Indonesian Economic Development and Japanese Technology

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Abstract

This paper examines possible contributions of Japanese technology to economic growth in Indonesia. It contains a historical survey and statistical profile of direct Japanese investment in Indonesia as well as a discussion of the transfers of Japanese technology in Indonesia, both in general and specifically within individual Japanese subsidiaries. It argues that there is considerable potential for technology transfers due to the very size and diversity of Japanese investment in Indonesia. Effective technology transfer has indeed taken place in Japanese-controlled enterprises but the important question is, first, what kinds of technology transfer have been realized, and secondly, whether the transferred technologies have contributed to enhancing local technological capabilities among Indonesian employees. The study aims at contributing important insights into an on-going discussion on the effectiveness of Japanese technology transfers. It presents empirical evidence that operational capabilities can generally be successfully transferred whereas the transfer of adaptive and acquisitive capabilities, let alone innovation, takes place less frequently. In this respect the paper attempts to provide answers why the transfer of those latter technological capabilities has been less successful. The paper concludes with emphasizing the need for a stronger local technological effort in order to enhance Indonesian absorption capacity of Japanese technology and what measures can be taken to enhance Indonesia's absorptive capacity for mastering foreign technologies. The report also contains a separate supplement exploring the socio-cultural aspects of the application of Japanese technology in Indonesian enterprises.

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1 Introduction

`We should buy or even steal the technology … If we keep waiting for Japan to be willing to transfer its technology to us, we'll be disappointed.' This provocative statement was made in 1996 by the late Hero Kuntjoro-Jakti of the Center of Japanese Studies at the University of Indonesia in Jakarta (*Jakarta Post,* 14 June 1996). It reflected a pre-crisis, but erroneous conviction among some Indonesian economists that a continued industrialization would involve an industrial upgrading which in turn would require a rapid technological advancement that could only be accomplished through access to and mastery of modern technologies available abroad. The cited statement, however, also reflected the writer's pessimism about the actual technological impact of Japanese investment in Indonesian manufacturing.[1] Yet such a judgment needs qualification. It is a one-sided and erroneous standpoint since the technological development above all depends on the firm's own technological efforts. A passive dependence on technology transfers from abroad will indeed result in a limited impact on the acquisition of technological capabilities. A pro-active attitude of the firm in question is required in the sense that the firm in question needs to invest in the development of its technological capabilities. Experiences in manufacturing in South Korea and Taiwan testify to this effect (Hill and Thee 1998). This study is about the link between Japanese technology and the prospects for economic growth in Indonesia. Is the situation as discouraging as some thought it was before the crisis? Does today's situation with Indonesia on the threshold of struggling to achieve economic recovery inspire more confidence?

[1] A common view was that `Japanese firms offer little hope for an increase in the technological capabilities of Indonesian firms' [`perusahaan-perusahaan Jepang kurang memberikan harapan bagi peningkatan kemampuan teknis perusahaan Indonesia'] (*Suara Karya,* 1 July 1993).

This question is addressed by reviewing the existing literature and drawing on empirical data on the level of individual firms within the wider context of direct Japanese investment in Indonesia. An historical perspective is applied to sketch this general background (section 2) whereas specific attention is given to the scope for technological transfers deriving from a statistical profile of Japanese firms operating in Indonesia today (section 3). A brief digression on technology transfers in Indonesia in general (section 4) serves as an introduction to the more detailed discussion of actual transfers of technology as realized in several Japanese-controlled firms (sections 5). The paper also contains some concluding remarks (section 6) as well as a list of references and a number of tables.

2 Japanese direct investment in Indonesia

Major macroeconomic changes in both countries involved coincided in giving a powerful impetus to fresh Japanese investment in Indonesia in the late 1960s and early 1970s. The climate for foreign investment improved significantly with the Foreign Investment Law introduced by the New Order government in 1967 whereas in Japan restrictions on international capital movements were eased while large Japanese firms facing rising wage costs at home started to look for overseas production sites. Foreign direct investment in general, including Japanese direct investment in the late 1950s and early 1970s, may be considered as a `defensive investment' undertaken in order to retain market shares in light of the import-substitution policies of the Indonesian government which were supported by strong import protection (cp. Corden 1978: 332).

Many of the Japanese pioneers starting out in the years 1969-1973 have gained a familiar ring in Indonesia. Early investors in manufacturing included Ajinomoto in food processing, Kanebo (KTSM) and Century (CENTEX) in textiles, Toyota Astra in motor car assembly, Sanyo and National Gobel (Matsushita) in electrical and electronic products, Asahimas Flat Glass, Kalimantan Steel (KALISCO), Kediri Wood, Voksel Electric in wire-making and Tanabe Abadi in pharmaceutical products. Outside manufacturing, Misaja Mitra and Maluku Pearl in fisheries as well as Nisconi (Nippon

Steel) and Jaya Obashi in construction or Dai Nippon in printing all began operations prior to the Tanaka riots in January 1974.

The process of further accumulation of Japanese direct investment in Indonesia may be divided into a number of phases based on numbers of new establishments and capital committed (Table 1). The first phase, up to the anti-Japanese riots in January 1974 and the turn to a slightly more restrictive climate for foreign investment in Indonesia in response to these riots, had brought a fair number of relatively large enterprises, especially in consumer goods assembling and basic metals industry. The largest two were Asahimas Flat Glass, starting in 1973 and eventually reaching a paid-up capital corresponding to some. $ 80 million, and Yamaha Indonesia in the motor cycle manufacturing, commencing operations in 1974 and drawing on a paid-up capital of $ 61.8 million. Apparently the anti-Japanese riots did not cause a halt or even slowdown to incoming Japanese investment. Yet, newly arriving firms during the second half of the 1970s were on the average smaller, numbering about 13 per year with less than $ 7 million each in terms of paid-up capital. One notable exception to the rule was Mitsubishi Krama Yudha for the production of automobile engines, starting in 1975 and now registered with a paid-up capital at $ 27.6 million. A prominent feature of investment throughout the 1970s was the concentration on labour-intensive production for purposes of import substitution and on resource-oriented investment for exports back to Japan or to third countries. This was a characteristic which the Japanese-affiliated enterprises shared with both foreign direct investment from other resource-poor countries, such as South Korea which undertook large investments in for instance the timber industry, and also with new domestic Indonesian firms. Textile manufacturing was especially favoured at this time (Mizuno 1996: 29),

There was a lull in incoming Japanese investment and investment from other source countries as well during the early 1980s, notably in the years 1980-1982, in response to the increasingly restrictive policies pursued by the Indonesian government towards foreign direct investment. Numbers of new subsidiaries fell to five or six per year which in turn was ascribed to the poor growth performance if Japanese firms throughout the 1970s as well as to rising competition from domestic producers and adverse government policies, in particular with regard to requirements for a gradual `Indonesianization' of

equity holdings. The time was not yet ripe for a shift in manufacturing production from import substitution to export orientation and policies favouring import substitution had not yet been abandoned (Kinoshita 1986: 42, 47, 49-51). Figures on average paid-up capital during this transitory phase are highly misleading as the huge Asahan aluminum smelter in North Sumatra, a joint venture with the Indonesian government, alone accounted for $ 920 million or almost two-thirds of the total for all firms during the entire first half of the 1980s.

The shift to export-oriented manufacturing followed in the late 1980s, in response to the end of the oil boom in 1982 and the steep yen appreciation after 1985. The former forced the Indonesian government to formulate export promotion policies so as to reduce the excessive dependence on oil revenues. This implied that the Indonesian government needed to introduce various deregulation measures in order to promote a more efficient a and internationally competitive private non-oil sector with a considerable participation by foreign investors. Numbers of newly established Japanese firms – as well as those of other foreign firms - began to climb in 1988 in response to the improvement in the investment climate created by deregulation. Large Japanese investors starting operations in that year included YKK Alumico, for making aluminum billets and doors, and Ajinex International for seasoning products citing a paid-up capital of respectively $ 46 and $ 44 million. The late 1980s also saw the arrival of major Japanese-controlled banks such as Sumitomo, Sanwa and Sakura, in response to the far-reaching deregulation and liberalization in Indonesian banking at the time.

The upward trend continued into the 1990s. A peak year was 1992 when 48 new Japanese firms became operational, including Styrindo Mono with a paid-up capital of $ 81 million in the petrochemical industry. This was the period in which a new type of Japanese investment in Southeast Asia took shape involving not only large enterprises but also small- and medium-size Japanese firms in response to the lifting of restrictions of foreign investment by small- and medium-size firms. The new subsidiaries operated within regional subcontracting and procurement networks. The characteristics of this change in the character of Japanese foreign investment after the Plaza Accord of 1985 has been described in detail elsewhere and need not be repeated here (Phongpaichit 1990; Fukushima and Kwan 1995). Significantly, numbers of new Japanese foreign investment

projects were four times as high during the first half of the 1980s compared to the second half of the 1980s whereas average equity had dropped to only one-half of it previous level.

The mid-1990s brought fresh Japanese investment to a climax. Numbers of new arrivals reached a maximum in 1996 at almost 100 whereas net inflows of foreign direct investment, as recorded by the Indonesian central bank, climbed to $ 6.2 billion or three times as much as in 1994 and 40 % above the level in 1995 (JETRO 2000b: 3).[2] The general trend towards a stronger participation by medium-size Japanese investors was continued from the early 1990s. A notable exception to the rule was Chandra Asri in the petrochemical industry, starting operations in 1995 with a paid-up capital of $ 400 million. The surge of incoming Japanese investment in the mid-1990s was greatly aided by the successive liberalization of Indonesian regulations for foreign investment culminating in the relaxation of the divestment requirements to a minority equity holding of maximum 49 % that became effective in June 1994. The rise of new Japanese investment was of course accompanied by an even steeper increase of investment from the East Asian NIEs (Newly Industrializing Economies, i.e. South Korea, Taiwan, Hong Kong and Singapore).

A second major characteristic of foreign investment in Indonesia in general and Japanese direct investment in particular was the continuous tendency towards diversification into the most varied branches of manufacturing and services. By 1996, a total of $ 25 billion had been pledged by Japanese companies for investment in other sectors than banking, finance and oil. Manufacturing accounted for 85 % of the total and the foremost industries were machinery, including electrical and electronic products, and chemicals whereas a traditional labour-intensive industry such as textiles was good for less than 10 % of the total (Table 2).[3] The increasing diversification of Japanese business in Indonesia is crucial also with respect to the potential for transfers of technology.

[2] It should be noted that statistics on outflows as collected by the Ministry of Finance in Japan are significantly lower, $ 2.4 billion for fiscal year 1996/97, 50 % above the figure for fiscal year 1995/96 (JETRO 2000b: 17).

[3] These data are based on approvals by the Indonesian Coordinating Board for Capital Investment, BKPM. It is clear that realized investment was far less but regrettably the BKPM does not disclose such data for individual investors. For a digression on these and related technical matters, see Hill 1988.

The record for the year 1997 still reflected the pre-crisis optimism among investors in Indonesia. The number of new subsidiaries was still relatively high, 65, whereas net incoming flows, according to the balance of payments statistics, amounted to $ 4.7 billion, still more than had been the case in 1995. Sumi Rubber started operations only a couple of months before the rupiah was allowed to float in August 1997 and committed $ 100 million to its new tire factory in West Java. Then came the crisis. Numbers of new arrivals collapsed and inflows fell to levels which had not prevailed since the early 1990s.[4] According to the Japanese Ministry of Finance, direct investment in Indonesia accounted for slightly more than $ 1 billion in fiscal year 1998/99 but balance of payments data hint at an effective net outflow of some $ 350 million (JETRO 2000b: 3, 17). The situation was no better in 1999 when only seven new Japanese subsidiaries were set up, including sizeable investments undertaken by Honda Prospect Motor and Mitsubishi Smelting in copper processing. Just like for 1998, reports and notifications with the Japanese Ministry of Finance suggest a markedly lower level than before, about $ 900 million, whereas balance of payments data again point at a net outflow of as much as $ 2.7 billion (JETRO 2001c: 18).

Circumstantial evidence indicates that most Japanese investors chose to adjust to the crisis by seeking compensation for the weak domestic market in increased foreign exports (Thee 2000: 441). In addition, Japanese equity participation was raised as Indonesian partners often lacked funds for planned investments. Spectacular Japanese equity gains were the virtual takeover of IKI (Indah Kabel Indonesia) by Sumitomo in September 1998, the increase of equity held by Nissho Iwai in Kaltim Methanol from 25 % to 85 in July 1999, the takeover of the Indonesian cosmetics firm Tancho by Mandom Corporation in August 2000 and the purchase of one-half of Federal Motor by Honda in September 2000.

The experiences of Japanese investors in Indonesia at the time of crisis are quite well documented. It appears that the predicaments of crisis were especially felt in the results over 1997. Out of 258 surveyed Japanese firms, 44 % (113 firms) still made a profit in 1997 while about one-half (131 firms) reported losses (JETRO 1999: 23). Corresponding

[4] The high averages for new subsidiaries and their paid-up capital applying to the second half of the 1990s in Table 1 obviously give a skewed impression since the period contains both the boom years 1995-1997 and the crisis years 1998-1999.

figures for 1998 were 58 % (130 firms out of 226) and 38 % (85 firms) respectively. Expectations for 1999 were optimistic so that the percentages were projected at 69 % and 18 % respectively (JETRO 2000c: 10). A large majority of the firms surveyed in late 1999 expected sales to increase from 2000 onwards.

The score of profit-making firms was strikingly high in certain major branches of manufacturing. Out of 35 respondents in the electrical and electronics industry, 23 made profits in both 1998 and 1999 whereas the score for an equal number of chemical manufacturers (35) rose from 21 in 1998 to 27 in 1999. Textile producers did it worse in 1999 than in 1998 with 16 out of 25 firms reporting a positive performance against 22 in 1999 (again out of 25). Plans to expand in the near future were reported by about one-half of the firms surveyed in early 2000 and in this regard the chemical firms displayed the greatest optimism (JETRO 2000d: 13, 28). Numerous well-known Japanese firms caught headlines in the Indonesian press in 2000 and early 2001 with announcements of new, bold investment projects, for instance Mitsui with a petrochemical plant in East Java, Nissan with a new transmission factory, Hitachi with a construction machinery factory in Jakarta and Honda with a new assembly plant or Asahimas with new facilities for flat glass manufacturing. This all suggests a rather successful adjustment by Japanese firms to the economic crisis in Indonesia.

During the past three decades Japanese companies have obviously acquired a highly significant position in the Indonesian economy. Japanese investment easily dwarfs other foreign investment in Indonesian manufacturing. In terms of realized – as opposed to approved – investment, Japanese manufacturing firms have invested twice as much as British or Hong Kong competitors and three times as much as firms from Singapore, Taiwan, South Korea or the United States.[5]

[5] Data obtained from the BKPM office in Jakarta in July 2000. Figures on realized investment are accumulated over the period 1967-January 2000. The total is $ 67 billion. The aggregate accumulated value of approved investment over the same period amounts to $ 228 billion which implies an average realization rate of 29 %.

3 Statistical profile of current Japanese investment

The Japanese presence in Indonesia today is conspicuous. In 2000 the number of Japanese nationals working in Indonesia was about 4,600 or one-quarter of all expatriates working in foreign-controlled enterprises. The Japanese firms have between them generated employment for almost 220,000 Indonesians which, again, corresponds to one-quarter of all employment opportunities created by non-oil foreign direct investment in Indonesia (*Business News,* 27 October 2000). Apart from employment effects, the Japanese subsidiaries in Indonesia make a considerable contribution to the Indonesian economy in terms of export earnings and tax revenues – a quantification of these effects appears to be sadly lacking in the literature. Yet the main expectation from the Indonesian side is to gain access to advanced foreign technology through Japanese investment in production facilities. The potential scope for effective technology transfers is in the first place determined by the character of foreign investment projects. In general, a foreign firm will have to apply more advanced technologies and management methods in order to survive in the competition with domestic firms. The realization of effective technology transfers depends strongly on the interplay between the dissemination of technology by the foreign investor on the one hand and the absorption by the local partner on the other. This section focuses on the former of these two factors whereas the interplay between dissemination and absorption is discussed below (sections 4 and 5).

A statistical profile of the entire population of Japanese subsidiaries in Indonesia enables us to characterize the type of investment ventures which has evolved over the years with greater precision than may be gleaned from general impressions or circumstantial evidence. For this purpose, information was examined concerning 681 Japanese subsidiaries registered as operating in Indonesia in 2000 and/or 2001.[6] As may be expected, there is a strong predominance of manufacturing in the total, both in terms of numbers of firms and paid-up capital (Table 3).[7] Seven out of ten Japanese firms are in

[6] The total number of Japanese firms in Indonesia is larger as it also includes representative offices and agencies. In total the BKPM has granted approvals to 1200 Japanese investment projects since 1967. Two consecutive issues of the same directory were used in order to minimize omissions due to underreporting.

[7] In measuring equity preference was given to paid-up capital above authorized capital but on rare occasions the latter was used as no data was given on the former while there was reason to believe that the company had indeed become operational. Paid-up capital was given in US $ in 565 cases, in rupiah in 98

manufacturing and more than three-quarters % of all paid-up equity is found in this sector alone. However, the role of finance (banking, insurance, leasing and other financial services) is far from insignificant with as much as 15 % of total equity against only 7 % of all enterprises. It is the other way around in Other services claiming a markedly larger share in numbers of firms, 21 %, than in terms of paid-up capital, 7 %.

Small-scale Japanese business is especially characteristic for the primary sector and other than financial services. The minute primary sector contains such diverse lines of production as crocodile farming, a tea plantation, pearl fisheries in Maluku and a coal mine in East Kalimantan. Other services forms an equally amorphous agglomeration of economic activities. Investment in office buildings and real estate is the largest sub-sector with 37 % of all equity in the sector. The single largest enterprise is Wisma Kyoei Prince, managing office buildings since 1993 and eventually reaching a paid-up capital level of $ 42 million. Other property management covers for instance industrial estates, the Nikko Hotel in Bali or the Summit Mas and the Sari Pan Pacific in downtown Jakarta. Construction, printing, trading and shipping taken together account for more than one-half of all firms in this sector but total equity corresponds to less than one-quarter of the total. Operations of several firms in these branches date from the 1970s, for instance Pakarti Tata in shipping (1976) and Taiyo Sinar Raya Teknik in construction (1977). Yet another 40 % of total equity in the sector labeled Other services has been gone into a wide variety of services including consultancy, security and maintenance, soft- and hardware support and recreation facilities. The two largest enterprises in this category are the Damai Indah Golf Course in Tangerang near Jakarta, which opened up in 1993 with a paid-up capital of $ 27.2 million and the Jakarta International Trade Fair from 1992 whose equity is as much as Rp. 150 billion or $ 60 million at the pre-crisis exchange rate but a mere $ 15 million at the exchange rate of 2001.

Finance forms a particularly interesting category of investment as it is regulated by another law administered by the Department of Finance and thus by definition not

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cases and not at all in 18 cases, i.e. data are missing in less than 3 % of all cases. When converting equity given in rupiah into US $, it was impossible to apply the exchange rate at the time of payment as that would be different for each individual firm and even within the stages of build-up of the same firm. See further Table 1, note. Use of post-crisis exchange rates, for instance the most recent one of Rp. 10,000/$, would obviously reduce all rupiah-denominated equity dramatically and vastly understate the value of the investment at the time it was made.

included in the data provided by the Coordinating Board for Capital Investment (*Badan Koordinasi Penanaman Modal*, BKPM) and therefore often left out altogether in reviews of Japanese investment in Indonesia. There are ten banks, of which the oldest one, Daiwa Perdania, began operations already during the Sukarno period. The largest one, Bank Sumitomo, reports a paid-up capital of Rp. 753 billion, i.e. $ 300 million at the pre-crisis exchange rate but only $ 75 million at the subsequent depreciated rupiah value. The ten banks account for almost two-thirds of all equity in this sector whereas other financial institutions, such as Nikko Securities and Nomura Indonesia, claim one quarter of the total. Dipo Star Finance in Jakarta of 1984 is the largest single enterprise with an equity of Rp. 100 billion or $ 40 million at the pre-crisis exchange rate. The insurance and leasing business both date from the 1970s counting the Mitsui Marine insurance company from 1976 and PERLI (Perjahl Leasing Indonesia) from 1975 among its pioneers. Not surprisingly, very few firms in this sector started out after 1997. One notable exception is Royal and Sun Alliance Indrapura Insurance which set up business with support from Nissan in September 1998 registering a paid-up capital of Rp. 15 billion, at that time worth no more than $ 6 million. These summary data convey the impression that finance has emerged as an important complement to manufacturing activities of Japanese firms in Indonesia.

The various services and finance have traditionally had in common that little advanced technology was required, at any rate in terms of machinery. This may be changing as services are increasingly computerized and become highly dependent on international communication networks. Here a combination of imported Japanese equipment and the acquisition of skills in order to operate such equipment may provide opportunities for a dissemination of new technologies within the Indonesian work force. However, much depends on the educational achievement of employees prior to entering the Japanese firm. At any rate, it is advisable to include also firms in the services sector when assessing transfers of technology inside Japanese companies operating in Indonesia.

Manufacturing remains the sector with the highest potential for the introduction of new, modern advanced technologies not available in the host country but this potential is likely to show a considerable variation by industry and it is important to assess which industries are important and which are not. Already the summary statistics cited above (section 2)

testify to a shift in Japanese-affiliated manufacturing in Indonesia away from traditional labour-intensive branches such as textiles in favour of industries with a higher technological sophistication such as the electrical and electronics goods production or the chemical industry (Thee 1994). This is also brought out by the detailed information on the entire population of Japanese firms in operation in 2001 (Table 4).[8] There is a marked contrast between heavy industry such as chemicals and metals on the one hand, with one-half of the sector's total equity, against only 8 % being invested in textiles, including garments. Transport equipment, i.e. automobiles and motor cycles, and fabrication of electrical and electronic goods each account for about one-eighth of the total. The remainder, about 15 %, is taken up by a whole host of industries such as food processing, wood and paper, plastics and rubber, and other machinery.

Large enterprises are especially found in the chemical and metallurgical industries but in the latter case the average is inflated by the very large equity committed to the Asahan aluminum smelter. Other large enterprises in metals include Mitsubishi Smelting ($ 150 million), YKK Alumico ($ 46 million) and NSK Bearings Manufacturing ($ 45 million). The size distribution of firms in the chemical industry is also skewed towards a small number of very large enterprises, albeit to a less extreme extent than in the metals industry. One single investor, Chandra Asri for the production of ethylene and polyethylene, accounts for $ 400 million or one-fourth of total paid-up capital in the industry total whereas two other firms each registered a paid-up capital of almost $ 100 million or more: Amoco Mitsui PTA ($ 160 million) and Bakrie Kasei of Mitsubishi Chemical ($ 146 million). In the plastics and rubber industry, these highest ranks are occupied by Sumi Rubber of Sumitomo ($ 100 million) and IRC INOAC of Inoue (Rp. 110 billion). It is not easy to predict the potential for effective transfers of technology in the various branches of heavy industry. Medium-level technologies are likely to be applied in the production process with chemicals and machinery ranking higher on this account than rubber, plastics and metal fabrication (Hatzichronoglou 1997:6). Equipment from abroad is applied which necessitates the training of Indonesian personnel to operate and maintain the machines. On the other hand, the high ratio between capital and labour

[8] The classification in the original source differentiates between 23 different branches of manufacturing that have here been merged into ten homogenous categories (Table 4).

implies that the number of persons affected remains limited. By its sheer weight in the total of Japanese investment, heavy industry could possibly make a substantial contribution towards technological upgrading of Indonesian manufacturing but the degree to which this is realized may in practice prove rather limited.

The textile and garments industry in Indonesia expanded exceptionally fast in the period 1986-1996 in response to the new export opportunities opened up by the shift to export promotion policies in the late 1980s. Foreign partners served as a key to the technological upgrading of production but newcomers investors benefiting from low Indonesian wages came from the Asian NIEs rather than from Japan. Among the larger Japanese firms in the industry, ITS Toray (Indonesia Toray Synthetics) with a paid-up capital of $ 54.8 million and TIFICO (Teijin Indonesia Fiber) with Rp. 93 billion at its disposal, both date their operations from the 1970s whereas Nikawa for manufacturing cotton fabrics and yarns ranks as the single largest late-comer citing a paid-up capital of $ 50 million. There has been an increasing tendency towards a high capital intensity and a high degree of automation in production among Japanese late-comers in the industry which contrasts with the emphasis on large-scale employment at low wages that prevailed in the initial phase. The increasing technological sophistication in some of the Japanese-affiliated textile production has probably enhanced the potential for technology transfers but the scope remains limited since this industry has come to occupy a rather marginal role within total Japanese investment in Indonesian manufacturing.

Metal components manufacturing saw a spectacular expansion in Indonesia between the mid-1970s and 1997 in response to the mandatory `deletion' program for the engineering goods industries introduced in the late 1970s and only abandoned in 1993 in favour of a so-called `incentive' policy to promote firms supplying components. Total employment increased from 87,000 in 1975 to 520,000 by 1995 but, significantly, the proportion of employment in sheer assembly operations in the total fell from 60 % to 32 % Foreign firms have played a key role in monitoring both the rapid expansion and the technological of production but the import share of procurement has frequently been very high, for instance 93 % in electronics or 89 % in automobile production (Sato 1998: 111, 118-121). The potential for technology transfers is considerable due to the level of technology applied, ranked from medium to high (Hatzichronoglou 1997: 6). In addition,

relatively large numbers of workers are involved as production processes may be characterized as both capital- and labour-intensive. On the other hand, it is well known that linkages with domestic suppliers do not easily materialize. Local organization of production and local absorption capacities become especially important here but this is a matter to which we will return in due course (section 5). These characteristics apply to the two main production lines in metal components manufacturing, i.e. transport equipment and electrical and electronic goods.

Assemblers of motor cars and automotive components make up most of the Indonesian-Japanese joint ventures in the transport equipment industry: 61 out of 68 firms. There has been a tendency towards concentration among the Indonesian partners who have had a particularly important role to play in this industry since most establishments date from before the relaxation of the requirement of majority Indonesian equity ownership in 1994. Four Indonesian partners divide the market for Japanese cars in Indonesia between them: Astra (Toyota, Daihatsu, Isuzu and Nissan diesel buses), Indomobil (Mazda, Suzuki, Nissan passenger cars and Hino buses) , Imora (Honda passenger cars) and Krama Yudha (Mitsubishi). The largest firms include Honda Prospect Motor that began production only in 1999 aided by a paid-up capital of $ 70 million, Astra Daihatsu from 1983 ($ 50 million), Indomobil Suzuki from 1991 ($ 45 million) and Hino Indonesia from 1986 ($ 40.3 million). Three major motor cycle manufacturers produce for the Indonesian market, and to a small extent for exports, the old-timers Honda and Yamaha from the pioneering period in the early 1970s and the late-comer Kawasaki, starting out only in 1995. Honda Astra Motor is market leader with about 50 % of total sales whereas Yamaha has the largest paid-up equity capital (Thee 1997).

Well-known brand names also mark the successive build-up of the Japanese-controlled manufacturing of electrical and electronic goods. Sanyo and Matsushita (National Gobel) both count among the earliest pioneers whereas the acceleration of new Japanese investment in the mid-1990s brought export-oriented production facilities of firms such as Sony, NEC, Sharp, Epson, Hitachi (apart from the existing production of construction machinery) and Toshiba. Largest are two subsidiaries of Matsushita, Lighting in Rembang in East Java and Semiconductors near Jakarta, each representing a paid-up capital of $ 60 million. Both began operations on the eve of crisis in 1997. Just as with

the producers of automobiles and motor cycles, the manufacturers of electrical and electronic goods do not form extremely large companies as in the chemicals or metals industries but rather medium-sized local subsidiaries of leading Japanese concerns with very considerable resources for research and development. This may intuitively suggest promising prospects for technology transfers. Yet, again, realization depends highly on the way in which production is organized locally.

A final important aspect of our profile of current Japanese business in Indonesia refers to patterns of equity distribution. The requirements in terms of a majority local equity participation in force between 1974 and 1994 served to improve the chance that foreign investors, in particular Japanese firms, would indeed part with their technological know-how. On the other hand, there is a strong preference for a majority equity ownership on the part of the Japanese investor, just as among foreign investors in general in order to maintain management control over their operations. This clearly causes a conflict of interests and it is important to survey the situation as it has evolved since 1994 when these requirements were relaxed. Already existing Japanese firms were likely to seize the opportunity to raise their equity participation until above 50 %, especially when an expansion of existing production facilities had be financed. Newcomers would generally not settle for less than one-half of total equity. Out of the 670 firms for which equity distributions could be traced, 28 % (188 firms) opted for 100 % Japanese ownership whereas another 58 % chose to hold between 50 and 99 % of equity. By implication, only 14 % (92 firms) of the surveyed firms operated under an equity arrangement affording majority rule by the Indonesian partner.[9] The strong Japanese predominance in terms of equity ownership in subsidiaries in Indonesia today implies at any rate that the scope for actual transfers of technology is more determined by Japanese business strategies and the absorptive capacity of the Indonesian employees than by Indonesian policies.

[9] Among firms with a minority Japanese equity ownership, a relatively large group (37 firms) held exactly 49 % of equity, presumably a heritage from the time when a gradual shift to wards Indonesian majority ownership was required by law.

4 Technology transfer in Indonesia

A thorough examination of the extent to which technology transfers actually take place presupposes a clarification of terminology. In the most general sense of the word, `technology' is a system of production in which inputs are transformed into outputs. It includes specifications of inputs, outputs and organizational arrangements. Productive activities may are of three types: operations, improvement and innovation. The latter two can refer to both processes and products. Taken together they convey technical change (Kuroda 2001: 38-39, 186). An especially important form of improvement is adaptation to local conditions. Not all imported technologies are equally suited for implementation in a developing country such as Indonesia. This study therefore implicitly also addresses the question whether technologies transferred through Japanese investment are indeed the most appropriate ones for Indonesia. Transfers of technology may prove ineffective precisely because not the right kind of technology was chosen in the first place or because local absorptive capacities were inadequate.

The success of an international technology transfer is measured by the extent to which Indonesian nationals have achieved technological capability so that they can use imported or transferred technology efficiently. It is useful to distinguish between four types of industrial technological mastery (Sripaipan 1990: 7):[10]

(1) *Acquisitive* capability, i.e. knowledge and skills required to search, assess, negotiate and procure relevant foreign technologies as well as to install and start up the newly set-up production facilities.

(2) *Operational* capability, i.e. knowledge and skills required for an efficient operation of the production process, including maintenance and repair of the machinery.

(3) *Adaptive* capability, i.e. knowledge and skills required to carry out minor modifications of processes and/or products.

(4) *Innovative* capability, i.e. knowledge and skills needed to carry out research and development (R&D) in order to make major changes in process and/or product technologies.

[10] For a slightly different formulation (acquisition – development – utilization – maintenance) see Prayoon 1991: 175-176.

The effectiveness of technology transfers is measured by scores on the development of each of these capabilities.

Much of the literature applies a rather narrow conception of technology transfer stressing the actual transmission of skills from one individual to another. This is accomplished through training, both formal and non-formal, as well as through participation and observation while working in a foreign-controlled firm. Chief channels for such transfers are foreign direct investment and technical assistance programs under the auspices of official aid. Such a narrow conception of technology transfer has an important shortcoming as it leaves out the absorption of foreign technologies through technical licensing or use of imported machinery and equipment. In either case, there need not be any foreign equity participation or direct foreign involvement with the firm in question. A broader conception of technology transfer should incorporate also the absorption on the level of the individual firm and the diffusion of imported technology throughout industries. Both in turn are highly dependent on conditions in the receiving country, especially with regard to economic incentives and human resource development.

Japanese firms made use of their comparative advantage when making a major contribution towards building up the manufacturing sector in Indonesia during the New Order period. Yet complaints persisted that Japanese firms in Indonesia applied only outdated, labour-intensive production techniques not in vogue any more at home and that they were even less willing than Western firms to share their advanced technologies with local partners (*Kompas,* 20 January 1994; Yamashita 1992: 6).[11] Technological capabilities were shown to have improved more in local firms operating under technical licensing agreements (i.e. without Japanese equity participation) than in foreign-controlled firms. A possible explanation is that a greater effort to master new technology was required in the former case (Thee 1990).

More recent research has produced some new insights. The idea that Japanese firms are unwilling to part with their knowledge is refuted by empirical evidence on the numerous opportunities for training of Indonesian personnel offered by Japanese firms (Thee 1994:

[11] One recent example of offering outdated Japanese equipment to Indonesia was the grant of 72 second-hand Japanese trains, mostly about 30 years old, by the Tokyo metropolitan government to the Jakarta metropolitan transport authority in May 2000 but it must, of course, be remembered that this equipment was provided for free.

53-54). The higher productivity in manufacturing branches with a strong foreign presence was taken as an indication of technological spillovers from foreign-controlled to domestic firms within the same line of production (Sjöholm 1998). There was ample evidence of successful but limited transfers of technology in export-oriented firms in a number of industries such as textiles, garments and electronics. Operational capabilities in particular had by and large been acquired by domestic firms whereas innovative capabilities still remained beyond reach (Thee and Pangestu 1998: 261-262). An in-depth study of the implementation of Toyota's production system (TPS), in the assembly lines of Toyota-Astra in Jakarta showed that operational and adaptive capabilities, including some process design, had been successfully transferred to the Indonesian personnel (Nakamura and Wicaksono 1999). The need to improve the image of Japanese firms as motors of Indonesian industrialization even surfaced in the daily press, for instance in 1997 when a Sumitomo-NEC combination announced plans for investment in a semiconductor plant in Bekasi near Jakarta while pledging to contribute to technological progress (*Jakarta Post*, 11 June 1997). Such public statements underscore the relevance of a study as the present one.

The focus in the literature has so far been on technology transfers in Japanese-affiliated enterprises in manufacturing. Scant attention has so far been paid to applications of imported Japanese technology in domestic Indonesian firms. An additional avenue refers to the degree to which Japanese firms in Indonesia procure materials and parts from domestic sources. Such procurement may result in the introduction of new lines of production and the setting of new standards of technological sophistication among local suppliers. Indonesia is known to have lagged behind Thailand and Malaysia in terms of raising levels of local procurement by Japanese subsidiaries. The share of locally obtained inputs in Indonesia rose from only 14 % in 1975 to 41 % in 1985 which was the same level that had prevailed in Thailand already in 1975 but far below the Malaysian level even at that time (Kimbara 1991: 161). According to surveys among Japanese investors in Indonesia undertaken in 1998 and 1999, one-third of responding firms reported that they acquired at least one-half of inputs from local sources. Another one-third purchased more from Japan than from any other source. Significantly, among firms procuring locally in the first place, more than 45 % relied on other Japanese firms in

Indonesia for at least one-half of their inputs (JETRO 1999: 34; JETRO 2000c: 27; JETRO 2000d: 21). This tells us that Japanese confidence in the capabilities of local Indonesian suppliers is at best limited which in turn may restrict the scope for an effective diffusion of technology.

Any discussion of technology transfers from Japan to Indonesia must include also a brief mention of transfers within the context of official development aid. There are two channels of government-sponsored transmission of Japanese technologies to Indonesia, one for Indonesians going to Japan for training, the other for Japanese instructors coming to Indonesia. The former flow is administered by the Indonesian-Japanese *Lembaga Kerjasama Teknik* (Institution for Technical Co-operation) which was set up already in 1979. By 1994 almost 1200 Indonesian participants from small- and medium-size private firms had been dispatched to Japan (*Suara Pembaruan,* 17 May 1994). The reverse flow of experts takes place under responsibility of the Japan Overseas Development Cooperation (JODC) that is partly funded by the Japanese Ministry for Trade and Industry (MITI, now called Ministry for the Economy, Trade and Industry, METI). Between 1979 and 2001, the JODC sent almost 950 Japanese experts, mainly engineers, to Indonesia for instruction in private firms that in turn bore 25 % of the costs. The JODC targets both domestic Indonesian firms and Japanese-controlled firms operating in Indonesia attaching equal priorities to the two types of recipients.[12] Such activities are likely to further the diffusion of new technical skills throughout various branches of manufacturing.

5 Technology transfers in Japanese firms

The true test of whether technology is actually transferred can only be carried out on the level of the individual firm. For this purpose seven Japanese-controlled companies operating in Indonesia were selected. The seven firms were selected so as to do justice to the high degree of variation in Japanese-affiliated business in Indonesia. The important

[12] Information obtained directly from the Japan Overseas Development Cooperation head office in Tokyo in May 2001.

transport equipment industry is discussed with the aid of a leading motor cycle manufacturer and two producers of automotive parts and components, which also highlights the local supply networks built up Japanese firms in Indonesia. Other branches of manufacturing are represented by a pharmaceutical enterprise and a furniture maker. Engineering and human resource development, finally, form examples of the increasingly important services sector. Each firm is described briefly below and assessed in terms of actual transfers of technology.[13]

Firm 1. A pharmaceutical joint venture

This firm counts among the pioneers of Japanese investors entering Indonesia soon after the liberal Foreign Investment Law of 1967. It was established in 1971, commencing operations in 1972, in response to a total Government ban on imports of foreign-made health products and may therefore be considered as a `defensive investment'. The mother company is a giant Japanese chemical concern with its roots in an eighteenth-century shop for Chinese herbal medicine in Osaka. The mother company quotes annual sales in excess of ¥ 900 billion and employs more than 9000 persons.[14] It initially held 90 % of the equity leaving the remainder for the Indonesian importer of the company's pharmaceutical products. In 1982 the Japanese share was reduced to 70 % while paid-up equity remained at $ 1 million. The Indonesian subsidiary possesses a factory in Bekasi (East Jakarta) for mixing and packaging capsules, tablets and ointment. There are 105 workers in the factory and another 100 employees at the head office in Jakarta. Products are marketed through a network of 150-200 detailers spread out all over Indonesia. The Japanese executive director is the company's sole expatriate.

All active ingredients in the drugs are obtained from the mother company in Japan which leaves little scope for research and product development beyond quality control at the Indonesian plant. Annual R & D expenditures at the mother company exceed ¥ 80 billion corresponding to more than 500 times total turnover in the Indonesian subsidiary.

[13] The selected firms had main offices and sometimes factory plants in the Greater Jakarta metropolitan region but marketing and subcontracting activities were carried out through the country. Names of firms are suppressed in order to protect the privacy of informants. We are grateful for the generous co-operation offered by all firms covered during our field work. All information on individual companies was gathered during interviews and site visits in July and August 2001 We also gratefully acknowledge the support given by the Jakarta office of JETRO.

[14] All information on the Japanese mother companies from: Japan 2000.

The production process is fully operated by Indonesian supervisors. Minor process adaptations also fall under their responsibility and on occasion local managers have had a decisive say in the choice of new machinery. The transfer of managerial responsibility to Indonesian staff occurred in the 1990s. Significantly, this took place in response to developments in the mother company in Japan rather than as a result of local pressures. A shift to a more performance-based system of promotion in the mother company implied less senior Japanese staff in Indonesia and thus more opportunities for Indonesian managers.

Training at this firm serves, amongst others, to disseminate the Japanese management philosophy *kaizen* which stands for continuous process improvement. For this purpose, experts from Osaka are sent to Indonesia to work for short periods in the firm. In addition, selected supervisors, and sales and marketing managers are sent to Japan to learn about the specific features of for instance newly introduced products. Turnover of plant workers is low but rather high among the marketing staff.

After three decades in Indonesia, technology transfer in this firm has been successful in terms of operational and adaptive capabilities but has not extended to the development of new products.

Firm 2. A motor cycle joint venture

This firm produces motor cycles of well-known Japanese brand, including components. Assembling began already in 1971 in an Indonesian-owned company under license from the Japanese principal. Local assembling of motor cycle bodies dates from 1974 and was done by a majority-owned subsidiary of the Japanese mother company. A separate joint venture for the production of engines was added in 1985. During a stepwise merger between late 1999 and January 2001, these three firms were amalgamated with the sales division of a leading Indonesian transport equipment concern to form a new company which is for 50 % owned by the Japanese motor cycle manufacturer.

The new company employs 6,500 persons divided over two large factories in the Greater Jakarta metropolitan region. Production capacity amounts to 1.2 million units per year which is more than at the principal's main factory in Japan. It should be added that the principal's main interest lies in car manufacturing with motor cycles contributing only

10 % of total sales revenues. While the mother company differentiates between a whole host of models, the Indonesian firm concentrates on eight types, including a very popular and highly profitable one that alone accounts for 80 % of annual turnover. The firm is in principle not allowed to sell motor cycles outside Indonesia but claims to be able to exercise less than full command over its dealers in this regard. Domestic sales fell dramatically during the recent economic crisis, from 900,000 units in 1997 to 250,000 in 1998 and 1999. The production schedule was reduced to one shift and a substantial number of the older workers was laid off through early retirement. A slight recovery was achieved in 2000 followed by a more complete return to pre-crisis levels in 2001.

Local content in the firm's motor cycles has now reached 70 %. In fact, all necessary components could in principle be produced in Indonesia but still have to be imported from Japan due to the lack of scale economies in the Indonesian operations. Under the original licensing agreement, even the slightest product modifications were prohibited and only after a considerable time did the Indonesian management get permission to make minor improvement of the engine in the most popular motor cycle type. Access to the newest process technology is provided by the Japanese principal but only on condition that this knowledge is not retransferred. However, local contributions in process development are encouraged and have taken place. Examples include the application of French turbine-driven disks in the paint shop and a computerized on-line product control developed in the Indonesian factory. All investments in process innovation are financed locally.

A high priority is attached to technical training. So far more than 600 employees have been sent for on-the-job training during six months in Japan (including language training). Operators in the Jakarta factories receive on-the-job training during 2-3 months. Turnover is low and the firm employs only twelve Japanese expatriates.

Over the years this firm has acquired a high degree of operational and adaptive capabilities, especially in the production process. Since it has been operating for decades as a domestic firm producing under license, it has also been in a position to develop at least some acquisitive capabilities in terms of obtaining and implementing relevant technologies. This conclusion is slightly more optimistic than an earlier observation pertaining to the entire motorcycle industry (Thee 1997: 129-130).

Firm 3. A Japanese service and consultancy firm

This firm is newcomer in the Japanese business community in Indonesia. It was set up in late 1997 to provide overseas business services, in particular recruitment and training of Indonesian staff in Japanese firms. It is a small-scale company with seven Japanese employees at the office in downtown Jakarta. Paid-up equity is only $ 440,000 which is for 91 % held by the Japanese staff. The firm has about 200 clients, including several major Japanese concerns. Its target was to have recruited, screened and trained 1,000 Indonesian employees by the end of 2001.

A major aim of the firm's activities is to instill Japanese cultural values and work ethic in Indonesian employees. This includes emphasis on the Japanese management philosophy concept *kaizen* (continuous improvement; cp. firm 1 above). The firm believes that a Japanese work ethic is essential for an effective transfer of technology. At the same time, it also sees as its task to inform new Japanese investors about Indonesian culture in order to avoid possible misunderstandings and conflicts.

Human resource development lies at the core of the business of this firm which implies an especially strong emphasis on cultural aspects. However important, such a focus may divert attention away from other aspects of technology transfer in Japanese firms, for instance the incentive system facing Indonesian employees.

Firm 4. An automotive component joint venture

This firm makes transmission gears and engine shafts for Japanese brand motor cycles manufactured in Indonesia. It was established in 1972 with an equity of $ 600,000 and began operations in 1973. The Japanese partner originally held 80 % of the shares but its stake in the enterprise was increased to 89 % during the recent economic crisis. Since 1996 the firm is co-operating with the Japanese-Indonesian motor cycle joint venture described above (firm 2). There are 305 employees, including five Japanese in top managerial and advisory functions who serve as intermediaries between the Japanese mother company and the local firm. The firm operates a factory in an industrial estate in East Jakarta and has a production capacity of one million units per year. Demand for

transmission gears is rising in the Indonesian motor cycle market, the third largest in the world, and the firm needs to invest in additional capacity.

Machines and raw materials are primarily imported from Japan and only a small proportion of the inputs is obtained from a Japanese-affiliated iron casting firm in East Java. All production technology is provided by the Japanese mother company in the form of manuals which are translated directly from Japanese into Indonesian. The process technology is of the intermediate type with only a limited application of robots for transporting items in the so-called machining process (forging, hobbing, milling, grinding and pressing steel bars). The computerized quality control is still done by Japanese staff members.

Technical qualifications are of key importance in the selection and recruitment of personnel. Operators are required to have at least graduated from a senior technical high school (SMTA, *Sekolah Menengah Teknik Atas*).[15] A large majority of workers comes from Central Java and turnover is said to be low because the firm pays slightly higher wages than the average for the industry. So far about 30 Indonesian employees have been sent to Japan for on-the-job training during three months. Another ten will be sent to Japan in the near future. Training in the Jakarta factory focuses on repairs and maintenance of the machinery.

Despite the fact that this firm has been in operation in Indonesia during almost three decades, management control is still by and large exercised by Japanese expatriates. Operational capabilities have been acquired by Indonesian staff but apparently not to the full 100 % considering the Japanese involvement in production management. However, plans do exist to replace the Japanese production director with an Indonesian national. There were few signs of adaptive or acquisitive, let alone innovative capabilities being transferred.

Firm 5. A joint venture for engineering and construction design

This firm is a joint venture between Pertamina, Indonesia's state-owned oil and gas company, and a Japanese steel producer. The firm was established in 1972 with a fully

[15] The recruitment of 32 new operators had taken place just prior to our visit to the company in mid-August 2001. They were selected from a pool of 170 applicants of whom 52 were invited to take a psychological test.

paid-up equity capital of $ 1.5 million. The initial Japanese share of 90 % was eventually reduced to the current 70 %, i.e. Pertamina now holds, directly and indirectly through a subsidiary, 30 %. The Japanese mother company is a giant steel producer with annual sales in excess of ¥ 2500 billion and 21,000 employees. The Indonesian firm obviously operates at a far more modest scale. The core staff of engineers used to count 80 persons but has been reduced to 20-25, a number that can easily by raised by subcontracting arrangements with former employees. The staff, in total about 50 persons, includes five Japanese expatriates in management and technical advisory functions.

The firm functions both as an interface between foreign oil companies and local Indonesian subcontractors and as an intermediary between the Japanese supplier of steel products and clients among the foreign oil companies operating in Indonesia. It offers a wide variety of services including engineering, material procurement, fabrication of offshore facilities, construction of platform utilities and the maintenance of existing LPG (Liquefied Petroleum gas) and LNG (Liquefied Natural Gas) production sites. Much of the actual work is done by local subcontractors operating out of the firm's barges, two large ones with a 200,000-ton lifting capacity and three smaller ones. The barges are towed by tugboats from the main supplier of steel materials in Batam (in fact, another subsidiary of the same Japanese mother company) to the offshore production sites near East Kalimantan or North Sumatra or in the Java Sea. The whole process is managed by Japanese representatives of the firm while Indonesian engineers supervise the actual construction of facilities.

The specific technical skills required in this firm's activities can only be obtained through on-the-job training on the production site. In view of the long history of the Indonesian oil industry, dating back to the Dutch colonial period, one may expect the necessary basic technical skills to be locally available. A recent improvement in the quality of work done by Indonesian engineers was also reported. Therefore, the chief contribution of the Japanese staff has come to consist of managerial know-how. One bottleneck in building up such skills is attributed to the unwillingness of Indonesian engineers to spend protracted periods of time on offshore platforms.

Despite experiences reaching back three decades in time, the operational and acquisitive capabilities to facilitate the oil and gas industry do not yet appear to have been

fully transferred to Indonesian employees, at any rate with respect to managerial responsibility as opposed to technical supervision.

Firm 6. A joint venture for automotive components

This firm was established in 1978, starting operations in 1979, as a joint venture between a Japanese manufacturer specialized in shock absorbers cycles and a leading domestic assembler of cars and motor cycles. Paid-up equity amounts to $ 10 million, slightly less than the originally authorized equity capital. Equity is for 55 % held by the Japanese mother company and for 45 % by the Indonesian partner. The actual Japanese share in the firm rose to 77.5 % in January 2001 when 50 % of the shares in the Indonesian partner were acquired by a Japanese motor cycle and car producer operating in Indonesia (firm 2 above). The Japanese mother company is product leader for shock absorbers in the ASEAN region. It operates out of Nagoya and boosts annual sales of ¥ 5900 million and a total work force of 2800 persons. The Indonesian subsidiary saw sales climbing from less than Rp. 100 billion in 1994 to a peak at almost Rp. 200 billion in 1997, i.e. before the crisis reduced purchasing-power in the domestic market. The firm has 927 employees including five Japanese expatriates in top management positions.

The firm's original factory in North Jakarta, dating from 1978, was supplemented by an adjacent plant in 1995 and again by a far larger modern factory erected in the late 1990s in the Cikarang industrial estate east of Jakarta. These additions to capacity were undertaken in response to the very rapid increase in domestic Indonesian demand for motor cycles in particular during the years immediately preceding the economic crisis. Current capacity per day is 4200 shock absorbers for motor cycles and 300 absorbers for motor cars. Local content in production has risen above 50 % and the remainder consists largely of steel imported from Japan. Exports traditionally amounted to only 10 % of output but climbed to 20 % as the economic crisis hit the domestic Indonesian market.

In principle product design remains the prerogative of the Japanese mother company but in the event the Indonesian subsidiary has been able to implement a number of minor changes. One example is an increase in the capacity to withstand greater shocks because of less well-paved or even potholed roads in Indonesia. The technology applied in the production process is downgraded from the hi-tech level used in the plants of the Japanese principal. This is above all reflected in labour productivity. The ratio of

operators to machines in the Indonesian factory is 3:1 whereas in Japan it is 1:3. No robots are used in the Indonesian plant but quality control is fully computerized. Indonesian contributions to process technology have embraced the design and layout of certain segments of the production sequence in order to better fit local working conditions. There is a potential for a further Indonesian involvement in process design as this firm has been designated to become the manufacturing base in Southeast Asia for a new type of shock absorbers suited for power-steered vehicles.

Indonesian managers are regularly sent to Nagoya for training during periods of up to one year, including extensive language training. So far 25 Indonesian managers have participated in such training programs that were in part financed by a subsidy from the International Labour Organization. In addition 10 operators were also sent to Japan for six-month stretches of on-the-job training but this was fully paid for by the company. Other operators are trained in the Jakarta factories by Indonesian supervisors.

Technology transfers have been quite successful in this firm as Indonesian employees have developed not only basic operational but also some adaptive and acquisitive capabilities.

Firm 7. A Japanese furniture manufacturer

This firm is a fully-owned Japanese firm specializing in classical wooden furniture, mostly for the export market. It was originally set up in December 1973, starting operations by 1975, as a joint venture between a furniture-maker in Shizuoka, south of Tokyo, and an Indonesian businessman. The latter's contribution, corresponding to 35 % of the equity, took the form of a plot of land in an industrial estate in East Jakarta where the two plants of the firm are still located. However, when the Indonesian partner defaulted in repaying the mortgage on this land, the Japanese parent company took over the liabilities in return for equity. Current paid-up equity amounts to $ 1.7 million which is now for 100 % in possession of the Japanese partner. Total turnover rose above $ 4 million in 2000 of which 97 % stemmed from export revenues, especially in the United States. The firm has 441 employees including two Japanese expatriates in executive positions. All production managers and supervisors are Indonesian nationals.

The original rationale behind the joint venture was for the Japanese firm to secure supplies of cheap raw materials (tropical timber) and for the Indonesian partner to get access to the newest technology in furniture-making. The Japanese mother company assumed responsibility for plant layout and the organization of production. Basic product designs are tailored to meet customers' preferences and further elaborated by Indonesian employees applying computer-aided design software. The two plants in Jakarta are equipped with highly sophisticated machinery for the final finishing segment in the furniture-making process. This places considerable demands on the technical skills of the Indonesian operators. One bottleneck in terms of transferring wood-processing skills is that Japanese firms do not generally provide manuals but rather rely on observation by apprentices. Basic skills at the level of junior technical high school (STM, *Sekolah Teknik Menengah*) among the Indonesian operators were judged to be sufficient but problems allegedly on occasion rose due to a work ethos different from that of Japanese employees (cp. firm 3 above). Each year small groups of Indonesian managers receive on-the-job training at the factory of the mother company in Shizuoka.

Adequate operational capabilities have clearly been acquired by the Indonesian staff at this firm over the years. Adaptive capabilities and acquisitive capabilities, however, have scarcely been transferred.

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The seven firms surveyed here obviously form only a very tiny proportion of the total population of Japanese-affiliated companies operating in Indonesia (the total number is estimated at 435 by the JETRO office in Jakarta). Yet, circumstantial evidence does support a generalization of the findings of this survey to a larger body of Japanese firms operating in Indonesia. Returning to the differentiation between four kinds of industrial technological capability (see introduction above), the following scores may be given on basis of this survey:

Acquisitive capability	2
Full operational capability	4
Partial operational capability	2
Adaptive capability	3
Innovative capability	0

The sole firm in the services sector (firm 3) does not fit into this classification and must be considered a special case. It would probably be too much to expect that foreign-controlled enterprises would be willing to fully transfer innovative capabilities which are crucial to the international competitiveness of such firms. Establishment of R & D facilities in Indonesia would at any rate require a sufficiently large scale of operations and a minimum reservoir of scientific skills. Yet, even if these two conditions were met, local R & D in the foreign-controlled firm would remain a mere dependency of the R & D at the Japanese mother company.

6 Concluding remarks

The focus of this study was on the link between Japanese technology and economic development in Indonesia. It contained both a historical survey and a statistical profile of Japanese direct investment as it has been built up in Indonesia since the late 1960s as well as a discussion on transfers of Japanese technology in Indonesia, both in general and specifically within individual Japanese subsidiaries operating in Indonesia. The main conclusions are as follows:

(1) The sluggish accumulation of Japanese investment in Indonesia over the years has allowed for both an accelerated expansion and an increasing diversification, within as well as outside manufacturing. This enhances the potential scope for technological contributions to local growth.

(2) Prospects for technology transfers in manufacturing are more promising in the metal components industry (transport equipment and electrical and electronic goods) than in heavy industry or textiles. Japanese management policies are crucial, not in the least due to the predominance of Japanese majority equity ownership.

(3) Assessments of the effectiveness of transfers of Japanese technology in Indonesia have become more optimistic as compared to the initial stage of investment. This study fits into the lively discourse that has developed in the literature on this topic.

(4) Empirical findings show that the transfer of operational capabilities in Japanese subsidiaries to Indonesian personnel has generally been successful even if this has not

always been accomplished for the full 100 %. Transfers of adaptive and acquisitive capabilities do occur but far less frequently. Transfers of innovative capabilities were not encountered.

One final consideration concerns local technological effort, i.e. the conscious exertion by the Indonesian firm to use technological information and to accumulate know-how in order to choose, assimilate, adapt or even create technology (cp. Bell, Ross-Larson and Westphal 1984: 107-108). While foreign direct investment can go a long way in terms of making new technologies from abroad accessible to the local firm, it alone cannot transfer all required technological capabilities for accelerating economic development. To develop and master the full range of technological capabilities, determined local efforts are needed. Only then can the full benefits from technology transfers be reaped.

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Tables

Table 1. Establishment of Japanese subsidiaries in Indonesia, 1969-2001

Start	No. of firms	Paid-up capital ($ mill.)	
		Total	Average
Before 1970	3	51.5	17.2
1970/74	55	548.2	10
1975/79	67	445.5	6.6
1980/84	28	1408.8	52.2
1985/89	55	1061.2	20
1990/94	210	1724.5	8.5
1995/99	256	2423.3	9.7
From 2000	4	0.3	0.1
Year unknown	3	2.6	1.3
Total	681	7665.8	11.6

Note: Years indicate commencement of operations. Paid-up equity capital given in rupiah has been converted into US $ at a stylized rate of exchange as follows:
- if start before 1986: the flat rate of 1990 (Rp. 2705/$) in order to account for the substantial expansion in existing investment projects during the surge of the 1990s;
- if start between 1986 and 1991: the actual rate five years after start, i.e. varying between Rp. 2849/$ in 1991 and Rp. 3427/$ in 1996, assuming a continuous five-year expansion period for ending with the onset of the crisis in 1997;
- if start between 1992 and 1996: the actual rate of 1996 (Rp. 3427/$), assuming expansion went on up to the crisis;
- if start from 1997: the rate of exchange actually prevailing during the crisis, varying between Rp. 6274/$ in 1997 and Rp. 11299/$ in 1998, eventually stabilizing around Rp. 10,000/$ in 2000.

Sources: JETRO 2000a: 313; JETRO 2001a: 1-333.

Table 2. Approvals of direct investment from Japan in Indonesia outside finance and oil, cumulative 1967-1996.

Industry	$ mill.	%
Food & beverages	492.5	2
Textiles	2050.3	8
Wood	238.5	1
Paper	2577.7	10
Pharmaceutical	28.9	0
Chemical	5138.7	20
Non-metallic Minerals	1365.5	5
Basic metals	2762.3	11
Metal goods	6843.4	27
Other	150.7	1
All manufacturing	21648.5	86
Other	3503.1	14
Total	25151.6	100

Source: Unpublished data from the office of BKPM in Jakarta.

Table 3. Japanese investment in Indonesia by sector in 2001.

Sector	Firms (no.)	Paid-up capital (mill. $)	Share (%)	Average (mill. $)
Primary	20	73.5	1	3.7
Manufacturing	474	5930.1	77	12.7
Finance	45	1134.1	15	25.2
Other services	142	528.1	7	4.0
Total	681	7665.8	100	11.6

Note: Paid-up capital given in rupiah has been converted into US $ at a stylized rate of exchange (see further Table 1, note). Aggregate paid-up capital in rupiah amounted to Rp. Rp. 3563 billion in Finance, Rp. 1646 billion in Manufacturing and Rp. 218 billion in Other services (all equity in the primary sector was given in dollars).

Sources: JETRO 2000a: 1-313; JETRO 2001a: 1-333.

Table 4. Japanese investment in manufacturing in Indonesia by industry in 2001.

Industry	Firms (no.)	Paid-up capital (mill. $)	Share (%)	Average (mill. $)
Food & beverages	10	120.6	2	12.1
Textiles	54	472.7	8	9.1
Wood & paper	21	90.3	2	4.3
Chemicals	57	1501.1	25	26.3
Plastic & rubber	31	239.4	4	7.7
Basic metals	75	1403.3	24	18.9
Transport equipment	68	701.3	12	10.8
Electr. & electronics	89	790.8	13	9.1
Machinery	15	205.4	3	13.7
Other	54	405.2	7	7.5
Total	474	5930.1	100	12.7

Note: Chemicals includes also glass manufacture. Basic metals contains iron and steel products and non-ferrous metals. Transport equipment consists of automobiles and motor cycles. Other includes the manufacturing of batteries, concrete piles, cosmetics, electrical power, liquid gas, medical equipment, pharmaceutical goods and wires. Paid-up capital given in rupiah has been converted into US $ at a stylized rate of exchange (see Table 1, note). The largest rupiah-denominated aggregated paid-up capital was in Other manufacturing, Rp. 459 billion.

Sources: JETRO 2000a: 1-313; JETRO 2001a: 1-333.

SUPPLEMENT

Socio-cultural Aspects of Japanese Technology

By Bambang Purwanto and Djoko Suryo

Abstract

The following account forms a separate supplement to the working paper `Indonesian Economic Development and Japanese Technology' by J. Thomas Lindblad and Thee Kian Wie. It offers a historical perspective to the application of Japanese technology as reflected by the use of Japanese equipment in Indonesia and describes the gradual shift away from Western towards Japanese technology in the course of the twentieth century. Empirical evidence is presented on the actual use of Japanese technology by Indonesian entrepreneurs today drawing on extensive fieldwork in several localities in Central Java. The contribution of Japanese technology to the production process is very substantial in several branches of manufacturing but the introduction and implementation of such technology is often done in a less than structured manner. This may result in a certain underutilization of technological potentials but it may also reflect a rational choice on the part of the local businessperson. In recent years there has been a trend towards replacing Japanese machinery with equipment from China, Taiwan and South Korea. These tentative observations serve to underscore the need for more detailed knowledge about the social and cultural aspects of implementing Japanese technology in domestic Indonesian firms.

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Socio-cultural Aspects of Japanese Technology

by Bambang Purwanto and Djoko Suryo

1 Introduction

Technological choice remains a high-priority item in economic development not least because of its socio-cultural ramifications. Changes in economic conditions will generally lead to changes in the functioning and structure of technological choices within society since the very origin of new technologies can be wholly or in part traced to economic and social structures. At the same time, technology exerts a macro influence on societies with its transformation reflecting the immediate intentions of powerful organizations in both private business and government.

Imported technology has historically played a very significant role in Indonesian industrialization as well as in daily life. Although it is widely admitted that Japanese technology constituted the foremost factor in accumulating the body of technology used today in Indonesia, it was in fact not until the second decade of the twentieth century that Japanese business firms began to contribute to Indonesian economic and technological development. The growing importance of Japanese technologies was disrupted by the Pacific War, but the quick recovery of Japan in the 1950s and 1960s brought this country to the fore as one of the world's leading exporters of advanced technology. Therefore, it is not surprising that the pattern of socio-technological organization in Indonesia has been largely shaped by Japanese capital and technologies, especially since the 1970s.

2 From Western to Japanese technology

It is often argued that the basis for the urgently needed and ardently desired technological and economic development of Indonesia was laid already in the colonial period. Although it is difficult to assess objectively to what extent current conditions were affected by the scale, extent and depth of the penetration by colonialism, many historical

documents do in fact illustrate the flow of funds, ideas, skills, and technologies from Western countries to the Indonesian archipelago that occurred simultaneously with the expansion of colonial power and Western capitalism.

Western technology was adopted as a vehicle for agricultural modernization and industrialization as well as in daily life. The technological development at that time and the superiority of the colonial power also had an influence on the way local people viewed Western technology. It was always considered superior to local or other imported technologies. This became even more clear when, from the late nineteenth century onwards, the social and cultural modernization of local society became embedded in a process of Westernization. However, there was also a certain ambivalence in the way Indonesians appreciated Western technology that came to the fore in connection with the quest for a national identity.

Despite the existence of first Chinese, then Japanese goods and capital, everything from the West was regarded as being technologically superior by local society. There was a tremendous flow of Japanese capital and goods to Indonesia from the early twentieth century but this did not really affect the main issues of technological choice. From a purely technological point of view, the Chinese and Japanese technologies available in the market at the time were still a relatively early stage of development compared to the Western alternative.

It is true that in the 1920s Japanese sandals, bicycles, textiles and many other goods had already become a substitute to imports from Europe or the United States. At the same time, Japanese planters, miners, traders, and shop owners were already expanding their activities in the economic life of the colony. The discovery and diffusion of different technologies in textile processing allowed Japanese manufacturers, often together with Indians, to develop the textile industry in colonial Indonesia. In cooperation with local people and also with Chinese businessmen, the Japanese investors were able to compete with European economic interests. A report by the British Trading House in Batavia in the 1920s mentions the flooding of Japanese bicycles and textile into Indonesia. This was considered a threat to the sustainability of European economic interests preventing British business from further investment in the Dutch colony. The problem, however, lay not so much in technological superiority (except in textile production), although the flow

of Japanese goods intensified the competition even in a colony such as Indonesia which had been regarded immune to such competition on account of the strict protection of the internal market, monopolies and discriminative economic policies pursued by the colonial authorities. Therefore, the Indonesian people on the one hand relied heavily on cheap Japanese products, but on the other hand they also recognized the superiority of Western technology.

By the standards of the time, Japanese technology was still regarded as inferior, in both a technical and an economic sense. People bought Japanese goods because they were cheaper, not because of the quality of the product. Buying Japanese goods was often the only way in which people with a limited budget could improve their living standards. Cheap Japanese goods also became very important for local people making ends meet during the economic depression of the 1930s. The structure and process of production, including both machinery and gadgetry, economic factors of production such as know-how or economic progress in the colony, however, were hardly, if at all, associated with Japanese technology. On the contrary, Western technologies remained crucial to the entire range of economic activity and to human resource development. Large industrial plants, as for instance in the sugar industry, made exclusive use of Western technology whereas small and medium-size enterprises, for instance in food processing or local handicraft, all relied primarily on Western technologies.

Yet, in a wider perspective, i.e. when technology is seen in terms of a social and economic structure, Japanese technology did contribute substantially to Indonesian society already during the colonial period. Since technology can serve to define and regulate patterns of human interaction, Japanese technology became an important agent in the Indonesian nationalist movement against the Dutch colonial power. It offered an alternative to Western technology that was both politically and culturally preferable since Western technology was associated with the evils of colonialism and exploitative Western capitalism. Japanese technology was seen as a set of alternative ideology providing a separate identity to the Indonesian nationalists in their struggle for independence. This could be inferred from the way in which Indonesian nationalist leaders such as Sukarno and Hatta praised the growing importance of Japanese influence, including technology. A similar attitude was assumed by Indonesian traders or

businesspersons, who were capable of forging close connections with Japanese business circles. Japanese capital and the new economic opportunities it offered stimulated the formation of group of strong indigenous entrepreneurs, a new business group that came to play a very important role in the national economy of the newborn state after 1945. Nevertheless, the importance of Japanese elements in the development of Indonesian nationalism must not be exaggerated.

The proportions of the contributions by Western and Japanese technology in meeting basic technological requirements obviously varied by location and over time. The degree to which all available technologies were adopted in the first place varied in a similar way. Cultural and social patterns and institutions, political changes and local economic conditions were responsible for such differences. There was, for obvious reasons, little change in terms of technological orientation between 1945 and the late 1960s, although the Sukarno government pursued unfriendly policies towards Western countries while Japanese economic interests once again were built up in Indonesia. The general argument here is that Western technology was still widely used at all levels of the Indonesian society, despite a strong nationalistic feeling against everything associated with the West particularly during the late 1950s and early 1960s.

It was not until the emergence of Japan as Indonesia's main economic partner under the New Order government of Soeharto, from 1967 onwards, that the pattern of technological orientation in Indonesia began to change. The new regime in Indonesia stimulated close economic contacts with Japan next to restoring political and economic relations with Western countries. From the early 1970s, Japanese capital, goods, skills, and ideas became a symbol for economic development and change in Indonesia. At the early stage, just as in the past, Japanese technology was chosen not because of its quality. The chief reason for adopting Japanese technology was no doubt economical. Japanese technology was widely available and also cheaper, and it was capable of meeting the basic requirements of Indonesian society. Under these circumstances, Japanese technology was likely to become a mechanism for meeting basic needs and creating new economic opportunities. At a later stage, however, particularly after the 1980s, Japanese technology often replaced Western technology, both as a popular technology in Indonesia and for high-technology purposes. Although it is difficult, not to say impossible, to calculate

what would have been the theoretical maximum per capita contribution of Japanese technology to Indonesian society since the New Order, a very rough estimate of the historical maximum is probably not altogether ruled out. If we consider present Indonesian society, one may venture to say that, apart from a few isolated communities, most of Indonesian local society have widely applied Japanese technologies.

3 Underutilization or rational choice?

The pattern of socio-technological organization is largely based on market forces and economic self-interest. In order to explore social or cultural functions and effects as well as the significance of Japanese technology in Indonesian society today, this section considers technology in the context of its deployment. From a series of interviews with the owners and managers of no less than 55 small and medium-size enterprises in Sleman, Yogyakarta, Bantul and Klaten in Central Java,[16] it appears that more than 80 % of the companies considered Japanese technology as their first choice. It seems that the use of Japanese technologies accounted for an extraordinary growth in small and medium-size enterprises owned and operated by local people in these four localities.

The 55 companies are classified into six main industries:

(1) Furniture making and saw milling (13 companies);
(2) Food processing (6 companies);
(3) Rice milling (7 companies);
(4) Garments (18 companies);
(5) Automotive workshops (20 companies);
(6) Printing (11 companies).

All companies are personal or family businesses with only limited foreign capital holdings. Investment of foreign capital is generally based on personal relations or agreements about underhand economic activities rather than on formal business

[16] The fieldwork for this survey was carried out by the authors and their associates at the Gadjah Mada University in Yogyakarta in July and August 2001. Names of informants are suppressed. The authors gratefully acknowledge the generous co-operation given by the interviewed firm owners and managers.

arrangements such as equity holdings. Two of the six industries, furniture making and garments, produce for both the domestic and the foreign export market.

Six out of the seven rice mills started their business in the late 1960s or early 1970s. All used Japanese machines and other equipment from the beginning. One rice mill began operations in the mid-1990s and uses Japanese equipments just as the others. All printing companies rely predominantly on Japanese technologies with the exception of four firms using some German or Chinese equipment. The printing companies, usually dating from the late 1980s and the early 1990s, have the advantage that Japanese technology for printing, copying, compressing, binding, laminating and registering is readily available. German and Chinese equipment is only of importance for cutting the paper. In all garment companies, it was found that the great majority of firms hardly rely on a particular technology due to widely differing technological requirements in this industry. Four out of the 18 surveyed garment firms made exclusive use of non-Japanese technologies originating in China, Taiwan and Korea, whereas 14 firms relied on a mix of technologies. It appears safe to conclude that Japan contributes more than one-half of the required technologies.

A similar observation can also be made about the automotive workshops and furniture makers. Eight of the surveyed 20 automotive workshops (40 %) make no use at all of Japanese-made equipment but still rely on Japanese spare parts whereas the other 12 (60 %) enjoy the superiority of Japanese automotive technology. Due to the strong domination of Japanese cars and motorcycles in use in Indonesia, Japanese technology has clearly become by far predominant. It absorbs the largest proportion of available capital and labour in the automotive workshop activities. The dominant role of Japanese technology may also be witnessed in furniture making and saw-milling. Together with equipment from China and Taiwan, Japanese tools offer a great advantage to growing small and medium-size export-oriented furniture companies in Central Java. Finally, it is important to note that the growth of food processing has largely taken place without resorting to the use of Japanese technology. The main type of technology here, other than local know-how, has always been the Western one. Only one food processing company uses Japanese equipment in production but then only for minor functions.

These findings illustrate some fundamental characteristics of the application of Japanese technology in domestic manufacturing in Indonesia today, specifically in the small and medium-scale industries. For analytical purposes, it is useful to make a distinction between the various motivations behind the technological choice made by the companies. It is important to realize that low prices and technical simplicity are the two main reasons given by most interviewees when explaining why they chose Japanese technologies to support their production process. Paradoxically, however, another important motivation, mentioned by all respondents, is the high quality of Japanese equipment. A persistent tradition has evolved in the sense that the idea of adopting Japanese technology by most managers of owners in these four localities was backed by mix of motivations including limited capital resources, relatively unsophisticated technical requirements, low operational costs and long-term economic advantage. For most of the surveyed company-owners, `low cost' also refers to cheap labour, low costs of electricity and fuel, low maintenance costs and zero training costs. With regard to maintenance, all respondents emphasized the availability of spare parts, whether original, fake or second-hand, for virtually all Japanese-made equipment.

At the same time, attitudes towards technology itself are undergoing a change. Most company-owners do not think that they need to know in detail about the newly adopted technology before starting to use it. As a consequence, less than 10% of all respondents knew the specifications of the newly introduced equipment or had read the manual (primarily due to a language handicap) or had received any special training. In other words, there is no question of a well-planned or orderly structured transfer of knowledge and skills by the providers of technology to the users. Most users rely on their own personal experiences. They learn by doing. Most companies do not feel a need to recruit trained workers or an obligation to train their workers for operating new equipment. In only one of the seven rice mills did the owner state that he had asked the shop owner about how to operate his two engines and that he did read the manual before starting to use it. Yet he did not pass his knowledge and skills on to his workers. It is clear from our survey that small companies tend to neglect the importance of such transfers of know-how and skills.

It is not surprising then that there are cases in which equipment has been used in a different way than the intended one. For instance, most surveyed automotive workshops applied the same equipment and skills for repairing widely different types of motor cars, motorcycles and engines. There is no real division of labour in such a situation. Every technician should be able to deal with very different matters such as the engine, the auto or motor cycle body or the air conditioning and there is no guarantee that everything will be fixed properly. Some mechanics even pointed out that they have to handle very new technology, but are asked to pretend being capable to manage it without any previous experience - otherwise the consumer would go to another workshop. Only one owner out of twenty informed us that he works together with new workers for about six months, as a kind of training, before he lets the worker work alone. All rice mills operate the machines without carefully considering the function of the engine, the various operational stages and the skills of the workers. As a result, two owners bought engines far above their production needed capacity whereas three companies husk paddy and other grains using the same machine. It seems that little attention is given to economic efficiency but on the other hand these managers try to reap maximum economic advantage from the available technology.

Apart from the usual observation that there is a blurred conception of how local entrepreneurs adopt new technology, these accounts depict a situation in which people become more creative and less dependent on imported technology since technology is not merely machinery. Furniture making and garments provide an interesting case in point. All firms used both imported equipment, local skills, and local designs to manufacture various products, either for the domestic market or for foreign exports. Therefore, the imported tools form only one part of the technology used in the process of production. Workers do not need specific knowledge or skills to operate the imported equipment and to make products based on local designs as in fact the local component is predominant in such activities. Imported technology is thus modified in a continuous search for efficiency in the process of production and a wider range of saleable or profitable new products. Most interviewed furniture and garment manufacturers and workers pointed out that Japanese equipment is easier to be modified for their own purposes, and also

cheaper, compared to Western equipment. This view was shared by more than 75% of the owners and technicians in the automotive workshop.

4 Shift to other East Asian technologies

History repeats itself. This phrase appears relevant to describe a current trend in the technological choice of firms in the four surveyed localities. The way in which Japanese technology was adopted between the late 1960s and the 1990s created a boomerang effect for the Japanese economic interests. This social and cultural structure is now starting to push Japanese technology out of small and medium-size economic activities. Cheaper and less sophisticated Chinese, Taiwanese and Korean equipment are increasingly replacing the Japanese equipment.

It is important to realize that, since the early 1990s, more than 50 % of the companies in three of the six surveyed industries now prefer to buy equipment from China, Taiwan or Korea when replacing obsolete equipment. Ten out of thirteen companies in furniture making and saw-milling (77 %) do not use Japanese equipment – most of the non-Japanese equipment was purchased since the mid-1990s. A similar trend is discernible in the garments and automotive industries. Ten out of 18 companies in garments category (56 %) and 7 out of 20 automotive workshops (35 %) already used Chinese, Taiwanese and Korean tools next to the Japanese ones. One possible explanation is that there is no major difference in technical specifications between Chinese, Taiwanese or Korean equipment in comparison to Japanese equipment. Most owners mentioned that they considered equipment from China, Taiwan and Korea similar to the Japanese one, but they paid less for it. In printing and rice milling, however, Japanese technology is still the predominant one, but for how long?