Technology Imports — Japanese Style

How Japan has imported, organized, and adapted modern technology of others since World War II

BY E. ANTHONY ZALOOM*

This paper discusses license deals which Japanese firms have concluded with firms in the rest of the world. It also covers the subject of Japan's ability in the Twentieth Century, and more particularly in the period since World War II, to import, organize, and adapt the modern technology of other countries.

Let me first offer statistics relative to Japanese technology imports. They are interesting and surprising. I found them in a single volume published by Japan's Science and Technology Agency, every year until this year called "Annual Report of the Import of Foreign Technology." This year the volume carried a new title: "International Technological Assistance," and I doubt that this change in title was casual and without design. Rather, I think that it reflects an awareness on the part of the Japanese who compile this volume every year that their country has achieved, at least by one measure, a positive balance of payments with respect to international technology transfers.

Let's look at the figures. As a percentage of its technology payments, Japan's receipts for selling technology increased from a miniscule 2.7% in 1961 to 12.3% in 1971 to 22.6% in 1975. Your reaction may be, "Yes, this is an encouraging and even an apparently accelerating trend for Japan, but so what? Doesn't Japan still pay out more than four times as much as it receives with respect to international technology exchange?" But remember, these aggregate statistics are determined largely by royalty payments under technology agreements signed as many as 10 years ago, and so they change only slowly. A more sensitive indicator of Japan's standing is the ratio of receipts to payments arising from new contracts, those signed in the current calendar year. By this index Japan emerged as a net seller in 1972, when the ratio was 1.26, up from .71 in 1971. It climbed slightly higher to 1.27 in 1973, and then up to 1.37 in 1974. It is perhaps too early to tell whether this reflects a long-term trend, particularly since more than one-third of the technology exports were in one industry, chemicals, to one region, Southeast Asia.

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The point is that Japan now receives more money than it pays out in entering new contracts for international technology transfer. Probably a more important point, and I think one that all of us have been at least hazily aware of, is that Japan's import of foreign technology has contributed substantially if not decisively to its success in export markets. Practically every one of Japan's major export industries, whether steel, shipbuilding, automobiles, or consumer electronics, has had significant foreign technology input. A statistically positive rank correlation exists for the period 1963 to 1970 between the increase in the OECD export share of each Japanese industry and the number of technology import agreements between Japanese and foreign countries in the same industry.

More basically, foreign technology imports have played a very important role in Japan's phenomenal postwar economic growth, which, from 1959 to the early 1970's, averaged 10.8% a year. Most economists are agreed that this phenomenal economic growth is in large measures due to technological development in Japan. They are also generally agreed that there are at least three distinctive features of Japan in relation to technological development:

1. High return from importing technology in terms of exports and productivity.
2. Extensive government controls, but not prohibitions, over introduction of foreign technology and the use of these controls to shape the structure of some industries.
3. The adroit and extensive use of investment and domestic research and development to capitalize upon imported technology.

History

The history of Japan's postwar importation of technology can be divided into three periods. The first of these was from 1952 to 1960. This period was characterized by extensive governmental controls over the economy in general which were administered by the Ministry of International Trade and Industry and prompted primarily by concern with the balance of payments. The structure of these controls reflected the government's preoccupation with making Japan more self-sufficient in such intermediate material inputs as chemicals, iron and steel. Technology of prewar and wartime vintage was brought into Japan and often represented the first application of the particular technology in the country. Imports of technology usually required large-scale, capital-intensive production processes. Royalty rates reflected limited competition on the seller's side, with the initiative for transactions often coming from Japanese firms working very closely with the Ministry of International Trade and Industry.

Of course, buying technology requires that one have information about what to buy. This information was acquired by Japanese firms and government agencies by all the means which any one society usually uses to learn about another: textbooks, journals, travel, and foreign education. Another source was trade itself, and particularly in the early years the feedback from Japanese trading companies about the technology of foreign products and production. Finally, after 1955 there were the organized programs of the Japanese Productivity Center, which was founded with the financial support of Japanese companies and the government. From 1955 to 1961 the center sent parties of from 10 to 20 people each to the United States, with the United States government paying for the foreign exchange cost of these trips under its economic assistance program. About 2,500 persons participated in trips of this kind during those six years.

During the second period, between 1960 and 1965, the particular kinds of technology bought shifted considerably. The same technology-intensive industries — nonelectrical machinery, chemicals and electrical machinery — remained the major importers of technology. But within each industry greater emphasis was placed, first, on technology for consumer goods rather than product goods, second, on more importation of improvement technology and less on major products or processes, and third, on more importation of so-called duplicate technology and less of technology not already in use in Japan.

The first shift to more consumer-oriented technology is evidenced by the fact that more of the technology was for items like room air conditioners and color television sets and less for manufacturer's machinery. It is also evident from the fact that the number of technology agreements signed by local consumer-oriented industries such as packaging, leisure products, furniture, cosmetics, and dress designs rose quite sharply.

Duplicate Technology

As mentioned, duplicate technology, the third change, refers to agreements covering products and processes already brought into Japan by other Japanese firms through previous technology agreements, and as such, duplicate technology imports represent a diffusion of technology. Often such duplication occurs at least in part because the patent license terms of the initial agreement do not permit sublicensing, and thus force new Japanese users to sign new agreements. But even where the technology has become available in Japan, the Japanese firm would in that period often choose a foreign seller who would be more likely to supply know-how and offer more reasonable terms than would Japanese sellers. In addition, Japanese buyers are reluctant to deal with other Japanese firms since such aid may disclose their own technical and management practices.

Imports of technology since 1966, the first year of the third period, have been increasingly for improvements of technology previously imported. Again, they were more oriented toward consumer products and also required less investment for their application. The export orientation continued and duplicate imports came to account for most technology imported. Large American corporations, major sellers of technology, became more concerned with direct investment in Japan than with selling technology. The price of technology increased, and governmental controls on technology importation were further liberalized, particularly after 1968, due to outside pressures.

The periodization I have outlined will serve as a background for understanding the role of imported technology as a significant factor in postwar Japanese economic growth. Throughout this period Japanese firms purchased technology in a fairly elaborate market and expended significant sums. They also invested substantially in capital equipment and domestic research and development to utilize, adapt and improve imported technology, and an active set of government policies not only influenced the importation of technology but also shaped the structure of Japanese industry to that control.

Significant efforts were made in Japan to modify and improve technology through substantial domestic research and development. Data from a Ministry of International Trade and Industry survey made in 1962 shows that in that year one third of domestic R&D expenditures were for modifying or for improving imported technology. These expenditures are often viewed by foreigners as adaptive research, implying that the objective is simply to modify the technology for Japanese conditions. But, on closer examination it appears that these expenditures were more often for "improvement engineering." The emphasis first of all was on quality control, with the goal being to exceed the product quality of the foreign manufacturer whose technology had been imported, it being the view of Japanese businessmen that sales in both the domestic and export markets would be sensitive to quality defects, including reliability. The second and lower priority was to improve the products in terms of operating simplicity, attractiveness, and technical performance. Export and domestic sales were also considered to be highly responsive to such improvements particularly those that would make Japanese products distinctive and superior to competing foreign products.

Government Controls

One of the most distinctive features of Japan's import of technology has been the application of extensive government controls, based on Japan's Foreign Investment Act of 1950. Although the formal rationale for these controls has been concern for the balance of payments and as a set of safeguards against sudden disruptions in the small business sector, close examination does not bear this out. Royalty payments represented only .5% of all foreign exchange payments in 1953 and 1.8% in 1960. Actually there have been few reported cases of notable disruptions among small businesses in Japan on account of the induction of foreign technology. More important than any stated rationale for the controls has been their impact on the price of technology, the composition of the imported technology and even Japan's industrial structure.

On the subject of price, I'm sure that any dealt with Japanese licensees during the 1960s know about MITI as the inevitable third party in any negotiations. MITI's intervention in the mid-1960s especially had the effect of providing Japanese firms with technology on much more favorable terms than they would have been able to obtain in the more open economies of the United States or Western Europe. How this was achieved is well summarized in an OECD study which in relevant part states the following:

> "... after the Japanese and the foreign partner have agreed on the terms of a contract, the authorities make approval conditional on amendments, usually in favor of the former. The scope of the technology is frequently changed; the royalties and initial payments are reduced; minimum royalties and back royalties are eliminated; arrangements must be made for the Japanese partner to get privileged access to certain foreign markets; provisions are disallowed under which the Japanese partner renounces manufacture after the expiry of the contract or to make certain competitive products; sub-licensing is made subject to further governmental approval; undertakings are deleted under which the Japanese partner would hand over a list of his customers at the end of the contract; the duration of the contract is reduced; automatic renewal is excluded; etc. All these changes of the terms of his contract are imposed upon the resident (as well as the nonresident) whether he wishes it or not, although as long as they are in favor, he would be unlikely to object to this form of official guardianship over his interests."

After liberalization of MITI's controls on technology imports in 1968, at which time it discontinued most of the practices referred to above, there was a marked increase in royalty rates payable by Japanese licensees. In 1968 the average royalty rate on new contracts went from 4 to 5.1% and the median rate went from 3.8 to 5%. Of course there may very well have been other factors at work. A British journalist in a book written in 1969 reported that American firms began in the mid-1960s pressing for a higher royalty rate, even that "some foreign companies are refusing to sell, especially now that Japan is a dangerous competitor in the world market." This stiffening position reflected a general perception by sellers that their technology may have been under-priced in the early 1960s because of poor forecasts of both the growth of the Japanese market and the eventual loss of export sales in third markets to Japanese firms.

The second impact of governmental control, which I have mentioned, was that the composition of tecnology imports tended to be less consumer-oriented in the earlier years, but more so in later years as Japan's national economic priorities changed.

New Industries

What some observers feel has been the most important impact of governmental control has been the way in which it has shaped the structure of new industries. The gradual increase in duplicate imports of technology, many of which represent additional entrants into new industries, was the most visible consequence of gradual liberalization by MITI. The announced objective in controlling duplicate technology imports was effective utilization of imported technology, meaning that approval of a technology agreement was conditional upon its meeting MITI's interests, first with respect to the construction of plants of efficient scale, and second in avoiding excess capacity and the ensuing price competition. But to protect the economy from the dominance of a few sellers, MITI sought at the same time to bring new firms into industries. The hoped-for results of the interplay between these two sets of objectives, one restrictive and the other expansive, was an increase in the number of sellers, but never at the expense of unused capacity or excessive competition.

I would like to say just a few words about Japan's people and their apparently unique ability to borrow and improve upon imported foreign technology. It has become almost cliche that Japan has a higher literacy rate than even the United States. It has also increased drastically its professional manpower during the 1950s and 1960s, so that by early 1970s Japan ranked quite high in the international comparison of engineers and scientists per 1,000 population — ahead of West Germany, France and the United Kingdom, though still well behind the United States. The amount spent educating a Japanese student in the technical and scientific departments of Japanese universities is considerably lower than in the United States and the United Kingdom, but two features of Japanese society may have mitigated the effect of educating large numbers at low cost in universities: the rigor of high school instruction in mathematics, and the post-university training provided by large companies in Japan to their engineers. You've probably all read in the newspapers about the high math scores of Japanese teenagers internationally; all Japanese are expected to have mastered a considerable amount of calculus before they get out of high school. The training provided by large companies to their engineers typically involves treating newly hired engineers as trainees for the first three years and rotating them through a variety of assignments, including both production and research. They're also given occasional two-week courses at the company's educational center and in the third year, each trainee is assigned a thesis, an individual paper to be written on a technical topic. Training continues even after the third year with monthly seminars, one- and two-week full-time courses, and often graduate training abroad. Of course American firms have training programs for their technical personnel as well, but they are typically not as elaborate as those of Japan, probably because Japanese engineers are considered to be committed to a lifetime career in a particular firm. Therefore it pays the Japanese firm to make such an expensive investment in training.

One other aspect of the lifetime employment which characterizes Japanese industry is that Japanese management thereby has a labor force that in general is without incentives to oppose technological and organizational progress even of a labor-saving type.

A final distinctive feature is that the Japanese mix of technical manpower is heavily weighted toward a large number of engineers relative to the number of

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