Channels of International Technology Transfer in Indonesia: A Brief Survey

Thee Kian Wie
Senior Economist, Economic Research Center,
Indonesian Institute of Sciences (PPE-LIPI)
And
Visiting Researcher, ICSEAD

Working Paper Series Vol. 2001-32
November 2001

The International Centre for the Study of East Asian Development, Kitakyushu

CHANNELS OF INTERNATIONAL TECHNOLOGY TRANSFER IN INDONESIA: A BRIEF SURVEY

by

THEE Kian Wie[1]

Abstract

This paper describes the major channels through which imported technologies from the advanced countries are transferred to Indonesia and then tries to assess the extent to which each of these channels has contributed to the development of local technological capabilities (TCs). The development of these TCs is crucial to raise the international competitiveness of Indonesia's manufacturing sector, which has emerged as the major engine of Indonesia's economic growth and the major source of export earnings after the end of the oil boom era in the early 1980s. Based on several micro studies at the firm-level, this paper finds that the major channels of technology transfer to Indonesia, including foreign direct investment, technical licensing agreements, capital goods imports and participation in world trade, have generally contributed to the basic operational (production) capabilities, and occasionally also the acquisitive (investment) and adaptive (minor change) capabilities. None of these channels, however, has been able to encourage firms, whether FDI firms or local firms, to develop the more demanding innovative (major change) capabilities. To achieve this goal, two basic conditions are needed, namely a proper incentive system, including sound macro-economic policies and pro-competition policies, and a greater and better investment in human resources in order to raise the 'supply-side capabilities' of the firms.

---

[1] Senior Economist, Economic Research Centre, Indonesian Institute of Sciences (PPE-LIPI), Jakarta, and Visiting Researcher, ICSEAD, Kitakyushu (email: theekw@cbn.net.id).
This paper is a substantially revised version of a report prepared for the Fraunhofer Gesellschaft, Muenchen, Germany. as part of the PERISKOP project (Proyek Evaluasi Riset Sains Teknologi untuk Pembangunan) conducted for the Indonesian government. I am indebted to Dipl. Volkswirt Christian Schoen of the Fraunhofer Gesellschaft for his valuable comments and suggestions on an earlier draft of this report. I am very grateful to Professor Eric Ramstetter of ICSEAD, Kitakyushu, for his incisive comments and suggestions on an earlier draft of this paper and for his kind assistance in providing me with detailed FDI and trade data of Indonesia. However, I alone am responsible for any mistakes and shortcomings of this paper.

Contents

I. Introduction 4

II. Methodology and basic concepts 5

- Methodology 5

- Basic concepts 6

- Assessment criteria: categories of technological capabilities 9

- Channels of international technology transfer 11

III. Indonesia's challenge a net technology-importing country 12

IV. Information on technology transfer in Indonesia and the issue of regulating technology inflows 14

V. The major channels of international technology transfer in Indonesia 17

1. Foreign direct investment 17

2. Technical licensing agreements 24

3. Capital goods imports 26

4. Participation in world trade 29

VI. Findings of selected studies on technology transfer in Indonesian manufacturing through foreign direct investment and technical licensing agreements 34

1. Technology transfer through FDI: findings of some econometric studies 35

2. Findings of selected case studies on technology transfer FDI or technical licensing agreements 38

a. The textile industry 38

b. The garment industry 41

c. The electronics industry 42

i. The consumer electronics subsector 42

ii. The components and industrial electronics subsectors 43

d. The pharmaceutical industry 45

e. The automotive industry 48

f. The chemical industry 51

g. The food products industry 54

VII. Assessment of technology transfer through FDI, technical licensing agreements, capital goods imports and participation in world trade 56

VIII. Concluding remarks 60

References 65

Tables 70-75

I. Introduction

Like other developing countries, Indonesia is a net importer of advanced technologies developed in the developed countries. These advanced technologies are crucial to drive and sustain rapid economic growth necessary to raise the standard of living of the Indonesian people.

In view of the economic importance of these imported technologies, it is important to identify the major sources and channels through which these technologies are transferred to Indonesia and to assess the extent to which these transferred technologies has contributed to the development of local technological capabilities (TCs) in Indonesia. The development of these TCs is a crucial element in fostering and sustaining the growth of an internationally competitive manufacturing sector, which has emerged as the major engine of Indonesia's economic growth following the end of the oil boom era in the early 1980s.

The objectives of this study on international technology transfer in Indonesia are:

1. To identify and assess the importance of the major forms and channels through which advanced technologies have been transferred to Indonesia, specifically to Indonesia's manufacturing sector;

2. To identify the major problems in the international technology transfer in Indonesia;

3. To assess the extent to which these various channels of international technology transfer have contributed to the development of technological capabilities (TCs) in Indonesia, specifically in Indonesia's manufacturing sector.

This paper is organised into eight sections. Section II presents the methodology and basic concepts used in this paper, including the various categories of TCs used to assess the extent to which technology transfer has contributed to the development of local TCs, and the various channels of international technology transfer. Section III describes the challenges faced by Indonesia as a net technology-importing country. Section IV discusses the lack of information on international technology transfer in Indonesia and the issue of regulating technology inflows into the country. Section V reviews the major channels of international technology transfer in Indonesia, while section VI presents the findings of selected studies on technology transfer in Indonesian manufacturing through foreign direct investment (FDI) and technical licensing agreements. Section VII provides an assessment of the transfer of technology through FDI, technical licensing agreements, capital goods imports and participation in world trade. Section VIII, the last section, offers the major conclusions of this paper.

II. Methodology and basic concepts

Methodology

The following discussion of the various theoretical and conceptual issues related to international technology transfer is mainly based on a survey of the extensive relevant literature on this subject. The empirical evidence on the international transfer of technology on Indonesia is mainly based on the findings of several empirical studies on this subject conducted by Indonesian and foreign researchers, including this author. Most of this research was based on in-depth interviews with senior expatriate and Indonesian executives and managers of foreign-controlled and domestic firms and visits to plants. Other

relevant information was obtained from official reports and documents, relevant statistics from the Central Agency of Statistics (Badan Pusat Statistik, BPS), the Capital Investment Coordinating Board (Badan Koordinasi Penanaman Modal, BKPM), and the Bank of Indonesia.

Basic concepts

To get a better understanding of what the concept of international (cross-border) technology transfer involves, it is useful to define the concept of 'technology' first, before defining the concept of 'technology transfer'.

A general economic definition of technology is provided by Bell, Ross-Larson and Westphal in their World Bank study on the performance of infant industries. In their study, Bell, Ross-Larson and Westphal define technology as a collection of physical processes that transform inputs into outputs, the specification of the inputs and outputs, and the procedural and organisational arrangements for carrying out the transformations. (Bell, et.al., 1984: 107). However, in their view technology sometime refers only to production techniques. At other times technology refers only to operational expressions of technological information, or even to the technological information contained, for instance, in blueprints and operating manuals. (Bell, Ross-Larson & Westphal 1984: 107). In the latter case, however, it might be more correct to refer specifically to technological knowledge which could be defined as information about physical processes which underlies and is given operational expression in technology. (Dahlman & Westphal 1982: 105).

A similar definition is provided in the United Nations' World Economic and Social Survey, which defines technology as the 'knowledge about how to do things'. (United Nations 2000: 175).

Yet another definition views technology as the knowledge and machinery needed to run an enterprise. Under this definition technology would include both software (blueprints and operating manuals) and hardware (machinery and other capital equipment). (Chee 1981; 2).

Under the latter definition, technology transfer involves the transfer of skills and technical know-how as well as the transfer of machinery and other capital equipment (embodied technology). (Chee: 1981: 2). As this transfer usually involves the transfer of modern technologies from advanced countries to the importing, developing countries, this concept involves the international or cross-border transfer of technology. When technology is acquired by international (cross-border) transfer, the process of translation of technological knowledge or know-how (the information about physical processes which underlies and is given operational expression in technology), into practice is usually undertaken by expatriates rather than the nationals of the recipient countries. (Dahlman & Westphal 1981: 13). Hence, while international technology transfer is crucial to gain access to the modern technologies from the advanced countries, the real challenge facing developing countries, including Indonesia, is how its own nationals can eventually master these transferred technologies, that is acquire the capability of using these technologies effectively and efficiently. To achieve this local technological capability or mastery, technological effort is required.

The required technological capability or mastery in developing countries can thus be defined as the ability to make effective use of (borrowed or transferred) technology. (Bell, Ross-Larson & Westphal 1984: 107-8). A somewhat similar definition refers to technological capability as the ability to make effective use of technological knowledge in production,

investment and innovation to sustain competitiveness in price and quality. This technological capability enables a firm to assimilate, use, adapt, change or create technology and develop new products and processes in response to a changing economic environment. (Kim 1990: 143).

The technological effort required to achieve this technological capability (mastery) can then be defined as the conscious exertion to use the available technological information and to accumulate technological knowledge to choose, assimilate, adapt, or create technology. This technological effort is needed to evaluate and choose technology; to acquire and operate processes and produce products; to manage changes in products, processes, procedures and organisational arrangements; and to create new technology. (Bell, Ross-Larson & Westphal 1984: 107-8).

The initial transfer of technology will not automatically lead to its efficient operation if the necessary skills and technical and managerial know-how are not generated by the recipient country itself, as there are many 'implicit' or ‘tacit’ elements in technology that need a long period of learning. Although this learning may partly be the automatic result of production experience, in most activities it also requires technological effort in the form of purposeful investments by a firm in training its employees (managers, technicians, plant workers), searching for new technical and other relevant knowledge, experimentation, and developing the organisational expertise to create, communicate and diffuse knowledge internally within the firm itself. In the more advanced activities the absorption of new technologies also requires investment in research and development (R & D). (Lall 1993b: 100).

The important question facing developing countries is

therefore whether the international transfer of technology leads to the development of local or indigenous technological capabilities (TCs) which, in turn, will determine whether these technologies can be successfully applied in these countries. One important aspect of this successful application is the adaptations of these transferred technologies to local conditions. (United Nations 2000: 179). As technology transfer can take place through various channels, a related question would be which channels would be more conducive to the development of local technological capabilities.

Assessment criteria: categories of technological capabilities

As technological capability is a broad concept, encompassing different types and levels of technological capability, it would be helpful to make a distinction between the various types of technological capability. Although several classifications have been made of the various types of technological capability, the following classification of types of technological capability made by some Thai economists from the Thailand Development Research Institute(TDRI)(Kritayakirana & Srichandr, 1989: 6; Sripaipan 1990:7), is helpful in assessing the extent to which international technology transfer in Indonesia's manufacturing sector has contributed to the development of local industrial technological capabilities (ITCs):

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

2. Operational (production) capability refers to the knowledge and skills required for the efficient operation and control of the production process and the machinery in the plants, including the

maintenance and repair of the machinery;

3. Adaptive (minor change) capability refers to the knowledge and skills required to digest the transferred technologies and to carry out some minor modifications in the process and/or process technologies;

4. Innovative (major change) capability refers to the capability required to carry out significant in-house research and development (R & D), to make radical or major process or product modifications. and develop new products or processes.

This classification of various types of technological capability is largely similar to the one developed for a comparative study conducted for UNCTAD's Technology Program. This study, however, also includes linkage capability, that is the capability of a firm to establish mutually beneficial linkages with other firms and with the domestic science and technology infrastructure), and marketing capability as part of the general concept of technological capability. (Ernst, Mytelka and Ganiatsos 1998: 17-18).

The above four categories of technological capability will be used as a criterion to assess the extent to which international technology transfer to Indonesian nationals through foreign direct investment (FDI), technical licensing agreements, and other channels, particularly capital goods imports and participation in world trade, has succeeded in enhancing local TCs.

The above classification as well as that of UNCTAD's study are helpful in suggesting a sequential ordering of priorities for the industrial and technological strategies of late industrialising countries which are based on imported technology. This implies that a developing country at a relatively early stage

of industrialisation, such as Indonesia is in now, may have to spend much of its technological effort on the development of the more basic acquisitive, operational and adaptive capabilities, while the more advanced late industrialising countries, including Korea and Taiwan, would have to focus their technological effort on the development of the more demanding innovative capabilities in order to remain internationally competitive. (Ernst, Mytelka, & Ganiatsos 1998: 17-18). Korea's experience indeed shows an appropriate sequencing in its technological development, with operational capability being developed in advance of either acquisitive or innovation capability. The implication of this sequencing process is that policy-makers and managers of developing country firms can plan ahead in focusing their efforts at the national and corporate levels on developing the various categories of technological capabilities as industrialisation progresses.(Kim 1990: 157).

Channels of international technology transfer

Like in other developing countries, there are numerous channels of international technology transfer open to Indonesia. These include (World Bank 1996: 4; Dahlman, Ross-Larson & Westphal 1987: 768; Hill & Johns 1983: 61-62):

1. Formal modes of technology transfer, involving formal arms-length transactions, such as:

a. Foreign direct investment (FDI);
b. Technology (technical) licensing agreements;
c. Imports of capital goods;
d. Foreign education and training;
e. Turnkey projects.
f. Technical consultancies.

2. Informal modes of technology transfer, such as:

a. Copying or 'reverse engineering';
b. Participation in world trade.

Like in other developing countries, the bulk of international technology transfer to Indonesia takes place in the private sector, that is from private firms of the advanced countries to private Indonesian firms, although occasionally also from advanced country firms to Indonesian state-owned enterprises (SOEs). Another channel for international technology transfer takes place in the public sector through official development assistance (ODA) programs which usually also contain a technology transfer component (Hill & Johns 1983: 62, specifically in the form of technical assistance or manpower training programs provided by the technical assistance agencies of individual donor countries, such as the Japan International Cooperation Agency (JICA) or the Gesellschaft fuer Technische Zusammenarbeit (GTZ) of the German government, or by multilateral aid agencies, including the World Bank, the Asian Development Bank (ADB), and the United Nations Industrial Development Organisation (UNIDO). In general, however, technology transfer through the public sector is less important than what takes place through the private sector.

III. Indonesia’s challenge as a net technology-importing country

As a net technology-importing country, Indonesia faces the challenge of maximising the international transfer of the most relevant technologies, on the best available terms. The technologies that are actually transferred do not only involve the purchase of capital equipment or the acquisition of blue-prints but, more important, should also involve the development of the capacity to use, adopt, replicate, modify or further expand the knowledge and skills developed in another country. (Soesastro 1998: 304).

With even large firms in Indonesia being highly dependent on imports of ‘ready-made’ technology, sustained industrial growth in the future will greatly depend on the country’s ability to move from a passive dependence on technology transfer to a more active role in mastering and building upon imported technologies. (Lall 1998: 137). Technology development in Indonesia should at present be focused on acquiring the required technological capabilities (TCs), that is the capabilities to make effective use of imported (borrowed) technologies.(Bell, Ross-Larson, & Westphal 1984: 107-08). The development of these TCs does not only come from experience (though experience is also important), but even more from the technological efforts of firms, as described above.

The development of these TCs is crucial as Indonesia, facing sharp competition in international markets from other, rapidly industrialising countries, notably China, can no longer continue to rely only on its traditional sources of comparative advantage, including its large supplies of relatively cheap, but mostly low skill labour and its natural resources. Instead, Indonesia will have to develop a more sustainable source of comparative advantage in order to raise the international competitiveness of its manufacturing industries. To achieve this, Indonesia's manufacturing firms, including the small- and medium-scale enterprises (SMEs), will, just like Japan, and Korea and Taiwan a few decades earlier, have to make a much greater effort on developing and raising their technological and related organisational capabilities in order to be able to develop more technology- and skill-intensive, higher value added industries. (Thee 2000: 38).

Indonesia's manufacturing industries need to develop their TCs as their technological base is shallow and backward compared to that of the East Asian newly-industrialised economies

(NIEs), particularly Korea and Taiwan. Compared to them, Indonesia's capacity to absorb and improve upon complex imported technologies is narrow and weak; its capital goods sector, a crucial element of industrial deepening, is relatively underdeveloped, and its relatively modest technological effort (even before the Asian economic crisis) was distorted and concentrated (Lall 1998: 136), mostly on the 10 state-owned strategic industries, in particular the highly costly state-owned aircraft assembling enterprise IPTN, now renamed PT Dirgantara Indonesia (DI), and the state-owned shipbuilding enterprise PT PAL. Technology development is therefore crucial to improve the productivity, efficiency and competitiveness of Indonesia's manufacturing sector which, in turn, is essential to the recovery and sustained growth of this sector.

IV. Information on technology transfer in Indonesia and the issue of regulating technology inflows

Compared with some other Asian countries, Indonesia has since 1967 pursued a liberal, 'open door' policy with regard to technology imports through FDI and technical licensing agreements. No effort has been made to monitor or control foreign technology imports, as is done in some other developing countries. While the Capital Investment Coordinating Board (Badan Penanaman Koordinasi Penanaman Modal, BKPM), the agency in charge of investment licensing and regulation, screens the applications of foreign and domestic investors, the application forms to be filled out by prospective investors contain no questions on technology issues, including the payments for technology imports. As a result, exact quantitative information on the actual magnitude of cross-border technology inflows into Indonesia, as reflected by the fees and royalties paid for the imported technologies, is not available in Indonesia. (Thee 1998: 132).

Unlike the other three ASEAN countries, Malaysia, the Philippines, and Thailand, Indonesia does not have data on the number of technology licensing agreements signed by Indonesian firms (including both domestic firms without foreign equity ownership and joint ventures with foreign investors) with their foreign licensors. Nor is there a single satisfactory definition of technology inflows, especially concerning the transfer of human capital resources. But as an approximation one can use data on royalty and licensing payments to the major technology suppliers in the Asia-Pacific region, namely the U.S. and Japan. (Hill & Johns 1983: 62). For instance, in a publication of Japan's Agency of Industrial Science and Technology published in 1992 it was mentioned that out of Japan's total technology exports of yen 339.4 billion during fiscal 1990, 5.8 per cent of this total amount (yen 19.7 billion) went to Indonesia. (Agency of Industrial Science and Technology 1992: 34).

At present the only available data in Indonesia on cross-border technology inflows (technology imports) are those on capital goods imports (embodied technology imports), which offer only one aspect of the wide range of foreign technologies flowing into Indonesia. (Thee 1998: 132). While FDI inflows also involve technology inflows, FDI inflows are not equivalent to technology inflows since FDI, after all, involve the cross-border transfer of a package of capital, technology, managerial and marketing skills, and channels to overseas markets. Hence, technology is only one of the elements in the whole FDI package, the quantitative importance of which is unknown except to the two parties involved in the commercial transaction, namely the foreign licensor and its Indonesian licensee.

From time to time there have been calls for government regulation of technology transfer agreements on the grounds that foreign licensors (technology suppliers) may impose 'unfair'

restrictions and conditions in such agreements, and that Indonesian firms lack commercial experience in these matters in negotiating with foreign firms, particularly the transnational corporations (TNCs).(Hill 1995: 113-14). Hence, government intervention could increase the bargaining power of the local recipients (the Indonesian firms) in their negotiations with the prospective technology suppliers (the foreign firms).

Despite these suggestions, successive Indonesian governments have thus far not indicated any interest in changing the country's liberal technology import regime. There are strong arguments for continuing this stance, as government intervention in negotiations between prospective foreign technology suppliers and Indonesian technology buyers, particularly by attempting to eliminate or reduce what it perceives to be unduly restrictive conditions in technology licensing agreements, might very well slow down the inflow of new FDI, and the accompanying important inflow of technology imports (Thee 1998: 132), particularly now that new FDI inflows and the related technology inflows are needed more than ever to revive the Indonesian economy.

Another argument against government intervention in negotiations on technical licensing agreements is that Indonesian government officials in general, like government officials elsewhere, do not have the necessary business experience or knowledge about industrial technologies to make informed decisions on the appropriate levels and forms of royalty payments. (Hill 1995: 113-14). While royalty payments can often be quite high, restrictions on the amount of royalty payments could lead foreign licensors to circumvent them by resorting to other means, for instance 'transfer payments', to obtain what they felt was the right amount of royalty payments. (Thee 1998: 133).

Fortunately, the new chairman of the Capital Investment

Coordinating Board (BKPM), Mr. Theo Toemion, has in public speeches and press interviews repeatedly emphasised the necessity that 'BKPM has to develop a new role for itself in the era of globalisation and regional autonomy by shifting its role and functions from 'investment licensing and regulation' to 'investment facilitation and promotion'. In Toemion's view, BKPM would have to reorganise and revitalise its organisation to become a more professional, efficient and 'market-driven servicing agency', characterised by quality of service, responsiveness to and empathy with investors' concerns, reliability, and assurance.(Toemion 2001: 2-4). Toemion's strongly held views about the new role of BKPM as a 'market-driven servicing agency' indicates that BKPM will continue to pursue a liberal foreign investment regime, including a liberal technology import regime.

V. The major channels of international technology transfer in Indonesia

Several studies on international technology transfer in Indonesia's manufacturing sector indicate that foreign direct investment(FDI), technical licensing agreements, capital goods imports and, to a lesser extent, participation in world trade have been the major channels for international technology transfer in Indonesia. While several firms have also obtained technical and managerial consultancies from foreign experts, no comprehensive data are available on the number and costs of such consultancies.

1. Foreign direct investment

a. Foreign direct investment in Indonesia during the Soeharto era and the ensuing crisis years

The considerable improvement in Indonesia's investment

climate, as reflected by the enactment of a liberal Foreign Investment Law in 1967 and a Domestic Investment Law in 1968, and the prospect of rapid economic growth following the succesful stabilisation and rehabilitation measures by the Soeharto (New Order) government in the late 1960s led to a steady increase in foreign direct investment (FDI) (and domestic direct investment as well), both in terms of numbers of projects and amount of capital investment. However, in response to a resurgence of economic nationalism in the early 1970s and encouraged by the oil boom revenues of the 1970s, policies towards foreign direct investment (FDI) became increasingly restrictive.

It was only after the end of the oil boom in the early 1980s and the resultant decline in export earnings and government oil tax revenues, that the Indonesian government by the mid-1980s was compelled to gradually liberalise its foreign investment policies again in order to encourage more private investment, including FDI, in export-oriented activities. To this end, the government introduced a series of deregulation measures in order to improve the investment climate for private investors, particularly foreign investors, by lifting the various restrictive regulations governing FDI. After the onset of the Asian economic crisis and the ensuing fall of president Soeharto, both the governments of president Habibie and his successor president Abdurrachman Wahid governments continued the liberalisation of foreign investment policy to stem the outflow of FDI and attract new FDI, but with little success.

The data in Table 1 show that as a result of the new open-door policy towards foreign private investment, FDI since the late 1960s through the early 1970s steadily increased. However, as government policy towards FDI grew more restrictive in the early 1970s in response to a re-emergence of economic nationalism, particularly after widespread demonstrations against the perceived

‘over-presence’ of Japanese investment, FDI grew at a more sluggish rate after the mid-1970s. It was only when foreign investment investment policy became more liberal again after the mid-1980s that net realised FDI began to rise again. In fact, since the late 1980s Indonesia experienced a surge in FDI which was sustained through 1996. It was only after the onset of the Asian economic crisis in 1997 that rising net FDI inflows turned into a net FDI outflow, which has persisted until today. Obviously, the continuing net FDI outflows from Indonesia is a source of great concern, as the two other worst-afflicted East Asian countries, namely Korea and Thailand, are already experiencing FDI inflows. The continuing net FDI and other private, non-FDI outflows have also put great pressure on Indonesia’s balance of payments. (World Bank 2000: 5). The fact that practically no new FDI has entered Indonesia since the Asian crisis also means that no new infusions of modern technologies into Indonesia through FDI have taken place.

Table 1 here

In view of the various shifts in the foreign investment regime during the past 35 years, the relative share of FDI in total gross capital information in Indonesia has varied over this period, depending on whether these policies were relatively liberal or restrictive. The data in column 2 of table 1 show that after the introduction of more restrictive policies towards FDI in the mid-1970s, the relative shares of FDI in total gross capital formation was generally smaller than during the late 1960s and early 1970s. It was only after the increasing liberalisation of the foreign investment regime in the mid-1980s that the relative share of FDI in gross capital formation began to rise again, first slowly but then increasingly rapidly until 1997.

Nevertheless, despite the large inflows of FDI into the

country during the Soeharto era, FDI throughout this period only constituted a relatively small part of gross capital formation, even during the period of a more liberal foreign investment regime in the late 1960s and early 1970s and during the late 1980s and early 1990s. However, despite the relatively small share of FDI in gross capital formation, as compared with Singapore and Malaysia, successive Indonesian governments until today have always to take account of the potent force of economic nationalism whenever attempts were and are being made to liberalise the foreign investment regime.

The surge of FDI into Indonesia into Indonesia since the mid-1980s through 1986 actually consisted of two surges. The first surge which took place during the period 1987-90 was largely due to a favourable confluence of 'pull' and 'push' factors, which resulted in a large inflow of export-oriented FDI from the East Asian newly-industrialised economies (NIEs), particularly Korea and Taiwan. A significant part of these NIE investments took place in low skill, labour-intensive industries, including the textile, garments, footwear and consumer electronics assembling industries. As a result of this surge of export-oriented FDI, Indonesia experienced a surge of labour-intensive manufactured exports during the late 1980s and early 1990s. The second surge of FDI, which started in early 1994, was partly driven by the worldwide boom in FDI. (World Bank 1997: 12).

That export-oriented FDI contributed a great deal to the surge in Indonesia's manufactured exports during the first half of the 1990s has been clearly shown in a recent study by Ramstetter, which indicated that foreign (FDI) plants tended to have higher trade propensities than local plants (plants owned by domestic firms). Ramstetter's study also indicated that plants with high ownership shares had by far the highest export propensities, followed by plants with moderate foreign ownership shares and

plants with low foreign ownership shares. (Ramstetter 1999: 57).

The surge in manufactured exports, to which foreign-controlled plants contributed greatly, was quite remarkable as in 1981 manufactured exports accounted for only seven per cent of total exports, but by 1996 already accounted for 53 per cent of total exports. (Table 2). However, the data in table 2 also indicate that the surge in manufactured exports was mainly limited to the low-skill labour-intensive manufactured exports, such as textiles, garments (apparel), and electric & electronics products. On the other hand, the exports of pharmaceuticals, motor vehicles and chemicals were generally modest in view of the domestic market orientation of these industries.

Table 2 here

The major 'pull' factor accounting for the FDI surge since the late 1980s can to a large extent be attributed to the steady liberalisation of foreign investment policy after the end of the oil boom era in the early 1980s to attract more FDI, particularly export-oriented FDI. The first foreign investment deregulation measure was introduced in the May 1986 deregulation package and culminated in the important investment deregulation package of June 1994, which contained a substantial relaxation of the remaining restrictions on FDI operations. (Pangestu and Azis 1994: 21-24). The significance of the investment deregulation measure of June 1994 is reflected by the fact that following the introduction of this deregulation package in June 1994, an unprecedented surge in new foreign investment applications took place during the second half of 1994. (Hobohm 1995: 11).

A related 'pull' factor which accounted for the surge of export-oriented FDI (as well as export-oriented domestic direct investment, DDI) were the successive trade reforms, notably the

introduction of a duty exemption and drawback scheme in May 1986 for export-oriented firms (i.e. firms which exported at least 85 per cent of their output, and which was later lowered to 65 per cent), which the Indonesian government had introduced since the end of the oil boom era in order to encourage non-oil exports, including manufactured exports. The trade reforms led to a steady reduction in the 'anti-export bias' of the trade regime, and as a result it became more attractive for foreign and domestic investors alike to invest in export-oriented activities.

The outcome of these trade reforms is clearly indicated by the rapid rise of the indices of revealed comparative advantage (RCA) of the labour-intensive industries (textiles, garments, and electric and electronics products), as shown in table 2. However, the RCA indices of pharmaceuticals, motor vehicles, and chemicals generally did not experience a comparable rise, in view of the continuing domestic market orientation of these industries. This differential performance can be attributed to the fact that the trade reforms, though significant, were not comprehensive enough to eliminate the remaining 'anti-export bias' of the trade regime. In fact, by 1989 many import-competing industries continued to enjoy much higher rates of effective protection than export-competing industries. (Wymenga 1991: 138). In view of this continuing import-protection, there was little incentive for these industries to improve their competitiveness by enhancing their TCs. The lack of impressive development of TCs of these industries will be discussed in greater detail in section 6 of this paper.

The trade reforms, while not comprehensive, was significant enough to lead to a surge of FDI in export-oriented activities, particularly by firms from the East Asian NIEs, which tended, as noted earlier, to invest in low skill, labour-intensive industries. (Thee 1991: 61). The increasing interest in investing in export-oriented activities is reflected by the

steadily rising percentage of approved export-oriented FDI projects, which rose from 38 per cent in 1987 to 72 per cent in 1990. A similar development took place in domestic direct investment (DDI), where during the same period the percentage of approved export-oriented projects rose from 53 per cent to 71 per cent. (Thee 1994: 156).

Besides the above 'pull' (host country) factors, 'push' (home country) factors had also been at work in the potential home countries, namely Japan and the East Asian NIEs, particularly Korea and Taiwan. These 'push' factors were the steep appreciation of the Japanese yen (endaka) following the Plaza Accord in 1985 and the equally steep appreciation of the Korean won and the New Taiwan (NT) dollar and the rapidly rising real wage rates in these countries, which led to the loss of comparative advantage of the labour-intensive industries in these countries. (Watanabe 1989: 174). In turn, these developments led these industries to relocate their labour-intensive operations to lower wage countries in Southeast Asia, including Indonesia.

As a result of the surge of East Asian NIE investments into Indonesia since the late 1980s, these four East Asian NIEs (Korea, Taiwan, Hong Kong and Singapore) emerged as major sources of FDI into Indonesia.(Table 3).

Table 3 here

The bulk of FDI, including FDI from the East Asian NIEs, has taken place in the form of joint ventures (JVs) with large and to a lesser extent medium-sized domestic firms, since small domestic firms in general lacked the managerial and technical skills and the capital needed to reassure foreign investors that they were credible partners. Even though the Indonesian government has appealed and even offered fiscal incentives to

foreign investors to establish JVs with small firms and cooperatives, these efforts have largely been unsuccessful.

Most FDI in the non-oil and gas and financial sectors has taken place in the manufacturing sector, as shown in table 4.

Table 4 here

These data show that in the manufacturing sector, the chemicals industry has received by far the largest amount of FDI, followed by the metal products and the paper and paper products industries. During the the late 1980s and early 1990s a large part of FDI in the manufacturing sector was invested in the textile and textile products (garments), chemicals and rubber, and paper and paper products industries. During the first half of the 1990s much of realised FDI went to the food, paper and paper products, chemicals and rubber, basic metals and metal products industries. The FDI surge in Indonesia's manufacturing sector is also reflected by the fact that the number of foreign-controlled plants in this sector increased from 494 in 1988 to 1,194 in 1995, while their share in total manufacturing employment during the same period rose from 8.9 to 17.2 per cent. (Takii 2001: 15).

2. Technical licensing agreements

While FDI has in general been the major source of transferring new technologies to developing country firms, since the 1960s a number of other means of technology transfer, including technical licensing agreements (licensing), turnkey projects, technical consultancies, and management contracts have become increasingly important. (Lall 1993b: 95). In many cases developing countries have preferred these 'unpackaged' modes of technology transfer, as they give the host (developing) country control over management decisions, future levels of profit

remittances and development of local skills. Korea and to a lesser extent Taiwan are outstanding examples of countries which have extensively used these 'unpackaged' forms rather than relied on FDI. (Enos, Lall, & Yun 1997: 58-59).

Many foreign firms have also become more willing to enter into these 'new forms' of involvement in their less valuable technologies in response to the aspiration of many developing countries to establish independent industrial bases. The reason for this is that various technologies have matured and that new intermediaries and suppliers and specialised sellers of engineering and technical consultancy services and capital equipment have emerged that have little interest in undertaking direct investments overseas. and therefore been more willing to enter into these 'new forms' of involvement. (Lall 1993b: 95-6).

In Indonesia a major 'unpackaged' (non-equity) mode of technology transfer from advanced country firms to developing country firms has been technical licensing agreements (TLAs). Several foreign firms which have concluded these TLAs with Indonesian firms might have preferred to export their products to Indonesia or to undertake direct investments themselves in Indonesia, but subsequently abandoned these plans because of difficulties in exporting (high import barriers or import bans) or unexpected difficulties in making direct investments. (Thee 1990: 205, 209).

Some foreign firms, however, were reluctant to enter into licensing agreements with Indonesian firms because of their concern that the terms of these agreements may not be faithfully observed by the licensees because of the country’s weak protection of intellectual property rights (IPRs). For this reason foreign firms have preferred to choose large and bonafide domestic firms with a good reputation as their licensees rather than small firms

which are largely unknown to them. However, with poor commercial prospects after the onset of the Asian economic crisis, domestic firms must have been hesitant to enter into new technical licensing agreements with foreign firms.

Actually, TLAs often involve the transfer of older technologies that do not offer the recipient country a long-term competitive advantage in the global market. (Marks 1999: 6). However, for a country like Indonesia, which is still in the early stages of export-oriented industrialisation, acquiring and mastering these older technologies first is a good way to developing the important basic TCs, namely the acquisitive, operational and adaptive capabilities.

3. Imports of capital goods

Imports of capital goods provide another way of acquiring the means of production without the transactional costs involved in FDI or TLAs. (Dahlman, Ross-Larson & Westphal 1987: 768). Capital goods imports are actually embodied technology flows entering a country, as they introduce into the production processes machinery, other capital equipment and components that incorporate technologies which are new to the recipient firm. (Soesastro 1998: 304). These imported capital goods can also be a cheap way of developing technological capabilities (TCs) if they can be used as models for reverse engineering to produce the machines locally. (Dahlman, Ross-Larson & Westphal 1987: 768). However, unlike Japan or Korea, Indonesian firms have in general not engaged in ‘reverse engineering’ to master certain technologies.

The data in table 5 show Indonesia's imports of capital goods since the early 1990s through the third quarter of 2000.

Table 5 here

The data show an upsurge of imports during the investment boom, including the FDI surge, in the early 1990s which took place before Indonesia was hit by the Asian crisis. These data on capital goods imports are aggregate figures and do not reveal to which industries the various capital goods are channelled.

The close link between investment and imports of capital goods is caused by the fact that Indonesia's capital goods industry (engineering goods industry) is still relatively small and backward in most activity areas, not only compared to the other large Asian countries, such as China and India, but even compared to Malaysia. To a large extent the backwardness and lack of dynamism of Indonesia's capital goods industry should be attributed to the fact that it has been coddled for too long a time as an 'infant industry', enjoying the highest rate of effective protection (together with the food and beverages industry) and non-tariff protection until the mid 1990s. (World Bank 1994: 26-27). As a result, the bulk of capital goods required in production processes still needs to be imported.

The bulk of these capital goods are imported by large firms, both FDI-controlled firms (JVs) and large domestic firms, and to a smaller extent by medium- as well as small-scale domestic firms which in general use labour-intensive technologies, utilising mostly simple, relative cheap machinery. Not surprisingly, the sharp decline in manufacturing investment after the onset of the Asian economic crisis is therefore also reflected in the sharp decline in capital goods imports in 1998 and 1999. This implies that the Asian crisis has therefore led to a greatly reduced inflow of new technologies embodied in capital goods. Moreover, since the use of newer capital goods generally leads to higher labour productivity, the reduced inflow of capital goods

must have adversely affected the growth in labour productivity and efficiency of Indonesian manufacturing firms.

Technology transfer in the form of capital goods imports (embodied technology) also contains a disembodied element, as the foreign suppliers of these capital goods, specifically machinery, often send technical experts to Indonesian firms to train the workers of these firms how to operate, maintain and repair the imported machinery. This kind of technology and skill transfer by technical experts from foreign firms to Indonesian employees has been quite significant with most foreign firms supplying machinery and other capital equipment to Indonesian firms. This training is crucial as the imports of capital goods by themselves do not automatically lead to an enhancement of local TCs if local employees do not know how to operate, maintain or repair these imported machines and other capital equipment effectively and efficiently. However, if the imports of capital goods is accompanied by the effective training of local workers in how to operate, maintain and repair the imported machinery and other capital equipment, these imports will indeed lead to the enhancement of the operational capabilities of the firms and over time also to adaptive capabilities, specifically to carry out minor process adaptations.

That imported capital goods have undoubtedly contributed to the rise in labour productivity in Indonesian manufacturing is undeniable. However, a study by Professor Adam Szirmai of the Eindhoven University of Technology found that while labour productivity in Indonesian manufacturing rose steadily during the period 1975-1990, by the late 1980s this labour productivity was on the average still only 38 per cent of that of Korean workers and only 10 per cent of American workers. In fact, average labour productivity in Indonesian manufacturing in 1990 was still lower than that of Korean workers in 1970. (Szirmai 1994: 79-80). These

data indicate that merely importing capital goods does not automatically translate into improved local TCs, since enhancement of these local TCs depends crucially on enhanced labour skills.

4. Participation in world trade

Since the mid 1970s an important informal channel of international technology transfer for Indonesian firms, including small and medium-scale enterprises (SMEs), has been provided by their participation in world trade, specifically through exporting their products. This informal channel has been utilised effectively by local firms, particularly electronics firms, in the four East Asian NIEs, including Korea, Taiwan, Hong Kong and Singapore which, based on low wage rates, were able to build up basic operational (production) capabilities through simple assembly of mature products for exports, often developed through technical assistance provided by foreign buyers. (Hobday, 1994: 335; World Bank 1996: 4). These local NIE firms successfully coupled export and technological development, allowing export market needs (the needs and design and product specifications of their overseas buyers) to focus their investment in technological upgrading and to provide a channel for them to acquire foreign technologies from their overseas buyers. This process of coupling exports with technology development could be named 'export-led technology development'. (Hobday 1994: 335).

In these NIEs the successful firms utilised this assembly-based, technological learning period to develop some independent technological capability (TC) over time to undertake minor process and product improvements, which raised productivity and product quality. After having developed this TC, many of these East Asian firms were able to become OEM (original equipment manufacturing) producers for transnational corporations (TNCs) based on their cost competitiveness and ability to consistently

deliver products to the precise specifications of their buyers. Gradually, the most successful of these firms were able to develop product design skills, enabling them to progress from being OEM to ‘original design manufacturing’ (ODM) producers. Subsequently the most innovative and successful of these producers were even able to develop innovative capabilities, which enabled them to carry out R & D for products and processes in competition with Western and Japanese TNCs. (World Bank 1996: 4). Once they had reached these levels of capability, they were able to progress beyond ODM to become ‘original brand manufacturing’ (OBM) producers. A few of the most successful OBM producers eventually were able to enter into strategic alliances with the most advanced developed country firms. (Hobday 1994: 335).

Although not as striking and technologically advanced as the East Asian NIEs’s ‘export-led technology development’ process, the impressive export growth which the garment industry and other export industries in Bali, Indonesia, have experienced since the mid-1970s is somewhat similar to the experience of these East Asian firms. The remarkable growth of Bali's export industries, starting with the garments industry in the mid-1970s, and subsequently the silver jewelry, wood carving, quilting, leather products, bamboo furniture, ceramics, and stone carving industries, was based on vital information flows which these Balinese firms, received through strategic business alliances with foreign firms and businessmen. (Cole 1998: 257).

The remarkable thing about the export success of Bali's garment industry and of its other export industries is that they mostly consist of rural-based small and micro enterprises which are largely owned and run by pribumi (indigenous) Indonesian entrepreneurs. Another remarkable feature of the Bali export industry model is that these export industries were able within a relatively short time to produce highly competitive products for

the international market, and that these products were largely made from domestic material inputs. Moreover, unlike many large domestic firms which were able to benefit from government protection or implicit or explicit subsidies, Bali's export industries did not receive specific government subsidies. In fact, the rapid growth of these export industries was neither anticipated nor planned by the government. (Cole 1997: 2).

Over the past quarter of a century these Balinese labour-intensive export industries have been producing competitive products for international markets, based on highly flexible small-batch production, quick turnaround times and a capacity for rapid adjustment to new designs and methods of production. (Cole 1998: 257-58). The major factor which triggered this success was the presence of foreign buyers/entrepreneurs from Australia and later from the U.S., Europe and Japan, many of whom initially came as tourists, who were able to establish direct contacts with local entrepreneurs. The ongoing interaction of these two parties started a virtuous cycle of technological improvements and learning that was self-replicating and largely self-financing, which led to rapid and sustained export growth. (Cole 1998: 275). This export performance could be sustained even after the onset of the Asian economic crisis, since these foreign buyers/entrepreneurs, unlike foreign investors, still kept visiting Bali after the crisis as this island was largely spared the unrest and breakdown in safety, law and order which afflicted other regions in Indonesia.

Through the vital information transfer and technical and managerial assistance (for instance in plant lay-out, purchase of most appropriate machines), including strict quality control, provided by the foreign buyers/entrepreneurs to the operations of the Balinese firms, mostly owned by small entrepreneurs, these small Balinese firms were able to achieve high levels of

efficiency and accuracy. The specific assistance in the production process that was offered at each stage of the local firms' development was precisely and only what was appropriate for improving production quality and quantity at that level. This assistance was provided on a for-profit basis, as it was specifically tied to tangible product output results. (Cole 1998: 275; Thee & Hamid 1997).

A similar experience of the Bali export industries can be found in the export-oriented furniture industry in the Jepara district (kabupaten), Central Java, which actually consists of industry clusters including about 100 large and medium-scale firms as well as about 2,000 small firms and mobile skilled craftsmen which have been responsible for the rapid growth of this export industry. This clustering has made possible an efficient division of labour between the larger firms and the small firms, in which the larger firms concentrated their operations on specific and essential stages in the production process, while they recruited small firms as subcontractors to specialise on other, simpler stages which they could do more efficiently than the larger firms. During the period 1989-1998 Jepara furniture exports rose from US$ 3.8 million to US$ 97 million in 1996 and to US$ 147 million in 1998. In the mid 1990s these exports accounted for about 70 per cent of total value added generated by this industry, with the remaining 30 per cent being sold in the domestic market. (Sandee, Andadari & Sulandjari 2000: 1,5).

A crucial event which led this industry to focus on export markets was the participation of a number of Jepara furniture producers in a trade fair in Bali in 1989 which led to contacts with prospective foreign buyers who started visiting Jepara to have a look at the operations of these furniture producers. Just like in the case of the Bali garment industry and its other export-oriented industries, these foreign

buyers/entrepreneurs played an important role as the intermediary between Western customers and the Jepara furniture producers. As such they played a major role in introducing new, higher value added designs, teaching quality control methods, standardising output required for the rapid expansion of order-driven production tailored to the quickly changing preferences of foreign buyers, and opening up new export markets for modern Jepara furniture. As a result, the quality of Jepara furniture has been steadily upgraded (Sandee, Andadari & Sulandjari, 2000: 5-7), as has been the case with Bali's export products.

The economic crisis of 1997/98 forced the Jepara furniture industry to orientate their operations even more towards export markets, which was made the easier because of the steep depreciation of the rupiah and the fact that this industry is not heavily dependent on expensive raw material and capital goods imports. The better export opportunities after the crisis as a result of the steep rupiah depreciation also allowed the small firms which operated as subcontractors to the larger export-oriented firms to benefit from the export boom. However, just like in the case of the Bali export industries, this export trade was not really driven by the Indonesian firms themselves, but by the foreign buyers/entrepreneurs. (Sandee, Andadari & Sulandjari 2000: 8-10).

Participation in world trade has clearly allowed Indonesian firms, including SMEs, to gain access to foreign technologies, including designs, which in turn enabled them to improve their competitiveness by upgrading their TCs, particularly operational capabilities and to some extent also adaptive capabilities. However, as the export-oriented activities in Bali and Jepara were almost exclusively initiated by foreign buyers/consultants, the Bali and Jepara firms were in general not able to develop the acquisitive capabilities.

Moreover, the Bali and Jepara experiences as well as the experience of other export-oriented manufacturing firms, including the garment firms in Bandung, indicate a continuing reliance on foreign buyers or foreign buying agents acting on behalf of foreign buyers and therefore a 'passive' stance both in regard to gaining access to world markets and to foreign designs and technologies. In order to reduce this vulnerability, Indonesian firms need to make a serious effort to build up themselves close links with their overseas buyers in order to be able to identify quickly changes in consumer preferences.

VI. Findings of selected studies of technology transfer in Indonesian manufacturing through foreign direct investment and technical licensing agreements

Studies on the impact of foreign direct investment (FDI) on technology transfer have largely adopted one of two main approaches, namely an econometric approach which has in recent years been increasingly used by quantitative economists, and a more traditional, micro approach which is largely qualitative and based on in-depth interviews at the firm-level.(Hill & Athukorala 1998: 42). The first approach uses a large secondary data set in which foreign and domestic firms are separately identified. These studies focus on productivity (either total or labour productivity) trends among the two groups of firms and across industries to find out whether the presence of foreign firms has affected the levels and growth rates of the domestic firms. In general these studies are mainly concerned with the issue of whether or not technologies have been transferred, rather than with the transmission mechanism, that is how these technologies have been transferred. These studies are also unable to estimate the relative importance of FDI among other factors accounting for the productivity growth in the domestic firms. However, they do

provide presumptive evidence of causation. (Hill & Athukorala 1998: 42).

The second, more qualitative approach usually involve case studies of firms in which the assessment of the impact of FDI on technology transfer in the recipient firms is based on case studies of individual firms, the information of which are obtained from questionnaire surveys, in-depth interviews with the managers of these firms, and plant visits. While one advantage of this approach is that it can give a greater understanding of the ways and mechanisms in which technologies are transferred to the local employees of foreign-controlled firms or diffused to local firms, the disadvantage of such an approach is that its findings may be considered merely suggestive or impressionistic rather than explanatory. Moreover, as such case studies are based on interviews with the managers of firms which have, in general, not been selected on the basis of random sampling, the findings of these studies cannot be generalised.

In the following pages the findings of both approaches used in studying technology transfer in Indonesia's manufacturing sector will be presented.

1. Technology transfer through FDI: findings from some econometric studies

A recent econometric study conducted by Fredrik Sjoholm of the Stockholm School of Economics on technology transfer and spillovers from foreign-controlled establishments on domestic establishments in a number of Indonesia's manufacturing industries found that the foreign-controlled establishments in a number of Indonesia's manufacturing sector had higher total factor productivities (TFPs) than the establishments of domestic firms. This empirical evidence indicated that the TNCs had been able to

transfer more advanced techology to their Indonesian affiliates. The study also revealed that the structure of ownership, whether fully-owned subsidiary, joint venture with foreign majority ownership or joint venture with foreign minority ownership, had no effect on their TFP levels. (Sjoholm 1999: 611).

That the structure of ownership has not affected the level of TFP in joint ventures with foreign minority equity ownership is not so surprising, as a number of studies have indicated that in most cases the foreign partners were able to maintain management control even if majority equity ownership had been transferred to the Indonesian partner. If the amount of loan capital provided by the foreign partner to the joint venture was larger than the total amount of equity capital, it was relatively easy for the foreign partner to retain management control. By retaining management control, the foreign partners have generally been able to maintain the high productivity levels of these joint ventures. (Thee 2001: 10).

The technologies used by the foreign-controlled establishments also appeared to have benefited domestic establishments through favourable technological spillover effects, as domestic establishments in industries with relatively high levels of FDI were found to have comparable high levels of factor productivity. Insofar as the strong presence of foreign-controlled establishments in a number of Indonesia’s manufacturing industries are associated with higher factor productivities of the domestic establishments in these industries, Sjoholm’s findings indicate that the gradual liberalisation of Indonesia's foreign investment regime has been beneficial for the country's manufacturing sector in terms of the favourable technological spillover effects emanating from these foreign-controlled establishments.(Sjoholm 1998: 611). In other words, these favourable technological spillovers indicate that technology

transfer from these foreign-controlled establishments and its subsequent diffusion (domestic diffusion of the transferred technologies) did take place in these industries, amongst others by labour turnover from the foreign-controlled to domestic establishments and support of local supplier firms (Sjoholm 1999: 589).

A more recent econometric study by Sadayuki Takii of The International Centre for the Study of East Asian Development, Kitakyushu, on productivity spillovers from foreign-controlled establishments in Indonesia's manufacturing industries came up with slightly different conclusions than Sjoholm's study. Takii's study found that positive spillovers were generally smaller in industry-year combinations in which the foreign equity share in foreign-controlled plants was relatively high. This result could be caused by the fact that foreign-controlled plants in which the foreign partner held majority equity ownership were able to control the diffusion of their firm-specific assets better than other foreign-controlled plants and that, as a result, the magnitude of spillovers from these plants was smaller. (Takii 2001: 19).

Takii's study also found that spillovers tended to be relatively large in industries where the technological gaps between foreign-controlled and locally-owned firms were relatively small in the initial year. This result suggests that technological levels in locally-owned firms were not high enough in some industries to facilitate large spillovers from foreign-controlled firms. In addition, Takii's study found some weak evidence that spillovers were larger for locally-owned plants which were engaged in R & D. For this group of locally-owned firms, the presence of foreign-controlled firms with majority equity ownership did not reduce the size of spillovers. These results also indicate that encouraging more FDI by transnational

corporations (TNCs) does not necessarily lead to more favourable spillovers, especially in technologically backward industries. (Takii 2001: 20).

2. Findings of selected case studies on technology transfer through FDI or technical licensing agreements

Besides the above econometric studies, a number of researchers have also conducted in-depth, firm-level case studies on technology transfer through FDI or technical licensing agreements in a number of foreign-controlled and domestic firms in a few selected industries. Their findings are summarised below. It should be borne in mind that the large majority of the foreign-controlled firms are not fully-owned subsidiaries, but joint ventures (JVs) with in general majority equity ownership, and therefore management control held by the foreign investor. Even where the Indonesian partner held majority equity ownership, the foreign partner was more often than not able to retain management control over the joint venture's operation.

a. The textile industry

Technology transfer through FDI

A study for UNCTAD’s Technology Program conducted by Thee and Pangestu on the technological capabilities of two Japanese-Indonesian textile joint ventures (JVs) found that the acquisitive (investment) capabilities of the Indonesian employees of the JVs was relatively lower than those employed in private domestic firms without foreign equity involvement. The reason was that in these textile JVs, active involvement of the Indonesian employees in the procurement of the relevant technologies was minimal, if at all. However, the Indonesian employees were actively involved in the installation and start-up of the production facilities, including

the discussions on the lay-out of the plant, the purchase of the required machinery and other capital equipment, construction of the plant, and the start-up of the production process. Through this involvement they were able to acquire some degree of acquisitive capability.

In the course of the longstanding operations of these two textile JVs in Indonesia, dating back to the early 1970s, the Japanese managers and technical experts were able to transfer the basic operational capabilities to their local employees, specifically in the spinning and weaving operations. These local operational (production) capabilities were acquired through their active involvement in the various processes , including production planning, material and component sourcing, production management and engineering, quality control and the maintenance and repair of capital equipment. However, the fact that even after 20 years of operations both JVs still employed 10 or more Japanese expatriates indicates that the transfer of technology in these JVs has been less than complete. While a number of the senior Indonesian staff had been promoted to senior managerial positions in both JVs, they still had to be supported and advised by Japanese advisers.(Thee & Pangestu 1998: 236-38).

Technology transfer through technical licensing agreements

The same study by Thee and Pangestu on the TCs of two large, private, domestic, export-oriented textile firms indicated that through a package agreement, including a technical licensing agreement, with a Japanese textile firm as well as a Japanese general trading company, these firms had been able to gain access to new textile technology, new capital equipment and experienced technical experts from the Japanese textile firm. Although these two firms enjoyed access to new technology provided by the Japanese textile firm, this technology was not the newest

technology. The senior manager of these firms attributed this to the fact that the Japanese technical experts attached to these firms were mostly retired people over 50 years old who may not have followed the latest development in textile technology, but who were nevertheless still able to provide adequate expertise to these firms. However, through this access to new textile technology, new capital equipment and Japanese textile experts, these firms were able to export a large part of their output.

Under the above package agreement, the Japanese textile firm had carried out the feasibility study, designed the plant lay-out, supplied the textile machinery, constructed the plant and also set up the production lines. In addition, the Japanese textile firm had also provided suppliers' credit to the Indonesian firm to purchase modern textile machinery. During the early years of operation, the Japanese textile firm had also supplied the Indonesian firm with eight Japanese senior managers and technical experts to assist the Indonesian managers and technical experts in operating the plant. As a result, after some time the Indonesian managers and technical experts were able to operate the plants by themselves, even though the firm still relied on Japanese experts for quality control, since the bulk of its exports was handled by the Japanese general trading company. This meant that these two domestic textile companies greatly relied on the Japanese general trading company for the overseas marketing of their products. (Thee & Pangestu 1998: 237-38).

The experience of these two large domestic textile firms indicates that while through their technical licensing agreement with a Japanese textile firm, new textile technologies was continuously transferred to them, their technological effort was mostly focused on mastering the operational (production) capabilities, which enabled them to operate the plants efficiently. Having as its production director an experienced Indonesian

textile engineer who had studied textile engineering in Japan and had worked in a Japanese textile firm for eight years, enabled one of these firms to acquire greater TCs, including adaptive (minor change) capabilities. This was reflected by the fact that before this firm installed new capital equipment, its production director was actively involved in discussing with the overseas equipment suppliers the exact design and technical specifications of the capital equipment to make it suitable for local conditions. (Thee & Pangestu 1998: 237).

However, by relying on the Japanese textile firm to carry out the feasibility study, design the plant lay-out, supply the textile machines, construct the plant and set up the production lines, these two domestic textile firms had not developed the basic acquisitive (investment) capabilities. By relying on their Japanese partners in marketing their output overseas, these firms did not have the incentive to build up their marketing abilities. In short, by finding it profitable to continue to rely on their association with the Japanese firms, these two firms did not have the incentive to make a determined effort to lessen their technological dependence on their Japanese partners.

b. The garment industry

Technology transfer through FDI

Thee's and Pangestu's study also included one JV firm operating in the garment industry, namely a Korean-Indonesian export-oriented JV which made overcoats and jackets under OEM (Original Equipment Manufacturing) arrangements with its overseas buyers in Western Europe. In this JV the Korean partner held a 95 per cent majority share, while all the senior managers were Koreans. The only two Indonesian managers were in charge of accounting, respectively personnel, so none of them were involved

in production activities.

As production management and engineering, repair and maintenance of the capital equipment, and quality control were all carried out and led by the Korean managers, it appeared that no significant transfer of the basic operational and adaptive capabilities had as yet taken place. Since the procurement of the relevant technologies and the installation and the start-up of the plant had also been carried out by the Korean managers, no local acquisitive capabilities were acquired either. However, this absence of significant technology transfer may have been due to the fact that at the time of the interview this JV had only been in operation for three and a half years. (Thee & Pangestu 1998).

c. The electronics industry

i. The consumer electronics subsector

Technology transfer through FDI

Thee's and Pangestu's study on the TCs of consumer electronics firms indicated that foreign-controlled joint ventures (JVs) were quite prevalent among the large electronics firms. It was found that the Indonesian employees in an older, well-established Japanese-Indonesian JV (dating back to the early 1970s) had been more involved in the search and procurement of the relevant technologies and the installment and start-up of production facilities than those employed in the newer, majority-owned JVs, mostly Japanese-Indonesian and Korean-Indonesian JVs, established in the early 1980s and early 1990s. As a result, while the Indonesian employees in the former firm had been able to acquire some acquisitive (investment) capabilities, those in the latter did not. However, even in the former case, the staff of the Indonesian partner had only been involved in product selection,

site selection, and processing of the required licenses, without much involvement in the more essential acquisitive activities, such as product specification, process technology, design and plant lay-out.

Since the newer JVs had experienced difficulties in recruiting experienced local engineers and managers, many top positions were still being occupied by expatriates. The middle-level and lower positions, however, were filled by recent graduates from local universities who, upon recruitment, were trained in-house, at the head office of the principals in their home country or in the subsidiaries in Singapore and Malaysia. As a result, at the time of the interviews, the local employees in these new JVs had not yet fully mastered the requisite operational capabilities.
(Thee & Pangestu 1998: 250-51).

ii. The components and industrial electronics subsectors

Technology transfer through FDI

Thee's and Pangestu's study also included case studies of four JVs making electronics components. including a majority-owned Japanese-Indonesian JV, two Singaporean-Indonesian JVs and a Korean-Indonesian JV. In the case of the Japanese-Indonesian JV, the Indonesian engineers and workers were trained at the Japanese partner's plant in Japan, which enabled them to acquire some basic production capabilities from the Japanese staff. However, maintenance and repair of the capital equipment and quality control is still done under the supervision of the Japanese staff. Since this JV still relies greatly on Japanese expertise, the Indonesian employees have, aside from some basic production capabilities, not developed the acquisitive and adaptive capabilities.

The three other JVs making integrated circuits (ICs) were JVs with Indonesian majority ownership, including two Indonesian-Singaporean JVs and one Korean-Indonesian JV. Unlike the Japanese majority-owned JV, the Indonesian staff of the Korean-Indonesian JV and one Singaporean-Indonesian JV had to search and procure the relevant technologies as well as install and start up the production facilities themselves. In doing so, they were able to develop the basic acquisitive capabilities as well as the basic operational capabilities from their foreign partners. In addition they were also able to develop some limited adaptive capabilities.

The other Singaporean-Indonesian JV was previously owned by National Semiconductor, an American firm, which was taken over by this JV. As the workers of this former American firm had stayed on, this JV was able to acquire immediately the basic operational capabilities which, over time, they build up further, including the capability to source the important inputs (machinery and other capital equipment), to learn to use the new equipment, and to keep up with the rapid changes in IC technology.(Thee & Pangestu 1998: 250-51).

Technology transfer through technical licensing agreements

Thee's and Pangestu's study also discussed the experience of a domestic, private electronics firm which produced industrial electronics products (sound systems and computer monitors) under license from a Taiwanese electronics firm. Under its technical licensing agreement with its licensor (the Taiwanese firm), this domestic firm (the licensee) not only obtained the technology and product designs from its licensor, but was also able to send its engineers and plant workers to Taiwan for special training at the headquarters of the Taiwanese firm. This latter firm also dispatched two of its technical experts to work in the licensee's

plant in charge of quality control.

For marketing its products overseas, the licensee relied on its licensor, although it had also begun to make its own marketing efforts by opening up a marketing office in Singapore. Before its establishment, this firm itelf had searched, assessed, negoiated and procure the relevant technologies, which had led to the licensing agreement with the Japanese firm. Over time this domestic electronics firm was able to develop its own basic acquisitive and operational capabilities. With technical assistance from its Taiwanese licensor, this firm was also able to develop basic adaptive capabilities. (Thee & Pangestu 1998: 250-51).

d. The pharmaceutical industry

Technology transfer through FDI

A study for ESCAP’s Unit on TNCs by Thee on three of the oldest foreign-controlled pharmaceutical JVs manufacturing a wide range of manufactured products for the domestic market found that through on-the-job training and additional training at the foreign TNCs's headquarters in their home countries, the Indonesian managers and technical experts were able to develop good operational (production) capabilities in order to run the plants smoothly. As a result, after a few years these plants of these JVs, one a Japanese-Indonesian JV, another one a British-Indonesian JV, and the third one a German-Indonesian JV, could be managed and run by the Indonesian employees. The success of the Japanese-Indonesian JV in transferring operational capabilities to its Indonesian employees is reflected by the fact that at present all the leading managerial and technical positions in this firm are occupied by Indonesian employees, except for the position of President-Director which is still occupied by a Japanese.

However, like in most other JVs, the procurement of the relevant technologies and installment and start-up of the production facilities as well as some minor process adaptations (such as using older machines to fit the smaller Indonesian market and the introduction of more labour-intensive processes in peripheral activities, such as packaging) in these pharmaceutical JVs was conducted by the expatriate personnel. Like in the other pharmaceutical JVs and domestic pharmaceutical firms producing under license from foreign pharmaceutical TNCs, one of the provisions in the technical licensing agreement, signed by the Japanese pharmaceutical TNC and this JV, stipulated that the essential raw materials, namely the active ingredients of drugs, had to be purchased from the licensor, that is the Japanese TNC. Hence, product adaptations in any way were prohibited. As a result, in this JV nor in the other pharmaceutical JVs were the Indonesian employees able to develop the basic acquisitive (investment) and adaptive (minor change) capabilities. (Thee 1990: 213-17).

The British-Indonesian and German-Indonesian JVs had to pay royalties to their licensors (the British and German TNCs) for the purchase of the technologies provided by these TNCs which varied from three to five per cent of the total sales of these licensed products. The licensing agreements signed by these two JVs contained restrictive clauses which stipulated that the raw materials, specifically the active ingredients which in combination make up the drug, could only be purchased from the licensors. (Thee 1990: 216).

Technology transfer through technical licensing agreements

In the same study by Thee one case study involved a private domestic firm producing a wide range of pharmaceuticals,

most of it developed by the firm itself, and some selected pharmaceuticals which it was not able to develop itself and therefore made under license from some pharmaceutical TNCs. This firm had from the outset planned on developing most of the drugs itself, as the technologies for making (mixing) drugs could be bought off-the-shelf, for instance in Italy. However, for certain pharmaceuticals, such as a drug for cardiovascular disease, a licensing agreement was signed with a German pharmaceutical TNC, while for a potent antibiotic a licensing agreement was signed with a Japanese pharmaceutical TNC.

To enhance the technical knowledge of its personnel, this firm has sent out several of its technical experts on a regular basis to participate in training courses offered by the pharmaceutical TNCs. The costs of participating in these courses were borne by the firm itself. In addition, this firm has also assigned several of its high- and middle-level managers to participate in management training courses conducted by management training institutes in Jakarta. In this way this firm has been able to develop good operational capabilities, in addition to some acquisitive and adaptive capabilities. (Thee 1990: 211-13).

Under the terms of the licensing agreements, this firm had to pay its licensors royalties amounting to three per cent of total sales (calculated as total sales to its distributors) for an initial period of three years, to be automatically renewable, unless one or both parties wanted to terminate the agreement. A restrictive condition of the agreements signed with the two TNCs stipulated that the drugs made under license could only be sold in the domestic market. Another restrictive condition was the requirement that this domestic firm had to purchase the basic raw materials (active ingredients) from the licensors, unless the licensee could indicate that it could purchase the raw materials from other sources at a price which was more than 10 per cent

lower than the selling price of the licensor.

This domestic firm has not yet been able to reach the stage of conducting R & D on finding entirely new chemical entities in view of the huge costs of R & D and shortage of highly skilled scientists. Most of the small R & D facility has been devoted to study the available literature on new pharmaceutical developments in order to monitor recent developments in the international pharmaceutical industry and in pharmacology. (Thee 1990: 212).

e. The automotive industry

Technology transfer through FDI

Thee's study also covered a Japanese-Indonesian JV which manufactures automotive parts and components, specifically body-pressed parts, for commercial vehicles (buses and trucks). This JV was established in 1976 to fulfill the 'deletion program' (local content program) which was introduced by the Indonesian government as part of its ‘industrial deepening’ program. The Japanese TNC is one of the largest car assembling companies, not only in Japan but also in the world. Before this JV was established, this TNC had established another JV in 1971 with the same domestic firm to assemble cars for the domestic market.

This JV has put great emphasis on training and transferring technology and skills to its Indonesian employees, including the ability to operate machines, to make component designs, and to inspect the quality of the components. These training efforts were rated as quite successful. However, in regard to training its local employees in managing a production line, motivating the plant workers, conducting quality control, preventing damage to the machines and maintaining the equipment in

top working condition, controlling delivery schedules, controlling the dies manufacturing program, operating the plant, and maintaining and improving the plant, the training programs had not yet yielded the optimal results expected by the Japanese managers. In other words, while the Indonesian employees have been able to develop some operational (production capabilities), they had not yet acquired the full range of operational capabilities required for operating a technologically sophisticated plant on their own. (Thee 1990: 225).

Technology transfer through technical licensing agreements

Two studies by Thee, first for ESCAP's TNC Unit on TNCs and a few years later for IDE (Institute of Developing Economies), Tokyo, on the same domestic motorcycle assembling firm found that this firm has put a high priority on developing its own local TCs in order to raise the efficiency and competitiveness of its operations and to produce motorcycles of high quality. This domestic motorcycle firm was established in 1971 and since 1973 began assembling motorcycles under a technical licensing agreement with one of Japan's leading automotive TNCs. Over time this domestic firm emerged as the leading motorcycle assembling firm in Indonesia with a market share of more than 50 per cent.

This firm has put a high priority on developing its own local TCs in order to raise the efficiency and competitiveness of its operations and to produce motorcycles of high quality. With the full support of the firm's top management to promote the firm's own technological efforts to raise its productivity and competitiveness, efforts were made to forge a strong sense of cohesion among its staff so as to accumulate and consolidate a 'critical mass' of technological, organisational and marketing capability. (Thee 1990: 227).

This domestic firm has from the outset given high priority to advanced training for its managers. Most of its managers were sent abroad to acquire advanced training in management and technology at INSEAD, the European management training institute near Paris, France, or in the United States with the objective of forming a core group of highly-skilled Indonesian managers who could make the firm self-reliant in the long run. All these overseas training programs were wholly financed by this firm. (Thee 1990: 228).

In order to increase the capacity of its technical workers to absorb the technology transferred by its Japanese licensor, this firm has over the years sent hundreds of its employees to the main plant of its licensor in Japan for further training for a period of one to six months. New recruits of this firm have to follow first an intensive one-month training program to master the technical aspects of the operations of this firm and to learn the firm's corporate philosophy. (Thee 1997: 128-30).

All the technical workers were sent for training to the Japanese TNC’s home plant in Japan in view of this domestic firm’s dependence on the technology of the Japanese TNC. For advanced management training, however, the firm’s managers were sent to management training centres in Europe and the U.S. as it was felt that these management training centers had more to offer to Indonesian managers than did Japan, since management as a separate discipline is, with a few exceptions, generally not taught in Japanese universities. (Thee 1990: 228).

As a result of its technological effort, this firm has been quite successful in developing its operational (production) capabilities. As a domestic firm without foreign equity involvement, this firm has also been able to develop its acquisitive (investment) capabilities as well as a high degree of

adaptive (minor change) capabilities, including minor process adaptations and even some minor product adaptations which, however, had to be approved first by its licensor. While the licensing agreement includes some restrictive conditions, including a prohibition on exports and a secrecy rule, that is the obligation that upon termination of the agreement all company secrets had to be returned to the licensor, this firm's position as the market leader in the domestic market for motorcycles enabled it to export a part of its output (10-30 per cent of its output) with the tacit agreement of the Japanese TNC.(Thee 1997: 130).

On January 1, 2001, however, this domestic firm was converted into a joint venture between its erstwhile licensor, the Japanese TNC, and the holding company of this domestic firm, in which both partners each held 50 per cent of the equity. The proceeds of the sale of 50 per cent of the shares of this domestic firm to the Japanese TNC has been used by the holding company of this domestic firm to pay off some of its foreign debts which it had incurred before the onset of the Asian economic crisis. However, as a JV, management control of the JV has now shifted to the Japanese TNC. As a result, this JV now employs 12 Japanese managers and technical experts, while before it employed none.

f. The chemical industry

Technology transfer through FDI

Thee's study also included technology transfer in three JVs, one a JV between an Australian chemical company and a state-owned enterprise (SOE), one of the few JVs with an Indonesian SOE, producing industrial and medical gases; another one a British-Indonesian JV producing a range of paints for the decorative, refinish, automotive and industrial domestic market segments; and the third one a German-Indonesian JV making organic and inorganic

pigments, dyes and chemical auxiliaries.

Through its training efforts the Australian company has been quite successful in transferring technology to its Indonesian employees, specifically the production capabilities. This is reflected by the fact that after a few years all the expatriates (except for the managing director) could be replaced by Indonesian managers and technical experts. The replacement of these expatriates was facilitated by the fact that for the higher levels of management and technical positions, this JV had made a special effort to recruit graduates from Australian universities. The transfer of technology in this JV has not been wholly taken place from the Australian to the Indonesian side, as the Indonesian chief executive of this JV had for many years been employed with the big state-owned fertilizer enterprise in Palembang, South Sumatra, where he had gained valuable experience in running a big chemical plant using very advanced technology. This technological knowledge was subsequently being put to good use in this JV, albeit with some adjustments to the JV's specific conditions.(Thee 1990: 218-19).

Like the Australian-Indonesian JV, the British-Indonesian JV had also been successful in transferring technology to its Indonesian employees because of its commitment to make a long-term investment in the development of a highly-qualified local managerial and technical staff. This was reflected in the replacement of almost all the expatriates who occupied the senior managerial and technical positions by the Indonesian employees, except for one expatriate technical expert assigned to assist his Indonesian counterpart and other workers in installing and operating a new highly-automated equipment. As a result, the local staff was able to develop a high degree of operational and adaptive capabilities. These adaptive capabilities were acquired when some minor product adaptations had to be made, for instance

when some adaptations had to be made with the paints made by this JV to take account of the specific weather conditions in a tropical country, such as Indonesia. In addition, instead of importing all the raw materials from the British TNC, some raw materials were procured locally, including paste and acrylic. (Thee 1990: 220-22).

Unlike its plants in Germany, the German partner in the German-Indonesian JV, a leading chemical TNC, decided not to use a fully-automated production line in view of the great shortage of highly skilled mechanics who are essential to operating a fully-automated production line. To upgrade the skills of its key Indonesian employees, these employees are sent to the TNC's main plant in Germany every three years to keep abreast of the latest product developments. In addition, the local production manager is sent on triennal 'refresher' visits to Germany. As a result of these training efforts, the local staff were able to acquire adequate operational and adaptive capabilities which has enabled this JV to steadily reduce the numbers of expatriates and replace them by Indonesian staff. One of the minor product adaptations which were made included the lessening of the colour strength of the organic and inorganic pigments which this JV is making. In view of the high price elasticity of demand for these pigments, more white was added to make the pigments cheaper. (Thee 1990: 222-23).

The experience of these three JVs indicates that FDI projects have in general been quite successful in transferring the essential operational (production) capabilities and to a lesser extent the adaptive (minor change) capabilities to their Indonesian employees. However, as the procurement of the relevant technologies and the installment and start-up of the plants were mostly done by expatriates, the Indonesian employees were in general not able to acquire the acquisitive (investment)

capabilities.

g. The food products industry

Technology transfer through technical licensing agreements

A study conducted by Thee on three private, domestic manufacturing firms operating in the food products industry and producing their products under license of foreign companies, indicated that technical licensing agreements with transnational corporations (TNCs) generally contain more restrictive conditions than is the case with foreign firms which are no TNCs. The reason for including these restrictive conditions in the licensing agreement was that the licensed products of these TNCs had well-known brand names whose reputation depended on the assured high quality of their products. For instance, in the case of a large private, domestic food products firm producing confectioneries (sweetmeats, candies) under license from two foreign transnational corporations (TNCs), the licensing agreements contained an explicit provision that the basic raw materials, specifically the flavours which give these confectioneries their specific wellknown taste, had to be purchased from the licensors, that is the TNCs. The other raw materials, such as sugar, were purchased locally.

Another restrictive condition faced by this domestic firm was that no product modifications of any kind were allowed and that samples had to be sent first to the two licensors for quality control before final approval was given to start the commercial production of these confectioneries. (Thee 1990: 204-07).

The experience of this firm indicated that it had acquired adequate operational (production) capabilities as well as acquisitive (investment) capabilities. Unlike most JVs where the foreign partner usually undertakes the pre-investment (search, assess, negotiate and procure the relevant technologies) and

project execution (install and start up the newly set-up production facilities), this domestic firm (like most other domestic firms without foreign equity involvement) had to carry these activities itself, which enabled it to develop its acquisitive ability.

Unlike the first firm, the two other domestic firms had not signed licensing agreements with large TNCs, but with medium-sized foreign firms. One of these domestic firms made ice cream under license of an Australian dairy firm, while the other made biscuits under license of a Dutch biscuit company. Within the ice cream firm, technology transfer had proceeded satisfactorily, as most of the managers and technical experts, many of whom had studied in Australia, had been with this firm since the beginning and had therefore acquired substantial on-the-job training and experience. In doing so, these Indonesian employees had thus been able to develop good operational capabilities, as reflected by the fact that over the years Indonesian experts and technical experts had taken over all the leading positions in the firm which had formerly been occupied by Australian managers and technical experts assigned by the licensor. As a domestic firm producing its products under license, this firm had to undertake itself the various activities involved in searching and procuring the relevant technologies and setting up the plant, and thus was able to develop its acquisitive capabilities. (Thee 1990: 207-9).

In regard to the domestic firm producing biscuits under license from a Dutch biscuit company, the former firm had been able to develop its acquisitive, operational and adaptive capabilities with the help of a technical expert assigned by the licensor, who provided technical instructions to the senior local staff who would later be charged with running the plant themselves. In the absence of a qualified production manager, this technical

adviser also functioned as the de facto production manager. In view of the relatively young age of this domestic firm at the time of the inteview, the local staff had not yet been able to fully develop adequate production capabilities, let alone adaptive capabilities.
(Thee 1990: 209).

VII. Assessment of technology transfer through FDI, technical licensing agreements, capital goods imports, and participation in world trade

1. Technology transfer through FDI

The findings of the above case studies on technology transfer through FDI and technical licensing agreements and the discussion on the two other main channels of technology transfer in Indonesia, capital goods imports and participation in world trade, can be summarised in table 6.

Table 6 here

The data in table 6 indicate that in general the international technology transfer through FDI projects has indeed led to the development of the basic operational (production) capabilities and sometimes also to the development of adaptive (minor change) capabilities, primarily by introducing minor process adaptations to local conditions, particularly in the older, well-run FDI projects where experienced Indonesian local employees have worked for a long time to manage the operations of the plants, including the operation, maintenance and repair of the machinery and other capital equipment being used. On the other hand, minor product adaptations have usually not been allowed by the foreign licensors, particularly if the foreign licensors were large, well-known TNCs which had a large stake in upholding the reputation of

the brand names of their products.

In many FDI projects, however, local employees are not always or only partly involved in the procurement of the relevant technologies and the installation and start-up of the production facilities. As a result these local employees did not have the opportunity to develop the basic acquisitive abilities. Moreover, in view of the relatively small scale of Indonesia's domestic market, it did not and still does not make economic sense to undertake R & D activities in these FDI projects, particularly as such activities are very costly and also need a large number of highly qualified and experienced scientists and engineers, who are in short supply in Indonesia. For this reason FDI projects in Indonesia in general do not have fullfledged R & D units, but at most small laboratories for product testing and quality control. As a result, local conditions do not yet provide foreign-controlled firms with the proper incentive to develop local innovative capabilities.

Without doubt FDI is often the only way to obtain the latest technologies from abroad, and hence the only way to ensure a rapid transfer of technology. FDI can therefore play a vital role in the industrial and technological upgrading of a country. However, even if TNCs find it feasible and profitable to conduct R & D in a developing country, this R & D may provide relatively few external benefits. The reason for this is that this R & D by TNCS is likely to be tightly interwoven into the global R & D networks of the TNCs concerned, and is likely to be narrowly specialised in certain segments of the innovative process. Moreover, this R & D by TNCs is unlikely to raise significantly the TCs of local firms. (Lall 1991: 6). Relying on FDI from developed countries to lead the economy into advanced industry, as Singapore has done, also makes the development of local TCs highly dependent on foreign investors, and thus runs the risk of being subject to forces

outside the country's control. (Lall 1991: 5-6). Hence, a big country like Indonesia also needs to spend a lot of local technological effort on developing its own indigenous TCs to take full advantage of the presence of FDI.

In order to achieve the objective of achieving a more effective transfer of technology from FDI, Indonesia will have to take a more pro-active approach to attracting the kind of FDI Indonesia wants for more effective technology transfer. Indonesia also needs to make a much greater effort than it has done so far to build up a large pool of broadly skilled workers in order to raise the country's absorptive capacity for more advanced technologies.

2. Technology transfer through technical licensing agreements

Technology transfer through technical licensing agreements between foreign firms (licensors) and domestic firms (licensees) have generally provided a better opportunity for domestic firms to acquire not only the basic operational, but also the basic acquisitive and adaptive capabilities. The reason for this is that domestic firms have to make a much greater technological effort to actively develop the requisite technological capabilities (TCs), specifically the acquisitive and adaptive capabilities, than in the case of FDI projects. The reason for this is that in the case of domestic firms the local employees have to be actively involved from the outset of the investment project in the search for, assessment of, and the procurement of the relevant foreign technologies and in the installation and start-up of the production process. Through their active involvement in all these activities, these local employees were able to develop the basic acquisitive (investment) abilities.

Similarly, in the case of domestic firms producing under license from foreign licensors, the local employees also have to make a greater effort to develop the basic adaptive (minor change) capabilities themselves, particularly in regard to minor process adaptations to local conditions, which in the case of FDI projects are often carried out by the expatriates. However, for the same scale, financial and skill reasons, domestic firms producing under license from foreign licensors have, just like the above FDI projects, not yet established full-fledged R & D units, but only small laboratories for product testing and quality control. As a result these domestic forms too have not yet been able to develop local innovative capabilities.

3. Technology transfer through capital goods imports and participation in world trade

While capital goods imports have been an important channel for embodied foreign technology inflows into Indonesia, these imports cannot by themselves raise a domestic firm's TCs, unless these imports are accompanied by the important technical instructions provided by the technical experts of these capital equipment suppliers to the local employees of these domestic firms on how to operate, maintain and repair the imported machinery and other capital equipment. Obviously, these technical instructions and related manuals are a crucial element of these embodied foreign technology inflows, which should enhance the operational (production) capabilities of these local employees. However, while these capital goods imports provide a good opportunity to raise the local operational capabilities, this will ultimately depend on the skills and motivation of the local employees working with these capital goods.

Participation in world trade, particularly by exporting products under OEM arrangements, has also offered a good

opportunity to domestic firms to develop their TCs, as reflected by the favourable experience of Bali's garment and its other export-oriented industries and of Jepara's furniture industry. The important information flows and technical advice provided by foreign buyers, who often acted as consultants to Bali's and Jepara's firms, contributed to the development of the basic operational and to some extent also adaptive capabilities of these firms, including small- and micro enterprises. However, as the export-oriented activities were almost exclusively initiated and organized by foreign buyers/consultants, these firms have in general not been able to develop the acquisitive capabilities nor the marketing capabilities.

VIII. Concluding remarks

The above account of international technology transfer to Indonesia has argued that Indonesia, like other developing countries, is a net technology importer. It therefore needs to have free and unhampered access to the foreign technologies from the advanced and newly industrialised economies (NIEs) in order to enable it to improve the productivity, efficiency and competitiveness of its economy, notably its manufacturing industries. As Indonesia could choose from the large stock of available foreign technologies to decide which it should import on the best available terms, it would be technically and economically not feasible, except in a few cases, to attempt to invent technologies at its present relatively low level of scientific and technological development. Instead, Indonesia should focus its technology strategy on importing those technologies most relevant to its development needs on the most favourable terms, assimilate, adapt and wherever possible improve on these imported technologies, very much like Japan and later the East Asian NIEs had done so spectacularly in earlier decades.

Unlike the East Asian NIEs, however, Indonesia has thus far not yet been able to take full advantage of the various channels of international technology transfer open to it to develop and raise its TCs, notably through FDI and participation in world trade. In the case of FDI Indonesia has not been able to fully take advantage of FDI because of the frequent changes in policies towards foreign investment, which indicated that Indonesia's policy-makers did not have a clear idea of what they really expected of FDI beyond general goals, such as employment generation, saving or earning foreign exchange, promoting regional development and technology transfer.

Even with technology transfer, there was a lack of understanding of how this process could be encouraged beyond exhortations and regulations designed to prod foreign-controlled firms to accelerate the 'Indonesianisation' of their senior expatriate staff by replacing them with local staff and by providing training to their local employees at all levels. In fact, a major factor which has often hampered the efficient international transfer of technology through FDI has been the country's lack of absorptive capacity, specifically the shortage of adequately trained and skilled local employees who are able to fully comprehend and master the technologies transferred to them. This shortage is often caused by the generally acknowledged poor quality of education in Indonesia at all levels.

Another factor which has held back the smooth transfer of technology has been the past practice of requiring foreign investors to form joint ventures (JVs) with local businessmen, whom they sometimes did not know very well or trust, and to whom they had to transfer majority equity ownership within a specified period of time, initially within 10 years after the start of commercial operations, and later extended to 20 years. On the other hand, local partners in JVs were often content with

receiving their dividends without attempting to use their foreign partners more effectively for accelerating the process of technology transfer.

Although since the investment deregulation package of June 1994 foreign investors are no longer required to form JVs with local investors, the still prevailing preference for JVs might hamper some foreign investors to enter Indonesia, unless they are assured that they will be able to keep full management control over their operations. Such assurances could encourage foreign investors to transfer their technologies more readily to their local employees. To take better advantage of FDI to develop local TCs, Indonesia would also have to put top priority on overhauling its educational system and curricullum in order to improve the quality of education at all levels. Such improvements would require a much greater investment, both public and private, in education at all levels than is the case at present.

In spite of the fact that FDI is a crucial source of international technology transfer, only relying on FDI for a country's development runs the risk of making a country's technological development too much dependent on foreign investors, and thus runs the risk of being subject to forces outside the country's control. Hence, to prevent such an excessive dependence, the Indonesian government needs to encourage domestic firms to spend a lot of local technological effort itself on developing local technological capabilities in order to avoid excessive dependence on FDI as a vehicle for technological development. This would require first of all a proper incentive system, consisting of sound macroeconomic policies and pro-competition policies (specifically an export-promoting trade regime and sound domestic competition policies), and a much greater investment in human resources in order that these firms have access to better trained and skilled workers at all levels which, in turn, would enhance the firms' 'supply-side capabilities'.

Other factors which are important to enhance a firm's supply-side capabilities are access to finance and adequate technology support services. Access to finance, notably venture capital funds, is important as technology development requires long-term and risky investments in new technologies. Technology support services provided by a country's science and technology (S & T) institutes and institutes providing metrology, standardization, testing and quality (MSTQ) services are important to diffuse technological information and to assist firms, including SMEs, in making effective use of imported technologies, keeping up with technology trends, and assisting these firms to use this information effectively to improve their competitiveness. (World Bank 1995: 5). Unfortunately, both in regard to adequate access to sources of finance and adequate provision of technology support services, the performance of the relevant agencies and institutes in Indonesia are as yet far from satisfactory. (Thee 1998).

Capital goods imports and especially participation in world trade, specifically through exporting, has enabled many domestic, export-oriented firms to get access to valuable foreign technologies, including design. However, this export orientation has been largely the result of active approaches by foreign buyers with access to and knowledge of export markets rather than through the efforts of these domestic firms themselves to identify promising potential export markets, gather the necessary market information about prospective customers in the export markets, identify their specific tastes and preferences, establish the necessary distribution channels in their export markets and, if necessary, establish an adequate after-sales service.

In order to reduce the great dependence on foreign buyers, domestic, export-oriented firms need to develop themselves the

above marketing capabilities. By developing these marketing capabilities themselves, domestic firms would be able to gain continuing access to foreign technologies without being only dependent on foreign buyers. In this respect Indonesia could learn a great deal from the important role which Japan's sogo shosha (general trading companies) have played in gathering the important information about foreign markets for Japan's export-oriented firms, including SMEs, and in providing the valuable marketing channels to export markets.

While the Indonesian government has rightly pursued a liberal, 'open door' policy in regard to foreign technology imports, no effort has been made to require FDI projects and domestic firms producing under license from foreign licensors to report the royalty payments and other fees they pay to their foreign licensors. The absence of data on the payments for these technology imports is an important lacuna in Indonesia's international balance of payments. Hence, while it should be explicitly stated that the Indonesian government is firmly committed to maintaining its liberal and 'open door' regime in regard to foreign technology imports, there is a strong case for requiring FDI projects and domestic firms to report the technical licensing agreements they sign with foreign licensors and the amount of royalty payments they pay their foreign licensors. This knowledge would enable the Indonesian government to identify the competitive weaknesses of domestic firms and entrepreneurs and the steps required to remedy these weaknesses, not by direct, counterproductive intervention, but by positive, non-distorting measures, such as providing training courses to the managers and employees of domestic firms on TNC strategies and practices, negotiation strategies with TNCs, and on gaining access to off-the-shelf technologies and overseas marketing channels.

References

Agency of Industrial Science and Technology, 1992, Trends in Principal Indicators on Research and Development Activities in Japan, Technology Research and Information Division, General Coordination Department, Tokyo.

Asian Productivity Organization, 1994, Intra-Regional Investment and Technology Transfer in Asia - A Symposium Report, Tokyo.

Badan Pusat Statistik, Economic Indicators, successive issues.

Bell, Martin; Bruce, Ross-Larson & Larry E. Westphal, 1984, Assessing the performance of infant industries, Journal of Development Economics, Vol. 16, nos 1-2, September-October.

Chee, Peng Lim, 1981, EEC Investment in ASEAN and the Transfer of Technology: A Malaysian Case Study, Paper presented at the First Conference on ASEAN-EEC Economic Relations, Singapore, 6-8 August.

Cole, William, 1997, Bali’s Garment Industry - An Indonesian Case of Successful Strategic Alliances, unpublished paper, Jakarta.

_____, 1998, Bali's garment export industry, in: Hill & Thee (editors), 1998, pp. 255-78.

Dahlman, Carl J. & Larry E. Westphal, 1981, The meaning of technological mastery in relation to transfer of technology, in: Heston & Pack (editors), 1981.

Dahlman, Carl J.; Bruce Ross-Larson & Larry E. Westphal, 1987, Managing Technological Development: Lessons from the Newly Industrializing Countries, World Development, Vol. 15, no. 6, pp. 759-75.

Economic Planning Agency, 1999, Papers and Proceedings of the International Symposium on Foreign Direct Investment in Asia, Tokyo: October 22-23, 1998, Government of Japan.

Enos, John; Sanjaya Lall & Mikyung Yun, 1997, Transfer of Technology: An Update, in: Asian-Pacific Economic Literature, Vol. 11, no. 1, May, pp. 56-66.

Ernst, Dieter; Lynn Mytelka & Tom Ganiatsos (editors), 1998a, Technological capabilities in the context of export-led growth: a conceptual framework, in: Ernst, Mytelka & Ganiatsos (editors), 1998b, pp. 5 - 45.

_____,(editors), 1998b, Technological Capabilities and Export Success in Asia, Routledge, London.

Heston, Alan & Howard Pack (editors), 1981, The Annals of the American Academy of Political and Social Sciences - Special Issue: Technology Transfer: New Issues, New Analysis, no. 457, November.

Hill, Hal, 1995, Indonesia's Great Leap Forward? Technology Development and Policy Issues, in: Bulletin of Indonesian Economic Studies, Vol. 31, no. 2, August,pp. 83-123.

Hill, Hal & Johns, Brian, 1983, The transfer of industrial technology to Western Pacific developing countries, Prometheus, Vol. 1, no. 1, June, pp. 60-83.

_____, 1995, The role of foreign direct investment in developing East Asian countries, in: Weltwitschaftliches Archiv, Vol. 121, no. 2.

Hill, Hal & Prema-chandra Athukorala, 1998, Foreign Investment in East Asia: a survey, in: Asian-Pacific Economic Literature, Vol. 12, no. 2, November, pp. 23-50.

Hill, Hal & Thee Kian Wie (editors), 1998, Indonesia's Technological Challenge, Research School of Pacific and Asian Studies, The Australian National University, Canberra and the Institute of Southeast Asian Studies, Singapore.

Hobday, Mike, 1994, Export-Led Technology Development in the Four Dragons: The Case of Electronics, in: Development and Change, Vol. 25, no. 1.

Hobohm, Sarwar, 1995, Survey of Recent Developments, Bulletin of Indonesian Economic Studies, Vol. 31, no. 1, April, pp. 3-41.

Kim, Linsu, 1990, Korea: the acquisition of technology, in: Soesastro & Pangestu (editors),1990, pp. 144-57.

Krtayakirana, Kopr & Panya Srichandr, 1989, Technological Capability of Selected Thai Industries, TDRI Newsletter, Vol. 4, no. 2, June, pp. 6-14.

Lall, Sanjaya, 1991, Emerging Sources of FDI in Asia and the Pacific, Paper presented at the Roundtable on Foreign Direct Investment in Asia and the Pacific, East-West Center, Honolulu, Hawaii, March 26-28.

_____, 1993a, Understanding Technology Development, Development and Change, vol. 24, no. 4, pp. 719-53.

_____, 1993b, Promoting Technology Developmnt: The Role of Technology Transfer and Indigenous Effort, Third World Quarterly, Vol. 14, no. 1, pp. 95-108.

_____, 1998, Technology Policies in Indonesia, in: Hill & Thee (editors), 1998, pp. 136-68.

Marks, Stephen, 1999, Foreign Direct Investment in Indonesia and its Management through Governmental Policy, Partnership for Economic Growth, Department for Industry and Trade, Jakarta, March.

Pangestu, Mari & Iwan Jaya Azis, 1994, Survey of Recent Developments, Bulletin of Indonesian Economic Studies, Vol. 30, no. 2. August, pp.3 – 48.

Ramstetter, Eric D., 1999, Trade Propensities and Foreign Ownership Shares in Indonesian Manufacturing, Bulletin of Indonesian Economic Studies, Vol. 35, No. 2, August, pp. 43-66.

Sandee, Henry; Roos Kities Andadari & Sri Sulandjari, 2000, Small firm development during Indonesia's economic boom and crisis - The Jepara furniture industry, Amsterdam & Salatiga, unpublished paper.

Sjoholm, Fredrik, 1999, Joint Ventures, Technology Transfer and Spillovers: Evidence from Indonesian Establishment Data, in: Economic Planning Agency, 1999, pp. 587-616.

Soesastro, Hadi, 1998, Emerging Patterns of Technology Flows in the Asia-Pacific Region; The Relevance to Indonesia, in: Hill & Thee (editors), 1998, pp. 303-25.

Soesastro, Hadi & Mari Pangestu (editors),1990, Technological Challenge in the Asia-Pacific Economy, Sydney: Allen & Unwin.

Sripaipan, Chatri, 1990, The Acquisition of Technological Capabilities by Thai Manufacturing Firms, in: TDRI Newsletter, June.

Szirmai, Adam, 1994, Real Output and Labour Productivity in Indonesian Manufacturing, in: Bulletin of Indonesian Economic Studies, Vol. 30, no. 2, August, pp. 49-90.

Takii, Sadayuki, 2001, Productivity Spillovers and Characteristics of Foreign Multinational Plants in Indonesian Manufacturing, 1990 – 1995, ICSEAD Working Paper Series, Vol. 2001-14, June.

Thee, Kian Wie, 1990, Indonesia: technology transfer in the manufacturing industry, in: Soesastro & Pangestu (editors), 1990, pp. 200-32.

_____, 1994, Intra-Regional Investment and Technology Transfer in Indonesia, in: Asian Productivity Organization, 1994, pp. 137-66.

_____, 1997, The Development of the Motorcycle Industry in Indonesia, in: Pangestu & Sato (editors), 1997, pp. 95-136.

_____, 1998, Determinants of Indonesia's Industrial Technology Development, in: Hill & Thee (editors), 1998, pp. 117-34.

_____, 2000, Raising Indonesia's Industrial Competitiveness, Economics and Finance in Indonesia, Vol. XLVIII, no, 1, pp. 35-62.

_____, 2001, The role of foreign direct investment in Indonesia's industrial technology development, International Journal of Technology Management, Vol. X, no. 10, pp. 1 - 16.

Thee Kian Wie & Ahmad Hamid, 1997, Perkembangan Industri Garmen di Bali sesudah tahun 1990 (The development of the garment industry in Bali after 1990),Paper presented at the Conference of the Association of Indonesian Economists (Ikatan Sarjana Ekonomi Indonesia), Malang, 19 December.

Thee, Kian Wie & Mari Pangestu, 1998, Technological capabilities and Indonesia's manufactured exports, in: Ernst, Mytelka & Ganiatsos (editors), 1998, pp. 211-65.

Toemion, Theo, 2001, New Paradigm on Investment in Indonesia towards Economic Recovery, Keynote Address by the Chairman of the Capital Investment Coordinatinng Board at the Seminar on Indonesian Economic Institution Building in a Global Economy - Investment Policy and Institutional Development, Jakarta, 14 August.

United Nations, 2000, World Economic and Social Survey 2000, New York: Department of Economic and Social Affairs.

Watanabe, Toshio, 1989, A New Era Dawns in the Western Pacific, in: Japan Review of International Affairs, Fall/Winter.

World Bank, 1994, Indonesia - Industrial Policy - Shifting into High Gear, Washington, D.C.

_____, 1996, Indonesia - Industrial Technology Development for a Competitive Edge, Report no. 15451-IND, Washington, D.C., May 29.

_____, 2000, Indonesia: Accelerating Recovery in Uncertain Times, Brief for the Consultative Group on Indonesia, Washington, D.C., October 13.

Wymenga, Paul S.J., 1991, The Structure of Protection in Indonesia in 1989, Bulletin of Indonesian Economic Studies, Vol. 27, no. 1, April, pp. 127-49.

Table 1: FDI inflows (US$ millions) and ratios of FDI inflows to gross capital formation (percentage)

Year	FDI amount (US$ millions)	Ratio to gross capital formation (percent)
1967	-10	-2.20
1968	-2	-0.32
1969	32	3.29
1970	83	6.62
1971	139	9.39
1972	207	10.02
1973	15	0.52
1974	-49	-1.13
1975	476	7.68
1976	344	4.45
1977	235	2.55
1978	279	2.64
1979	226	2.10
1980	180	1.19
1981	133	0.49
1982	225	0.86
1983	292	1.19
1984	222	0.97
1985	310	1.25
1986	258	1.06
1987	385	1.57
1988	576	2.07
1989	682	1.91
1990	1,093	2.64
1991	1,482	3.26
1992	1,777	3.56
1993	2,004	4.30
1994	2,109	3.84
1995	4,346	6.73
1996	6,194	8.88
1997	4,677	6.83
1998	-356	-2.22
1999	-2,745	-15.94
2000	-4,551	-16.62
2001 (Jan-March)	-1,238	-16.98

Source: Bank Indonesia: *Indonesian Financial Statistics*, August 2001; International Monetary Fund: *International* Financial Statistics, August 2001, CD-ROM and 1994 Yearbook.

Table 2: Selected Exports from Indonesia

Year	Total Exports	Manu-facturing (5+6+7+8)	Tex-tiles (65)	Apparel (84)	Elec-tric & Elec-tronic (76+77)	Pharma-ceuti-cals (54)	Motor Vehi-cles (78)	Chemi-cals (51+52 +53+59)	Food (0)
AMOUNTS IN US$ millions									
1979	15,590	1,528	52	66	87	6	0	7	1,208
1980	21,909	1,693	46	98	97	12	4	14	1,291
1981	22,260	1,514	36	95	77	9	1	34	929
1982	22,293	1,566	44	117	119	12	0	19	905
1983	21,146	2,370	120	157	123	14	0	22	1,093
1984	21,888	3,067	200	296	140	12	1	67	1,368
1985	18,587	3,352	240	339	81	15	1	63	1,382
1986	14,805	4,114	307	522	16	16	0	66	1,772
1987	17,136	5,213	469	596	23	19	3	87	1,684
1988	19,219	6,762	680	797	63	23	21	97	2,001
1989	22,028	8,330	860	1,153	121	17	25	163	2,046
1990	25,675	9,969	1,264	1,666	205	18	39	191	2,291
1991	29,142	12,356	1,792	2,306	404	22	61	235	2,537
1992	33,967	16,466	2,870	3,219	938	19	182	345	2,467
1993	36,823	19,734	2,656	3,559	1,403	26	334	401	2,921
1994	40,053	21,081	2,516	3,273	2,086	35	314	512	3,551
1995	45,418	23,667	2,738	3,452	2,443	41	372	699	3,580
1996	49,815	26,219	2,857	3,655	3,154	49	348	819	3,764
1997	53,444	23,144	2,269	2,953	2,837	41	325	923	3,531
1998	48,848	22,177	2,358	2,681	2,421	54	312	1,071	3,717
1999	48,665	26,924	3,029	3,915	2,835	75	416	1,175	3,644
RCA indices									
1979	NA	0.15	0.10	0.20	0.09	0.04	0.00	0.01	0.86
1980	NA	0.12	0.07	0.22	0.07	0.06	0.00	0.01	0.66
1981	NA	0.11	0.06	0.21	0.06	0.05	0.00	0.04	0.45
1982	NA	0.11	0.07	0.25	0.08	0.05	0.00	0.02	0.45
1983	NA	0.17	0.19	0.34	0.08	0.06	0.00	0.02	0.54
1984	NA	0.21	0.30	0.56	0.08	0.05	0.00	0.06	0.68
1985	NA	0.26	0.42	0.74	0.06	0.08	0.00	0.07	0.88
1986	NA	0.37	0.62	1.22	0.01	0.09	0.00	0.09	1.35
1987	NA	0.40	0.79	1.09	0.02	0.10	0.00	0.10	1.19
1988	NA	0.46	1.10	1.37	0.04	0.10	0.01	0.10	1.28
1989	NA	0.50	1.24	1.69	0.06	0.07	0.01	0.15	1.17
1990	NA	0.52	1.56	2.06	0.09	0.06	0.02	0.16	1.17
1991	NA	0.56	1.94	2.38	0.15	0.06	0.02	0.17	1.12
1992	NA	0.63	2.63	2.67	0.29	0.04	0.05	0.22	0.92
1993	NA	0.70	2.33	2.74	0.36	0.05	0.09	0.24	1.03
1994	NA	0.68	2.02	2.39	0.45	0.06	0.08	0.27	1.17
1995	NA	0.67	1.99	2.42	0.44	0.06	0.09	0.33	1.07
1996	NA	0.69	2.00	2.37	0.53	0.06	0.07	0.36	1.04
1997	NA	0.56	1.47	1.66	0.43	0.05	0.06	0.38	0.96
1998	NA	0.57	1.73	1.66	0.40	0.06	0.06	0.47	1.15
1999	NA	0.70	2.45	2.62	0.44	0.08	0.08	0.54	1.22

Source: United Nations Statistics Division (2000). International Trade Statistics Supplied on CD-ROM.

Table 3: Cumulative realised FDI in Indonesia by the 10 most important home countries, 1967 – June 15, 2000 *)

Home country	Number of projects	Realised amount (millions of US$)
1. Japan	1,172	12,369.1
2. Hong Kong	446	7,160.9
3. Britain	210	6,431.8
4. Taiwan	424	4,966.7
5. Korea	497	4,746.7
6. Singapore	448	4,523.8
7. USA	259	3,828.1
8. Malaysia	79	2,733.2
9. Germany	111	1,621.0
10. Netherlands	171	1,392.8

*) Note: These FDI data do not include data on FDI in the oil, natural gas, insurance, banking and non-bank financial institutions and leasing sectors.

Source: Capital Investment Coordinating Board (BKPM): Monthly Investment Report, July 2000, table 3.20.

Table 4 Cumulative realised FDI in Indonesia by sector, 1967- 15 July 2000

Sector	FDI	
	No. of projects	Amount (millions of US$)
Agriculture	269	10,644.6
- Food crops	36	184.3
- Estate crops	69	1,493.3
- Livestock	22	1,062.2
- Fishery	93	3,025.5
- Forestry	49	287.8
Mining	143	4,591.4
Manufacturing	3,341	45,221.6
- Food products	250	2,072.6
- Textiles & leather	702	3,013.4
- Wood & wood products	204	649.4
- Paper & paper products	100	7,772.9
- Pharmaceuticals	80	225.5
- Chemicals	675	15,754.7
- Non-metallic minerals	141	2,704.1
- Basic metals	113	4,367.5
- Metal products	955	8,354.3
- Miscellaneous	121	307.2
Services	1,041	14,613.0
- Electricity, gas &	12	2,692.8
- water supply		
- Construction	177	891.8
- Trade	175	707.6
- Hotels & restaurants	156	4,200.9
- Offices	50	1,344.8
- Dwellings & industrial	76	1,705.0
- estates		
- Transport & communications	81	875.5
- Other services	314	2,194.6
Total	4,794	70,479.2

Source: Capital Investment Coordinating Board: Monthly Investment Report, July 2000, table 3.18.

Table 5: Imports of capital goods, 1981 – 2001 (Jan-March)

Y e a r	Imports of capital goods (billions of US$) *)
1981	2.0
1982	3.0
1983	2.9
1984	2.6
1985	1.7
1986	1.9
1987	2.4
1988	2.6
1989	3.8
1990	6.1
1991	7.7
1992	7.4
1993	7.1
1994	7.4
1995	8.7
1996	9.6
1997	9.3
1998	5.8
1999	3.1
2000	4.8
2001 (Jan-March)	1.5

*) Note : Rounded figures

Source: Badan Pusat Statistik: Economic Indicators, successive issues, section on international trade.

Table 6 Main channels of international technology transfer and their impact on the development of technological capabilities in Indonesia

Channels of technology transfer	Acquisitive	Operational	Adaptive	Innovative
FDI	OS	S	OS	NS
Technical licensing agreements	S	S	S	NS
Capital goods imports	NS	PS	PS	NS
Participation in world trade	PS	S	PS	NS

Explanatory notes: OS = occasionally successful
S = successful
NS = not successful
PS = potentially successful