International Trade in Electronics: U.S.–Japan Competition

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Since World War II the United States has been the acknowledged world leader in electronics development. Despite stiff competition from Japan and Western Europe and shifts in the manufacturing of labor-intensive electronics products to less developed countries, the United States has maintained a favorable overall balance of trade in electronics. In the category of consumer electronics, however, the United States in recent years has experienced a substantial trade deficit and last year imports exceeded exports by some $3.3 billion (Table 1). Some observers also foresee erosion of the U.S. position in high-technology electronics exports, notably computers, an area in which American industry has been dominant.

Department of Commerce estimated figures for 1976 show that the trade balance for electronics declined from $2.2 billion in 1975 to $916 million last year.* The surge in the import of consumer products—particularly color television sets and citizens band radios (CB's)—accounted mainly for the reduction in the balance.

The major challenge to the electronics industry has come from the Japanese (*1*), and the most conspicuous penetration of the American market by Japanese manufacturers in the 1970's has been with color television sets. In an 18-month period beginning in 1975 the percentage of the American market held by Japanese manufacturers of color television receivers rose from 15 percent to about 40 percent. This had led to a series of actions by U.S. manufacturers and unions seeking relief under trade laws against Japanese exports. These actions are regarded as having serious implications because they come at a time when economic relations between Japan and the United States are at a particularly sensitive stage. Trends in electronics trade have also caused alarm because they appear to raise questions about U.S. competitiveness in world trade.

The size and diversity of the U.S. electronics industry—the Department of Commerce figures indicate the major categories—make it difficult to generalize about the industry as a whole. The statistical picture is complicated also by ownership of overseas manufacturing facilities by American companies and by the licensing and sale of U.S. technology, the proceeds from which are not clearly reflected in the Department of Commerce figures.

Nevertheless, it is possible to trace an evolutionary pattern in international trade in electronics. U.S. industry came out of World War II with the momentum imparted by wartime development of radar and sophisticated weapons and communications equipment. Continued heavy government spending on military and space electronics, with special emphasis on miniaturization and reliability, encouraged very rapid technological innovation. With a huge domestic market, the U.S. electronics industry has been geared primarily to producing for domestic consumption.

The Japanese have excelled in the quick application of electronics technology to consumer products. Japanese industry made early inroads with electronics exports because of low labor costs but demonstrated rapidly increasing abilities in high-quality engineering and the development of advanced manufacturing techniques and successful marketing strategies for U.S. and Western Europe markets. Japanese industry is heavily oriented toward exporting.

The "export psychology" of the Japanese is attributed essentially to the fact that Japan is a densely populated island chain faced with the need to import food, raw materials, and fuel. The Japanese response to defeat in World War II was to undertake the rebuilding of the country's industry and economic infrastructure along lines which would reestablish Japan as a strong competitor in world markets. The goal was achieved through an alliance of government, industry, and the work force which has inspired Westerners to use the term "Japan Incorporated."

A pivotal role in this alliance is played by the government's Ministry of International Trade and Industry (MITI). This agency does much more than promote trade in the ways that Western governmental bodies do; MITI sets priorities, gives direction, and provides various forms of assistance to particular industries and individual companies.

Most Western observers feel that special characteristics of Japanese economic structure and attitudes give Japanese firms an advantage in competing in foreign markets. Japanese firms, by and large, put less emphasis on profits than U.S. companies and are more concerned with growth and with obtaining a larger share of export markets. Banks in Japan often have special ties to particular companies which makes it easier for firms to obtain investment capital on more favorable terms than it is for Western firms. Employment practices in Japan, which stress "lifetime" employment, give Japanese companies the advantages of a stable, skilled, and motivated work force. Japanese law, including tax law, generally provides incentives for export activities. And government policy, historically, has been to resist upward adjustment of the value of the yen, which would tend to make Japanese products less attractive in world markets.

To an extent unmatched in socialist and Western countries, and certainly in the United States, Japan has been successful in planning and implementing foreign economic policy. By the middle 1960's the country had overcome balance-of-payments problems and after 1965 became accustomed to having its international balance of payments in surplus and to accumulating reserves of foreign exchange. During this period Japan began to transfer low-wage manufacturing activities in electronics and other industries to less developed areas such as Hong Kong and Singapore in the same way that American firms were.

In the early 1970's the Japanese

*In general, the United States is strongest in the export of computers and semiconductor devices and also in avionics and sophisticated military and communications equipment. The total value of electronic products in terms of factory sales in the United States in 1975 was put at $36.4 billion by the Electronic Industries Association (EIA). Although comprehensive figures are elusive, total employment in the electronics industry at large in 1975 was put above 1.1 million by the EIA. Current Department of Commerce estimates put the largest contingent of electronics workers in components manufacturing—some 355,000. The next largest group, about 316,000 workers, makes electronic systems for military and industrial uses. The computer and calculator category has some 200,000 workers. About 76,000 workers make consumer products.

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reached a kind of apogee of their international industrial success. But that success brought new difficulties. Industrial expansion had caused serious pollution and congestion problems. There was friction with the United States over textile imports and with European Community countries over electronics. And nations in Southeast Asia found Japan's trade and investment policies threatening.

In response to these pressures, the Japanese set out to formulate policies which would enable them to deal comprehensively with the problems of success. A notable effort was a draft report, "International trade and industry policies for the 1970's" (*2*), from the industrial structure council of MITI. The main recommendation was that national priority be given to knowledge-intensive and energy-economizing industry. The report urged that emphasis be placed on products of an R & D-intensive, high-value-added sort, such as computers, aircraft, nuclear-related equipment, specialized metals and ceramics, and on equipment which requires highly sophisticated manufacturing and assembly techniques, such as telecommunications gear, business machines, and pollution-monitoring instruments.

Such industry would be desirable in that it would not require heavy imports of raw materials. But the social dimension of the strategy is as important as the economic. The priority industries would be relatively free from pollution and would provide favorable work conditions for labor. The report appears to have captured the imagination of the public, even more so after the energy crisis of 1973, which had heavy psychological as well as economic impact in Japan. However, the proposal fell short of being enshrined as official policy, perhaps because of the criticism from foreign customers and competitors who might well have felt threatened. But most observers feel that the policy was tacitly accepted and is being implemented.

It is not surprising that Japan's export operations have led to frictions with other governments, not only with the United States but with Western European countries and with the European Community as an entity. The EC recently imposed a 20 percent levy on imported Japanese ball bearings, after an antidumping complaint by European industry was upheld (*3*). Negotiations are in progress over imports of Japanese automobiles, and talks on how to limit a virtual Japanese monopoly in shipbuilding have been going on under the auspices of the Organization for Economic Cooperation and Development in Paris.

In the United States the focus currently is on three actions aimed at halting Japanese penetration of the consumer electronics market. Most imminent is a decision on a petition by a group of unions and manufacturers claiming that the U.S. electronics industry has been injured by imports and requesting that quotas be imposed under provisions of the Trade Act of 1974.

The U.S. International Trade Commission, which is hearing the case, is a federal agency that does not act in a regulatory capacity but, rather, advises the President on what action, if any, should be taken. The President may or may not follow the recommendations.

A second case before the ITC is based on a petition by GTE Sylvania Inc., claiming that certain Japanese electronics companies are conspiring to dominate the U.S. market. The ITC has suspended its investigation of that complaint until it reaches a decision on the other case.

Of the actions now pending, the most far-reaching implications are attributed to a suit before the Customs Court in New York filed by the Zenith Radio Corporation against the Japanese on antitrust grounds. The focus of the complaint is a 15 percent commodity tax which Japan levies on domestically manufactured goods and then rebates on products which are exported. Zenith claims that the rebate amounts to a subsidy and violates a 19th-century U.S. law forbidding such subsidies. The issue is complicated because later international trade agreements seem to permit such rebates, since the payment of the tax falls on buyers rather than on manufacturers. If Zenith succeeds in its suit, a lot of other dominoes would presumably fall, as the value-added tax levied by the EC countries and indirect taxes imposed by Canada and other countries are similar to the Japanese impost.

The issue raised by Zenith is troublesome enough, but it is only one point of friction over trade between Japan and the United States. A decade has elapsed since major comprehensive trade nego-

Table 1. High-technology, electronics-oriented industries. U.S. exports and imports, 1974, 1975, and 1976 (millions of dollars).

Category	Imports				Exports				Trade balance			
	1974	1975	1976*	Change (%) 1975–76	1974	1975	1976*	Change (%) 1975–76	1974	1975	1976*	Change (%) 1975–76
Computers and related equipment	115	129	235	+82.2	2196	2224	2588	+16.4	+2081	+2095	+2353	+12.3
Calculating and accounting machines	361	336	335	−0.3	338	261	217	−16.9	−23	−75	−118	+57.9
Consumer products	2337	2059	3788	+83.9	384	392	498	+27.04	−1953	−1667	−3290	−97.4
Phonograph records and so forth	16	18	26	+44.4	57	59	66	+11.9	+41	41	+40	−2.4
Telephone and telegraph equipment	162	93	100	+7.5	160	198	227	+14.6	−2	+105	+127	+20.9
Commercial, military, and industrial equipment	505	456	653	+43.2	811	1012	1278	+26.3	+306	+556	+625	+12.4
Components	1304	1160	1644	+41.7	2267	1987	2532	+27.4	+963	+827	+888	+7.4
X-ray apparatus and so forth	121	173	199	+15.1	152	196	223	+13.8	+31	+23	+24	+4.3
Electronic measuring and test instruments	150	153	180	+18.4	438	495	492	−0.6	+288	+343	+312	−9.1
Totals	5071	4576	7160	+56	6803	6824	8121	19	+1732	+2248	+961	−57.3

*Figures for 1976 are estimated. [Source: Bureau of Census, U.S. Department of Commerce]

tiations were concluded among Western trading nations and Japan. Another cycle of hard bargaining is in prospect and, in the altered circumstances of the 1970's, some observers see the threat of a trade war.

From the standpoint of the U.S. consumer electronics industry, the major issue is the import of color television receivers. Framers of the petition to the ITC (*4*) say that during the first 7 months of 1976 imports of color sets rose to 1.3 million, an increase of 153 percent over the same period in 1975.

Recent years have also seen the establishment of a different sort of beachhead in the industry. In 1974 Motorola was sold to Matsushita Electric Industrial Company. And Sanyo has acquired a controlling interest in Whirlpool's Warwick division, which produces private brand sets for mass merchandisers.

The petition to the ITC emphasizes a decline in employment in U.S. manufacturing. Between 1966 and 1970, average employment in all U.S. television receiver plants is said to have dropped from 62,473 to 42,703, a decrease of 32 percent, while hours worked declined by 42 percent in the same period. The petitioners argue that the decline in sales of sets manufactured in the United States is attributable to the pricing of Japanese sets 10 to 15 percent lower than American sets and not to the superior quality of the Japanese sets.

Opponents in the action include Korean and Taiwanese interests as well as the Japanese—Matsushita, Sanyo, and Toshiba were the major Japanese manufacturers represented—and also the American Retail Federation (ARF). Major arguments by the opponents include the claim that a major factor in the drop in U.S. sales in 1974–75 was the recession and that automation in U.S. plants, not imports, were the main cause of the decline in employment. The lower cost of Japanese sets was attributed to advanced techniques in manufacturing and to an earlier move by Japanese makers to solid-state technology, which resulted in lower costs. AFR took the line that U.S. manufacturers had virtually ignored certain sectors of the market where there was potential consumer demand—particularly for small monochrome sets—and when U.S. manufacturers did offer such sets, they were of lower quality and more costly to maintain.

It is significant that the Electronic Industries Association, the industry's major trade association, did not testify at the hearings. A consensus view could not be developed within the membership because of the diversity of interests and viewpoints. For example, Zenith, the plaintiff in the Customs Court suit, is said not to favor quotas, a conventional protectionist approach to the problem.

To cast the industry position in straight protectionist versus free-trade terms is to risk oversimplification. U.S. policy has generally been to support liberalization of international trade—that is, liberalizing admission of foreign-produced goods to U.S. markets and vice versa—but subject to a large number of exceptions and hedges. U.S. textiles are protected by tariffs and quota agreements, for example. The domestic watch industry has traditionally been sheltered. And, although the United States is the leading exporter of agricultural products in the world, domestic wines and cheeses are protected.

Military Electronics

The export of military electronics has been a steady contributor to the favorable U.S. trade balance in electronics, but such exports raise problems of protection in a different context. Sales of sophisticated weapons and military aircraft are subject to rigorous controls, but the export of some other high-technology products and components and the licensing and sale of technology with possible military applications raises much more complex problems.

The most widely discussed recent statement on the subject was made in a report to the Defense Science Board on the export of U.S. technology by a task force headed by J. Fred Bucy, president of Texas Instruments (*5*).

The report concentrated on "know-how," rather than end products, except for items of prime military importance, and urged control of the transfer of technology by high-technology firms to non-Western and socialist countries and also cautioned against the retransfer of technology through U.S. allies.

Focusing on aircraft, jet engines, instrumentation, and solid-state devices, the task force argued that design and manufacturing know-how is essential to the maintenance of U.S. technological superiority. The report identified several levels of technology transfer, ranging from the most effective, "active" transfers, such as those involving turn-key factories with substantial training provided and the sale of licenses accompanied by "active teaching." At the other, "passive," end of the spectrum were the least effective forms of transfer, such as provision of blueprints unaccompanied by information that transmitted know-how.

The task force urged that this country design a policy to maximize lead time by preventing the transfer of strategic technology, particularly in fields where the United States has a significant lead.

In the consumer electronics field there seems to be fairly wide agreement that West-to-East transfer of technology has not been the crucial factor in Japanese success. The use by Japanese firms of U.S. manufactured components and the licensing of technology has doubtless accelerated progress. And some observers point out that some U.S. electronics manufacturers were allowed to establish manufacturing operations in Japan, where such initiatives by Western firms are usually discouraged. But Japanese performance is attributed to their choice of product, manufacturing, and marketing abilities. By and large, Japanese strategy is to choose a product for which technology is "mature," and for which a sizable consumer market exists, making volume production feasible.

From the middle 1950's on, the Japanese successively established strong, often dominant positions in the American market with radios, record players, monochrome television sets, tape recorders, and most recently color television sets.

Although the general pattern has been for Japanese products to displace U.S. products in the U.S. market, U.S. firms on occasion have used technological innovations to make successful commercial counterattacks. A major case in point was the competition for the calculator sales described in a 1975 Department of Commerce report (*6*). After World War II, U.S. firms employing electromechanical technology dominated the domestic market. By the middle 1960's, Japanese manufacturers exploiting electronics technology had become serious competitors. As late as 1966, U.S. manufacturers, still relying on old technology, held 90 percent of a $112-million market. By 1970, U.S. firms controlled 37 percent of a $224-million market.

In the later 1960's, Japanese calculator manufacturers began to use integrated circuitry largely supplied by American firms. By the early 1970's, several U.S. firms had concluded that logic and memory circuitry necessary for a four-function calculator could be included on a single integrated circuit chip. Rapid innovation made possible simplification of manufacturing, reduction in size, and cuts in labor costs. A headlong reduction in

price ensued, and when the cost of small calculators dropped below $100 a booming consumer market began to develop. American semiconductor manufacturers began to produce calculators rather than simply selling components (*7*), and as a result of this competition the Japanese share of the market dropped from about 40 percent in 1971 to 21 percent of an estimated $750-million market in 1974.

The drop in the average price of calculators in 5 years from about $400 to under $20 in 1974 was a dramatic example of price competition in the consumer electronics market powered by the rapid exploitation of technology. Some observers say that semiconductor manufacturers in Japan have caught up with American counterparts and that production of calculators is again shifting overseas.

The Japanese continue to invest resources in products which they believe have a substantial economic niche. New manufacturing capacity is created almost invariably only when expansion of exports is foreseen. The Japanese, for example, moved quickly and successfully to exploit the American vogue for CB radios, although there is no significant home market, present or prospective.

An even clearer case of export targeting is the development of the video tape recorder as a consumer product for home use. Under Japan's Electronic Industry and Specified Machinery Industry Promotion Temporary Measure Law (1971–79) the TV tape recorder was chosen to receive government direction of development, financial assistance, and special legal treatment, notably an exception from Japan's anticartel law. Video recorders were included with semiconductors and integrated circuits to receive assistance with cost reduction and commercialization. According to the Commerce Department study the Japanese are convinced that TV recorders will be a central factor in the next generation of consumer electronics. So substantial a lead have the Japanese taken that some Americans acquainted with the subject predict that no competitive TV recorders may be produced by American firms for the consumer market.

While Japanese dominance in the consumer electronics market has made American firms resentful—as the recent trade actions show—U.S. industry has tended to see this dominance balanced by the success of American firms at the high end of the technology spectrum, particularly in computers. But most observers now see the Japanese moving to challenge the American position here, too. Many are convinced that the Japanese are determined to establish an indigenous computer industry capable of competing across the whole range of products, including the biggest, so-called "mainframe" computers. There is general agreement that U.S. companies currently maintain a substantial technical lead in the computer field and hold the advantage in cost competition. But there is a widespread feeling that the long-existing status quo is about to undergo a drastic change. The source of the change is intervention in the field on the part of the Japanese government. The government is providing major support for development of semiconductors and computers. The aim appears to be for Japanese industry to supply domestic computer needs and to mount a challenge in international markets with a line of hardware, software, and services comparable to that offered by IBM and other major U.S. manufacturers. The scale of support is said to be about $200 million for the components field and a similar amount for computers. For some time, the government has backed a program to improve Japanese competence in software, where industry has been deficient. The government programs are aimed at industrywide strength and will utilize such devices as a common patent pool which is illegal in the United States.

Nascent Competition

As things stand, Japanese penetration of the U.S. market for computers and related equipment is not regarded as significant, although there was substantial rise in imports in that category last year. Japan, however, is regarded as having a foothold in the minicomputer field and is expected to compete in the market for the so-called desk-top computer, which is thought to have major growth potential. Japanese electronics firms have initiated relationships with American components and computer manufacturers which could lead to some technological leapfrogging, but the dominant impression in this country is that the Japanese intend to concentrate on internal development.

Some U.S. observers expect to see a repetition of events in the consumer electronics industry, with the Japanese initially scoring success with advances in semiconductors, probably with microprocessors. Others feel that U.S. firms hold the technological initiative and have shown that they can retain it in the semiconductor and computer fields. Interpretations tend to be highly subjective, since trends in this area are by no means yet clear. However, there is widespread agreement that a major factor in future developments will be the U.S. government's attitude toward the intervention of other governments on behalf of their own electronics industries. The obvious case is Japan, but the governments of Western European countries, notably France and West Germany, have taken major steps to foster domestic computer industries. These actions are based not only on the judgment that computers constitute a desirable growth industry, but that "intelligent machines" will increasingly affect virtually every aspect of modern life. Leaving security considerations aside, the governments of most major industrial countries take the view that to be without a viable, vertically integrated data-processing industry invites second-class status in the post-industrial period.

Up to now U.S. industry seems to have been tacitly willing to trade off imports in consumer electronics for exports in high-technology products. Now the U.S. government is being pushed by industry to reexamine its policy on the electronics trade in the face of big subsidies by other governments.

The questions raised are only beginning to be seriously discussed. In a sense, U.S. industry gained advantages similar to those provided by subsidies from heavy U.S. government spending on military and space electronics. Some analysts, incidentally, believe that the experience of certain American electronics firms in dealing with the government as their sole client has conditioned them to be poor competitors in international markets. And because U.S. firms have become habituated to expecting innovation to come only from within U.S. industry, they are said not to be adept at making use of the rapidly increasing number of important innovations being made abroad.

American firms are accustomed to dealing with the U.S. government in an adversary role as regulator and guarantor of competition. Competitive electronics firms here would like to see the U.S. government find a way to apply U.S. standards of fair competition to foreign firms which operate in U.S. markets. But dealing with the issue of the support by foreign governments of their high-technology industry which competes in U.S. markets is likely to be one of the thorniest issues confronting the Carter Administration in the next round of major trade negotiations.

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Impact of Electronics on Employment: Productivity and Displacement Effects

Arthur L. Robinson

Structural unemployment is the technical name for the loss of jobs when changing technology makes currently held skills obsolete. If the question asked is "What impact will advances in electronics have on structural unemployment?", the answer is "Very little," according to most government economists and industry executives.

Nonetheless, individual workers will continue to feel substantial and sometimes traumatic impacts, including the need to learn new skills for jobs with different responsibilities and the necessity of relocating to other plants or to other parts of the country. Not only will the requirements for some old talents disappear and new ones be created, but, somewhat contrary to intuition, the electronics "revolution" may also open up opportunities for the relatively unskilled. In fact, the upcoming labor force may be structured into large numbers of relatively unskilled workers at one end and highly trained managers and engineers at the other, with very few medium-skilled individuals in between. And, as technological change continues at a rapid rate, a pattern of lifelong education and multiple careers will replace the tradition of training for one lifetime vocation.

According to some observers, the changes to be brought about by solid state electronics will, in the final analysis, be comparable to Henry Ford's move from custom to mass production. Since the invention of the transistor, the electronics industry has undergone a profound transition, and the changes of the last 25 years exceed those of the preceding 75. Moreover, there may be social impacts that even now are not fully appreciated. Some of these impacts most likely will involve the kinds of jobs that people work at and how many persons are needed for those jobs. If speculation about the electronics-dominated society of tomorrow turns out to be anywhere near the mark, then the impact of advances in electronics on employment could dwarf earlier concerns about automation, such as those typical of the early 1960's.

Hard numbers reflecting the impact of advances in electronics on employment are for the most part unavailable, in part because the problem is not yet of interest to manpower economists. Says one manpower specialist, "Displacement due to changing technology is now only a small part of the total job deficit, but the situation could change in the next two years if the recovery from the recession is slow and if technological change and competition from overseas increase." Technological change is also extremely difficult to separate from other influences, thus making its study unsatisfying.

One effect that can be documented is the large growth in the number of workers making and using electronics technology in the form of computers and communcations equipments. Marc Porat of the Department of Commerce's Office of Telecommunications has chronicled the rise of what some are calling the information economy (*1*). Included in the information economy are all jobs that involve the manufacturing of information machines, and the production, processing, transmission, distribution, or selling of knowledge or information. Also included are various information activities of both public and private bureaucracies, such as managing, planning, monitoring, marketing, and coordinating.

Not every occupation in the information economy depends, either directly or indirectly, on the existence of electronics technology, but a substantial fraction does. Porat's data show that, about 1955, a rising percentage of information jobs surpassed a declining percentage of industrial jobs, and that information activities became the dominant sector in the U.S. economy. From about 1965, the now dominant information sector accounted for about 45 percent of all employment (Fig. 1). Furthermore, as computers and information machines made their appearances in the late 1950's, exacerbating the trend toward large bureaucracies that began to build up in private industry and in government in the years after World War II, the percentage of the total national income earned by those in information occupations rose to more than 53 percent (Fig. 2).

Porat thinks that these trends offer considerable solace to those fearful of job displacements from electronics. In his view, every new computer or information machine introduced in an office, for example, leads to many more jobs than it displaces: in a more complex environment people are needed to gather information for the machine to process and to interpret what it puts out. A scenario of this type does, however, imply a steadily growing bureaucracy, and Porat worries how long society can support an increasing number of less and less productive individuals.

A more conventional viewpoint is that increased productivity arising from technological innovation will, given a reasonably healthy economy, create an increased demand for labor and raise real wages (*2*). C. Lester Hogan, vice-chairman of Fairchild Camera and Instrument Corporation, the third largest producer of semiconductor devices in 1976, says

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