
1 WORLDWIDE IC INDUSTRY ECONOMIC UPDATE AND FORECAST

INTRODUCTION

The *Status 1998* is organized into three segments. Section 1 provides information on world economic issues relating to the semiconductor industry in addition to market statistics relating to semiconductor production, and equipment sales. Section 2 provides profiles and current activities of key IC suppliers from around the world. Sections 3 through 7 deal with product trends related to specific ICs and packaging types (i.e., ASICs, microprocessors, memory, etc.), and associated manufacturing technologies.

1997 HIGHLIGHTS

1997 was a year of constant surprises. As we entered the year after having lower than expected semiconductor sales in 1996, it was anticipated that 1997 would be a year of recovery. Although not as high a growth rate as was hoped, the 8 percent rate estimated for 1997 has been a welcomed relief after weathering a number of unusual events. The significant 1997 events that have caused perturbations or concerns in the industry include: reunification of Hong Kong with China, the October stock market plunge, massive currency corrections in the Far East, continued devaluation of the yen, and a weakening Japanese economy.

Hong Kong's reunification with China was met with skepticism that the Chinese government would impose policies that would harm the island's economy and have negative implications for the surrounding countries that have built strong trade links to Hong Kong. To the contrary, this did not happen. However, poor government management of other Asian economies, in particular Korea, Thailand and Indonesia, has led to steep currency devaluations. Hong Kong did not adjust to these drops in currency values, making it less competitive in trade than surrounding countries. Finally, in late October 1997, the Hong Kong dollar was adjusted downward causing the Hong Kong stock market and other stock markets around the world to plunge. Tensions and concerns about equity and foreign investments and stock for all industries were high. Fortunately, for the world economy, the market has regained ground, and although the net change has been acknowledged as a correction, it is far less severe than originally feared (i.e., a 3.5 versus 10 percent drop in the Dow Jones Industrials average).

Despite adjustments to the HK\$, China is still targeting a 9.5 percent GDP for 1997 and 1998. For 1997 \$3.8 billion is attributed to IC production. The IC market in China is currently growing at a healthy clip of 25-30 percent per year.

Prior to these events many economies in the Far East had been declining. In hopes of stimulating growth most of these countries have chosen to devalue their currencies.

Unfortunately, those economies that have suffered currency devaluations may experience slower growth from a dollar stand point. However, some countries may be able to offset this decline by increased exports (since their products will appear less expensive to outside markets). Countries such as Korea, Thailand and Indonesia face added difficulties associated with large government deficits. Attempts of government to decrease deficits is often met with a slow down in industry growth. Pacific Rim GDP growth is estimated to be 7.9 percent for 1997 and 7.5 percent for 1998. The IC market for the ROW region is estimated to have grown to \$28.5B in 1997, a 10 percent increase over 1996.

Japan is another country, although known for having strong investment assets, carrying a large government budget deficit that it has been trying to overcome. In reaction to a declining economy, the yen has been allowed to devalue and consequently exports have started to rapidly rise. 1997 GDP growth for Japan is estimated to be 1.8 percent and could fall further in 1998 if the economy does not recover. Current GDP estimates for 1998 remain at 2.7 percent, assuming measures will be taken to hold down inflation and increase local spending.

Japan currently holds 23 percent of the 1997 worldwide merchant semiconductor market share, second only to the U.S. at 33 percent. Given growing competition from other Asian regions, Japan's share is anticipated to decline to 18 percent by 2002. Japan's 1997 merchant semiconductor production is estimated to be \$28B, down 2.3 percent from 1996.

One other 1997 highlight is the continued growth of business consolidations and alliances. Mergers, acquisitions, joint ventures, and alliances have been the keys to quickly increasing capability and capacity and keeping costs low if the price was right. This trend, which began in the mid-90s, is alive and well in 1997. Examples include, Intel's purchase of the Digital facility in Massachusetts, a joint venture facility co-owned by Fujitsu and IBM in New York, Chartered Semiconductor's new fab in Singapore now co-owned by various semiconductor companies around the world, and National Semiconductor's recent move to purchase Cyrix a microprocessor competitor to Intel. Among computer, communications and consumer electronics companies the number of strategic alliances formed has grown by more than 15 percent per year since the early 1990s. Advantages gained from these acquisitions will help to keep costs down and stabilize sales growth.

DEFINITIONS AND ASSUMPTIONS

The semiconductor industry data in *Status 1998* are analyzed and presented using two different methods. One describes the “market” for semiconductors while the other examines “production” or “sales” of semiconductor manufacturers. In ICE’s analysis, total worldwide semiconductor production equals worldwide semiconductor consumption in any given year. Sources for ICE’s information are given for each figure. It should be understood that ICE uses a variety of sources in addition to those listed, which include government databases, industry reports and journals, in addition to interviews with key company officials. Figure 1-1 shows some of the assumptions and definition guidelines to which ICE will adhere throughout *Status 1998*.

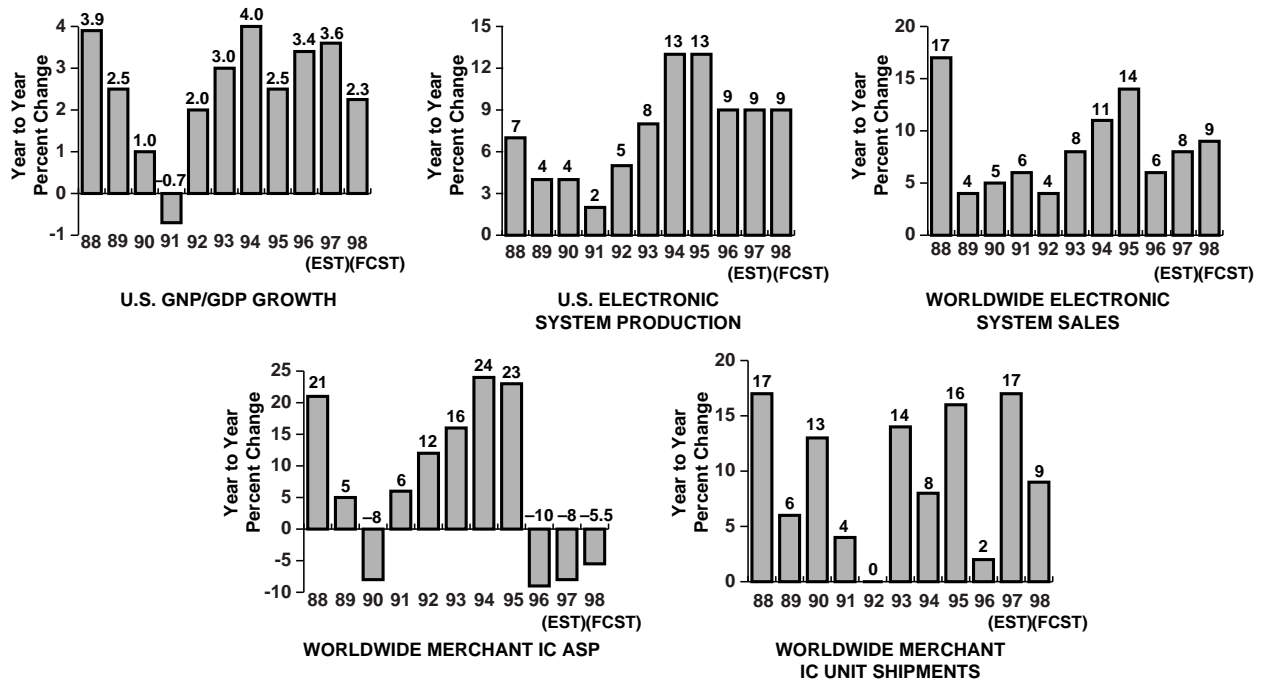
- **All figures that include “market” in the title: market is considered equal to consumption. The North American market is what is sold within the geographical borders of North America.**
- **The sum of individual companies’ “sales” exceeds the total world “production.” A company’s sales could include its device sales, whether produced internally or externally, and its sales of wafers to another semiconductor company. Production figures attempt to not double-count “foundry” sales.**
- **“Merchant” semiconductor production, sales, or market figures include North American captive (e.g., Digital and Hewlett-Packard) merchant sales, but not internal transfers at the captives.**
- **All figures that describe “sales or production by company” include all sales or production regardless of where the devices are produced or sold. For example, all of Texas Instruments’ semiconductor sales or production, including those from its Japanese and European facilities, would be listed in the North American company semiconductor segment.**
- **In all of ICE’s sales and production figures, internal transfers and ASIC NRE revenue are included.**
- **“Semiconductor” sales and production figures include ICs and discretes but do not include hybrids.**
- **The former Eastern European market and production figures are not included in the European or world forecasts (but are discussed at the end of this section).**

Source: ICE

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Figure 1-1. Definitions

Figure 1-2 lists ICE’s economic assumptions. These economic expectations are the basis for ICE’s semiconductor industry estimates and forecasts. As shown, 1997’s IC market is expected to have been influenced by both a decline in ASPs in addition to increased IC shipment. In contrast to the 1996 IC market where shipments did not change significantly.



*1997 and beyond worldwide figures use 2Q97 exchange rates (see currency fluctuation comments in Figure 2-8).

Source: ICE

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Figure 1-2. ICE's Economic Assumptions*

Figure 1-3 shows the 1992 through 1996 actual GNP or GDP (Gross Domestic Product) changes, and the 1997 estimates and 1998 forecast for five major economies. The big story for the first half of the 1990s was the weakness of the Japanese economy and the strength of the yen. In 1996 the yen began to weaken significantly, and the Japanese economy temporarily rebounded.

Country/Segment	Percent Growth						
	1992	1993	1994	1995	1996	1997 (EST)	1998 (FCST)
U.S.	2.0	3.0	4.0	2.5	3.4	3.6	2.3
Europe	0.8	-0.6	2.5	2.9	1.4	1.9	2.7
Japan	1.5	0.2	0.8	0.9	3.6	1.8	2.7
Pacific Rim	5.9	6.2	7.6	7.9	7.1	7.9	7.5
China	12.8	10.2	11.3	9.5	8.7	9.5	9.5

Sources: Consensus Economics/
Blue Chip Economic Indicators

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Figure 1-3. Real GDP Growth

In October 1996, the Liberal Democratic Party gained further strength in Japan's political landscape. Many economic observers believed that because of the LDP's historical record of "careful" change, the needed push for swift fiscal policy measure and deregulation would not take place. To date,

1997 has shown both a weakened economy and falling yen. Several government attempts have been made to lower the deficit, but have only exacerbated the declining GDP, keeping consumer spending and business investing down. 1997 estimates for GDP in Japan are at 1.8 percent growth, which is considered an optimistic forecast. The 1998 GDP forecast targets 2.7 percent growth rate, however, should the economy continue to decline, the GDP could easily slip below 2 percent.

For 1997, Japan is the only country of the five major regions expected to display less growth than 1996. In the U.S., a 3.6 percent increase is anticipated due to a strong economy (i.e., strong dollar, low interest rates, etc.). The European economy is also expected to experience satisfactory growth of 1.9 percent.

The Pacific Rim, having focused on attracting foreign investment and industrialization, is expected to grow by 7.9 percent for 1997. Despite the drastic currency corrections that have occurred this year, this region is still expected to experience a healthy GDP increase for 1997. The 1998 estimate of 7.5 percent is optimistic given continued declines in currencies. However, the export capability of this region should keep 1998 GDP growth well above 5 percent.

China is also expanding at a relatively high rate year to year. Despite fears that the Chinese government would put economic policies in place that would dampen growth and make foreign investors go elsewhere, foreign investment still remains healthy, and business growth although less than in the early 1990s, is expected to grow 9.5 percent for 1997 and 1998. Additionally it should be noted, although Hong Kong business is anticipated to change as a result of its re-unification with China, economic policy in Hong Kong has not changed substantially. What is now facing many of the businesses in Hong Kong is the loss of revenue as the Hong Kong dollar falls in response to the currency devaluation of surrounding Asian countries. It is expected that Hong Kong, historically a healthy business center, will rebound by Q2 1998 when currency fluctuations in this region subside.

The varying and moderating GDP growth rates of the major economic regions (North America, Japan, Pacific Rim, China and Europe) are expected to help keep semiconductor industry growth climbing at a steady pace for the remainder of the 1990s. Many still believe that growth rates beyond 30 percent are a thing of the past. However, positive swings in any one of these five major regions could easily send the growth rate soaring. In particular, if the Japanese economy booms in 1998 instead of remaining flat or slumping, the semiconductor market could once again approach or exceed 30 percent.

An important factor that has historically had a significant impact on worldwide sales and market levels is exchange rates (Figure 1-4). When examining the sales and market figures, it must be remembered that all numbers are adjusted by yearly exchange rates. Furthermore, as these exchange rates fluctuate, they can impact worldwide and regional sales figures in addition to

trade balance. For example, what is now projected as an 8 percent increase in semiconductor sales for 1997 would have been in excess of 10 percent if the yen had not fallen in value to 121 yen per dollar (as of 3Q97) from its 1996 level of 109.

Country (Currency)	1993	1993/1992 (%)	1994	1994/1993 (%)	1995	1995/1994 (%)	1996	1996/1995 (%)	1997 (FCST)	1997/1996 (FCST, %)
U.K. (Pound)	0.67	-18	0.65	3	0.63	3	0.64	-2	0.60	6
France (Franc)	5.72	-8	5.54	4	4.99	10	5.11	-2	5.88	15
Germany (Mark)	1.66	-6	1.62	3	1.44	11	1.51	-5	1.75	-16
Japan (Yen)	110	13	102	8	94	8	109	-16	117	-7

Source: ICE

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Figure 1-4. Japanese and European Exchange Rates (Per Dollar)

ICE uses estimated 4Q97 exchange rates for the 1998 market forecast and beyond. Most European and Japanese currency levels have had a noticeable impact on the overall semiconductor market figures over the past few years. Strong European currencies and a very strong yen helped inflate the 1994 and 1995 semiconductor market figures when reported in dollars.

For 1996, currency fluctuations had a tremendous negative impact on the semiconductor dollar market. In 1996, European and Japanese market figures (when reported in dollars) were deflated by about 4 and 14 percent, respectively.

Figure 1-5 illustrates how quickly the Japanese yen gained strength in early 1993. Besides making the Japanese sales and production dollar figures look stronger, it is estimated that each time the dollar falls one yen, the Japanese auto and electronics industries lose 50 billion yen (\approx \$500 million) a year in revenue. Unfortunately, since 1995 the yen has continued to devalue and is now approaching 121 yen/\$. The Japanese currency has negatively effected worldwide industry growth rate as measured in dollars. If the yen/\$ rate is allowed to rise further, this can lead to declines in ASP and can cause significant trade imbalances (see U.S.-Japan Trade section).

ELECTRONIC SYSTEM PRODUCTION

Key drivers to the growing market for semiconductors in electronic equipment include computers, communications equipment, and consumer products. Computers, representing more than 30 percent of total electronic equipment sales, continue to increase in complexity and capability. Consequently the semiconductor content per computer continues to increase.

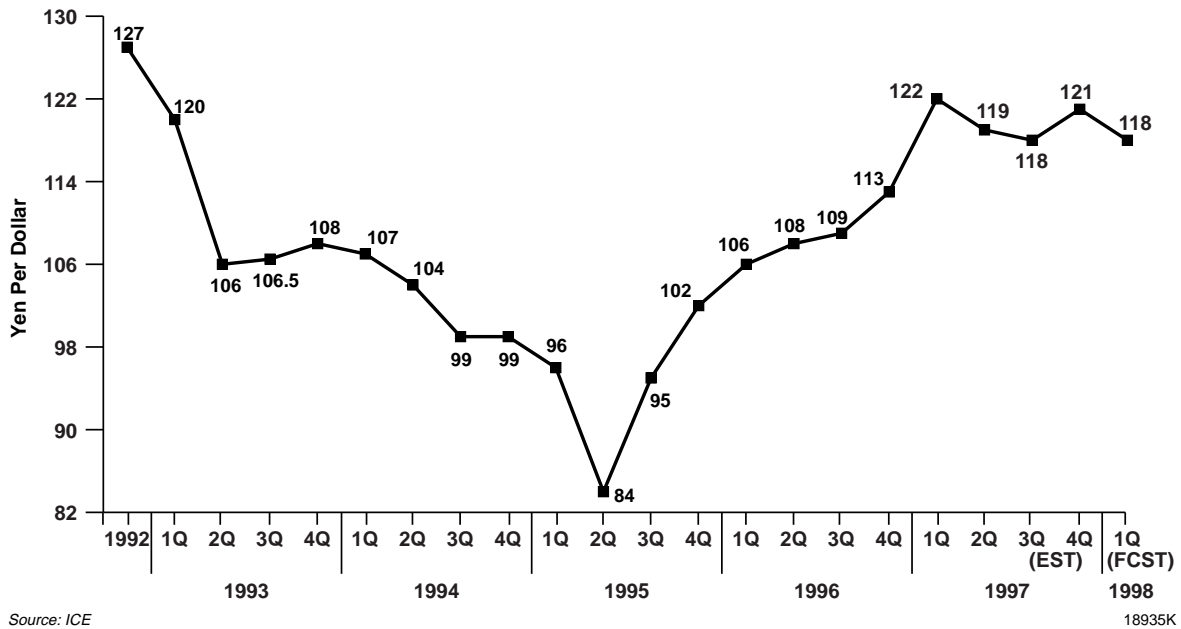


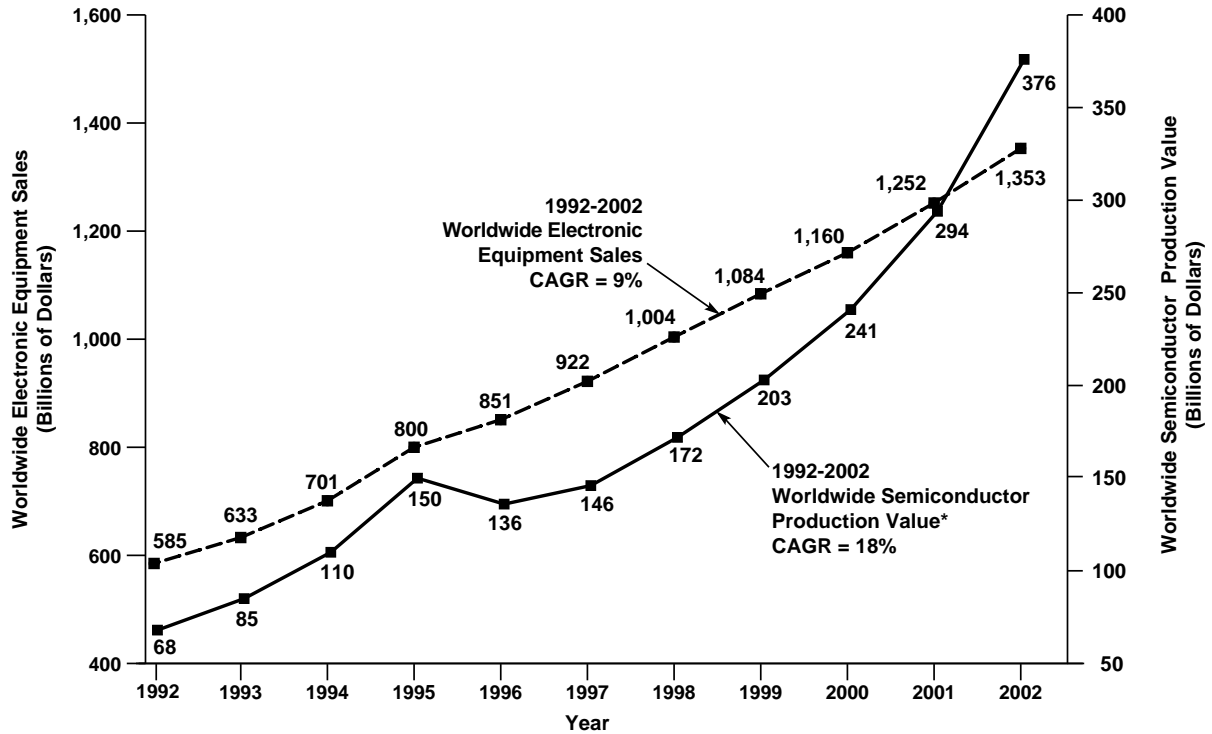
Figure 1-5. The Yen's Dramatic Fluctuations

Figure 1-6 examines the market relationship between semiconductor component and electronic system production. The semiconductor cumulative average annual growth rate (CAGR) is forecast to be almost twice the rate of electronic systems due to the continuing increase in the use of semiconductors in electronic systems. As will be shown later in this section, IC value in PCs is about 30-35 percent of the total system price.

Because of the increasing pervasiveness of semiconductors in electronic equipment, the overall "percent semiconductor" figure will increase over time. For example, the percent semiconductor figure averaged 10.9 percent for 1983-1991 and is forecast to average 18 percent for 1992-2002.

In estimating worldwide electronic system production, ICE subtracted the electronic component values from published (EIA, EIAJ, etc.) total electronics production figures so as not to double count or overestimate actual system sales. The electronic components segment includes all active devices (e.g., ICs and discrettes) as well as relays, speakers, antennas, disks, capacitors, etc. Since all of these components are used in building various electronic systems, including their sales volume with system sales would falsely inflate.

As shown, semiconductor component sales as a percent of total electronic system sales was 16.2 percent in 1996 and is forecast to be 27.1 percent in 2002. It should be noted that 1996's percent semiconductor figure dropped 2.6 percentage points from 1995 as a result of the correction from the inflated DRAM pricing of 1994 and 1995.



Percent Semiconductor	11.6	13.4	15.7	18.8	16.2	16.2	17.1	18.7	20.8	23.5	27.1
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*Including captive "if sold" value.

Source: ICE/WSTS

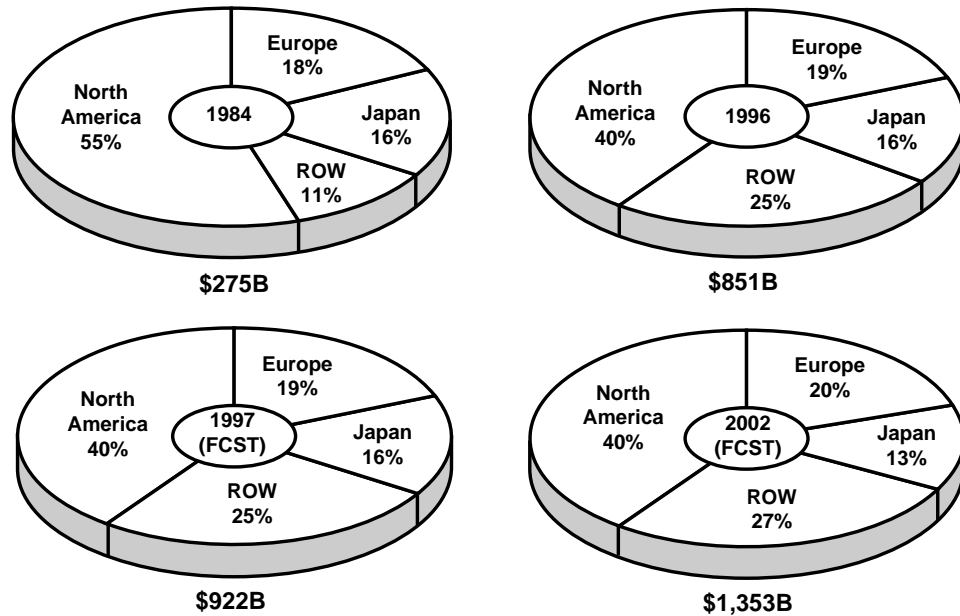
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Figure 1-6. Semiconductor and Electronic Equipment Sales Trends (1992-2002)

As shown in Figure 1-7, North America is the largest producer of electronic equipment in the world. It should be noted that almost all of the 1984-1996 loss in the North American share of electronic equipment production was offset by gains in the ROW region. This is directly a result of movement of production to ROW assembly facilities in combination with the establishment of new businesses quick to take advantage of local government tax incentives and cheap labor costs.

North American system producers are heavily concentrated in the fast growing PC and telecommunications segments. Although the overall U.S. economy grew less in 1995 than in 1994, the PC and telecommunications markets were still very healthy. This trend continued throughout 1996 and is the reason the U.S. gained one point of market share in 1996.

Through 2002, ICE forecasts that the North American region will hold onto its 1996 market share while the ROW region will increase two points. It is forecast that the Japanese region will continue to lose market share, declining three points from 1996 to 2002 and displaying only a seven percent CAGR.



Source: ICE

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Figure 1-7. Electronic Equipment Production

The expected loss of system production market share in the Japanese region is not due to a forecasted slumping economy through 2002. The loss is primarily due to the continued shift of foreign-owned system production to ROW locations. The Japanese companies attribute this movement to the need to take advantage of lower labor costs, getting “close” to many electronic system markets (e.g., China) that are currently in their infancy, and fleeing the highly regulated and restrictive Japanese infrastructure.

The trend of North American, Japanese, and European system producers taking advantage of low offshore labor costs, coupled with the demonstrated capability of Korea and other Asia-Pacific countries to supply personal computers and other electronic systems, is spurring the steady increase in ROW-based electronic system production. Figure 1-8 shows worldwide electronic equipment production by producing region for 1993-1996 as well as ICE’s estimate for 1997.

Using local currencies instead of U.S. dollars shows that worldwide electronic system production has surged from only a six percent increase in 1993 to a 10 percent growth rate in 1996. Using local currencies instead of estimated 1997 exchange rates, Japan’s electronic equipment production would have registered a strong 15 percent increase in 1997 instead of a 4 percent increase.

GEOGRAPHIC SEGMENT	ELECTRONIC SYSTEM PRODUCTION (\$B)									
	1993	1993/1992 PERCENT CHANGE	1994	1994/1993 PERCENT CHANGE	1995	1995/1994 PERCENT CHANGE	1996	1996/1995 PERCENT CHANGE	1997 (FCST)	1997/1996 PERCENT CHANGE
North America	242	8	274	13	311	13	339	9	370	9
Japan	118	6	126	7	140	11	137	-2	142	4
Europe	130	7	139	7	161	16	166	3	178	7
ROW	143	12	162	13	188	16	209	11	232	11
Total	633	8 ¹	701	11 ²	800	14 ³	851	6 ⁴	922	8

¹ 1993/1992 would show about a 6 percent gain without exchange rate fluctuations.

² 1994/1993 would show about an 8 percent gain without exchange rate fluctuations.

³ 1995/1994 would show about an 11 percent gain without exchange rate fluctuations.

⁴ 1996/1995 would show about a 10 percent gain without exchange rate fluctuations.

Source: ICE

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Figure 1-8. Worldwide Electronic System Production

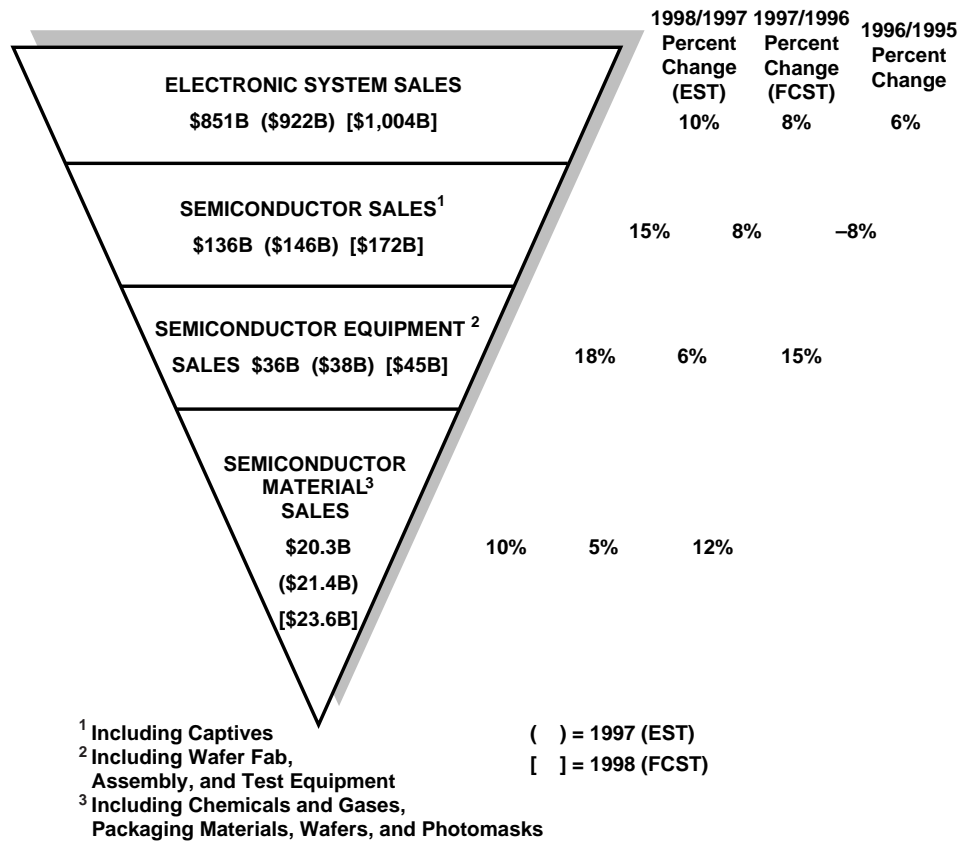
THE WORLDWIDE ELECTRONICS INFRASTRUCTURE

The worldwide electronic market can be thought of as a food chain where electronic system sales feed semiconductor sales that drive semiconductor equipment sales and so forth. Usually as the electronic equipment market grows so do the other markets down the food chain. Contrary to this symbiotic mechanism, in 1996 the semiconductor market actually declined while the systems market grew. This is attributed to the 1996 DRAM price decline and IC inventory correction at the system level. System manufacturers who typically carried 2-3 weeks worth of inventory adjusted downward as supply became more readily available and costs were brought under control. The result was an unusually low 1996 sales level.

For 1997 ICE estimates that semiconductor equipment sales experienced modest growth. Fluctuations in Far East currencies have kept capital spending down. Projections for 1998 are up 18 percent from 1997. This is anticipated because of continued fab expansions and the assumption that currency fluctuations will subside. However, should Asia currency values continue to decline, this could have a major negative impact on the 1998 equipment forecast.

Semiconductor materials sales for 1997 are expected to be lower than previous years, up 8 percent. This lower growth rate is likely due to a delayed reaction to the 1996 decrease in semiconductor production and sales. Materials sales growth rates typically lag six or more months behind semiconductor sales.

The worldwide electronics market can be thought of as an inverted pyramid (Figure 1-9). In general, the semiconductor, semiconductor equipment, and semiconductor materials markets are all ultimately dependent upon healthy electronic system sales.



Source: ICE

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Figure 1-9. 1996-1998 Worldwide Electronics Marketplace

As shown, 1996 was a very difficult year for the overall semiconductor industry. It was one of the very rare years where the semiconductor market declined while the electronic system market grew.

Figure 1-10 shows the discrete, IC, and total semiconductor markets segmented by system-type use from 1991 to 2002. As shown in Figures 1-11 and 1-12, the IC market is driven primarily by the computer industry whereas the discrete segment's greatest demand still comes from consumer and industrial systems. 1993 was the first year that the computer segment represented more than half of the IC market (up two points from 1992). In 1997 the computer segment will represent about 55 percent of the total IC market. The military market now represents about one percent of total semiconductor sales (down from 2.3 percent in 1991) and will most likely continue to shrink from even this low level moving into the next century.

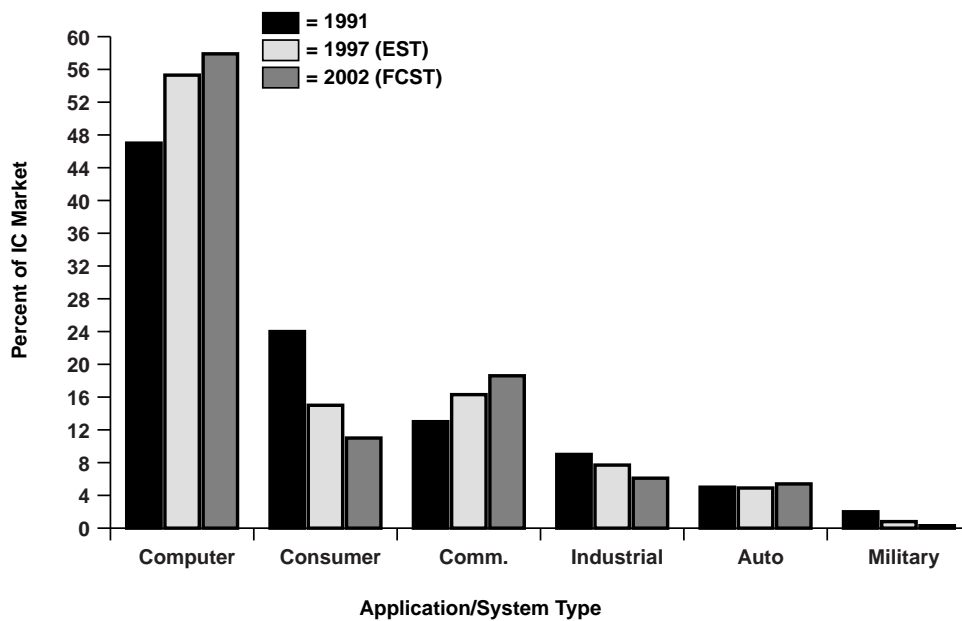
One of the hottest areas of the semiconductor market since 1994 has been the communications segment. In many countries the telecom business is booming even more than the PC industry. ICE estimates that the communications segment of the worldwide semiconductor market has gained more than two points since 1991.

Semiconductor Markets	Actual						Estimate			Forecast						
	1991 (\$B)	Percent of Total	1995 (\$B)	Percent of Total	1996 (\$B)	Percent of Total	1996/1995 % Change	1997 (\$B)	Percent of Total	1997/1996 % Change	1998 (\$B)	Percent of Total	1998/1997 % Change	2002 (\$B)	Percent of Total	1996/2002 CAGR %
IC MARKETS																
Computer	21.9	47.4%	72.7	56.5%	64.9	55.1%	-11%	70.3	55.3%	8%	87.7	58.5%	25%	196.8	57.9%	20%
Consumer	11.0	23.8%	20.1	15.6%	18.3	15.5%	-9%	19.1	15.0%	4%	22.3	14.9%	17%	37.4	11.0%	12%
Communications	6.0	12.9%	18.4	14.3%	18.3	15.5%	-1%	20.7	16.3%	13%	22.5	15.0%	8%	63.2	18.6%	23%
Industrial	4.1	8.9%	10.4	8.1%	9.5	8.1%	-9%	9.8	7.7%	3%	10.5	7.0%	7%	23.1	6.8%	16%
Automotive	2.1	4.6%	5.7	4.4%	5.7	4.8%	—	6.2	4.9%	9%	5.0	4.0%	-4%	18.4	5.4%	22%
Military	1.1	2.4%	1.4	1.1%	1.2	1.0%	-14%	1.0	0.8%	-15%	1.0	0.7%	3%	1.0	0.3%	-3%
Total IC Market	46.3	100.0%	128.7	100.0%	117.9	100.0%	-8%	127.2	100.0%	8%	149.8	100.1%	18%	339.9	100.0%	19%
DISCRETE MARKETS																
Computer	1.2	11.5%	2.7	14.4%	2.9	16.5%	7%	3.2	17.0%	11%	3.8	18.0%	18%	7.9	21.5%	18%
Consumer	4.2	40.2%	5.8	30.6%	5.1	29.0%	-12%	5.3	28.0%	4%	6.4	30.5%	21%	7.8	21.2%	7%
Communications	1.6	15.7%	3.4	17.7%	3.2	18.1%	-6%	3.4	18.2%	7%	3.7	17.4%	6%	6.9	15.9%	14%
Industrial	2.2	21.1%	4.9	25.7%	4.5	25.2%	-8%	4.9	25.7%	8%	5.0	23.6%	2%	9.9	27.1%	14%
Automotive	1.0	9.4%	2.1	10.9%	1.9	10.5%	-10%	2.0	10.5%	4%	2.1	10.0%	6%	4.1	11.1%	14%
Military	0.2	2.1%	0.1	0.7%	0.1	0.7%	—	0.1	0.6%	13%	2.1	0.5%	-7%	0.1	0.2%	-5%
Total Discrete Market	10.5	100.0%	19.0	100.0%	17.7	100.0%	-7%	18.9	100.0%	7%	21.0	100.0%	11%	36.8	100.0%	13%
SEMICONDUCTOR MARKETS																
Computer	23.2	40.8%	75.4	51.1%	67.8	50.0%	-10%	73.6	50.3%	8%	91.4	53.5%	24%	204.7	54.4%	20%
Consumer	15.2	26.8%	25.9	17.5%	23.4	17.3%	-10%	24.4	16.7%	4%	28.7	16.8%	18%	45.2	12.0%	11%
Communications	7.6	13.4%	21.8	14.7%	21.5	15.9%	-1%	24.2	16.5%	12%	26.1	15.3%	8%	70.2	18.6%	21%
Industrial	6.3	11.2%	15.3	10.4%	14.0	10.3%	-8%	14.7	10.0%	5%	15.5	9.0%	5%	33.1	8.7%	22%
Automotive	3.1	5.5%	7.8	5.2%	7.5	5.5%	-4%	8.2	5.6%	10%	7.9	4.7%	-1%	22.4	6.0%	20%
Military	1.3	2.3%	1.5	1.0%	1.3	1.0%	-13%	1.1	0.8%	-13%	1.2	0.7%	2%	1.1	0.3%	-3%
TOTAL SEMI MARKET	56.8	100.0%	147.7	100.0%	135.5	100.0%	-8%	146.1	100.0%	8%	170.8	100.0%	17%	376.7	100.0%	19%

Source: WSTS/ICE

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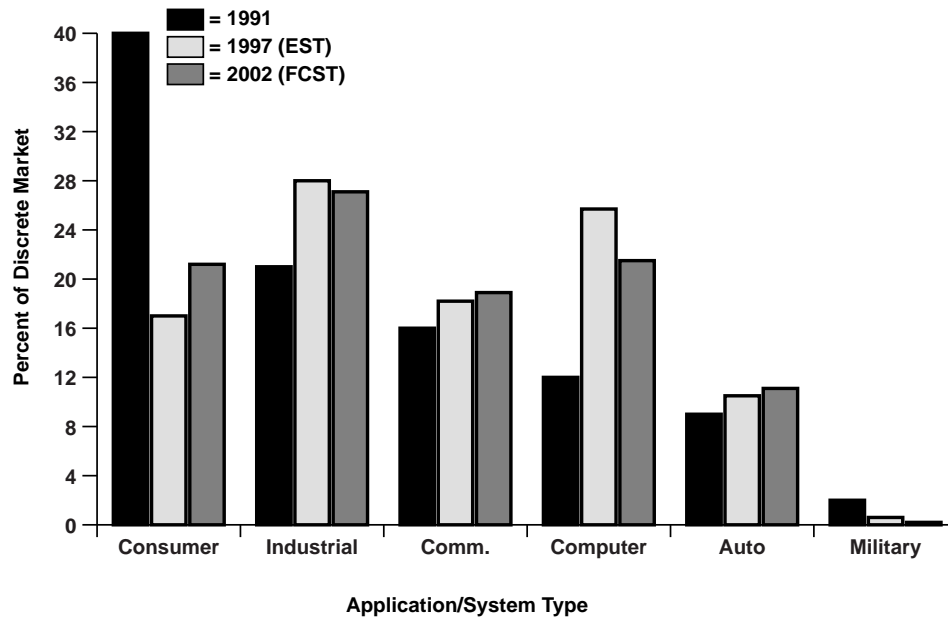
Figure 1-10. 1991-2002 Worldwide IC, Discrete, and Total Merchant Semiconductor Usage



Source: WSTS

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Figure 1-11. IC Dollar Volume End-Use Trends



Source: WSTS

21670B

Figure 1-12. Discrete Dollar Volume End-Use Trends

Each of the major IC market regions (i.e., Japan, North America, Europe, and ROW) has a very different makeup of end-use consumption (Figure 1-13). As shown, the North American market is highly dependent upon the computer industry. In fact, the computer and communications industries represented 81 percent of all IC use in North America in 1996.

The Japanese IC market is more reliant on the consumer systems industry. With economic uncertainty running high among the Japanese population and no new blockbuster-hit consumer products being introduced, Japanese IC consumption for consumer systems has been flat since 1992. However, in 1997 the devaluation of the yen has helped to stimulate growth, increasing consumer product exports. Additionally, long awaited new consumer products like DVD (digital video disk players) are soon to be released which may further boost Japanese consumer sales. Furthermore, being shut out of many of the high-volume desktop PC markets, thus far many Japanese companies have successfully penetrated the laptop and palmtop and office-automation equipment (e.g., printers, fax, copiers) markets.

One of the bright spots in the 1996 European market was the communications segment. With the opening of Eastern Europe, a tremendous pent-up demand for telecommunications systems still exists. Establishing this infrastructure requires a tremendous amount of IC-based telecom equipment. As shown, communications ICs represent one-fourth of Europe's total IC market.

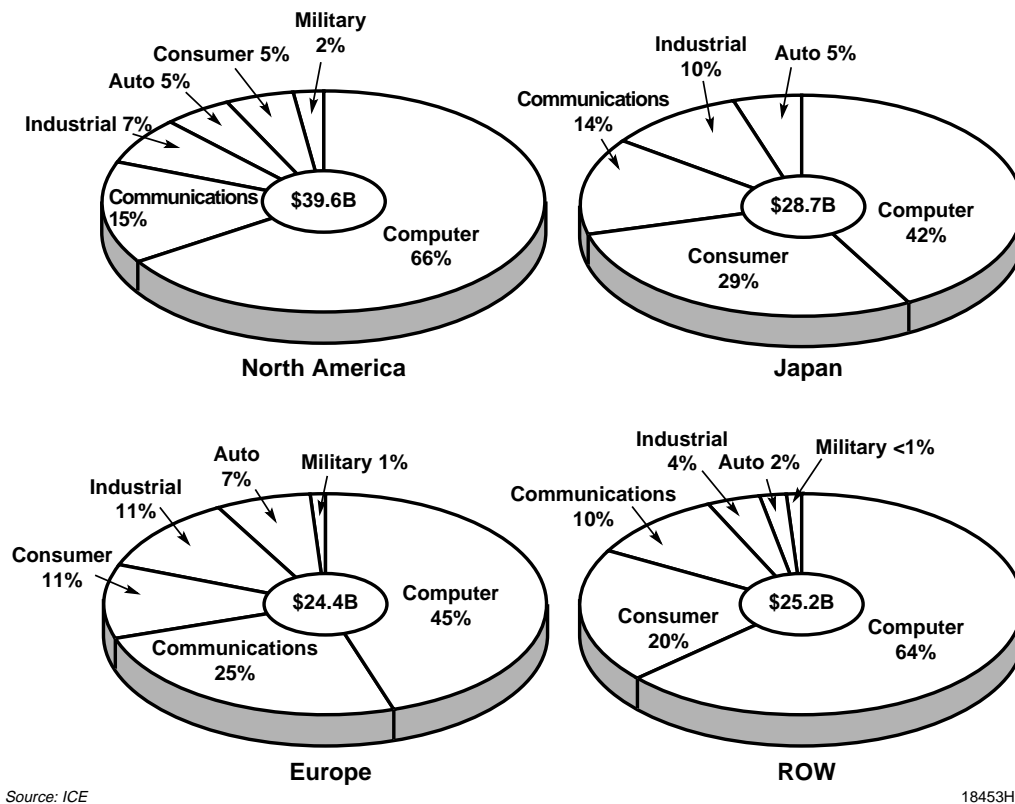


Figure 1-13. 1996 Merchant IC Usage by Region and End Use

The ROW sector has benefited from its participation in the high-growth PC industry. As shown, almost two-thirds of ROW IC consumption was in the computer segment in 1996. The ROW IC market segment was just slightly ahead of Europe as the third largest consuming region for ICs in 1996. For 1997 and 1998, telecommunications and consumer products in addition to computers are anticipated to be hot areas of growth for this region.

WORLDWIDE SEMICONDUCTOR PRODUCTION UPDATE AND FORECAST

Figure 1-14 shows the semiconductor industry's annual growth rates for 1974 through 2002. The 1989-1992 period was the longest period ever in the semiconductor industry where growth was 10 percent or less in each year. Even the 1992 boom year turned out to be a record fourth year in a row where growth did not top 10 percent. As shown, 1993-1995 turned out to be boom years even in the face of the oftentimes slumping Japanese and European economies.

Since the end of 1988 it has become apparent that the four-year semiconductor industry boom cycle is no longer coinciding with U.S. presidential election years. This cycle would have had 1992 and 1996 being boom years while 1993-1995 would have been slower years. Of course, it is currently obvious that just the opposite occurred.

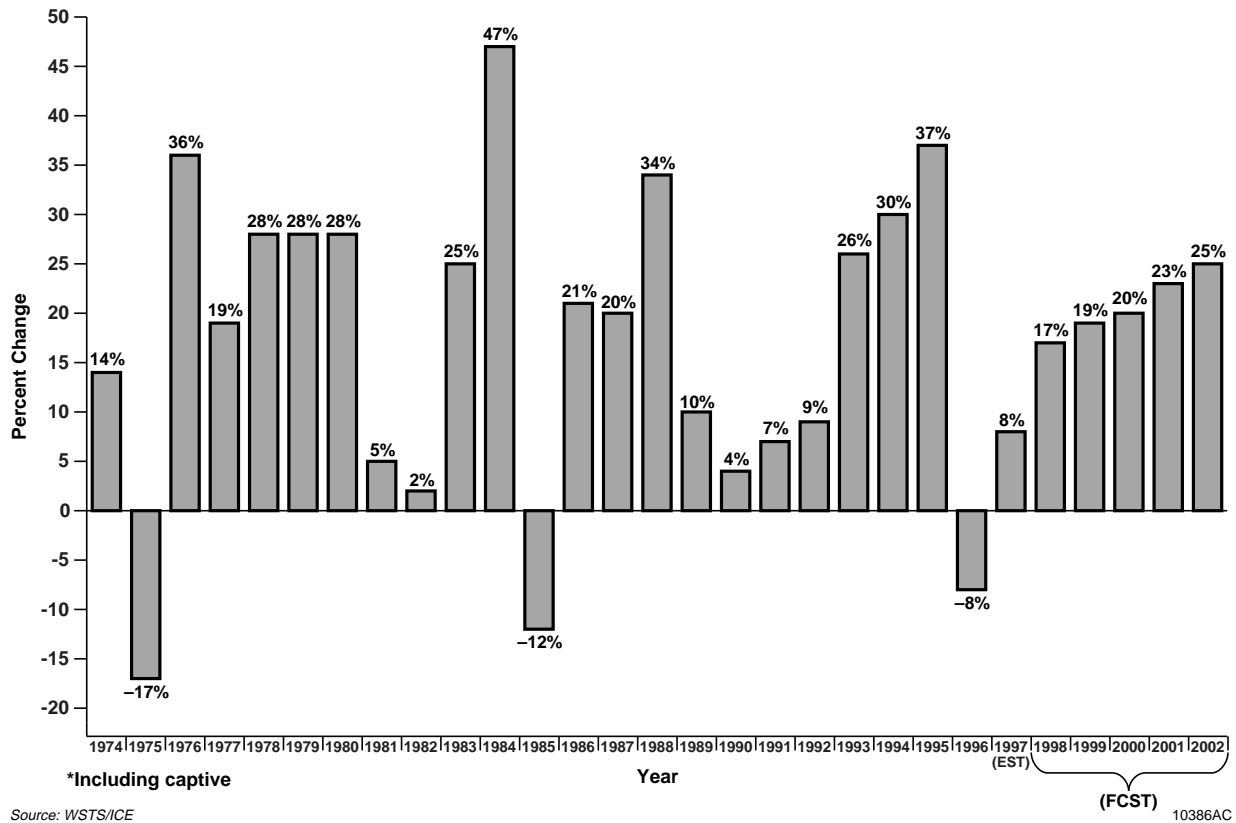


Figure 1-14. Worldwide Semiconductor Production* Growth Rates (\$)

Although foreign currencies helped inflate the early 1990s semiconductor market figures as expressed in dollars, there was very strong real growth from 1993 through 1995. Using a constant exchange rate estimate for 1997, ICE forecasts that the CAGR for the 1997-2002 worldwide semiconductor industry will be a healthy 21 percent. A long-term positive outlook for the computer market coupled with an absence of extended significant overcapacity for leading-edge IC production are the main reasons for ICE's bullish forecast for the 1997-2002 semiconductor market.

ICE's long-term worldwide merchant semiconductor sales forecast is given in Figure 1-15. 1994 was the first year the merchant semiconductor industry passed the \$100 billion level and 1995 was the first year the merchant IC-only market passed the \$100 billion mark. ICE estimates that the merchant semiconductor market will be \$146 billion in 1997 and reach \$378 billion in 2002.

1996's negative worldwide semiconductor market was due to three major factors. The first was the declining price of DRAMs (discussed further in Section 7). The second was inventory corrections at system suppliers. System houses that typically carried 2-3 weeks worth of inventory pared down their inventory in response to increased availability of ICs and need to control costs. The third factor leading to the 1996 decline was declining currency values. In 1996, currencies of non-U.S. countries all declined in value in comparison to the dollar; leading the drop was the

Japanese yen. It should be noted that when using local currencies instead of U.S. dollars and not including DRAMs in 1996 market figures, the worldwide semiconductor market would have shown a 10 percent increase as opposed to a 8 percent decrease.

YEAR	IC MERCHANT	PERCENT GROWTH OVER PREVIOUS YEAR	DISCRETE MERCHANT	PERCENT GROWTH OVER PREVIOUS YEAR	TOTAL MERCHANT SEMICONDUCTOR	PERCENT GROWTH OVER PREVIOUS YEAR
1992	51,840	12	10,410	-1	62,250	10
1993	68,180	32	11,830	14	80,010	29
1994	90,270	32	14,320	21	104,590	31
1995	128,645	43	19,040	33	147,685	41
1996	117,940	-8	17,700	-7	135,640	-8
1997*	127,225	8	18,940	7	146,165	8
1998*	149,842	18	21,036	11	170,877	17
1999*	179,810	20	23,770	13	203,580	19
2000*	217,570	21	26,860	13	244,430	20
2001*	269,787	24	31,158	16	300,945	23
2002*	339,931	26	36,767	18	376,698	25

*Using estimated 2Q97 exchange rates

Source: ICE

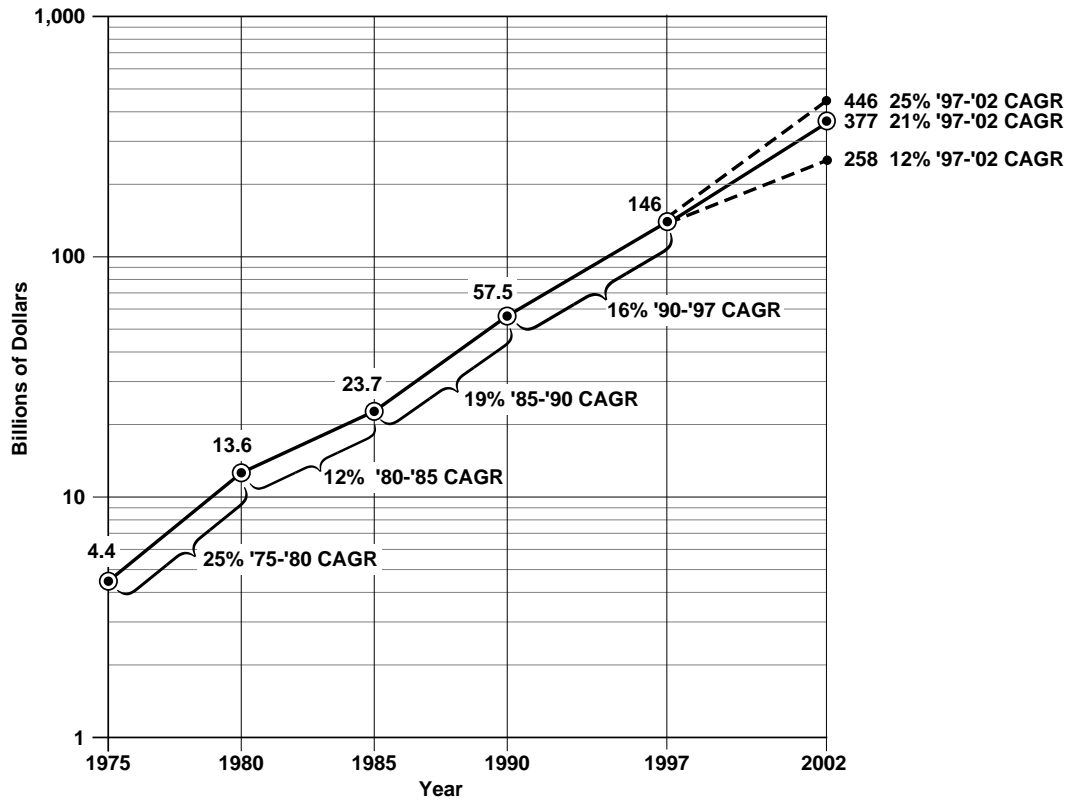
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Figure 1-15. Worldwide Merchant Semiconductor Production Forecast (\$M)

The 1997 growth rate of 8 percent is considered optimistic given recent declines in ASPs and Far East currency fluctuations. 1998 is predicted to be a more typical year showing a growth rate of 17 percent. This assumes that currency values stabilize.

Is a \$377 billion merchant semiconductor market a reasonable expectation for 2002? Figure 1-16 attempts to show why ICE believes that it is reasonable. The figure shows the history of the worldwide merchant semiconductor market from 1975 to 2002 in five-year and seven-year increments. The range of five-year and seven-year CAGRs from 1975 to 1997 went from a low of 12 percent to a high of 25 percent.

Figure 1-17 examines ICE's 1998 assumptions. As shown, the key trends that are expected to cause a similar growth rate over the next five years compared to the previous five years are increased demand for computer systems, communications, and consumer products. Despite the correction in 1996, ICE is still forecasting a very positive long-term worldwide semiconductor market outlook as is evidenced by the 21 percent 1997-2002 CAGR.



Source: ICE

20436D

Figure 1-16. Worldwide Merchant Semiconductor Market History and Forecast

- Capacity
 - Fab equipment suppliers start shipping 300 mm equipment for pilot production.
 - DRAM business continues to represent 18 to 20% of the worldwide merchant semiconductor market.
 - Total IC supply and demand in relative balance in 1998.
 - Leading-edge capacity (<0.30um) still tight at foundries
- Far East currency fluctuations observed in 1997 will subside in 1998.
- PC market growth rates continue to show 8-10% increases per year.
- The worldwide PC unit market (not including NC computers) will display a 15% CAGR from 1996 to 2002.
 - PC unit shipments will grow from 71M in 1996 to 160M in 2002.

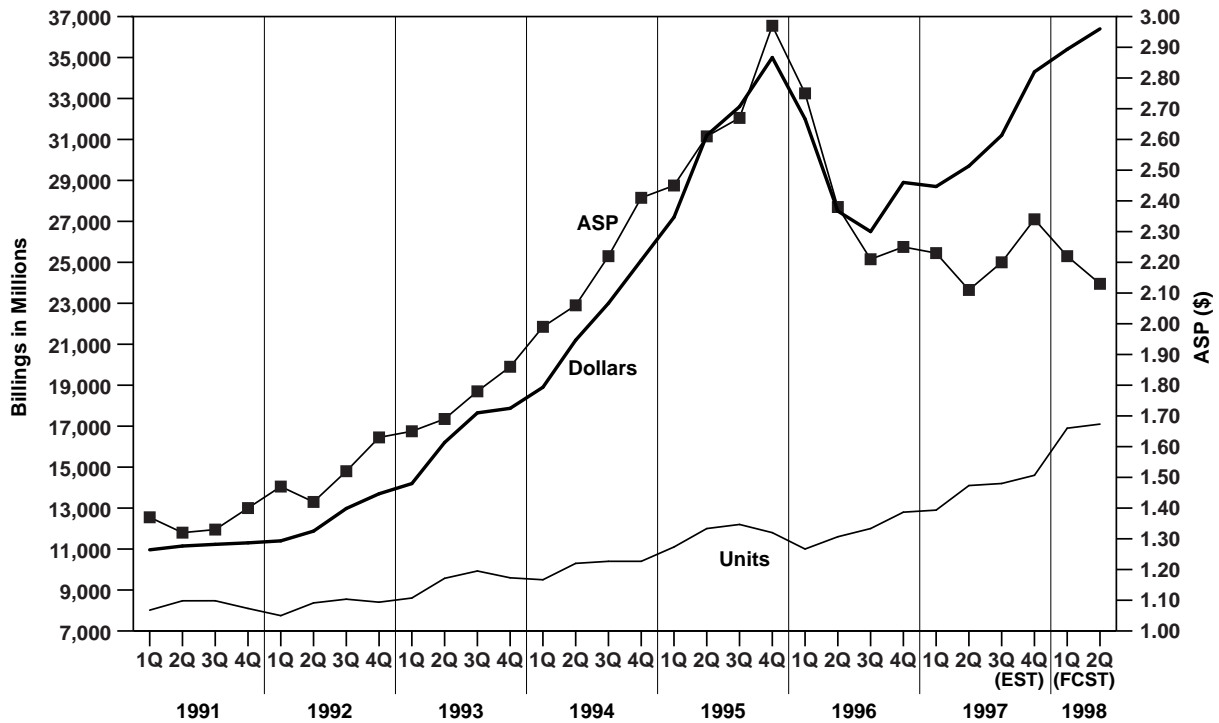
Source: ICE

20327E

Figure 1-17. Status 1998 Assumptions for 1998-2002

THE WORLDWIDE SEMICONDUCTOR MARKET

Figure 1-18 shows the quarterly IC market trends for 1991 through 1998. IC average selling price (ASP) continued to rise until 1Q96 when the DRAM ASP plummeted. Although the worldwide merchant IC market increased 43 percent in 1995, IC unit volume was up only about 18 percent. Thus, the majority of IC market growth in 1995 came from ASP increases, not unit volume increases.



Source: WSTS/ICE

19204H

Figure 1-18. Total Merchant IC Market (Dollars and Units in Millions)

As shown in Figure 1-18, ICE believes that 2Q97 was the low point for IC ASPs through 1997. Moreover, ICE expects that 1Q97 was the beginning of a gradual recovery in the IC market that will carry throughout 1997 and into 1998.

Figure 1-19 shows semiconductor ASPs and unit volume shipments for 1991-1998. The cause of fluctuations in the market as measured in dollars is usually understood by examining ASP and unit volume changes. As was shown earlier, the total IC market in 1996 was more influenced by ASP than by unit volume changes.

YEAR	ICs			DISCRETES			TOTAL SEMICONDUCTOR		
	MERCHANT MARKET (\$B)	ASP	UNIT VOLUME (B)	MERCHANT MARKET (\$B)	ASP	UNIT VOLUME (B)	MERCHANT MARKET (\$B)	ASP	UNIT VOLUME (B)
1991	46.4	\$1.35	34.4	10.5	\$0.093	112.9	56.9	\$0.386	147.3
1992	51.8	\$1.51	34.3	10.4	\$0.093	111.8	62.2	\$0.426	146.1
1993	68.2	\$1.75	39.0	11.8	\$0.098	120.4	79.8	\$0.502	159.4
1994	90.3	\$2.17	41.6	14.3	\$0.102	140.2	104.6	\$0.575	181.8
1995	128.7	\$2.68	48.0	19.0	\$0.106	179.6	147.7	\$0.649	227.6
1996	117.9	\$2.40	49.1	17.7	\$0.102	173.5	135.6	\$0.609	222.6
1997 (EST)	127.2	\$2.22	57.3	18.9	\$0.092	205.9	146.2	\$0.555	263.2
1998 (FCST)	149.8	\$2.40	71.4	21.0	\$0.087	241.5	170.8	\$0.546	313.0
1991-1997 CAGR	18%	9%	9%	10%	—	11%	17%	6%	10%
1986-1990 CAGR	20%	7%	13%	9%	-2%	11%	18%	6%	11%

Source: ICE

13745X

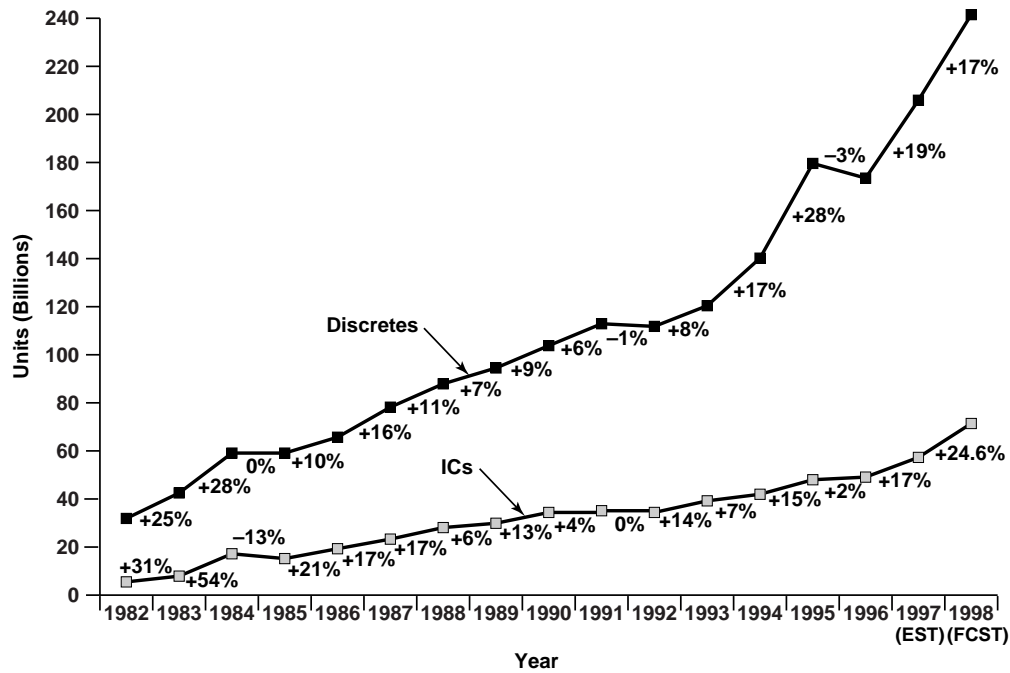
Figure 1-19. Worldwide Merchant Semiconductor Market, ASP, and Unit Volume Shipments

It is interesting to compare semiconductor ASPs and shipments from the late 1980s with the early to mid-1990s. As shown, IC ASPs in the first seven years of the 1990s displayed higher annual increases compared with the late 1980s while unit volume average increases declined. For discretives, annual average unit volume increases of 11 percent are close to the norm (about the same increase as total system sales dollars) with ASPs staying flat in the 1990s instead of decreasing.

Figure 1-20 shows the discrete and IC unit volume shipments from 1982-1997. After a flat semiconductor unit shipment year in 1992, healthy growth for IC and discrete unit volumes was registered in 1993, 1994, and 1995. A surge in automotive and telecommunications applications of discrete semiconductors, as well as some inventory building, were the main reasons for the strong gain in discrete unit shipments in 1994 and 1995.

Both IC and discrete unit volume shipments in 1996 were about flat when compared with 1995. One reason for IC unit shipment rate-of-growth declines is the continuation of the trend of high-density devices replacing numerous low-density units.

Another reason for flat 1996 unit sales is the paring down of inventory by the electronic system houses. Although a significant amount of excess IC inventory was not built-up in 1995, system suppliers began lowering the typical level of parts supply they keep in inventory. For example, while many PC suppliers were keeping three to four weeks worth of IC inventory in 1995, in 1996 IC inventory levels were down to only two days at some companies.



Source: WSTS

11083AE

Figure 1-20. Worldwide Merchant Semiconductor Unit Shipments

For 1997 both IC and discrete volumes are estimated to have grown at 17 and 19 percent respectively. Now that system manufacturers have inventories under control, a more normal rate of semiconductor sales is underway.

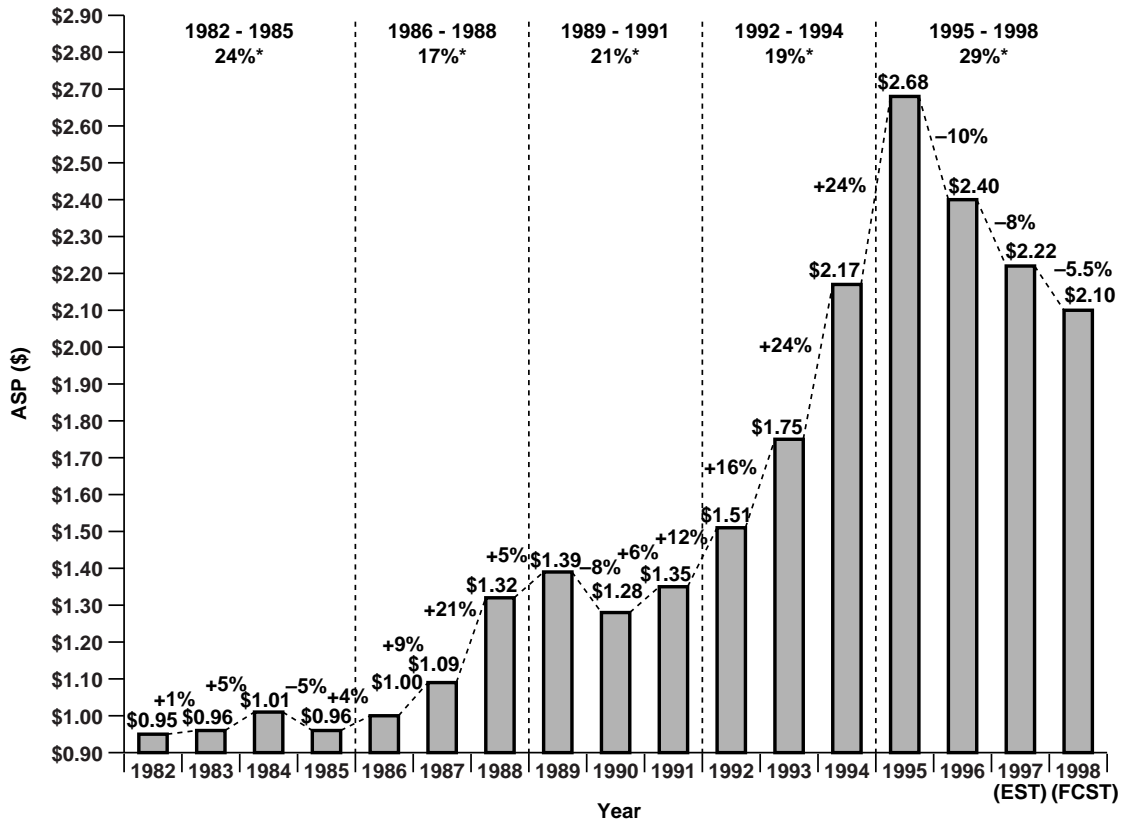
As is almost always the case, an overcapacity situation leads to steady or declining pricing. Conversely, a shortage of capacity will usually lead to dramatically increasing prices. To help gauge the capacity situation in the semiconductor market, ICE has tracked worldwide capital spending as a percent of worldwide semiconductor sales from 1979-1996.

As one would imagine, the 26-27 percent capital spending as a percent of semiconductor sales in 1984-1985 led to significant overcapacity while the 16 percent spending rate in 1986-1987 ultimately led to a capacity shortage during the 1988 expansion. ICE estimates that it currently takes about a 21 percent spending rate to meet the relentless capacity needs of the semiconductor industry.

Figure 1-21 shows IC ASP trends from 1982-1997. Also shown on the chart is the average capital spending as a percent of semiconductor sales for each three or four-year period.

As shown, each period where capital spending averaged over 21 percent or more, IC ASP stayed flat or declined. Even during the boom year of 1984, IC ASP increased only five percent. However, when the spending rate averaged less than 21 percent, IC ASP displayed significant

increases (from 1986 to 1988 and from 1992 to 1994). The 1996 ASP decline was a direct result of the excess spending (particularly for DRAMs) by the IC industry in 1995. ICE forecasts that 1997 and 1998 will display ASP declines as well.

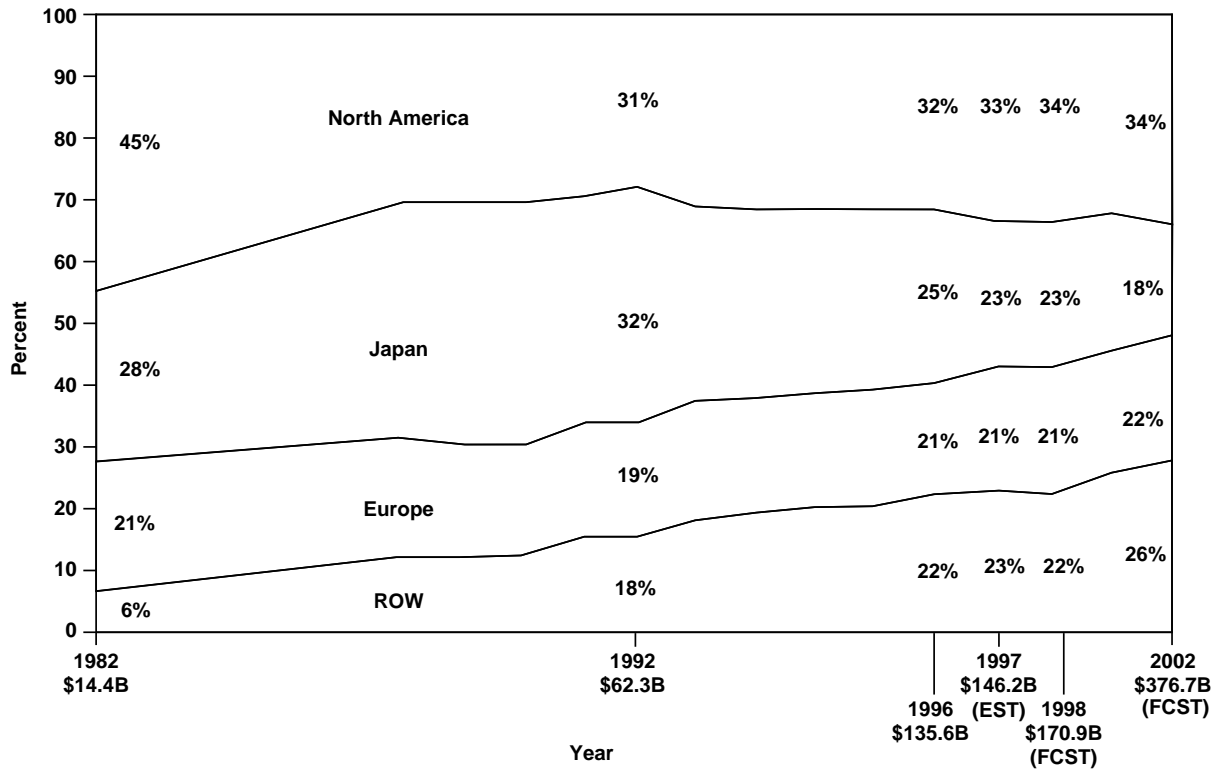


13748AA

Figure 1-21. Merchant IC ASPs (1982-1998)

Figure 1-22 shows the percentage of the market represented by each geographical region for 1982, 1992, 1996, 1997, 1998, and 2002. Drawing upon the same assumptions used for ICE's electronic system production forecasts (shown earlier), the Japanese market is expected to significantly decline in share while the North American and European segments are forecast to stay relatively flat. The ROW region will continue its role as the fastest growing region by gaining three points of market share by 2002. Figure 1-23 shows the 1997 to 2002 CAGR forecast for the four major semiconductor market regions.

Figure 1-24 shows 1993-1996 actuals and ICE's 1997 estimate and 2002 forecast for the merchant semiconductor market by region. The Japanese market would have displayed only a 12 percent 1993-1996 CAGR if expressed in yen. Figure 1-25 shows some key points drawn from the data shown in Figure 1-24.



Source: ICE/WSTS

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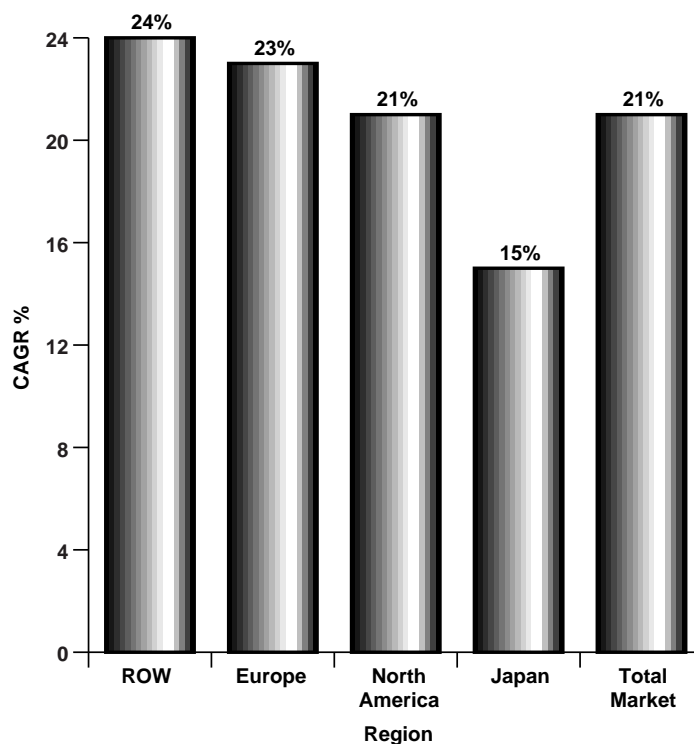
Figure 1-22. Worldwide Merchant Semiconductor Markets

Ultimately, the evolution of the semiconductor market (i.e., consumption) will follow the electronic system industries. ICE expects the electronic system production base to continue slowly migrating to China, Singapore, Korea, Taiwan, etc., and along with it, an increasing percentage of the semiconductor market. As has been discussed, the opposite is forecast to happen in Japan.

THE NORTH AMERICA SEMICONDUCTOR MARKET

In the fourth quarter of 1993 it appeared as if the North American semiconductor market boom period was about to end (Figure 1-26). However, in December of 1993 and throughout 1994 and 1995, the good times returned with the book-to-bill ratio reaching 1.19 in July of 1995 (Figure 1-27).

The good times ended with a jolt beginning in January of 1996. It was in this month that DRAM suppliers reached that magical supply-and-demand balance, and prices started to tumble. Also in January, the book-to-bill ratio dropped below 1.00. However, as shown, October's book-to-bill ratio surged to 1.10 as computer makers returned to the market after their inventories were pared-down as far as possible. Subsequently, positive quarter-to-quarter growth occurred in the fourth quarter of 1996 (refer back to Figure 1-26).



Source: ICE

20207E

Figure 1-23. 1997-2002 Semiconductor Market CAGR by Region

Semiconductor Markets	1993 (\$B)	1994/1993 Percent Change	1994 (\$B)	1995 (\$B)	1995/1994 Percent Change	1996 (\$B)	1996/1995 Percent Change	1997 (FCST, \$B)	1997/1996 Percent Change	2002 (FCST, \$B)	1997-2002 CAGR (%)
Discrete Markets											
North America	2.5	25	3.1	3.9	26%	3.6	-8%	3.9	8%	7.3	13%
Japan	4.7	14	5.4	6.7	31%	5.9	-12%	6.0	2%	8.9	8%
Europe	2.1	24	2.6	3.8	45%	3.6	-5%	4.0	11%	8.8	17%
ROW	2.5	33	3.2	4.6	47%	4.6	—	5.0	9%	11.8	19%
Total Discrete	11.8	21	14.3	19.0	35%	17.7	-7%	18.9	7%	36.8	14%
IC Markets											
North America	23.0	37	31.2	43.5	39%	39.6	-9%	44.7	13%	118.7	22%
Japan	19.6	26	24.5	33.4	36%	28.7	-14%	28.0	-2%	58.4	18%
Europe	12.8	37	17.5	24.8	42%	24.4	-2%	26.0	7%	75.4	24%
ROW	12.8	36	17.1	27.0	58%	25.2	-7%	28.5	13%	87.5	25%
Total IC	68.2	32	90.3	128.7	43%	117.9	-8%	127.2	8%	339.9	22%
Semiconductor Market											
North America	25.5	36	34.3	47.4	38%	43.2	-9%	48.6	13%	126.0	21%
Japan	24.3	23	29.9	40.1	34%	34.6	-14%	34.0	-2%	67.2	15%
Europe	14.9	35	20.1	28.6	43%	28.0	-2%	30.0	7%	84.2	23%
ROW	15.3	35	20.3	31.6	56%	29.8	-6%	33.5	12%	99.3	24%
Total Semiconductor	80.0	31	104.6	147.7	41%	135.6	-8%	146.1	8%	376.7	21%

Source: ICE

18946H

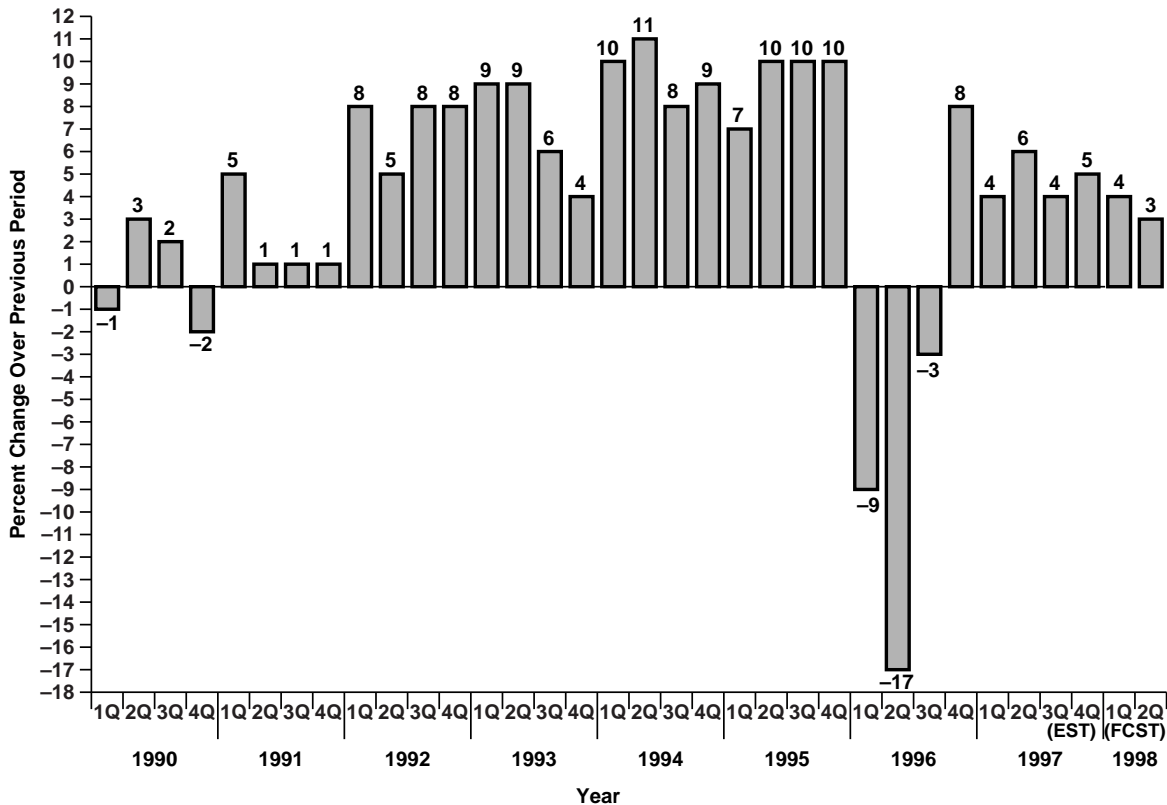
Figure 1-24. Worldwide Merchant Semiconductor Market Forecast

- In yen, the Japanese semiconductor market from 1993-1997 is forecast to increase at only a 10% CAGR. The total semiconductor market showed a 16% CAGR during this same timeframe.
- Exchange rate fluctuations were the main cause behind the -14% drop in the 1996 Japanese market. The weak Yen will again be the primary cause of the negative 1997 Japanese market.
- ROW IC market became larger than that of Europe in 1995.
- ROW and European semiconductor regions are forecast to be larger than Japan by 2002.
- The North American IC market is forecast to be over \$120 billion in 2002, more than twice the size of the Japanese IC market.

Source: ICE

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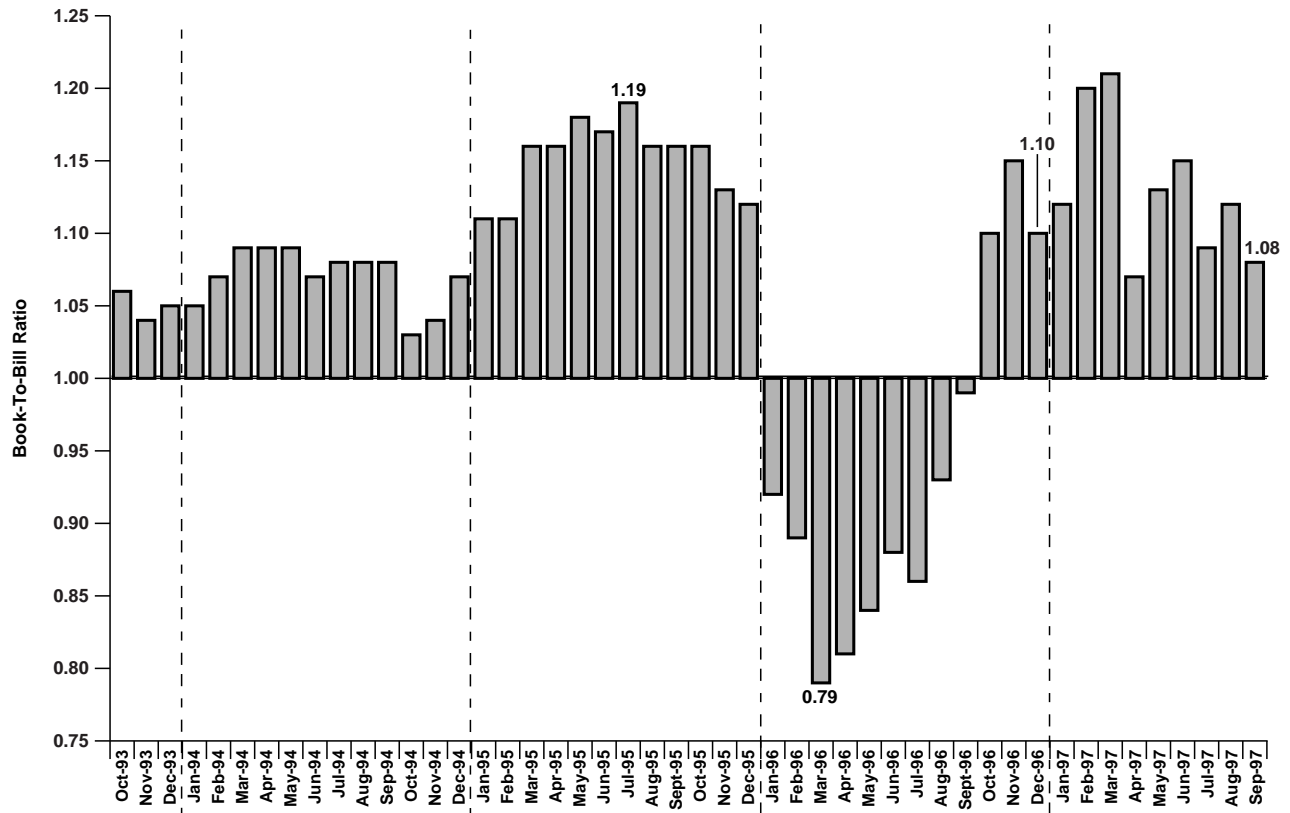
Figure 1-25. Worldwide Merchant Semiconductor Market Forecast Highlights



Source: ICE

18936J

Figure 1-26. Quarterly 1990-1998 North American Merchant Semiconductor Market Growth



Source: WSTS

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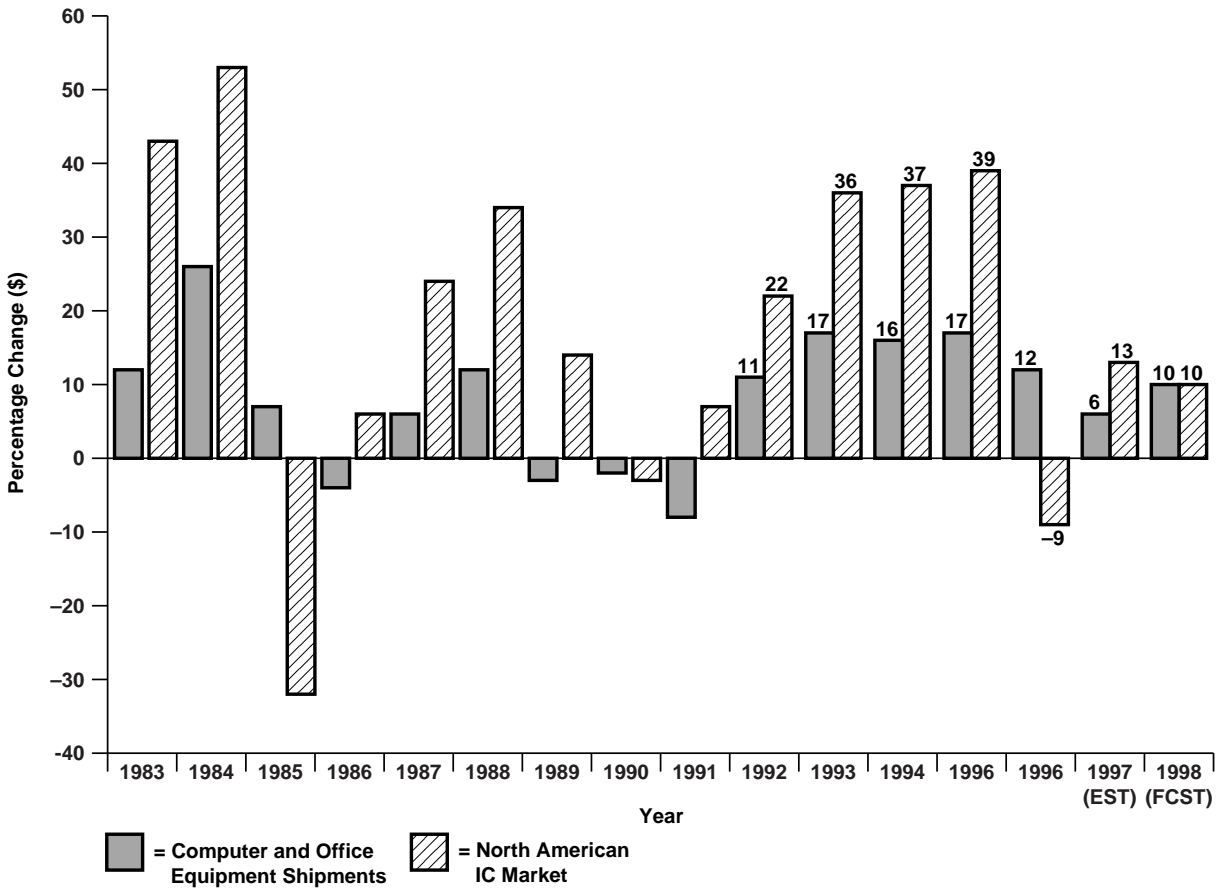
Figure 1-27. North American Semiconductor Market Seasonally Adjusted Book-To-Bill Ratios

As was shown earlier, computer and office automation systems production drives the majority of IC consumption (i.e., market) in North America. With so much of the North American IC market dependent upon one segment of the systems industry, it is helpful to examine the computer and office automation sector in greater detail.

Figure 1-28 compares the annual North American computer and IC market growth rates from 1983 through 1997. Until 1996, the only year that computer shipment growth performed significantly better than the IC market was in 1985. This anomaly was caused when significant IC inventory built up in 1984 and was used throughout 1985. In 1995, electronic systems houses did not accumulate any significant IC inventory overhang. However, in 1996 the system companies lessened the amount of inventory held to a couple of weeks or less. In 1997 system companies continued to streamline their operations so that inventories and overhead were more closely controlled.

Typically the IC market increases much faster than computer shipments. For 1992, 1993, 1994, and 1995, the IC market grew at least twice as fast as computer shipments. Overall, ICE believes that 1996 (12 percent computer shipment growth versus a -9 percent IC market) came closer to

resembling 1985 than 1995. For 1997, North American computer shipments and IC production will grow at 6 and 13 percent respectively. The closeness of these growth rates is likely attributed to better inventory control at system manufacturers and declines in ASPs that kept U.S. IC revenues from growing beyond 10 percent.



Source: ICE

19092J

Figure 1-28. North American Computer Shipment and IC Market Growth Rates (1983-1997)

The reason for the typically much faster growth rate of the IC market versus computer shipments is two-fold: First, computer unit shipments usually grow faster than computer dollar shipments. Thus, while the dollar value of PC shipments may grow 18 percent, unit shipments will grow 20-22 percent indicating PC system pricing declines. Because each PC needs MPU and an increasing amount of memory, and when memory IC prices stay firm, the IC dollar market grows much faster than computer dollar shipments. In 1996, however, memory (especially DRAM and SRAM) prices plummeted.

From December 1996 to January 1997 memory prices took a steep 31 percent drop in ASP. However, over the course of the year ASPs have remained relatively steady—many speculate whether or not memory manufacturers have reached their bottom limit. However, activities in the Far East are expected to drag down 1998 ASPs. As a consequence, worldwide IC ASPs for 1998 are expected to decrease by as much as 5.5 percent. This ASP decrease will force the IC market to show a slower growth rate than previous years.

Another reason for the typically faster IC dollar market growth as compared to computer dollar growth is the growing IC content in new computer systems. As shown in Figure 1-29, percent IC content per computer system is estimated to be 30-35 percent for a PC, based on 1996 data. This number continues to grow each year as new capabilities and features are made available (i.e. previously added capabilities: sound and video imaging; future capabilities: DVD, DSL modems). This is well supported by previous data in Figure 1-6, where semiconductors as a percent of electronic systems has been seen to increase from 11.6 percent in 1992 to 16.2 percent in 1996 and is expected to grow to more than 27 percent by 2002.

Computer Type	IC Content (%)
Mainframe	8 – 10%
Midrange Systems	10 – 14%
Workstations	15 – 18%
Personal Computer (PC)	30 – 35%
Personal Digital Assistant (PDA)	40 – 50%
Network Computer (NC)	50 – 70%

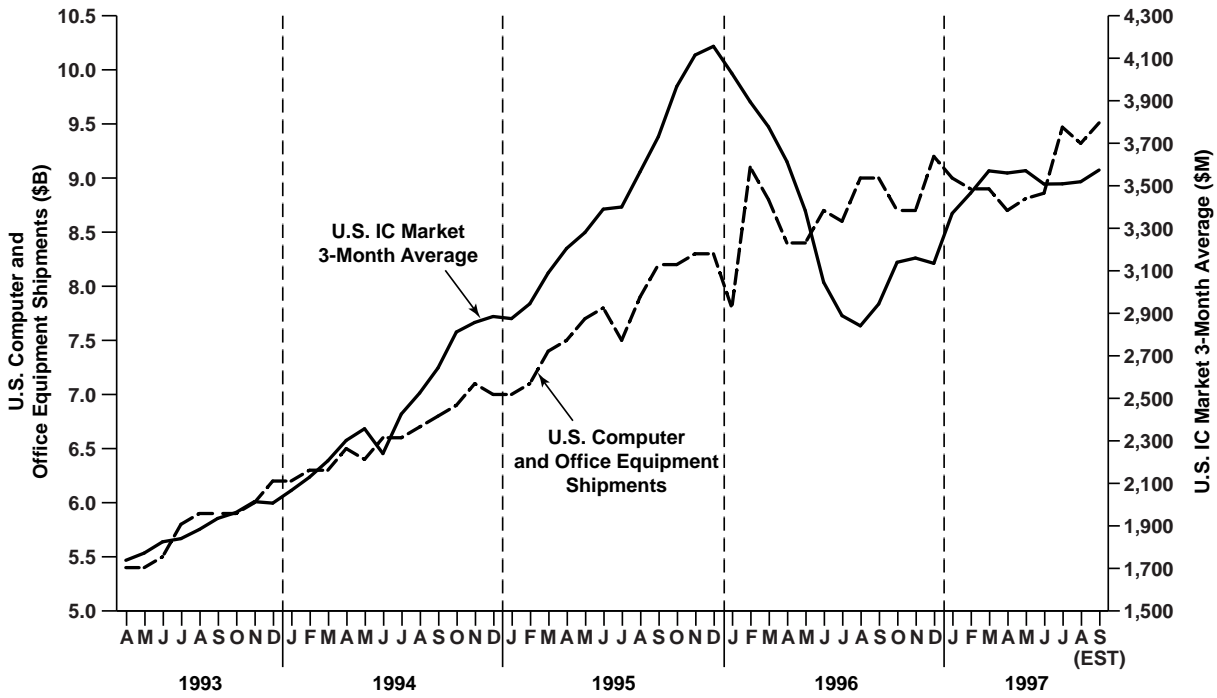
Source: ICE

19265B

Figure 1-29. 1996 IC Content in Computer Systems

The PC market is anticipated to experience steady growth through 2000 with significant growth in the consumer market in combination with the growing market for portable computers and PDAs (personal digital assistants).

Figure 1-30 shows how well computer shipments and IC market trends correlate. From July of 1993 through July 1994 strong revenue correlation existed between the two markets. By mid-1994, the IC market began to outpace computer and office equipment shipments slightly; this was attributed to increases in IC production, yields and decreases in price per chip function. Beginning in June 1996, the U.S. IC market and computer and office equipment trend lines diverged. Growth in the electronic systems markets remained strong, but the U.S. IC market declined by 9 percent from 1995 to 1996 (a 30 percent drop in monthly sales from January 1996 to October 1996).



Source: U.S. Department of Commerce/WSTS

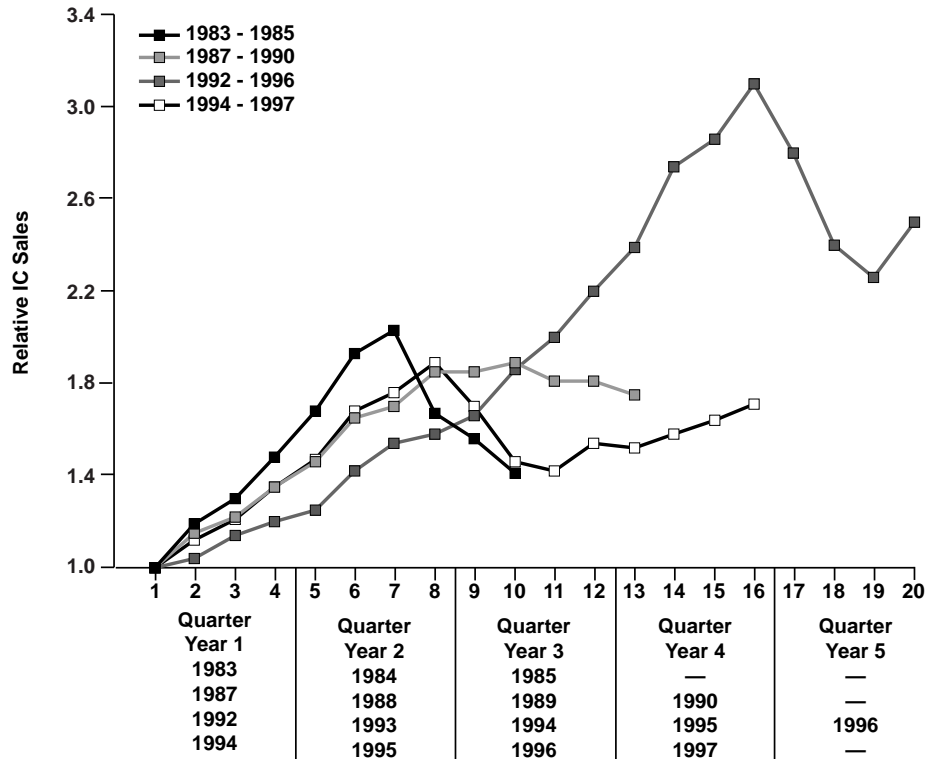
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Figure 1-30. U.S. Computer Shipments Versus U.S. IC Market

As previously mentioned, the two main factors causing this decline were the collapse of the DRAM market and inventory corrections of electronic system producers. ICE believes that the upturn in the IC market beginning in September 1996 was an indication that the bottom of a corrective period was reached in 3Q96.

For 1997, given a slight drop in IC ASPs from the end of 1996 and conservative buying on part of system producers, the U.S. IC market is expected to show steady growth, yet not as steeply as periods prior to 1996. In 1998, IC revenues are expected to grow at a slower rate, as a result of decreasing ASPs and increased competition from Far East markets.

What does the future hold for the North American semiconductor market? As figure 1-31 shows, the 1992-1995 boom period lasted two years longer than the two previous cycles. As was discussed earlier, high inventories and DRAM overcapacity forced a correction in 1996. As with any maturing market, an increase in the revenue cycle period is expected with time. For this reason, an equal or longer period of growth is anticipated over the next several years, i.e., from 1997 through 2000. As can be seen by the data for 1997, a new upward cycle may be forming.



Source: ICE

21418B

Figure 1-31. Worldwide IC Market “Boom” Period Comparisons

U.S. - JAPAN SEMICONDUCTOR TRADE

Japan has long been a competitor to the U.S. in the semiconductor market. Although the U.S. leads Japan in sales (1996 worldwide market shares for Japan and U.S. were 25 percent and 32 percent respectively), fluctuations in the yen or changes Japanese business economy can have significant impacts on U.S. market share and trade balance.

For example, as the value of the yen to the dollar decreases, Japanese exports become more attractive to non-Japanese buyers, often shifting the balance in trade. This is of particular concern to the U.S., especially since Japan is considered the second largest importer of goods to the U.S. after Canada and the largest importer of microelectronics to the U.S. representing more than 24 percent of all microelectronics imported into the U.S., in 1996.

Japanese Economic Issues

1997 was not a good year for the Japanese economy. Government attempts at stimulating business by pumping up public works spending, tax cuts, and low interest government loans had temporary effects to boost the 1996 economy. Unfortunately, toward the end of 1996 export sales and

domestic spending in Japan were disappointingly low. Compounding this GDP problem, in the first half of 1997 the Japanese government raised taxes equivalent to 2.4 percent of GDP and reduced government spending by 0.5 percent (including a 10 percent cut in public works). This move was a direct result of the growing government budget deficit (1997 estimated to be as high as 7 percent of gross domestic product). As a result of these changes, business investments that have risen consistently for more than 2 years fell 1.5 percent. The result to date has been further weakening of Japan's GDP.

In attempts to counteract these measures, the value of the yen has been allowed to decline declining 2.5 percent as measured against the dollar from January to September of 1997; exports, also known as Japan's "traditional weapon of last resort", are now on a rapid rise.

As a result of the devaluation of the yen, Japanese sales growth from 1996 to 1997 is expected to be down nearly 2 percent as opposed to up by 7.5 percent if the yen had remained stable. In terms of the impact on the worldwide industry, what is now projected as an 8 percent increase in worldwide sales would have been a growth of more than 10 percent.

As a result of these changes in the Japanese economy, 1998 Japanese semiconductor unit volume exports are anticipated to rise, ASPs for memory chips (which represent a major portion of the Japanese IC production) will be held down, and the U.S. deficit will rise. Some financial analysts foresee Japan heading into a recession if government deregulation is not allowed to occur. However, given the long history of government intervention in Japanese business, this is not likely to occur overnight, and may take 5-10 years. A continued decline in the Japanese economy could mean an even lower valued yen making DRAM and other memory chip sales rise further and lead to slower growth from a worldwide perspective, as is already predicted for 1997. In addition, Japan's rising trade surplus will rapidly become an issue for its trading partners who may cause trade friction that could lead to an appreciation in the yen, resulting in less profitable Japan exports. In the fiscal half-year from April through September, Japan's trade surplus with the U.S. jumped up 55 percent over the same period last year.

Unfortunately, the Southeast Asian currency crisis presents an added threat to the Japanese economy. As the buying power of these countries declines, a large negative impact on Japanese exports is expected. Additionally, Japanese investments in other Asian countries have not helped to buoy the economy. Given bad debt situations at home and abroad, 16 Japanese banks and related financial institutions have closed, and many other Japanese banks and life insurance companies are at risk. Those Japanese bankers left standing are now facing concerns over how vulnerable their \$265 billion in Asian loans and bank deposits will be in the face of the Asian economic slowdown.

U.S.- Japan Semiconductor Trade Agreements

In 3Q94, U.S. and Japanese trade negotiators agreed to extend the semiconductor trade agreement, originally signed in September 1986, until July 1996. The original U.S. goal was for the foreign share of the Japanese market to be about three times the nine percent level it was at the beginning of the trade pact. In 1Q96, this market share goal had been exceeded. Moreover, since 1986, foreign market share in Japan has increased almost two points per year.

All the anticipation associated with the targeted 20 percent foreign market share in Japan was well documented. As shown in Figure 1-32, the first three quarters of 1993 witnessed the slide in foreign market share in Japan before rebounding in 4Q93 and 1994. In fact, the 1993 average figure was 19.4 percent and 1994 was the first year that averaged over 20 percent.

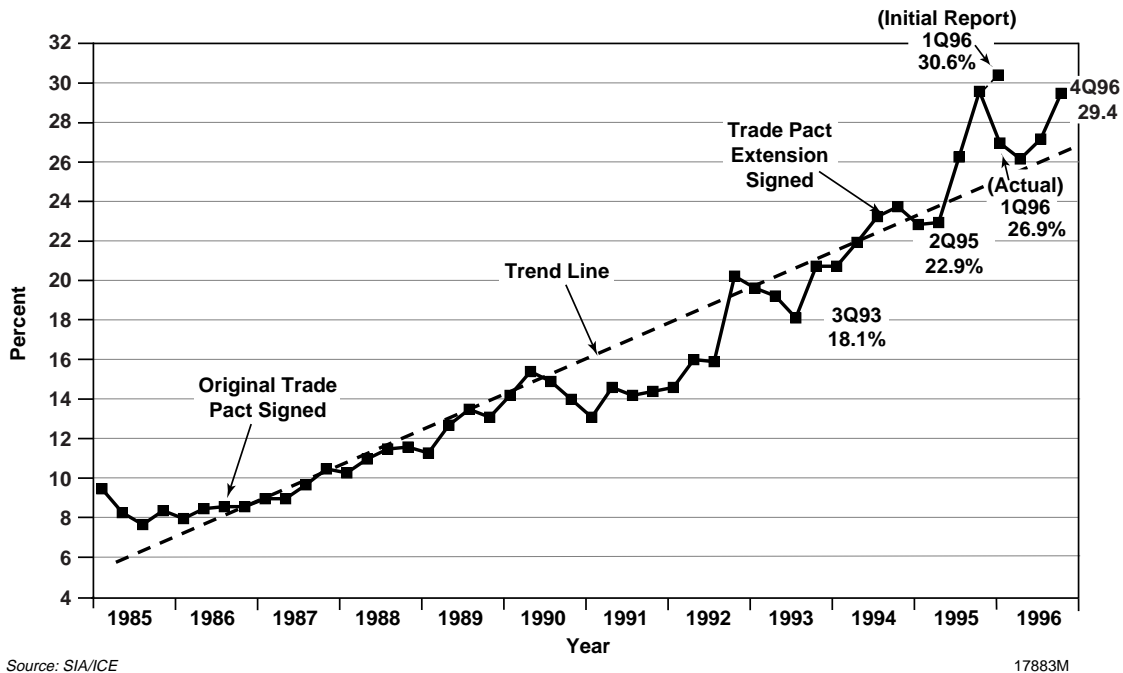


Figure 1-32. Foreign Semiconductor Market Share In Japan

It is generally known that the SIA wanted to see the foreign market share grow in Japan to 25 to 30 percent by mid-1996. In late-1995 these goals were met with a 29.6 percent foreign market share (30.2 percent by Japanese calculations). However, the Japanese government became very negative toward continually meeting hard market share figures and did not want to extend the trade pact monitoring by U.S. or Japanese governments beyond July 1996.

In August 2, 1996, two new bilateral agreements were signed in Vancouver, Canada. The first of the two agreements was an industry focused agreement, that emphasizes cooperation between the U.S. and Japan semiconductor industries and reduces the amount of government intervention. This industry agreement also created the Semiconductor Council (now recognized as the World Semiconductor Council, WSC) to address market-access concerns and promote cooperative industry activities. The council is open to industry associations from major semiconductor-producing countries that have eliminated or agree to eliminate tariffs on semiconductors.

The second of these two agreements established the Global Governmental Forum, that major semiconductor producing countries are invited to join for discussion of global issues such as tariffs, taxation and environmental rules. This government agreement also provides a forum for consultations between the U.S. and Japanese governments, and governments of other countries that have joined the WSC, to review the progress on cooperative activities and recommendations of the Semiconductor Council.

In addition to these two new agreements, in December 1996, U.S. and Japanese industry associations signed an agreement on procedures to expedite handling of future DRAM dumping investigations.

Europe: Early	1997 = 7%
July	1997 = 3.5%
January 1998	= 1.75%
January 1999	= 0%
Korea: Early	1997 = 8%
July	1997 = 4%
January 1998	= 2%
January 1999	= 0%

Source: ICE

22762

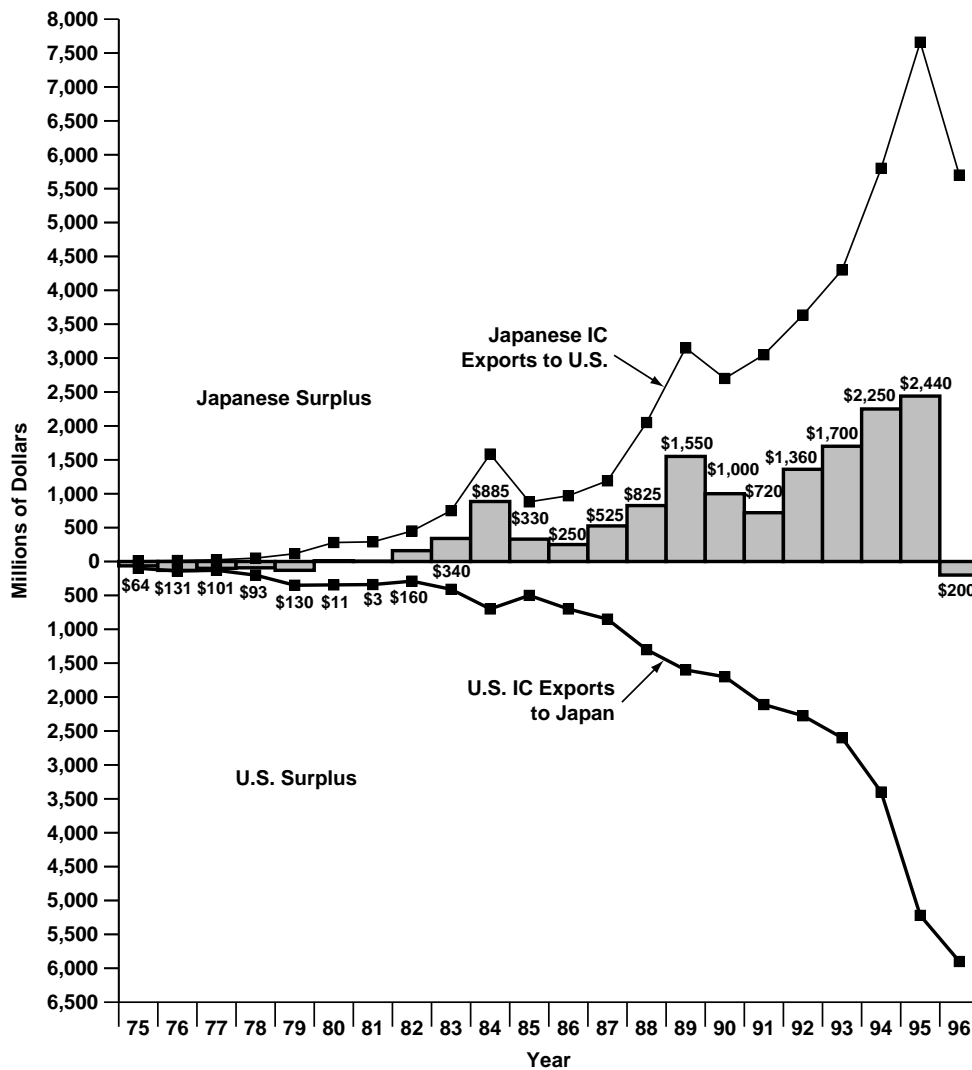
Figure 1-33. Semiconductor Tariff Reduction Schedules

The first official meeting of the WSC was held on April 11, 1997, in Hawaii. In attendance were the SIA of the U.S., the European Electronics Component Manufacturers Association (EECA), the Korean SIA (KSIA), and the Electronic Industries Association of Japan (EIAJ). Although Korea and Europe currently impose tariffs on semiconductor trade, both countries have plans in place to reduce these tariffs to zero by January 1999 (see Figure 1-33).

At the first WSC meeting, the Council agreed to encourage cooperation on 300mm wafer standards, exchanged information on environmental safety and health issues, and reviewed reports on semiconductor market and trade flow data. The next meeting of the WSC is scheduled for June 1998 in Tokyo.

U.S. - Japan Trade Surplus

Certainly, Japan has enjoyed a large IC trade surplus with the U.S. for several years as revealed in Figure 1-34. As shown, the 1995 trade gap was the largest ever, surpassing 1994 by over eight percent. A significant factor contributing to Japan's declining trade surplus in 1990 and 1991 was the dramatic reduction in 1M DRAM pricing. In contrast, the widened trade gap of 1993, 1994, and 1995 was mostly due to high-volume shipments of expensive DRAMs. Following historical patterns, 1996 witnessed a U.S. surplus (the first since 1978) in IC trade with Japan due to weak DRAM pricing levels. 1997 DRAM prices have fallen approximately 30 percent from 1996 levels. DRAM pricing is also expected to decline slightly for 1998 as a result of Far East Asia currency devaluations. The return to a U.S. trade deficit with Japan is anticipated for 1998.

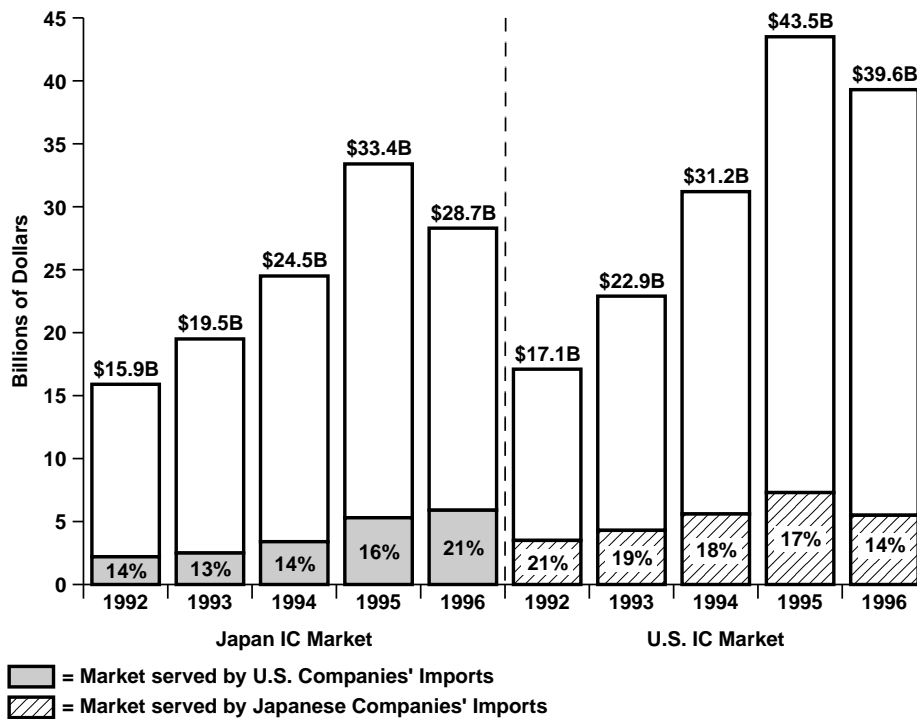


Source: Japan Finance Ministry

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Figure 1-34. Japan-U.S. IC Trade

Figure 1-35 shows how much the U.S. and Japan have infiltrated each other's markets. The U.S. lost one percentage point of market share in Japan in 1993, gained it back in 1994, gained two points in 1995, and surged five points in 1996. The increase in the U.S. market share in the early 1990s was a good sign that U.S.-made ICs were getting more design-ins into Japanese electronic systems.



Source: ICE

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Figure 1-35. U.S. and Japanese IC Imports as a Percent of the Local IC Market

The big gain in U.S. companies' share of the Japanese IC market in 1996 was due to the collapse of DRAM prices. Since most of the U.S. IC exports to Japan are non-DRAM devices (MPUs, ASICs and DSPs) the U.S. share of the 1996 total Japanese IC market surged.

Japan's shrinking U.S. market share through 1996 can be partly explained by the numerous Japanese companies that have either invested in large fab facilities on U.S. soil. Among the examples are NEC, Roseville, California, and the IBM/Fujitsu plant in New York. (Note: sales from Japanese owned fabs located on U.S. soil are not counted as imports and therefore are not considered in Figures 1-34 and 1-35.)

Since DRAM prices have continued to fall in 1997, one might guess that a similar trend to that seen in 1996 might have been expected. However, given the devaluation of the yen, the U.S. market share in Japan is expected to decline and Japan's market share in the U.S. is anticipated to grow.

Figure 1-36 shows the country of origin for Japanese IC imports in 1995 and 1996. As shown, the Korean share dropped significantly in 1996, once again due to steep DRAM price declines. It is interesting to note the strength shown by Taiwanese companies in the Japanese IC market. This increase in the Taiwanese share is indicative of overall gains that Taiwanese producers have made in the IC industry since 1994. For 1997 it is anticipated that the U.S. and European shares will decline and, given the devaluation of other Asian currencies, it is anticipated that the market share for IC imports to Japan will increase for Taiwan, Korea and other Asian countries.

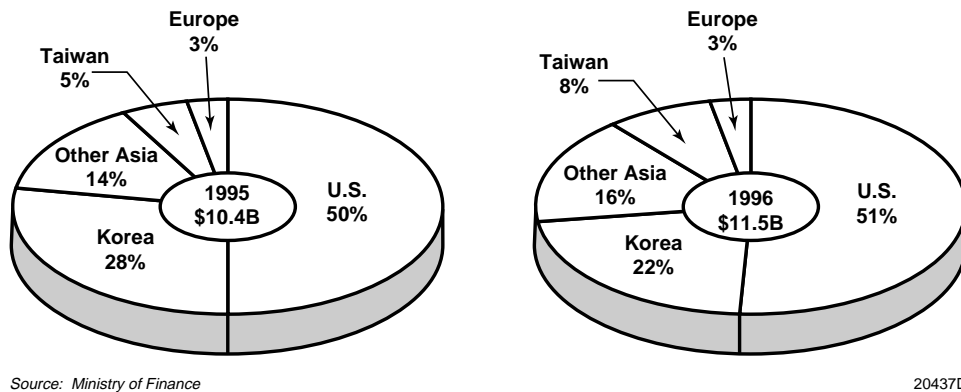


Figure 1-36. 1995 Versus 1996 Japanese IC Imports by Country of Origin

U.S. - CHINA TRADE

It is generally agreed that the ROW semiconductor market with the greatest potential in the late 1990s and early 2000s is China. China is the world's largest consumer market with 1.2 billion citizens whose incomes are rising.

Computers and communications are of particular importance to the Chinese government. The country's market for personal computers was 350,000 units in 1993 and is forecast to reach 2.5 million units by 2001. In the area of communications, telephone subscriptions totaled 26 million units in 1993 and are forecast to jump to 73 million by the year 2001.

Of course, strong demand for electronic products means strong demand for semiconductors. As shown in Figure 1-37, China's dollar value consumption of ICs is forecast to increase on the average of about 32 percent per year from 1993 to 1997. In 1996, the majority of those ICs were built into consumer products such as TVs, audio equipment, and game machines. However, demand for ICs for communications equipment, personal computers, and VCRs will experience the strongest growth in the coming years.

Year	IC Market (\$B)	IC Market (Unit B)	Domestic China IC Production (Units B)	Percent Domestic
1993	1.25	0.85	0.20	24
1994	1.74	1.00	0.25	25
1995	2.38	1.50	0.45	30
1996	3.00	1.90	0.60	32
1997 (FCST)	3.75	2.35	0.80	34

Source: China Ministry of Electronics, Industrial Technology Research Institute, SEMI

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Figure 1-37. IC Market In China

The first U.S.-China Summit in eight years was held on October 29, 1997. The summit was considered as success by both sides. Agreements between the two countries included:

- Chinese agreement to sign the International Technology Agreement, taking tariffs from 23 percent to 0 percent on \$1.4B worth of American exports of information technology.
- Regularizing Summits with President Clinton accepting an invitation to go to China next year.
- Establishment of a hot-line between Beijing and the White House.
- Official communications between the Chinese and U.S. militaries.

For 1997 China is expected to see a GDP growth rate of 8 percent. Currently, China is one of the few Asian countries whose domestic spending has not plummeted and whose currency has not fluctuated wildly. This is directly a result of high projectionist barriers controlling import growth and a non-convertible currency.

However, similar to some problems in other countries, overcapacity in most goods has increased as a result of local banks extending low interest loans to spur growth. Unfortunately, this has resulted in overbuilt real estate in Shanghai and Beijing, in addition to \$90B worth of bad-debt loans.

To counter-act inflation the government has put policies in place to tighter fiscal and monetary policies. Although this will slow down overall growth, it will help to reduce overcapacity. Growth is anticipated to remain at 8 percent or better from 1997 to 1998.

As of 1996, \$8.3B or 1.7 percent of all U.S. exports were sold to China. Of this \$8.3B, one billion dollars were attributed to microelectronics, representing 3 percent of all U.S. microelectronics exports. In terms of imports to the U.S., in 1996 China sold \$2.75B of products to the U.S. representing 5.4 percent of all U.S. microelectronics imports.

Although China has been considered the greatest potential for the semiconductor market, tight government controls have hindered trade. Now that China has agreed to sign the ITA, trade into China for electronics products should start to grow more quickly in 1998. Given an increasing local demand for computers and electronic consumer goods, an increase of semiconductor imports into this market should help to increase overall GDP for 1998.

To date, China is behind in semiconductor technology. The few fabrication facilities that do exist use design rules equivalent to the U.S. guidelines of the mid-1980s. Given their current level of technology, Chinese semiconductor fabs may have trouble competing with an increase in semiconductor imports from countries with a higher level of expertise such as Japan, Taiwan, Korea, Europe, and the U.S.

U.S. - SOUTH KOREA TRADE

As part of the requirement to join the World Semiconductor Council, in April 1997 Korea agreed to a semiconductor tariff elimination schedule that spans 1997 through 1999. Korea signed an agreement setting the tariff at 3.5 percent by July 1997 (down from 7 percent), reducing it to 1.75 percent by January 1998, and finally eliminating semiconductor tariffs by January 1999.

For 1997 South Korea is expected to see a GDP growth rate of 6.4 percent. GDP is expected to drop in 1998 to less than 6 percent. Growth rates in the region have slowed as a result of a financial crisis that began earlier this year when one of the largest Korean conglomerates, the Hanbo Group, went into bankruptcy. In reaction to this bankruptcy, the Korea financial sector went into hiding, concerned about accumulating more bad debt. These banks restricted access to funds causing a major crisis at four other conglomerates who were dependent on bank funds for their continued growth. To date, a total of six of the chaebols have gone into bankruptcy. As of October 1997 South Korea banks have tallied more than \$60B in bad-debt loans.

Contributing to slow growth has been the falling yen that has caused more active competition for what used to be considered less expensive Korean-made products.

Unfortunately, the government has been slow to provide monetary support. The one action that is anticipated to have a noticeable impact is the drop in value of the won. Now at 1139 won to the dollar, the won has dropped in value by more than 67 percent over the course of 1997. Although this should help to stimulate exports it may not provide the revenues the country needs in the short term. If government measures taken over the last quarter of 1997 prove unsuccessful, the International Monetary Fund may have to help infuse capital into South Korea, estimated to be as much as \$40B.

As of 1996, \$19B or 3 percent of all U.S. exports were sold to South Korea. Of this \$19B, less than one billion dollars were attributed to microelectronics. However, South Korea is considered one of the top five exporters of microelectronics to the U.S., shipping more than \$6.6B of product to the U.S. in 1996 (13 percent of all microelectronics imports into the U.S.).

The 1996 slash in DRAM prices hindered the Korean semiconductor industry. A massive reduction in 1996 revenues in combination with a continued building of production capacity caused many companies to reduce their 1997 revenue projections by as much as 26 percent. Attempts in 1996 to support DRAM pricing by reducing fab output further hindered the country's growth rate. Instead of helping to keep DRAM prices from dropping, it allowed other DRAM competitors to scoop up market share from South Korean fabs. These fabs have development programs in place to diversify their product lines into non-memory areas, such as ASICs, however, progress has been slow.

The falling of the won in combination to the drop in value of the yen is sure to cause 1998 DRAM pricing to decline further, making U.S. sources less competitive. However, this will allow Korea to compete more successfully with other Asian sources of memory, such as Japan and Taiwan. How the devaluation of the won will impact overall semiconductor sales is unclear, given high ASPs in other worldwide product areas, such as microprocessors, ASICs, etc. Trade into the U.S. from South Korea will increase, however, the overall trade deficit will climb slowly given declining ASPs.

Given South Korea's declining economy, U.S. products are bound to be less competitive and trade into South Korea is anticipated to decline for 1998.

U.S. - EUROPEAN TRADE

The semiconductor tariff barrier around the Western European Countries was recently halved to 3.5 percent. This move was made in response to the World Semiconductor Council's requirement to eliminate tariffs as a pre-condition of membership. The original commitment made to the WSC by the European Electronic Components Association (EECA) was to decrease the semiconductor tariff from 7 percent to 3 percent by January 1998. Now that the tariff has already been reduced, the EECA is recommending that the tariff be reduced to zero by early 1998.

GDP growth rates in Western Europe have been slow yet steady. Estimated at 2.5 percent growth for 1997, most of Western Europe is experiencing slow growth due to measures taken to meet the Maastricht Criteria as part of European Monetary Union (EMU) requirements. The EMU requires implementation of fiscal policies leading to fiscal deficits no greater than 3 percent and reduction of total country debt to less than 60 percent. As a result, many countries are putting policies in place to trim government spending, raise taxes, and cut inflation. Although countries such as the

U.K. and Italy have not officially joined the union, the majority of Western European countries are taking steps that will allow them to be eligible to participate when the Euro-currency goes into effect on January 1, 1999.

Of the Western European countries, the U.K. is showing the strongest growth with 3 percent growth in GDP expected for both 1997 and 1998. Although export sales for 1997 have slowed, the U.K. is one of the few countries to be close to meeting the Maastricht Criteria.

France is second to the U.K. with growth for 1997 estimated to be 2.2 percent, and a GDP growth rate for 1998 forecasted to be 2.7 percent. Germany, although hindered by economic adjustments required to unify East with West Germany, is expected to show less than a 2 percent growth for 1997, and 1998 is forecasted to be 2.7 percent. Despite increased labor rates, export sales and consumer spending are on the rise.

Italy, well known in Europe for having one of the largest government deficits, has been making steady efforts to lower government spending that has helped to lower inflation and interest rates. These measures in combination with the recent tying of the lira to the German mark has caused lower growth. Consequently, 1997 GDP growth for Italy is estimated to be 1.2 percent. In hopes that consumer spending and export sales improve in 1998, GDP growth rate for 1998 is forecast to be 2.2 percent.

As of 1996, the U.S. exported \$85B worth of goods to Western Europe. This accounts for some 17.5 percent of total U.S. exports. 1996 microelectronics exports from the U.S. to Western Europe totaled \$5.1B, representing 14.2 percent of all microelectronics exported from the U.S. Microelectronics imported from Western Europe to the U.S. totaled \$4.9B or 9.7 percent of all microelectronics imported to the U.S.

For 1998, Western Europe will not cause any major impact on the semiconductor market, however, activities in the Far East will likely effect the businesses in this region. As currency values in the Far East decline, exports from these Asian countries are bound to compete with more expensive locally produced products. Offsetting this negative effect on the Western European economies is the benefit that may be gained from European companies that have manufacturing and component suppliers in the Far East. For companies such as Phillips and SGS-Thomson that do have Far East manufacturing facilities and suppliers, lower prices resulting from devaluation of Far East currencies can actually help to lower overall costs.

With regards to U.S. business, the economic problems occurring in the Far East will hurt U.S. exports to Western Europe, as competing Far East products will look less expensive (and more attractive) as a result of devalued currencies.

U.S. - EASTERN EUROPE TRADE

As mentioned in prior ICE *Status* reports, the collapse of communism in East Block countries has devastated the local demand for semiconductor devices. As a result, only a handful of semiconductor fabs exist today. These companies, being four to five technology generations behind the west, are unable to effectively support local OEM industry and mostly cater to specific military applications.

GDP growth rates for Eastern Europe were negative year to year until 1996, where a slight increase in GDP of 0.4 percent was observed. Growth rates for 1997 and 1998 should be 3.7 percent and 4 percent respectively. The market for semiconductor products in Eastern Europe was estimated to be \$700M in 1996. Of this \$700M, two-thirds was purchased from local manufacturers and one-third was acquired from imports. Although this figure includes 11 countries, from Russia to the Slovak Republic, the majority of purchases, >80 percent, were placed by Russian companies. Worldwide imports into this region have been growing 35 percent per year on average over the past 4 years.

Although GDP growth and import growth are higher than reported in other regions of the world, volumes are relatively low: fewer than one billion dollars in semiconductor sales. In order for the East European electronics market to come close to parity with the western world, this market will need to continue growing at a minimum of 30 percent per year for 15 to 20 years.

U.S. - TAIWAN TRADE

Although much of the Far East has been battling economic problems over the course of 1997, Taiwan does not face the same problems of overbuilding in real estate and bad debt that faces much of the region. GDP growth in Taiwan is estimated to be 6.6 percent for 1997 and forecasted at 6.4 percent in 1998.

The weakness of the Taiwanese economy is the high percentage of stock owned by individual investors. With the bulk of the stock market listings held by individual investors (>90 percent), consumer spending is often linked to stock market share prices. A steep fall in share prices can cause large negative changes in local spending and hence GDP.

Electronics accounts for more than 20 percent of Taiwan's total manufacturing. Semiconductor production and personal computers make up the larger part of this market. Hence, large changes in Taiwan's electronics business can have major impacts on the economy.

Twenty-four percent of all Taiwanese exports were sold to the U.S. The largest export segment (41 percent of all exports) is sold to the rest of Asia, excluding Japan.

Taiwan is considered one of the largest exporters of microelectronics into the U.S. In 1996 Taiwan was responsible for more than \$4.3B of microelectronics exports to the U.S., or 8.6 percent of all microelectronics exports into the U.S.

The economic woes of other Far East countries will soon come to bear on Taiwan. Although Taiwan touts a much more stable economy, because it heavily relies on trade, it will be hindered by increased competition from other Asian countries with lower currency values and labor costs.

Taiwan has recently announced plans to double its semiconductor capacity within the next six months. This will consequently add pressure to DRAM overcapacity problems in Korea. If Taiwan continues with its plans, it will create an even worse outlook for DRAM ASPs as companies and countries compete for business with already low DRAM prices.