6.6. The U.S. Resurgence in the 1990s

American responses to Japanese challenges

- Domino effects into the overall SC industry?
  - DRAM
  - microprocessors
  - ASICs

The Semiconductor Trade Agreement 1986

- Section 301 complaint in 1985
  - the year when Intel quit the DRAM market
  - restrictive domestic market
- Anti-dumping complaints
  - Micron (DRAM)
  - Intel, National Semiconductors… (EPROMs)

- Dumping?
  - 'predatory pricing'
  - 'forward pricing'

"In the case of semiconductors, the problem is compounded by the fact that, because of the learning-curve effects, pricing below cost – so-called forward pricing – is in fact the appropriate and desirable policy … Moreover, this was a policy pioneered in semiconductors not by the Japanese but by Texas Instruments, which used it to good advantage in the 1960s and 1970s" (Langlois and Steinmueller 1999: 59)

The Semiconductor Trade Agreement 1986

- Hitachi, NEC cutting back productions and raising prices
- STA signed in 1986
  - FMVs (foreign-market values) for each Japanese firms: a price floor
  - a 'secret' letter guaranteeing a 20% Japanese market share of American firms
- Windfall gains to Japanese DRAM producers for a while
  - "bubble profits" at $3-4 billion

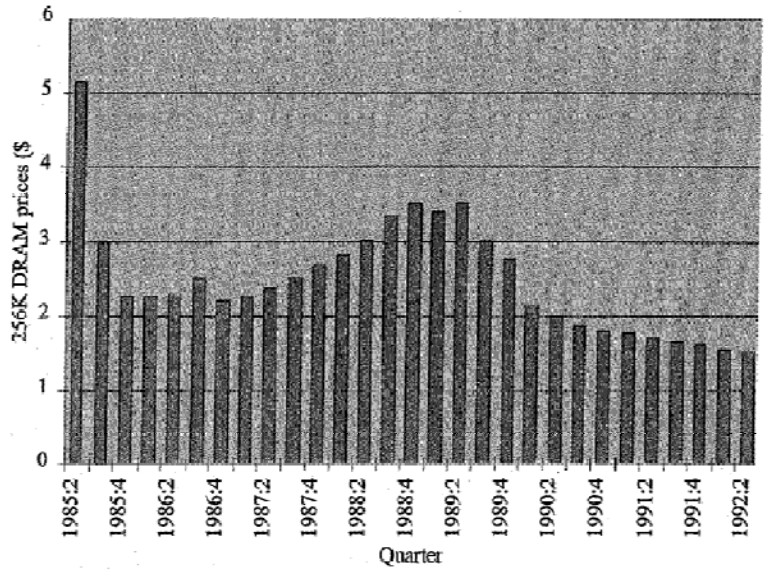

Figure 2.1. Average Selling Prices for 256K DRAMs. *Source*: Dataquest, cited in Tyson (1992, p 115)

Unintended consequences of STA

- A breathing space for Korean and Taiwanese manufacturers

"By stabilizing DRAM prices and making that market so profitable, the cartel arrangement kept Japanese firms heavily invested in what was to become a low-margin commodity item. When the high prices attracted entry from Korea and Taiwan, prices and profits began to fall, and the cartel collapsed" (Langlois and Steinmueller 1999: 62)

Unintended consequences of STA

- Serving high-margin strategy of American firms

"By contrast, American firms like Intel were arguably well served in the medium term by their failure in DRAMs, a failure that left them free to pursue high-margin logic and specialty chips that would be in high demand in the burgeoning American personal computer market (Langlois and Steinmueller 1999: 62)

Restructuring driven by the financial market

(1) wave of corporate restructuring towards lean management

(2) M&As

(3) A dramatic comeback in some industries

eg. steel, DRAM

(4) taking leads in new areas like the Internet and biotechnology

Restructuring through globalisation

(1) 'Wintelism'

- power shift from the final assemblers to the standard setters
- broader use of 'outsourcing'

IBM $\rightarrow$ Windows + Intel

(2) global production network

- decoupling

Specialization

- Quitting from DRAMs
- Focusing on higher-value items
  - microprocessors
  - ASICs (design)
- Revival of Micron Technologies

Microprocessor

- Faster growth of the microprocessor segment
  - due to faster growth of the computer industry
  - the share of computer applications
    40% (1989) → 52% (1994)
  - consumer and automotive applications
    28% (1989) → 23% (1994)
- Dominating the segment
  Americans 66%, Japanese 29% in 1994
  → the case of Intel

Table 2.11. *Worldwide Merchant Market Product Segments (Percentage)*

	1988	1994
MOS Memory	29	35
MPU and related	17	26
MOS Logic	23	20
Bipolar Logic	11	3
Analog	18	16
Other	2	<1

Source: Integrated Circuit Engineering Corporation (1989, 1995)

Decoupling

- Separation between design and production
  - fabless semiconductor firms

    cf. The Fabless Semiconductor Association in 1994

    [Chip start-ups can] “jump on a freight train moving 150 miles an hour” (51)
- Taiwan leading establishing ‘silicon foundries’

Manufacturing improvements

- A rapid catching-up game in CMOS technologies
  - competing with Japanese in ASICs head to head
- Increasing expenditure on quality control
  - still some gaps due to smaller scales of fabs

Intel

- Giving in to the Japanese competition in DRAMs

  cf. HP's evaluation in 1980

  - comparing quality of 16K DRAMs from 3 American and 3 Japanese manufacturers

  "The parts that cam from the very best American firm showed six times as many errors as those from the worst Japanese firm" (Jackson 1997: 247)

Intel

- DRAM, the industry's technology driver
  - cells have same structure
    → easier to experiment with new designs than more complex chips
  - mass produced item
    → manufacturing improvements from volume production process

- Quitting from DRAMs

  "Gordon Moore and I were discussing the quandary … I turned back to Gordon and asked, 'if we got kicked out and the board brought in a new CEO, what do you think he would do?' Gordon answered without hesitation, 'He would get us out of memories', I stared at him, numb, then said, 'Why should'nt you and I walk out the door, come back and do it ourselves?" (Andy Grove, quoted in Jackson 1997: 253)

Strengthening competitive edge in microprocessors

(1) Legal battle for copyrights

- extension of copyright law to cover S/W in 1980
- lobbying for 'copyrighting entire design of mask' from 1981

→ the Semiconductor Protection Act 1984

- Protecting 'microcode'
  - NEC buying a license to Intel's 8086 and 8088, and launching improved version in Japan in 1984 (V series)
  - unprecedented lawsuit regarding 'microcode'
  - final verdict

  "… microcode is copyrightable but Intel losing its claim against NEC"

  → competitors have to devise their own microcodes in 'clean room' environments

- Beefing up the legal department

" … anything that kept competitors away from its market just for a while could have a disproportionately positive effect on Intel's bottom line. Give [Andy] Grove the choice between investing money and time to shave 10 percent off the manufacturing cost of a microprocessor and investing the same money and time in keeping a competitor out of the market for a year who would otherwise have built a 10 percent market share, and there was no contest. The fight to protect Intel's intellectual property would take priority every time" (Jackson 1997: 282)

Strengthening competitive edge in microprocessors

(2) Removing second-sourcing agreements with AMD

- Going for a monopolistic position

- Change in profitability after ending the second-sourcing agreement

- a standard 8-bit processor $4.06

	cost	price	profit rate
286	$34	$250	86%
386	$141	$900	84%

Strengthening competitive edge in microprocesors

(3) Accelerating the pace of generational changes of microprocessors

- the power shift in the computer industry
- establishing itself as a major 'standard setter' in the industry
- time taken for hitting 25% market share
  - 4 ½ years for 386
  - 3 ½ years for 486
  - 1 ½ year for Pentium

Strengthening competitive edge in microprocesors

(4) Partnership marketing campaign

- Intel Inside
- “marketing development fund”
  : providing computer manufacturers with 3% of spending on microprocessors
- maintaining and strengthening its brand name
- possible because its position as a monopolistic technology & market leader

Strengthening competitive edge in microprocesors

(5) Winning the standards war

- RISC (Power PC camp: reduced instructrion-set computing) vs. CISC (complex instruction-set computing)
- IBM, Motorola, Apple …
- similar to the case of QWERTY, VHS vs. Beta …

- Danger as a leading standard setter

"… Intel was a prisoner of its history and its customers. Making sure that its new products were as compatible as possible with its current range was always a high priority with the company – and this backward compatibility made it well-nigh impossible for Intel to build RISC machine … [However] if a switch [to RISC] began to take place, Intel's hold on the market - and its ability to charge hundreds of dollars for processors that cost only ten or twenty bucks to make – would be jeopardy" (Jackson 1997: 302-4)

- RISC

- promise: 60% better performance than Pentium
- series of bug
- eventually, only 15% performance improvement when it was introduced in the market in 1995

- Great manufacturing improvements with CISC
  - reducing the gate length to 0.35 microns
  - reducing the size and increasing the speed of chips

- Pentium-Pro
  - a rapid introduction of an improved version
  - faster than RISC chips

  “The launch of the Pentium Pro signed the commercial death warrant of RISC technology in the mainstream PC market” (Jackson 1997: 370)
- A victory of improvement along a technological trajectory over an introduction of a new trajectory

Changes in the US NIS

(1) Increase in industrial R&D

- decline in basic research and federal R&D

(2) Increase in collaborative R&D

- more than 450 bw 1985-1994
- increase in international collaborative R&D

→ joint development, manufacture, or marketing of products

* The weakening of antitrust law

① facilitating mega mergers

② easy acquisition of startups by large firms

③ National Cooperative Research Act of 1984

- reducing anti-trust penalties for collaboration among firms in pre-commercial research

→ collaborative R&Ds like SEMATECH

(3) Increased outsourcing of R&D to universities

- universities' share of total R&D performance: 7.4% (1960) → 16% (1995)

(4) Strengthening technology transfer mechanism

① Bayh-Dole Act of 1980: permitting federally funded researchers to file for patents on the results

→ considerable growth in university patent licensing and technology transfer offices (in 240 universities)

② Establishment of NTTC (National Technology Transfer Centre) in 1990

→ free gate way service on TT, training, patent consulting...

③ technology transfer office in federal research institute

Federal Technology Transfer Act of 1986 and amendment of 1989 authorized federal laboratories to conduct cooperative research and development agreement (CRADAs) with private firms

④ regearing defense related R&D

→ promoting 'dual-use' technologies

→ "expanded the federal role in supporting civilian technology development" (Mowery 1998: 643)

(5) Pioneering deregulations

eg. deregulation in telecommunication industries

"The result was the entry of numerous providers of specialized and value-added services, which created fertile terrain for the rapid growth of companies supplying hardware, software, and services in computer networking. This trend benefited the U.S. computer industry, the U.S. semiconductor industry, and the domestic users (both manufacturing and nonmanufacturing companies) ..." → diffusion of IT

(6) Opening markets abroad

- offensive trade policy

e.g. Section 301 complaint, STA

(7) implementing property rights globally

".. at least 14 Congressional bills passed during the 1980s focused on strengthening domestic and international protection of intellectual property rights

eg. the Semiconductor Chip Protection Act of 1984

(8) promotion of nascent industries

e.g. Information Super Highway, E-Commerce …

① permitting the patenting, sometimes on fairly shaky ground, of a host of business processes, so that no self-respecting e-commerce firm is now without its in-house patent lawyer

② imposing a moratorium on new taxes on anything bought over the web. (*Economist*, 26 Feb. 2000)

"America has a sophisticated industrial policy for the uptake of IT; so should the developing countries." (Jeffery Sachs, "A Map of the World" in *The Economist,* 22 June 2000)