

The Development of the Japanese Computer Industry¹

Japanese researchers at the University of Tokyo, the **Electrotechnical** Laboratory (run by **MITI** after 1952), **NEC**, **Fujitsu**, **NTT** and elsewhere resumed pre-war work on computing machines in the late 1940s and early 1950s. The computers they developed were generally small, low-cost, and technically well-behind the better financed efforts in the west. In 1955, a **MITI-sponsored** committee recommended that the computer sector be given more financial support, be protected by limiting imports, and be assisted in the acquisition of foreign technology. The first test came the following year.

In 1956, IBM requested **MITI's** permission to create a wholly owned manufacturing subsidiary (it already had a sales subsidiary) in Japan with the right to return royalty payments and profits to its parent company. Permission was denied. A settlement was not reached until 1960, when IBM was allowed to establish its desired subsidiary and to repatriate 10 percent royalties back to its parent in return for licensing its patents to all interested Japanese companies for a 5-year period at a single reduced rate--5 percent on computer systems, and 1 percent on parts, among other concessions. **MITI** negotiated these licensing rights on behalf of the individual companies to prevent competitive bidding-up of the royalties and to prevent the establishment of a domestic monopoly.

Even with the 1960 settlement, IBM-Japan operations were closely controlled by the government on the grounds that it might hurt domestic industry. IBM-Japan was not allowed to begin production until 1963; its 1964 request to produce the 360 series was delayed for a full year--until after **Fujitsu** and **NEC** had introduced their own "family series"; its importation of critical parts which could not be produced locally was slowed; and the entry of capital that it needed to build facilities was restricted.

Beginning during this same period, the Japanese Government began an extraordinary series of initiatives to enable Japanese firms to become world class competitors in computer technologies and markets.

First, the Japanese Government provided domestic firms direct financial support. Subsidies and tax breaks totaled about \$130 million and loans totaled more than \$400 million during the 1960s. Together, this was nearly twice what domestic firms themselves invested in R&D,

plant, and equipment for commercial computer development.

That funding was often not used at the firms' discretion. Much of it went to **specific** investments that government, business, and university researchers agreed would contribute most to technical progress and production efficiency. Support was also **targeted** towards specific firms to develop certain classes of computers (**Fujitsu**, **NEC**, and **Hitachi**) and particular pieces of peripheral equipment (**Oki**, **Mitsubishi**, and **Toshiba**). This divided the market and improved the scale economies for the firms in each segment. Firms chosen by the government to lead the effort in **specific** segments varied over time on the basis of competitive proposals and past performance. For example, **Hitachi** was chosen to lead the 1966 Super High-Performance Computer Project--intended to develop a domestic counter to IBM's 360 Series--on the basis of its design proposal.

The government-backed Japan Electronic Computer Co. (**JECC**) was another important source of direct support. Most of its directors were former **MITI** or Japan Development Bank **officials**; and it was financed with low-interest loans either directly through the Japan Development **Bank**, or through a **MITI-organized** private financing cooperative with the loans guaranteed by the **JDB**. As of 1978, the **JECC** was the 20th largest firm in Japan in terms of capital; yet had no sales division, did not advertise, had just 120 employees, and averaged annual profits of less than 0.1 percent of rental assets.

The **JECC** (est. 1961) purchased computers at relatively high fixed values to prevent price competition and provide producers reasonable profits; and then rented them to users at values designed to undercut IBM. This gave computer makers their cash up front, and shifted much of the financial burden from the computer firms to the **JECC**. While 15 companies had licensed IBM's basic patents, only the top seven firms were allowed to enter **JECC** in order to prevent excessive competition such as "redundant investment and cut-throat pricing." The top three--**Fujitsu**, **Hitachi**, and **NEC**--were given preferential treatment. Following the establishment of the **JECC**, Japanese companies share of the domestic market jumped from 18 percent in 1961, to 33 percent in 1962,

¹Principal sources include: Marie **Anchordoguy**, "The State and the Market: Industrial Policy Towards Japan's Computer Industry," draft, 1986 and *Computers, Inc.* (Cambridge, MA: Harvard University Press, 1989); Jonah D. **Levy** and Richard J. **Samuels**, "Institutions and Innovation: Research Collaboration As Technology Strategy in Japan," MITJSTP 89-02, Massachusetts Institute of Technology, 1989; **Kenneth Flamm**, *Targeting the Computer: Government Support and International Competition, Creating the Computer: Government, Industry, and High Technology* (Washington, DC: Brookings Institution, 1988); **Robert Sobel**, *IBM vs. Japan: The Struggle for the Future* (Briarcliff Manor, NY: Stein & Day Publishers, 1986); Charles H. **Ferguson**, "Technological Development, Strategic Behavior, and Government Policy in Information Technology Industries," PhD. Thesis, Massachusetts Institute of Technology; **Ira C. Magaziner** and Thomas M. Hout, "Japanese Industrial Policy," Report #585 (London, England: Policy Studies Institute, 1980); "A Worldwide Strategy for the Computer Market," *Business Week*, Dec. 14, 1981; John **Markoff**, "Fujitsu Will Pay \$833.3 Million to IBM To Settle Software Fight," *New York Times*, Nov. 30, 1988.

to 52 percent in 1965 despite the technical inferiority of their computers.

The **JECC** only bought the specific machines that users ordered for rent and, further, required computer makers to buy back at book value any computers that users wished to trade in after the minimum 15 months. This forced the producers to compete for customers through continuously developing better computers. At the same time, domestic content requirements were only slowly increased. When these **buybacks** became excessive for computer companies, however, the government accelerated depreciation, further lowered the interest rate charged **JECC**, and allowed these companies to put money for trade-ins into tax-free reserves. By 1972, for example, some 60 percent of the cost of a computer could be depreciated in the first year.

Firms began developing their own rental systems in the early **1970s** to circumvent (undercut) **JECC's** price cartel and thus gain market share. Hitachi, for example, put some \$180 million into its rental system in 1973 alone, using profits from its consumer electronics division.

Second, the government organized cooperative R&D beginning in 1962. Cooperative R&D reduced the financial burden on individual firms, promoted the diffusion of critical technologies, and increased competition by preventing any one firm from gaining control of critical technologies. Many projects, including the first—the **FONTAC** project—fell far short of their goals. With each project, however, more was learned about managing such cooperative ventures, the R&D was done at a lower cost than if firms had each done it individually, and, with experience, better computers were developed. Projects which maintained a strong competitive environment between firms were generally more successful than those which placed all bets on a single horse.

The Japan Software Co., for example, was established in 1966 as a joint venture between Hitachi, **NEC**, Fujitsu and the Industrial Bank of Japan. It was intended to develop the software needed for the **MITI-organized** effort involving all of the Japanese computer firms to match the IBM 360 computer. It failed. The company presumed it had an assured market and made little effort to build up outside customers. Software technology is complex and abstract and realistic goals were difficult to formulate. The company was left with little direction. In addition, software technology changed rapidly and became increasingly important in overall system cost, increasing the desire of firms to keep software development within their own company rather than contracting for it outside. The presence of the Japan Software Co. also discouraged other firms from entering the software market. When the project ended in 1972, its orders dropped precipitously leading to bankruptcy and dissolution in December 1972.

Third, the government allowed firms to establish agreements with foreign partners for technological cooperation, while at the same time denying foreign firms (with the exception of IBM) direct entry into their market. Other firms had less market power and fewer patents to trade upon and were thus generally unable to get terms even as favorable as **IBM's**—**IBM** was the only computer firm to get a wholly owned subsidiary during the 1960s. Sperry Rand, for example, was able to enter the Japanese market only by accepting a minority interest in a joint venture with **Oki Electric**. Between 1961 and 1964, Hitachi, Mitsubishi, **NEC**, **Oki**, and Toshiba formed agreements with RCA, TRW, Honeywell, **Sperry Rand**, and GE respectively. This dependence on U.S. firms caused considerable turmoil in the **1970s** when firms such as RCA and GE abandoned their computer businesses.

Fourth, the government increased protection for the domestic computer industry. Tariffs on imported computers were raised from 15 percent to 25 percent in June 1960 and tariffs on computer peripherals were raised to 25 percent when the government decided to enter that market in the late 1960s. The tariffs on computers were lowered in 1964 when Japan entered **GATT** and the OECD. Quotas also limited imports, and were not ended until the early **1970s**. As already noted, IBM's production in Japan was similarly limited. Foreign firms, IBM in particular, were also excluded from certain data-processing markets which developed in the late 1960s by changing various laws that had restricted **NTT's** entry. This allowed **NTT** to begin a cooperative research project in 1968 to develop a large, high performance computer for on-line data processing and to subsequently provide these services and dominate this market. **NTT** has also been a major source of R&D funding as well as a major market for computer firms.

Fifth, government control over computer imports gave it strong leverage over firms applying for import licenses to instead buy a Japanese made-computer. These efforts were effective. Purchases of foreign computers (including those made in Japan) were reduced from 93 percent in 1958 to 43 percent in 1969 despite the technological inferiority of Japanese-made machines.

This "Buy Japan" policy did cause inefficiency and hardship, particularly in the 1960s when production was just getting underway and the technological gap was the largest. Firms objected to this pressure from **MITI** to buy domestic computers, usually unsuccessfully. The **government** allowed, however, the import of some foreign computers to prevent excessive damage to critical sectors and to push firms to do better by showing them the level of technology needed to compete in world markets.

Sixth, government procurement played an important role in Japan just as it had in the United States. In the

1960s, the Japanese Government purchased or rented 25 percent of all domestic computers.

These efforts helped. The U.S. hardware advantage was reduced **from** some 10 years in the mid-1960s to perhaps 4 years by the early **1970s**. The Japanese share of their domestic market increased to some 60 percent by 1970. The introduction of the IBM 370 in the early **1970s**, reduced the Japanese share of their domestic market to 48 percent in 1974. RCA, GE, and others **left** the market at this time due to the heavy investment that would have been required to remain even somewhat competitive with IBM.

Japanese producers might have left the market as well had it not been for government protection and support. Indeed, IBM had enormous advantages in the scale of its operations. In the late 1960s, the top three Japanese computer firms each manufactured about 2 percent of the number of computers made by IBM for any given type. At the same time, their currency was revalued, they were under increasing pressure from the United States to open their markets, and oil prices were crippling their heavy industries.

In response to IBM's 370 Series, the government organized the firms into three groups: Fujitsu and Hitachi focused on large computers; **NEC** and Toshiba on small and **midlevel** machines; and Mitsubishi and Oki on specialized scientific and industrial machines. From 1970-75, more than \$600 million in subsidies, including tax breaks, and over \$1 billion in low-interest loans helped these firms make the investments needed to compete with IBM. Indeed, these subsidies and loans totaled nearly 1.7 times what the firms themselves invested in R&D plant and equipment.

Similarly, the computer firms would have had to massively increase their debt in order to finance their computer sales directly rather than through the **JECC**. Fujitsu, for example, would have had to more than double its long-term loans during the 1960s, and then nearly triple them again in the **1970s**—**pushing** its debt-equity ratio to 21—in order to provide this financing itself.

A *major* opportunity also arose when a former top designer for IBM spun off a startup firm in 1970 to produce IBM compatible **mainframes**. Unable to secure sufficient funding, he turned to Fujitsu for help in 1972

and received \$54 million between 1972-76 in exchange for technical information. In 1974, Fujitsu announced it would produce computers in Japan for this company, **Amdahl**, to market in the United States. **Amdahl** is now 49 percent owned by Fujitsu and sells over \$1 billion of IBM-370 compatible mainframes annually.

The intensive internal effort and external technology acquisitions helped Japanese manufacturers produce computers competitive with the 370 series within 3 to 4 years of IBM's offering. When these machines became available beginning in the mid-1970s, Japanese users quickly began trading in their IBM systems for those of domestic producers. The number of IBM systems rented out actually declined for some models while the comparable Japanese offerings showed increasing usage.

The role of the Japanese Government continued to be important even after the market was officially opened in 1975. Direct subsidies totaled some \$1 billion between **1976-81**—**equal** to a quarter of private-sector investment in R&D, plant, and equipment. If low-interest loans are included, government support nearly equaled private sector investment during this period.

The Japanese computer firms have grown enormously in strength. They offer IBM compatible equipment that is **often** as good, sometimes even better, than IBM itself, and they are willing to drastically cut prices to capture market share. Hitachi, for example, has offered central banks, government agencies, and others discounts of 50 to 60 percent below **IBM** prices in order to win customers. These tactics have worked. Between 1975-85, Japanese computer exports increased 35 times, while imports only doubled.

World reliance on IBM-compatible hardware and software continues *to be* a serious weakness for Japanese **firms**—**one** which they have sometimes gone to great lengths to circumvent. In 1982, for example, an FBI sting operation caught Hitachi and Mitsubishi stealing IBM technology. Recently, Fujitsu was required to pay IBM nearly \$1 billion for its ongoing unauthorized use of IBM software. These and other incidents have led to Japan's current Fifth Generation, Supercomputer, and other projects which include the goal of ending their dependence on IBM-compatible software.