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Semiconductors

A Defining Experience: The U.S.-Japan Crisis of the 1980s

Though an entire decade has passed and the industry and world competitive conditions have changed dramatically, semiconductor trade policy remains haunted by precedents, actions, and mistakes made during the period (1986 to 1991) of extreme conflict between the United States and Japan over semiconductors. From the origin of the industry to the 1980s, U.S. semiconductor firms dominated the market, though Japanese companies had appeared on the scene as real players by the late 1970s, as demand for semiconductors shifted away from U.S. government defense and space purchases toward consumer electronics and other commercial applications. In the mid-1980s, consumer electronics accounted for almost half of semiconductor demand in Japan, while data processing accounted for 44 percent of U.S. demand.

At the end of the 1970s, American firms accounted for 60 percent of the world market and the Japanese less than 30 percent. By 1985, both countries held world market shares of about 45 percent, with the Japanese moving to a position of leadership. Most Japanese inroads came in dynamic random access memory (DRAM) computer chips, the natural entrée point (as it would be later for Korea) because of the straightforward design technology compared to other semiconductor devices. In DRAMs, by the mid-1980s Japan had completely reversed positions with the United States, controlling 70 percent of the world market, a percentage held by the United States in the late 1970s (Flamm 1996; Irwin 1998).

The crisis was precipitated by a number of factors, including in the background a high U.S. dollar that greatly undermined U.S. export capacity and decreased fixed investment because of the high cost of capital. Then a substantial boom in the semiconductor market from 1983 to 1984 quickly turned into a deep industry recession in 1985, triggered largely by a slump in computer sales. The DRAM market contracted by 60 percent. Interestingly, the recession itself was the chief cause of the

grief that came to U.S. semiconductor manufacturers. Three quarters of the decline in revenue in the mid-1980s stemmed from declining overall demand; only one quarter came from lost market share.

This boom and bust cycle remains a defining characteristic of the semiconductor industry, with the main variation being that individual product life cycles have become ever shorter and price fluctuation ever wider over time. Typically, several years after a bust, demand once again swells suddenly, often unexpectedly, and DRAM manufacturers all scramble to increase capacity in order to maintain market share. In the end, a glut of chips has once again been produced—or there is a shift in demand to a more advanced or different technology. Then the market crashes again, accompanied by the cyclical dumping described above. Because inventory and technology become obsolete very quickly, semiconductor producers cannot simply sit out the down periods of the cycle—they must continue to produce and invest heavily in R&D even during a downturn in order to meet the increased demand for new technology when the cycle turns up again. Predictably, this subjects them to serious financial problems.

In 1985, irrespective of these economic realities, huge pressures rose for the U.S. government to counter Japanese "predatory practices." Though the semiconductor trade association never achieved consensus on antidumping actions, individual companies mounted suits against particular semiconductor chip technologies: In an unprecedented step, the Commerce Department self-initiated a case against Japanese makers of DRAMs. Commerce's preliminary determination found high dumping margins, and the USITC also quickly reached an affirmative decision of material injury against U.S. companies.

Japan capitulated in the summer of 1986 and on July 30 signed the infamous Semiconductor Trade Agreement (STA) with the United States in return for suspension of the dumping actions. Under the STA, Japan agreed to take steps to end alleged dumping into the U.S. market, and Japanese firms agreed to supply price and sales data on a monthly basis to the Commerce Department (Flamm 1996; Dick 1995; Lindsey 1992; Irwin 1996).

The Ministry of International Trade and Industry (MITI) actually had no statutory authority to force Japanese firms to reduce production, and initially it had trouble getting them to comply with its request, which included a target of 10 percent reduction over a short period. In April 1987, however, the United States strengthened MITI's hand when it

unleashed a stunning tariff retaliation (100 percent tariffs on Japanese electronics merchandise, including DRAMs). At that point, Japanese semiconductor firms fell into line and, in effect, MITI put together a government-led cartel. As the ultimate Japan basher of the time, Clyde Prestowitz, admitted, "For the free traders of the United States to be asking Japan to cartelize its industry was the supreme irony" (Prestowitz 1989, 167).

As with supercomputers and flat-panel displays, in this case the result of wielding the heavy-handed weapon of antidumping policy had both negative and unintended consequences. In the year after the STA, DRAM prices skyrocketed, and Japanese semiconductor companies went along for the ride because, as Prestowitz again stated, "The Japanese government force[d] its companies to make a profit" (Prestowitz 1989, 167).

Actually, they were already making a profit—what the STA did was to force them to make a "super profit." A Brookings Institution study estimated that extra profits on 1M DRAM sales for Japanese producers was $1.2 billion in 1988 alone and between $3 and $4 billion on all devices in 1989. This represented a direct transfer of money from U.S. consumers and U.S. companies dependent on semiconductor chips for their final products. Aware that the STA had instantly made them much less competitive against Japanese firms in the world market, the U.S. computer industry promptly established its own organization in order to counter the negative competitive effects of government policy (Flamm 1996).

The action also did not save American semiconductor companies, all of which left the DRAM market within a decade, with the exception of Micron Technology. What the U.S. action did accomplish, however, was to accelerate the entrance of Korean companies onto the world DRAM scene—as with Japanese companies, the supernormal profits that were obtainable in the years immediately after the U.S.-Japan agreement allowed Korean firms such as Hyundai, Samsung, and LG to reap unexpected returns and gain a foothold at the lower end of the semiconductor technology ladder. This was a very expensive way to increase world competition, however, and provide additional DRAM sources for U.S. computer companies (Yoon 1992; Irwin 1998).

Further, in terms of historical lessons, it is clear in retrospect that once again U.S. government officials, including the Pentagon, wholly misunderstood the technological trajectory of a high-tech industry. A Defense Science Board report in 1987 stated firmly that DRAMs were the key to future U.S. technology leadership—a central element of the "technology food chain," and that loss of the DRAM industry would cripple the ability

of U.S. firms to compete in all other high-tech electronic sectors (U.S. Department of Defense 1987). What the Defense Science Board and other policy entrepreneurs pushing industrial policy for the United States did not understand was that American companies had already discerned that DRAMs were becoming a high-volume, low-profit commodity and that the wave of the future for U.S. firms was in more advanced microprocessors and specialty chips, along with chip design rather than actual production.

Finally, the mantra of U.S. government officials, corporate leaders, and purveyors of gloom and doom about America's technological future during the entire period had been the necessity to dismantle "Japan, Inc." and with it MITI's alleged control of Japanese industries. But the STA had just the opposite effect: it allowed MITI officials, who actually had been losing control of Japanese multinationals, to reassert their authority. For it was MITI that divided the spoils by setting the production targets for individual companies, and it was MITI that monitored prices so that high rates of profit would be maintained. As Kenneth Flamm of the Brookings Institution (often a supporter of activist policies for semiconductors) subsequently stated:

> Contradictions between tactical compromises and strategic, long-run principles in U.S. trade policy ultimately [came] home to roost. Having failed to achieve function access to the Japanese market in the mid-1970s, after formal trade barriers were removed, the United States essentially decided to use the informal system of MITI guidance and government collaboration with an industrial inner circle to achieve an outcome that at least resembled what it thought real system reform might have accomplished. Paradoxically, this decision probably strengthened what had been waning MITI influence in the Japanese semiconductor industry. . . . Rather than supporting a system that would guarantee real competition in global markets for high-technology products, the United States [came] to wear the mantle of defender of the status quo. (Flamm 1996, 457–458)

Postscript

From 1990 to 1995, U.S. fortunes in the semiconductor sector reversed and worldwide, for all types of chips and microprocessors, U.S. firms regained parity with Japan and producers from other nations. Japan remained an important presence in DRAMs, but most observers take this lingering hold on a comparatively low-technology chip as a telling sign that—in contrast to the dire predictions of the mid-1980s—Japan has fallen far behind the United States in many segments of the high-tech end of electronics.

Still, old habits die hard. During the entire decade, one of the two surviving U.S. DRAM manufacturers, Micron, whose sales had jumped sixfold during the STA crisis, continued to attempt to use U.S. antidumping laws as a competitive tool, abetted as always by U.S. trade and commercial officials. In April 1992, Micron filed an antidumping suit against the new boys on the block, the Koreans—Hyundai Electronics, Samsung, and LG Semicon (LGS). The Department of Commerce (DOC) found small dumping margins, and a year later a deeply divided USITC declared that the domestic U.S. industry suffered material damage (U.S. International Trade Commission 1993).

Three years later, Samsung, the largest Korean DRAM manufacturer, won an appeal against the DOC's determination, resulting in its removal from the antidumping order (U.S. Department of Commerce 1995, 1996). This left the order standing only against Hyundai (which later in 1999 took over LGS). Subsequently, the Commerce Department's annual reviews of Hyundai's prices found no continuing evidence of dumping for three straight years; it still refused to lift the original 1993 dumping order (U.S. Department of Commerce 1999).

Micron continued its strategic use of antidumping laws by filing suit against Taiwanese DRAM producers in October 1998. Dutifully, Commerce found dumping margins of 8 to 69 percent, but then, in a surprising but economically sound decision, the USITC ruled that Micron and other U.S. producers were *not* being injured or even threatened with injury by Taiwanese imports (U.S. International Trade Commission 1999a). As a result of this decision, the only outstanding U.S. government antidumping action against foreign manufacturers in the semiconductor industry was the anomalous order still pending against Hyundai.

At the end of 1999, U.S. trade officials at the Commerce Department and the International Trade Commission began a "sunset review" of the antidumping order against Hyundai, under new rules negotiated during the Uruguay Round, which mandate that WTO members review all antidumping orders after they have been in place for five years. The aim of a sunset review is to determine whether revocation would lead to either continued dumping or injury to the U.S. industry. The broader review relates to material injury because the USITC will examine a number of factors such as the composition of the industry, effects on prices and volume of imports, likely production shifts, and a kind of catchall, the overall impact on American producers.

With respect to the antidumping duty order on DRAMs from Korea, the International Trade Commission never completed its sunset review analysis

because Micron essentially gave up in the middle of the proceeding. Just as the USITC was about to begin its final analysis, Micron submitted a letter to the Commerce Department stating that it no longer opposed termination of the antidumping duty order. As a result of Micron's letter, the Commerce Department found that no domestic party had an interest in continuing the antidumping duty order and therefore revoked it (U.S. Department of Commerce 2000).

Micron's decision to "sue for peace" before the USITC's analysis was not surprising. Any economic analysis of the competitive realities of the worldwide semiconductor industry in the late 1990s—whether conducted as a part of a sunset review or for *de novo* antidumping proceedings—would lead directly to the conclusion not only that this particular antidumping duty order was unwarranted, but also that the entire rationale behind antidumping actions for this industry is flawed and inevitably results in a reduction of world economic welfare. The following sections will explain why this is so.

Internationalization and Consolidation of the Semiconductor Industry

What a difference a decade makes. As we have seen, in the early 1990s, it was widely predicted that Japan would dominate the semiconductor market and that U.S. companies would permanently exit the sector—and no one paid much attention to upstarts like Korea or Taiwan. Today, Japanese companies are leaving DRAMs behind; one U.S. company, Micron, has become the world technology leader, and the Koreans, followed by the Taiwanese, have become major players.

In the semiconductor industry as a whole, American companies regained home market shares after the mid-1990s: In 1995, domestic company production was about 60 percent of the total U.S. semiconductor market, but by the end of the 1990s, this share had increased and stabilized at just over 70 percent. At the same time, Japan's share of the semiconductor market, both globally and in the United States, declined dramatically and was replaced by Korea in most markets. Japan's global market share fell from 46 percent in 1991 to 28 percent in 2001; by 2001, Japan's share of the U.S. market had dropped to 11 percent. Third-country producers (largely Korean and European) had increased world market share to over 20 percent by the late 1990s (Cooney 2003; Manyin, Cooney, and Grimmette 2003).

TABLE 1
MAJOR DRAM PRODUCERS IN THE MID-1990S

Country	DRAM Producers
United States	IBM, Motorola, Micron, Texas Instruments
Japan	NEC, Matsushita, Mitsubishi, Hitachi, Toshiba
Korea	Samsung, Hyundai, LG Semiconductor
Europe	Siemens, Phillips

DRAMs. As with the overall semiconductor industry, the recent history of DRAM producers has been characterized by consolidation and internationalization. The accompanying tables demonstrate the major changes within the industry over the past several years. Up until the mid-1990s, there were ten DRAM producers with more than 5 percent of world market share (Table 1).

By 2001, the top four DRAM manufacturers controlled 80 percent of the market.

In the United States, the driving force behind the consolidation was the decision of a number of high-end electronic companies to exit the commodity DRAM market in favor of manufacturing more sophisticated and flexible chips and integrated circuits. The consolidation began in 1998 when Micron bought out Texas Instruments' (TI's) semiconductor business. It continued over the next several years, with both IBM and Motorola deciding to get out of DRAM production. IBM sold its share in a joint venture with Toshiba (which in turn sold out to Micron), and Motorola sold its share in a joint venture to its partner, Infineon (Cooney 2003).

Boom and Bust. Outside of the United States, the 1997 Asian financial crisis and then the 2000–2001 "dot.com" crash and the ensuing worldwide economic slowdown drastically accelerated an industry shakeout in Asia. The 2000–2001 crash was the deepest in the history of the semiconductor industry, with worldwide sales falling one-third, or $66 billion. Capacity utilization dropped to 65 percent by the end of 2001, before rebounding to about 75 percent in 2002, largely as a result of plants being taken out of production (Cooney 2003). Japan's economy, which experienced four recessions during the 1990s, was a continual drag on Japanese semiconductor companies even before the onset of the 1997 crisis. With regard to the hitherto highly successful Korean firms, the combination of the crippling blows delivered by the financial crisis of

TABLE 2
WORLDWIDE DRAM MARKET SHARES, 1999, 2000, AND 2001

	1999	2000	2001
Micron	14.4%	18.9%	19.1%
Infineon	7.3%	8.5%	9.7%
Hynix	19.3%	17.2%	14.5%
Samsung	20.7%	21.1%	27.0%
All others	38.2%	34.4%	29.7%

Source: Dataquest 2002.

1997 and the "dot.com" bust just two years later forced a wholesale restructuring.

After the 1997 Asian crisis, strong growth and demand for DRAMs continued in the still burgeoning U.S. market, and producers worldwide hugely increased capacity and production. But if the run-up of demand and prices was swift, so was the crash. DRAM prices peaked in early 2000 at twelve to thirteen dollars per chip, but by the end of that year had fallen as low as ninety cents to one dollar per chip. Over the next eighteen months, virtually all DRAM manufacturers were producing chips at a substantial loss. Because of the technological/competitive imperatives described above, each individual company refrained from temporarily halting production or lowering prices, hoping that other companies with less economic strength would be forced to exit the market. By the end of 2001, the clear losers were Japanese producers, and just four major companies remained as major players in the global DRAM market (Table 2).

Samsung emerged as the worldwide leader in DRAM sales (27 percent), followed by Micron (19.1 percent), Hynix (14.5 percent), and Infineon (9.7 percent). Micron and the smaller Infineon seemed to have benefited most by the shakeout, gaining together about a 7 percent increase in worldwide sales. As noted below, Hynix was created in 1999 by the merger and spinoff of the DRAM plants of Hyundai and the LG Group in Korea. Infineon was a spinoff from Siemens in Europe and, though smaller than other producers, is attempting to build important alliances with Taiwanese firms such as Nanya, Winbond, and Promos Technologies. And as for Japan, it had now largely left the competition to others: Toshiba exited the DRAM market in 2000, and Hitachi and NEC had combined their operations in a new, much smaller spinoff company, Elpida, which is competing with Infineon for key Taiwanese alliances (Willkie Farr & Gallagher 2002; Manyin, Cooney, and Grimmett 2002). As

TABLE 3
U.S. DRAM MARKET SHARES, 1999, 2000, AND 2001

	1999	2000	2001
Micron	21.0%	27.0%	26.2%
Infineon	6.7%	7.4%	11.5%
Hynix	15.2%	13.6%	10.6%
Samsung	22.5%	23.7%	28.3%
All others	34.6%	28.4%	23.4%

Source: Dataquest 2002.
Note: Hynix and Samsung include non-subject U.S. production.

Table 3 shows, the U.S. market generally mirrored the world market, though in the U.S. market, Micron replaced Samsung as the leader in sales in 2000.

Finally, even with the dramatic shakeout, the DRAM industry remains a global one, with each major company supporting R&D and production facilities around the world. In the United States, for instance, all of the major competitors with Micron maintain important production plants: Samsung (Texas), Hynix (Oregon), and Infineon (Virginia). And in a true "world turned upside down" phenomenon, since 1999 KMT Semiconductor (Micron's joint venture with Kobe Steel) has become a leading DRAM producer in Japan. Table 4 lists the various facilities of the major DRAM producers around the world.

Micron. Over the past half decade, Micron's world has also changed dramatically, with important consequences for current and future U.S. antidumping policy toward semiconductors. Long called the "America First" DRAM maker and noted for its aggressive use of antidumping laws as a competitive tool, since the late 1990s Micron has been catapulted onto the world scene as a major player with the acquisition of TI's manufacturing plants in Italy, Japan, Scotland, and Singapore. This is a startling development for a company whose international operations as late as mid-1998 consisted of sixty workers in sales offices scattered around Asia and the United Kingdom. By 2002, more than 50 percent of Micron's DRAM production was outside of the United States (Industry Trade Reports 1997–2000).

At the present time, Micron, Infineon, and Samsung are in a heated contest for technological leadership. By the end of 2002, more than 50 percent of Micron's capacity in DRAM production was expected to come from

TABLE 4
LOCATION OF MAJOR DRAM PRODUCERS' MANUFACTURING FACILITIES, 2002

	Manufacturing Locations	Activity	Established	Ownership
Micron	Boise, Idaho, USA	Production	1981	Full
	Avezzano, Italy	Production	1998	Full
	Singapore, Singapore	Production	1998	JV[6] with Canon, Hewlett Packard, Singapore Gov.
	Singapore, Singapore	A&T[4]	1998	Full
	East Kilbride, Scotland	A&T	2000	Full
	Lehi, Utah, USA[5]	A&T	2000	Full
	Nishiwaki City, Japan	Production	2001	Full
	Manassas, Virginia, USA	Production	2002	Full
Infineon[1]	Malacca, Malaysia	A&T	n.a.	Full
	Hsinchu, Taiwan	Production	1997	JV with MoselVitelic
	Porto, Portugal	A&T	1998	Full
	Richmond, Virginia, USA	Production	1998	Full
	Dresden, Germany	Production	1999	JV with Motorola
	Corbeil, France	Production	1999	JV with IBM
	Taouyen, Taiwan	Production	Late 2003	JV (50:50) with Nanya
Hynix[2]	Ichon, Korea	Production	1983	Full
	Eugene, Oregon, USA	Production	1996	Full
	Cheongju, Korea	Production	1999	Full
	Kumi, Korea	Production	1999	
Samsung[3]	Kiheung, Korea	Production	1983	Full
	Onyang, Korea	A&T	1990	Full
	Austin, Texas, USA	Production	1998	JV, with Intel (Intel owns less than 10%)
	Hwasung, Kyunggi-do, Korea	Production	2000	Full
	Suzhou, China	A&T	To expand to DRAMs in 2003	Full

(1) Source: Infineon Technology 2002.
(2) Source: Mr. S. W. Kim, swkim@hsma.us.hynix.com, (541)338-5000, Strategic Planning Manager, Eugene, Oregon, USA.
(3) Source: Samsung Electronics 2002.
(4) A&T = Assembly and Testing
(5) The facility at Lehi, Utah, will be converted into a manufacturing facility "when it makes sense to do so according to prevailing market conditions" Source: Mr. Sean Mahoney, smahoney@micron.com, (208) 368-3127, Media Relations, Boise, Idaho, USA.
(6) JV = Joint Venture

advanced .13-micron technology, while Infineon has made 100 percent conversion of chipmaking to .14-micron technology. Since the TI acquisition, Micron has moved aggressively to retool all of its newly acquired plants with the latest advances in chip-making (Willkie Farr & Gallagher 2002; Manyin, Cooney, and Grimmett 2003).

Second, industry experts point out that as a bonus from the TI acquisition, Micron mastered one lesson of international competition without even trying. TI had done the necessary homework for placing plants strategically—near its customers—around the world. In Singapore, for instance, Hewlett-Packard and Dell build PCs using Micron chips; and the Micron plant in Scotland is a forty-minute drive from Compaq, Hewlett-Packard, and Sun Microsystems plants.

Policy Lessons

If Micron's transition from a national to a multinational company is the stuff of business school casebooks, it also presents fascinating challenges to the company in the public policy arena and the question—in the words of Jack Robertson, one of the keenest reporters observing the industry—of whether the company might "soften its feisty stand on some international issues" (Robertson 1998, 4).

Taiwan's 1998 actions on antidumping issues are a good case in point on this question. After Micron filed an antidumping claim against Taiwanese companies in that year, the Taiwanese responded almost immediately with a counterclaim that Micron was dumping in Taiwan's market. Later, after the United States found that Taiwanese companies were not injuring the U.S. semiconductor industry, the Taiwanese government reversed a preliminary decision of guilt and dropped the case. It was clear that Taiwan was now quite prepared to play the antidumping card against U.S. companies in response to actions against its own companies. (In 2003, with even greater protection against U.S counter-retaliation afforded by its new membership in the WTO, it is likely that Taiwan will become even more aggressive in wielding the antidumping weapon.)

As noted earlier, the spread of antidumping actions around the world—targeting the United States and Europe particularly—is coming back to haunt U.S. companies that repeatedly used the U.S. trade remedy laws as tools to beat back more efficient competitors. Though Micron escaped an adverse action, in recent years other major U.S. companies

(Dow Chemical, Exxon, 3M, International Paper, USX, Frigidaire, Union Carbide, Whirlpool, Bristol-Myers, and Squibb, just to name a few) have felt the sting (and lost sales) from antidumping actions in foreign markets (Lindsey and Ikenson 2001).

Second, given the global nature of the semiconductor industry at this point—manufacturing facilities for each of the major DRAM producers dotted around the world—it is preposterous to argue that the conditions that produce dumping are likely or even possible (that is, the existence of a protected sanctuary market from which producers can export at below-cost prices, while making up the difference at home). Samsung, Hynix, and Infineon all produce DRAMs in the United States, thus precluding monopoly pricing and export dumping by Micron. Conversely, why would any of the foreign producers "dump" in the U.S. market, thereby undercutting the competitiveness of its own U.S. plant?

The third lesson stems from quite recent events. Leading U.S. firms in sectors such as steel and semiconductors have "cried wolf" so often in trying to get the U.S. government to invoke trade remedy laws in their defense that when a potentially legitimate complaint arises, they face major credibility problems. Such is the case in the unfolding dispute over a series of rescue packages over the past two years that have kept the Korean semiconductor company Hynix in business by continually allowing it to restructure its debt of $6.5 billion.

Hynix: A Legitimate Use of Countervailing Duties Against Subsidies? The issues concern the degree to which the Korean government was involved in these rescues and whether this involvement constituted a violation of WTO subsidy rules. Behind these public policy questions lies a private market puzzle of whether Hynix faces such intractable structural deficiencies that it will not survive in world competition.

Hynix was created in 1999 by the merger of a Hyundai spinoff (also named Hynix) with the DRAM components of the LG Semiconductor company. In sealing the merger, Hynix took on over $4 billion in debt from the LG Semiconductor company, in addition to its own inherited debt from Hyundai. As a result of this outsized debt (and the fact that Hyundai stripped the new company of substantial cash reserves), Hynix was particularly vulnerable to the crash that occurred in the worldwide DRAM market in late 2000 (Manyin, Cooney, and Grimmett 2003).

Even before the bottom fell out, Hynix had benefited from a government-led assistance package for its parent company, Hyundai. In January 2000,

the state-owned Korea Development Bank organized a $1 billion aid plan for several of the Korean *chaebol* (conglomerates) that were about to default on their debts; and Hynix was the beneficiary of some of this direct state intervention. Subsequently, Hynix creditor Korean banks—with small contributions by non-Korean financial institutions such as Citibank and Commerzbank, which also hold debt from the company—have constructed three separate "assistance packages." These restructuring actions, which occurred in May and October 2001 and again in December 2002, included some new funds but largely consisted of deals to roll over existing debt or repackage it with debt for equity swaps. As a result of the latest December 2002 bailout, Hynix debts have been rescheduled to come due in 2006, and creditors now own two-thirds of the company (*Financial Times [FT]* December 9, 13, 31, 2002; Interview, James P. Durling, in Willkie Farr & Gallagher 2002; Manyin, Cooney, and Grimmett 2003).

In addition, matters had been further complicated in the spring of 2002 when negotiations began for Micron to take over the Hynix DRAM business. Under a deal announced in April, Micron would acquire this business for $3.4 billion in cash and Micron stock transfers. The offer garnered the support of the Korean government and Hynix's creditors, but Hynix's board of directors vetoed the plan at the last moment, arguing that the sale price amounted to a fire sale and a recent increase in world chip prices would give Hynix the means of surviving alone. Subsequently, Micron stated it no longer had any interest in acquiring Hynix or any of its individual pieces (Interview, James P. Durling, in Willkie Farr & Gallagher 2002; *FT* December 9 and 13, 2002).

From the time of the first government-led bailout in January 2000, Micron and the U.S. government, as well as Infineon and the EU, have strongly protested that such rescue packages violate WTO subsidy rules and constitute unfair trade practices under both U.S. and EU law. In June 2002, Infineon filed a countervailing duty case against Hynix (and Samsung, for good measure) with the EU. In November 2002, at the behest of Micron a similar suit was filed against both companies in the United States. The United States and the EU are also taking steps to file a WTO complaint, arguing that the bailouts violate the WTO Agreement on Subsidies and Countervailing Measures (SCM) (Manyin, Cooney, and Grimmett 2003; *FT* December 31, 2002).

Defenders of Hynix point out that the initial January 2000 government intervention was not directed solely at DRAM producers but more generally

at the entire Korean manufacturing sector, and the bond refinancing was at then-market rates. The Korean government avers that it did not pressure the banks to bail out the company in the subsequent rollovers and cash infusions. It also points out that foreign banks such as Citibank and Commerzbank supported the 2001–2002 rescue efforts—and that some Korean banks refused to participate in the bailouts. In order to avoid further exposure, they simply wrote off their loans and accepted 75 percent losses (Durling 2002).

Against this defense, critics (both governments and private sector competitors) claim it was no coincidence the consortia that organized the package were composed of "private" banks either owned outright or controlled by the Korean government, as a result of nationalization during the Asian financial crisis (90 percent of the new loans given to Hynix came from banks in which the government was the largest stockholder). Looking at the broader context of the Korean economy's operation, critics point out that for decades, Korean banks have operated as financial arms of the government, with credit allocation based not upon risk assessment but upon political connections. In an interview with the *Financial Times* after the announcement of the most recent bailout, Steve Appleton, chairman and CEO of Micron, charged that "since 1998, Hynix has received $11 billion in various forms of subsidies. It's like the movie, *Groundhog Day.* Every day, we are competing against a company that is subsidized by a government. We can compete against any company in the world but not against governments. Market principles should come into play" (*FT* December 13, 2002; see also *FT* December 9, 2002; Manyin, Cooney, and Grimmett 2002).

Ironically, whatever the legal and political outcome of the various cases, the market and technological imperatives may ultimately dictate the final outcome in this instance. As outside observers have noted, the realities of the DRAM business cycle may finally defeat Hynix. Over the past two years, its financial problems have prevented key investment in the technological improvements and upgraded equipment it must employ in order to compete in the next upturn in demand and prices. According to most estimates, Hynix's investments in upgrading and new technology amount to less than one-quarter of that plowed back by Samsung and Micron. Thus, at some point over the next few years, Hynix could well be back on the auction block, forcing another test of the Korean government's nonintervention resolve.