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Japan's Imports of Technology

by Jan Winiecki, Warsaw *

There are important reasons why Japan's policy regarding imports of technology should find its place in the literature devoted to the economic development of Asia, Africa and Latin America. It is Japan which mastered to a highest degree the ability to subordinate technology imports to development requirements of the national economy, and even though the procedure and instruments of this policy, as well as its effects, were applied and obtained in different socio-cultural and educational settings, the possibility of drawing from Japan's experience by developing countries seems considerable.

The post-war imports of technology by Japan were caused by the "technological gap". The aspiration to close the gap as a prerequisite to accelerate economic growth, to bring about intended transformations in the branch structure of industry and to ensure the competitiveness of export production on world markets, were the main motives behind the government's policy of technology imports. After the evaluation of alternative policies to achieve its goal the government gave priority to imports of technology under the form of licence purchase, considering it the most advantageous for two fundamental reasons:

- the import of technology was deemed to be the fastest, minimizing the risk of failure and the least expensive method of narrowing the technological gap,
- the import of technology was deemed to be the best method to stave off the danger of foreign economic dominance in the Japanese economy.

The above policy was a continuation of the policy implemented consistently since the Meiji reforms in 1868. Aware of the fact that technology imported from the West would not always be the most modern, Japanese policy makers have selected this option understanding that in view of the high level of education and qualifications of the labour force, the imported technology would be adjusted and improved upon, thus creating premises for the accomplishment of the prescribed goals.

As a result of government policy the number of contracts for imports of technology, and their value, has been steadily increasing since 1950. Taking into account the so-called "category A" contracts (with the period of transfer of technology or the repayment period longer than one year), their number has increased from 101 in 1951 to 320 in 1961 and 1,546 in 1971, and their value respectively from US\$ 7 mn in 1951 to 113 mn in 1961 and 469 mn in 1971. During the period 1950–1971 Japan spent \$ 3 bn on imports of technology.

Mass purchases of foreign technology have placed Japan at the head of the list of world licence importers long before Japan became the world power in trade. Japan's share in world imports of licences is twice as high as its share in world imports of goods (5.8% in 1970) and many times higher than its share in world imports of foreign capital in the form of direct capital investments. Thus, the government policy to close the technological gap by means of licence imports in the first place, and to a lesser extent through imports of investment goods or foreign capital imports (combined with foreign technology and management) is fully reflected in practice.

Out of 9,870 category A licence contracts in the period 1950–1971 79.4% were licences for engineering and chemical industries (together with metallurgy even 83.9%). This dominant position of both industries has been maintained throughout the period, but within the industries some changes took place, reflecting changes in the level of modernity and international competitiveness of different branches of engineering industry, as perceived by government and business.

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In engineering industry a gradual increase in the level of modernity of production and an increasingly strong position of Japan in exports of electric and electronic machinery (in particular durable consumer goods) enhanced by domestic technical achievements, contributed to a decline in the share of licence purchases from 23.7% of the total in 1950–1954 to 14.0% in 1970–1971 (in terms of number of contracts). The situation was different in non-electric machinery industry, and particularly in production of capital goods, in which field Japan lags behind its Western competitors. In the 1950s the share of this branch was between 22% and 24% of total licence purchases and in the next decade it increased to 28–30%.

While reviewing the structure of licence imports three other trends should also be emphasized:

□ radical decline in the share of metallurgy in licence imports that began in the mid 1960s (decline from 8–9% to 4.6% and recently to 2.5%). In this branch Japan has attained the highest world standards;

□ dynamic increase in licence imports for products and technologies for the production of plastics (from 0.2% in 1950–1954 to 5.9% in 1970–1971), the branch being deemed to have a great future;

□ constant and relatively high share (5%) of licence imports for the textile industry. The share of this industry in total industrial output and particularly in exports has been steadily decreasing but the development of the most up-to-date and competitive products is being stimulated by constant inflow of foreign technology.

Structure of Technology Imports

As may be seen from the above, Japan's policy of technology imports, constituting an integral part of the country's overall economic policy, gave different priorities to specific branches of industry at different stages of the post-war economic development of the country. In the period of laying foundations under modern heavy industry the preference was given to the metallurgy and engineering industry in general, as well as to production of industrial chemicals. Later, in the mid-1960s in the strive to modernize still further the industrial structure, the preferences were given to more technology-intensive and science-based branches, such as non-electrical machinery, plastics and synthetic fibers. This subordination of technology import policy to the policy of structural changes is reflected partly in the table; partly because an increased share of preferred branches in total imports of technology remains high for a certain

period even after they achieved a planned technical level and place in the industrial structure.

Only a few empirical studies have been made so far that analyse the role of imports of technology in economic development, structural changes and export expansion – and only indirectly for that matter. Thus, it was calculated with the use of a production function that in the period 1955–1970 the contribution of the so-called residual factor (technical and organizational progress, higher qualifications of the labour force, economies of scale, etc.), to economic growth of Japan was 47%, the remaining 53% being attributable to the increase in the inputs of labour and capital¹.

Contribution to Economic Development

The contribution of technical progress (and other factors making up for the residual factor) to the growth of production in the manufacturing industry, calculated according to the same method, in the decade 1956–1966 was 41.1%. It should be stressed that among the branches with a higher than average contribution of technical progress were almost exclusively branches of heavy industry benefiting most from imports of technology and domestic R and D: chemical industry (72.3%), transport equipment (60.2%), paper and pulp industry (59.7%), non-electric machinery (52.3%), metal industry (46.3%) and metallurgy (45.6%)².

Finally, the result of research indicating a strong positive relationship between the investments and technology imports itself should also be stressed. The survey conducted by the Japanese Agency for Science and Technology proved that 27.7% of new investments of firms importing foreign technology were direct results of purchase of foreign technology. Furthermore, technology imports had a strong indirect impact on investments as a result of the necessity to adjust the existing equipment to new technological processes, different scale of production, etc.³

T. Ozawa who maintains that the major stimulus for Japanese export expansion after the Second World War was provided by the advanced foreign technology acquired by way of licence purchases, made some empirical tests for the period 1950–1960 to check this hypothesis. The tests proved the existence of high correlation between the volume of technology imports by different branches of industry and the dynamics of exports of the same

² For calculations see K. Oshima, *Research and Development and Economic Growth in Japan*, in: B. R. Williams (ed.), *Science and Technology in Economic Growth*, London 1973, pp. 311–313. It seems, however, that the conclusions drawn there on the contribution of technical progress to the growth of production are formulated too categorically.

³ See T. Ozawa, *Japan's Technological Challenge to the West, 1950–1974: Motivation and Accomplishment*, Cambridge, Mass., 1974, pp. 37–43.

¹ Japan's Economy in 1985. The Outlook for a Trillion Dollar Economy, The Japan Economic Research Center, April 1971, p. 7.

branches. While acknowledging the deficiencies of the analytical tools used, the author confined himself to a more general statement, that "export competitiveness of Japan is related to the purchase of foreign technology"⁴.

The lack of comparable research makes it impossible to determine whether this high correlation lasted in the 1960s. The fragmentary data available prove only indirectly that in the period of "great acceleration" the relationship between technology imports and exports of goods remained strong: only 13% of the category A licences purchased in 1969 were used for the production of goods destined solely for the domestic market.

Another indicator is reflecting the role of technology imports in terms of degree of achievement of goals in the structural transformations of Japanese industry and exports. The share of heavy industry (metallurgy, engineering and chemical industries) in the output of the manufacturing industry of Japan increased from 43.7% in 1955 to 57.7% in 1960, 59.9% in 1965 and 63.0% in 1970. The share of these industries in Japan's exports was 38% in 1955, 43.4% in 1960, 62.5% in 1965 and 72.4% in 1970. The changes in the structure of exports followed changes in the structure of the manufacturing industry. Heavy industry being very technology-intensive, the high dynamics of its

growth and a growing share in the total output called for a constant flow of innovations. These innovations were based to a large extent on the imported technology. As mentioned before, metallurgy, chemical and engineering industries acquired among themselves 83.9% of all licences bought in the period 1950-1971. The crucial role of technology imports, not easily measurable in quantitative terms, seems unquestionable.

Government Policy

Imports of technology to Japan in the post-war period, as in the whole period after 1868, have been managed and controlled by the government in order to guarantee the consistency of the dynamics, structure and conditions of these imports with the aims of the economic policy discussed above. The scope of the control diminished, as the Japanese economy reached higher levels of development and as the technological gap in relation to the most developed countries narrowed, but was at every stage suited to the policy requirements of that particular stage. The distinctive features of this policy directly connected with technology imports are noteworthy as they have contributed, together with other factors, to Japan's success in catching up with the world technological leaders.

Firstly, as a result of foreign exchange controls, the government had an instrument with which to regulate the dynamics and structure of the im-

⁴ T. Ozawa, Imitation, Innovation and Japanese Exports. In the Open Economy. Essays on International Trade and Finance, P. B. Kenen and R. Lawrence (Eds.), New York 1968, pp. 199-201.

Share of Industrial Branches in Imports of "Category A" Licences in 1950-1971

(% of number of licences)

1	1950-54 number	%	1955-59 number	%	1960-64 number	%	1965-69 number	%	1970-71 number	%	1950-71 number	%
	2	3	4	5	6	7	8	9	10	11	12	13
Metallurgy	38	8.3	56	9.7	96	8.8	181	4.6	733	2.5	444	4.5
Engineering industry (total)	254	35.9	310	53.9	1,312	64.3	2,216	56.4	1,464	50.9	5,546	56.2
Electric machinery	108	23.7	109	18.9	469	23.0	664	16.9	414	14.4	1,764	17.8
Non-electric machinery	98	21.6	139	24.2	627	30.7	1,094	27.8	743	25.8	2,701	27.3
Transport equipment	42	9.2	34	5.9	94	4.6	209	5.3	147	5.1	516	5.2
Metal products	6	1.3	20	3.4	74	3.6	124	3.2	89	3.1	313	3.2
Precision instruments	—	0	8	1.4	48	2.3	125	3.2	71	2.4	252	2.5
Chemical industry (total)	98	21.6	138	24.0	398	19.5	960	24.4	700	24.3	2,294	23.2
Chemicals	82	18.1	116	26.2	280	19.7	678	17.2	471	16.3	1,627	16.5
Plastics	1	0.2	5	0.8	94	4.6	209	5.3	169	5.9	478	4.8
Oil and coal products	15	3.3	17	2.9	24	1.2	73	1.8	60	2.1	189	1.9
Stone, clay, glass	10	2.2	8	1.4	45	2.2	81	2.0	88	3.0	232	2.3
Textile industry	24	5.3	33	5.7	83	4.1	172	4.4	208	7.2	520	5.2
Food processing industry	—	0	1	0.2	8	0.4	58	1.5	65	2.2	132	1.3
Construction	10	2.2	6	1.0	17	0.8	39	1.0	20	0.7	92	0.9
Other	20	4.4	23	4.0	80	3.9	219	5.6	240	8.3	582	5.9

Sources: Calculated on the basis of T. Ozawa: "Japan's Technology Now Challenges the West", Columbia Journal of World Business, No. 2, 1972, p. 42 (1950-1969), and "Les Echos", January 4, 1973 (1970-1971).

ported technology. The regulation was necessary because of the limited availability of foreign currencies in Japan (the problem ceased to play an important role in the mid 1960s). Policy aimed at the shaping of branch structure of imports was intended to direct the flow of foreign technology to the branches that were given priority⁵.

A gradual relaxation of the scope of control did not impair the government's ability in this respect; even after the most recent steps aimed at liberalization of technology imports a tight control is still being maintained over the purchases of licences in selected branches recognized as crucial to the national economy and to country's defences (armament industry, aviation, space, nuclear energy) or most modern branches in which Japan still remains behind the world's leading manufacturers (computer industry, petrochemical industry). Furthermore, as far as contracts exceeding in value US \$ 50,000 are concerned, the government has the right to veto such contracts if it regards them as detrimental to the national economy. Such a non-approval must be formally issued no later than one month after the application for the licence has been filed.

Secondly, the government has tried to ensure that the purchased technology would be the most modern and the best among the technologies available on the international market. The competence of the Ministry of Industry and Trade (MITI) and its consultative organs in this respect are considered to be especially high.

Thirdly, the government strengthens the bargaining power of Japanese enterprises in their dealings with foreign firms. This is done by means of curbing the competition between the Japanese firms which want to buy the same technology and by means of intervention in the terms of the contract if they are recognized to be flagrantly unfavourable to the Japanese side⁶.

It should be stressed that in order to close the technological gap the Japanese government does not confine itself to control of technology but integrates it with the overall economic policy. Here a few particular features should be mentioned.

Beginning with 1948 and throughout the 1950s the government policy made available to Japanese firms in preferred branches (metallurgy, electrical machinery, shipbuilding, etc.) low-interest loans for investments aimed at improving the technical level of production, most frequently on the basis of foreign technology. This policy has been continued, although on a smaller scale, in the 1960s. Even apart from loans on special terms, the credit policy has played constantly an important role in

ensuring a high degree of innovation in Japanese industry. In the circumstances, the debt-to-equity-ratio being much higher in Japan than in other capitalist countries, the effects of the selective credit policy based on branch preferences are very strong.

Another aspect of integration of technology imports with economic policy is the regulation of the flow of licences to individual branches. The appropriate government agencies coordinated with the enterprises not only the activities directly connected with licence purchases, but also the time schedule of introduction, the volume of production based on a given licence, production targets, etc. On the basis of available information, the government temporarily blocked further purchases of licences for given production for the period necessary for the first manufacturers to achieve the profitable volume of production.

Influencing Demand

A further aspect of this integration was the government intervention in the sphere of demand. When Japanese manufacturers reached the capacity sufficient to satisfy the domestic demand, the imports of the goods in question were limited on the formal infant industry basis, as well as indirectly in form of various non-tariff limitations.

Where this kind of policy was impracticable, a flexible solution, adapted to the concrete conditions, was always found. For example, a subsidiary of the American corporation IBM occupied a dominant position for many years on the Japanese computer market (in 1965 40% of the number and 60% of the value of all computers sold). Import restrictions were not applicable to the subsidiary operating within Japan. So, in order to ensure for Japanese firms a growing share of the domestic market, the government established a public computer leasing corporation that leases only computers produced by Japanese firms. The enterprise buys the computers and then leases them to the domestic users charging competitive prices. Furthermore, when new Japanese models come out the enterprise buys from users the machines of the older generation at advantageous prices broadening this way the market for Japanese manufacturers. That these measures are effective it is sufficient to say that in 1972 the computers made by Japanese firms contributed to over 50% of the sales and leases on the domestic market⁷.

⁵ See T. Ozawa, Japan's Technology Now Challenges the West, in: Columbia Journal of World Business, No. 2, 1972, p. 42; K. Oshima, op. cit., p. 320; T. D. Long, Japanese Technology Policy: Achievements and Perspectives, in: Research Policy, No. 4, 1975, p. 12.

⁶ See T. Ozawa, Japan's Technology..., p. 43, and K. Oshima, op. cit., pp. 320-321.

⁷ T. D. Long, op. cit., p. 9-10.

The government policy sketched above has been carried out in an environment enhancing innovation processes. Among environmental sources of success are the following:

High level of qualifications and skills of the labour force. As a result of the education policy dating back one hundred years, the level of education in Japan is among the highest in the world (according to estimates for 1975 more than 50% of the employed attended school for more than 10 years, and 12% had completed at least college level education)⁸. Furthermore, a well developed system of on-the-job training ensures a continuous updating and increase of qualifications.

Intellectual attitudes conducive to the technical progress. Despite a relatively low share of outlays for R and D in GNP in comparison with other highly developed industrial countries Japan is among the world's leaders in basic research. A high level of general theoretical knowledge makes possible easier absorption, adaptation and improvement of the imported technology.

Non-existence of psychological barriers when learning from abroad. M. Dobroczyński stresses that despite the high level of education, science and industry achieved, "the propensity to learn from the outside world in Japan has been elevated to the rank of a dogma"⁹. A particular feature of the Japanese society, a great sensitivity to foreign opinion is conducive to the process of foreign technology absorption. T. Ozawa writes in this context, half-jokingly but rightly, about the "advantages of inferiority complex"¹⁰.

Lower outlays for imported technology. This is the consequence of the impact of factors listed above. Japanese firms, while importing foreign technology, buy a narrower range of services than firms in other countries. They confine themselves to the purchase of licence and a minimum know-how indispensable to launch the production. The majority of details of the purchased technology are solved by the Japanese themselves.

Integration of technology imports and domestic R and D. The coordination of measures related to the technical progress is not confined to the government level only but covers also the activities of Japanese enterprises. Only in very rare instances Japanese firms apply foreign technologies in the original unchanged form: R and D in the firms formed an integral part of the innovation process initiated very often by imports of technology. It is worth stressing that successful

integration of policy measures related to technical progress at governmental and enterprise level — starting with the review of foreign technology, then its purchase, adoption, adaptation and improvement — allays the fears that dependence on imports of technology creates the danger of perpetuation of the technological gap between the importing country and the world leaders in the field of technology.

Prospects for Technology Imports

To judge the future role of imports of technology in the development of the Japanese economy and export expansion one must examine the need for such imports as well as their possibilities. To begin with, the need for substantial technology imports will be felt also in the foreseeable future. The Japanese economy is in the process of another transformation of industrial structure aimed at the increase of the share of the R and D-based branches. To this one must add the increase in demand for new technology for the generation of energy and the protection of the environment. A considerable part of the new technology will have to be purchased abroad.

One should not neglect, however, the other side of the problem, that is the changes in the availability of new technology in comparison with the 1950s and 1960s. The acceleration of the rate of growth of the Japanese economy and the effectiveness of export expansion contributed to changed attitudes of the potential Western suppliers of technology who are now wary of selling it to strong and dynamic competitors. If they do agree to such transactions it is not in exchange for royalty payments for licences but for more profitable access to the large and expanding Japanese domestic market, that is, in exchange for a share in Japanese firms buying licences. According to the inquiry carried out by MITI, already in 1967 83% of Japanese partners entered joint-ventures in order to gain modern technology which was not available by means of simple licence purchase¹¹. It seems that this trend has been intensified and will be so in the future as well. Similarly, foreign licensors will increasingly tend to negotiate cross-licence agreements giving them access to technological improvements made by the Japanese firm.

In conclusion then, even though the value and number of contracts in absolute terms will continue to increase, the rate of growth will rather be lower than in the past, and the share of expenditures on technology imports in the GNP will remain at the present level or may even decrease.

⁸ Japan's Economy in 1985 . . . , op. cit., p. 79.

⁹ M. Dobroczyński, Światowa ekspansja gospodarki japońskiej (World Expansion of the Japanese Economy), Warszawa 1975, p. 83.

¹⁰ T. Ozawa, Japan's Technology . . . , p. 46.

¹¹ T. Ozawa, Technology Imports and Direct Foreign Investment in Japan, in: Journal of World Trade Law, No. 6, 1975, p. 670.