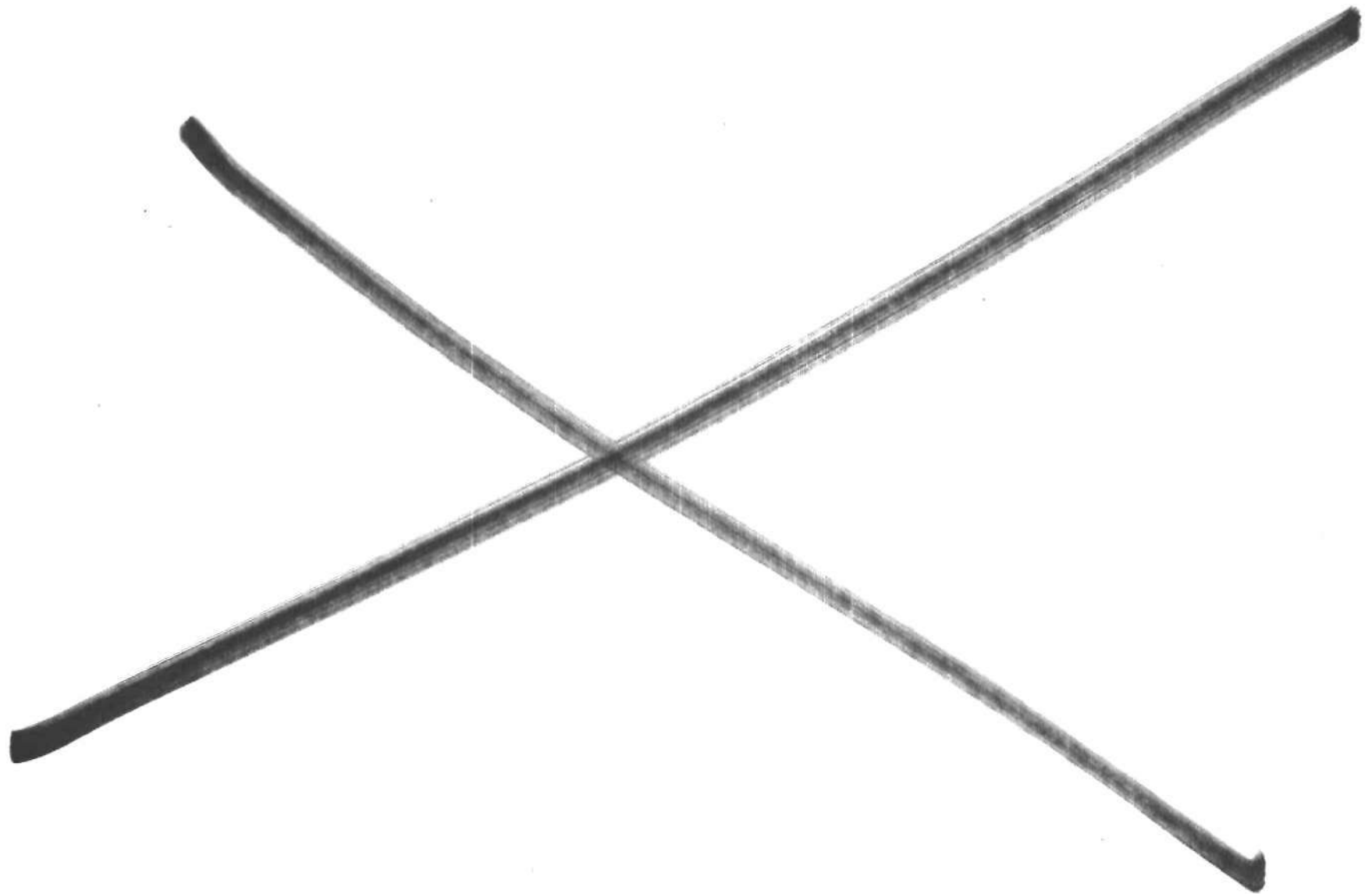
Source: Dataquest (November 1991)

Table 2

Estimated Singaporean Semiconductor Consumption—Total Electronics
(Growth Rate—Percentage)

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Total Semi.	26.3	13.6	13.1	16.4	19.4	18.1	17.3	16.8
Total IC	19.8	7.8	13.3	17.8	20.6	19.1	16.6	17.5
Bipolar	-15.0	0.6	-5.9	-10.9	-5.9	-8.2	-5.9	-7.4
Bip. Memory	-25.8	139.8	-9.8	-14.5	-16.0	-22.2	-2.2	-13.2
Bip. Logic	-14.6	-4.2	-5.5	-10.6	-5.1	-7.3	-6.1	-6.9
MOS Digital	26.2	4.0	14.4	20.0	21.3	21.8	15.0	18.5
MOS Memory	29.5	1.8	12.7	22.1	17.2	22.1	13.4	17.4
MOS Micro.	33.0	9.3	18.8	21.5	28.2	20.8	12.7	20.3
MOS Logic	15.5	2.3	12.3	14.9	20.4	22.6	20.7	18.1
Analog	20.2	21.3	16.7	19.5	23.6	16.5	23.1	19.8
Discrete	80.4	57.4	12.0	10.0	13.2	11.9	21.8	13.7
Total Opto.	19.3	14.9	12.5	9.3	16.4	21.4	17.1	15.3

Source: Dataquest (November 1991)



Market Share--South Korea

INTRODUCTION

The analysis of semiconductor markets through estimation of market share by manufacturer is an integral part of Dataquest's Asian semiconductor industry database. This analysis provides insights into semiconductor markets and reinforces estimates of consumption, production, and company revenue that were made using other data. The tables show the Asian market shares for all major Japanese, U.S., European, and Asia/Pacific-ROW semiconductor manufacturers. Table 1 is a currency conversion chart; Table 2 shows South Korean semiconductor consumption by country. Tables 3 through 16 present South Korean semiconductor market share by company for 1984, 1985, 1986, and 1987. Tables 17 through 20 present South Korean semiconductor market share by company and product for 1984 through 1988. Table 21 presents the 1988 semiconductor market share; these figures represent the most recent historical data available for this market.

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 South Korean won, in order to provide a more accurate presentation of real growth rates for the Asian companies.

Tables are constructed by 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. As far as possible, the estimates are prepared in terms of local currencies before conversion to U.S. dollars. The dollar exchange rates by year are given in Table 1.

Need for Careful Interpretation

Care is taken in gathering and analyzing the available data and in attempting to categorize those data in a meaningful way. Nevertheless, 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.

Market Share--South Korea

MARKET SHARE

Historically, Japanese and U.S. manufacturers have had the largest share of the South Korean semiconductor market. However, native South Korean manufacturers gained an increasing share between 1983 and 1987. Regional market share for semiconductors consumed in South Korea is shown in millions of dollars and as a percentage of the total in Table 2.

Japanese manufacturers historically have had the largest share of this semiconductor market. Japanese sales of \$110 million in 1983 accounted for 48.9 percent of the local market. Japanese sales grew 47.4 percent cumulatively over the 1983 to 1987 period. This growth rate is lower than the market, which increased 54.4 percent over the same period. The Japanese share had declined slightly to 40.3 percent by 1987.

U.S. manufacturers' sales to the South Korean market also grew at a slightly higher rate than the market. U.S. 1983 revenue of \$63 million grew at a cumulative annual rate of 56.9 percent to reach \$382 million in 1987. The U.S. market share, estimated at 27.8 percent in 1983, reached 29.5 percent of the market in 1987.

In 1983, South Korean manufacturers' revenue was approximately \$30 million, or 13.3 percent of the native market. Their revenue has grown at a cumulative annual rate of 66.8 percent, reaching \$232 million dollars in 1987. This growth has resulted in an increase in market share to 18.0 percent in 1987.

Revenue of Asia/Pacific-ROW manufacturers, notably European and Asian companies, also showed rapid growth and a slight increase in share of the South Korean market between 1982 and 1984. Asia/Pacific-ROW revenue was approximately \$24 million in 1983, a 10.6 percent share of the market. This revenue grew at a cumulative annual rate of 60.0 percent to reach \$157 million in 1987.

Market Share--South Korea

Table 1

Exchange Rate--South Korea (Won to U.S. Dollar)

<u>Year</u>	<u>Won per Dollar</u>
1982	748.8
1983	795.5
1984	827.4
1985	890.2
1986	861.4
1987	792.3

Source: Far Eastern Economic Review
Dataquest
December 1989

Table 2

Semiconductor Consumption--South Korea Estimated Share of Worldwide Manufacturers Regional Historical Summary (Millions of U.S. Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>CAGR</u> <u>1983-1987</u>
Total Semiconductor	\$227	\$304	\$432	\$793	\$1,291	54.4%
Japan	\$110	\$127	\$179	\$322	\$ 520	47.4%
United States	63	89	127	239	382	56.9%
South Korea	30	46	69	135	232	66.8%
Asia/Pacific-ROW	24	42	57	97	157	60.0%

(Percent of Total)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Total Semiconductor	100.0%	100.0%	100.0%	100.0%	100.0%
Japan	48.9%	41.7%	41.5%	40.6%	40.3%
United States	27.8	29.2	29.4	30.2	29.5
South Korea	13.3	15.2	16.0	17.0	18.0
Asia/Pacific-ROW	10.6	13.9	13.1	12.2	12.2

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 3

Semiconductor Market--South Korea Estimated Share of Worldwide Manufacturers by Company Total Semiconductor (Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	\$126.8	\$179.5	\$321.6	\$ 518.9
Fujitsu	2.4	6.0	13.1	28.0
Hitachi	21.9	27.7	47.5	70.0
Matsushita	10.5	12.0	14.7	40.0
Mitsubishi	8.2	9.5	20.8	50.0
NEC	25.3	31.0	49.9	84.0
Sanyo	17.6	20.0	40.0	67.3
Sharp	2.4	3.0	5.5	15.0
Toshiba	16.7	26.0	52.6	98.5
Others	21.8	44.3	77.5	67.1
United States	\$ 88.8	\$127.2	\$239.5	\$ 381.7
AMD	2.4	5.0	8.5	17.0
AMI	0.6	1.0	1.6	1.0
Fairchild	5.9	5.6	4.8	12.0
GI	4.5	5.0	10.3	21.6
Intel	3.5	6.0	15.0	35.0
MMI	0.1	1.0	1.6	2.0
Mostek	2.5	4.0	1.8	0.0
Motorola	21.2	20.0	49.6	80.0
NSC	9.7	13.5	23.8	30.0
RCA	2.1	3.0	6.3	9.0
Signetics	3.1	3.0	7.4	12.0
TI	20.6	22.0	46.1	67.0
Others	12.6	38.1	62.7	92.9
South Korea	\$ 46.2	\$ 69.1	\$134.6	\$ 232.2
Daewoo	0.0	0.0	1.0	1.0
Goldstar	7.5	8.1	13.7	22.7
Hyundai	0.0	0.0	1.8	7.6
KEC	19.3	23.6	45.0	63.0
Samsung	17.8	23.7	46.5	98.0
Others	1.6	13.7	26.6	39.9
Asia/Pacific-ROW	\$ 42.2	\$ 56.5	\$ 97.3	\$ 157.6
ITT	1.6	2.0	2.2	6.6
Philips	3.9	5.0	6.1	5.7
Rifa	1.6	1.0	1.0	1.0
SGS	11.8	12.5	16.3	26.3
Siemens	2.3	3.0	3.2	3.6
Thomson	6.8	7.0	6.2	8.4
UMC	1.6	4.0	7.0	10.0
Others	12.6	22.0	55.3	96.0
Total	\$304.0	\$432.3	\$793.0	\$1,291.4

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 4

Semiconductor Market--South Korea Estimated Share of Worldwide Manufacturers by Company Total Semiconductor (Billions of Won)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	W104.9	W159.8	W277.0	W 411.9
Fujitsu	2.0	5.3	11.3	22.2
Hitachi	18.1	24.7	40.9	55.5
Matsushita	8.7	10.7	12.7	27.7
Mitsubishi	6.8	8.5	17.9	43.6
NEC	20.9	27.6	43.0	66.6
Sanyo	14.6	17.8	34.5	53.3
Sharp	2.0	2.7	4.7	11.9
Toshiba	13.8	23.1	45.3	78.0
Others	18.0	39.4	66.8	53.2
United States	W 73.5	W113.2	W206.3	W 302.4
AMD	2.0	4.5	7.3	13.5
AMI	0.5	0.9	1.4	2.5
Fairchild	4.9	5.0	4.1	9.5
GI	3.7	4.5	8.9	17.1
Intel	2.9	5.3	12.9	27.7
MMI	0.1	0.9	1.4	1.6
Mostek	2.1	3.6	1.6	0.0
Motorola	17.5	17.8	42.7	63.4
NSC	8.0	12.0	20.5	23.8
RCA	1.7	2.7	5.4	7.1
Signetics	2.6	2.7	6.4	9.5
TI	17.0	19.6	39.7	53.1
Others	10.4	33.9	54.0	73.6
South Korea	W 38.2	W 61.5	W115.9	W 184.0
Daewoo	0.0	0.0	0.9	0.8
Goldstar	6.2	7.2	11.8	18.0
Hyundai	0.0	0.0	1.4	6.0
KEC	16.0	21.0	38.8	49.9
Samsung	14.7	21.1	40.1	77.6
Others	1.3	12.1	22.9	31.6
Asia/Pacific-ROW	W 34.9	W 50.3	W 83.8	W 124.9
ITT	1.3	1.8	1.9	5.2
Philips	3.2	4.5	5.3	4.5
Rifa	1.3	0.9	0.9	0.8
SGS	9.8	11.1	14.0	20.8
Siemens	1.9	2.7	2.8	2.9
Thomson	5.6	6.2	5.3	6.7
UMC	1.3	3.6	6.0	7.9
Others	10.4	19.6	47.6	76.1
Total	W251.5	W384.8	W683.1	W1,023.2

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 5

Semiconductor Market--South Korea Estimated Share of Worldwide Manufacturers by Company Integrated Circuit (Millions of U.S. Dollars)

Companies	1984	1985	1986	1987
Japan	\$179.2	\$139.5	\$259.7	\$432.1
Fujitsu	1.6	5.0	10.1	20.0
Hitachi	20.3	25.7	42.5	63.0
Matsushita	2.7	9.0	11.7	30.0
Mitsubishi	5.4	6.5	15.8	48.0
NEC	19.8	25.0	40.0	71.0
Sanyo	10.1	11.0	22.6	40.0
Sharp	1.6	2.0	3.1	13.0
Toshiba	9.3	18.0	41.8	80.0
Others	3.4	37.3	72.1	67.1
United States	\$ 55.9	\$109.4	\$196.9	\$320.1
AMD	2.4	5.0	8.5	17.0
AMI	0.6	1.0	1.6	3.2
Fairchild	2.3	2.6	3.3	10.0
GI	1.6	2.0	4.2	9.6
Intel	3.5	6.0	15.0	35.0
MMI	0.1	1.0	1.6	2.0
Mostek	2.5	4.0	1.8	0.0
Motorola	13.2	12.0	36.6	60.0
NSC	10.6	12.5	20.1	25.0
RCA	2.1	3.0	6.3	9.0
Signetics	3.1	3.0	7.4	12.0
TI	17.1	21.0	45.4	65.0
Others	0.7	36.3	45.1	72.3
South Korea	\$ 21.4	\$ 36.3	\$ 73.5	\$147.1
Daewoo	0.0	0.0	1.0	1.0
Goldstar	5.9	6.9	13.0	22.0
Hyundai	0.0	0.0	1.8	7.6
KEC	2.3	3.2	8.0	15.0
Samsung	12.4	17.2	31.5	75.0
Others	0.8	9.0	18.2	26.5
Asia/Pacific-ROW	\$ 19.6	\$ 33.7	\$ 52.0	\$ 93.5
ITT	0.8	1.0	1.2	4.0
Philips	2.4	3.0	4.1	3.7
Rifa	1.6	1.0	1.0	1.0
SGS	9.5	8.5	10.8	20.8
Siemens	0.8	1.0	1.2	1.6
Thomson	4.3	5.0	4.0	4.0
UMC	1.6	4.0	7.0	10.0
Others	0.6	10.2	22.7	48.4
Total	\$176.1	\$318.9	\$582.1	\$992.8

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Table 6

Semiconductor Market—South Korea Estimated Share of Worldwide Manufacturers by Company Integrated Circuit (Billions of Won)

Companies	1984	1985	1986	1987
Japan	W 65.5	W124.2	W223.9	W342.4
Fujitsu	1.3	4.5	8.7	15.8
Hitachi	16.8	22.9	36.6	49.9
Matsushita	6.4	8.0	10.1	23.8
Mitsubishi	4.5	5.7	13.6	38.0
NEC	16.4	22.3	34.5	56.3
Sanyo	8.4	9.8	19.5	31.9
Sharp	1.3	1.8	2.7	10.3
Toshiba	7.7	16.0	36.0	63.4
Others	2.8	33.2	62.1	53.2
United States	W 46.3	W 97.4	W169.6	W253.6
AMD	2.0	4.5	7.3	13.5
AMI	0.5	0.9	1.4	2.5
Fairchild	1.9	2.3	2.8	7.9
GI	1.3	1.8	3.6	7.6
Intel	2.9	5.3	12.9	27.7
MMI	0.1	0.9	1.4	1.6
Mostek	2.1	3.6	1.6	0.0
Motorola	9.3	10.7	31.5	47.5
NSC	7.2	11.1	17.3	19.8
RCA	1.7	2.7	5.4	7.1
Signetics	2.6	2.7	6.4	9.5
TI	14.1	18.7	39.1	51.5
Others	0.6	32.3	38.8	57.3
South Korea	W 17.7	W 32.2	W 63.3	W116.5
Daewoo	0.0	0.0	0.9	0.8
Goldstar	4.9	6.1	11.2	17.4
Hyundai	0.0	0.0	1.6	6.0
KEC	1.9	2.8	6.9	11.9
Samsung	10.3	15.3	27.1	59.4
Others	0.7	8.0	15.7	21.0
Asia/Pacific-ROW	W 16.2	W 30.0	W 44.8	W 74.1
ITT	0.7	0.9	1.0	3.2
Philips	2.0	2.7	3.5	2.9
Rifa	1.3	0.9	0.9	0.8
SGS	6.2	7.6	9.3	16.5
Siemens	0.7	0.9	1.0	1.3
Thomson	3.6	4.5	3.4	3.2
UMC	1.3	3.6	6.0	7.9
Others	0.5	8.9	19.6	18.3
Total	W145.7	W283.9	W501.4	W786.6

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 7

Semiconductor Market--South Korea
Estimated Share of Worldwide Manufacturers by Company
Bipolar Digital
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	\$11.4	\$ 6.0	\$21.7	\$ 37.2
Hitachi	6.2	0.7	9.5	13.0
Matsushita	0.0	0.0	0.0	4.0
Mitsubishi	2.3	3.0	4.8	8.0
Toshiba	0.8	0.0	3.2	7.0
Others	2.1	2.3	4.2	5.2
United States	\$14.4	\$29.8	\$44.4	\$ 63.7
AMD	0.8	1.0	2.4	4.0
Fairchild	1.5	1.5	1.6	4.0
MMI	0.1	1.0	1.6	2.0
Motorola	3.1	1.0	6.6	13.0
NSC	2.0	2.5	6.3	7.0
Signetics	0.0	1.0	1.6	2.0
TI	6.2	7.0	13.4	15.0
Others	0.7	14.8	10.9	16.7
South Korea	\$ 0.8	\$ 2.2	\$ 5.8	\$ 12.0
Goldstar	0.8	2.2	5.8	12.0
Asia/Pacific-ROW	\$ 2.9	\$ 3.5	\$ 3.5	\$ 5.9
Philips	0.8	1.0	1.3	0.9
SGS	1.6	2.0	2.0	5.0
Others	<u>0.5</u>	<u>0.5</u>	<u>0.2</u>	<u>0.0</u>
Total	\$29.5	\$41.5	\$75.4	\$118.8

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
 December 1989

Market Share--South Korea

Table 8

Semiconductor Market--South Korea
Estimated Share of Worldwide Manufacturers by Company
Bipolar Digital
(Billions of Won)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	W 9.4	W 5.3	W18.7	W27.5
Hitachi	5.1	0.6	8.2	10.3
Matsushita	0.0	0.0	0.0	3.2
Mitsubishi	1.9	2.7	4.1	6.3
Toshiba	0.7	0.0	2.8	5.5
Others	1.7	2.0	3.6	4.1
United States	W11.9	W26.5	W38.2	W50.5
AMD	0.7	0.9	2.1	3.2
Fairchild	1.2	1.3	1.4	3.2
MMI	0.1	0.9	1.4	1.6
Motorola	2.6	0.9	5.7	10.3
NSC	1.7	2.2	5.4	5.5
Signetics	0.0	0.9	1.4	1.6
TI	5.1	6.2	11.5	11.9
Others	0.6	13.2	9.4	13.2
South Korea	W 0.7	W 2.0	W 5.0	W 9.5
Goldstar	0.7	2.0	5.0	9.5
Asia/Pacific-ROW	W 2.4	W 3.1	W 3.0	W 4.7
Philips	0.7	0.9	1.1	0.7
SGS	1.3	1.8	1.7	4.0
Others	<u>0.4</u>	<u>0.4</u>	<u>0.2</u>	<u>0.0</u>
Total	W24.4	W36.9	W64.9	W94.1

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 9

Semiconductor Market--South Korea
Estimated Share of Worldwide Manufacturers by Company
MOS
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	\$30.1	\$ 60.9	\$108.3	\$187.5
Fujitsu	1.6	5.0	10.1	20.0
Hitachi	9.4	15.0	18.0	25.0
Matsushita	2.3	3.0	3.9	16.0
Mitsubishi	0.8	1.0	3.0	20.0
NEC	10.5	15.0	25.0	39.0
Sanyo	1.6	2.0	3.1	15.0
Sharp	1.6	2.0	3.1	13.0
Toshiba	2.3	8.0	20.0	39.0
Others	0.0	9.9	22.1	0.5
United States	\$24.1	\$ 51.8	\$ 90.1	\$148.4
AMD	1.6	2.0	3.1	9.0
AMI	0.6	1.0	1.6	3.2
Fairchild	0.1	0.1	0.8	4.0
GI	0.8	1.0	1.6	6.6
Intel	3.5	6.0	15.0	35.0
Mostek	2.5	4.0	1.8	0.0
Motorola	3.4	6.0	16.0	27.0
NSC	1.7	5.0	7.8	10.0
RCA	1.3	2.0	2.3	5.0
Signetics	0.8	1.0	0.8	4.0
TI	7.8	10.0	17.0	30.0
Others	0.0	13.7	22.3	14.6
South Korea	\$ 7.0	\$ 11.2	\$ 28.2	\$ 63.6
Goldstar	0.8	1.5	4.0	6.0
Hyundai	0.0	0.0	1.8	7.6
Samsung	6.2	9.7	18.0	50.0
Others	0.0	0.0	4.4	0.0
Asia/Pacific-ROW	\$ 6.0	\$ 10.0	\$ 17.6	\$ 39.4
Philips	0.8	1.0	1.2	1.2
SGS	1.3	1.5	3.1	9.1
Thomson	2.3	3.0	2.0	2.0
UMC	1.6	4.0	7.0	10.0
Others	<u>0.0</u>	<u>0.5</u>	<u>4.3</u>	<u>17.1</u>
Total	\$67.2	\$133.9	\$244.2	\$438.9

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 10

Semiconductor Market--South Korea
Estimated Share of Worldwide Manufacturers by Company
MOS
(Billions of Won)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	W24.9	W 54.2	W 93.3	W148.6
Fujitsu	1.3	4.5	8.7	15.8
Hitachi	7.8	13.4	15.5	19.8
Matsushita	1.9	2.7	3.4	12.7
Mitsubishi	0.7	0.9	2.6	15.8
NEC	8.7	13.4	21.5	30.9
Sanyo	1.3	1.8	2.7	11.9
Sharp	1.3	1.8	2.7	10.3
Toshiba	1.9	7.1	17.2	30.9
Others	0.0	8.8	19.0	0.4
United States	W19.9	W 46.1	W 77.6	W117.6
AMD	1.3	1.8	2.7	7.1
AMI	0.5	0.9	1.4	2.5
Fairchild	0.1	0.1	0.7	3.2
GI	0.7	0.9	1.4	5.2
Intel	2.9	5.3	12.9	27.7
Mostek	2.1	3.6	1.6	0.0
Motorola	2.8	5.3	13.8	21.4
NSC	1.4	4.5	6.7	7.9
RCA	1.1	1.8	2.0	4.0
Signetics	0.7	0.9	0.7	3.2
TI	6.5	8.9	14.6	23.8
Others	0.0	12.2	19.2	11.6
South Korea	W 5.8	W 10.0	W 24.3	W 50.4
Goldstar	0.7	1.3	3.4	4.8
Hyundai	0.0	0.0	1.6	6.0
Samsung	5.1	8.6	15.5	39.6
Asia/Pacific-ROW	W 5.0	W 8.9	W 15.2	W 31.2
Philips	0.7	0.9	1.0	1.0
SGS	1.1	1.3	2.7	7.2
Thomson	1.9	2.7	1.7	1.6
UMC	1.3	3.6	6.0	7.9
Others	0.0	0.4	3.7	13.5
Total	W55.6	W119.2	W210.4	W347.8

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 11

Semiconductor Market--South Korea
Estimated Share of Worldwide Manufacturers by Company
Linear
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	\$37.7	\$ 72.6	\$129.7	\$207.4
Hitachi	4.7	10.0	15.0	25.0
Matsushita	5.4	6.0	7.8	10.0
Mitsubishi	2.3	2.5	8.0	20.0
NEC	9.3	10.0	15.0	32.0
Sanyo	8.5	9.0	19.5	25.0
Toshiba	6.2	10.0	18.6	34.0
Others	1.3	25.1	45.8	61.4
United States	\$17.4	\$ 27.8	\$ 62.4	\$108.0
AMD	0.0	2.0	3.0	4.0
Fairchild	0.7	1.0	0.9	2.0
GI	0.8	1.0	2.6	3.0
Motorola	4.7	5.0	14.0	20.0
NSC	5.0	5.0	6.0	8.0
RCA	0.8	1.0	4.0	4.0
Signetics	2.3	1.0	5.0	6.0
TI	3.1	4.0	15.0	20.0
Others	0.0	7.8	11.9	41.0
South Korea	\$13.6	\$ 22.9	\$ 39.5	\$ 71.5
Daewoo	0.0	0.0	1.0	1.0
Goldstar	4.3	3.2	3.2	4.0
KEC	2.3	3.2	8.0	15.0
Samsung	6.2	7.5	13.5	25.0
Others	0.8	9.0	13.8	26.5
Asia/Pacific-ROW	\$10.7	\$ 20.2	\$ 30.9	\$ 48.2
ITT	0.8	1.0	1.2	4.0
Philips	0.8	1.0	1.6	1.6
Rifa	1.6	1.0	1.0	1.0
SGS	4.6	5.0	5.7	6.7
Siemens	0.8	1.0	1.2	1.6
Thomson	2.0	2.0	2.0	2.0
Others	<u>0.1</u>	<u>9.2</u>	<u>18.2</u>	<u>31.3</u>
Total	\$79.4	\$143.5	\$262.5	\$435.1

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 12

Semiconductor Market--South Korea Estimated Share of Worldwide Manufacturers by Company Linear (Billions of Won)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	W31.2	W 64.6	W111.7	W164.3
Hitachi	3.9	8.9	12.9	19.8
Matsushita	4.5	5.3	6.7	7.9
Mitsubishi	1.9	2.2	6.9	15.8
NEC	7.7	8.9	12.9	25.4
Sanyo	7.0	8.0	16.8	19.8
Toshiba	5.1	8.9	16.0	26.9
Others	1.1	22.3	39.5	48.6
United States	W14.4	W 24.7	W 53.8	W 85.6
AMD	0.0	1.8	2.6	3.2
Fairchild	0.6	0.9	0.8	1.6
GI	0.7	0.9	2.2	2.4
Motorola	3.9	4.5	12.1	15.8
NSC	4.1	4.5	5.2	6.3
RCA	0.7	0.9	3.4	3.2
Signetics	1.9	0.9	4.3	4.8
TI	2.6	3.6	12.9	15.8
Others	0.0	6.9	10.3	32.5
South Korea	W11.3	W 20.4	W 34.0	W 56.6
Daewoo	0.0	0.0	0.9	0.8
Goldstar	3.6	2.8	2.8	3.2
KEC	1.9	2.8	6.9	11.9
Samsung	5.1	6.7	11.6	19.8
Others	0.7	8.0	11.9	21.0
Asia/Pacific-ROW	W 8.9	W 18.0	W 26.6	W 38.2
ITT	0.7	0.9	1.0	3.2
Philips	0.7	0.9	1.4	1.3
Rifa	1.3	0.9	0.9	0.8
SGS	3.8	4.5	4.9	5.3
Siemens	0.7	0.9	1.0	1.3
Thomson	1.7	1.8	1.7	1.6
Others	0.1	8.2	15.7	24.8
Total	W65.7	W127.7	W226.1	W347.7

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 13

Semiconductor Market--South Korea
Estimated Share of Worldwide Manufacturers by Company
Discrete
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	\$ 43.6	\$31.6	\$ 47.6	\$ 77.0
Fujitsu	0.8	1.0	3.0	8.0
Hitachi	1.6	2.0	5.0	7.0
Matsushita	2.8	3.0	3.0	5.0
Mitsubishi	2.8	3.0	5.0	7.0
NEC	4.7	5.0	8.0	10.0
Sanyo	6.7	8.0	15.0	25.0
Toshiba	6.6	7.0	8.4	15.0
Others	17.6	2.6	0.2	0.0
United States	\$ 32.2	\$15.9	\$ 39.0	\$ 58.0
Fairchild	3.6	3.0	1.5	2.0
GI	2.3	2.0	4.6	10.0
Motorola	10.0	8.0	13.0	20.0
NSC	1.0	1.0	3.7	5.0
TI	3.5	1.0	0.7	2.0
Others	11.9	0.9	15.5	19.0
South Korea	\$ 23.2	\$30.8	\$ 59.1	\$ 82.1
Gold Star	1.6	1.2	0.7	0.7
KEC	15.4	18.4	35.0	45.0
Samsung	5.4	6.5	15.0	23.0
Others	0.8	4.7	8.4	13.4
Asia/Pacific-ROW	\$ 21.9	\$19.8	\$ 42.2	\$ 56.6
ITT	0.8	1.0	1.0	2.6
Philips	1.5	2.0	2.0	2.0
SGS	4.3	4.0	5.5	5.5
Siemens	1.5	2.0	2.0	2.0
Thomson	2.5	2.0	2.2	4.4
Others	<u>11.3</u>	<u>8.8</u>	<u>29.5</u>	<u>40.1</u>
Total	\$121.0	\$98.1	\$187.9	\$273.7

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 14

Semiconductor Market--South Korea Estimated Share of Worldwide Manufacturers by Company Discrete (Billions of Won)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	W 36.1	W28.1	W 41.0	W 61.0
Fujitsu	0.7	0.9	2.6	6.3
Hitachi	1.3	1.8	4.3	5.5
Matsushita	2.3	2.7	2.6	4.0
Mitsubishi	2.3	2.7	4.3	5.5
NEC	3.9	4.5	6.9	7.9
Sanyo	5.5	7.1	12.9	19.8
Toshiba	5.5	6.2	7.2	11.9
Others	14.6	2.3	0.2	0.0
United States	W 26.7	W14.2	W 33.6	W 46.0
Fairchild	3.0	2.7	1.3	1.6
GI	1.9	1.8	4.0	7.9
Motorola	8.3	7.1	11.2	15.8
NSC	0.8	0.9	3.2	4.0
TI	2.9	0.9	0.6	1.6
Others	9.8	0.8	13.4	15.1
South Korea	W 19.2	W27.4	W 50.9	W 65.0
Gold Star	1.3	1.1	0.6	0.6
KEC	12.7	16.4	30.1	35.7
Samsung	4.5	5.8	12.9	18.2
Others	0.7	4.2	7.2	10.6
Asia/Pacific-ROW	W 18.1	W17.6	W 36.4	W 44.8
ITT	0.9	0.9	0.9	2.1
Philips	1.2	1.8	1.7	1.6
SGS	3.6	3.6	4.7	4.4
Siemens	1.2	1.8	1.7	1.6
Thomson	2.1	1.8	1.9	3.5
Others	<u>9.3</u>	<u>7.8</u>	<u>25.4</u>	<u>31.8</u>
Total	W100.1	W87.3	W161.9	W216.9

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
December 1989

Market Share--South Korea

Table 15

Semiconductor Market--South Korea
Estimated Share of Worldwide Manufacturers by Company
Optoelectronics
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	\$4.0	\$8.4	\$14.3	\$10.8
NEC	0.8	1.0	1.9	3.0
Sanyo	0.8	1.0	2.4	2.3
Sharp	0.8	1.0	2.4	2.0
Toshiba	0.8	1.0	2.4	3.5
Others	0.8	4.4	5.2	0.0
United States	\$0.6	\$1.9	\$ 3.6	\$ 3.6
GI	0.6	1.0	1.5	2.0
Others	0.0	0.9	2.1	1.6
South Korea	\$1.6	\$2.0	\$ 2.0	\$ 3.0
KEC	1.6	2.0	2.0	3.0
Asia/Pacific-ROW	<u>\$0.7</u>	<u>\$ 3.0</u>	<u>\$ 3.1</u>	<u>\$ 7.5</u>
Total	\$6.9	\$15.3	\$23.0	\$24.9

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
 December 1989

Market Share--South Korea

Table 16

Semiconductor Market—South Korea
Estimated Share of Worldwide Manufacturers by Company
Optoelectronics
(Billions of Won)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Japan	W3.3	W 7.5	W12.3	W 8.6
NEC	0.7	0.9	1.6	2.4
Sanyo	0.7	0.9	2.1	1.8
Sharp	0.7	0.9	2.1	1.6
Toshiba	0.7	0.9	2.1	2.8
Others	0.5	3.9	4.5	0.0
United States	W0.5	W 1.7	W 3.1	W 2.9
GI	0.5	0.9	1.3	1.6
Others	0.0	0.8	1.8	1.3
South Korea	W1.3	W 1.8	W 1.7	W 2.4
KEC	1.3	1.8	1.7	2.4
Asia/Pacific-ROW	<u>W0.6</u>	<u>W 2.7</u>	<u>W 2.7</u>	<u>W 5.9</u>
Total	W5.7	W13.6	W19.8	W19.7

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest
 December 1989

Market Share--South Korea

Table 17

South Korean Semiconductor Market—1984 Estimated Share of Worldwide Manufacturers Total Semiconductors (Millions of Dollars)

<u>Companies</u>	<u>Bip. Dig.</u>	<u>MOS</u>	<u>Linear</u>	<u>Discrete</u>	<u>Opto.</u>	<u>Total</u>
Total	\$29.5	\$67.2	\$79.4	\$121.0	\$6.9	\$304.0
Japan	\$11.4	\$30.1	\$37.7	\$ 43.6	\$4.0	\$126.8
Fujitsu	0.0	1.6	0.0	0.8	0.0	2.4
Hitachi	6.2	9.4	4.7	1.6	0.0	21.9
Matsushita	0.0	2.3	5.4	2.8	0.0	10.5
Mitsubishi	2.3	0.8	2.3	2.8	0.0	8.2
NEC	0.0	10.5	9.3	4.7	0.8	25.3
Sanyo	0.0	1.6	8.5	6.7	0.8	17.6
Sharp	0.0	1.6	0.0	0.0	0.8	2.4
Toshiba	0.8	2.3	6.2	6.6	0.8	16.7
Others	2.1	0.0	1.3	17.6	0.8	21.8
United States	\$14.4	\$24.1	\$17.4	\$ 32.3	\$0.6	\$ 88.8
AMD	0.8	1.6	0.0	0.0	0.0	2.4
AMI	0.0	0.6	0.0	0.0	0.0	0.6
Fairchild	1.5	0.1	0.7	3.6	0.0	5.9
GI	0.0	0.8	0.8	2.3	0.6	4.5
Intel	0.0	3.5	0.0	0.0	0.0	3.5
MMI	0.1	0.0	0.0	0.0	0.0	0.1
Mostek	0.0	2.5	0.0	0.0	0.0	2.5
Motorola	3.1	3.4	4.7	10.0	0.0	21.2
NSC	2.0	1.7	5.0	1.0	0.0	9.7
RCA	0.0	1.3	0.8	0.0	0.0	2.1
Signetics	0.0	0.8	2.3	0.0	0.0	3.1
TI	6.2	7.8	3.1	3.5	0.0	20.6
Others	0.7	0.0	0.0	11.9	0.0	12.6
Korea	\$ 0.8	\$ 7.0	\$13.6	\$ 23.2	\$1.6	\$ 46.2
Daewoo	0.0	0.0	0.0	0.0	0.0	0.0
Goldstar	0.8	0.8	4.3	1.6	0.0	7.5
Hyundai	0.0	0.0	0.0	0.0	0.0	0.0
KEC	0.0	0.0	2.3	15.4	1.6	19.3
Samsung	0.0	6.2	6.2	5.4	0.0	17.8
Others	0.0	0.0	0.8	0.8	0.0	1.6
Asia/Pacific-ROW	\$ 2.9	\$ 6.0	\$10.7	\$ 21.9	\$0.7	\$ 42.2
ITT	0.0	0.0	0.8	0.8	0.0	1.6
Philips	0.8	0.8	0.8	1.5	0.0	3.9
Rifa	0.0	0.0	1.6	0.0	0.0	1.6
SGS	1.6	1.3	4.6	4.3	0.0	11.8
Siemens	0.0	0.0	0.8	1.5	0.0	2.3
Thomson	0.0	2.3	2.0	2.5	0.0	6.8
UMC	0.0	1.6	0.0	0.0	0.0	1.6
Others	0.5	0.0	0.1	11.3	0.7	12.6

Source: Dataquest
December 1989

Market Share--South Korea

Table 18

South Korean Semiconductor Market--1985 Estimated Share of Worldwide Manufacturers Total Semiconductors (Millions of Dollars)

<u>Companies</u>	<u>Bip. Dig.</u>	<u>MOS</u>	<u>Linear</u>	<u>Discrete</u>	<u>Opto.</u>	<u>Total</u>
Total	\$41.5	\$133.9	\$143.5	\$98.1	\$15.3	\$423.3
Japan	\$ 6.0	\$ 60.9	\$ 72.6	\$31.6	\$ 8.4	\$179.5
Fujitsu	0.0	5.0	0.0	1.0	0.0	6.0
Hitachi	0.7	15.0	10.0	2.0	0.0	27.7
Matsushita	0.0	3.0	6.0	3.0	0.0	12.0
Mitsubishi	3.0	1.0	2.5	3.0	0.0	9.5
NEC	0.0	15.0	10.0	5.0	1.0	31.0
Sanyo	0.0	2.0	9.0	8.0	1.0	20.0
Sharp	0.0	2.0	0.0	0.0	1.0	3.0
Toshiba	0.0	8.0	10.0	7.0	1.0	26.0
Others	2.3	9.9	25.1	2.6	4.4	44.3
United States	\$29.8	\$ 51.8	\$ 27.8	\$15.9	\$ 1.9	\$127.2
AMD	1.0	2.0	2.0	0.0	0.0	5.0
AMI	0.0	1.0	0.0	0.0	0.0	1.0
Fairchild	1.5	0.1	1.0	3.0	0.0	5.6
GI	0.0	1.0	1.0	2.0	1.0	5.0
Intel	0.0	6.0	0.0	0.0	0.0	6.0
MMI	1.0	0.0	0.0	0.0	0.0	1.0
Mostek	0.0	4.0	0.0	0.0	0.0	4.0
Motorola	1.0	6.0	5.0	8.0	0.0	20.0
NSC	2.5	5.0	5.0	1.0	0.0	13.5
RCA	0.0	2.0	1.0	0.0	0.0	3.0
Signetics	1.0	1.0	1.0	0.0	0.0	3.0
TI	7.0	10.0	4.0	1.0	0.0	22.0
Others	14.8	13.7	7.8	0.9	0.9	38.1
South Korea	\$ 2.2	\$ 11.2	\$ 22.9	\$30.8	\$ 2.0	\$ 69.1
Daewoo	0.0	0.0	0.0	0.0	0.0	0.0
Goldstar	2.2	1.5	3.2	1.2	0.0	8.1
Hyundai	0.0	0.0	0.0	0.0	0.0	0.0
KEC	0.0	0.0	3.2	18.4	2.0	23.6
Samsung	0.0	9.7	7.5	6.5	0.0	23.7
Others	0.0	0.0	9.0	4.7	0.0	13.7
Asia/Pacific-ROW	\$ 3.5	\$ 10.0	\$ 20.2	\$19.8	\$ 3.0	\$ 56.5
ITT	0.0	0.0	1.0	1.0	0.0	2.0
Philips	1.0	1.0	1.0	2.0	0.0	5.0
Rifa	0.0	0.0	1.0	0.0	0.0	1.0
SGS	2.0	1.5	5.0	4.0	0.0	12.5
Siemens	0.0	0.0	1.0	2.0	0.0	3.0
Thomson	0.0	3.0	2.0	2.0	0.0	7.0
UMC	0.0	4.0	0.0	0.0	0.0	4.0
Others	0.5	0.5	9.2	8.8	3.0	22.0

Source: Dataquest
December 1989

Market Share--South Korea

Table 19

South Korean Semiconductor Market--1986 Estimated Share of Worldwide Manufacturers Total Semiconductors (Millions of Dollars)

<u>Companies</u>	<u>Bip. Dig.</u>	<u>MOS</u>	<u>Linear</u>	<u>Discrete</u>	<u>Opto.</u>	<u>Total</u>
Total	\$75.4	\$244.2	\$262.5	\$187.9	\$23.0	\$793.0
Japan	\$21.7	\$108.3	\$129.7	\$ 47.6	\$14.3	\$321.6
Fujitsu	0.0	10.1	0.0	3.0	0.0	13.1
Hitachi	9.5	18.0	15.0	5.0	0.0	47.5
Matsushita	0.0	3.9	7.8	3.0	0.0	14.7
Mitsubishi	4.8	3.0	8.0	5.0	0.0	20.8
NEC	0.0	25.0	15.0	8.0	1.9	49.9
Sanyo	0.0	3.1	19.5	15.0	2.4	40.0
Sharp	0.0	3.1	0.0	0.0	2.4	5.5
Toshiba	3.2	20.0	18.6	8.4	2.4	52.6
Others	4.2	22.1	45.8	0.2	5.2	77.5
United States	\$44.4	\$ 90.1	\$ 62.4	\$ 39.0	\$ 3.6	\$239.5
AMD	2.4	3.1	3.0	0.0	0.0	8.5
AMI	0.0	1.6	0.0	0.0	0.0	1.6
Fairchild	1.6	0.8	0.9	1.5	0.0	4.8
GI	0.0	1.6	2.6	4.6	1.5	10.3
Intel	0.0	15.0	0.0	0.0	0.0	15.0
MMI	1.6	0.0	0.0	0.0	0.0	1.6
Mostek	0.0	1.8	0.0	0.0	0.0	1.8
Motorola	6.6	16.0	14.0	13.0	0.0	49.6
NSC	6.3	7.8	6.0	3.7	0.0	23.8
RCA	0.0	2.3	4.0	0.0	0.0	6.3
Signetics	1.6	0.8	5.0	0.0	0.0	7.4
TI	13.4	17.0	15.0	0.7	0.0	46.1
Others	10.9	22.3	11.9	15.5	2.1	62.7
South Korea	\$ 5.8	\$ 28.2	\$ 39.5	\$ 59.1	\$ 2.0	\$134.6
Daewoo	0.0	0.0	1.0	0.0	0.0	1.0
Goldstar	5.8	4.0	3.2	0.7	0.0	13.7
Hyundai	0.0	1.8	0.0	0.0	0.0	1.8
KEC	0.0	0.0	8.0	35.0	2.0	45.0
Samsung	0.0	18.0	13.5	15.0	0.0	46.5
Others	0.0	4.4	13.8	8.4	0.0	26.6
Asia/Pacific-ROW	\$ 3.5	\$ 17.6	\$ 30.9	\$ 42.2	\$ 3.1	\$ 97.3
ITT	0.0	0.0	1.2	1.0	0.0	2.2
Philips	1.3	1.2	1.6	2.0	0.0	6.1
Rifa	0.0	0.0	1.0	0.0	0.0	1.0
SGS	2.0	3.1	5.7	5.5	0.0	16.3
Siemens	0.0	0.0	1.2	2.0	0.0	3.2
Thomson	0.0	2.0	2.0	2.2	0.0	6.2
UMC	0.0	7.0	0.0	0.0	0.0	7.0
Others	0.2	4.3	18.2	29.5	3.1	55.3

Source: Dataquest
December 1989

Market Share--South Korea

Table 20

South Korean Semiconductor Market—1987 Estimated Share of Worldwide Manufacturers Total Semiconductors (Millions of Dollars)

Companies	Bip. Dig.	MOS	Linear	Discrete	Opto.	Total
Total	\$118.8	\$438.9	\$435.1	\$273.7	\$24.9	\$1,291.4
Japan	\$ 37.2	\$187.5	\$207.4	\$ 77.8	\$10.8	\$ 519.9
Fujitsu	0.0	20.0	0.0	8.0	0.0	28.0
Hitachi	13.0	25.0	25.0	7.0	0.0	70.0
Matsushita	4.0	16.0	10.0	5.0	0.0	35.0
Mitsubishi	8.0	20.0	20.0	7.0	0.0	55.0
NEC	0.0	39.0	32.0	10.0	3.0	84.0
Sanyo	0.0	15.0	25.0	25.0	2.3	67.3
Sharp	0.0	13.0	0.0	0.0	2.0	15.0
Toshiba	7.0	39.0	34.0	15.0	3.5	98.5
Others	5.2	0.5	61.4	0.0	0.0	67.1
United States	\$ 63.7	\$148.4	\$108.0	\$ 58.0	\$ 3.6	\$ 381.7
AMD	4.0	9.0	4.0	0.0	0.0	17.0
AMI	0.0	3.2	0.0	0.0	0.0	3.2
Fairchild	4.0	4.0	2.0	2.0	0.0	12.0
GI	0.0	6.6	3.0	10.0	2.0	21.6
Intel	0.0	35.0	0.0	0.0	0.0	35.0
MMI	2.0	0.0	0.0	0.0	0.0	2.0
Mostek	0.0	0.0	0.0	0.0	0.0	0.0
Motorola	13.0	27.0	20.0	20.0	0.0	80.0
NSC	7.0	10.0	8.0	5.0	0.0	30.0
RCA	0.0	5.0	4.0	0.0	0.0	9.0
Signetics	2.0	4.0	6.0	0.0	0.0	12.0
TI	15.0	30.0	20.0	2.0	0.0	67.0
Others	16.7	14.6	41.0	19.0	1.6	92.9
South Korea	\$ 12.0	\$ 63.6	\$ 71.5	\$ 82.1	\$ 3.0	\$ 232.2
Daewoo	0.0	0.0	1.0	0.0	0.0	1.0
Goldstar	12.0	6.0	4.0	0.7	0.0	22.7
Hyundai	0.0	7.6	0.0	0.0	0.0	7.6
KEC	0.0	0.0	15.0	45.0	3.0	63.0
Samsung	0.0	50.0	25.0	23.0	0.0	98.0
Others	0.0	0.0	26.5	13.4	0.0	39.9
Asia/Pacific-ROW	\$ 5.9	\$ 39.4	\$ 48.2	\$ 56.6	\$ 7.5	\$ 157.6
ITT	0.0	0.0	4.0	2.6	0.0	6.6
Philips	0.9	1.2	1.6	2.0	0.0	5.7
Rifa	0.0	0.0	1.0	0.0	0.0	1.0
SGS	5.0	9.1	6.7	5.5	0.0	26.3
Siemens	0.0	0.0	1.6	2.0	0.0	3.6
Thomson	0.0	2.0	2.0	4.4	0.0	8.4
UMC	0.0	10.0	0.0	0.0	0.0	10.0
Others	0.0	17.1	31.3	40.1	7.5	96.0

Source: Dataquest
December 1989

Market Share--South Korea

Table 21

South Korean Semiconductor Market--1988 (Millions of Dollars)

Supplier	1988						Total
	Bipolar Digital	MOS	Linear	Tot IC	Discrete	Opto.	
Total	\$162	\$654	\$535	\$1,351	\$380	\$51	\$1,782
Japanese Companies	\$ 49	\$232	\$246	\$ 527	\$136	\$21	\$ 684
Fujitsu	0	40	0	40	10	0	50
Hitachi	13	35	25	73	5	0	78
Matsushita	4	10	16	30	5	1	36
Mitsubishi	1	25	20	46	4	0	50
NEC	10	45	45	100	10	5	115
Oki	0	2	0	2	0	0	2
Sanyo	6	14	67	87	22	1	110
Sharp	0	10	0	10	0	6	16
Toshiba	10	45	45	100	40	6	146
Others	5	6	28	39	40	2	81
United States Companies	\$ 58	\$179	\$125	\$ 346	\$ 71	\$10	\$ 443
AMD	5	12	5	22	0	0	22
Chips & Technologies	0	16	0	0	0	0	16
GI	0	11	0	11	11	0	22
Intel	0	66	0	66	0	0	66
Motorola	13	20	25	58	20	0	78
NSC	8	10	10	28	5	0	33
Fairchild	4	4	2	10	5	0	15
Harris	0	5	5	10	2	0	12
TI	17	35	30	82	8	0	90
Others	11	0	48	59	20	10	89
South Korean Companies	\$ 22	\$210	\$102	\$ 334	\$117	\$10	\$ 461
Daewoo	2	0	5	7	0	0	7
Goldstar	20	20	15	55	1	0	56
Hyundai	0	30	0	30	0	0	30
KEC	0	0	20	20	45	5	70
Samsung	0	160	35	195	38	0	233
Others	0	0	27	27	33	5	65
Asia/Pacific-ROW Companies	\$ 33	\$ 33	\$ 62	\$ 128	\$ 56	\$10	\$ 194
ITT	0	0	4	4	3	0	7
Philips	3	7	8	18	3	0	21
SGS-Thomson	3	11	13	27	8	0	35
Siemens	2	2	3	7	2	0	9
UMC	0	9	3	12	0	0	12
Others	25	4	31	60	40	10	110

Source: Dataquest
December 1989

Market Share--Taiwan

INTRODUCTION

The analysis of semiconductor markets through estimation of market share by manufacturer is an integral part of Dataquest's Asian Semiconductor Industry data base. This analysis provides insights into semiconductor markets and reinforces estimates of consumption, production, and company revenue that were made using other data. The tables show the Taiwanese market shares for all major Japanese, U.S., European, and Rest of World semiconductor manufacturers. Table 1 is a currency conversion chart; Table 2 shows Taiwanese semiconductor consumption by country. Tables 3 through 10 present Taiwanese semiconductor market share by company for 1984, 1985, and 1986.

The totals given for the companies reflect the portion of their worldwide production that is sold in the Taiwanese 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 NT dollars, in order to provide a more accurate presentation of real growth rates for Taiwanese companies.

Tables are constructed by 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. Also, as far as possible, the estimates are prepared in terms of local currencies before conversion to U.S. dollars. The won to dollar exchange rates by year are given in Table 1.

Market Share--Taiwan

NEED FOR CAREFUL INTERPRETATION

Care is taken in gathering and analyzing the available data and in attempting to categorize those data in a meaningful way. Nevertheless, 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.

MARKET SHARE

U.S. and Japanese vendors have dominated the Taiwanese semiconductor market in the past years. However, native Taiwanese and South Korean manufacturers increased their market share significantly in 1986.

Market Share--Taiwan

Table 1

EXCHANGE RATE--TAIWAN
(NT Dollar to U.S. Dollar)

<u>Year</u>	<u>NT\$ per US\$</u>
1982	40
1983	40
1984	40
1985	40
1986	36

Table 2

SEMICONDUCTOR CONSUMPTION--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS
(Millions of U.S. Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total Semiconductor*	\$560.3	\$496.0	\$694.0
Japanese	236.0	220.0	300.0
U.S.	220.0	180.0	240.0
Taiwanese	61.9	48.3	82.5
South Korean	6.7	12.5	34.0
European	35.6	35.2	37.5

(Percent of Total)

	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total Semiconductor	100.00%	100.0%	100.0%
Japanese	42.15	44.36	43.23
U.S.	39.25	36.29	34.58
Taiwanese	11.05	9.74	11.89
South Korean	1.20	2.52	4.90
European	6.35	7.09	5.40

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 3

SEMICONDUCTOR MARKET--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
TOTAL SEMICONDUCTOR
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	\$560.3	\$496.0	\$694.0
Japanese	\$236.0	\$220.0	\$300.0
Fujitsu	20.0	15.0	25.0
Hitachi	30.0	30.0	40.0
Matsushita	15.0	13.5	20.0
Mitsubishi	13.6	15.0	28.0
NEC	41.3	35.0	50.0
OKI	5.1	8.0	15.0
Sanyo	16.6	15.0	20.0
Sharp	8.8	8.0	10.0
Toshiba	29.1	25.4	35.0
Others	56.0	55.0	57.0
U.S.	\$220.0	\$180.0	\$240.0
AMD	10.0	8.0	12.0
AMI	4.5	3.0	4.0
Fairchild	15.1	11.3	12.5
GI	16.5	13.2	14.5
Intel	10.9	12.0	20.0
MMI	7.1	5.0	8.0
Mostek	1.8	1.2	0.5
Motorola	43.2	33.5	38.0
NSC	16.5	19.0	20.0
RCA	10.0	8.0	10.0
Signetics	8.0	7.0	8.0
TI	30.0	24.0	40.0
Others	45.0	34.8	52.2
Taiwanese	\$ 61.9	\$ 48.3	\$ 82.5
ERSO	21.5	16.0	20.0
Fine Products	3.2	1.1	3.0
Liton	6.1	3.5	4.5
Nectron	3.4	2.6	3.0
UMC	8.9	16.2	40.0
Others	18.8	8.9	12.0
South Korean	\$ 6.7	\$ 12.5	\$ 34.0
European	\$ 35.6	\$ 35.2	\$ 37.5
Philips	9.1	7.3	9.0
Siemens	7.5	8.0	8.5
SGS	15.5	12.8	15.0
Thomson	3.1	3.0	3.0
Others	0.4	4.1	2.0

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 4

SEMICONDUCTOR MARKET--TAIWAN ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY TOTAL SEMICONDUCTOR (Millions of NT Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	NT22,412	NT19,840	NT24,984
Japanese	NT 9,940	NT 8,800	NT10,800
Fujitsu	800	600	900
Hitachi	1,200	1,200	1,440
Matsushita	600	540	720
Mitsubishi	544	600	1,008
NEC	1,652	1,400	1,800
OKI	204	320	540
Sanyo	664	600	720
Sharp	352	320	360
Toshiba	116	1,016	1,260
Others	2,240	2,200	2,052
U.S.	NT 8,800	NT 7,200	NT 8,640
AMD	400	320	432
AMI	180	120	144
Fairchild	604	452	450
GI	660	528	520
Intel	436	480	720
MMI	284	200	288
Mostek	72	48	18
Motorola	1,728	1,340	1,368
NSC	660	760	720
RCA	400	320	360
Signetics	320	280	288
TI	1,200	960	1,440
Others	1,800	1,392	1,879
Taiwanese	NT 2,476	NT 1,932	NT 2,970
ERSO	860	640	720
Fine Products	128	44	108
Liton	244	140	162
Rectron	136	104	108
UMC	356	648	1,440
Others	752	356	432
South Korean	NT 268	NT 500	NT 1,224
European	NT 1,424	NT 1,408	NT 1,350
Philips	364	292	324
Siemens	300	320	306
SGS	620	512	540
Thomson	124	120	108
Others	16	164	72

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 5

SEMICONDUCTOR MARKET--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
TOTAL BIPOLAR DIGITAL
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	\$111.3	\$95.0	\$133.0
Japanese	\$ 41.1	\$36.8	\$ 51.5
Fujitsu	7.5	4.0	8.0
Hitachi	7.5	10.5	15.0
Matsushita	0	0	0
Mitsubishi	7.0	4.4	7.0
NEC	2.1	1.8	2.5
OKI	0	0	0
Sanyo	0	0	0
Sharp	0.2	0.2	0.5
Toshiba	6.8	5.9	7.5
Others	10.0	10.0	11.0
U.S.	\$ 69.6	\$56.6	\$ 79.0
AMD	10.0	7.0	10.0
AMI	0	0	0
Fairchild	0.9	0.7	1.0
GI	0	0	0
Intel	0	0	0
MMI	7.1	5.0	8.0
Mostek	0	0	0
Motorola	21.6	16.8	20.0
NSC	6.1	7.0	8.0
RCA	0	0	0
Signetics	2.4	2.2	2.5
TI	16.5	13.2	25.0
Others	5.0	4.7	5.0
European	0.5	1.6	1.9
Philips	0	0	0
Siemens	0	0	0
SGS	0	0.9	1.2
Thomson	0.2	0.2	0.2
Others	0.3	0.5	0.5

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 6

SEMICONDUCTOR MARKET--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
TOTAL BIPOLAR DIGITAL
(Millions of NT Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	NT4,452	NT3,800	NT4,788
Japanese	NT1,644	NT1,472	NT1,854
Fujitsu	300	160	288
Hitachi	300	420	540
Matsushita	0	0	0
Mitsubishi	280	176	252
NEC	84	72	90
OKI	0	0	0
Sanyo	0	0	0
Sharp	8	8	18
Toshiba	272	236	270
Others	400	400	396
U.S.	NT2,784	NT2,264	NT2,844
AMD	400	280	360
AMI	0	0	0
Fairchild	36	28	36
GI	0	0	0
Intel	0	0	0
MMI	284	200	288
Mostek	0	0	0
Motorola	864	672	720
NSC	244	280	288
RCA	0	0	0
Signetics	96	88	90
TI	660	528	900
Others	200	188	180
European	NT 20	NT 64	NT 68
Philips	0	0	0
Siemens	0	0	0
SGS	0	36	43
Thomson	8	8	7
Others	12	20	18

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 7

SEMICONDUCTOR MARKET--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
MOS
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	\$176.4	\$174.0	\$252.7
Japanese	\$ 75.4	\$ 75.0	\$ 90.0
Fujitsu	7.5	7.0	8.0
Hitachi	7.5	7.5	10.0
Matsushita	3.8	3.5	4.0
Mitsubishi	2.7	5.3	6.0
NEC	11.5	11.3	15.0
OKI	5.1	8.0	9.0
Sanyo	3.3	3.5	5.0
Sharp	7.5	7.0	8.0
Toshiba	6.5	5.7	8.0
Others	20.0	17.0	17.0
U.S.	\$ 63.6	\$ 59.3	\$ 70.0
AMD	0	1.0	2.0
AMI	4.5	3.0	4.0
Fairchild	9.6	7.2	8.0
GI	7.5	6.5	7.0
Intel	10.9	12.0	20.0
MMI	0	0	0
Mostek	0.5	0.6	0.5
Motorola	2.2	1.7	2.5
NSC	4.6	5.3	5.5
RCA	2.0	2.0	2.0
Signetics	4.8	4.4	4.4
TI	9.0	7.2	10.0
Others	8.0	8.0	6.0
Taiwanese	\$ 28.4	\$ 31.2	\$ 58.0
ERSO	19.5	15.0	18.0
Fine Products	0	0	0
Liton	0	0	0
Kectron	0	0	0
UMC	8.9	16.2	40.0
Others	0	0	0
South Korean	\$ 0	\$ 4.5	\$ 25.0
European	8.9	8.5	9.5
Philips	1.8	2.0	2.0
Siemens	3.3	3.7	4.0
SGS	1.6	1.2	2.0
Thomson	0.9	0.9	1.0
Others	1.3	0.7	1.0

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 8

SEMICONDUCTOR MARKET--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
MOS
(Millions of NT Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	NT7,056	NT6,960	NT9,097
Japanese	NT3,016	NT3,000	NT3,240
Fujitsu	300	280	288
Hitachi	300	300	360
Matsushita	152	140	144
Mitsubishi	108	212	216
NEC	460	452	540
OKI	204	320	324
Sanyo	132	140	180
Sharp	300	280	288
Toshiba	260	228	288
Others	800	660	612
U.S.	NT2,544	NT2,372	NT2,520
AMD	0	40	72
AMI	180	120	144
Fairchild	384	288	288
GI	300	272	252
Intel	436	480	720
MMI	0	0	0
Mostek	20	24	18
Motorola	88	68	90
NSC	184	212	198
RCA	80	80	72
Signetics	192	176	158
TI	360	288	360
Others	320	320	216
Taiwanese	NT1,136	NT1,248	NT2,088
ERSO	780	600	648
Fine Products	0	0	0
Liton	0	0	0
Rectron	0	0	0
UMC	356	648	1,440
Others	0	0	0
South Korean	NT 0	NT 180	NT 900
European	NT 348	NT 340	NT 342
Philips	72	80	72
Siemens	132	148	144
SGS	64	48	72
Thomson	36	36	36
Others	52	28	36

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 9

SEMICONDUCTOR MARKET--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
LINEAR
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	\$143.3	\$124.7	\$174.6
Japanese	\$ 83.1	\$ 72.6	\$100.0
Fujitsu	5.0	4.0	6.0
Hitachi	6.0	3.0	8.0
Matsushita	8.8	8.0	10.0
Mitsubishi	1.9	3.8	5.0
NEC	21.1	15.6	25.0
OKI	0	0	0
Sanyo	9.3	8.5	12.0
Sharp	0.2	0.2	0.5
Toshiba	10.8	9.5	12.0
Others	20.0	20.0	20.0
U.S.	\$ 40.3	\$ 36.2	\$ 48.0
AMD	0	0	0
AMI	0	0	0
Fairchild	0	0	0
GI	0	0	0
Intel	0	0	0
MMI	0	0	0
Mostek	1.3	0.6	0.6
Motorola	9.1	7.0	9.0
NSC	4.6	5.3	6.0
RCA	5.0	4.0	6.0
Signetics	0.8	0.7	1.0
TI	4.5	3.6	7.0
Others	15.0	15.0	18.0
Taiwanese	\$ 2.0	\$ 1.0	\$ 2.0
South Korean	\$ 0	0	4.6
European	17.9	14.9	20.0
Philips	1.8	2.0	2.0
Siemens	2.6	3.1	3.0
SGS	10.7	7.9	11.0
Thomson	0.4	0.4	0.5
Others	2.4	1.5	2.5

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Taiwan

Table 10

SEMICONDUCTOR MARKET--TAIWAN
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
LINEAR
(Millions of NT Dollars)

<u>Companies</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total*	NT5,732	NT4,988	NT6,286
Japanese	NT3,324	NT2,904	NT3,600
Fujitsu	200	160	216
Hitachi	240	120	288
Matsushita	352	320	360
Mitsubishi	76	152	180
NEC	844	624	900
OKI	0	0	0
Sanyo	372	340	432
Sharp	8	8	18
Toshiba	432	380	432
Others	800	800	720
U.S.	NT1,612	NT1,448	NT1,728
AMD	0	0	0
AMI	0	0	0
Fairchild	0	0	0
GI	0	0	0
Intel	0	0	0
MMI	0	0	0
Mostek	52	24	22
Motorola	364	280	324
NSC	184	212	216
RCA	200	160	216
Signetics	32	28	36
TI	180	144	252
Others	600	600	648
Taiwanese	NT 80	NT 40	NT 72
South Korean	0	0	NT 166
European	NT 716	NT 596	NT 720
Philips	72	80	72
Siemens	104	124	108
SGS	428	316	396
Thomson	16	16	18
Others	96	60	90

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

INTRODUCTION

The analysis of semiconductor markets through estimation of market share by manufacturer is an integral part of Dataquest's Hong Kong Semiconductor Industry data base. This analysis provides insights into semiconductor markets and reinforces estimates of consumption, production, and company revenue that were made using other data. Table 1 is a currency conversion chart. Tables 2 through 16 show the Hong Kong market shares for all major Japanese, U.S., South Korean, and Rest of World semiconductor manufacturers. The tables present the Hong Kong semiconductor market share by product line for 1985 and 1986. The totals given for the companies reflect the portion of their worldwide production that is sold in the Hong Kong 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.

Estimates are first presented in tables that use U.S. dollars to make the tables useful in comparing companies based in different countries. Estimates are then presented in tables that use H.K. dollars to provide a more accurate presentation of real growth rates for the Hong Kong companies.

Tables are constructed by 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. As far as possible, the estimates are prepared in terms of local currencies before conversion to U.S. dollars or H.K. dollars.

Need for Careful Interpretation

Care is taken in gathering and analyzing the available data and in attempting to categorize those data in a meaningful way. Nevertheless, 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

Market Share--Hong Kong

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.

MARKET SHARE

U.S. and Japanese vendors have dominated the Hong Kong semiconductor market in past years. However, native Hong Kong and Rest of World manufacturers have recorded a significant increase in market share between 1982 and 1986. The regional market share for semiconductors consumed in Hong Kong is tabulated in millions of U.S. dollars and as a percentage of the total in Table 2.

Japanese manufacturers have had the largest share of this semiconductor market, which amounts to \$210.5 million. Japanese sales of \$80 million in 1982 accounted for 38.93 percent of the local market. Japanese sales grew at an estimated 27.4 percent cumulative annual growth rate between 1982 and 1986. This growth rate is higher than the market itself, which increased 23.5 percent over the same period.

U.S. manufacturers' sales in the Hong Kong market grew at a lower rate than the market itself. U.S. 1982 sales of \$102.5 million grew at a cumulative annual rate of 13.1 percent to reach \$168 million in 1986. The U.S. market share, estimated at 49.88 percent in 1982, declined to 35.2 percent in 1986.

In 1982, Hong Kong manufacturers' revenue was \$2.5 million (1.22 percent of the local market). Their revenue has grown at an impressive cumulative annual rate of 42.3 percent, reaching \$10.25 million in 1986.

South Korean manufacturers' revenue grew from \$5.5 million (2.67 percent of the market share in 1982) to \$49.1 million (10.3 percent of market share in 1986). The CAGR for 1982 to 1986 recorded an impressive 72.8 percent increase.

Revenue of the Rest of World manufacturers (mostly European companies) has also recorded a rapid CAGR of 27.9 percent between 1982 and 1986. Rest of World revenue was \$15 million in 1982, a 7.3 percent share of the market. In 1986, revenue is estimated to be \$40.15 million, 8.4 percent of the market.

Market Share--Hong Kong

Table 1

EXCHANGE RATE--HONG KONG
(HK DOLLAR to US DOLLAR)

<u>Year</u>	<u>HK\$ per US\$</u>
1982	6.00
1983	7.80*
1984	7.80
1985	7.80
1986	7.80

*Conversion rates of HK\$6.00
to US\$1.00 for 1982 and HK\$6.50
to US\$1.00 for 1983 were used to
compute figures for this report.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 2

SEMICONDUCTOR MARKET--HONG KONG ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS (Millions of U.S. Dollars)

	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>CAGR</u> <u>1982-1986</u>
Total						
Semiconductor*	\$205.50	\$329.00	\$460.00	\$333.50	\$478.00	23.5%
Japanese	80.00	130.00	190.00	135.90	210.50	27.4%
U.S.	102.50	163.00	205.00	130.50	168.00	13.1%
Hong Kong	2.50	4.00	7.00	6.00	10.25	42.3%
South Korean	5.50	14.00	28.00	35.10	49.10	72.8%
Rest of World	15.00	18.00	30.00	26.00	40.15	27.9%

(Percent of Total)

	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Total					
Semiconductor	100.00%	100.00%	100.00%	100.00%	100.00%
Japanese	38.93	39.51	41.30	40.75	44.00
U.S.	49.88	49.55	44.56	39.13	35.20
Hong Kong	1.22	1.21	1.52	1.80	2.20
South Korean	2.67	4.25	6.09	10.52	10.30
Rest of World	7.30	5.47	6.52	7.80	8.40

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 3

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
TOTAL SEMICONDUCTOR
(Millions of U.S. Dollars)

Companies	1985	1986
Japanese	\$135.90	\$210.50
Fujitsu	3.50	9.00
Hitachi	21.00	27.50
Matsushita	6.50	10.00
Mitsubishi	5.50	10.00
NEC	22.00	29.00
Sanyo	11.00	15.00
Sharp	7.50	15.00
Toshiba	21.00	30.00
Oki	4.00	10.00
Others	34.00	55.00
U.S.	\$130.50	\$168.00
AMD	2.20	4.50
AMI	0.50	0.50
Fairchild	5.00	7.00
GI	3.00	3.50
Intel	7.50	8.00
MMI	0.10	1.00
Mostek	2.50	1.50
Motorola	19.00	26.00
NSC	17.00	20.00
RCA	6.00	7.50
Signetics	12.00	13.50
TI	28.00	45.00
Others	27.70	30.00
Hong Kong	\$ 6.00	\$ 10.25
South Korean	\$ 35.10	\$ 49.60
Gold Star	5.00	7.40
KEC	6.78	9.50
Samsung	19.20	28.20
Others	4.12	4.50
Rest of World	\$ 28.00	\$ 40.15
ITT	0.15	0.68
Philips	5.00	5.50
Rifa	0.45	0.42
SGS	10.00	12.00
Siemens	0.30	1.00
Thomson	4.60	6.50
UMC	6.00	12.50
Others	1.50	1.55
Total*	\$335.50	\$478.00

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Table 4

SEMICONDUCTOR MARKET--HONG KONG ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY TOTAL SEMICONDUCTOR (Millions of H.K. Dollars)

Companies	1985	1986
Japanese	\$1,060.00	\$1,641.90
Fujitsu	27.30	70.20
Hitachi	163.80	214.50
Matsushita	50.70	78.00
Mitsubishi	42.90	78.00
NEC	234.00	226.20
Sanyo	85.80	117.00
Sharp	58.60	117.00
Toshiba	163.80	234.00
Oki	31.20	78.00
Others	265.20	429.00
U.S.	\$1,017.90	\$1,310.40
AMD	17.16	35.10
AMI	3.90	3.90
Fairchild	39.00	54.60
GI	23.40	27.30
Intel	58.50	62.40
MMI	0.78	7.80
Mostek	19.50	11.70
Motorola	148.20	202.80
NSC	132.60	156.00
RCA	46.80	58.50
Signetics	93.60	105.30
TI	218.40	351.00
Others	216.06	234.00
Hong Kong	\$ 46.80	\$ 79.95
South Korean	\$ 273.78	\$ 386.88
Gold Star	39.00	57.72
KEC	52.88	74.10
Samsung	149.76	219.96
Others	32.14	35.10
Rest of World	\$ 209.43	\$ 312.62
ITT	1.17	5.30
Philips	39.00	42.90
Rifa	2.34	2.73
SGS	78.00	93.60
Siemens	2.34	7.80
Thomson	35.88	50.70
UMC	42.90	97.50
Others	7.80	12.09
Total*	\$2,607.91	\$3,731.75

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 5

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
INTEGRATED CIRCUIT
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$114.98	\$181.52
Fujitsu	2.88	9.00
Hitachi	18.90	26.50
Matsushita	5.85	8.70
Mitsubishi	4.95	9.20
NEC	17.00	23.50
Sanyo	6.30	8.90
Sharp	6.75	14.20
Toshiba	17.15	25.00
Oki	3.60	10.00
Others	31.60	46.52
U.S.	\$119.52	\$157.50
AMD	1.98	4.50
AMI	0.45	0.50
Fairchild	4.50	4.50
GI	2.70	2.90
Intel	6.75	8.00
MMI	0.09	1.00
Mostek	2.25	1.50
Motorola	17.10	19.50
NSC	15.30	19.50
RCA	5.40	7.50
Signetics	10.80	13.50
TI	25.20	45.00
Others	27.00	29.60
Hong Kong	\$ 6.00	\$ 10.25
South Korean	\$ 16.20	\$ 23.10
Gold Star	2.00	2.40
KEC	1.50	2.50
Samsung	10.50	15.70
Others	2.20	3.00
Rest of World	\$ 22.30	\$ 33.63
ITT	0.13	0.18
Philips	3.50	5.50
Rifa	0.27	0.35
SGS	9.00	10.50
Siemens	0.20	0.30
Thomson	2.70	3.00
UMC	5.50	12.50
Others	1.00	1.30
Total*	\$279.00	\$406.00

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 6

SEMICONDUCTOR MARKET--HONG KONG ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY INTEGRATED CIRCUIT

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$ 896.84	\$1,415.86
Fujitsu	22.46	70.20
Hitachi	147.42	206.70
Matsushita	45.63	67.86
Mitsubishi	38.61	71.76
NEC	132.60	183.30
Sanyo	49.14	69.42
Sharp	52.65	110.76
Toshiba	133.77	195.00
OKi	28.08	78.00
Others	246.48	362.86
U.S.	\$ 932.26	\$1,228.50
AMD	15.44	35.10
AMI	3.51	3.90
Fairchild	35.10	35.10
GI	21.06	22.62
Intel	52.65	62.40
MMI	0.70	7.80
Mostek	17.55	11.70
Motorola	133.38	152.10
NSC	119.34	152.10
RCA	42.12	58.50
Signetics	84.24	105.30
TI	196.56	351.00
Others	210.60	231.66
Hong Kong	\$ 46.80	\$ 79.95
South Korean	\$ 126.36	\$ 180.18
Gold Star	15.60	18.72
KEC	11.70	19.50
Samsung	81.90	122.46
Others	17.16	23.40
Rest of World	\$ 173.94	\$ 262.31
ITT	1.05	1.40
Philips	27.30	42.90
Rifa	2.11	2.73
SGS	70.20	81.90
Siemens	1.83	2.81
Thomson	21.06	23.40
UMC	42.90	97.50
Others	7.80	10.00
Total*	\$2,176.20	\$3,166.80

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 7

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
BIPOLAR DIGITAL
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$ 6.41	\$11.11
Hitachi	3.30	4.26
Mitsubishi	1.10	1.98
Toshiba	0.50	1.62
Matsushita	1.00	2.15
Others	0.51	1.10
U.S.	\$13.42	\$17.20
AMD	0.20	0.45
Fairchild	1.30	1.45
Motorola	1.80	1.90
NSC	2.20	3.50
Signetics	1.50	1.75
TI	6.00	7.65
Others	0.42	0.50
South Korean	\$ 0.42	\$ 0.54
Rest of World	\$ 1.53	\$ 2.40
Philips	0.50	1.00
SGS	0.50	1.30
Others	<u>0.53</u>	<u>0.10</u>
Total*	\$21.78	\$31.25

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 8

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
BIPOLAR DIGITAL
(Millions of H.K. Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$ 50.00	\$ 86.76
Hitachi	25.74	33.23
Mitsubishi	8.58	15.45
Toshiba	3.90	12.63
Matsushita	7.80	16.77
Others	3.98	8.58
U.S.	\$104.68	\$134.16
AMD	1.56	3.51
Fairchild	10.14	11.31
Motorola	14.04	14.82
NSC	17.16	27.30
Signetics	11.70	13.65
TI	46.80	59.67
Others	3.28	3.90
South Korean	\$ 3.28	\$ 4.20
Rest of World	\$ 11.93	\$ 10.84
Philips	3.90	7.80
SGS	3.90	2.34
Others	<u>4.13</u>	<u>0.70</u>
Total*	\$169.89	\$235.94

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 9

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
MOS
(Millions of U.S. Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$ 73.92	\$125.36
Fujitsu	2.88	9.00
Hitachi	13.86	19.43
Matsushita	4.29	6.70
Mitsubishi	3.63	6.42
NEC	15.00	20.50
Sanyo	4.62	6.50
Sharp	4.95	14.20
Toshiba	14.65	19.30
Oki	2.64	10.00
Others	7.40	13.31
U.S.	\$ 85.90	\$110.29
AMD	1.45	0.90
AMI	0.33	0.33
Fairchild	3.30	3.96
GI	1.98	2.31
Intel	6.75	8.00
Mostek	1.65	0.99
Motorola	12.54	13.86
NSC	11.22	12.54
RCA	3.96	6.95
Signetics	7.92	9.75
TI	16.50	30.00
Others	18.30	20.70
Hong Kong	\$ 6.00	\$ 10.25
South Korean	\$ 11.88	16.00
Gold Star	2.38	1.50
Samsung	9.50	14.50
Rest of World	\$ 9.72	\$ 17.30
Philips	1.00	1.00
SGS	2.00	2.00
Thomson	2.00	2.00
UMC	4.42	12.00
Others	<u>0.30</u>	<u>0.30</u>
Total*	\$187.42	\$279.20

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 10

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
MOS
(Millions of H.K. Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$ 576.55	\$ 977.81
Fujitsu	22.46	70.20
Hitachi	108.11	151.55
Matsushita	33.46	52.26
Mitsubishi	28.31	50.08
NEC	117.00	159.90
Sanyo	36.04	50.70
Sharp	38.61	110.76
Toshiba	114.27	150.54
Oki	20.59	78.00
Others	57.72	103.82
U.S.	\$ 641.87	\$ 860.26
AMD	11.31	7.02
AMI	2.57	2.33
Fairchild	25.74	30.89
GI	15.44	18.02
Intel	52.65	62.40
Mostek	12.87	7.72
Motorola	97.81	108.11
NSC	87.52	97.81
RCA	30.86	54.20
Signetics	61.78	76.05
TI	128.70	234.00
Others	161.32	161.46
Hong Kong	\$ 46.80	\$ 79.95
South Korean	\$ 92.66	\$ 124.80
Gold Star	18.56	11.70
Samsung	74.10	113.10
Rest of World	\$ 75.81	\$ 134.90
Philips	7.80	7.80
SGS	15.60	15.60
Thomson	15.60	15.60
UMC	34.47	93.60
Others	<u>2.34</u>	<u>2.30</u>
Total*	\$1,461.89	\$2,177.72

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 11

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
LINEAR
(Millions of US Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$34.65	\$45.04
Hitachi	1.74	2.81
Matsushita	1.00	2.00
Mitsubishi	0.80	0.80
NEC	2.00	3.00
Sanyo	1.68	2.50
Toshiba	2.00	4.08
Others	25.43	29.85
U.S.	\$20.20	\$30.41
Fairchild	1.50	1.80
GI	0.50	0.60
Motorola	4.00	4.80
NSC	4.20	5.70
RCA	0.70	1.50
Signetics	1.80	2.00
TI	2.50	7.00
Others	5.00	7.01
South Korean	\$ 4.19	\$ 5.04
Gold Star	1.00	1.00
KEC	0.90	1.30
Samsung	2.10	2.20
Others	0.19	0.54
Rest of World	\$10.53	\$14.80
ITT	0.13	0.18
Philips	2.50	3.34
Rifa	0.10	0.15
SGS	6.50	8.50
Siemens	0.20	0.30
Thomson	0.80	1.50
Others	<u>0.30</u>	<u>0.83</u>
Total*	\$69.57	\$95.29

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 12

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
LINEAR
(Millions of HK Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$270.27	\$351.31
Hitachi	13.57	21.92
Matsushita	7.80	15.60
Mitsubishi	6.24	6.24
NEC	15.60	23.40
Sanyo	13.10	19.50
Toshiba	15.60	31.82
Others	198.36	232.83
U.S.	\$157.56	\$237.20
Fairchild	11.70	14.04
GI	3.90	4.68
Motorola	31.20	37.44
NSC	32.76	44.46
RCA	5.46	11.70
Signetics	14.04	15.60
TI	19.50	54.60
Others	39.00	54.68
South Korean	\$ 32.68	\$ 39.31
Gold Star	7.80	7.80
KEC	7.02	10.14
Samsung	16.38	17.16
Others	1.48	4.21
Rest of World	\$ 82.13	\$115.43
ITT	1.01	1.40
Philips	19.50	26.05
Rifa	0.78	1.17
SGS	50.70	66.30
Siemens	1.56	2.34
Thomson	6.24	11.70
Others	<u>2.34</u>	<u>6.47</u>
Total*	\$542.64	\$743.25

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 13

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
DISCRETE
(Millions of US Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$13.20	\$17.00
Hitachi	0.80	1.00
Matsushita	1.50	1.30
Mitsubishi	0.50	0.80
NEC	4.50	4.70
Sanyo	3.00	3.20
Toshiba	2.00	2.10
Others	0.90	1.00
U.S.	\$ 7.92	\$10.50
Fairchild	2.50	2.60
GI	0.50	0.60
Motorola	4.70	6.50
NSC	0.10	0.50
TI	-	-
Others	0.12	0.30
South Korean	\$17.60	\$24.00
Gold Star	3.00	5.00
KEC	5.28	7.00
Samsung	8.70	10.50
Others	0.62	1.50
Rest of World	\$ 5.28	\$ 7.50
ITT	0.28	0.50
SGS	1.30	1.50
Siemens	0.45	0.75
Thomson	2.50	3.50
Others	<u>0.75</u>	<u>1.25</u>
Total*	\$44.00	\$59.00

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Market Share--Hong Kong

Table 14

SEMICONDUCTOR MARKET--HONG KONG
ESTIMATED SHARE OF WORLDWIDE MANUFACTURERS BY COMPANY
DISCRETE
(Millions of H.K. Dollars)

<u>Companies</u>	<u>1985</u>	<u>1986</u>
Japanese	\$102.96	\$132.60
Hitachi	6.24	7.80
Matsushita	11.70	10.14
Mitsubishi	3.90	6.24
NEC	35.10	36.66
Sanyo	23.40	24.96
Toshiba	15.60	16.38
Others	7.02	7.80
U.S.	\$ 61.78	\$ 81.90
Fairchild	19.50	20.28
GI	3.90	4.68
Motorola	36.66	50.70
NSC	0.78	3.90
TI	-	-
Others	0.94	2.34
South Korean	\$137.28	\$187.20
Gold Star	23.40	39.00
KEC	41.18	54.60
Samsung	67.86	81.90
Others	4.84	11.70
Rest of World	\$ 41.18	\$ 58.50
ITT	2.18	3.90
SGS	10.14	11.70
Siemens	3.51	5.85
Thomson	19.50	2.73
Others	<u>5.85</u>	<u>9.75</u>
Total*	\$343.20	\$460.00

*Columns may not add to totals shown because of rounding.

Source: Dataquest
March 1987

Semiconductor Production—Singapore

INTRODUCTION

The following set of detailed tables contains figures that quantify Singapore's semiconductor industry production in US and Singapore currencies for 1985 through 1990. Semiconductor production tables are historical data tables with an estimation of the current year, 1990. Please note that after 1988, revenue does not include assembly and test of revenue.

Singapore semiconductor industry production data are not clearly recorded based on the product categories. Assembly and packaging of ICs compound the problem, because some assembly and packaging revenue is counted as semiconductor production and some is not.

Semiconductor production Tables 1 and 2 include all semiconductor products manufactured in Singapore—including ICs, transistors, optoelectronics, and related components such as lead frames, hybrid ICs, and packaging—between 1985 and 1987.

The ASETS database tracks production from 1988 to 1990 of front-end, nonpackaging revenue.

Table 1

Semiconductor Production—Singapore (Millions of US Dollars)

	1985	1986	1987	1988	1989	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	1,074	1,127	1,704	192	248	273	26.0%	19.2%
Total Integrated Circuit	911	931	1,485	135	180	204	27.7%	22.9%
Total Discrete	133	166	178	37	43	49	15.7%	15.1%
Total Optoelectronic	30	30	40	20	25	20	15.5%	0

Note: Figures for 1984 through 1987 include foundry, assembly, and test revenue.

Figures for 1988 through 1990 do not include assembly and test revenue.

*Estimated

Source: Dataquest (August 1990)

Table 2

Semiconductor Production—Singapore (Millions of Singapore Dollars)

	1985	1986	1987	1988	1989	1990*	CAGR 1984-1987	CAGR 1988-1990*
Total Semiconductor	2,363	2,446	3,561	386	484	527	22.8	16.8%
Total Integrated Circuit	2,004	2,020	3,104	271	351	394	24.4%	20.5%
Total Discrete	293	360	372	74	84	95	12.8%	12.8%
Total Optoelectronic	66	65	84	40	49	39	12.5%	(2.0%)

Note: Figures for 1984 through 1987 include foundry, assembly, and test revenue.

Figures for 1988 through 1990 do not include assembly and test revenue.

*Estimated

Source: Dataquest (August 1990)

Market Share—Asia/Pacific Countries

INTRODUCTION

The analysis of semiconductor markets through estimation of market share by manufacturer is an integral part of Dataquest's Asian semiconductor industry database. This analysis provides insights into semiconductor markets and reinforces estimates of consumption, production, and company revenue on a regular basis. The tables show the Asian market shares for the 30 most significant Japanese, US, European, and Asia/Pacific semiconductor manufacturers.

Table 1 lists the total shipments to Asia/Pacific, which consists of Hong Kong, Singapore, South Korea, Taiwan, and other Asian countries excluding Japan. Tables 2 through 11 list 1989 company shipments to Asia/Pacific, Hong Kong, Singapore, South Korea, Taiwan, and the Rest of Asia (ROA), representing more than 90 percent of the Asia/Pacific-Rest of World (ROW) market.

Individual company shipment revenue to each country is provided in US dollars as well as local currencies. The currency units per US dollar in 1989 were HK\$7.80 in Hong Kong, S\$1.95 in Singapore, W674.29 in South Korea, and NT\$26.41 in Taiwan, according to the US Federal Reserve Bank. All historical company shipment data for South Korea, Taiwan, and Hong Kong are located in "Market Share—South Korea," "Market Share—Taiwan," and "Market Share—Hong Kong" service sections at the end of this tab, respectively.

Table 1

Asia/Pacific Semiconductor Market Share—1989
(Millions of US Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronic
Total Market	\$6,360	\$5,120	\$430	\$3,270	\$1,420	\$1,059	\$181
Asia/Pacific Companies	1,143	957	29	752	176	169	17
Daewoo	10	10	0	0	10	0	0
Goldstar	111	110	24	79	7	1	0
Hyundai	78	78	0	78	0	0	0
Korean Electronic Co.	82	23	0	0	23	53	6
Samsung	568	505	0	422	83	63	0
United Microelectronics	84	84	0	84	0	0	0
Other A/P Companies	210	147	5	89	53	52	11
North American Companies	1,870	1,634	195	1,078	361	215	21
Advanced Micro Devices	93	93	24	67	2	0	0
Chips & Technologies	123	123	13	110	0	0	0
Intel	213	213	1	212	0	0	0
Micron Technology	37	37	0	37	0	0	0
Motorola	398	288	30	175	83	107	3
National Semiconductor	213	184	44	87	53	29	0
Texas Instruments	294	279	63	158	58	14	1
Other N.A. Companies	499	417	20	232	165	65	17
Japanese Companies	2,671	2,059	144	1,255	660	480	132
Fujitsu	148	136	7	121	8	7	5
Hitachi	317	238	70	158	16	70	9
Matsushita	130	100	2	34	64	28	2
Mitsubishi	277	266	38	228	0	11	0
NEC	288	224	2	163	59	60	4
NMB	56	56	0	56	0	0	0
Oki	93	93	0	93	0	0	0
Rohm	79	40	0	5	35	33	6
Sanken	111	45	0	0	45	66	0
Sanyo	204	160	5	48	107	30	14
Sharp	120	76	0	73	3	0	44
Sony	87	84	0	3	81	3	0
Toshiba	543	400	20	198	182	109	34
Other Japanese Companies	218	141	0	77	60	63	14
European Companies	676	470	62	185	223	195	11
Philips	166	119	39	35	45	45	2
SGS-Thomson	171	133	5	57	71	38	0
Siemens	62	47	4	34	9	11	4
Telefunken	50	28	0	5	23	17	5
Other European Companies	227	143	14	54	75	84	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 2

Estimated 1989 Semiconductor Market Share—South Korea
(Millions of US Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronic
Total Market	\$2,014	\$1,559	\$147	\$886	\$526	\$402	\$53
Asia/Pacific Companies	669	517	25	377	115	135	17
Daewoo	10	10	0	0	10	0	0
Goldstar	60	59	20	34	5	1	0
Hyundai	46	46	0	46	0	0	0
Korean Electronic Co.	75	20	0	0	20	49	6
Samsung	332	282	0	232	50	50	0
United Microelectronics	7	7	0	7	0	0	0
Other A/P Companies	139	93	5	58	30	35	11
North American Companies	445	377	70	189	118	63	5
Advanced Micro Devices	16	16	4	10	2	0	0
Chips & Technologies	18	18	0	18	0	0	0
Intel	53	53	0	53	0	0	0
Micron Technology	6	6	0	6	0	0	0
Motorola	92	70	15	25	30	22	0
National Semiconductor	43	37	11	12	14	6	0
Texas Instruments	100	90	20	38	32	10	0
Other N.A. Companies	117	87	20	27	40	25	5
Japanese Companies	734	551	43	277	231	154	29
Fujitsu	52	45	0	45	0	7	0
Hitachi	48	40	6	22	12	7	1
Matsushita	34	27	2	15	10	5	2
Mitsubishi	45	40	9	31	0	5	0
NEC	108	92	2	47	43	12	4
NMB	18	18	0	18	0	0	0
Oki	4	4	0	4	0	0	0
Rohm	22	10	0	0	10	10	2
Sanken	34	13	0	0	13	21	0
Sanyo	114	93	5	17	71	18	3
Sharp	30	20	0	20	0	0	10
Sony	26	25	0	1	24	1	0
Toshiba	155	108	15	45	48	40	7
Other Japanese Companies	44	16	4	12	0	28	0
European Companies	166	114	9	43	62	50	2
Philips	23	19	3	7	9	4	0
SGS-Thomson	38	29	4	12	13	9	0
Siemens	12	9	2	4	3	3	0
Telefunken	16	9	0	2	7	5	2
Other European Companies	77	48	0	18	30	29	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 3

Estimated 1989 Semiconductor Market Share—South Korea
(Billions of South Korean Won)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronic
Total Market	1,358	1,051	99	597	355	271	36
Asia/Pacific Companies	451	349	17	254	78	91	11
Daewoo	7	7	0	0	7	0	0
Goldstar	40	40	13	23	3	1	0
Hyundai	31	31	0	31	0	0	0
Korean Electronic Co.	51	13	0	0	13	33	4
Samsung	224	190	0	156	34	34	0
United Microelectronics	5	5	0	5	0	0	0
Other A/P Companies	94	63	3	39	20	24	7
North American Companies	300	254	47	127	80	42	3
Advanced Micro Devices	11	11	3	7	1	0	0
Chips & Technologies	12	12	0	12	0	0	0
Intel	36	36	0	36	0	0	0
Micron Technology	4	4	0	4	0	0	0
Motorola	62	47	10	17	20	15	0
National Semiconductor	29	25	7	8	9	4	0
Texas Instruments	67	61	13	26	22	7	0
Other N.A. Companies	79	59	13	18	27	17	3
Japanese Companies	495	372	29	187	156	104	20
Fujitsu	35	30	0	30	0	5	0
Hitachi	32	27	4	15	8	5	1
Matsushita	23	18	1	10	7	3	1
Mitsubishi	30	27	6	21	0	3	0
NEC	73	62	1	32	29	8	3
NMB	12	12	0	12	0	0	0
Oki	3	3	0	3	0	0	0
Rohm	15	7	0	0	7	7	1
Sanken	24	9	0	0	9	14	0
Sanyo	77	63	3	11	48	12	2
Sharp	20	13	0	13	0	0	7
Sony	18	17	0	1	16	1	0
Toshiba	105	73	10	30	32	27	5
Other Japanese Companies	30	11	3	8	0	19	0
European Companies	112	77	6	29	42	34	1
Philips	16	13	2	5	6	3	0
SGS-Thomson	26	20	3	8	9	6	0
Siemens	8	6	1	3	2	2	0
Telefunken	11	6	0	1	5	3	1
Other European Companies	52	32	0	12	20	20	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 4

Estimated 1989 Semiconductor Market Share—Taiwan
(Millions of US Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronics
Total Market	\$1,834	\$1,522	\$118	\$1,032	\$372	\$255	\$57
Asia/Pacific Companies	211	195	3	159	33	16	0
Daewoo	0	0	0	0	0	0	0
Goldstar	23	23	3	20	0	0	0
Hyundai	10	10	0	10	0	0	0
Korean Electronic Co.	5	3	0	0	3	2	0
Samsung	89	85	0	70	15	4	0
United Microelectronics	44	44	0	44	0	0	0
Other A/P Companies	40	30	0	15	15	10	0
North American Companies	662	598	60	432	106	57	7
Advanced Micro Devices	42	42	10	32	0	0	0
Chips & Technologies	80	80	10	70	0	0	0
Intel	90	90	0	90	0	0	0
Micron Technology	12	12	0	12	0	0	0
Motorola	95	70	5	47	18	24	1
National Semiconductor	83	72	15	39	18	11	0
Texas Instruments	84	82	20	52	10	2	0
Other N.A. Companies	176	150	0	90	60	20	6
Japanese Companies	758	591	40	384	167	121	46
Fujitsu	41	37	3	30	4	0	4
Hitachi	79	59	20	37	2	18	2
Matsushita	38	29	0	8	21	9	0
Mitsubishi	90	87	15	72	0	3	0
NEC	82	66	0	60	6	16	0
NMB	15	15	0	15	0	0	0
Okai	29	29	0	29	0	0	0
Rohm	26	14	0	4	10	10	2
Sanken	30	12	0	0	12	18	0
Sanyo	31	23	0	13	10	6	2
Sharp	44	32	0	30	2	0	12
Sony	24	23	0	1	22	1	0
Toshiba	140	105	2	55	48	25	10
Other Japanese Companies	89	60	0	30	30	15	14
European Companies	203	138	15	57	66	61	4
Philips	57	40	14	11	15	16	1
SGS-Thomson	53	41	0	18	23	12	0
Siemens	20	15	1	12	2	3	2
Telefunken	13	7	0	1	6	5	1
Other European Companies	60	35	0	15	20	25	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 5

Estimated 1989 Semiconductor Market Share—Taiwan
(Millions of New Taiwan Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronics
Total Market	48,430	40,191	3,116	27,252	9,823	6,734	1,505
Asia/Pacific Companies	5,572	5,149	79	4,199	871	423	0
Daewoo	0	0	0	0	0	0	0
Goldstar	607	607	79	528	0	0	0
Hyundai	264	264	0	264	0	0	0
Korean Electronic Co.	132	79	0	0	79	53	0
Samsung	2,350	2,245	0	1,848	396	106	0
United Microelectronics	1,162	1,162	0	1,162	0	0	0
Other A/P Companies	1,056	792	0	396	396	264	0
North American Companies	17,481	15,791	1,584	11,408	2,799	1,505	185
Advanced Micro Devices	1,109	1,109	264	845	0	0	0
Chips & Technologies	2,113	2,113	264	1,848	0	0	0
Intel	2,377	2,377	0	2,377	0	0	0
Micron Technology	317	317	0	317	0	0	0
Motorola	2,509	1,848	132	1,241	475	634	26
National Semiconductor	2,192	1,901	396	1,030	475	290	0
Texas Instruments	2,218	2,165	528	1,373	264	53	0
Other N.A. Companies	4,648	3,961	0	2,377	1,584	528	158
Japanese Companies	20,017	15,607	1,056	10,140	4,410	3,195	1,215
Fujitsu	1,083	977	79	792	106	0	106
Hitachi	2,086	1,558	528	977	53	475	53
Matsushita	1,003	766	0	211	555	238	0
Mitsubishi	2,377	2,297	396	1,901	0	79	0
NEC	2,165	1,743	0	1,584	158	423	0
NMB	396	396	0	396	0	0	0
Oki	766	766	0	766	0	0	0
Rohm	687	370	0	106	264	264	53
Sanken	792	317	0	0	317	475	0
Sanyo	819	607	0	343	264	158	53
Sharp	1,162	845	0	792	53	0	317
Sony	634	607	0	26	581	26	0
Toshiba	3,697	2,773	53	1,452	1,268	660	264
Other Japanese Companies	2,350	1,584	0	792	792	396	370
European Companies	5,361	3,644	396	1,505	1,743	1,611	106
Philips	1,505	1,056	370	290	396	423	26
SGS-Thomson	1,400	1,083	0	475	607	317	0
Siemens	528	396	26	317	53	79	53
Telefunken	343	185	0	26	158	132	26
Other European Companies	1,584	924	0	396	528	660	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 6

Estimated 1989 Semiconductor Market Share—Hong Kong
(Millions of US Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronics
Total Market	\$905	\$742	\$48	\$499	\$195	\$138	\$25
Asia/Pacific Companies	122	115	0	102	13	7	0
Daewoo	0	0	0	0	0	0	0
Goldstar	7	7	0	7	0	0	0
Hyundai	7	7	0	7	0	0	0
Korean Electronic Co.	0	0	0	0	0	0	0
Samsung	64	60	0	50	10	4	0
United Microelectronics	30	30	0	30	0	0	0
Other A/P Companies	14	11	0	8	3	3	0
North American Companies	296	262	21	184	57	30	4
Advanced Micro Devices	11	11	2	9	0	0	0
Chips & Technologies	10	10	1	9	0	0	0
Intel	37	37	0	37	0	0	0
Micron Technology	6	6	0	6	0	0	0
Motorola	57	41	4	27	10	15	1
National Semiconductor	29	25	6	12	7	4	0
Texas Instruments	40	39	8	26	5	1	0
Other N.A. Companies	106	93	0	58	35	10	3
Japanese Companies	384	295	19	184	92	70	19
Fujitsu	19	19	2	15	2	0	0
Hitachi	48	35	12	22	1	12	1
Matsushita	20	15	0	4	11	5	0
Mitsubishi	32	30	4	26	0	2	0
NEC	40	30	0	25	5	10	0
NMB	8	8	0	8	0	0	0
Oki	20	20	0	20	0	0	0
Rohm	11	5	0	0	5	5	1
Sanken	15	6	0	0	6	9	0
Sanyo	19	14	0	6	8	2	3
Sharp	18	10	0	10	0	0	8
Sony	11	11	0	0	11	0	0
Toshiba	83	62	1	33	28	15	6
Other Japanese Companies	40	30	0	15	15	10	0
European Companies	103	70	8	29	33	31	2
Philips	28	20	7	6	7	8	0
SGS-Thomson	27	21	0	9	12	6	0
Siemens	10	7	0	6	1	2	1
Telefunken	7	4	0	1	3	2	1
Other European Companies	31	18	1	7	10	13	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 7

Estimated 1989 Semiconductor Market Share—Hong Kong
(Millions of Hong Kong Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronics
Total Market	7,060	5,788	374	3,893	1,521	1,077	195
Asia/Pacific Companies	952	897	0	796	101	55	0
Daewoo	0	0	0	0	0	0	0
Goldstar	55	55	0	55	0	0	0
Hyundai	55	55	0	55	0	0	0
Korean Electronic Co.	0	0	0	0	0	0	0
Samsung	499	468	0	390	78	31	0
United Microelectronics	234	234	0	234	0	0	0
Other A/P Companies	109	86	0	62	23	23	0
North American Companies	2,309	2,044	164	1,435	445	234	31
Advanced Micro Devices	86	86	16	70	0	0	0
Chips & Technologies	78	78	8	70	0	0	0
Intel	289	289	0	289	0	0	0
Micron Technology	47	47	0	47	0	0	0
Motorola	445	320	31	211	78	117	8
National Semiconductor	226	195	47	94	55	31	0
Texas Instruments	312	304	62	203	39	8	0
Other N.A. Companies	827	725	0	452	273	78	23
Japanese Companies	2,996	2,301	148	1,435	718	546	148
Fujitsu	148	148	16	117	16	0	0
Hitachi	374	273	94	172	8	94	8
Matsushita	156	117	0	31	86	39	0
Mitsubishi	250	234	31	203	0	16	0
NEC	312	234	0	195	39	78	0
NMB	62	62	0	62	0	0	0
Oki	156	156	0	156	0	0	0
Rohm	86	39	0	0	39	39	8
Sanken	117	47	0	0	47	70	0
Sanyo	148	109	0	47	62	16	23
Sharp	140	78	0	78	0	0	62
Sony	86	86	0	0	86	0	0
Toshiba	647	484	8	257	218	117	47
Other Japanese Companies	312	234	0	117	117	78	0
European Companies	803	546	62	226	257	242	16
Philips	218	156	55	47	55	62	0
SGS-Thomson	211	164	0	70	94	47	0
Siemens	78	55	0	47	8	16	8
Telefunken	55	31	0	8	23	16	8
Other European Companies	242	140	8	55	78	101	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 8

Estimated 1989 Semiconductor Market Share—Singapore
(Millions of US Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronics
Total Market	\$871	\$717	\$62	\$486	\$169	\$134	\$20
Asia/Pacific Companies	67	62	0	52	10	5	0
Daewoo	0	0	0	0	0	0	0
Goldstar	8	8	0	8	0	0	0
Hyundai	5	5	0	5	0	0	0
Korean Electronic Co.	0	0	0	0	0	0	0
Samsung	37	35	0	30	5	2	0
United Microelectronics	2	2	0	2	0	0	0
Other A/P Companies	15	12	0	7	5	3	0
North American Companies	309	262	18	189	55	44	3
Advanced Micro Devices	9	9	1	8	0	0	0
Chips & Technologies	9	9	1	8	0	0	0
Intel	30	30	0	30	0	0	0
Micron Technology	5	5	0	5	0	0	0
Motorola	110	80	4	56	20	30	0
National Semiconductor	24	21	5	10	6	3	0
Texas Instruments	34	33	7	22	4	1	0
Other N.A. Companies	88	75	0	50	25	10	3
Japanese Companies	390	318	25	219	74	57	15
Fujitsu	18	18	1	15	2	0	0
Hitachi	43	34	13	20	1	7	2
Matsushita	16	12	0	3	9	4	0
Mitsubishi	107	106	10	96	0	1	0
NEC	33	23	0	20	3	10	0
NMB	7	7	0	7	0	0	0
Oki	10	10	0	10	0	0	0
Rohm	11	5	0	0	5	5	1
Sanken	13	5	0	0	5	8	0
Sanyo	14	10	0	5	5	2	2
Sharp	10	5	0	5	0	0	5
Sony	10	10	0	0	10	0	0
Toshiba	71	53	1	28	24	13	5
Other Japanese Companies	27	20	0	10	10	7	0
European Companies	105	75	19	26	30	28	2
Philips	24	17	6	5	6	7	0
SGS-Thomson	3	18	0	8	10	5	0
Siemens	8	6	0	5	1	1	1
Telefunken	7	4	0	1	3	2	1
Other European Companies	43	30	13	7	10	13	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 9

Estimated 1989 Semiconductor Market Share—Singapore
(Millions of Singapore Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronics
Total Market	1,699	1,399	121	948	330	261	39
Asia/Pacific Companies	131	121	0	101	20	10	0
Daewoo	0	0	0	0	0	0	0
Goldstar	16	16	0	16	0	0	0
Hyundai	10	10	0	10	0	0	0
Korean Electronic Co.	0	0	0	0	0	0	0
Samsung	72	68	0	59	10	4	0
United Microelectronics	4	4	0	4	0	0	0
Other A/P Companies	29	23	0	14	10	6	0
North American Companies	603	511	35	369	107	86	6
Advanced Micro Devices	18	18	2	16	0	0	0
Chips & Technologies	18	18	2	16	0	0	0
Intel	59	59	0	59	0	0	0
Micron Technology	10	10	0	10	0	0	0
Motorola	215	156	8	109	39	59	0
National Semiconductor	47	41	10	20	12	6	0
Texas Instruments	66	64	14	43	8	2	0
Other N.A. Companies	172	146	0	98	49	20	6
Japanese Companies	761	620	49	427	144	111	29
Fujitsu	35	35	2	29	4	0	0
Hitachi	84	66	25	39	2	14	4
Matsushita	31	23	0	6	18	8	0
Mitsubishi	209	207	20	187	0	2	0
NEC	64	45	0	39	6	20	0
NMB	14	14	0	14	0	0	0
Oki	20	20	0	20	0	0	0
Rohm	21	10	0	0	10	10	2
Sanken	25	10	0	0	10	16	0
Sanyo	27	20	0	10	10	4	4
Sharp	20	10	0	10	0	0	10
Sony	20	20	0	0	20	0	0
Toshiba	139	103	2	55	47	25	10
Other Japanese Companies	53	39	0	20	20	14	0
European Companies	205	146	37	51	59	55	4
Philips	47	33	12	10	12	14	0
SGS-Thomson	45	35	0	16	20	10	0
Siemens	16	12	0	10	2	2	2
Telefunken	14	8	0	2	6	4	2
Other European Companies	84	59	25	14	20	25	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

Table 10

Estimated 1989 Semiconductor Market Share—Rest of Asia
(Millions of US Dollars)

	Total SC	Total IC	Bipolar Function	MOS Function	Analog	Discrete	Opto- electronics
Total Market	\$736	\$580	\$55	\$367	\$158	\$130	\$26
Asia/Pacific Companies	74	68	1	62	5	6	0
Daewoo	0	0	0	0	0	0	0
Goldstar	13	13	1	10	2	0	0
Hyundai	10	10	0	10	0	0	0
Korean Electronic Co.	2	0	0	0	0	2	0
Samsung	46	43	0	40	3	3	0
United Microelectronics	1	1	0	1	0	0	0
Other A/P Companies	2	1	0	1	0	1	0
North American Companies	158	135	26	84	25	21	2
Advanced Micro Devices	15	15	7	8	0	0	0
Chips & Technologies	6	6	1	5	0	0	0
Intel	3	3	1	2	0	0	0
Micron Technology	8	8	0	8	0	0	0
Motorola	44	27	2	20	5	16	1
National Semiconductor	34	29	7	14	8	5	0
Texas Instruments	36	35	8	20	7	0	1
Other N.A. Companies	12	12	0	7	5	0	0
Japanese Companies	405	304	17	191	96	78	23
Fujitsu	18	17	1	16	0	0	1
Hitachi	99	70	15	55	0	26	3
Matsushita	22	17	0	4	13	5	0
Mitsubishi	3	3	0	3	0	0	0
NEC	25	13	0	11	2	12	0
NMB	8	8	0	8	0	0	0
Okai	30	30	0	30	0	0	0
Rohm	9	6	0	1	5	3	0
Sanken	19	9	0	0	9	10	0
Sanyo	26	20	0	7	13	2	4
Sharp	18	9	0	8	1	0	9
Sony	16	15	0	1	14	1	0
Toshiba	94	72	1	37	34	16	6
Other Japanese Companies	18	15	0	10	5	3	0
European Companies	99	73	11	30	32	25	1
Philips	34	23	9	6	8	10	1
SGS-Thomson	30	24	1	10	13	6	0
Siemens	12	10	1	7	2	2	0
Telefunken	7	4	0	0	4	3	0
Other European Companies	16	12	0	7	5	4	0

Note: Columns or rows might not add to totals shown because of rounding.
Source: Dataquest (August 1990)

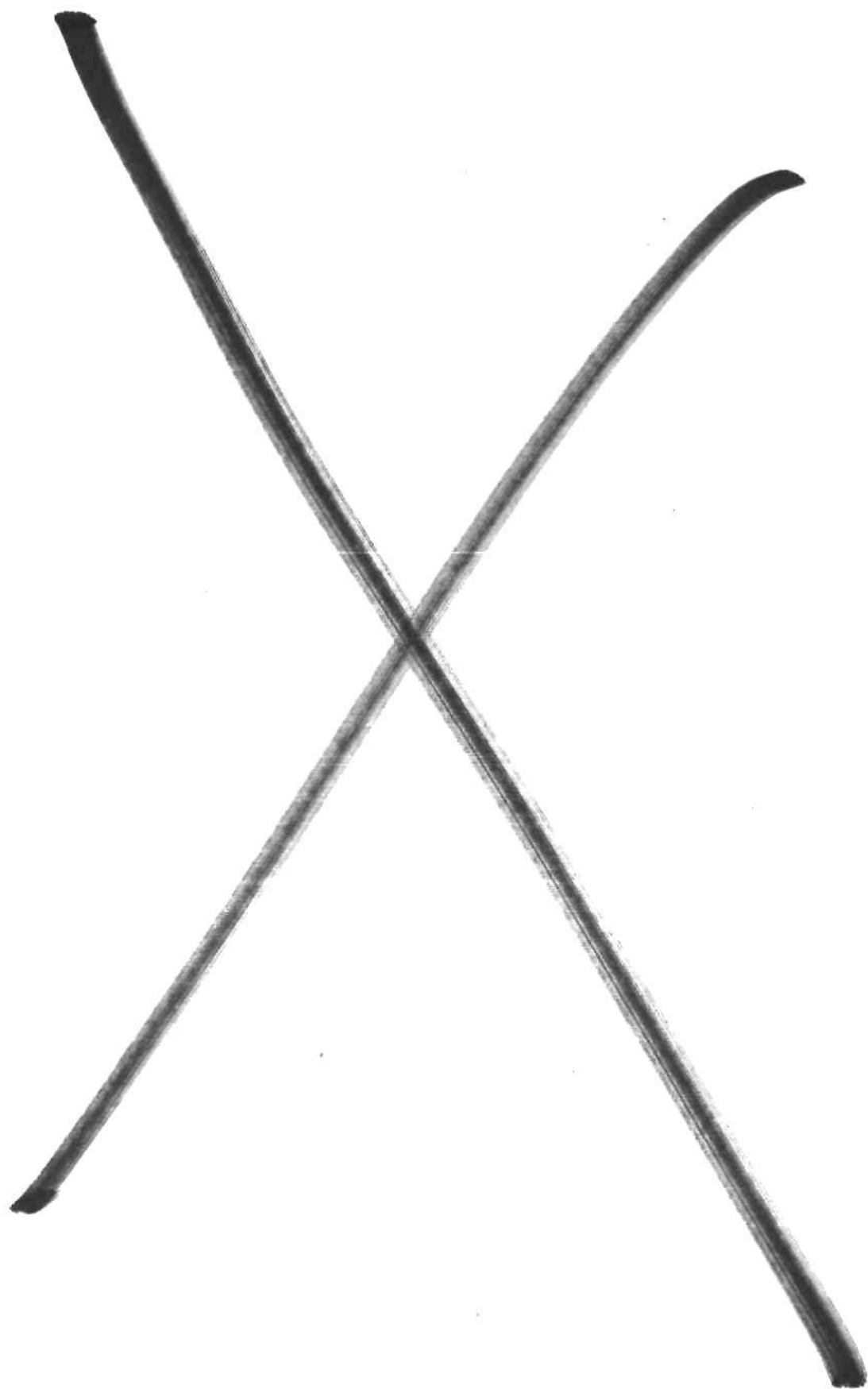
MARKET SHARE TABLES

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.

Need for Careful Interpretation

Care is taken in gathering and analyzing the available data and in attempting to categorize those data in a meaningful way. Nevertheless, 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.



Distribution—China

SEMICONDUCTOR PRODUCT SALES CHANNELS

Distribution channels in China are described as follows:

- **Direct**—A direct transaction is usually between a major semiconductor manufacturer outside China and a major user inside China, with the intervention of an import/export corporation, generally the China National Electronics Import & Export Corp. (CEIEC), which has 20 domestic and 4 foreign branch offices. These are usually large-volume, significant transactions leading, for example, to a technical transfer or joint venture. CEIEC has gained support at home and abroad since 1980, providing channels in and out of China for more than 100 countries.
- **Through authorized representatives**—For less significant transactions, quite often a representative authorized by a semiconductor manufacturer signs a contract with an import/export corporation to sell semiconductor devices to the end user. Most of these authorized representatives are based in Hong Kong and have salespeople actively scanning the market in China.
- **Through unauthorized traders**—For small transactions where the margin does not quite cover the cost of business, authorized representatives are not interested in regular business channels. Instead, they obtain supplies from Hong Kong-based Chinese traders who usually have a personal connection with an end user. This indirect method quite often does not go through legal channels. In fact, quite a high percentage of ICs are hand-carried into China in briefcases by these traders, who do not use the proper export procedures. The activity of these traders increased in 1985 and 1986 when China tried to discourage official importation of semiconductor devices.

Table 1 lists major semiconductor distributors and agents in China.

Table 1

Major Semiconductor Distributors and Agents—China

Supplier	Branch	Sales Rep/ Distributor	Person in Charge	Phone Number
Hitachi	Hitachi	—	Rex Mai	86-1-802-2089
	—	Nissei Sangyo	Masaro Takami	86-1-501-4345
Texas Instruments	Texas Instruments	—	Peter Chang	86-1-500-2255
NEC	—	Ryosan	Tetsuya Kaneko	86-1-320-3773

Source: Dataquest
May 1990

Distribution—Hong Kong

SEMICONDUCTOR PRODUCT SALES CHANNELS

The three types of product sales channels in Hong Kong are as follows:

- Branch offices, which handle multinational and domestic large-scale companies
- Agents, which handle local middle- and small-scale companies that are long-term accounts
- Distributors, which provide stock to the companies that need the products immediately, including many Hong Kong companies

Japanese and U.S. companies always maintain branch offices and several agents in Hong Kong; European companies (e.g., Philips, Siemens, and Thomson) adopt a sole-agent system. Domestic manufacturers sell their products through distributors.

Distributors are of the following four types:

- Registered companies licensed to import and export electronic products directly
- Registered companies not licensed to import and export electronic products (their products must be imported through agents)
- Part-time semiconductor product vendors that purchase products from their own sources and resell them for a large profit to end users when the end users' usual suppliers are out of stock
- Vendors that purchase products discarded by foreign companies in Southeast Asia, bring them back to Hong Kong, and select the usable products to resell to end users for a large profit

Distributors account for 10 to 15 percent of total market sales.

Differences between Agents and Distributors

Agents and distributors differ as follows:

- Method of payment
 - When buying through an agent, the user issues a letter of credit directly to the head office of the company the agent represents.
 - When buying through a distributor, the user pays the distributor directly.
- Time for receiving products
 - When buying through an agent, there is a lead time before users receive the products.
 - When buying through a distributor, products are available immediately.
- Brands sold
 - In general, an agent sells only a specific brand.
 - In contrast, a distributor sells many brands.

Table 1 lists Hong Kong's major agents and distributors.

Table 1

Major Semiconductor Distributors and Agents—Hong Kong

Supplier	Branch	Sales Rep/ Distributor	Person in Charge	Phone Number
AMD	AMD	—	M.F. Ballard	8654525
	—	Tektron	W.K. Lo	3880629
General Instrument	—	Astec	Terrance Chu	4155818
Hitachi	Hitachi	—	K.Y. Yung	7359218
	—	Nissei Sanyo	W.K. Yoshida	3343441
	—	Astec	Terrance Chu	4155818
Hyundai	—	Jardine	James Reid	5716213
Intel	Intel	—	David Shrigley	8444555
	—	Schmidt	John Kwan	8330314
Liton	—	JERS	Jackson Chu	3418311
National Semiconductor	National	—	Gene Taatjes	7331800
NEC	—	Sanshin	W. Ishida	7999862
Rockwell	—	Tekcomp	Kenneth Wong	3880629
Matsushita	—	Texny	Dickson Cheung	7650118
Motorola	Motorola	—	S.K. Yeung	4891111
	—	Nanco	Tim Wong	7653080
	—	Alberta	Olive Lee	3342415
RCA	—	Atek	Eric Lo	3621833
Mitsubishi	—	Ryoden	A. Sakimura	8907021
Samsung	—	JERS	Jackson Chu	3418311
Siliconix	—	Atek	Eric Lo	3621833
Texas Instruments	TI	—	Gilbert Wai	7351223
	—	Atek	Eric Lo	3621833

Source: Dataquest
May 1990

How Agents Are Chosen

The most frequent factors that influence a head office in choosing an agent are sales ability, reliability, and the relationship the agent maintains with the head office. Head offices in different countries emphasize different factors: for Japanese companies, relationships are most important; for U.S. companies, sales abilities.

Because an agent's main responsibility is to get purchase orders in order to earn sales commissions, his or her risk is smaller than that of a distributor. Unlike distributors, agents do not usually incur the expense of maintaining product inventories. If a company acts as both agent and distributor, it can get a better price for stock than a distributor alone can get. Therefore, many companies compete with one another to act as agents. A company that is awarded agent's rights signs a contract with the manufacturer's branch office or head office. Agents must present yearly

sales plans to the manufacturers they represent. If an agent cannot achieve the planned sales quotas, some branch offices will cancel the company's right to act as agent, but most branch offices will not annul the contract unless an agent has made mistakes. Branch offices provide technical assistance to agents, but agents must negotiate with the head office of the company they represent.

Distribution: South Korea

Semiconductor sales in South Korea take place through the following three sales channels:

- Manufacturer to branch to end user
- Branch to sales representative/distributor to end user
- Sales representative/distributor to end user

A major difference between U.S. and South Korean market channels is that the functions of sales representative and distributor are managed by one company in South Korea, whereas they are separate operations in the United States. In South Korea, sales by manufacturers' branches do not exceed 40 percent of total sales.

South Korean semiconductor companies such as Samsung, Goldstar, and KEC, have their own sales organizations in addition to several sales representatives/distributors to deal with big customers in South Korea. Normally these sales representatives/distributors handle small orders for small customers.

Table 1 lists South Korea's semiconductor sales network.

Table 1

Sales Network in South Korea

Supplier	Branch	Sales Rep/ Distributor	Person in Charge	Phone Number
AMD	AMD Korea	-	H. K. Kang	784-0030
	-	Goldstar Electron	K. S. Baek	785-3767
	-	ENC	W. J. Kim	587-5724
AMI	-	Dongsung Moolsan	D. H. Kim	547-0860
Chips & Tech.	Chips & Tech Korea	-	O. B. Kim	558-5559
Erso	-	Shin-A	M. C. Lim	541-2003
Fujitsu	-	KML	K. S. Choi	588-2011
Harris	Harris Semicon.	-	C. K. Park	551-0931
	-	Panwest	I. S. Tak	552-0341
	-	Inwha Trading	S. J. Yoon	552-8443
	-	Kumo Electric	S. H. Lee	701-5011
Hitachi	Hitachi Korea	-	Shunji Morii	784-4241
	-	LGI	D. H. Kang	785-5924
	-	IMEX	Y. N. Baek	266-9034
	-	Sukyoung	J. S. Moon	272-6811
HMC	-	E-Won	K. W. Lee	785-0352
Intel	Intel Korea	-	Ken Lee	784-8186
	-	J-Tech	J. C. Kim	782-8039
ITT	-	Kukje	H. D. Shin	777-4414

(Continued)

Table 1 (Continued)

Sales Network in South Korea

Supplier	Branch	Sales Rep/ Distributor	Person in Charge	Phone Number
LSI Logic	LSI Logic Korea	-	S. M. Kim	785-1693
Macronix	-	E-Won	K. W. Lee	785-0352
Matsushita	-	Daeduk	S. K. Choi	552-5213
Microchip Tech.	-	Daeho Sangsa	J. K. Kim	739-6040
Mitsubishi	-	Koshida	H. Y. Woo	785-1742
Motorola	Motorola Korea	-	W. S. Chun	554-5118
NEC	NEC HK Seoul Branch	-	Iida	551-0450
	-	Anse	B. K. Ahn	566-6105
	-	Hana International	J. H. Yoo	783-8830
NSC	NSC Korea	-	S. I. Kim	784-8051
	-	Dongbaek	D. W. Kim	716-6625
Oki	-	A-MI	D. W. Kim	716-6625
	-	Woosung	J. D. Yu	273-4730
Philips	Philips Korea	-	B. J. Shin	794-5011
Ericsson Comp.	-	Kortronics	K. W. Park	562-9055
Sanyo	Sanyo Korea	-	N. Kiichi	774-0296
	-	Baekyoung	N. D. Baek	279-7857
	-	Yangwon	N. K. Yang	846-7367
SEEQ	-	Hanaro	K. Ha	784-1144
SGS-Thomson	SGS-Thomson Korea	-	H. J. Chang	553-0399
	-	Doil	S. H. Han	712-7071
	-	Booksung	S. K. Choi	854-1362
Sharp	Sharp Korea	-	S. Y. Lee	782-8637
Siemens	Siemens Korea	-	S. W. Oh	275-6111
Signetics	Philips Korea	-	B. J. Shin	794-5011
SIS	-	Jace International	J. W. Cha	558-1541
SMC	-	Kortronics	K. W. Park	562-9055
TI	TI Korea	-	L. B. Chiang	551-2800
Toshiba	Teal Seoul Ltd.	-	Wagatsuma	757-2473
	-	KEC	Teng Yeol	757-5700
	-	Shinkwang	T. R. Lee	784-8471
UMC	-	Kortronics	K. W. Park	562-9055
Western Digital	W. D. Korea	-	P. J. Min	554-0508
Winbond	-	Shin-A	M. C. Lim	541-2003
Zilog	Zilog Korea	-	K. H. Hwang	552-5401
	-	ENC	W. J. Kim	587-5724

Source: Dataquest
January 1990

Distribution--Taiwan

SEMICONDUCTOR PRODUCT SALES CHANNELS

The three types of product sales channels in Taiwan are:

- Branch offices, which handle multinational and domestic large-scale companies
- Agents, which handle local middle- and small-scale companies that are long-term accounts
- Distributors, which provide stock to the companies that need the products immediately, including many Taiwanese companies

Japanese and U.S. companies always maintain branch offices and several agents in Taiwan; European companies (e.g., Siemens, Thomson, and Philips) adopt a sole agent system. Domestic manufacturers sell their products through distributors.

Distributors are of four types:

- Registered companies licensed to import and export electronic products directly
- Registered companies not licensed to import and export electronic products (their products must be imported through agents)
- Part-time semiconductor product vendors that purchase products from their own sources and resell them for a large profit to end users when the end users' usual suppliers are out of stock
- Vendors that purchase products discarded by foreign companies in Southeast Asia, bring them back to Taiwan, and select the usable products to resell to end users for a large profit

Distributors account for 10 to 15 percent of total market sales.

Differences between Agents and Distributors

Agents and distributors differ as follows:

- Method of payment
 - When buying through an agent, the user issues a letter of credit directly to the head office of the company the agent represents.
 - When buying through a distributor, the user pays the distributor directly.

Distribution--Taiwan

- Time for receiving products
 - When buying through an agent, there is a lead time before users receive the products.
 - When buying through a distributor, products are available immediately.
- In general, an agent sells only a specific brand. In contrast, a distributor sells many brands.

Table 1 lists Taiwan's major agents and distributors.

How Agents Are Chosen

The most frequent factors that influence a head office in choosing an agent are sales ability, reliability, and the relationship the agent maintains with the head office. Head offices in different countries emphasize different factors: for Japanese companies, relationships are most important; for U.S. companies, sales abilities.

Because an agent's main responsibility is to get purchase orders so as to earn sales commissions, his or her risk is smaller than that of a distributor. Unlike distributors, agents do not usually incur the expense of maintaining product inventories. If a company acts as both agent and distributor, it can get a better price for stock than a distributor alone can get. Therefore, many companies compete with each other to act as agents. A company that is awarded agent's rights signs a contract with the manufacturer's branch office or head office. Agents must present yearly sales plans to the manufacturers they represent. If an agent cannot achieve the planned sales quotas, some branch offices will cancel the company's right to act as agent, but most branch offices will not annul the contract unless an agent has made mistakes. Branch offices provide technical assistance to agents, but agents must negotiate with the head office of the company they represent.

Distribution--Taiwan

Table 1

Major Semiconductor Distributors and Agents--Taiwan

<u>Supplier</u>	<u>Branch</u>	<u>Sales Rep/ Distributor</u>	<u>Person in Charge</u>	<u>Phone Number</u>
AMI	--	Frametech	Jones Lee	02-7670101
AMD	Far East	--	Philip Leung	02-7213393
	--	Weiken	Component Div.	02-7763512
	--	Asec	Component Div.	02-0507025
NSC	NSC	--	C. Jem	02-5973205
	--	ADI	Gray Wu	02-7212305
Fujitsu	--	Framework	Jones Lee	02-7617743
Hitachi	Hitachi	--	S.H. Chen	02-7521567
		Audix	H.J. Chang	02-7114231
	--	Astec	Richard Lee	02-7098240
	--	Victron	Simmon Day	02-5014122
	--	Sentronic	H.E. Shih	02-7123710
General Instruments	G.I.T.	--	Norman McFall	02-9113861
	--	Adico	Component Div.	02-7172273
Intel	Intel	--	David Tan	02-7169660
	--	Mitac	Component Div.	02-5018531
	--	Sertek (Acer)	Miller Ho	02-5010055
Matsushita	--	Hen Shen	K.M. Chiang	02-7818182
	--	Jas Electr.	T.H. Wang	02-7727251
	--	Hua Wei	T.L. Wang	02-7112112
	--	Koho	S.W. Lin	02-5510293
	--	Sakata	C.F. Lin	02-7814283
	--	Yamato	H.H. Tseng	02-5216740
	--	Sung Tien Mou	Charles Ho	02-7417500
	--	Kuang Yuan	W.H. Lin	02-5014122
	--	Setsuyo	P.C. Hsieh	02-7070161
	--	TEM	C.Y. Chang	02-5417251
Mitsubishi	Mitsubishi	--	Yoshi Zawa	02-7041909

(Continued)

Distribution--Taiwan

Table 1 (Continued)

Major Semiconductor Distributors and Agents--Taiwan

<u>Supplier</u>	<u>Branch</u>	<u>Sales Rep/ Distributor</u>	<u>Person in Charge</u>	<u>Phone Number</u>
Motorola	Motorola	--	Tim Lin	02-7216956
	--	Strong	Component Div.	02-5651313
	--	Solomon	Component Div.	02-5651313
	--	Mercury	Component Div.	02-5031111
Mostek	--	Huge	K.W. Chu	02-7174114
National Semiconductor	National	--	Bruce Chen	02-5017227
	--	Sertek (Acer)	Component Div.	02-5010055
	--	Lite-On	Component Div.	02-7769950
	--	Lead torn	Component Div.	02-5717241
	--	Teco	Component Div.	02-7766920
NEC	NEC H.K.	--	Ohki	02-5224192
	--	TEM	C.Y. Chang	02-5417251
	--	Jas Electr.	T.H. Wang	02-7727251
	--	Ryotai	Y. Chung	02-7311425
	--	Sun Shine	N/A	02-5218701
	--	Tsansin	N/A	02-5715346
	--	Tso Yao	W.H. Cheng	02-5218271
	--	Yuban	Y.L. Lin	02-7529155
OKI	--	General	C.S. Wu	02-7645126
	--	Sertek (Acer)	Component Div.	02-5010055
Philips/ SGS-Thomson	Philips	--	Component Div.	02-7120500
	SGS Asia	--	Component Div.	02-7128203
	--	Yosun Semi	Component Div.	02-5010700
	--	Nan Lien	Component Div.	02-7002911
	--	Huge Co., Ltd.	Component Div.	02-7165373
Sanyo	--	OS Electronics	T.F. Chi	02-5374094
	--	Tong San	Y.Y. Lu	02-5435431
	--	Tosho Semi	P. Isshiki	02-5417649
Toshiba	Toshiba	--	T.P. Liao	02-5029641
Sharp	--	Aurora	C.P. Liu	02-5375107

(Continued)

Distribution--Taiwan

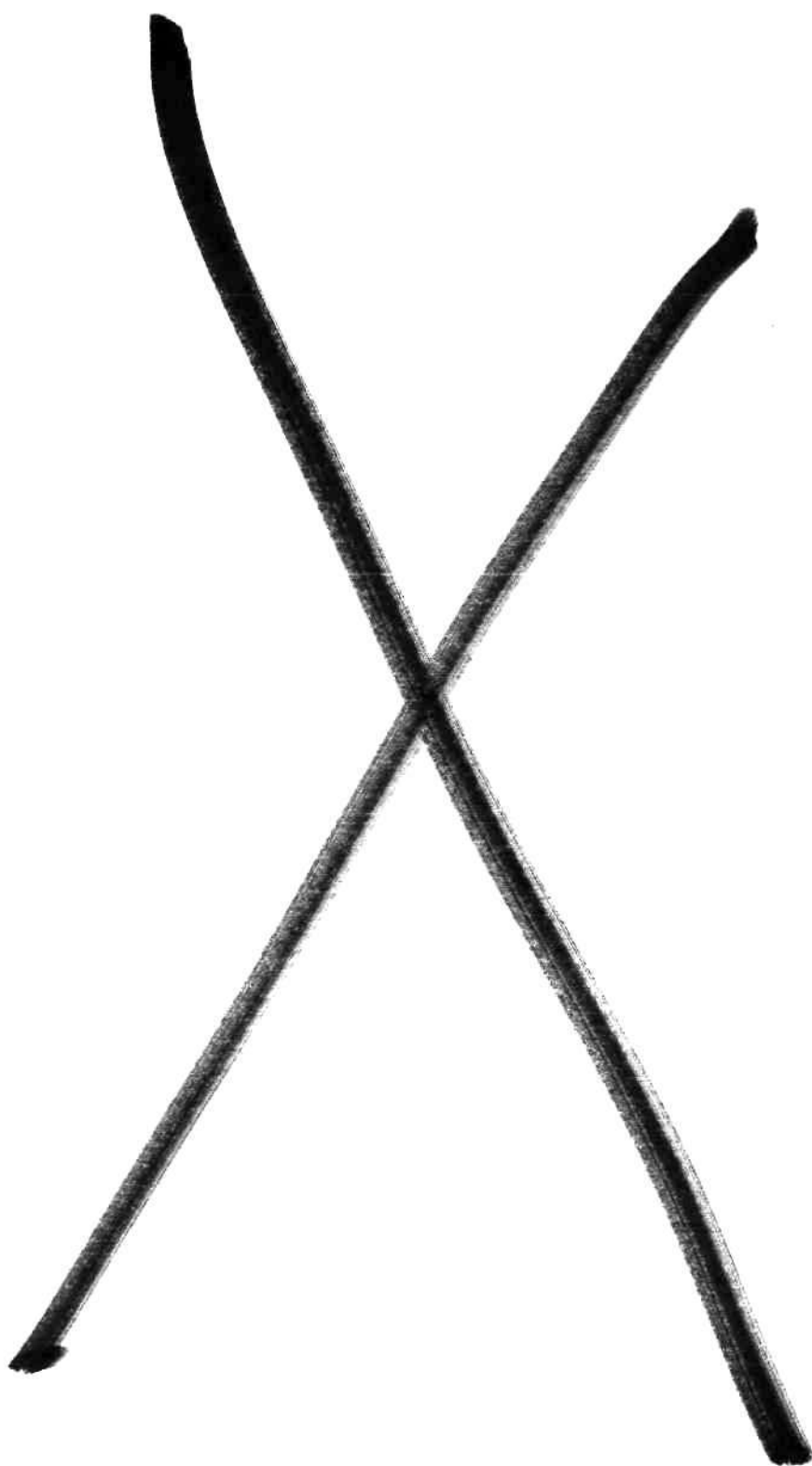
Table 1 (Continued)

Major Semiconductor Distributors and Agents--Taiwan

<u>Supplier</u>	<u>Branch</u>	<u>Sales Rep/ Distributor</u>	<u>Person in Charge</u>	<u>Phone Number</u>
Siemens	--	Tai Engineer.	H.J. Chen	02-5367070
Texas	TI	--	David Lin	02-7139311
Instruments	--	World Peace	Simmon Huang	02-7212154
Western Digital	Western Digital	--	Alex Chen	02-7174775
Zilog	--	Sertek	Frank Yeh	02-5018231

N/A = Not Available

Source: Dataquest
April 1989



Asia/Pacific and Rest of World Fab Database
 All Semiconductor Front-End Fab Lines Excluding R&D
 (Includes new fabs going into production during 1990)

Company	Country or Territory	City or District	Fab Name	Products Produced	Process Technology	Min. Line Width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. in. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mer., Cap., Res.
ADVANCE DEVICES TECH.	TAIWAN	HSINCHU	N/A	DIS OPTO	BIP MOS	0.00	0	0	0	0	0	TAIWAN	M
AMALGAMATED WIRELESS	AUSTRALIA	SYDNEY	N/A	ASIC	CMOS	1.50	6	0	0	0	0	AUST./ENGL.	M
AMPI	TAIWAN	HSINCHU	N/A	PWR ICs	N/A	0.00	4	8000	97389	0	0	TAIWAN	M
BEIJING NO.2	CHINA	BEIJING	N/A	INTERFACE IC	BIP TTL	5.00	3	0	0	0	0	CHINA	C
BEIJING NO.3	CHINA	BEIJING	N/A	LOG TRANS LIN MEM WATCH	CMOS MOS	5.00	3	15000	105975	0	0	CHINA	C
BEIJING NO.5	CHINA	BEIJING	N/A	OP AMP LOG PWR TRAN	N/A	5.00	3	0	0	0	0	CHINA	C
BEIJING NO.878	CHINA	BEIJING	N/A	DIS	N/A	5.00	3	0	0	0	0	CHINA	C
BEIJING TUBE FACTORY	CHINA	BEIJING	N/A	DIS	N/A	5.00	4	0	0	0	0	CHINA	C
BEL	INDIA	BANGALORE	N/A	DIS	N/A	4.00	4	0	0	0	0	INDIA	M
CHARTERED S/C	SINGAPORE	N/A	N/A	ASIC	CMOS	1.20	6	5000	136907	0	0	SING./U.S.	M
CONTINENTAL DEVICES	INDIA	DELHI	N/A	DIS DIODE TRAN PWR SCR	N/A	0.00	3	0	0	0	0	INDIA	M
DAEWOO	KOREA	SEOUL	GURD	CUSTOM AUTOMOTIVE AUDIO	BIP	0.00	4	9000	109563	0	0	KOREA	M
DAEWOO	KOREA	SEOUL	GURD	TELECOM MPR CUSTOM	CMOS	0.00	4	9000	109563	0	0	KOREA	M
DONG GUANG PLANT	CHINA	BEIJING	N/A	LOG MPU	BIP TTL	5.00	3	0	0	0	0	CHINA	C

(Continued)

Asia/Pacific and Rest of World Fab Database
 All Semiconductor Front-End Fab Lines Excluding R&D
 (Includes new fabs going into production during 1990)

Company	Country or Territory	City or District	Fab Name	Products Produced	Process Technology	Min. Line Width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. in. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mer., Cap., Res.
ELCAP	HONG KONG	TAI PO	N/A	MEM MPU LOG LIN	MOS	0.00	3	90000	635850	0	0	HONG KONG	M
ELECT. COMPONENTS INDIA	INDIA	HYDERABAD	N/A	DIS CONSUMER ICs	BIP	0.00	3	0	0	0	0	INDIA	M
FINE MICROELECT.	TAIWAN	HSINCHU	N/A	OPTO TRAN	N/A	0.00	3	0	0	0	0	TAIWAN	M
FUCHOU	CHINA	FUCHOU	N/A	N/A	N/A	5.00	3	0	0	0	0	CHINA	M
GENERAL INSTRUMENT	TAIWAN	N/A	N/A	PWR DIS	BIP	0.00	3	12000	84780	0	0	U.S.	M
GOLDSTAR	KOREA	ANYANG	N/A	MPU ASIC 64K SRAM	CMOS	0.00	5	10000	190175	0	0	KOREA/U.S.	M
GOLDSTAR	KOREA	GUMI	PLANT 1	LIN	BIP	0.00	4	25000	304341	0	0	KOREA/U.S.	M
GOLDSTAR	KOREA	GUMI	PLANT 2	64K SRAM MPU ARRAYS	CMOS MOS	0.00	5	15000	285262	0	0	KOREA/U.S.	M
GOLDSTAR	KOREA	WOONYUN	N/A	LOG LIN DIS CONSUMER	BIP	0.00	5	3000	57052	0	0	KOREA/U.S.	M
GOLDSTAR	KOREA	WOONYUN	N/A	256K DRAM 1Mb PROTO	CMOS HITACHI	1.20	6	18000	492866	0	0	KOREA/U.S.	M
GOVERNMENT OF IRAQ	IRAQ	N/A	N/A	N/A	N/A	0.00	0	0	0	0	0	IRAQ	C
HARBIN FACTORY	CHINA	HARBIN	N/A	TRAN	N/A	5.00	3	0	0	0	0	CHINA	C
HUA KO ELECTRONICS	HONG KONG	TAI PO	N/A	MEM MPU LOG LIN	MOS	0.00	4	4500	54781	0	0	HONG KONG	M
HUALON MICROELECT.	TAIWAN	HSINCHU	FAB 1	SRAM DRAM POLY2 M2	CMOS	1.50	5	30000	570524	0	0	TAIWAN	M

(Continued)

Asia/Pacific and Rest of World Fab Database
 All Semiconductor Front-End Fab Lines Excluding R&D
 (Includes new fabs going into production during 1990)

Company	Country or Territory	City or District	Fab Name	Products Produced	Process Technology	Min. Line Width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. in. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mer., Cap., Res.
HUALON MICROELECT.	TAIWAN	HSINCHU	FAB 2	MEM TELECOM SRAM	CMOS	0.00	6	30000	821444	0	0	TAIWAN	M
HYUNDAI	KOREA	ICHON	S/C 1	16K SRAM EPROM	CMOS MOS	1.50	5	15000	285262	0	0	KOREA	M
HYUNDAI	KOREA	ICHON	S/C 2	256K 1Mb DRAM 256K SRAM	CMOS TI	1.20	6	25000	684536	0	0	KOREA	M
HYUNDAI	KOREA	ICHON	S/C 3	1Mb DRAM 64K 256K SRAM	CMOS	0.80	5	8000	152140	0	0	KOREA	M
HYUNDAI	KOREA	ICHON	S/C 4	1Mb DRAM 4Mb PROTO SRAM	CMOS	1.00	6	20000	547629	0	0	KOREA	M
INDIAN TELEPHONE	INDIA	BANGALORE	N/A	ARRAYS TELECOM	CMOS VLSI	1.50	5	0	0	0	0	INDIA	C
INDIAN TELEPHONE	INDIA	BANGALORE	N/A	DIS	BIP	0.00	3	0	0	0	0	INDIA	C
INTEL	ISRAEL	JERUSALUM	FAB 8	386 MPU 286 MPU	CMOS	1.50	6	21000	575011	24000	10	U.S.	M
JINAN NO.1	CHINA	JINAN	N/A	LOG OP AMP	N/A	5.00	3	0	0	0	0	CHINA	C
JINAN NO.2	CHINA	JINAN	N/A	1K SRAM 4K DRAM	MOS	5.00	3	0	0	0	0	CHINA	C
KOREA ELECTRONICS	KOREA	GUMI	N/A	DIS L1N OPTO	BIP	0.00	4	20000	243473	0	0	KOREA	M
KUO HUA	TAIWAN	N/A	N/A	N/A	N/A	0.00	5	10000	190175	0	0	TAIWAN	M
LIAONING FACTORY	CHINA	JINZHOU	N/A	TRAN	N/A	5.00	3	0	0	0	0	CHINA	C

(Continued)

Asia/Pacific and Rest of World Fab Database
 All Semiconductor Front-End Fab Lines Excluding R&D
 (Includes new fabs going into production during 1990)

Company	Country or Territory	City or District	Fab Name	Products Produced	Process Technology	Min. Line Width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. in. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mer., Cap., Res.
MIN MACHINERY INDUSTRY	CHINA	N/A	N/A	LOG PWR TRAN	MOS GE	5.00	3	0	0	0	0	CHINA/U.S.	C
MOTOROLA	MALAYSIA	SEREMBAN	N/A	PWR TRAN DIS SST	N/A	0.00	6	0	0	6000	0	U.S.	M
NATIONAL S/C	ISRAEL	HA-EMEK	N/A	32-bit MPU	CMOS	1.20	6	6400	175241	20000	10	U.S.	M
NATIONAL S/C	MALAYSIA	PENANG	N/A	LOG	N/A	0.00	4	0	0	0	0	U.S.	M
PHOTRONICS	TAIWAN	N/A	N/A	OPTO	N/A	0.00	0	0	0	0	0	TAIWAN	M
QIANMEN S/C FACTORY	CHINA	BEIJING	N/A	DIG WATCH IC	N/A	5.00	3	0	0	0	0	CHINA	C
QUASEL	TAIWAN	N/A	N/A	MEM	MOS	0.00	4	0	0	0	0	TAIWAN	M
RAMAX	AUSTRALIA	MELBOURNE	N/A	FERRAM	CMOS GaAs	0.00	0	0	0	0	0	AUST./U.S.	M
RCL S/C	HONG KONG	N/A	N/A	MEM MPU LOG LIN TRAN	CMOS	0.00	4	4000	48695	0	0	HONG KONG	M
RECTRON	TAIWAN	TAIPEI	NO. 1	DIS	N/A	0.00	2	90000	282600	0	0	TAIWAN	M
ROHM	KOREA	SEOUL	N/A	DIS OPTO	N/A	0.00	0	0	0	0	0	JPN.	M
S. AFRICAN MICROELECT.	SOUTH AFRICA	PRETORIA	N/A	A/D D/A TELECOM	BIP	5.00	3	0	0	0	0	SOUTH AFRICA	M
S. AFRICAN MICROELECT.	SOUTH AFRICA	PRETORIA	N/A	A/D D/A TELECOM	CMOS	3.00	4	0	0	0	0	SOUTH AFRICA	M
SAMI	KOREA	N/A	N/A	LASER DIODE	GaAs	0.00	2	0	0	0	0	KOREA	M
SAMSUNG	KOREA	BUCHON	N/A	LIN	BIP	0.00	4	25000	304341	0	0	KOREA	M
SAMSUNG	KOREA	BUCHON	N/A	MPU LOG ASIC PWR MOSFET	CMOS MOS	2.00	5	20000	380350	0	0	KOREA	M
SAMSUNG	KOREA	KIHEUNG	FAB 1	64K DRAM SRAM EEPROM ASIC	MOS	2.00	4	35000	426078	0	0	KOREA	M

(Continued)

Asia/Pacific and Rest of World Fab Database

Asia/Pacific and Rest of World Fab Database
All Semiconductor Front-End Fab Lines Excluding R&D
(Includes new fabs going into production during 1990)

Company	Country or Territory	City or District	Fab Name	Products Produced	Process Technology	Min. Line Width Size	Waf. Size (4 wks.)	Wafer Start Capacity (4 wks.)	Sq. in. Start Capacity (4 wks.)	Clean Room Area (square feet)	Origin of Class Owner	Mer., Cap., Res.
SAMSUNG	KOREA	KIHEUNG	FAB 2	256K DRAM 256K EPROM SRAM	MOS	1.50	6	35000	958351	0	0 KOREA	M
SAMSUNG	KOREA	KIHEUNG	FAB 3	1Mb DRAM 4Mb SAMPLE	CMOS	1.00	6	30000	821444	0	0 KOREA	M
SAMSUNG	KOREA	KIHEUNG	FAB 4	1Mb DRAM 4Mb DEVELOP	CMOS	0.80	6	30000	821444	0	0 KOREA	M
SGS-THOMSON	SINGAPORE	ANG MO KIO	N/A	SRAM PWR TRAN	BIP MOS	0.00	5	25000	475437	14000	10 ITALY	M
SHANGHAI NO.5 CHINA	CHINA	SHANGHAI	N/A	LOG MEM LIN DIS	CMOS	5.00	3	10000	70650	0	0 CHINA	C
SHANGHAI NO.8331	CHINA	SHANGHAI	N/A	OP AMP PWR TRAN	BIP TTL	5.00	3	0	0	0	0 CHINA	C
SHANGHAI PHILIPS NO.7	CHINA	SHANGHAI	N/A	OP AMP PWR TRAN DIS	BIP TTL	5.00	3	20000	141300	0	0 CHINA/NETH.	M
SID MICROELECT.	BRAZIL	CONTAGEN	N/A	LIN PWR TRAN SST	BIP	30.00	3	0	0	15000	100 BRAZIL/JPN.	M
SID MICROELECT.	BRAZIL	CONTAGEN	N/A	PWR ICS PWR ICS	CMOS	2.00	4	0	0	15000	0 BRAZIL	M
SPIC ELECTRONICS	INDIA	MADRAS	N/A	PHOTO VOLTAGE DIS	N/A	3.00	3	0	0	0	0 INDIA	M
SYNTEK	TAIWAN	N/A	N/A	N/A	N/A	0.00	0	0	0	0	0 N/A	M

(Continued)

Asia/Pacific and Rest of World Fab Database
 All Semiconductor Front-End Fab Lines Excluding R&D
 (Includes new fabs going into production during 1990)

Company	Country or Territory	City or District	Fab Name	Products Produced	Process Technology	Min. Line Width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. in. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mer., Cap., Res.
TIAN GUANG FACTORY	CHINA	SHAOXING	N/A	LOG	BIP ECL TTL	5.00	4	14000	170431	0	0	CHINA	C
TIANJIN NO.1	CHINA	TIANJIN	N/A	AUDIO IC	CMOS FUJI	5.00	3	0	0	0	0	CHINA/JPN.	C
TSMC	TAIWAN	HSINCHU	FAB 1	LOG ASIC SRAM ROM DRAM	MOS CMOS	1.50	6	10000	273815	7637	10	TAIWAN	M
TSMC	TAIWAN	HSINCHU	FAB 2-A	SRAM ROM DRAM LOG CUSTOM	CMOS	1.20	6	20000	547629	40000	1	TAIWAN	M
UNITED MICROELECT.	TAIWAN	HSINCHU	FAB 1	MCU LIN 64K SRAM CUSTOM	CMOS MOS M2	1.25	4	50000	608683	0	0	TAIWAN	M
UNITED MICROELECT.	TAIWAN	HSINCHU	FAB 2	MCU TELECOM SRAM CUSTOM	CMOS MOS M2	1.00	6	30000	821444	45000	0	TAIWAN	M
WINBOND	TAIWAN	HSINCHU	FAB 1	ASIC NPR TELECOM SRAM ROM	CMOS MOS ERSO	1.50	5	15000	285262	0	10	TAIWAN	M
WUXI FACTORY	CHINA	WUXI	N/A	TRAM DIODES LIN LOG MEM	MOS TOSHIBA	5.00	4	15000	182605	0	0	CHINA/JPN.	M
YANHE RADIO FACTORY	CHINA	XIAN	N/A	LIN LOG	N/A	5.00	3	0	0	0	0	CHINA	C

Source: Dataquest
 March 1990

Taiwan Manufacturers' Database: Technology and Capacity

Table 1 summarizes the technology and capacity aspects of Taiwan's semiconductor manufacturers. Additional information on each company's products, markets, revenue, and employees is included in the service sections that follow this one. Please refer to our capital spending and semiconductor production service sections for further information on Taiwan's semiconductor industry. As company strategies change, ASETS may publish updates to these companies' activities. These updates supplement our company profiles.

Table 1

Planned and Existing Semiconductor Manufacturing Facilities in Taiwan

Company	Factory Name	Start Date	Location	Cost (US\$M)	Wafer (Inch)	Technology	Wafers/ Month	Process Technology	Expansion Plans		
									Wafer Size	Wafer Technology	Wafers/ Month
AMPI	Fab 1	Q3/88	Hsinchu	13.5	4	2.0-5.0 μ	8,000	CMOS			
Hualon	Fab 1	Q3/88	Hsinchu	160.0	5	1.2 μ	30,000	CMOS	6	1.0 μ	15,000
TSMC	Fab 1	Q4/87	Hsinchu	220.0	6	1.2 μ	14,000	CMOS	6	0.6-0.8 μ	20,000
	Fab 2	Q3/90	Hsinchu	150.0	6	0.8-1.0 μ	20,000	CMOS	8	0.6 μ	40,000
UMC	Fab 1	1980	Hsinchu	18.0	4	1.5-5.0 μ	45,000	CMOS	8	.08 μ	20,000
	Fab 2	Q3/89	Hsinchu	140.0	6	1.0 μ	15,000	CMOS			
Winbond	Fab 1	Q4/88	Hsinchu	50.0	5	1.0-5.0 μ	20,000	CMOS	6	1.0 μ	15,000
ADT	Fab 1	1987	Hsinchu	NA	4	2.0-5.0 μ	12,000	CMOS			
Vitelic	Fab 1	1992	Hsinchu	150.0	6	1.0 μ	20,000	CMOS			
Holtek	Fab 1	Q4/91	Hsinchu	16.0	5	2 μ	10,000	CMOS			
MOSel	Fab 1	Q1/93	Hsinchu	100.0	6	1.0 μ	6,000	BiCMOS			
Macronix	Fab 1	Q4/91	Hsinchu	125.0	6	1.2 μ	16,000	CMOS			
TI/Acer	Fab 1	Q3/91	Hsinchu	300.0	6	1.0 μ	30,000	CMOS			
Utic	Fab 1	Q4/91	Hsinchu	20.0	5	3.0 μ	8,000	Bipolar			
Current Total				751.5			164,000				
Planned Total				711.0			254,000				22,000

NA = Not available

Source: Dataquest (July 1991)

Taiwan Manufacturers' Database: Products and Markets

Table 1 summarizes the product and marketing activities of the current and planned semiconductor manufacturing facilities in Taiwan.

Table 1

Planned and Existing Semiconductor Manufacturing Facilities in Taiwan

Company	Factory Name	Products	Merchant, Captive, or Research	Applications	Product Types (%)		
					Standard	Custom	Foundry
AMPI	Fab 1	Discrete	M	Consumer	40	0	60
Hualon	Fab 1	SRAM, ROM, Micro	M	Communications, Data Processing, Consumer	95	0	5
TSMC	Fab 1		M				100
	Fab 2		M				
UMC	Fab 1	SRAM, ROM	M	Consumer	82	3	15
	Fab 2	SRAM, EPROM	M	Consumer, Data Processing			
Winbond	Fab 1	ROM, SRAM, Micro	M	Communications, Data Processing, Consumer	85	5	10
ADT	Fab 1	Discrete	M	Consumer	90		10
Vitellic	Fab 1	1Mb DRAM	M	Data Processing			
Holtek	Fab 1	ASIC, ROM	M	Data Processing			
MOSel	Fab 1	ASIC, SRAM	M	Data Processing			
Macronix	Fab 1	EPROM	M	Communications			
TI/Acer	Fab 1	4Mb DRAM	M	Data Processing			
Utic	Fab 1	Discrete	M	Consumer			

Source: Dataquest (July 1991)

Taiwan Manufacturers' Database: Factory Revenue

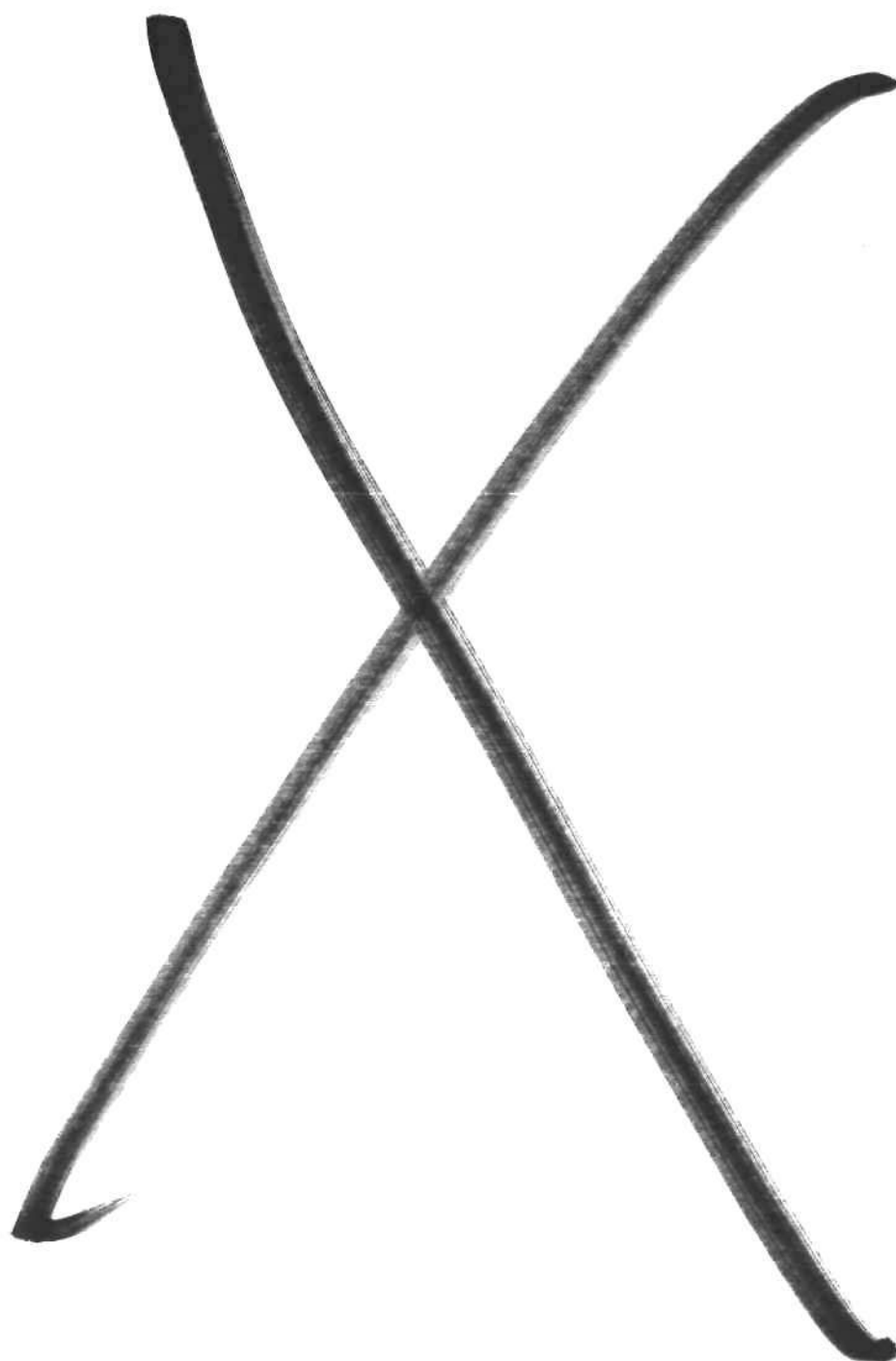
Table 1 provides a summary of the factory revenue that each Taiwan-based manufacturer has reported in 1989 and 1990.

Table 1

Estimated Company Factory Revenue and Number of Employees

Company	1989 Revenue (US\$M)	1990 Revenue (US\$M)	Total Employees
AMPI	8.0	1.5	165.0
Hualon	48.0	44.0	879.0
TSMC	76.0	82.0	1,250.0
UMC	130.0	148.0	1,700.0
Winbond	40.0	48.0	782.0
ADT	8.0	1.5	170.0
Vitellic	0	0	NA
Holtek	0	0	NA
MOSel	0	0	NA
Macronix	0	0	NA
TI/Acer	0	0	NA
Utic	0	0	NA
Total	310.0	325.0	4,946.0

NA = Not available
Source: Dataquest (July 1991)



Capital Spending by Company: Asia/Pacific Manufacturers

ASIA/PACIFIC CAPITAL SPENDING

Dataquest surveys all major semiconductor manufacturers in Asia/Pacific (South Korea, Taiwan, and the Rest of Asia region) once a year and estimates both their year-previous capital spending and planned spending for the current year.

Table 1 summarizes each region's total semiconductor capital from 1986 through 1990 and forecasts 1991 spending. Table 2 explains each company's relative share of Asia/Pacific total spending.

Table 1
Estimated Semiconductor Capital Spending in Asia/Pacific
(Millions of U.S. Dollars)

Company	1986	1987	1988	1989	1990	1991*	CAGR (%) 1986-1990
South Korea Total	328	400	799	1,565	1,046	1,120	33.6
Daewoo	25	56	27	25	21	10	-4.3
Goldstar	90	118	245	450	350	330	40.4
Hyundai	43	90	75	400	150	200	36.7
KEC	20	6	42	60	15	10	-6.9
Kukje	0	0	0	30	15	20	NM
Sammi	0	0	0	0	15	20	NM
Samsung	150	130	410	600	480	530	33.7
Taiwan Total	48	56	210	189	325	788	61.3
ERSO	16	11	5	2	40	50	25.7
Hualon	0	0	30	40	40	40	NM
Macronix	0	0	0	5	20	100	NM
TI/Acer	0	0	0	5	72	220	NM
TSMC	1	5	40	75	85	160	NM
UMC	6	12	110	40	23	26	39.9
Vitellic	0	0	0	10	35	80	NM
Winbond	0	12	25	12	10	112	NM
Others	25	16	0	0	0	0	NM
Rest of Asia Total	7	18	71	119	124	131	61.3
Chartered Semiconductor	0	0	30	20	20	15	NM
SGS-Thomson (Singapore)	4	10	19	25	35	25	NM
Elcap	2	2	6	5	1	1	NM
Hua-Ko	1	2	2	1	1	1	NM
RCL	0	1	1	1	1	1	NM
Motorola (Malaysia)	0	0	8	34	33	25	NM
Philips (Shanghai)	0	0	0	5	20	50	NM
Beijing Steel (NEC)	0	0	0	0	0	0	NM
Shanghai Belling	0	0	0	2	2	2	NM
Shanghai #19	0	0	0	1	1	1	NM
Wuxi	0	3	5	25	10	10	NM
Motorola (Tianjin)	0	0	0	0	0	0	NM
Others	0	0	0	0	0	0	NM
Total	383	474	1,080	1,873	1,495	2,039	40.6

*Forecast

NM = Not meaningful

Source: Dataquest (July 1991)

Capital Spending by Company: Rest of Asia Manufacturers

REST OF ASIA CAPITAL SPENDING

Dataquest surveys all major semiconductor manufacturers in the Rest of Asia region once a year and estimates their year-previous capital spending and their planned spending for the current year.

Table 1 summarizes each company's total semiconductor capital from 1986 through 1990 and forecasts 1991 spending. Table 2 explains each company's relative share of Asia/Pacific total spending.

Table 1
Estimated Company Capital Spending in Rest of Asia
(Millions of U.S. Dollars)

Company	1986	1987	1988	1989	1990	1991*	CAGR (%) 1986-1990
Chartered Semiconductor	0	0	30	20	20	15	NM
SGS-Thomson (Singapore)	4	10	19	25	35	25	72.0
Elcap	2	2	6	5	1	1	-15.9
Hua-Ko	1	2	2	1	1	1	0
RCL	0	1	1	1	1	1	NM
Motorola (Malaysia)	0	0	8	34	33	25	NM
Philips (Shanghai)	0	0	0	5	20	50	NM
Beijing Steel (NEC)	0	0	0	0	0	0	NM
Shanghai Belling	0	0	0	2	2	2	NM
Shanghai #19	0	0	0	1	1	1	NM
Wuxi	0	3	5	25	10	10	NM
Motorola (Tianjin)	0	0	0	0	0	0	NM
Others	0	0	0	0	0	0	NM
Total	7	18	71	119	124	131	105.2

*Forecast

NM = Not meaningful

Source: Dataquest (July 1991)

Table 2

**Estimated Company Capital Spending in Rest of Asia
Share of Rest of Asia Capital Spending
(Percentage)**

Company	1986	1987	1988	1989	1990	1991*
Chartered Semiconductor	0	0	42.3	16.8	16.1	11.5
SGS-Thomson (Singapore)	57.1	55.6	26.8	21.0	28.2	19.1
Elcap	28.6	11.1	8.5	4.2	0.8	0.8
Hua-Ko	14.3	11.1	2.8	0.8	0.8	0.8
RCL	0	5.6	1.4	0.8	0.8	0.8
Motorola (Malaysia)	0	0	11.3	28.6	26.6	19.1
Philips (Shanghai)	0	0	0	4.2	16.1	38.2
Beijing Steel (NEC)	0	0	0	0	0	0
Shanghai Belling	0	0	0	1.7	1.6	1.5
Shanghai #19	0	0	0	0.8	0.8	0.8
Wuxi	0	16.7	7.0	21.0	8.1	7.6
Motorola (Tianjin)	0	0	0	0	0	0
Others	0	0	0	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Forecast

Source: Dataquest (July 1991)

Capital Spending by Company: South Korean Manufacturers

SOUTH KOREAN CAPITAL SPENDING

Dataquest surveys all major semiconductor manufacturers once a year and estimates both their year-previous capital spending and planned spending for the current year.

Table 1 summarizes each company's total semiconductor capital from 1986 through 1990 and forecasts 1991 spending. Table 2 explains each company's relative share of Asia/Pacific total spending.

Table 1

Estimated Company Capital Spending in South Korea (Millions of U.S. Dollars)

Company	1986	1987	1988	1989	1990	1991*	CAGR (%) 1986-1990
Daewoo	25	56	27	25	21	10	-4.3
Goldstar	90	118	245	450	350	330	40.4
Hyundai	43	90	75	400	150	200	36.7
KEC	20	6	42	60	15	10	-6.9
Kukje	0	0	0	30	15	20	NM
Sammi	0	0	0	0	15	20	NM
Samsung	150	130	410	600	480	530	33.7
Total	328	400	799	1,565	1,046	1,120	33.6

*Forecast

NM = Not meaningful

Source: Dataquest (July 1991)

Table 2

**Estimated Company Capital Spending in South Korea
Share of South Korean Capital Spending
(Percentage)**

Company	1986	1987	1988	1989	1990	1991*
Daewoo	7.6	14.0	3.4	1.6	2.0	0.9
Goldstar	27.4	29.5	30.7	28.8	33.5	29.5
Hyundai	13.1	22.5	9.4	25.6	14.3	17.9
KEC	6.1	1.5	5.3	3.8	1.4	0.9
Kukje	0	0	0	1.9	1.4	1.8
Sammi	0	0	0	0	1.4	1.8
Samsung	45.7	32.5	51.3	38.3	45.9	47.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Forecast

Source: Dataquest (July 1991)

Capital Spending by Company: Taiwanese Manufacturers

TAIWANESE CAPITAL SPENDING

Dataquest surveys all major semiconductor manufacturers in Taiwan once a year and estimates both their year-previous capital spending and planned spending for the current year.

Table 1 summarizes each company's total semiconductor capital from 1986 through 1990 and forecasts 1991 spending. Table 2 explains each company's relative share of Asia/Pacific total spending.

Table 1

Estimated Company Capital Spending in Taiwan (Millions of U.S. Dollars)

Company	1986	1987	1988	1989	1990	1991*	CAGR (%) 1986-1990
ERSO	16	11	5	2	40	50	25.7
Hualon	0	0	30	40	40	40	NM
Macronix	0	0	0	5	20	100	NM
TI/Acer	0	0	0	5	72	220	NM
TSMC	1	5	40	75	85	160	NM
UMC	6	12	110	40	23	26	39.9
Vitellic	0	0	0	10	35	80	NM
Winbond	0	12	25	12	10	112	NM
Others	25	16	0	0	0	0	NM
Total	48	56	210	189	325	788	61.3

*Forecast

NM = Not meaningful

Source: Dataquest (July 1991)

Table 2

Estimated Company Capital Spending in Taiwan
Share of Taiwanese Capital Spending
(Percentage)

Company	1986	1987	1988	1989	1990	1991*
ERSO	33.3	19.6	2.4	1.1	12.3	6.3
Hualon	0	0	14.3	21.2	12.3	5.1
Macronix	0	0	0	2.6	6.2	12.7
TI/Acer	0	0	0	2.6	22.2	27.9
TSMC	2.1	8.9	19.0	39.7	26.2	20.3
UMC	12.5	21.4	52.4	21.2	7.1	3.3
Vitellic	0	0	0	5.3	10.8	10.2
Winbond	0	21.4	11.9	6.3	3.1	14.2
Others	1.0	0	0	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Forecast

NM = Not meaningful

Source: Dataquest (July 1991)

Table 2

**Estimated Semiconductor Capital Spending in Asia/Pacific
Share of Asia/Pacific Capital Spending
(Percentage)**

Company	1986	1987	1988	1989	1990	1991*
South Korea Total	85.6	84.4	74.0	83.6	70.0	54.9
Daewoo	6.5	11.8	2.5	1.3	1.4	0.5
Goldstar	23.5	24.9	22.7	24.0	23.4	16.2
Hyundai	11.2	19.0	6.9	21.4	10.0	9.8
KEC	5.2	1.3	3.9	3.2	1.0	0.5
Kukje	0	0	0	1.6	1.0	1.0
Sammi	0	0	0	0	1.0	1.0
Samsung	39.2	27.4	38.0	32.0	32.1	26.0
Taiwan Total	12.5	11.8	19.4	10.1	21.7	38.6
ERSO	4.2	2.3	0.5	0.1	2.7	2.5
Hualon	0	0	2.8	2.1	2.7	2.0
Macronix	0	0	0	0.3	1.3	4.9
TI/Acer	0	0	0	0.3	4.8	10.8
TSMC	0.3	1.1	3.7	4.0	5.7	7.8
UMC	1.6	2.5	10.2	2.1	1.5	1.3
Vitellic	0	0	0	0.5	2.3	3.9
Winbond	0	2.5	2.3	0.6	0.7	5.5
Others	6.5	3.4	0	0	0	0
Rest of Asia Total	1.8	3.8	6.6	6.4	8.3	6.4
Chartered Semiconductor	0	0	2.8	1.1	1.3	0.7
SGS-Thomson (Singapore)	1.0	2.1	1.8	1.3	2.3	1.2
Elcap	0.5	0.4	0.6	0.3	0.1	0
Hua-Ko	0.3	0.4	0.2	0.1	0.1	0
RCL	0	0.2	0.1	0.1	0.1	0
Motorola (Malaysia)	0	0	0.7	1.8	2.2	1.2
Philips (Shanghai)	0	0	0	0.3	1.3	2.5
Beijing Steel (NEC)	0	0	0	0	0	0
Shanghai Belling	0	0	0	0.1	0.1	0.1
Shanghai #19	0	0	0	0.1	0.1	0
Wuxi	0	0.6	0.5	1.3	0.7	0.5
Motorola (Tianjin)	0	0	0	0	0	0
Others	0	0	0	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Forecast

Source: Dataquest (July 1991)

Capital Spending in Asia

OVERVIEW

The Asian newly industrialized economies (NIEs) of South Korea, Taiwan, Hong Kong, and Singapore are emerging as major competitors in the fields of semiconductors and electronics. Consequently, the rates of increased capital expenditure in their semiconductor industries are the highest in the world. The NIEs have surpassed Europe already in terms of capital spending (see Figure 1). Dataquest believes that the Asia/Pacific region will continue to make a concerted private and public effort to become technologically sufficient in production of semiconductors necessary to feed its growth in electronics.

This section explains historical (1984 to 1988) and forecast (1989 through 1993) growth in capital expenditure. Tables 1 and 2 compare the capital expenditure of the Asia/Pacific region with the three other major regions of the world. Tables 3 and 4 track growth in South Korea and Taiwan. Tables 5 and 6 present the total capital expenditure by company in South Korea and Taiwan, respectively.

Please note that in Asia, South Korea and Taiwan have increased investment in capital equipment and facilities the fastest. The Asia/Pacific region is home to many major semiconductor producers. Front-end production in the NIEs grew at a compound annual growth rate (CAGR) of 61 percent from 1983 to 1988, resulting in an increased worldwide share from 1 to 3 percent of total production. Tables 5 and 6 list the dollar value of capital spending among South Korean and Taiwanese companies, respectively, from 1984 to 1989.

Figure 1

Estimated Capital Spending in Asia/Pacific and Europe

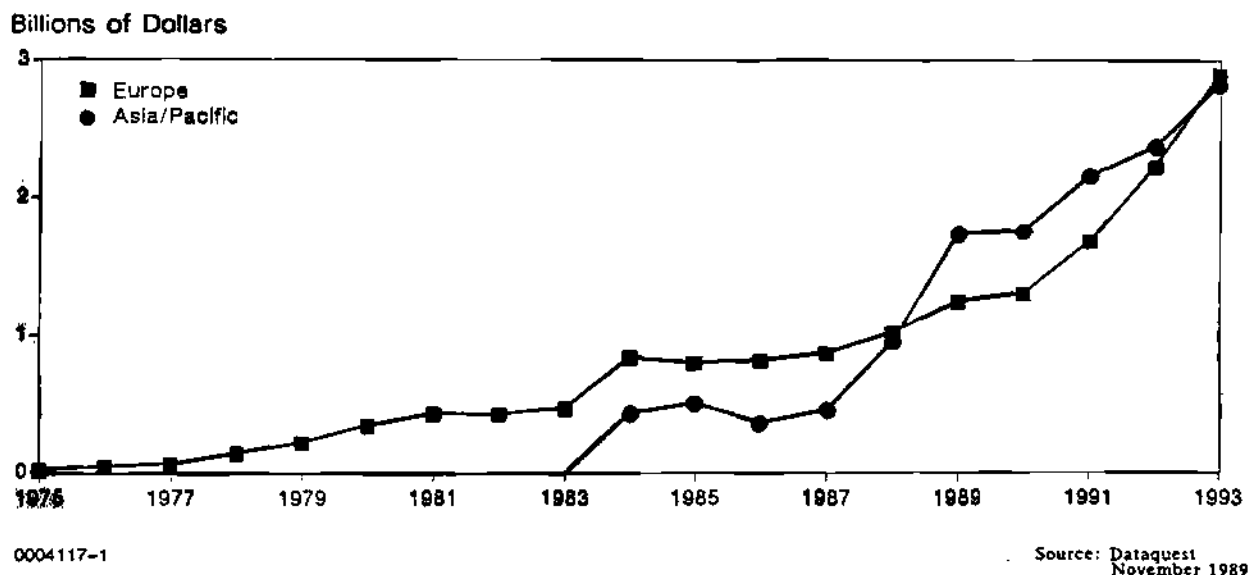


Table 1

Historical Capital Spending—Worldwide
(Millions of U.S. Dollars)

	1984	1985	1986	1987	1988	CAGR 1984-1988
North America	\$3,661	\$2,629	\$2,082	\$2,594	\$ 3,434	(1.6%)
Japan	3,900	3,336	1,845	2,432	4,586	4.1%
Europe	816	800	765	875	1,025	5.9%
Asia/Pacific	513	548	383	471	1,023	18.8%
Total	\$8,890	\$7,313	\$5,075	\$6,372	\$10,068	3.2%

Source: Dataquest
November 1989

Table 2

Forecast Capital Spending—Worldwide
(Millions of U.S. Dollars)

	1989	1990	1991	1992	1993	CAGR 1988-1993
North America	\$ 3,826	\$ 3,826	\$ 4,629	\$ 6,053	\$ 7,961	20.1%
Japan	5,488	5,488	6,915	9,439	12,864	23.7%
Europe	1,250	1,250	1,684	2,231	2,920	23.3%
Asia/Pacific	1,963	1,866	2,290	2,520	3,005	11.2%
Total	\$12,527	\$12,430	\$15,518	\$20,243	\$26,750	20.9%

Source: Dataquest
November 1989

Table 3

Historical Capital Spending—Asia/Pacific
(Millions of U.S. Dollars)

	1984	1985	1986	1987	1988	CAGR 1984-1988
South Korea	\$463	\$490	\$328	\$397	\$ 757	13.1%
Taiwan	50	58	48	56	195	40.5%
Other	0	0	7	18	71	N/M
Total	\$513	\$548	\$383	\$471	\$1,023	18.8%

N/M = Not Meaningful

Source: Dataquest
November 1989

Table 4

Forecast Capital Spending—Asia/Pacific
(Millions of U.S. Dollars)

	1989	1990	1991	1992	1993	CAGR 1988-1993
South Korea	\$1,600	\$1,297	\$1,591	\$1,751	\$2,088	6.9%
Taiwan	296	466	572	629	750	26.2%
Other	67	103	127	140	167	25.6%
Total	\$1,963	\$1,866	\$2,290	\$2,520	\$3,005	11.2%

Source: Dataquest
November 1989

Table 5

Capital Spending—South Korea
(Millions of U.S. Dollars)

	1984	1985	1986	1987	1988	1989*	CAGR 1984-1989
Daewoo	N/M	N/M	\$ 25	\$ 65	\$ 27	\$ 25	N/M
GoldStar	\$112	\$107	90	125	245	615	40.6%
Hyundai	138	141	43	71	29	410	24.3%
KEC	37	22	20	6	16	60	10.2%
Kukje	0	0	0	0	0	30	N/M
Samsung	176	220	150	130	440	460	21.2%
Total	\$463	\$490	\$328	\$397	\$757	\$1,600	28.1%

*Forecast
N/M = Not Meaningful

Source: Dataquest
November 1989

Table 6

Capital Spending—Taiwan
(Millions of U.S. Dollars)

	1984	1985	1986	1987	1988	1989*	CAGR 1984-89
ERSO	\$ 5	\$15	\$16	\$11	\$ 5	\$ 2	(16.7%)
Hualon	0	0	N/M	N/M	30	40	N/M
Rectron	1	2	5	0	0	0	N/M
TSMC	0	0	21	21	25	123	N/M
UMC	10	8	6	12	110	40	32.0%
Vitalic	0	0	0	0	0	80	N/M
Winbond	0	0	0	12	25	12	N/M
Total	\$16	\$25	\$48	\$56	\$195	\$297	79.4%

*Forecast
N/M = Not Meaningful

Source: Dataquest
November 1989

Design Centers—Overview

Major Design Centers

Country	Number of Major Design Centers
South Korea	7
Taiwan	28
Hong Kong	9
Singapore	8
China	5

Source: Dataquest
April 1990

Design Centers—South Korea

SAMSUNG

Samsung's design centers for internal product development have three locations—Buchon, Suwon, and SSI in the United States. 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 South Korea. In 1986, the Buchon Design Center was relocated in Seoul. The Seoul facility has approximately 15 employees and is equipped with three Daisy workstations.

GOLDSTAR

Goldstar's South Korean design center is currently established in Seoul. It employs 30 design engineers and is equipped with two Calma GDS II systems, five workstations, and a minicomputer. Its U.S. design center, Goldstar Technology Inc., a wholly owned subsidiary of the Lucky-Goldstar Group, is located at 3003 N. First Street, San Jose, California 95134-2004 (telephone 408-432-1331).

HYUNDAI

The Hyundai design center is equipped with two Calma GDS-II systems and four workstations. Its address is 113-2 Ami-ri Bubal-Myan, Ichan-Kun, Kyoungki-Do, South Korea (telephone 822 741-0661).

In 1988, the company purchased LL-7000 gate array technology from LSI Logic.

ANAM SEMICONDUCTOR DESIGN CO., LTD.

Anam Semiconductor Design Co., Ltd., was established in 1987 under a joint venture with VTI. The company is located in 995-16, Daechi-dong, Kannam-gu, Seoul, Korea (telephone 822 553-2106).

LSI LOGIC KOREA

LSI Logic Korea was founded in 1987 as a subsidiary of LSI Logic Corporation in the United States. Its address is 27-2, Yoido-dong, Youngdungpo-gu, Seoul, Korea (telephone 785-1693).

DAEWOO TELECOM

Daewoo Telecom started its design operation in 1987 with ZyMOS design technology. Its address is 60-8, Karibong-dong, Youngdung, Seoul, Korea (telephone 864-8200).

TI KOREA

TI Korea expanded its operation in 1988. The company is developing full-custom design and system design in Korea. Its address is 28F, Trade Tower, 159 Samsung-dong, Kangnam-gu, Seoul, Korea (telephone 551-2801).

Design Centers—Taiwan

The number of design centers in Taiwan has increased dramatically, to between approximately 40 and 50 during the past year. Table 1 describes Taiwan's major design centers.

Table 1

Domestic Companies

Year	Company	Address/Telephone/Fax
1985	United Microelectronics Corp.	No. 3 Industrial E. Third Road Science-Based Industrial Park Hsinchu Tel: 035-773131 Fax: 035-774767
1986	Alphatek	N/A
1986	Microelectronics Corp.	2/F, 317, Sung Chiang Road Taipei Tel: 02-5014996 Fax: 5056421
	ERSO	195, Sec. 4, Chung Hsing Road Chutung, Hsinchu Tel: 035-966100 Fax: 035-953587
1986	Princeton Technology	3F, No. 207, Tun Hua N. Road Taipei Tel: 02-7171439 Fax: N/A
1986	Realtek	N/A
1986	Silicon Integrated Systems	2F, No. 17, Innovation Road I Science-Based Industrial Park Hsinchu Tel: 035-774922 Fax: 035-778774

(Continued)

Table 1 (Continued)

Domestic Companies

Year	Company	Address/Telephone/Fax
1986	Syntek Design Technology Co. Ltd	No. 3, Technology Fifth Road Science-Based Industrial Park Hsinchu Tel: 035-773180-2 Fax: N/A
1987	Proton	N/A
1987	Micron	N/A
1987	Holtek Semiconductor Inc.	3/F, No. 1, Lane 487 Sec. 7, Chung Hsiao E. Road Taipei Tel: 02-7032183/5 Fax: 02-7837106
1987	Acer International	602 Ming Sheng E. Road Taipei Tel: 02-7132252 Fax: 02-7151950
1987	AST Taiwan Ltd.	No. 46 Park Avenue II Science-Based Industrial Park Hsinchu Tel: 035-774951 Fax: 035-775333
1987	MOSIC Corp.	5/F, 185, Sec. 2 Chung Shan N. Road Taipei
1987	Tamadack Microelectronics Inc.	16/F, 1, Fu Hsing N. Road Taipei Tel: 02-7727658 Fax: 02-7760545
1989	Hertai Computer Systems Corp.	N/A
1989	Winbond Electronics Corp.	No. 2 Science-Based Industrial Park Hsinchu, Taiwan, ROC Tel: (035) 77-0066 Fax: 35-774527

(Continued)

Table 1 (Continued)

Foreign Companies

Year	Company	Address/Telephone/Fax
1981	Motorola	4F, Sunrise Plaza Bldg. 2 Par Deh Road, Sec. 3 Taipei Tel: 02-7528944
1985	National Semiconductor (Multitech cosponsor)	N/A
1985	Texas Instruments	9F Bank Tower 205 Tung Hua N. Road Taipei Tel: 035-774767
1985	Ferranti	N/A
1985	Hitachi	N/A
1985	Philips	4F, 150 Tung Hua N. Road Taipei Tel: 02-712-0500 ext. 454
1986	SGS-Thomson	12F, 571 Tung Hua S. Road Taipei Tel: 02-755-4111
1988	Seiko-Epson	N/A
1988	Toshiba	N/A
1989	LSI Logic	N/A
1989	Motorola Corp.	N/A

N/A = Not Available

Source: Dataquest
March 1990

Design Centers—Hong Kong

Table 1 describes Hong Kong's major design centers.

Table 1

Foreign Companies

Year	Company	Address/Telephone/Fax
1982	Hitachi Asia Ltd.	Unit 606, North Tower World Shipping Centre Harbour City, Canton Road Tsimshatsui, Kowloon, Hong Kong Tel: 7359218 Fax: 7359218
1984	National Semiconductor Hong Kong Ltd.	8/F DPE Cheung Kong Electrical Building 4 Hing Yip Street, Kwun Tong, Kowloon, Hong Kong Tel: 3411241 Fax: 3439453
1984	Texas Instruments Hong Kong Ltd.	8/F World Shipping Centre 7 Canton Road Kowloon, Hong Kong Tel: 7351223 Fax: 7354954
1986	Motorola	Asia Pacific Design Centre 7/F Profit Industrial Building Phase II, 1-15 Kwai Fung Crescent, Kwai Chung, New Territories, Hong Kong Tel: 4808333 Fax: 4891181
1987	Central System Design Ltd.	Room 1704 Westlands Centre 20 Westlands Road Quarry Bay, Hong Kong Tel: 5620248 Fax: 5658046

(Continued)

Table 1 (Continued)

Foreign Companies

Year	Company	Address/Telephone/Fax
1987	Oki Electronics (Hong Kong) Ltd.	Room 1801-4 Tower One China Hong Kong City 33 Canton Road Tsimshatsui, Kowloon, Hong Kong Tel: 7362336 Fax: 7362395
1988	VLSI Design Ltd.	Room 2812 Shui On Centre 8 Harbour Road Wanchai, Hong Kong Tel: 86653755 Fax: 8653159
N/A	Toshiba Electronics Asia Ltd.	10/F, Sun Plaza, 28 Canton Road Tsimshatsui Kowloon, Hong Kong Tel: 7216111 Fax: 7398969

N/A = Not Available

Source: Dataquest
April 1990

Design Centers—Singapore

The number of design centers in Singapore has increased to eight in total. A new design center was completed last year. Advanced Micro Devices (AMD) plans to build one in the distant future. Table 1 describes both foreign and domestic design centers in Singapore.

Table 1

Design Centers

Year	Company	Address/Telephone/Fax
1984	Hewlett-Packard	1150 Depot Road Singapore 0410 Tel: 2719444 Fax: 2785319
1984	Menor Graphics	2 Science Park Drive #53 The Faraday Singapore Science Park Singapore 0511 Tel: 7791111 Fax: 7794455
1984	SGS-Thomson Microelectronics	28 Ang Mo Kio Industrial Park 2 Singapore 2056 Tel: 4821488 Fax: 4820240
1985	AT&T Microelectronics	14 Science Park Drive #03-02A/04 The Maxwell Singapore 0511 Tel: 7788833 Fax: 7777495
1986	Silicon Systems	3015A Ubi Road 1 #03-01 Singapore 1440 Tel: 7447700 Fax: 7477609
1987	Chartered Semiconductor Pte. Ltd.	No. 1 Science Park Drive SISIR Bldg. #02-42 Singapore 0511 Tel: 7772566 Fax: 7771933

(Continued)

Table 1 (Continued)

Design Centers

Year	Company	Address/Telephone/Fax
1987	Silicon Compilation Technology P/L	80 Marine Parade Road #08-02 Singapore Fax: 3444489
1989	N Electronics	3 Ang Mo Kio Industrial Park 2 Singapore 2056 Tel: 4819881 Fax: 4818497

Source: Dataquest
April 1990

Design Centers--China

MICROELECTRONICS CENTER, CHINESE ACADEMY OF SCIENCES

Address: Qijiahuozi, Deshengmenwai
Beijing, China
Telephone: 449540

SHANGHAI INSTITUTE OF METALLURGY, ACADEMIA SINICA

Addresses: 509 Cao Bao Road
Caohejing Microelectronic Industrial Park
Shanghai, China
865 Chang-ning Road
Shanghai, China
Telephone: 520050
Telex: 33489 ASSIM CN
Cable: 0253

SHANGHAI NO. 14 RADIO FACTORY

Address: 872 Longhua Road
Shanghai, China
Telephone: 361072, 360607
Telex: 30213 BOCST CN
Cable: 7014

SHANGHAI SEMICONDUCTOR DEVICE RESEARCH INSTITUTE

Address: 397 Jiao Zhou Road
Shanghai, China
Telephone: 565869

WUXI MICROELECTRONICS CORP.

Address: Da Wang Ji
Wuxi, Jiangsu, China
Telephone: 667123
Telex: 36207 JSDFCN

Strategic Alliances—South Korea

Table 1 summarizes the semiconductor technology agreements made by semiconductor companies and organizations in South Korea with foreign partners or other domestic companies from 1980 through 1989.

Table 1

Semiconductor Technology Alliances by Company—South Korea (Year, Partner, Agreement, and Products)

Year	Partner	Agreement	Products
Daewoo			
1986	ZyMOS	TTA	MOS process, standard cell
1988	ZyMOS	TTA	Standard cell
Goldstar			
1981	AT&T	TTA	Bipolar
1982	AT&T	TTA	MOS
1983	Zilog	TTA	8-bit MPU
1984	LSI Logic	TTA	Gate array
1984	AMD	TTA	64K DRAM design
1985	UMI	TTA	HCT logic
1985	LSI Logic	TTA	Gate array
1985	BRI	TTA	Standard cell
1985	Fairchild	TTA	64K SRAM
1986	UMI	TTA	256K DRAM, 1Mb DRAM
1986	Fairchild	TTA	Combo IC
1987	UMI	TTA	CMOS TTL
1988	Hitachi	TTA	4-bit MCU
1989	Hitachi	TTA	1Mb DRAM
1989	GS Tech	TTA	4Mb ROM, UART
Hyundai			
1983	HEA	TTA	MOS process, 16K SRAM
1984	Inmos	TTA	256K DRAM
1984	ICT	T/C	64K EPROM, 1K EEPROM
1984	TI	TTA	64K DRAM
1985	Mosel	TTA	64K SRAM
1985	Western Design	TTA	8-bit and 16-bit CMOS MCU
1985	Vitellic	TTA	256K DRAM
1986	Vitellic	TTA	256K SRAM, 256K VRAM, 1Mb DRAM
1987	MOS Electronics	TTA	1Mb SRAM
1987	MOS Electronics	TTA	256K SRAM
1987	Alto	TTA	Wafer processing
1988	Sanki Engineering	TTA	Clean room design

(Continued)

Table 1 (Continued)

Semiconductor Technology Alliances by Company—South Korea
(Year, Partner, Agreement, and Products)

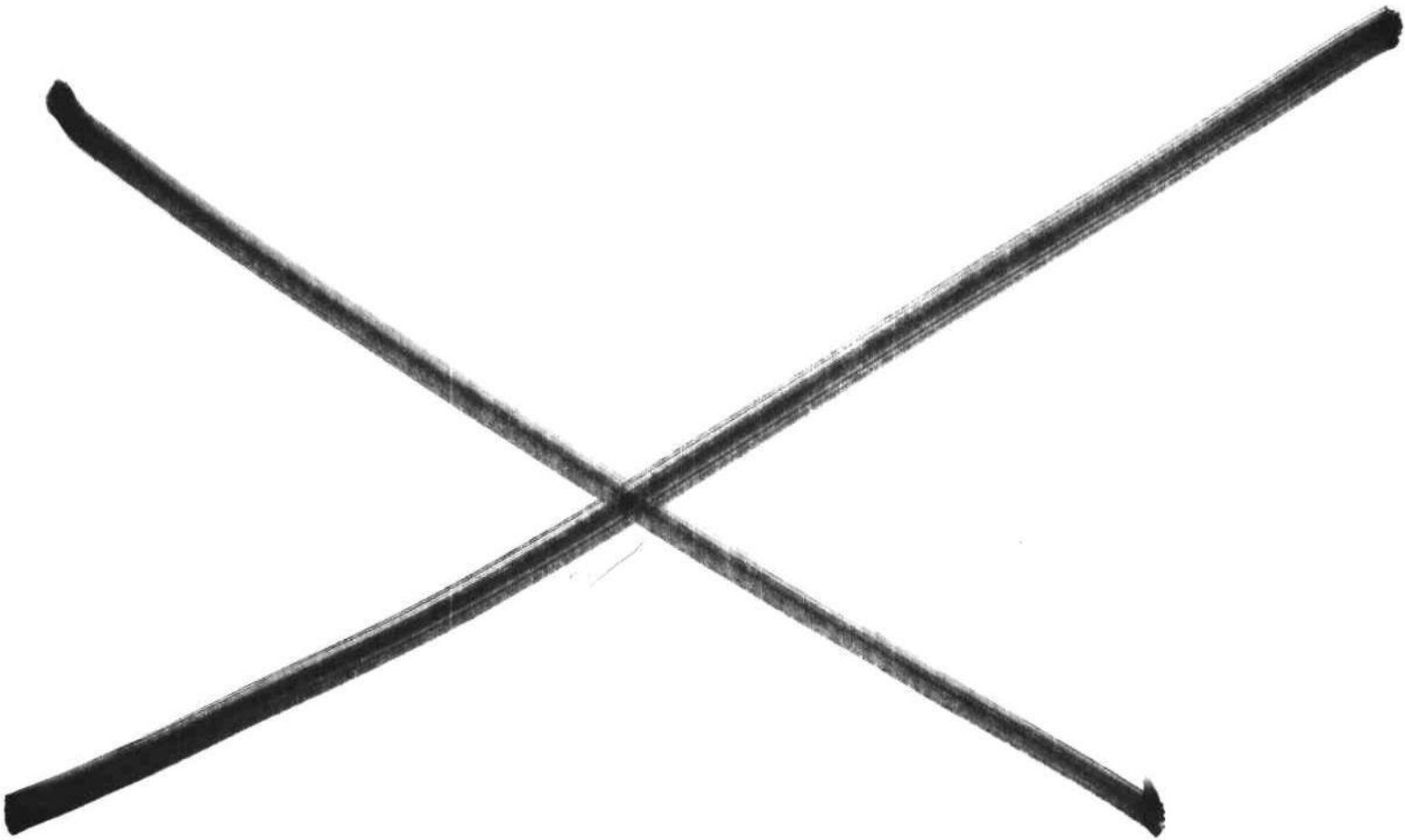
Year	Partner	Agreement	Products
Hyundai (Continued)			
1988	LSI Logic	TTA	ASICs
1988	Sanki Engineering	TTA	1Mb and 4Mb DRAM, 1Mb VRAM
1988	Vitellic	TTA	Wafer processing
KEC			
1978	Toshiba	TTA	Pellet
1983	Toshiba	TTA	LIC
1984	Toshiba	TTA	MOS technology
1989	ECI Semiconductor	TTA	BiCMOS
Samsung			
1982	Sharp	TTA	4-bit MCU
1982	DITTI	TTA	LIC, CMOS, SS Tr.
1983	Sharp	TTA	MOS process
1983	Micron Tech.	TTA	64K and 256K DRAM
1984	DITTI	TTA	CIT process
1984	SSI	TTA	16K EEPROM, 64K DRAM, 16K SRAM
1985	Intel	T/C	MPU/MCU
1985	SSI	TTA	64K SRAM, 256K DRAM, EPROM
1985	Zytex	TTA	Standard logic
1986	Intel	TTA	EPROM
1986	Ixys Corp.	TTA	Power MOSFET
1987	SSI	TTA	Microperipherals
1987	Advanced MOS	TTA	LCD-CTV IC
1987	Advanced MOS	TTA	VTR IC
1987	SSI	TTA	Submicron process
1988	Advanced MOS	TTA	Ramdac
1988	SSI	TTA	FIFO, others
1988	Ixys Corp.	TTA	Smart-power IC
1989	NSC	TTA	Printer control IC
1989	Intel	TTA	Video controller
1989	NCR	TTA	ROM
1989	Functional Logic	TTA	ASIC
1989	Advanced MOS	TTA	LCD drive
1989	SSI	TTA	Wafer processing
1989	NCR	TTA	ASIC
1989	Zilog	TTA	8-bit MCU
1989	SSI	TTA	CPL, others

TTA = Technology Transfer Agreement (second sourcing)
T/C = Technology Cooperation Agreement

Source: Dataquest
April 1990

ECONOMIC INDICATORS

TEMPORARY TAB



Asia/Pacific Economic Indicators

INTRODUCTION

This section presents information on major economic indicators among the newly industrialized countries (NICs), also known as the newly industrialized economies (NIEs)—South Korea, Taiwan, Hong Kong, Singapore, and the People's Republic of China. The far-reaching and outward-looking industrial, commercial, and financial policy of the NICs has unleashed unprecedented economic expansion of the region's industrial, service, and agricultural sectors. The region's rapid economic expansion has led to meteoric advances in electronics and information technology. Tables 1 through 8 and Figures 1 through 3 show the major economic indicators for South Korea, Taiwan, Hong Kong, Singapore, and China. The service sections that follow explore in detail each country's semiconductor and electronic equipment production and consumption and their areas of growth.

Table 1

Asian Foreign Exchange Rates—1987 to 1990 (Local Currency per U.S. Dollar)

	1987	1988	1989	1990	CAGR (%) 1987-1990
South Korea (Won)	825.94	734.52	674.29	710.64	-4.9
Taiwan (Dollar)	31.75	28.64	26.41	26.92	-5.4
Hong Kong (Dollar)	7.80	7.81	7.80	7.79	0
Singapore (Dollar)	2.11	2.01	1.95	1.81	-5.0
P.R. China (Rmb)	3.73	3.73	3.77	4.79	8.7
India (Rupee)	12.94	13.90	16.21	17.49	10.6
Thailand (Baht)	25.77	25.31	25.73	25.61	-0.2
Malaysia (Ringgit)	2.52	2.62	2.71	2.71	2.5
Australia (Dollar)	70.14	78.41	79.19	78.07	3.6
Japan (Yen)	144.60	128.17	138.07	145.00	0.1

Source: U.S. Federal Reserve, U.S. Department of Treasury, Dataquest (March 1991)

Table 2

**Asian Currency Appreciation/Depreciation, Percent—Year to Year
(Local Currency per U.S. Dollar)**

	1988	1989	1990
South Korea	-11.1	-8.2	5.4
Tawain (Dollar)	-9.8	-7.8	1.9
Hong Kong (Dollar)	0.1	-0.1	-0.1
Singapore (Dollar)	-4.7	-3.0	-7.2
P.R. China (Rmb)	0	1.1	27.1
India (Ruppee)	7.4	16.6	7.9
Thailand (Baht)	-1.8	1.7	-0.5
Malaysia (Ringgit)	4.0	3.4	0
Australia (Dollar)	11.8	1.0	-1.4
Japan (Yen)	-11.4	7.7	5.0

Source: Dataquest (March 1991)

Table 3

**Asia/Pacific Gross Domestic Product
(Percentage of Growth)**

	1987	1988	1989	1990	1991 ¹	1992 ¹
Asia/Pacific Average ²	5.8	6.9	5.0	4.6	4.7	5.0
South Korea	5.8	11.3	6.3	8.9	8.0	8.0
Taiwan	13.8	7.3	7.3	5.6	6.5	6.5
Hong Kong	13.9	7.0	2.5	2.3	3.0	3.0
Singapore	8.8	11.1	9.2	7.6	6.6	6.6
P.R. China	9.4	10.8	3.9	3.5	4.0	4.3
India	4.0	9.6	4.4	5.5	5.8	6.2
Thailand	8.4	12.0	10.5	5.5	6.0	6.4
Malaysia	4.2	8.7	8.5	7.2	8.0	8.5
Australia	NA	3.7	4.8	1.8	2.4	2.6
Japan	4.9	5.7	4.8	4.5	4.3	4.3
United States	3.7	4.6	2.5	0.9	0.9	3.1
West Europe	2.7	3.6	3.5	2.9	2.1	2.5

¹Forecast²Includes Japan

NA = Not available

Source: The Dun & Bradstreet Corporation, Dataquest (March 1991)

Table 4

**Asia/Pacific Gross Domestic Product
(Millions of U.S. Dollars)**

	1988	1989	1990*
Total	374,988	448,251	519,495
South Korea	168,154	204,367	240,000
Taiwan	125,500	150,400	171,578
Hong Kong	55,291	63,024	71,847
Singapore	24,779	28,892	34,298
P.R. China (US\$ Billions)	1,264	1,568	1,772

*Preliminary

Source: U.S. Department of Commerce, Dataquest (March 1991)

Table 5

**Asia/Pacific per Capita GDP
(Current U.S. Dollars)**

	1988	1989	1990*
Total	29,768	34,647	39,810
South Korea	3,089	4,040	4,834
Taiwan	6,333	7,518	8,498
Hong Kong	9,732	10,939	12,250
Singapore	9,350	10,740	12,656
P.R. China (Rmb)	1,264	1,410	1,572

*Preliminary

Source: U.S. Department of Commerce, Dataquest (March 1991)

Table 6

**Asia/Pacific Consumer Price Index
(Percentage of Growth)**

	1988	1989	1990	1991 ¹
Asia/Pacific Average ²	4.9	5.4	5.3	6.0
South Korea	7.2	5.6	8.0	8.0
Taiwan	1.1	5.0	5.1	5.3
Hong Kong	7.5	10.1	9.7	8.8
Singapore	1.5	2.4	3.5	4.0
P.R. China	20.7	18.0	8.5	15.0
India	9.4	7.9	10.1	10.8

(Continued)

Table 6 (Continued)

Asia/Pacific Consumer Price Index
(Percentage of Growth)

	1988	1989	1990	1991 ¹
Thailand	3.8	5.4	7.0	7.5
Malaysia	2.0	2.8	3.5	5.0
Australia	7.6	7.1	6.8	7.0
Japan	1.0	2.0	3.0	3.0
United States	4.0	5.0	5.0	5.0
West Europe	5.0	6.0	7.0	7.0

¹Forecast²Includes Japan

Source: The Dun & Bradstreet Corporation, Dataquest (March 1991)

Table 7

Asia/Pacific Balance of Trade
(Millions of U.S. Dollars)

	1987	1988	1989	1990*
Total Trade Balance	-20,946	-10,480	-3,858	-11,368
Export	212,326	271,226	298,624	331,055
Import	191,380	260,746	294,766	319,687
South Korea	6,261	9,507	509	3,000
Export	47,281	60,696	62,109	65,000
Import	41,020	51,189	61,600	62,000
Taiwan	20,210	13,807	13,956	14,000
Export	53,220	60,585	66,205	72,000
Import	33,010	46,778	52,249	58,000
Singapore	-3,870	-4,560	-4,998	-8,459
Export	28,616	39,282	44,668	52,081
Import	32,486	43,842	49,666	60,540
Hong Kong	6	-574	991	827
Export	48,475	63,163	73,142	80,974
Import	48,469	63,737	72,151	80,147
P.R. China	-1,991	-7,700	-6,600	2,000
Export	34,734	47,500	52,500	61,000
Import	36,395	55,200	59,100	59,000

*Preliminary

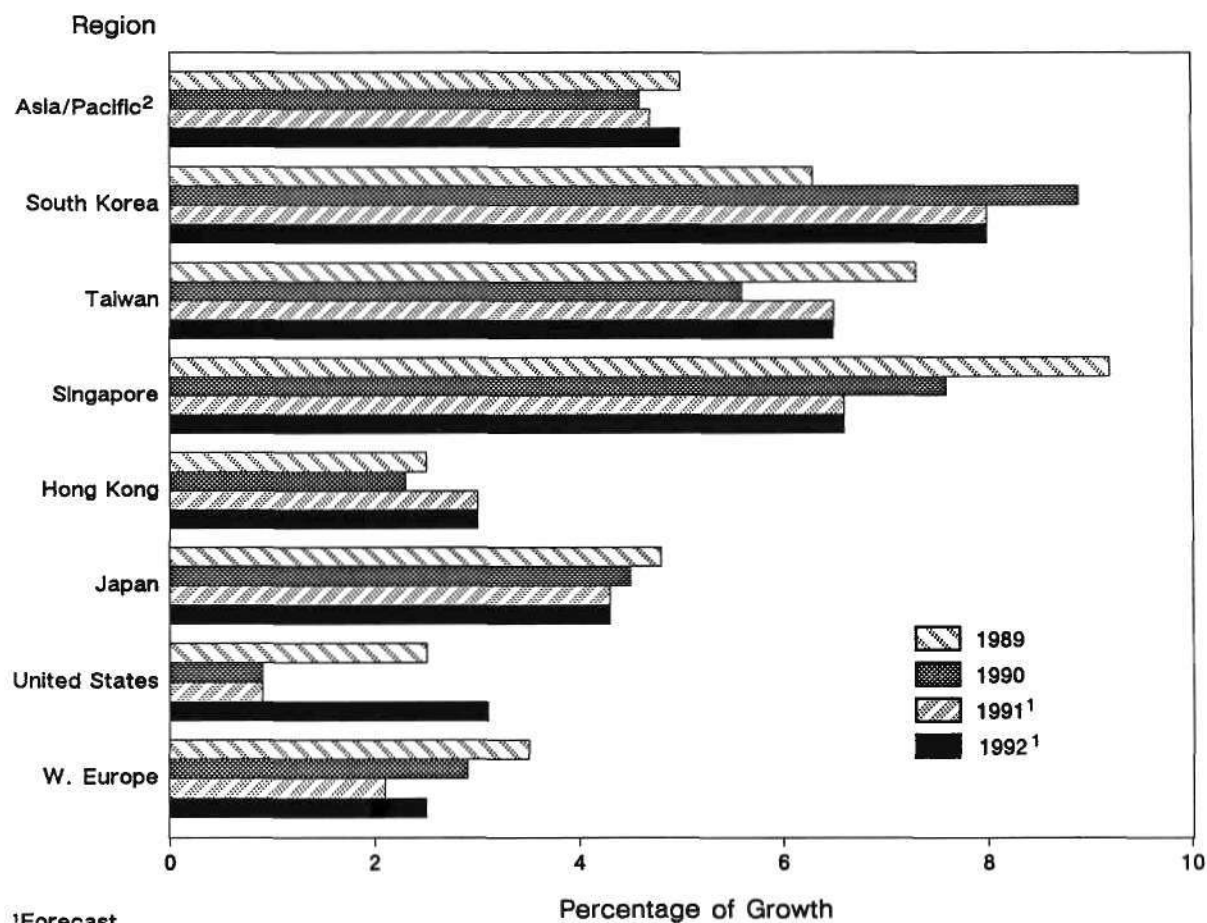
Source: U.S. Department of Commerce, Dataquest (March 1991)

Table 8
Asia/Pacific Population
(Millions of Persons)

	1986	1987	1988	1989	1990	CAGR (%) 1990-1990
Total	1,119.3	1,137.9	1,166.2	1,183.0	1,198.6	1.7
South Korea	41.6	41.6	42.0	42.4	42.8	0.7
Taiwan	19.4	19.5	19.9	20.1	20.3	1.1
Hong Kong	5.5	5.6	5.7	5.8	5.8	1.2
Singapore	2.6	2.6	2.6	2.7	2.7	1.1
P.R. China	1,050.2	1,068.6	1,096.0	1,112.0	1,127.0	1.8

Source: U.S. Department of Commerce, Dataquest (March 1991)

Figure 1
Asia/Pacific Gross Domestic Product
(Percentage of Growth)



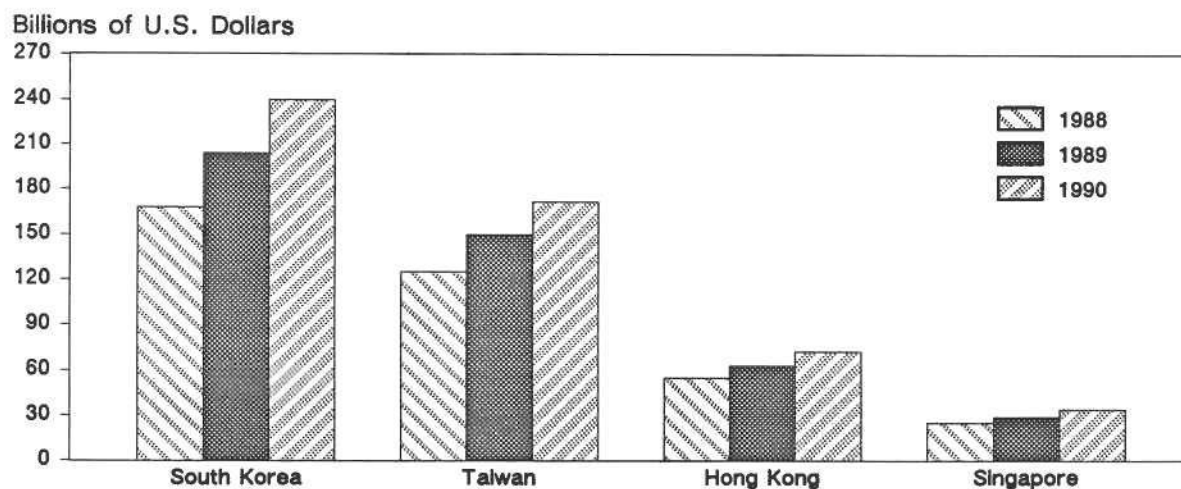
¹Forecast

²Includes Japan

Source: The Dun & Bradstreet Corporation, Dataquest (March 1991)

Figure 2

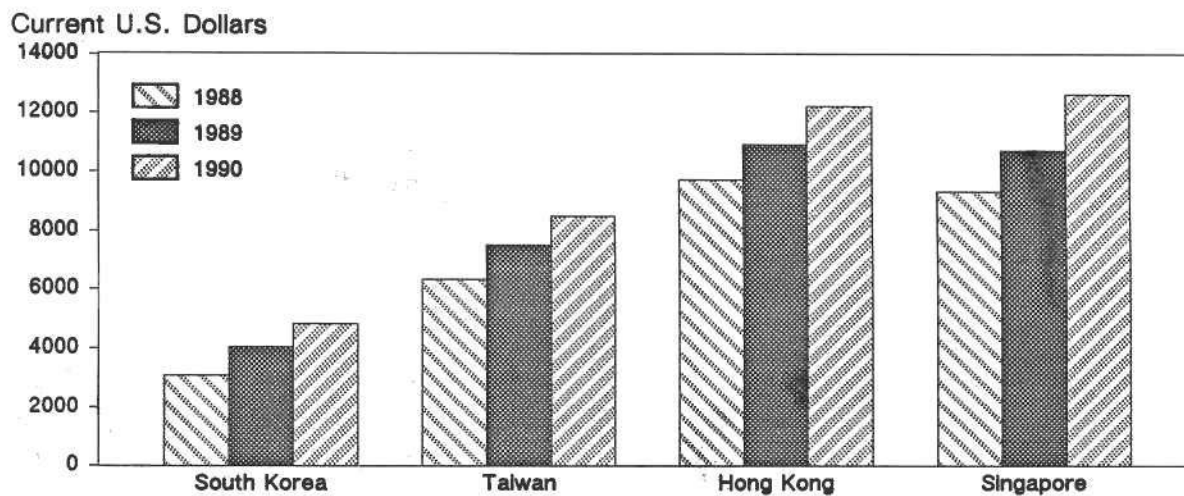
Asia/Pacific Gross Domestic Product
(Billions of U.S. Dollars)



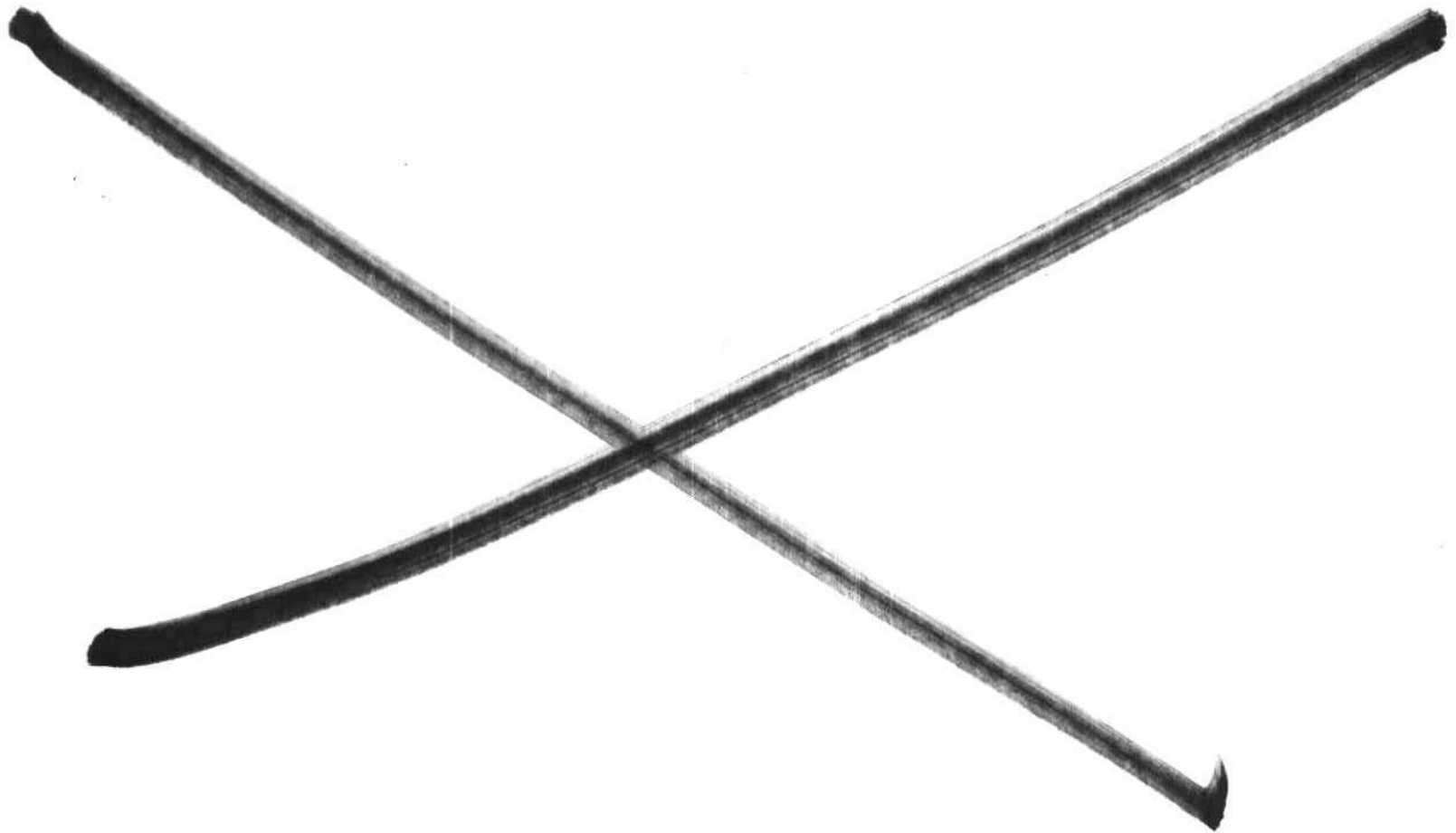
Source: U.S. Department of Commerce, Dataquest (March 1991)

Figure 3

Asia/Pacific Gross Domestic Product—Per Capita
(Current U.S. Dollars)



Source: U.S. Department of Commerce, Dataquest (March 1991)



Strategic Alliances—Taiwan

Table 1 summarizes the semiconductor technology agreements made by semiconductor companies and organizations in Taiwan with foreign partners or other domestic companies from 1980 to February 1990.

Table 1

Semiconductor Technology Alliances by Company—Taiwan (Year, Partner, Agreement, and Products)

United Microelectronics Corporation			
Year	Partner	Agreement	Products
1980	ERSO	TTA	N/A
1982	ERSO	TTA	5.0u, 3.5u CMOS
1983	AMI	T/C	Telephone dialer ICs
1983	IDT	TTA	2.5u CMOS
1984	MOSel	T/C	16K SRAMs
1985	MOSel	TTA	1.25u retrograde CMOS
1985	TRW	TTA	Telephone dialer ICs
1986	SMC	TTA	CRT controllers
1986	Sunol	TTA	Hard disk controllers
1986	SDC	TTA	ASICs
1989	ERSO	TTA	Submicron IC R&D plant
ITRI/ERSO			
Year	Partner	Agreement	Products
1984	Vitellic	T/C	64K CMOS DRAMs 256K CMOS DRAMs 64K CMOS EPROMs
1989	Philips	T/C	HDTV ICs
1989	AMPI, HMC, UMC, Winbond, Vitelic	T/C	Submicron IC R&D
1989	Philips	T/C	Optical disk drive
Taiwan Semiconductor Manufacturing Co., Ltd. (TSMC)			
Year	Partner	Agreement	Products
1986	Philips	TTA	Main process
1986	ERSO	TTA	Mainstream products
1986	ERSO	T/C	Fab lease
1987	ERSO	TTA	N/A
1987	Philips	TTA	N/A
1989	Vitellic	TTA	Memory ICs; 1Mb DRAMs
1989	Philips	J/V	Consumer ICs
1989	ERSO	T/C	Submicron IC R&D

(Continued)

Table 1 (Continued)

Semiconductor Technology Alliances by Company—Taiwan
(Year, Partner, Agreement, and Products)

Hualon Microelectronics Corporation (HMC)

Year	Partner	Agreement	Products
1988	ERSO	TTA	Consumer ICs
1989	ERSO	T/C	Submicron IC R&D

Winbond

Year	Partner	Agreement	Products
1988	ERSO	TTA	Consumer ICS
1989	NCR	TTA	ASICs
1989	ERSO	T/C	Submicron IC R&D

AMPI

Year	Partner	Agreement	Products
1988	ERSO	TTA	Power ICs
1989	ERSO	T/C	Submicron IC R&D

ACC Microelectronics Corporation

Year	Partner	Agreement	Products
1989	Motorola	TTA	Floppy disk drive control chips

Acer Group
Agreement

Year	Partner	Agreement	Products
1989	Texas Instruments	J/V	1Mb, 4Mb DRAMs
1990	National	TTA	Super I/O chips

N/A = Not Available

TTA = Technology Transfer Agreement (second sourcing)

J/V = Joint Venture

R/A = Representative Agreement

T/C = Technology Cooperation Agreement

Source: Dataquest
March 1990

Strategic Alliances—South Korea

Table 1 summarizes the semiconductor technology agreements made by semiconductor companies and organizations in South Korea with foreign partners or other domestic companies from 1980 through 1989.

Table 1

Semiconductor Technology Alliances by Company—South Korea (Year, Partner, Agreement, and Products)

Year	Partner	Agreement	Products
Daewoo			
1986	ZyMOS	TTA	MOS process, standard cell
1988	ZyMOS	TTA	Standard cell
Goldstar			
1981	AT&T	TTA	Bipolar
1982	AT&T	TTA	MOS
1983	Zilog	TTA	8-bit MPU
1984	LSI Logic	TTA	Gate array
1984	AMD	TTA	64K DRAM design
1985	UMI	TTA	HCT logic
1985	LSI Logic	TTA	Gate array
1985	BRI	TTA	Standard cell
1985	Fairchild	TTA	64K SRAM
1986	UMI	TTA	256K DRAM, 1Mb DRAM
1986	Fairchild	TTA	Combo IC
1987	UMI	TTA	CMOS TTL
1988	Hitachi	TTA	4-bit MCU
1989	Hitachi	TTA	1Mb DRAM
1989	GS Tech	TTA	4Mb ROM, UART
Hyundai			
1983	HEA	TTA	MOS process, 16K SRAM
1984	Inmos	TTA	256K DRAM
1984	ICT	T/C	64K EPROM, 1K EEPROM
1984	TI	TTA	64K DRAM
1985	Mosel	TTA	64K SRAM
1985	Western Design	TTA	8-bit and 16-bit CMOS MCU
1985	Vitellic	TTA	256K DRAM
1986	Vitellic	TTA	256K SRAM, 256K VRAM, 1Mb DRAM
1987	MOS Electronics	TTA	1Mb SRAM
1987	MOS Electronics	TTA	256K SRAM
1987	Alto	TTA	Wafer processing
1988	Sanki Engineering	TTA	Clean room design

(Continued)

Table 1 (Continued)

Semiconductor Technology Alliances by Company—South Korea
(Year, Partner, Agreement, and Products)

Year	Partner	Agreement	Products
Hyundai (Continued)			
1988	LSI Logic	TTA	ASICs
1988	Sanki Engineering	TTA	1Mb and 4Mb DRAM, 1Mb VRAM
1988	Vitelc	TTA	Wafer processing
KEC			
1978	Toshiba	TTA	Pellet
1983	Toshiba	TTA	LIC
1984	Toshiba	TTA	MOS technology
1989	ECI Semiconductor	TTA	BiCMOS
Samsung			
1982	Sharp	TTA	4-bit MCU
1982	DITTI	TTA	LIC, CMOS, SS Tr.
1983	Sharp	TTA	MOS process
1983	Micron Tech.	TTA	64K and 256K DRAM
1984	DITTI	TTA	CIT process
1984	SSI	TTA	16K EEPROM, 64K DRAM, 16K SRAM
1985	Intel	T/C	MPU/MCU
1985	SSI	TTA	64K SRAM, 256K DRAM, EPROM
1985	Zytex	TTA	Standard logic
1986	Intel	TTA	EPROM
1986	Ixys Corp.	TTA	Power MOSFET
1987	SSI	TTA	Microperipherals
1987	Advanced MOS	TTA	LCD-CTV IC
1987	Advanced MOS	TTA	VTR IC
1987	SSI	TTA	Submicron process
1988	Advanced MOS	TTA	Ramdac
1988	SSI	TTA	FIFO, others
1988	Ixys Corp.	TTA	Smart-power IC
1989	NSC	TTA	Printer control IC
1989	Intel	TTA	Video controller
1989	NCR	TTA	ROM
1989	Functional Logic	TTA	ASIC
1989	Advanced MOS	TTA	LCD drive
1989	SSI	TTA	Wafer processing
1989	NCR	TTA	ASIC
1989	Zilog	TTA	8-bit MCU
1989	SSI	TTA	CPL, others

TTA = Technology Transfer Agreement (second sourcing)
T/C = Technology Cooperation Agreement

Source: Dataquest
April 1990

Strategic Alliances—China

Table 1 is a summary of semiconductor technology agreements made by major Chinese Semiconductor companies.

Table 1

Semiconductor Technology Agreements to China

<u>Company</u>	<u>Type of Activity</u>	<u>Value</u>	<u>Product</u>	<u>Location</u>	<u>Comments</u>
Applied Materials	Joint venture	-	Semi. prod. systems, epitaxial reactors	Beijing	Service center
Belgium-Bell	Joint venture	\$12.0M	Telecom chip	Shanghai	4" fab 1989
Cermetek	Turnkey mfg.	US\$1.7M	Thick-film hybrid ICs, modem components	Anhui	Option to buy back products, telecom ind. support
Fuji Electric	Turnkey mfg.	US\$4.6M	Silicon diodes	Tianjin	-
GE	Turnkey mfg.	-	Power transistors	-	-
Crow Electric	Turnkey mfg.	-	Bipolar transistors (color TV)	Dandong	-
Mostek	Turnkey mfg.	-	16K production line	-	Used line
Motorola	Wholly owned	\$100.0M	ICs	Tianjin	5" fab will be finished by 1992
National Semiconductor	Turnkey mfg.	-	MSI line (3 inch)	Shanghai	Option for National to use for assembly, used line
NBC	Joint venture	\$60.0M	ICs	Beijing	5" fab will be finished by 1991
Nippon Ceramic	Joint venture	-	Sensor	Shanghai	-
Philips	Joint venture	\$40.0M	Consumer ICs	Shanghai	5" fab will be finished by 1991
Siemens	Technology transfer agreement	-	ICs	Wuxi	5" fab will be finished by 1991
Solid State Sci.	Turnkey mfg.	-	CMOS line (3 inch), watch ICs (5 micron)	Shanghai	Used line (5-6 yrs.)
Toshiba	Technology transfer agreement	-	TV chip set, consumer ICs	Wuxi	-

Source: Dataquest
February 1990