OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED

IPCT.127(SPEC.)
21 November 1990

ORIGINAL: ENGLISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Technology Trends Series: No. 12

TRENDS IN TECHNOLOGY FLOWS TO DEVELOPING COUNTRIES AND RELATED POLICIES

Prepared by

International Industrial and Licensing Consultants, Inc.*

* P.O. Box 20459, New York, N.Y. 10017/9993

V.90-89711

NOTE

This report was prepared for the Industrial Technology Development Division.

Tables referred to in the text will be found following the footnotes at the end of the chapter in which they are cited.

The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of UNIDO.

The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of UNIDO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

This document has not been edited.

CONTENTS

INTRODUCTION

The critical role of technology in the process of industrialization and the essential need for rapid growth of technological capability has been increasingly recognized in developing countries. This has become all the more accentuated with the revolutionary innovative developments in microelectronics, biotechnology and new materials in industrialized market economies in recent years and the growing technological gap between these countries and most developing economies. A wide range of policies, legislative measures and development programmes on various aspects impacting on technological development have been undertaken in recent years in a number of these countries, together with greater emphasis on research and new technological applications. These policies and programmes have yielded useful results in several countries, particularly in South-East Asia and in some of the larger developing countries. In most others, however, major economic constraints have continued to seriously impede technological growth, absorption and development and, in general, developing countries are lagging far behind industrialized market economies with respect to technological developments and applications.

The present study on "Trends in technology flows to developing countries and related policies", is an integral element in the series of studies undertaken by UNIDO over the last decade with respect to industrial technology, trends in new and emerging technologies and policies and institutional measures in developing countries on technology transfer and development. This study reviews the nature and extent of technology flows to developing countries, particularly during the 1980s, together with developments and changes in national policies towards industrial technology and the impact of such changes in a number of these countries. The assessment of technology flows is made primarily with respect to payments for technology and knowhow, together with trends in sectoral development. With the enormous variation in socio-eonomic conditions and levels of development in developing countries, it is only practicable to relate the pattern of technology flows, and of policies relating to technology, to the experience of selected countries in different regions, as also at varying levels of economic and technological development. It is important to stress that the study does not deal comprehensively with policies on scientific and technological development and research. This analysis primarily concentrates on host country policies impacting on technology flows to their countries and the experience of developing countries with respect to alternative policies and approaches in this regard.

The study is divided into four principal sections. The first chapter deals with definitive aspects of technology flows, the relationship between inflow of foreign direct investments (FDI) and inflow of technology, together with alternative channels for technology inflow and transfer, highlighting trends in inflow of industrial technology to developing countries during the 1980s, and the countries whose enterprises have constituted major sources of investment and technology for developing countries in this period. The second chapter describes national policies on technology transfer which have direct impact on technology flows to developing countries and examines recent changes and trends in such policies and their likely impact on technology flows. The third section deals with the policies and experience of selected developing countries with respect to industrial technology. The countries include Brazil, Mexico and the Andean Group in Latin America; Bangladesh, India,

Malaysia, the Republic of Korea, and Pakistan in South and South-East Asia; Kenya and Nigeria in Africa, and the Arab countries in West Asia and North Africa.

In addition, there are references to other countries in the developing regions. The coverage of country experience is primarily intended to highlight the effects of specific policies in particular country situations, and their likely impact on technology inflow and development. The final chapter discusses policy issues facing developing countries during the 1990s, in the context of growing demand for industrial technology and the policy options for ensuring adequate technology inflow and development, and the institutional measures and arrangements that may be necessary for this purpose.

The study has been prepared with the assistance of Rana K. Singh, President, International Industrial and Licensing Consultants, Inc., New York.

CHAPTER I

TRENDS IN TECHNOLOGY FLOWS TO DEVELOPING COUNTRIES

Technology flows can be considered and assessed under different categories. Generally, such flows can relate to various non-commercial and commercial channels for technological information and transfer between institutions, enterprises and individuals in different countries. Non-commercial flow of technology includes technological data as well as information from books, journals and magazines and such other information that is considered to be in the public domain. Various forms of technical assistance provided at governmental and institutional levels between different countries would also fall in this category. Commercial flows of technology, on the other hand, involve specific payments for technology, knowhow or technological services that may be provided. These range from payments for machinery and equipment dealing with technological developments, to payments for licensing of patents and supply of production technology and knowhow in specific fields, as well as payments for a wide range of technological services, ranging from technological information in international databases to consultancy engineering, turnkey and construction contracts and management and service agreements.

The various forms of technology flows are closely linked with different types of financial and technological participation and contractual arrangements between technology suppliers and recipient enterprises. For developing countries, the most important of these has traditionally been foreign direct investment (FDI) by transnational corporations (TNCs), ranging from investments through wholly-owned subsidiaries to affiliates and joint ventures with varying levels of foreign participation. An alternative form involving either participation in ownership or purely contractual arrangements may be through a franchise, involving the use of a foreign name, together with provision of specialized expertise, for certain products or services.

Inflow of technology has invariably accompanied foreign investments, though the extent of technology transferred has primarily depended on the role ascribed to the subsidiary or affiliate by the parent corporation. During the 1960s and 1970s, with increased emphasis on national ownership in several developing countries, joint ventures with minority foreign holdings of up to 49% became increasingly popular. This pattern continued during the 1980s also. In the last two decades, however, with the establishment of state-owned enterprises in petroleum, mining and several other production and service sectors and the rapid growth and expansion of nationally-owned enterprises in a number of developing countries, there has also been considerable increase in non-affiliate licensing of technology and knowhow through licensing agreements which do not involve foreign equity participation.

Considerable technology inflow to developing countries takes place through contractual arrangements. These range from machinery supply agreements to turnkey contracts for basic and detailed plant engineering and project implementation up to the stage of commencement of production, or contracts for supply of technology and knowhow, or for specialized technical

services. With the increase in the pace of industrialization in a number of developing countries, particularly during the 1970s and early 1980s, there has been a substantial increase in such contractual arrangements during this period, both for supply of machinery and equipment and for various technological services.

The impact of technology flows on national technological development can vary considerably, depending on the channel and mechanism for technology transfer and the form and extent of participation of the technology supplier. The extent of technology inflow and transfer obviously varies in the case of supply of specific machinery and equipment involving only operational knowhow, compared to contracts for supply of production technology, involving transfer of blueprints, drawings and manufacturing technology for a particular product or group of products. Similarly, there is considerable variation in the extent of technology flow and transfer between contracts for supply of technology and knowhow, both for products or processes, and agreements for provision of specific technological services. It is important, therefore, that in assessing technological flows, particularly in the context of development of national technological capability, a distinction is made between imports of machinery and equipment in which technological developments are embodied, and trade in technology, reflected in payments for technology, knowhow and technical services.

Imports of machinery and equipment

Innovations in products and processes are often incorporated, in varying degrees, in modifications in related machinery and equipment, although there may be a significant time-lag in such absorption. To the extent that technological developments are reflected in various categories and ranges of capital goods, such developments are, therefore, transferred with the machinery and equipment that may be purchased. This would be applicable both to common-use equipment such as pumps, compressors, machine tools, data-processing equipment, where developments in digital techniques and automation may have been incorporated, as also to industry-specific equipment where recent technological developments may have been embodied through production and control mechanisms in electrical, mechanical and transport equipment. The extent and trends in capital-goods imports undoubtedly provide valuable information as to the level of technologies that are being used in various sectors. This may not, however, necessarily be an accurate indicator of national technological capability in terms of technological absorption and adaptation in the particular field.

There has been a significant fall in capital-goods imports by developing countries during the period 1982-1987, compared to the previous decade. While such imports rose from about $9 billion in 1965 to over $127.9 billion in 1981, there has been considerable decline in subsequent years. An UNCTAD study has assessed that such imports declined by 10% during 1981-1986, compared to 1970-1981 when an average growth of over 20% was experienced. 1/

1/ UNCTAD, "Recent trends in international technology flows and their implications for development", TD/B/C/6-145, Geneva, August 1988.

Capital-goods imports by developing countries declined to $97.8 billion in 1985 and $107.7 billion in 1986. The sharpest decline has been in developing countries in Latin America and Africa, although there was also substantial reduction in machinery imports by petroleum-exporting countries. A significant feature, however, has been the increase in machinery exports from developing countries, which rose to $26.3 billion to industrialized market economies and $11.2 billion to other developing countries in 1986. The latter figures indicate that there has been considerable technology flow and substantial absorption of machinery-production technologies in several developing countries during the decade 1975-85.

Trade in non-embodied technology

While capital-goods imports serve as a useful indicator of trends in sectoral production and technological usage in different fields, international trade in technology is generally considered as relating to non-embodied technology, comprising of transfer of intellectual property rights such as patents, trademarks and copyrights on the one hand, and trade secrets and unpatented knowhow, together with various technological services, on the other. Transactions with respect to such technology and knowhow are measured in payments of fees or royalties or a combination of the two. Global transactions as reflected in fees and royalties for technology have increased steadily in the last two decades. From a total level of technology receipts and payments of over $7.5 billion in 1972, which comprised mostly of technology transactions between developed-country enterprises, total transactions for technology reached a level of $21.8 billion in 1984, also largely between developed-country enterprises, with payments to industrialized market economies amounting to $10.9 billion. 1/ Trends in 1985-1987 suggest that fees and royalties for technology have tended to stabilize during this period. This is at least partly attributable to an overall decline in technology flows to developing countries. Such payments increased from a level of around $1 billion annually during the early 1970s to $2.2 billion in 1980 and around $2.5 billion annually during 1984-1985. Technology payments during the period since 1985 have shown considerable slowdown, largely due to a decline in the pace of industrialization and consequently in technology flows, in a number of developing countries, particularly in Latin America. There was also a decline in payments for technological services, partly because of reduction in the number of industrial projects and partly because of increased local capability for technological services in several developing countries.

The availability of national data on technology flows, as reflected in payment of fees and royalties, differs considerably from region to region. For most industrialized market economies, such information is available in considerable detail, both with respect to inflow and outflow of technology and knowhow. In several developing countries also, detailed information is publicly available regarding the number of technology agreements, the sectors to which they relate, the country sources, and total payments made annually for technology and knowhow. In a number of other countries, however, such information is not collated and is often difficult to collect, though

---

1/ UNCTAD, op. cit.

information on payments to foreign entities is generally available from central banks. In making any detailed determination of the nature and extent of technology flows, it is necessary to recognize that relevant information on technology agreements and payments may not be available for a number of countries. Despite the shortcomings and inadequacy of the data on technology flows, it is nevertheless possible to assess the overall pattern of technology flows and their impact on technological development.

Outflow of technology and knowhow, particularly through technology contracts, has largely taken place from certain industrialized market economies, with the USA continuing to play the most important role, followed by Great Britain, the Federal Republic of Germany, Japan and France and, to a lesser extent, by other West European countries. Technology and knowhow in certain sectors has also been supplied to some developing countries by the U.S.S.R. and other socialist countries from Eastern Europe. A beginning has also been made by some developing countries, particularly Brazil, India and the Republic of Korea, in exports of technology and knowhow through technology-supply and service contracts in several fields. Nevertheless, exports of technology and knowhow continue, by far, to be dominated by a few industrialized market economies.

The United States has continued to be the principal supplier of technology and knowhow, as reflected in receipts of fees and royalties, during the 1980s. Income from technology transactions 1/ in the United States increased from $4.3 billion in 1978 to $4.5 billion in 1983, $5.3 billion in 1985 and $9.2 billion in 1988. Payments by United States firms of technology fees and royalties were low in comparison and amounted to only $1.2 billion in 1983, $1.7 billion in 1985 and $3.5 billion in 1988. Net receipts from technology transactions during the 1980s have been significantly higher and have continued to rise through this period. Income payments on foreign investments in the United States, however, rose from $13.8 billion in 1983 to $28.6 billion in 1988. The highest proportion of technology transactions of United States firms has been, by far, with West European and Japanese enterprises, and technology receipts from developing countries comprise a small proportion of total receipts. The major share of US technology licensing to developing countries has been to South-East Asian countries and receipts from such licensing increased from $109 million in 1980 to $333 million in 1985. 2/ An interesting feature has been that technology receipts from newly- industrializing Asian countries have been mostly from non-affiliated companies, comprising $218 million in 1985, as against $115 million from United States affiliates in these countries. This reflects the growing trend towards non-affiliate technology licensing and services in these countries.

With respect to sectoral flows of technology from the United States, there has been a marked decline with respect to petroleum technology (3-5 per cent during 1982-1986) and a significant increase in royalties and fees from technology licensing for machinery products (34-36% during 1982-1986);

1/ US Department of Commerce, Survey of Current Business, June 1989, pp. 66-67.

2/ Ibid., 1985.

chemicals (18-24% during 1982-1986); electrical machinery (13-15 per cent during 1982-1986); transportation equipment (5 to 7 per cent during 1982-1986), and in various other manufacturing sectors. Technology income from developing countries during the 1980s was mainly derived from licensing of knowhow in the manufacturing sector and technological services in various fields.

Technology licensing by companies from the United Kingdom accounted for receipts of about $1 billion in 1980 1/ and have remained at a level of between $850 million to $1.2 billion during 1981-1987. Imports of technology, mostly from the United States, have accounted for payments of over $800 million in 1980 and have ranged from over $750 million to $900 million in subsequent years. The proportion of technology receipts from developing countries as against total receipts has been higher for companies from the United Kingdom than from the United States, although here also the trend has been increasingly towards non-affiliate licensing and technological services.

Exports of technology from the Federal Republic of Germany amounted to $548 million in 1980 2/ and have ranged between $450 million to $650 million during subsequent years. Payments for technology by German companies have been significantly higher than receipts, ranging from $900 million to over $1 billion annually. Most technology transactions have been with companies in industrialized market economies, although there has also been an increase in non-affiliate licensing to certain developing countries.

Technology receipts of French companies have tended to range between $450 million 3/ to $650 million annually during the 1980s. Payments for technology, mainly to United States companies, have tended to be much higher than receipts and have ranged from $800 million to over $1 billion annually, during the 1980s. Technology trade with developing countries, which registered an increase during the 1980s, largely took the form of non-affiliate licensing and technological services, except for the supply of technology and services to affiliate companies and industrial projects in French-speaking African countries.

There have been significant developments in technology transactions of Japanese companies. While there was a very large inflow of technology into Japan during 1960-1980, with over 36,000 technology agreements and payments of over $9 billion, there has continued to be substantial inflow of foreign technology into Japan during the 1980s, with total technology payments of

---

1/ Department of Industry, United Kingdom, Business Monitor - Overseas Transanctions (various issues).

2/ Deutsche Bundesbank, Federal Republic of Germany.

3/ Ministère de l'Economie, des Finances et du Budget, Statistiques et Etudes Financières.

$1.3 billion in 1980 to over $2 billion in 1983 1/ and ranging from $1.5 billion to over $2 billion in subsequent years. An important feature, however, has been the rapid increase in receipts for supply of technology, knowhow and technical services by Japanese companies, which rose from $349 million in 1980 and $587 million in 1983 to well over $1 billion in subsequent years. Most technology transactions by Japanese companies have related to the manufacturing sector, with technology imports relating primarily to various fields of manufacture, including computers and telecommunications and production of machinery and equipment, besides steel and chemicals, and exports of technology primarily in consumer goods products, including automotive assembly and manufacture of consumer electronics. Outflow of technology from Japan has often accompanied foreign investments and has tended to concentrate in the United States and certain West European countries on the one hand and Asian economies, particularly South East Asian countries, on the other.

Technology flows to developing countries

The flow of industrial technology to developing countries, as measured in payments of fees and royalties for technology and technical services, appears to have slowed down during the period 1985-1988. Such payments increased from a total of about $1 billion annually in the early 1970s to around $2.5 billion annually during 1981-1983. Since 1985, however, aggregate payments of fees and royalties by developing countries have tended to stagnate and even to decline below $2 billion annually during 1985-1987. Such stagnation and decline is, as pointed out earlier, also reflected in reduced imports of capital goods, and has also been accompanied by a decline in FDI in developing countries. Since FDI continues to be an important channel for technology flows to developing countries, trends in this regard are of considerable significance, as also trends in contractual arrangements for supply of technology and knowhow.

Foreign investment inflow in developing countries declined during the 1970s, as compared to the 1960s, largely because of nationalization and takeovers of petroleum and mineral companies in several developing countries. During the early 1980s, however, considerable investments, mainly in the manufacturing sector, took place principally in Asian and Latin American countries and FDI in developing countries reached a level of $20.7 billion during 1981 and 1982. In subsequent years, however, FDI in developing countries tended to stagnate and declined to $10.9 billion in 1985 and $10.8 billion in 1986. Most of the decline took place in countries of Latin America and Asia. Foreign investments in African developing countries also continued to remain at a fairly low level between $1.5 to $2 billion annually for the period 1981-1988. The stagnation in foreign investments in the latter half of the 1980s also contributed to reduced inflow of technology in these countries.

Contractual arrangements for supply of technology and services are closely related to the overall pace of industrialization and economic development. With major economic difficulties, ranging from the debt crisis and unstable economic conditions and an overall slackening of industrial

---

1/ Bank of Japan, Balance of Payments Monthly.

growth in several developing countries, the extent and number of contracts for supply of technology and knowhow would also be expected to fall, together with the decline in FDI and capital goods imports. This has not, however, taken place to the same extent, except in certain developing countries and with respect to infrastructure and industrial projects in petroleum-exporting countries, where there has been a slowdown. In several developing countries, which have achieved significant levels of industrial capability, such as Brazil, India and the Republic of Korea, the number and range of technology contracts has increased considerably. This has largely been due to policy changes in these countries, which are discussed in the next chapter, and also due to the level of technological diffusion and absorption which has enabled enterprises from these countries to avail themselves of technology licensing and specific technical services to a much greater extent than in the 1970s.

The inflow of industrial technology, combined with local adaptations, has resulted in considerable growth of manufacture and production in selected sectors in developing countries. The share of industrial output, as measured in manufacturing value-added (MVA) in 1975, and as projected for 1988 and 1989 may be seen from Tables 1 and 2 below, while Table 3 indicates sectoral projections.

Table 1

Percentage share of developing countries in global MVA
(Based on constant 1980 US dollars)

1970	9.8
1975	11.2
1988 (projected)	13.8
1989 (projected)	14.1

Source: Industry and Development, Global Report 1988/89, UNIDO, 1988.

Table 2

Average annual growth rates of MVA
(Based on constant 1980 US dollars)

	Developing countries	Developed countries
1975-85	4.6	3.0
1985-89	6.7	3.8

Source: Same as Table 1.

Table 3

Estimated share of industrial output (MVA) of developing countries in world total in 1975 and projected shares for 1988 and 1989

(Percentage)

ISIC		Share of developing countries in world total			Average annual growth			
			Projected		Developed countries		Developing countries	
		1975	1988	1989	1975-1985	1985-1989	1975-1985	1985-1989
3	Manufacturing	11.2	13.8	14.1	3.0	3.8	4.6	6.7
311	Food products	16.1	19.9	20.3	2.4	3.0	4.9	4.1
321	Textiles	20.9	24.1	24.8	1.2	2.4	2.3	5.5
322	Wearing apparel	13.2	17.4	18.0	1.2	1.8	3.4	5.6
323	Leather and fur products	14.9	17.2	17.7	0.4	1.6	1.3	4.5
324	Footwear	15.5	20.0	20.5	0.7	0.1	2.5	4.2
331	Wood and wood products	11.1	11.7	12.1	1.5	4.4	3.2	2.3
341	Paper and paper products	8.8	11.4	11.7	3.5	4.7	5.7	7.5
351	Industrial chemicals	8.9	13.5	14.0	3.7	3.8	8.0	6.8
352	Other chemical products	16.1	19.1	19.5	4.0	4.6	6.0	5.5
356	Plastic products	12.0	14.5	14.8	5.8	6.5	7.5	8.7
371	Iron and steel	8.1	14.9	15.5	0.6	1.3	5.1	9.0
372	Non-ferrous metals	8.6	11.4	11.7	2.4	3.3	4.9	5.7
381	Metal products	8.4	12.3	12.6	2.2	3.0	4.8	8.4
382	Non-electrical machinery	4.4	4.7	4.8	4.4	4.4	3.3	9.8
383	Electrical machinery	6.7	10.8	11.2	6.3	5.6	8.3	16.1
384	Transport equipment	7.2	8.3	8.5	2.9	3.9	3.6	6.9

Source: UNIDO statistical data base.

While there has been considerable growth of industrial manufacture and consequently of technological absorption in developing countries as a whole, there has been very wide variation in the pace of such growth in particular countries and country-groups and it would be useful to attempt a broad classification of such countries. Obviously, with very wide variation in national factor endowments and levels of development, such a classification can, at best, only suggest broad country groupings with respect to technology flows and transfer of industrial technology, as also the absorption and adaptation of such technologies. It may also highlight certain policy trends and other trends which may have a significant impact on the pattern of technology flows to particular country groups or subgroups in the next few years.

The first group comprises of several countries in South-East Asia, particularly the Republic of Korea, Singapore, Taiwan Province and Hong Kong and, to a lesser extent, Thailand, Malaysia and the Philippines. These countries, which had significant inflow of foreign investment during the 1970s and 1980s, have developed considerable industrial capability and absorptive capacity in industrial technology, including microelectronics. Most of these economies are highly export-oriented, with exports covering a wide range of products and components, extending from textiles, garments and processed food products to consumer and industrial electronics, and durable consumer goods. The manufacturing sector in particular has grown, and continues to expand rapidly in these countries not only in production of consumer goods but also intermediate products and selected ranges of machinery and equipment. The growth of manufacture in selected newly-industrialized countries, including certain South-East Asian economies may be seen from Table 4. While foreign technology has constituted the essential technological base and considerable technology inflow continues to take place in these countries, there has also been a substantial degree of technological adaptation in various sectors, including electronic products and components.

During the period 1965-1986, manufactured exports from developing countries increased rapidly and rose from 8.5 per cent of total exports of manufactured products in 1965 to 15.7 per cent in 1986. Much of this increase took place in a few developing countries. Table 5 provides the pattern of growth of exports in various sectors for four of the South-East Asian economies, indicating the wide range of technological absorption.

Table 4

Manufacturing growth in newly-industrialized countries

	Share of world manufacturing output (per cent)				Average annual growth in manufacturing (per cent)		
	1963	1970	1980	1986	1960-70	1970-80	1980-86
Hong Kong	0.08	0.15	0.22	0.29	---	10.1	7.1
Korea Rep. of	0.11	0.22	0.49	0.92	17.6	15.6	12.5
Singapore	0.05	0.06	0.11	0.12	13.0	9.7	0.9
Taiwan Province of China	0.11	0.23	0.46[a]	---	15.5[b]	11.5[c]	---
Brazil	1.57	1.73	2.03	1.80	---	8.7	-0.6
Mexico	1.04	1.27	1.40	1.30	9.4	7.1	-0.7
Portugal	0.23	0.27	0.24	0.22	8.9	4.5	-0.1
Yugoslavia	1.14	1.25	0.77	0.86	5.7	7.1	3.0

Source: Dicken, P., Global shift: Industrial change in a turbulent world, London, 1988; UNIDO data base.

a/ 1977; b/ 1961-1970; c/ 1971-1978.

Table 5

Growth and structure of exports by group of manufactures for selected Asian countries 1975, 1985
(Percentage)

	SITC	Product group	Average annual growth rate of exports, 1975-85	Share in total exports of manufactures	
				1975	1985
Hong Kong	65	Textile yarn, fabric	8.7	9.6	6.2
	84	Clothing	11.2	44.3	35.6
	85	Footwear	10.0	1.2	0.8
	69	Metal manufactures	11.8	2.7	2.3
	71	Non-electrical machinery	27.3	2.2	6.9
	72	Electrical machinery	15.7	12.5	15.1
	83	Travel goods	8.3	2.0	1.3
	86	Instruments, watches	23.5	3.9	8.9
Republic of Korea	0 (part of)	Food products	3.2	5.7	1.2
	65	Textile yarn, fabric	14.5	14.4	8.7
	84	Clothing	14.5	25.4	15.3
	85	Footwear	23.2	4.2	5.3
	63	Wood manufactures	-11.0	5.0	0.2
	67	Iron and steel	22.9	5.1	6.3
	69	Metal manufactures	28.7	2.6	5.1
	71	Non-electrical machinery	30.9	1.7	3.9
	72	Electrical machinery	23.4	9.8	12.4
	73	Transport equipment	42.4	4.1	21.6
Singapore	0 (part of)	Food products	5.9	4.8	1.9
	4	Animal, vegetable fats	21.1	2.3	3.6
	65	Textile yarn, fabric	10.5	2.9	1.8
	84	Clothing	16.4	2.7	2.8
	332	Petroleum products	13.1	40.0	31.3
	67	Iron and steel	9.2	2.0	1.1
	71	Non-electrical machinery	21.4	8.5	13.4
	72	Electrical machinery	20.6	14.0	20.8
	73	Transport equipment	13.1	5.1	4.0
	86	Instruments, watches	10.3	2.8	1.7
Thailand	0 (part of)	Food products	10.4	60.9	39.8
	65	Textile yarn, fabric	17.8	7.2	9.1
	84	Clothing	26.8	4.8	12.5
	85	Footwear	60.5	0.1	1.8
	61	Leather	35.4	0.2	1.1
	62	Rubber manufactures	31.1	0.3	1.0
	63	Wood manufactures	11.8	2.0	1.5
	66	Non-metal mineral manufactures	4.8	2.5	1.0
	67	Iron and steel	30.0	0.5	1.5
	68	Non-ferrous metals	7.6	10.3	5.2
	69	Metal manufactures	15.0	1.0	0.9
	71	Non-electrical machinery	45.8	0.4	3.8
	72	Electrical machinery	33.9	2.1	9.4

Source: Handbook of industrial statistics 1988, UNIDO, 1988.

The second group comprises some of the larger developing countries such as Argentina, Brazil, China, India and Mexico and to a lesser extent, countries such as Indonesia and Pakistan. With sizeable internal markets, these countries have achieved considerable industrial growth and varying degrees of import substitution in different fields. Policies towards foreign investments and technology have varied considerably, but there has been special emphasis on the growth of national technological capability. Technology inflow has been fairly substantial, both through TNC subsidiaries and affiliates and through non-affiliate licensing by nationally-owned enterprises, including state-owned corporations. The growth of the manufacturing sector has been combined with a high level of technological absorption in most of these countries. Industrial research has also received considerable emphasis and has contributed towards technological adaptation in several fields. Despite significant technological growth, however, most of these countries, with the exception of Brazil, continue to lag behind industrialized market economies, particularly in the application and development of new and emerging technologies.

A third group comprises a number of middle-size developing countries in Latin America and Asia and certain countries in Africa, particularly North Africa, where a certain level of technological development and absorption has been achieved. Several petroleum-exporting countries would fall in this category. The extent of technology flow and of technological absorption varies from country to country and has taken place, both through TNC subsidiaries and affiliates and joint ventures, or through licensing and contractual arrangements by state-owned enterprises in these countries. The overall level of technology inflow, particularly with respect to new technologies, has not, however, been high or substantial, as compared to South-East Asian economies and some of the larger developing countries.

The fourth group comprises a number of developing countries, including least developed countries and several island economies in which there has been relatively little technological development and inflow of technology, either through TNC subsidiaries/affiliates or through nationally-owned enterprises. There has consequently been limited development of technological capability and absorption of industrial technologies, particularly new technologies, in these economies.

The above classification is, in its nature, purely indicative and primarily serves to highlight the range and variation in levels of technological development in various groups of developing countries. The experience and trends with respect to technology inflow in selected developing countries has been examined in greater detail in the third chapter, while specific policies impacting directly on technology flows are discussed in the next chapter. It must be emphasized, however, that the nature and extent of technology inflow, and its impact on technological development, has emerged as an important determinant of technological capability in these countries and policies in these countries may need to be appropriately adjusted to ensure that adequate technology inflow does take place in accordance with national objectives and priorities and on equitable terms and conditions.

CHAPTER II

HOST COUNTRY POLICIES IMPACTING ON TECHNOLOGY FLOWS

There has been considerable evolution of policies and measures relating to inflow and transfer of technology in recent years in a number of developing countries. Such policies cover a very wide range and can extend from the development of technological infrastructure in terms of human resources and specialized manpower skills of capability for engineering and technical services, to measures relating to foreign technology and transfer, absorption and adaptation of such technologies and policies directly related to endogenous technological developmnt, including capability for research and development and application of new technologies. While these aspects have received varying degrees of emphasis in a number of developing countries over the last three decades, special importance was given during the 1970s to the implications of foreign technology and to ensure that the inflow of such technologies was in accordance with national objectives and on equitable terms and conditions. In the 1980s, with the growing need for technology inflow and absorption, there has been considerable liberalization in policies towards foreign technology in several countries. Such relaxations have often accompanied and been part of liberalized policies and procedures towards foreign direct investments. At the same time, with increased non-affiliate licensing in several developing countries where a significant level of industrialization has been achieved, locally-owned enterprises in these countries are playing a much greater role in technology acquisition, within the framework of national policy parameters and guidelines.

Policies towards foreign technology inflow have to be viewed against the principal objective of ensuring rapid growth of technological infrastructure and capability. With the continuing dependance on technological processes and services on enterprises from industrialized market economies, policies and measures have been oriented towards development of capability for technology choice and negotiations and improved terms of acquisition, on the one hand, and for effective technological absorption and adaptation, on the other. The exercise of effective technology choice requires information and knowledge of the international market for particular technologies and of alternative technologies and services in different fields, together with capability in negotiations for acquiring selected technology or services on suitable terms and conditions. It is of even greater importance to ensure rapid technological absorption and adaptation through innovative applications and developments and the pace of indigenous research and application needs to be greatly accelerated in various priority sectors. These objectives have generally guided the formulation of specific policies on industrial technology and the development of institutional infrastructure for dealing with foreign technology and development of endogenous technological capability.

The implementation of national policies on foreign technology has undoubtedly had significant impact on technology flows to developing countries, although the extent of such impact cannot be quantified. Often, regulatory measures and guidelines have been interpreted in such manner as to result in restrictions on inflow of much-needed technology. Where rigidly applied, such guidelines have often caused delay and frustration and even the

fact of prescribed rules and conditions have served as a deterrent to technology inflow in certain fields. At the same time, policies and institutional measures, where applied with flexibility and pragmatism, have been quite successful in a number of developing countries, and have resulted in considerable improvements in the terms of technology transactions.

A wide range of policies for accelerating the pace of endogenous technological development, particularly enhancement of scientific and technical education and specialized training facilities, together with the establishment of industrial research institutions, have been undertaken in a number of developing countries during the last three decades. These measures contributed to the development of scientific and technological infrastructure. However, the process of industrialization has been based primarily on foreign technology imported initially mainly through TNC investments and subsequently through joint ventures and non-affiliate licensing. The impact of policies directly impinging on technology flows was felt mainly in the 1970s when considerable attention in several developing countries was concentrated on the conditions imposed in foreign technology contracts, together with the role and implications of foreign investments through TNCs. A considerable body of critical opinion emerged in many developing countries against TNCs and the terms and conditions of foreign technology transfer. This resulted in several developing countries prescribing regulatory control over foreign technology during the 1970s, partly to regulate the activities of TNCs in this field but mainly to improve the terms and conditions of technology transactions. These measures were undertaken either through specific legislation for this purpose or through administrative regulations and guidelines and various mechanisms were set up to regulate and review foreign technology agreeemnts. These ranged from interdepartmental committees, such as the Foreign Investment Board in India to Registries for Technology as in several Latin American countries and to the organizations responsible for industrial property rights as in Brazil and Nigeria. In many other developing countries, however, no control was exercised with respect to foreign technology, and contracts have been left to be negotiated between the enterprises concerned, including between parent TNCs and their subsidiaries and affiliates in these countries.

In some developing countries, particularly India, contracts relating to foreign technology and services were regulated and screened by governmental agencies even during the 1960s, although detailed policy guidelines were issued only in November 1969. These measures, with subsequent modifications, and together with the Foreign Exchange Regulation Act of 1973, constituted the main policy framework for controlling the operations of foreign companies. During the 1970s, regulation of foreign technology was extended in several other countries of Latin America and Asia, besides some African countries. In other developing countries, however, such as Indonesia, Singapore and Thailand and petroleum-exporting countries in Asia and most countries in Africa, no regulatory measures were imposed with respect to foreign technology transactions.

In Latin America, specific legislation was enacted in Argentina in 1971 (later amended and finally repealed), Mexico in 1973, the Andean Group countries during the 1970s (although Chile later withdrew from the Andean pact), and in Brazil (Normative Law 15 of 1975). In Asia, specific regulatory

measures relating to foreign technology were introduced in the Republic of Korea, Malaysia and the Philippines, while in other countries such as Bangladesh, Pakistan, and several Arab countries, technology-supply agreements were examined as part of the process for approval of new industrial projects. In Africa, technology regulation measures were introduced in Ghana, Kenya and Nigeria, while in other countries, technology contracts were examined as part of the process for approval of new foreign investments. In countries where technology contracts were subjected to review, fairly detailed guidelines were prescribed with respect to contractual terms and provisions which would, or would not, be approved by the reviewing agency prescribed by the respective government. These guidelines generally stressed the objectives for technology inflow as being for industrial diversification or development of production or export capability in various fields, and thereafter prescribed specific norms and guidelines on contractual conditions generally incorporated in technology agreements. Such norms related to duration (generally limited to a maximum of 10 years); use of the technology after expiry of the agreement; payments for technology (including limits on percentages of royalty in certain countries); access to improvements, warranty, avoidance of undue restrictions on exports and tie-in conditions for supply of imported inputs solely through the technology supplier; patents and trademarks (in certain countries); training, and governing law. These guidelines followed a fairly similar pattern in most countries where regulatory control was exercised on technology contracts. In addition, performance requirements were often prescribed, particularly with respect to local integration or value-added requirements, and development of export capability over a period of time.

The principal features of policies on industrial growth impacting directly on technology flows relate to the norms and guidelines generally prescribed for dealing with foreign technology agreements. In some cases, such norms have primarily served to remove certain inequitable restrictions often imposed by technology suppliers. In other instances, particularly restrictions on technology payments, there could be direct impact on the extent of technology flows. It would be useful, in this context, to review the nature of the guidelines usually prescribed in developing countries where technology inflow is screened and regulated and the likely implications of such norms with respect to inflow of new technologies in the future.

Regulatory norms and guidelines

Selection of technology: Developing-country guidelines usually provide that the technology should be appropriate to the needs of the country. While such a principle does not pose any problem, the decision as to the use of a particular technology needs to rest with the user of the technology, the recipient enterprise. The question of appropriateness must be judged in relation to the factor resources and conditions of application of the user enterprise. In some cases, the most advanced technologies, involving extensive computerization and automation, may not be suitable for developing countries. Some of the latest techniques may, however, be quite appropriate such as the use of computer-aided designs for production of ready-made garments for exports. It is obviously not practicable for a technology regulation agency to determine the appropriateness of particular technologies for specific situations. Only certain broad parameters can be defined. One such parameter is the use of technology involving substantial imported inputs. Unless gradual local production of such inputs can be planned and integrated, the use of such technology may have a negative impact on foreign

exchange and result in high local costs for the final product. It may also be desirable to link the type of technology to be acquired with the stage of industrial growth and the extent of employment that can be generated without affecting competitive efficiency.

The role of any technology-reviewing agency in the matter of technology choice may need to be re-oriented from being a primarily regulatory function to that of providing information on alternatives or ensuring that the recipient enterprise has considered the relevant alternatives and their implications. Beyond that, the choice has to be left to the user enterprise. In actual implementation of technology guidelines, most regulatory agencies have confined themselves to checking whether the recipient enterprise has considered relevant alternatives. There have been relatively few instances of technology agreements being rejected on the grounds of inappropriate technology. The implications of particular technology choice may, however, have led to prolonged negotiations on several proposals.

The issue of technology choice may, however, assume much greater dimension in the future when the choice may not only be between traditional processes and new, highly-automated techniques but also between various levels of usage of automation and computerized technology The extent of blending of new and traditional processes is likely to constitute an important element of technology choice. This, in turn, necessitates a greater degree of knowledge and awareness on the part of recipient enterprises in developing countries. Support functions in this regard will need to be provided by information institutions and research agencies in these countries.

Technology payments: Payments for industrial technology often constitute an area where technology-regulation bodies tend to play an important role. In a number of instances, the level of such payments, either fixed-sum or royalties, have been reduced in the process of review of technology agreements. This undoubtedly represents savings in the costs of acquiring technologies and may be quite justified in most cases. At the same time, if somewhat arbitrary reductions in technology payments are enforced by regulatory agencies, this may affect the relationship betwen the licensor and licensee enterprise. It may also indirectly lead to increased payments for supply of technological services or of imported units, which may be more difficult to control. In certain countries, a maximum rate of royalty is prescribed for certain categories of technologies. This may not be desirable, as it introduces an element of rigidity in a field where there should be considerable flexibility.

Rigidity with respect to technology payments may pose considerable difficulties with respect to inflow of new technologies. With the high costs of industrial research in industrialized economies, and the fairly rapid obsolescence of new products and processes, costs of new technologies may be substantially higher than in the past, in certain fields. Alternatively, restricted and lower payments may provide access only to the tail-end of new technological developments. It is essential to ensure a high degree of flexibility in determining payments for new technologies. There should be greater concentration on rapid absorption and adaptation of such technologies, so that these can lead to local innovations and developemnts. The example of Japan during the 1960s and early 1970s and of the Republic of Korea during the 1980s is particularly salutary in this regard.

The relationship between technology payments and the level of capital participation by the technology licensor is difficult to determine. Several developing countries, where technology agreements are reviewed, tend to permit lower payments for technology with increased foreign capital participation, to the point that no technology payments are allowed in the case of wholly-owned subsidiaries. This may have some justification. A major factor in allowing wholly-owned TNC subsidiaries may be their access to technology from parent corporations. At the same time, in the case of joint ventures with varying levels of foriegn holdings, which is likely to be a fairly popular form of foreign capital participation in the near future, there would appear to be justification for technology payments at levels similar to those in the case of non-affiliate technology licensing. It is mainly in the case of foreign-majority holdings going up to 100 per cent, that the level of technology payments may be sought to bear some relationship to the extent of foreign ownership. Even in the case of wholly-owned subsidairies, however, it may be necessary to negotiate the extent of payments for supply of knowhow, particularly with respect to new technologies.

Duration: In most developing countries where technology contracts are reviewed, the duration is limited, generally to a maximum of ten years. This is desirable, both in the interests of limiting technology payments to a reasonable period of time, and in order to ensure that effective absorption takes place in the licensee enterprise during such period. It must be recognized however that, with fast-changing technologies, duration and renewals of technology contracts should be linked to constant upgrading of technology.

Post-agreement use of technology: A source of some controversy has been the imposition of restrictions by licensors on the use of technology and knowhow after expiry of the period of agreement. In most developing countries where agreements are reviewed, such a provision is not permitted. There should be no restrictions on the use of licensed technology after expiry of the period of agreement, except where such technology is covered by specific industrial property rights for a further period of time.

Patents, trade marks and industrial property rights: A large proportion of technology contracts relate to licensing of patents and industrial property rights. In developing countries, a wider composite package, including knowhow and technical services, has also generally to be included. With respect to industrial property rights, particularly patents, and copyrights on software, there are significant differences in approach between developed and developing countries and modifications in international conventions and treaties in this regard have been under negotiation for some time. These aspects cannot be covered in the present paper. What is, however, necessary is that guidelines, where these have been prescribed, should provide for a listing of patents and provide that licensors will bear the responsibilities for possible infringement of third-party rights. With respect to trade marks, there is a trend towards increased use of local trade names or trade marks, particularly after expiry of technology agreements.

Tie-in provisions for input supplies: An important element in technology agreements is the channeling of supply of imported inputs solely through the licensor which may often lead to inequitable transfer pricing. Guidelines in several developing countries provide that licensees should be free to obtain

such inputs from other sources. In actual fact, however, most licensees in developing countries do depend on their licensors for supply of imported inputs. It may be necessary in future to consider suitable mechanisms for appropriate pricing of such inputs, rather than providing only for option of the licensee to purchase from alternative sources, which is generally not exercised.

Territorial sales rights: With the emphasis on exports from developing countries, several such countries do not permit contractual provisions providing for major restrictions on exports, in technology agreements. At the same time, most TNC licensors have exclusive licensing arrangements in several countries and are unable to provide unrestricted export rights. This is a matter which can only be resolved through negotiations, although, in the future, the extent of rights to export may be an important determinant in choosing the source for particular technology.

Other contractual provisions: In developing countries where technology agreements are reviewed, norms and guidelines have also been prescribed on several other contractual terms and conditions. These range from guidelines on provisions relating to guarantee or warranty for the technology, access to improvements, and training, to provisions relating to governing law and arbitration and settlement of disputes. These generally present less difficulty in negotiations between licensor and licensee enterprises.

The imposition of norms and guidelines with respect to terms and conditions of technology contracts has undoubtedly had considerable impact on technology contracts in these countries. These have certainly led to improvement in the bargaining position of licensee enterprises in developing countries. They have also resulted in reduction of payments for particular technology than what may otherwise have been paid. The imposition of norms and guidelines has also brought national authorities and agencies into the process of decision-making with respect to technology transactions. At the same time, regulation of technology contracts may have led to significant restrictions in technology inflow, the extent of which cannot be quantified. While technology flows to certain countries with large internal markets such as Brazil, China and India, would continue despite the imposition of guidelines, the same may not necessarily be true of countries with smaller markets and limited factor resources. Even in the larger countries, the flow of technology may be significantly larger if rigid regulatory norms are replaced by flexible guidelines interpreted with pragmatism and realism in relation to international trends in technology transactions in various fields.

Trends towards liberalization

With the increasing demand for industrial technology in developing countries, there has been considerable liberalization in regulatory guidelines on technology agreements in several developing countries. This has taken various forms. Firstly, in certain countries, regulatory measures with respect to technology contracts have been dropped or modified substantially. Secondly, in several countries which continue to review foreign technology contracts, regulatory guidelines have been significantly relaxed or are being interpreted liberally. Thirdly, in countries where technology contracts are considered as part of any proposal for new investments, particularly foreign investments, the technology agreements are left principally for negotiations between the parties concerned.

In the first category, certain countries such as Egypt and Sri Lanka introduced extensive liberalization in policies towards foreign direct investments and foreign ownership during the first half of the 1970s. In Chile also, significant liberalization in policies towards foreign investments took place, after the Allende régime was replaced. Though these changes were designed primarily to promote FDI, for which incentives and facilities were also provided, they also had considerable impact on technology flows which accompanied such investments. With respect to policies specifically related to technology transfer, Argentina made wide-ranging changes in its technology transfer legislation during the latter 1970s. In the early 1980s, major liberalization with respect to technology transfer guidelines and procedures took place in the Republic of Korea.

In the second group, India effected major liberalization in its technology regulations and guidelines during the 1980s, particularly during 1984-1985, leading to a significant increase in the number of foreign technology agreements during the period 1985-1988. In the implementation of their technology guidelines, Brazil, Mexico and the Andean group of countries have also been increasingly flexible and liberal in their implementation of technology guidelines. The result in terms of increased technology flows and number of agreements has not been as marked as in the Republic of Korea and India but this was largely due to debt problems and economic difficulties, which resulted in industrial slowdown in most of these countries. In South-East Asia, Malaysia and the Philippines have also been more liberal in their review of foreign technology guidelines, without major changes in the guidelines themselves.

In the third group of countries, increased liberalization has largely taken the form of a more flexible attitude towards foreign capital ownership and leaving technology transfer arrangements largely to the parties concerned. Investment codes in several African countries provide various promotional measures for foreign investments, including tax and fiscal incentives. The growing debt problem of several developing countries has also led to structural adjustment programmes being undertaken, with major emphasis on privatization of state-owned undertakings in many of these countries. The privatization programme, which assumed significant dimensions in several Latin American and African countries during 1986-1988 is continuing and will extend into the 1990s. Though such privatization again primarily deals with foreign ownership and capital flows, it should also enhance inflow of technology in the privatized enterprises.

The situation with respect to technology flows to developing countries at the end of the 1980s is likely to be significantly different from what prevailed at the beginning of this decade. Firstly, the demand for industrial technology, including new technologies, is likely to increase sharply and the stagnation and decline in technology flows during 1986-1988 is likely to be substantially reversed during the 1990s. Secondly, with increased knowledge and awareness of the intricacies of technology acquisition and negotiations on the part of potential licensee enterprises in developing countries, the need for rigid regulatory norms and guidelines is likely to become substantially reduced. While such guidelines may continue in several developing countries, they may serve primarily as policy parameters rather than inflexible contract norms. Thirdly, with greater reconciliation of interests of host developing countries and TNCs, there is likely to be increased technological participation of TNCs and proprietors of technology in enterprises in

developing countries. `While the trend may not necessarily be towards substantial increase in foreign investments in developing countries, with the exception of a few countries, it is likely to lead to considerable growth in non-affiliate licensing and joint ventures with minority foreign holdings. Finally, there is very substantial scope for increased technological co-operation between developing countries, which should rise significantly in the 1990s. Countries such as Brazil, India, the Republic of Korea, Singapore and others are in a position to supply a wide range of technologies to other developing countries and much greater technology transfer between such countries should, and is likely to, take place in the next decade.

In this chapter, attention has largely been concentrated on the nature and impact of regulatory control over foreign technology inflow. This is examined further in the next chapter in relation to the specific experience of a number of developing countries. At the same time, the development of technological capability is not solely related to policies on foreign technology, whether regulatory or otherwise. Technological development necessitates actions and programmes on a number of fronts and these are highlighted in Chapter IV of this study.

CHAPTER III

TECHNOLOGY FLOWS AND POLICIES IN SELECTED DEVELOPING COUNTRIES

It is proposed, in this chapter, to deal with technology policies and flows of industrial technology in selected developing counries. The nature and extent of technology flow is governed by a variety of economic factors and it may be difficult to establish a direct and causal relationship between the implementation of certain policies and the level of technology inflow. Nevertheless, national policies on foreign investment and technology inflow, and on related aspects such as intellectual property rights and the like, do undoubtedly have an impact on technology flows. The selection of countries, whose policies on technology inflow have been examined in this chapter have, therefore, been grouped under three principal categories, depending on the nature and extent of specific policies being followed in this regard. Policy distinctions in this regard cannot be sharply defined and differences in policy measures can often be fairly blurred with respect to countries where technology contracts are specifically screened by a governmental agency and in those where such agreements may be reviewed as part of an overall investment proposal. Nevertheless, it is possible and appropriate to categorize countries on the basis of, firstly, whether foreign technology contracts are screened and reviewed in acordance with specific policy norms and guidelines; secondly, if the conditions of technology transfer are taken into consideration as part and parcel of a proposed investment which requires governmental approval, and thirdly, where foreign-owned or nationally-owned enterprises are not required to submit foreign technology contracts for any form of approval, except for determining the extent of remittance that may be necessary in a particular case. The last category includes countries where earlier policies towards foreign investment and technology inflow may have been significantly modified over the last decade to the extent that prior approval of most technology contracts is no longer necessary.

The first category of developing countries, where technology inflow is regulated and technology contracts are reviewed by a governmental body, includes several countries ranging from Brazil, Mexico and the Andean Group of countries in Latin America, India, Malaysia and the Philippines in Asia, and Ghana, Kenya, and Nigeria from among countries in Africa. Information on technology flows in most of these countries has been provided. It is important to stress, however, that while reviewing mechanisms and policy norms and guidelines continue to operate, there has been considerable liberalization of decisions relating to foreign technology inflow in most of these countries. The second group, comprising those countries where approvals are required for industrial projects but not specifically for foreign technology contracts, cover a number of developing countries. Information on technology flows have been compiled for some of these countries, together with technology policies in Arab countries. The third category comprises a large number of developing countries where no approval of foreign technology contracts is necessary. This also includes certain countries where earlier regulatory measures relating to foreign investment and technology have been removed or significantly modified. The countries in this category include Argentina, Chile and the Republic of Korea.

BRAZIL

Brazil experienced rapid industrial growth during the 1960s and early 1970s and, despite periods of slowdown in the mid-1970s and during 1986-1988, because of the serious debt crisis, there has been sustained and extensive industrial and technological diversification in most production and service sectors. Policies on foreign investment have been liberal, with total FDI reaching a level of over $25 billion in 1986. Since the mid-1970s, however, foreign technology inflow has taken place within the framework of a well-defined system of regulation of technology agreements, the overall objective of which has been to accelerate the pace of endogenous technological development, including in new and emerging technologies.

The Industrial Property Code (Law 5772 of 1971) followed by Normative Act 15 (1975) of the National Institute of Industrial Property (INPI), which was entrusted with the regulation of foreign technology, set up the initial structure of regulatory control. Normative Act 15 provided for registration with INPI of all patent licenses, trademark licences, technical-industrial co-operation contracts and contracts for specialized technical services, in accordance with detailed norms and guidelines regarding contractual conditions. Normative Act 32 of 1978 provided for compulsory prior review of all such contracts involving royalties and payments, except for technical service contracts up to $20,000 and those relating to inspection or supervision of assembly of imported equipment. Royalty payments between affiliates were not permitted and the contract period was generally limited to 5 years. Normative Act 60 was enacted in 1982 with respect to contracts for specialized technical services and provided that design technology could also be imported with the participation of a national engineering company. Normative Act 61 of 1982 prescribed certain rules relating to licensing of trademarks and prescribed that royalties would not be permitted for "variations" in trademarks after expiry of the original period of 10 years. Normative Act 64 of September 1983 provided that investments in research and in risk capital would need to be committed for recordal of agreements involving technology transfer. In December 1982, the Special Secretariat for Informatics issued Normative Act No. 22, which provided certain definitions and norms for the registration of computer software and programmes. The latter measure was accompanied by severe restrictions imposed by the Law on Informatics in 1984 on the import of desktop computers, peripheral equipment and systems and which resulted in foreign manufacturers in Brazil being mainly confined to medium and large mainframe computers. A Technology Centre for Informatics (CTI) was also set up by Decree 90 of 1984 to co-ordinate and develop R and D activities in this field. Tax incentives for R and D were provided in Decree 92 of 1984. The law on computer software (1987) provided copyrights for software for 25 years.

Regulatory control over foreign technology in Brazil, including restrictions in imports of computers and systems, has been combined with major emphasis and resource allocations for endogenous research in a number of Brazilian enterprises and institutions. This has resulted in rapid technological growth of Brazilian companies in most sectors, including the computer industry. At the same time, inflow of technology in Brazil has been fairly substantial during the 1980s. This has been largely due to the large size of the Brazilian market, which has led to foreign investors and technology suppliers continuing to transfer technology in a large number of

industrial sectors. Substantial inflow has also been due to a highly pragmatic approach on the part of INPI in recent years in processing and approving foreign technology proposals. While prescribed guidelines are being implemented, INPI has been liberal in their interpretation, and this has been an important contributory factor.

Technology flow in Brazil has covered most sectors of modern industrial production. By 1985, a strong base with respect to capital goods manufacture had been created, as also in chemicals, plastics and textiles. This can be seen from Table 6. This pattern has continued during the period 1985-1988, when there has been a significant shift towards electrical, electronics and communications technology, besides capital goods, chemicals and other sectors. This may be seen from Table 7.

The total number of contracts (1093) in 1988 was the highest since 1979-1982, during which period the number of contracts averaged about 1200 annually. While the number of contracts, by itself, may not be an accurate indicator of the nature and extent of technology flows, it does suggest that the decline in technology inflow, which took place during 1983-1986, is gradually being reversed, particularly with respect to inflow of contemporary technology in electronics and informatics and in chemicals and plastics.

The number and percentage of different types of technology contracts, namely, patent licences, knowhow agreements, technical co-operation contracts and contracts for specialized services, during 1979 to 1988, may be seen from Table 8. This indicates a substantial increase in patent and knowhow agreements and a reduction in agreements for specialized services.

Table 9 provides a breakdown of costs of specialized service contracts for different sectors. The number of such contracts has gone down reflecting increased national capability for various technical services. At the same time, the cost of such services has gone up considerably during 1988, indicating more specialized requirements than in earlier years.

Table 10 provides the country sources for technology tansfer to Brazil. Apart from substantial increase in technology transfer by Brazilian enterprises during 1987-1988, country sources for technology have remained fairly varied. Contracts from the United States have declined in number during 1988 but were the highest in 1987.

Table 11 provides information regarding payments for imported technology in Brazil. This indicates that, though the number of technology contracts was fairly high in 1987 and 1988, total payments for technology have tended to decline during these years.

The above review of technology flows in Brazil suggests that, on the one hand, considerable inflow of industrial technology has continued to take place, despite the implementation of regulatory control since a decade, and that, on the other, there has been considerable development of endogenous technological capability, apart from significant improvement in the terms and conditions of technology contracts for Brazilian enterprises.

Table 6

Brazil: Production of principal manufacturing industries, 1985

(Percentages)

Industry	*Share of value, 1980*	*Change of volume, 1985*
Non-metal products	4.1	7.5
Metallurgy	13.8	7.0
Machinery	7.8	10.1
Electrical equipment	5.3	19.3
Transport equipment	7.7	11.7
Pulp and paper	2.8	6.4
Chemicals	19.1	6.5
Plastics	2.1	11.3
Textiles	6.9	13.6
Clothing, shoes and woollens	3.5	7.5
Food products	13.8	0.1
Total including others	100.0	8.3

Source: Fundaçao Instituto Brasileiro de Geografia e Estatistica.

Table 7

Brazil: Contracts in principal sectors, 1979-1988

Sector \ Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Mineral extraction	134	131	117	103	81	37	49	116	109	98
Production of metals	47	44	40	52	35	33	28	26	29	14
Metallurgy	263	261	291	160	145	106	73	115	126	115
Mechanical	179	201	142	161	120	126	141	122	197	222
Electrical and telecommunications	63	48	38	62	77	59	55	75	150	179
Transport	86	80	50	71	60	60	43	52	39	51
Chemicals	129	108	98	98	58	58	79	89	99	109
Pharmaceuticals	8	6	4	7	7	1	5	1	2	2
Textiles	57	70	43	59	47	40	29	27	37	49
Food processing	10	8	7	15	13	5	9	7	9	4
Services (electrical)	65	69	83	82	37	35	36	18	37	81
Commercial	2	1	1	1		2	4	3	6	2
Consultancy	102	95	77	70	44	40	27	25	19	37
Engineering services	49	46	37	46	37	9	11	14	16	9
Scientific institutions	6	6	15	28	17	12	10	15	21	22
Others	145	112	105	107	95	81	64	81	67	99
Total	1.345	1.286	1.148	1.122	873	704	663	786	963	1.093

Source: INPI/DIRCO.

Table 8

Brazil: Number and percentage of technology contracts, by categories, 1979-1988

Category / Year	Patent Licences		Knowhow agreements		Techn. Co-operation contracts		Specialized services		All categoreis		Trademark licences		Total
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	Total
1979	85	5,5	130	8,3	147	9,4	983	62,9	1345	86,1	217	13,9	1562
1980	83	5,2	100	6,3	194	12,2	909	57,1	1286	80,9	306	19,2	1592
1981	63	4,1	75	4,9	105	6,9	905	59,3	1148	75,2	378	24,8	1526
1982	112	7,3	146	9,6	127	8,3	737	48,3	1122	73,5	405	26,5	1527
1983	118	8,3	95	6,7	98	6,9	562	39,7	873	61,6	544	38,4	1417
1984	111	8,7	89	7,0	109	8,5	395	30,8	704	55,0	577	45,0	1281
1985	94	6,8	83	6,0	103	7,5	383	27,7	600	43,4	718	52,0	1381
1986	92	6,7	102	7,5	86	6,3	506	37,0	786	57,5	582	42,5	1368
1987	148	7,4	170	8,4	96	4,8	549	27,2	963	47,7	1053	52,2	2016
1988	135	7,2	236	12,5	78	4,1	633	33,6	1082	57,5	800	42,6	1882

Source: INPI/DIRCO.

Table 9

Brazil: Contracts for specialized services, 1985-1988

(In US$ million)

Year	1985			1986			1987			1988		
Sector	No.	Total value	Average	No.	Total value	Average	No.	Total value	Average	No.	Total value	Average
Mineral extraction	49	31,391	641	112	29,852	267	106	35,944	339	95	64,220	676
Metal production	24	9,611	400	21	6,852	326	19	841	44	9	73	8
Metallurgy	55	6,390	116	86	18,317	213	92	19,083	207	81	7,593	96
Mechanical equipment	20	1,181	59	42	1,646	39	74	7,267	98	104	7,131	67
Electrical products	6	690	115	24	262	11	27	1,138	42	19	3,315	174
Transport	17	409	28	24	2,582	8	17	988	58	21	558	27
Chemicals	53	2,457	46	48	5,049	105	45	4,493	100	58	6,590	114
Textiles	28			25	53	2	35	453	13	47	412	9
Energy production	35	32,866	939	18	3,576	199	37	10,806	292	81	43,769	540
Consultancy	22	748	34	18	1,381	77	19	1,815	96	30	4,997	166
Engineering	8	3,293	412	12	6,279	523	13	1,061	82	7	1,922	275
Scientific institutions	9	5,246	583	14	6,107	436	13	1,459	112	20	2,437	122
Administration	2	505	252	9	3,295	366	2	7,872	3,936	12	2,009	167
Other sectors	104	1,259	12	53	1,314	25	50	5,238	105	58	7,978	137
Total	432	95,746	255	506	86,586	171	549	94,458	179	642	153,004	238

Source: INPI/DIRCO.

Table 10

Brazil: Contracts by country sources, 1979-1988

Year / Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Brazil	114	96	148	146	209	192	195	182	418	369
Canada	31	29	18	30	28	11	09	20	46	37
United States	461	472	489	507	430	423	489	431	657	331
France	133	131	107	106	112	101	119	93	149	96
Italy	71	85	84	75	80	62	60	61	67	64
Japan	157	159	198	117	65	70	58	59	90	58
Netherlands	24	20	23	29	29	18	28	34	34	33
United Kingdom	76	95	73	91	93	71	78	102	81	45
Germany, Fed. Rep.	295	291	211	260	211	174	159	194	231	148
Switzerland	55	74	66	52	69	74	90	85	71	74
Others	145	140	109	114	91	85	96	107	172	627
Total	1562	1592	1526	1527	1417	1281	1381	1368	2016	1882

Source: INPI/DIRCO.

Table 11

Brazil: Payments for technology
(In US$ 10 million)

Year	Patents and trademarks	Industrial technology and knowhow	Technical co-operation	Specialized services	Total
1979	9	11	6	287	313
1980	12	14	11	284	321
1981	12	12	18	284	276
1982	5	10	17	208	240
1983	12	14	10	182	218
1984	9	8	8	177	202
1985	5	41	21	108	175
1986	2	43	20	119	184
1987	3	26	39	106	174
1988	3	27	12	93	135
Total	72	206	162	1,798	2,238

Source: DIRCO.

MEXICO

After decades of stable industrial growth until the 1970s, Mexico has been facing serious economic difficulties in recent years, largely due to its high external indebtedness. The pace of industrialization slowed down during the early and mid-1980s, but is now gradually picking up again. With respect to foreign investments and technology inflow, Mexico promulgated specific legislation on both these issues in 1973. While the law on FDI provided for Mexican majority holdings, except in exceptional circumstances, the law for registration of technology contracts provided certain specific guidelines as to contractual conditions governing such contracts. During the 1980s, several legislative measures were enacted which related to technology. The law on technology transfer was amended in 1981 and provided greater flexibility in dealing with foreign technology agreements. In the same year, a law on development of computer facilities provided for several incentives in this sector. A law in 1984 provided for legal protection for computer software. A new patent law was passed in 1985 which provided patentability of chemical and pharmaceutical products after a 10-year transition period. A law on technology development in 1985 defined rules and procedures for co-ordination of technological development.

The implementation of the laws on foreign investments and technology contracts in Mexico has, in general, improved the terms and conditions of such contracts for Mexican enterprises and has also provided a more prominent role for Mexican partners and shareholders in new joint ventures. While there have been certain exceptional cases where majority foreign holdings have been permitted in Mexico, the practice in general has been to limit foreign holdings to 49 per cent. With respect to technology contracts, the establishment in 1973 of a Registry where foreign technology contracts were reviewed and registered and the issue of guidelines on technology agreements, had a salutary impact on the terms and conditions of technology transactions in Mexico. Over the years, the Mexican Registry for Technology has also gathered valuable information on technology trends in various sectors and has been able to provide considerable assistance to Mexican enterprises on technology choice and contractual terms and conditions.

Information on foreign investments and on technology contracts in Mexico is provided in the Tables below for the period 1983-1987. During this period, the Commission on Foreign Investments approved 1439 applications, involving investments of over $7 billion. These included 149 applications for new projects and 135 applications for setting up new companies. A breakdown of the figures on FDI is provided in Table 12.

Table 13 indicates the sectoral breakdown of FDI proposals in Mexico during 1987. This suggests the increased emphasis on the manufacturing sector, in recent years.

Most proposals for FDI have involved technology transfer arrangements and the number of such contracts linked with FDI is provided in Table 14. The number of technology contracts registered with the National Registry of Technology was 1730 during 1983, 2047 during 1984, 1792 during 1985; 1761 during 1986, 1875 during 1987 and 1555 during 1988.

The breakdown of technology contracts in terms of specific functions and services for the period 1983-1987 is provided in Table 15. In the manufacturing sector, the maximum number of contracts was for metal-transformation and equipment (1516 during 1983-1988), followed by chemicals and petrochemicals (1335 during 1083-1988), textiles and garments (989 during 1983-1988), and food and beverages (869 during 1983-1988). [Source: Dirección General de Desarrollo Tecnológico].

The country sources for industrial technology contracts in Mexico are indicated in Table 16. This suggests the rapid growth of technology licensing by Mexican enterprises, which comprises the major share of contracts.

Despite the country's continuing economic difficulties, the flow of FDI and technology has continued in Mexico at a fairly satisfactory pace in recent years. The implementation of technology regulations and guidelines has had a positive effect for Mexican recipient enterprises, and cannot be said to have significant negative impact on technology inflow, including of new technologies. The implementation of technology policies, and of guidelines on technology contracts, has been fairly flexible and pragmatic and does not appear to have unduly hampered flow of technology into Mexico.

Table 12

Mexico: Foreign direct investments, 1983-1987

(Million US dollars)

Projects	Total a/		1983		1984		1985		1986		1987 a/	
	Value	Per cent	Value	Per cent	Value	Per cent	Value	Per cent	Value	Per cent	Value	Per cent
Number of projects	10,295.4	100.0	683.7	100.0	1,442.2	100.0	1,871.0	100.0	2,420.9	100.0	3,877.2	100.0
Authorization by Commission	7,348.4	71.4	393.7	57.6	796.6	55.2	1,337.6	71.5	1,559.8	64.4	3,260.7	84.1
Capital contributions	2,946.6	28.6	290.0	42.4	645.6	44.8	533.4	28.5	861.1	35.6	616.5	15.9
Capital increase by existing enterprises	2,881.0	28.0	282.0	41.2	617.4	42.8	526.7	28.1	846.6	35.0	606.3	15.7
New enterprises	65.6	0.6	8.0	1.2	28.3	2.0	6.7	0.4	14.5	0.6	8.2	0.2

Source: Secretaria Ejecutiva de la C.N.I.E., Dirección General de Inversiones Extranjeras.

a/ Preliminary.

Table 13

Mexico: Foreign direct investments, 1987 p/
(In 000 dollars)

Sector	Proposed	Approved	Rejected	Pending
TOTAL:	3'732,769	3'260,708	59,828	412,233
Agriculture & fisheries	27,114	26,913	----	201
Extraction industries	27,402	26,902	500	----
Manufacturing sector	1'797,474	1'634,890	18,841	143,743
Commercial activities	39,689	12,159	----	27,530
Other services	1'841,090	1'559,844	40,487	240,759

Source: Secretaría Ejecutiva de la C.N.I.E.
Dirección General de Inversiones Extranjeras

p/ Preliminary.

Table 14

Mexico: Technology contracts with foreign direct investments, 1983-1987

Participation (Percentage)	TOTAL Number	TOTAL (Percentage)	1983	1984	1985	1986	1987 P/
TOTAL:	1 650	100.0	328	357	332	326	307
1 - 25	561	34.0	112	117	115	113	104
26 - 49	429	26.0	84	93	82	86	84
50 - 100	660	40.0	132	147	135	127	119

P/ Preliminary

Source: Subsecretaría de Regulación de Inversiones Extranjeras y Transferencia de Tecnología.
Dirección General de Transferencia de Tecnología.

Table 15

Mexico: Technology contracts by services and functions, 1983-1987

Object of contract	TOTAL P/		1983	1984	1985	1986	1987 P/
	Number	%					
Total	9 432	100.0	2 516	2 493	1 687	1 726	1 011
Technical assistance	1 879	19.9	434	487	366	399	193
Basic engineering	347	3.7	75	99	74	72	27
Technical knowhow	1 119	11.9	279	283	234	222	101
Detailed engineering	336	3.6	74	96	65	72	27
Industrial services	7	0.1	1	1	2	3	..
Assessment services	198	2.1	46	41	38	52	21
Computer programmes	777	8.2	197	240	102	133	105
Authorizations	310	3.3	99	61	62	67	31
Use of trademarks	1 382	14.6	302	349	275	272	184
Use of patents	218	2.3	58	68	42	25	25
Administrative services	2 357	25.0	630	680	393	383	271
Use of commercial names	502	5.3	321	96	34	25	26

Source: Dirección General de Transferencia de Tecnología.

p/ Preliminary.

Table 16

Mexico: Technology contracts by country source of origin, 1983-1987

Country	TOTAL p/ Number	TOTAL p/ %	1983	1984	1985	1986	1987 p/
Total	8 260	100.0	1 646	1 850	1 907	1 886	961
Mexico	5 598	67.8	1 224	1 373	1 137	1 183	681
United States	1 989	24.1	269	329	592	574	225
France	90	1.1	17	22	28	16	7
Germany, Federal Rep.	83	1.0	32	20	14	11	6
Spain	62	0.8	10	12	25	11	4
Japan	62	0.8	15	12	21	12	2
Great Britain	60	0.7	12	17	15	11	5
Italy	56	0.7	16	12	13	11	4
Canada	45	0.5	11	13	7	12	2
Sweden	40	0.5	9	4	13	7	7
Switzerland	36	0.4	9	5	10	8	4
Panama	35	0.4	7	5	7	11	5
Holland	15	0.2	3	6	2	2	2
Finland	8	0.1	2	1	3	2	.
Austria	7	0.1	1	.	3	2	1
Others	64	0.8	9	19	17	13	6

Source: Dirección General de Transferencia de Tecnología.

p/ Preliminary.

Note: Does not include marks, patents and commercial numbers.

ANDEAN GROUP OF COUNTRIES

The Andean Group of countries, comprising Bolivia, Columbia, Chile (which later withdrew), Ecuador, Peru and Venezuela entered into the Cartagena Agreement and its follow-up measures in the early 1970s for a joint approach towards foreign investments and technology agreements. Decision 84 of the Agreement provided guidelines for authorization, registration and control of foreign investments and for foreign technology contracts. Various provisions were made for the regulation of technology agreements in accordance with fairly detailed norms on specific contract conditions.

During the 1970s, while the concept of a joint approach towards foreign direct investments and technology has been maintained in principle, the guidelines were liberalized considerably in 1987 and the provisions of Decision 24 were significantly revised with respect to the region's policies towards foreign investments and technology transfer. These changes have not, however, had significant impact so far.

Trends in foreign direct investments in the Andean Pact countries indicated very slow growth in the early 1980s, which may be seen from Table 17 below. This pattern has not changed significantly in subsequent years.

The flow of technology has been closely related to foreign investments and was largely confined to certain sectors. Most foreign investments were in the manufacturing sector, followed by petroleum and minerals. The details in this regard may be seen from Table 18 below.

Inflow of technology, as reflected by the number of technology contracts, has largely been in the manufacturing sector, where 2391 contracts were entered into up to 1985. Most of these contracts were with United States companies (1135 constituting 47.5 per cent), followed by EEC countries (29.7 per cent). Out of the 36 technology agreements in the mining, and the agricultural sectors, 19 were with United States' companies. The total number of technology contracts registered up to 1985 in the Andean Group countries came to 2782. 1/

1/ SAIT.

Table 17

Andean Group: Foreign direct investments (accumulated) in Andean Group countries

(In million US dollars)

Country \ Year	1981	1982	1983	1984	1985
Bolivia	459,2 2/	494,2	505,3	524,0	529,2
Colombia	1 200,7	1 314,2	1 431,4	1 741,2	2 230,7
Ecuador	1 037,7	1 091,3	1 135,3 3/	1 207,5	1 267,6 */
Perú	1 126,8	1 190,8	1 311,4	1 361,0	1 412,9 */
Venezuela	1 768,0	2 020,7	2 189,3	2 275,0	2 396,9 */
SUBREGION	5 591,4	6 111,2	6 572,7	7 108,7	7 837,3

Source: Sisteema Andino de Infromac'ion Technologica (SAIT).

1/ Does not incclude investments in hydrocarbons in Colombia, Ecuador, and Venezuela.
2/ Revised figures.
3/ For January-September only.
4/ Estimates.

Table 18

Andean Group: Foreign direct investments (cumulative) in Andean Group countries, by sectors of activity 1/

(In million US dollars)

Sector	1981	%	1982	%	1983	%	1984	%	1985 2/	%
Agriculture and fisheries	92,8	1,7	97,6	1,6	113,0	1,7	122,5	1,7	130,7	1,7
Petroleum and minerals	994,3	17,7	1 110,8	18,2	1 145,1	17,4	1 369,8	19,3	1 827,1	23,4
Manufacturing	2 817,6	50,4	3 141,0	51,3	3 419,1	52,0	3 645,0	51,3	3 803,6	48,8
Electricity, gas and water	153,2	2,7	148,8	2,4	147,9	2,3	148,3	2,1	149,0	1,9
Construction	67,0	1,2	76,5	1,3	82,0	1,3	82,1	1,1	81,9	1,0
Commerce	481,2	8,6	510,8	8,4	520,8	7,9	545,7	7,7	568,1	7,3
Transport and communications	75,2	1,4	77,4	1,3	76,7	1,2	76,3	1,1	77,2	1,0
Banks and insurance	870,8	15,6	908,4	14,9	994,6	15,1	996,9	14,0	1 032,6	13,3
Other services	39,3	0,7	39,9	0,7	73,5	1,1	121,8	1,7	125,0	1,6
Total	5 591,4	100,0	6 111,2	100,0	6 572,7	100,0	7 108,4	100,0	7 795,2	100,0

Source: SAIT.

1/ The data for Colombia, Ecuador and Venezuela do not include the hydrocarbon sector.

2/ For Venezuela, the data are up to November 1985.

CHILE

The withdrawal of Chile from the Andean Group of countries took place in the latter 1970s as part of the liberalized approach towards foreign investments and technology, following the change of Government in 1975. Apart from measures encouraging greater flow of such investments and technology, a new law relating to intellectual property was passed in 1985, which provided protection to computer programmes.

The flow of technology, as measured by payments of fees and royalties, increased considerably during the early 1980s and stabilized at a lower level in subsequent years. This may be seen from Table 19.

The number of technology contracts registered up to end-1986 was estimated at 270, 1/ of which 121 related to petroleum, chemicals and pharamceuticals; 568 to the automotive and metal-transformation industries, 10 to electronics; 32 for agro-industries, fisheries and food and tobacco; 22 for computer software; 19 for services, and the remaining contracts in other sectors. During 1986, however, 86 technology contracts were entered into or renewed, mostly in the petroleum, chemicals and pharmaceutical sectors (27 contracts), metal-transformation (14), and in computer software (13 contracts). During 1987, the number of contracts increased to 112, mostly in chemicals and pharmaceuticals, computer software and in textiles and shoes. In 1988, 98 technology contracts were entered into in Chile, mostly with respect to chemicals and pharmaceuticals (36), and in agroprocessing and food industries (18).

In Latin America, as a whole, varying degrees of regulatory control over technology contracts have continued in most countries, with the exception of Argentina and Chile, during the 1980s. Despite such regulation, there has been considerable flow of technology in various sectors, including in electronics and informatics in recent years. This has largely been due to pragmatic and flexible interpetation of guidelines on technology contracts in Brazil, Mexico and the Andean Group countries. In Chile, on the other hand, the number of technology contracts increased significantly during 1986-1988, suggesting a substantial increase in technology inflow.

In Argentina, where technology regulation was introduced in the early 1970s, there was a major change in 1981 when the law on transfer of technology was substantially amended, allowing considerable freedom in technology transactions to enterprises. A new policy on electronics and informatics was prescribed in 1984 and a National Commission on Informatics was set up, in order to accelerate the pace of electronics development in the country.

Despite internal difficulties, the pace of technological absorption and diffusion was fairly high in Argentina since the late 1970s. The growth of manufacturing output by 1985 may be seen from Table 20 below.

1/ Banco Central de Chile, Santiago.

Table 19

Chile: Payments of royalties for technology contracts

Period	Amount in 000 US dollars
1978	15 859
1979	20 161
1980	28 919
1981	38 890
1982	33 155
1983	32 351
1984	25 617
1985	23 108
1986	25 695
1987	21 939
1988	28 858

Source: Banco Central de Chile, Santiago.

Table 20

Argentina: growth of manufacturing output, 1985

Industry	Percentage share
Food, beverages and tobacco	26.0
Textiles and leather	8.6
Wood and furniture	1.2
Paper and printing	5.4
Chemicals	17.9
Non-metal minerals	3.9
Metal working	6.2
Machinery and equipment	23.8
Other industries	6.9
Total	100.0

Source: Fundación de Investigaciones Ecónomicas Latinoamericanas.

ASIAN COUNTRIES

As in the case of most Latin American countries, varying degrees of regulatory control, direct or indirect, are exercised with respect to technology inflow in a number of Asian countries. The nature of such policies and the pattern of technology inflow is examined below for several Asian countries, namely, Bangladesh, India, Malaysia, Pakistan, the Republic of Korea and Thailand.

BANGLADESH

A National Science and Technology Policy was announced in 1986 and is under implementation at present. Major emphasis has been given in this programme to promotion of research, establishment of research units and laboratories, training of specialized personnel and the development of a suitable environment for scientific and technological research. Sectoral emphasis in research activities has been given to the agricultural sector, water resources and land reclamation, health, energy, industry, and transport and communications.

Technology inflow has taken place to the extent of new investments in industrial sectors. During the 1980s, the pattern of such growth has been similar to that of the 1970s and has not registered significant developments or changes. There has been considerable technological diffusion in traditional fields of manufacture, including production and processing of jute, tea, leather and rubber, manufacture of common-use equipment such as engines, pumps and compressors, besides hand tools and implements, shoes and textiles and several other import-substitution products and items.

The conditions of foreign technology inflow are reviewed as part of the process of approval for industrial projects and new foreign investments. A fairly pragmatic approach has been adopted and no rigid guidelines have been sought to be enforced. The number of technology contracts has registered increase during the 1980s.

INDIA

India expericened fairly steady industrial growth over the last two decades, with a high level of technological diffusion and absorption in most production and service sectors. Special emphasis was given to capital-goods production and the country is fairly self-sufficient in standard industrial equipment and is also exporting a fairly large range of machinery. Both state-owned enterprises and private-sector industries have expanded in various fields of manufacture, with small-scale industries having a substantial share of total production.

India's industrial expansion has depended considerably on foreign technology inflow, at initial stages of production in various sectors, but the pace of technological diffusion and absorption has been very rapid and sustained. Technology inflow has taken place both through TNC subsidiaries and joint ventures with Indian-owned enterprises and through non-affiliate licensing to state-owned and large Indianprivate-sector enterprises. The

policy on foreign investments has been to generally limit such investments to a maximum of 40 per cent of equity holdings, except for export-oriented production and in certain high-technology fields. The country's policy towards foreign companies is governed by the Foreign Exchange Control Act of 1973.

While there is no specific law governing foreign technology inflow in India, such inflow has in fact been regulated since the 1960s, through administrative measures. Detailed guidelines on technology contracts were issued in November 1969, which listed sectors and industries where foreign technology would be permitted, either with foreign equity up to certain levels or without foreign equity holdings, and sectors where no foreign holdings would be permitted. Over the last two decades, several modifications have been made to the guidelines and procedures relating to foreign technology agreements. During the early 1980s, a more pragmatic and liberal approach towards foreign technology was adopted. This was greatly accentuated during 1984-1985, when there was considerable relaxation of controls and restrictions on technology inflow. Despite such liberalization and considerable flexibility, however, technology contracts continue to be regulated by a governmental reviewing agency.

The number of technology contracts approved by the Government rose to 6232 by 1980. 1/ During the period 1969-1979, by far the majority of such contracts did not involve foreign equity, and such participation took place only in 15 per cent of the contracts during this period, and was limited to below 30 per cent in most cases. Most of the technology contracts related to production of machinery and equipment, chemicals, pharmaceuticals and a wide range of intermediate products. During the 1980s, with increased liberalization of regulatory guidelines, technology inflow increased considerably. In 1980, 526 technology contracts were approved by the Government. During 1982-1985, the number of such contracts has increased steadily, to reach a level of 1024 approved contracts in 1985 and between 900 to 1100 contracts annually in subsequent years, including a number of technology agreements in electronics and telecommunications. A significant change has been the increased proportion of technology contracts involving foreign equity ownership, the proportion of such contracts rising to over 30 per cent in 1988, though the maximum foreign holdings have been mostly limited to 40 per cent. Foreign direct investments through such joint ventures rose to Rs. 1970 million (approx. $165 million) in 1987 and well over Rs.2200 million in 1988. (US$ 1 was equivalent to Rs14 too Rs16 in this period.) Most foreign investments during 1987-1988, have been from the United States and the United Kingdom, followed by the Federal Republic of Germany and Japan.

Total payments for technology, by way of fees and royalties, were of the order of around Rs1000 million towards the end-1970s, but rose substantially to over Rs3000 million annually during the latter half of the 1980s.

The number of technology agreements approved in India annually during 1948 to 1986 may be seen from Table 21 below. A similar number were approved during 1987-1988.

1/ Government of India, Ministry of Industry (SIA).

The sectoral distribution of technology inflow (1976-1986) may be seen from Table 22. Agreements approved during 1987-1988 follow a similar pattern.

The experience of technology regulation in India has been fairly satisfactory. The guidelines prescribed in 1969 and even earlier, have ensured that technology inflow has taken place on acceptable terms and conditions, particularly since 1969 and that required technology has, in fact, been imported. Such inflow has also enabled Indian-owned enterprises, both state-owned and private, to expand and diversify rapidly, with the role of foreign subsidiaries becoming limited.

It is difficult to envisage the extent of technology inflow that may have taken place in India if unrestricted inflow of foreign investments and technology had been permitted. Much of such investments may well have taken place in non-priority sectors and for various consumer products involving substantial outflow of foreign exchange. At the same time, there may have been greater technological diversification and strengthening of the country's technological base. Nevertheless, India's technological absorption and capability has grown rapidly and is very impressive in most fields, although it continues to lag behind industrialized countries in the fast-growing areas of microelectronics and informatics.

Table 21

India: Foreign collaboration approvals, 1948-1986

Total	Total number of cases approved	Cases involving foreign capital participation
1948-55	284	-
1956	82	-
1957	81	-
1958	103	-
1959	150	-
1960	380	-
1961	403	165
1962	298	124
1963	298	115
1964	403	123
1965	241	71
1966	202	49
1967	182	62
1968	131	30
1969	134	29
1970	183	32
1971	245	46
1972	257	36
1973	265	34
1974	359	55
1975	271	40
1976	277	39
1977	267	27
1978	307	44
1979	267	32
1980	526	65
1981	389	56
1982	588	113
1983	673	129
1984	740	148
1985	1041	256
1986	960	256
Total	10987	2176

Table 22

India: Foreign collaboration approvals, by industry, 1976-1986

Year	Alternate/ Renewal Sources of Energy	Industrial Machinery	Electricals & Electronics	Chemical Industry	Mechanical Engg.	Metal-lurgical	Machine Tools	Textile	Trans-portation	Othe-rs	R&D and Consultancy	Total
1976	-	57	63	32	13	12	19	2	19	60	-	277
1977	-	74	67	23	4	7	10	2	19	61	-	267
1978	-	76	48	30	7	18	20	2	22	84	-	307
1979	-	72	52	24	15	12	14	-	26	52	-	267
1980	-	121	114	52	29	31	26	6	41	106	-	526
1981	-	*96	*55	*27	*49	*9	*5	*5	*19	*42	-	389*
1982	3	110	134	54	125	36	6	7	24	82	7	588
1983	5	144	149	76	69	24	24	3	34	134	11	673
1984	4	169	162	85	99	32	27	7	25	120	10	740
1985	14	215	315	69	89	54	38	13	52	162	20	1041
1986	5	87	246	135	145	69	28	16	54	175	-	960

* There were 82 cases cleared under delegated power by various Administrative Ministries. These 82 cases are included in the total figure of 389 but are not included in the sectorwise breakup.

MALAYSIA

Malaysia has had fairly steady industrial growth since its formation in 1963. The First Malaysia Plan (1966-70) placed special emphasis on agricultural diversification and agro-industries, as also on foreign direct investments. The Pioneer Industries Ordinance of 1958 marked the changing emphasis to industrial growth, based initially on an import substitution strategy. Tax exemptions or "pioneer status" were granted to manufacturing firms, providing tax relief for varying periods up to five years. Subsequently, the Investment Incentives Act of 1968 provided additional incentives for the manufacturing sector. A Federal Industrial Development Authority (MIDA) was also set up, which is responsible for promotion and evaluation of all industrial projects.

During the 1970s, the Government adopted a promotional policy towards FDI in the manufacturing sector in order to generate additional employment and to promote exports of non-traditional exports on the other. Foreign investments were accorded a key role, both for inflow of capital, product designs, and industrial technology but also to access overseas markets. The impetus for Malaysia's export industries came, to a significant extent, from TNC subsidiaries availing themselves of low-cost supply of labour and materials.

By the end of the 1970s, the manufacturing sector had become the most dynamic and fastest-growing sector in Malaysia. On average, the annual rate of growth was 11.5 per cent in the 1960s and 12.5 per cent in the 1970s or about twice the growth rate of real GDP. With this, the share of manufacturing in GDP rose from 8.7 per cent in 1960 to 12.2 per cent in 1970 and 20.5 per cent in 1980. The pace of growth was slower in the early 1980s (4.9 per cent per annum during the period 1980-1983). This was accompanied and followed by a period of relative decline in the flow of FDI. The Government responded by introducing new incentives through the Promotion of Investments Act of 1986 as well as formulating new guidelines for foreign equity participation in order to attract new investments.

A New Economic Policy (NEP) was also initiated in 1970 basically to restructure Malaysian ownership of industry so as to reduce income imbalances among the major ethnic groups and between the urban and rural areas. This policy aimed at an average of 30 per cent equity participation of Bumiputras (indigenous community) in the corporate sector by 1990.

With foreign paid-up capital declining during the Fourth Malaysia Plan (1981-1985), more aggressive efforts were undertaken for export promotion. The formulation of the Industrial Master Plan (IMP) for the period 1986-1995 highlights the country's efforts to shift to a largely planned or target-oriented approach within a free enterprise economy.

According to IMP, industries based on rubber products, wood, tin, and palm oil are identified as export-oriented industries, while petrochemicals and the non-metallic mineral-based industries are classified as mainly for the domestic market. Similarly, the electronics industry and textiles and apparel are defined as export-oriented industries, while transport equipment, iron and steel, and industries based on non-ferrous metals are regarded as being for the domestic market. The food processing industry and the capital-goods sector are considered as composite industries, comprising diversified products, some for exports and others for local consumption.

The flow of technology into Malaysia, as reflected in formal contractual agreements, has increased rapidly in recent years. As shown in Table 23, between 1970 and 1987, a total of 1432 agreements were approved, with increasing numbers since 1980. While such agreements averaged less than 60 a year during the 1970s, the average number nearly doubled in the period after 1980. This is indicative of fairly rapid industrial diversification since the late 1970s. Of the agreements approved since 1970, 52.6 per cent are technical assistance and know-how agreements, while another 22.2 per cent are management agreements and joint ventures.

Table 24 indicates that Japan accounts for a substantial proportion (32.2 per cent) of all agreements signed between 1975 and 1987. Other important sources are the United Kingdom and the United States, accounting for 13.7 and 10.6 per cent, respectively. Japan has also become the principal supplier of machinery (34-40 per cent), which machinery imports from the United States accounted for an average of 26 per cent.

Table 25 indicates that a large proportion of the agreements signed between 1975 and 1987 are in the electronics and electrical industries (17.7 per cent), fabricated metal industries (10.8 per cent), and chemical industries (12.3 per cent).

Table 26 provides the number of technology agreements and royalty rates for various industries.

Table 23

Malaysia: Types of agreements, 1970-1987

Type of Agreement	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total	Per cent
1. Technical assistance and know-how	9	15	33	34	28	27	30	21	48	54	57	64	48	61	71	51	50	53	754	(52.6)
2. Management	-	1	13	5	3	12	7	7	11	13	13	6	10	13	10	6	10	5	145	(10.1)
3. Joint venture	-	2	7	6	7	6	6	4	7	8	14	22	14	14	17	9	19	11	173	(12.1)
4. Service	4	2	9	5	5	12	5	1	12	3	6	7	2	7	2	1	1	1	85	(5.9)
5. Trademarks/patents	3	2	4	3	6	1	5	-	4	4	4	8	8	7	1	19	33	30	142	(9.9)
6. Turnkey and engineering	-	-	-	-	-	-	-	-	-	-	5	5	4	4	6	-	1	-	25	(1.9)
7. Others a/	-	-	-	-	-	-	-	-	-		15	19	8	25	12	10	9	10	108	(7.5)
TOTAL	16	22	66	53	49	58	53	33	82	82	114	131	94	131	119	96	123	110	1 432	(100.0)

Source: Ministry of Trade and Industry.

a/ Others include supply and purchase, sales, marketing and distribution.

Table 24

Malaysia: Agreements by country of origin, 1975-1987

Countries	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total	%
1. Japan	22	21	7	32	21	32	35	33	46	39	33	38	37	396	32.2
2. United Kingdom	18	6	4	13	11	20	17	6	19	11	14	21	17	169	13.7
3. USA	6	4	1	9	8	11	14	10	18	12	13	12	12	130	10.6
4. India	3	5	8	7	5	5	4	4	4	2	6	1	-	54	4.4
5. West Germany	-	1	4	6	11	9	11	10	2	2	3	2	5	66	5.4
6. Australia	3	2	1	-	4	10	5	6	2	5	3	9	3	53	4.3
7. Hong Kong	1	-	3	3	2	9	2	3	2	7	4	7	7	50	4.1
8. Singapore	3	2	2	1	2	4	7	5	3	8	2	3	4	46	3.7
9. France	2	4	-	-	2	-	7	-	4	1	-	4	3	27	2.2
10. Italy	1	1	-	1	1	2	-	-	-	-	2	1	1	10	0.8
11. Panama	-	-	3	-	1	1	-	1	-	-	-	5	1	12	1.0
12. Switzerland	-	-	-	2	1	-	3	1	2	2	1	1	1	14	1.1
13. Norway	-	-	-	-	1	1	-	2	1	2	5	-	2	14	1.1
14. South Korea	-	1	-	1	-	-	-	2	4	6	1	3	1	19	1.5
15. Others *	7	6	-	7	17	9	26	12	24	22	9	16	16	171	13.9
Total	58	53	33	82	87	113	131	95	131	119	96	123	110	1231	100.0

Source: Ministry of Trade and Industry.

Table 25

Malaysia: Agreements by indsutry groups, 1975-1987

Type of Agreement	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total	Per cent
1. Electronics and electrical	17	9	5	21	15	19	16	19	15	21	20	12	29	218	17.7
2. Fabricated metal	8	3	5	7	16	6	14	7	12	3	9	22	21	133	10.9
3. Chemical	3	-	4	19	8	11	21	5	15	17	16	15	18	152	12.3
4. Transport equipment	5	4	-	5	7	10	11	11	22	17	20	15	4	131	10.6
5. Food	4	7	2	2	8	14	15	4	21	6	10	8	8	109	8.9
6. Textiles	6	7	2	4	-	8	5	2	5	6	1	7	2	55	4.5
7. Basic metal	-	5	3	3	5	7	10	13	5	5	1	1	2	60	4.9
8. Wood and wood products	4	1	6	5	4	-	-	4	1	6	-	4	1	36	2.9
9. Pulp, paper, printing and publishing	-	-	-	-	-	-	-	-	-	-	3	4	1	8	0.6
10. Rubber and rubber products	6	-	1	2	5	8	14	2	7	5	4	13	8	75	6.1
11. Non-metallic mineral products	1	6	1	1	7	5	4	16	9	17	7	7	12	93	7.6
12. Hotel and tourist complex	-	5	1	-	2	4	2	4	8	7	4	4	1	42	3.4
13. Plastic	1	-	2	-	3	5	4	1	2	7	-	4	-	31	2.5
14. Other	3	6	1	13	7	17	13	6	9	2	1	7	3	88	7.1
TOTAL	58	53	33	82	87	114	131	94	131	119	96	123	110	1 231	100.0

Source: Ministry of Trade and Industry.

Table 26

Malaysia: Number of agreements by industry and royalty rates, 1985-1987

Industry	< 1%	1-1.99%	2-2.99%	3-3.99%	4-4.99%	5-5.99%	6-6.99%	7-7.99%	8-8.99%	9-9.99%	> 10%	Total
Food, Beverages and Tobacco	3	3	6	4	2	4						22
Textiles and Wearing Apparel	6	2	2	2								12
Paper & Paper Products		1	1	1		1						4
Chemicals	7	6	15	7	1	3						39
Rubber Products	2	3	7	9	2	1	1					25
Non-Metallic Mineral Products	4	6	9	4								24
Basic Metals	2	1	2	1								6
Fabricated Metal Products	2	6	6	1	1							16
Machinery (except electrical)	1		2	2	1	1						7
Electrical Machinery & Appliances	8	11	16	4		5						44
Transport Equipment	6	5	15	6	1	1	2					36
Professional & scientific & measuring, & controlling equipment			1									1
Wholesale Trade	1	1										2
Retail Trade	1											1
Hotels	1		4		2	3		1				11
Total	44	45	96	41	10	19	3	2		1		251

Note : a. Royalty rates are based on net sales
b. A total of 385 agreements were registered, while 251 agreements involved royalty payments

Source : Ministry of Trade and Industry.

PAKISTAN

Considerable industrial growth has taken place in Pakistan over the last two decades. With a liberal policy towards foreign investments, the country has attracted considerable investments in various industrial sectors, including consumer industries and production of intermediate products and certain ranges of capital goods.

Varying degrees of control with respect to foreign technology contracts are exercised as part of the process for approving new industrial investments and projects. In general, however, a fairly liberal and flexible policy has been followed and technology transactions have been largely left to the enterprises concerned.

Payments for technology have increased considerably over the last decade and rose from Pak Rs12 million in 1977-1978 to Pak Rs18.75 million in 1981-1982, over Pak Rs41 million in 1985-1986, over Pak Rs70 million in 1986-1987, and over Pak Rs85 million in 1987-1988. 1/

1/ State Bank of Pakistan. Quoted from figures provided by UNCTC-ESCAP Joint Unit, Bangkok.

PHILIPPINES

The Philippines have registered fairly satisfactory industrial growth over the last two decades. The geographical distribution of FDI flows in the Philippines can be seen from Table 27.

The extent to technology flows, as measured by payment of fees and royalties may be seen from Table 28 below. A flexible and pragmatic policy has been followed in reviewing foreign technology contracts. Fairly detailed guidelines have been provided in this regard.

Table 27

Philippines: Industrial distribution of foreign direct investment flows, (inward investment), 1979-1987

(In million US dollars)

	1979	1980	1981	1982	1983	1984	1985	1986	1987
PRIMARY	0.49	7.07	7.15	24.86	7.50	0.85	2.17	0.84	3.80
Agriculture	0.33	3.58	7.03	1.38	1.29	0.82	1.97	0.66	3.39
Mining & quarrying	0.16	3.49	0.13	23.48	6.21	0.03	0.19	0.18	0.40
SECONDARY (Manufacturing)	105.91	34.18	19.52	26.98	24.09	25.41	68.90	32.16	36.66
TERTIARY	7.92	12.01	7.18	21.69	6.94	8.52	9.15	10.43	35.50
Construction	0.27	0.20	0.49	3.59	0.99	0.25	0.05	0.22	0.09
Wholesale & retail trade	2.55	1.56	3.19	5.02	1.01	1.52	1.18	4.86	10.81
Trans., storage & comms.	0.31	3.46	0.52	1.26	0.27	0.17	0.51	0.37	2.51
Fin., insur. & busi. services	4.64	5.75	2.85	11.53	4.42	6.44	1.73	4.80	21.70
Electricity, gas & water	-	0.45	-	0.01	0.04	-	-	-	0.02
Community, social & personal services	0.15	0.59	0.13	0.26	0.21	0.14	5.68	0.19	0.35
TOTAL	114.31	53.26	33.85	73.52	38.52	34.78	80.21	43.43	75.95

Source: Securities and Exchange Commission, Philippines

Notes to Table IIE:

1. Exch. Rate: Pesos/Dollar	7.378	7.511	7.900	8.540	11.113	16.699	18.607	20.386	20.568

2. Investment refers to initial paid-in capital and increases in paid-in capital in domestic stock corporations and partnerships.

3. Nationality of investor is based on citizenship. Thus, amounts include investments by resident aliens funded from local sources and without any inward remittance of foreign exchange.

Table 28

Philippines: Royalty receipts and payments, 1978-1987

(In million US dollars)

	PAYMENTS	RECEIPTS
1978	17.40	0.01
1979	18.06	0.02
1980	19.37	0.02
1981	23.56	0.04
1982	23.32	0.05
1983	22.71	0.57
1984	0.51	0.02
1985	26.24	0.01
1986	20.22	-
1987	30.95	0.03

Source: Dept. of Econ. Research, Central Bank of the Philippines

Notes:

1. Data cover copyright and patent royalties.
2. Data prior to 1978 not available.

THAILAND

Thailand has liberal procedures and incentives for foreign direct investments, with the Board of Investment determining the level of incentives in particular cases. Technology contracts are not reviewed by any governmental body and are left for negotiations between the enterprises concerned. Such contracts are, however, registered with the Central Bank and constitute the basis on which remittances of fees and royalties are permitted.

There has been considerable inflow of technology in Thailand and, by 1981, there were 689 contracts, involving 438 companies in Thailand, with remittances amounting to 1330 million Baht in that year. The industries covered a wide range, extending from food industries and beverages to textiles and weaving apparel, industrial chemicals and various chemical products, and various items of machinery. During the period 1981-1988, the number of contracts has grown rapidly, averaging 200-250 contracts each year and extending to a variety of modern technologies, including electronics and telecommunications.

The industrial distribution of FDI for the period from 1970 to 1987 may be seen from Table 29.

Total remittance relating to FDI including payments for technology by firms in Thailand may be seen from Table 30.

In general, Thailand has experienced rapid industrial growth during the 1980s. The pace of technological absorption has also increased considerably in recent years.

Table 29

Thailand: Industrial distribution of foreign direct investment flows (inward investment)

(In million baht

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Primary	18.7	52.6	175.8	48.1	1,194.7	64.4	88.2	91.1	49.3	158.8	806.5	775.2	1,697.7	1,502.4	2,854.8	592.8	442.4	477.9
Agriculture	0.0	0.0	4.9	5.0	15.2	2.1	1.3	(0.2)	(18.2)	4.6	209.8	7.5	15.6	48.2	67.6	77.0	202.2	285.9
Mining and quarrying	8.4	9.2	35.87	18.4	20.2	28.6	11.6	68.0	39.2	9.0	155.9	37.1	150.4	354.6	132.3	85.8	3.8	(59.3)
Oil exploration	10.3	43.4	135.1	24.7	1,159.3	33.7	75.3	23.6	28.3	145.2	440.9	730.6	1,531.7	1,099.6	2,654.9	430.0	236.4	251.3
Secondary	446.9	110.7	308.3	608.7	1,030.8	582.1	458.8	659.1	465.4	723.9	1,011.9	2,526.1	1,230.9	2,567.5	3,167.0	1,358.2	2,123.8	4,754.4
Food	45.8	12.5	5.3	26.7	237.3	82.3	30.1	61.7	17.1	51.8	91.3	156.9	(257.3)	217.7	105.9	394.8	286.9	436.6
Textiles	138.6	34.5	177.9	433.1	378.3	192.6	158.6	415.9	127.4	(10.4)	(1.5)	(32.2)	420.7	13.2	452.5	59.8	85.7	995.7
Metal and non-metallic	11.7	15.7	3.0	3.4	118.4	22.1	4.9	2.5	32.5	32.9	47.8	149.0	123.5	1,022.2	78.3	(125.7)	(22.6)	365.1
Electrical appliances	18.3	27.9	46.3	37.0	111.6	110.1	129.2	126.4	189.9	351.4	448.2	624.4	666.7	394.0	1,045.3	280.1	617.0	1,136.5
Machinery and transport equipment	22.4	4.7	(27.0)	15.4	57.8	1.8	(0.8)	161.1	33.2	59.1	92.1	129.5	227.3	421.6	119.8	32.0	(14.9)	159.9
Chemicals	78.8	(43.8)	68.1	111.9	67.0	91.6	136.9	(2.0)	66.0	73.3	213.4	177.5	106.5	350.3	283.3	488.4	484.0	868.1
Petroleum products	99.8	50.3	20.9	(33.2)	(20.0)	43.3	0.8	(140.4)	67.5	126.7	2.2	1,246.8	(129.1)	0.0	934.2	0.0	8.2	(15.8)
Construction materials	4.4	2.5	9.2	7.7	26.9	7.0	0.0	4.0	(100.0)	(29.4)	1.3	12.5	8.8	19.1	5.8	38.3	5.4	11.5
Others	27.0	6.4	4.6	6.7	53.3	31.1	(1.0)	29.8	31.8	67.9	117.1	61.8	63.8	129.3	141.9	190.4	674.1	796.8
Tertiary	424.9	645.2	943.0	948.2	1,610.9	1,098.3	1,067.2	1,413.3	620.2	244.9	2,059.8	3,113.2	1,459.2	4,155.0	3,623.5	2,452.3	4,341.9	3,816.7
Construction	93.6	222.6	315.6	132.7	96.7	168.6	152.3	227.0	190.4	293.8	782.6	1,276.8	736.9	741.6	1,066.2	1,585.3	1,234.9	1,349.1
Trade	234.0	303.0	332.7	446.5	226.5	545.4	436.4	306.4	347.8	341.3	750.6	479.6	699.0	1,697.7	1,893.6	1,082.9	1,783.4	852.0
Transportation and travel	38.6	45.1	119.5	62.3	(17.2)	(21.7)	241.9	235.4	63.6	94.5	214.9	333.0	263.4	199.4	185.1	198.0	255.6	220.6
Financial institutions	51.9	49.6	127.1	169.7	1,276.7	392.9	218.3	606.1	(5.4)	(546.3)	(173.0)	674.2	(480.3)	996.5	150.3	(1,279.2)	510.2	444.4
Housing and real estate	0.0	0.1	33.4	48.6	9.1	0.1	7.6	29.7	9.0	3.4	150.9	14.1	(3.8)	94.8	94.6	305.5	42.7	328.2
Hotels and restaurants	0.0	0.2	2.9	69.0	7.6	13.6	5.8	(5.1)	1.8	1.9	87.7	91.7	137.5	35.6	92.3	222.8	100.3	94.7
Other services	6.8	24.7	11.8	19.4	11.6	(0.5)	4.8	14.0	12.9	56.4	246.2	243.7	106.1	389.5	141.4	337.2	414.8	527.7
Total net inward investment flows	890.5	808.4	1,427.1	1,604.9	3,836.3	1,744.8	1,614.2	2,163.8	1,134.8	1,127.6	3,878.2	6,414.4	4,387.9	8,224.8	9,645.3	4,403.3	6,908.1	9,049.0

Source: Derived from Bank of Thailand data.

Notes: 1. For the period 1970-1977, it was not possible to separate outward from inward investment. However, the outward investment during that period was probably very small. 2. The total figure for 1978 was 124 million baht higher, because there was no country breakdown of outard invetment for that year.

Table 30

Thailand: Total remittances related to foreign direct investment flows a/

(Million baht)

Year	Profits & Dividends	Management Fees	Royalty & Technology Fees	Interest	Total Remittance Outflows (1)	Total Net FDI Inflows (2)	(1)/(2)
1970	576	53	66	378	1,073	891	120.5%
1971	585	45	100	478	1,207	808	149.3%
1972	566	44	131	510	1,250	1,427	87.6%
1973	646	59	164	664	1,532	1,605	95.5%
1974	903	78	178	1,392	2,551	3,836	66.5%
1975	1,410	63	255	1,587	3,315	1,745	190.0%
1976	1,613	121	257	1,410	3,400	1,614	210.7%
1977	1,635	159	338	1,504	3,637	2,164	168.1%
1978	1,661	153	402	2,492	4,707	1,011	465.6%
1979	1,972	185	457	4,321	6,935	1,048	661.9%
1980	2,049	146	610	6,264	9,069	3,816	237.7%
1981	3,406	515	816	8,881	13,619	6,363	214.0%
1982	2,714	569	873	6,408	10,564	4,339	243.5%
1983	2,714	736	934	6,066	10,450	8,192	127.6%
1984	2,902	832	1,161	7,349	12,245	9,624	127.2%
1985	3,588	808	1,238	9,246	14,880	4,379	339.8%
1986	2,962	832	1,250	7,957	13,000	6,880	188.9%
1987	3,663	929	1,454	6,814	12,860	4,712	272.9%

Source: Compiled from Bank of Thailand data.

Note: a/ Breakdowns according to whether payments are made to affiliates or not are not available. Data on receipts are not available but are likely to be negligible.

REPUBLIC OF KOREA

The spectacular industrial success achieved in the Republic of Korea should be viewed against the background of a system of technology regulation in the 1970s and major liberalization of such regulations during 1980-1981. While the purpose of the Foreign Capital Inducement Act (1966) was to stimulate foreign investments and technology inflow, a Technology Development Promotion Law was enacted in 1967 and revised in 1972 to develop the country's technological capability. A Technology Transfer Centre was set up in 1976 to review and check technology contracts and also to assist Korean industry in identifying and evaluating relevant technologies. Detailed guidelines were prescribed by the Centre for reviewing foreign technology contracts.

The approach towards foreign technology inflow underwent significant change towards the end of the 1970s, when a far more liberal approach was adopted. This was partly because considerable technological lag was developing in several sectors, particularly machinery manufacture and electronics and partly because Korean companies were increasingly in a position to evaluate and negotiate suitable agreements for complex technologies. The liberalization of regulatory measures commenced in 1978 and was expanded substantially in the next year. Basically, the approval system for technology agreements was greatly simplified and greater latitude was given to enterprises negotiating technology contracts. In 1979, a system of automatic approval was implemented for agreements in heavy industries and for contracts with a duration of less than 3 years and initial payment of less than US$ 30,000 and running royalty of up to 3 per cent. In 1980, the automatic approval system was extended to several sectors for agreements of up to 10 years or involving payments of up to 10 per cent royalty and down payment of over US$ 500,000 or, in the case of outright purchase of technologies, up to US$ 1 million. Agreements with indefinite duration were also permitted in priority sectors where technological changes occurred rapidly. Following the liberalization of technology regulation measures, inflow of technology increased rapidly. The number of technology agreements rose to 222 in 1980 and to 247 in 1981. By end-1981, nearly 57 per cent of the agreements were with Japanese companies, followed by 13.6 per cent with United States companies.

Several other measures were enacted during the 1980s. In 1982, tax exemptions were provided on income from exports based on patent rights and from licensing of patents within the country. In 1982, there was considerable liberalization of controls over foreign investments and, in 1985, there was further relaxation of controls over imports of technology. The Patent Law was comprehensively revised in 1986, while a new copyrights law extended copyright protection to computer software. The Trademark Act of 1986 increased penalties for trademark infringements.

Table 31 below provides the industrial distribution of foreign investment flows during 1979 to 1987, while royalty payments and receipts are indicated in Table 32.

Table 31

Republic of Korea: Industrial distribution of foreign direct investment (inward investment) 1/

(In million Won)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total
PRIMARY	2,036.67	287.98	471.90	175.55	266.97	1,016.93	301.76	723.77	758.64	4,239.79	1,598.25	9,553.56
Agriculture	1,738.04	118.58	346.06	131.86	170.26	771.29	65.16	723.77	227.06	2,799.49	1,155.71	6,410.66
Mining and quarrying	298.63	169.40	125.84	23.69	96.71	245.64	236.60	-	531.58	1,440.30	442.54	3,142.90
Oil	-	-	-	-	-	-	-	-	-	-	-	
SECONDARY (manufacturing)	43,527.58	45,665.87	58,919.54	59,923.56	76,974.78	81,742.06	54,668.66	103,594.20	145,877.11	213,756.04	308,366.67	1,098,822.62
Food, beverages, tobacco	931.22	514.49	5,403.38	377.21	8,093.36	4,488.83	6,259.53	9,897.43	3,668.87	15,792.94	32,207.73	86,189.28
Textile, leather & clothing	707.12	525.62	51.79	136.06	542.10	2,382.59	1,395.57	1,748.17	194.88	5,549.61	8,023.35	20,024.12
Paper and allied	-	-	244.42	817.60	1,778.85	5,023.25	38.79	801.14	4,167.40	386.08	250.88	13,508.41
Chemicals and allied	25,169.94	19,004.74	21,550.58	28,905.16	36,551.56	29,839.03	12,059.81	19,124.29	25,072.23	29,560.31	57,912.22	260,575.19
Coal and petroleum products	2,436.94	5,964.82	2,247.70	5,054.43	340.52	194.47	-	3,929.96	-	-	10,130.51	21,917.59
Non-metallic	155.85	1,235.65	954.93	515.71	839.71	367.00	65.94	644.78	522.88	7,004.00	5,108.16	16,023.11
Metals	4,490.07	1,415.70	3,698.73	3,498.80	9,025.69	897.04	1,102.34	4,019.42	2,928.49	1,748.80	5,710.28	32,629.59
Mechanical equipment	2,553.58	4,029.78	10,126.25	4,170.61	4,056.21	1,814.54	1,688.03	4,939.85	5,250.57	15,056.93	21,240.40	68,343.39
Electrical equipment c/	5,362.72	9,145.66	7,509.74	11,164.56	15,423.97	19,879.53	19,173.44	50,162.58	32,993.77	35,011.19	129,453.59	320,772.37
Motor vehicles	1,013.50	2,950.95	1,789.35	4,651.09		15,495.97	12,009.39	6,920.14	68,879.48	98,920.73	30,564.23	239,230.38
Other transport												
Other manufacturing	706.64	878.46	342.67	632.33	322.81	1,359.81	875.82	1,406.44	2,198.54	4,725.45	7,745.32	19,609.19
TERTIARY	23,620.17	41,629.81	40,126.50	19,442.01	25,052.36	11,269.60	40,047.32	51,465.85	58,746.36	202,899.21	204,583.03	653,632.24
Construction					6,170.13	193.74	729.20	8,147.65	17 215.96	-	7,392.44	39,849.12
Wholesale and retail trade			4.84	168.87	47..67	489.09	77.58	80.60	12,403.88	2,051.13	558.53	15,882.19
Transport and storage	198.44	2,290.29	1,502.82	7,012.17	2,683.94	525.65	617.50	736.67	568.12	-	491.07	14,137.94
Finance, insurance and business services	6,317.17	7,658.33	24,103.20	7,876.54	5,258.91	7,602.50	21,458.02	11,100.76	17,544.82	4,959.04	14,238.69	114,142.48
Communications												-
Other services d/	17,104.56	31,681.19	14,515.64	4,384.43	10,891.71	2,458.62	17,165.02	31,400.17	11,013.58	195,889.04	181,902.30	469,620.51
TOTAL	69,184.42	87,583.66	94,517.94	79,541.12	102,294.11	94,028.59	95,017.74	155,783.82	205,382.11	420,895.04	514,547.95	1,762,008.42

Source: Ministry of Finance, op. cit.

a/ Arrival basis.
b/ Including fishery amnd forestry.
c/ Including electronics and communication equipment.
d/ Including hotels.

Table 32

Republic of Korea: Royalty receipts and payments, 1972-1987

(In million Won)

	PAYMENTS	RECEIPTS
1972	4,032	
1973	4,577	
1974	7,124	
1975	12,845	
1976	14,725	
1977	28,009	
1978	41,172	145
1979	45,464	920
1980	65,136	3,945
1981	72,941	8,036
1982	84,578	13,306
1983	115,982	14,662
1984	171,860	13,540
1985	257,083	9,831
1986	362,276	10,294
1987	430,800	7,945

Sources: Ministry of Science and Technology, The Korean Yearbook of Science and Technology (various years); Korea Industrial Technology Promotion Association, Major Statistics on Industrial Technologies, 1988.

AFRICAN COUNTRIES

Among African countries, foreign technology contracts are reviewed by governmental agencies in certain countries such as Nigeria, Ghana and Kenya. The institutional arragnements vary, although the coverage of the guidelines followed in these countries tend to be similar. In most other African countries, arrangements for technology supply are considered as part of the overall proposal for new investments.

NIGERIA

The legal and institutional framework for dealing with foreign technology in Nigeria is the National Office of Industrial Property (NOIP) Decree No. 72 of 1979. Under this enactment, all technology agreements entered into with foreign partners by Nigerian companies must be registered with NOIP, which provides the institutional framework for handling technology inflow and foreign technology contracts in Nigeria.

The National Office of Industrial Property constitutes one of the principal instruments for implementation of Nigerian technology policy. Broad objectives and goals of such policy have been set, which also serve as the objectives and norms for dealing with technology contracts. NOIP supervises the acquisition of foreign technology, while encouraging the most efficient use of acquired technologies. The functions of NOIP include:

(i) the encouragement of more efficient processes for identification and selection of foreign technology;

(ii) the development of negotiating skills of Nigerians with a view to ensuring appropriate contractual terms and conditions by Nigerian partners and licensees;

(iii) ensuring increased adaptation of imported technology;

(iv) the registration of all existing and new contracts for transfer of foreign technology to Nigerian partners;

(v) monitoring, on a continuous basis, the implementation of registered agreements.

The contracts that are covered by the provisions of the Decree are those relating to:

(i) the use of trademarks;

(ii) the right to use patented inventions;

(iii) the supply of technical expertise in the form of the preparation of plans, diagrams, operating manuals or any other forms of technical assistance of any description whatsoever.

(iv) the supply of basic or detailed engineering;

(v) the supply of machinery and plant, and

(vi) the provision of operating staff or managerial assistance and the training of personnel.

The law imposes obligations upon NOIP to define, in the process of contract evaluation the "right" price for imported technology. This is one of the essential tasks of the technology transfer registry. Decree No. 70 also defines various restrictive provisions which have to be eliminated from the text of an agreement prior to registration.

Despite strict formulation of Decree No. 70 especially with respect to restrictive clauses, the law grants substantial discretion for final approval of technology agreements to the National Office. Payments for technology transfer are valid for payment purposes by the Federal Ministry of Finance, the Central Bank of Nigeria or any licensed bank in the country only after such agreements have been approved and registered by the National Office.

Table 33 indicates the number of agreements submitted to NOIP during 1983-1987.

The number of registered technology agreements according to regional sources may be seen from Table 34.

Table 35 provides information on sectoral distribution of technology agreements during 1987, indicating the nature of technological flows and diversification.

Table 33

Nigeria: Comparative data on number of agreements submitted submitted to NOIP according to industrial sector (1983-1987)

Industrial sector	Agreements submitted to NOIP				
Agro-based sector	73	44	88	68	36
Chemical/mineral based sector	48	31	98	90	60
Light/heavy engineering sector	89	31	78	64	25
Service sector	21	10	13	18	10
Total	231	116	227	240	131

Table 34

Nigeria: Number of registered agreements according to sources of technology by industrial sector in 1987

Industrial sector	North South America	United Kingdom/ Western Europe	Asia	Others	Total
Agro-based sector	1	15	2	-	18
Chemical/mineral based	6	24	4	-	34
Engineering sector	3	17	1	-	21
Services sector	2	6	-	-	8
Total	12	62	7	-	81

Table 35

Nigeria: Technology agreements evaluated in 1987 by industrial sector

Industrial sector	Submitted agreements (Number)	Registered agreements (Number)	Agreements abandoned (Number)	Agreements rejected (Number)	Agreements pending (Number)
Agro-based sector	36	18	-	2	16
Chemical and mineral base sector	60	34	-	2	24
Light and heavy engineering	25	21	-	-	4
Services	10	8	-	1	1
Total	131	81	-	5	45

KENYA

Kenya has had fairly sustained growth over the last two decades, with GNP per capita increasing at an average annual rate of 2 per cent during 1965-1985. The country's economic strategy stresses rapid increase in private-sector investments, including foreign capital inflow which has served as a major source of investment and industrial technology. Foreign equity inflow in the manufacturing sector was of the order of $44.9 million during 1974-1978, $39.9 million during 1979-1983, and $28.3 million during 1984-1987. In the services sector, foreign invesmtents increased from $3.19 million in 1974-1978 to $15.69 million during 1979--1983, and $27.7 million during 1984-1987. 1/ The growth of the manufacturing sector, though limited, has extended over several subsectors.

With the emphasis on attracting new investments and technology inflow, a fairly liberal policy has been adopted towards foreign technology contracts. Such contracts are reviewed in the Central Bank of Kenya, by a committee consisting of representatives of the Ministries of Finance and Industry, besides the Central Bank. Certain broad guidelines are observed in the review of such agreements but, by and large, such agreements are left to the enterprises concerned.

The nature and extent of foreign equity and technology flows in recent years in various sub-sectors of the Kenyan economy can be seen from Table 36.

Issues relating to technology acquisition and transfer have received considerable attention in recent years in several other African countries. An intergovernmental committee of experts for science and technology development meets periodically under the aegis of the Economic Commission for Africa. At the national level, new investment codes andpolicies have been increasingly oriented so as to attract new investments in African countries, particularly for export-oriented industries. An important trend has also been with respect to new patent legislation in these countries, both at national and regional level. An African Regional Industrial Property Organization (ARIPO) has been formed with 12 member States. Certain other African countries, which are mostly French-speaking, have constituted an African Intellectual Property Organization (OAPI). The development and implementation of appropriate industrial property legislation in African countries should assist technology flows to these countries.

1/ Source: Central Bank of Kenya.

Table 36

Kenya: Subsectoral foreign exchange transaction with foreign business interests
(In million US dollars)

Subsectors	(1) Equity Inflows 1974-87	(2) Equity Inflows 1979-87	(3) Equity Inflows 1984-87	(4) Total Fees 1979-84	(5) Total Fees 1984-87	(6) Royalties 1984-87	(7) Dividends 1984-87	(8) Interest Payments 1984-87	(9) Fees (1984-1987) Mgt.	(10) Tech.	(11) Other
Finance, Banking, Insurance	33.20	32.21	20.69	4.29	2.55	0.49	27.92	23.30	2.18	0.31	0.06**
Tourism, Hotels	4.47	3.84	0.83	2.75	1.79	0.33	4.89	4.76	1.48	0.29	0.02**
All Other Services	8.87	7.30	6.14	7.36*	4.79	0.16	10.58	11.93	****0.03	1.13	3.63**
Food, Beverages, Tobacco, and Agro-Business	34.77	26.34	12.45	29.47	7.01	1.12	61.70	19.80	3.99	2.99	0.03**
Textiles, Fibres	18.99	5.22	1.42	4.44	1.23	0.10	2.07	3.60	0.67	0.56	0.00**
Footwear, Leather, Apparel	0.86	0.18	0.18	1.13***	0.62	0.00	5.41	0.25	0.00	0.62	0.00**
Paper, Pulp, Printing, Publishing	1.94	0.50	0.48	10.79	3.29	0.90	8.50	7.44	0.67	2.62	0.00**
Raw material processing	10.41	8.75	0.48	6.71	2.24	0.05	0.97	4.34	0.00	2.09	0.15**
Chemicals, Pharmaceuticals	18.79	10.50	5.24	16.25	7.28	2.20	45.00	19.57	0.04	4.87	2.37**
Metallic, Non-metallic products	13.19	8.23	5.22	5.83	3.61	0.95	14.83	4.98	0.06	3.55	0.00**
Rubber, Tires, Plastics	3.15	1.46	1.24	7.49	4.66	0.52	10.54	0.75	0.00	4.66	0.00**
Mechanical and Engineering goods (non-electrical)	n.a.	n.a.	n.a.	**1.22	**0.45	**0.00	****1.51	1.27	0.00	0.00	0.45**
Electrical machinery, Appliances	6.21	5.16	0.28	3.07	0.96	0.99	5.62	43.17	0.00	0.96	0.00**
Office equipment, Data process	n.a.	n.a.	n.a.	n.a.	n.a.	0.37	****1.84	n.a.	0.00	0.00	0.00**
Motor Vehicles and Transport Equipment	4.70	1.78	0.35	5.13	2.05	0.02	n.a.	24.45	1.91	0.14	0.00**
Other Manufacturing	0.10	0.00	0.00	n.a.	n.a.	0.27	6.11	n.a.	0.00	0.00	0.30**
T O T A L	159.65	111.57	56.00	105.93	42.53	8.47	207.49	169.41	10.36	24.08	7.01**

Note: *Missing 1980;
**Missing 1987;
***Missing 1984, 85, 87;
****Missing 1985;
n.a. - no year data available

Source: From unpublished data researched and compiled in the Central Bank of Kenya.

ARAB COUNTRIES

Considerable importance has been accorded in recent years to the development of endogenous technological capability in Arab countries. In Egypt, a National Technology Policy was announced in 1984, with the Academy of Scientific Research and Technology playing a leading role in its implementation. Broad criteria have also been defined for technology choice and contracts. In Jordan, Law No. 30 of 1987 provided for the establishment of the Higher Council for Science and Technology. In Iraq, a Department for Science and Technology has been set up, besides laws on foreign direct investments and industrial property. In Algeria, a 1973 law (Avis 72 of February 1, 1973) dealt with financial aspects of technology transfer and provided for registration of all contracts. The organization dealing with industrial properties, INAPI, is responsible for contracts involving such rights. In Kuwait, legislation relating to industrial growth established an Industrial Development Committee which is responsible, inter alia, for approving technology transfer projects. In Saudi Arabia, while proposals for new industries require the approval of the Ministry of Industry, technology contracts are left to the parties concerned. In most other Arab countries, including Morocco, Sudan and Tunisia, certain aspects of technology transfer are considered as part of the review of foreign investment proposals or of new industrial undertakings. The Ministry of Industry is generally the principal department dealing with technology imports as part of industrial projects. In some countries, such as Tunisia, a committee reviews technology-supply proposals from economic and technical angles. Detailed guidelines for reviewing technology agreements have not generally been prescribed and considerable flexibility is exercised in most Arab countries with respect to the content of technology contracts.

Inflow of foreign technology to Arab countries has increased enormously during the last 15 years. Most such technology has related to infrastructure development and to the petroleum and petrochemical sectors in petroleum-exporting Arab countries. Much of such technology has been supplied through turnkey projects, implemented under the supervision of foreign companies and contractors, but a large number of joint ventures have also been established. At the same time, there has also been substantial inflow of industrial technology with respect to a wide range of consumption goods and intermediate products. With technology agreements largely left to the enterprises concerned, including state-owned undertakings, there has been considerable freedom on the part of such enterprises in negotiating suitable terms and conditions for technology inflow. The magnitude of technology and equipment flows to several Arab countries may be seen from Table 37 below.

The above review of developing-country experience with respect to technology flows and technology policies has highlighted present policies and trends in certain developing countries and regions. It has obviously not been possible to deal with all, or even most, of the developing countries. The experience in several of these countries is undoubtedly of great interest. The Joint Venture Law, followed by other legislation, including the Patent Law in China, resulted in considerable inflow of technology in China during 1983-1988. In Indonesia, inflow of foreign technology has been fairly

substantial during the 1980s, together with the volume of foreign direct investments. With the BKPM in Indonesia serving as a one-stop agency for foreign investments and technology, procedures for dealing with such cases have been considerably streamlined. In Turkey, technology inflow has continued at a fairly steady pace, with 254 technology agreements during 1981-1985, as against 813 agreements during 1963 to 1981. A significant development has also been the major emphasis now being given to foreign investment and foreign technology inflow by certain socialist developing countries, namely, Angola, Ethiopia and Vietnam. These trends and the growing needs of developing countries for industrial technology suggest that the range and volume of technology inflow to developing countries would increase significantly during the next decade and that national policies would be largely oriented to this goal.

Table 37

Arab countries: Technology contracts among six developed countries and 15 Islamic countries of the Middle East

Supplier	*Type of contract*			
	Technical services	*Equipment supply*	*Construction*	*Total*
		(billions of dollars)		
Total amount	$4.4	$10.8	$13.6	$28.8
		(Percentage)		
Six major industrial countries	46.1	69.1	76.1	68.9
Other	23.2 [c]	30.3 [d]	16.2	22.5
Local and Middle East	30.7	0.6	7.6	8.5
		(billions of dollars)		
Six major industrial countries	$2.0	$7.4	$10.3	$19.7
		(Percentage)		
United States	75.5	37.2	43.6	44.4
Japan	3.4	16.5	7.9	10.7
Federal Republic of Germany	2.8	10.2	7.0	7.8
United Kingdom	16.3	11.6	1.5	6.8
France	0.2	21.5	30.9	24.3
Italy	1.9	2.9	9.1	6.1
Total major industrial countries	100	100	100	100

Source: *Technology transfer to the Middle East*, Washington D.C., United States Congress, Office of Technology Assessment, September 1984.

a Sectors covered: communications, commercial aircraft support systems, medical services, and petrochemical facilities. Incomplete coverage, especially for 1978-79 and 1982.

b Saudi Arabia, Iran (Islamic Republic of), Algeria, Egypt, Iraq, Kuwait, Libyan Arab Jamahiriya, United Arab Emirates, Syrian Arab Republic, Lebanon, Jordan, Qatar, Oman, Yemen Arab Republic, P.D.R. Yemen.

c Comprised entirely of one large Canadian communications technical services contract (Bell of Canada).

d Comprised primarily of a few Sweden/Netherlands telecommunications equipment contracts.

CHAPTER IV

REORIENTATION OF TECHNOLOGY POLICIES IN DEVELOPING COUNTRIES

It is necessary to consider the major changes in technology policies that may be required, and are likely, in developing countries during the 1990s. There can be no doubt that the demand for industrial technology and the range of such demand will increase considerably during the 1990s. The slowdown in the pace of industrialization and the stagnation, and even decline, in the level of technology flows, during 1985-1987, in several developing countries, is likely to be replaced by a resurgence in industrial growth and technology requirements. The extent of technology flows to developing countries should consequently increase rapidly. With the continuing pace of technological innovations at the global level, and the technological lag in most developing countries, it will also be necessary for policies in these countries to be re-oriented so as to ensure substantial inflow of required industrial technology and the adaptation of such technologies to local factor-resoruces and the development of innovative capability, as well as the application of such capability to various production and service sectors. Such reorientation would primarily relate to measures which impinge directly on foreign technology inflow, particularly inflexible regulatory guidelines on contract conditions, together with policies on foreign investments, intellectual property legislation and other regulatory measures which adversely affect such inflow. At the same time, a well-defined and comprehensive programme for endogenous technological development in selected sectors would also have to be undertaken. While an institutional base has been created for technological development in most developing countries, efforts have been largely concentrated on science and technical education and local research in certain fields, specially related to agriculture. Policies and programmes on technology planning, industrial research and application and linkages with industry will require to be significantly strengthened and reoriented in order to ensure that new technological developments are fully availed of and integrated in the process of socio-economic development. Varying degrees of technological pluralism are inevitable in most developing economies. Nevertheless, technology policies must aim at ensuring that these countries are able to benefit from global technological developments in critial sectors and can relate such developments to local conditions and requirements.

The role of the State in channelling industrial and technological development in certain directions will continue to be of vital importance in most developing countries. In industrialized economies, defence-oriented research or direct subsidies for advanced research in various fields have played a vital role in technological development. For developing countries with limited financial resources, the role of the State will have to extend beyond research activities, both for ensuring adequate technology inflow and effective technological adaptation and innovation.

It is important that a planned programme for technological development is prepared at national level as an integral element of socio-economic planning in developing countries. Such a plan should take stock of contemporary technological developments and their implications in critical sectors in each

economy, and assess and relate such developments to the needs and potential of the principal production sectors, agriculture and industry, and the major subsectors under these two broad categories. Such relationship would define the technological infrastructure requirements and would enable technology planning to be complementary to sectoral plans in priority sectors of each economy.

Technology planning in the context of the 1990s would need to cover certain critical elements. Firstly, it would be necessary to identify technological needs of the economy, specially in terms of priority sectors and in relation to global technological developments. Technological needs should normally be assessed in terms of achieving global competitive capability projected over a period of time, say 5 to 10 years. In certain fields of production and manufacture which are primarily utilized for national consumption and where other priorities such as rural employment have to be covered, alternative technologies may need to be considered, together with a blending of traditional processes with new techniques such as use of microprocessors. In several sectors, technological requirements, consequent on present-day technological developments, are fairly obvious and can be defined in specific terms. In others, this task may be fairly complex and may require careful assessment of alternative technologies. Secondly, the technological infrastructure in most developing countries will need to be substantially strengthened in relation to identified needs. Apart from development of specialized and skilled human resources and institutional capability in engineering, design and applied research, all of which should receive the highest priority, technology information systems and linkages also need to be developed. Thirdly, reorientation of policies may be required with respect to acquisition and inflow of foreign technology, which will continue to be increasingly vital at various levels of industrialization. This may necessitate the review of policies on FDI and intellectual property rights. Fourthly, the pace of technological absorption and adaptation will need to be accelerated. The role of national research institutions as also of industrial enterprises would be critical, and research programmes will need to concentrate not only on areas of priority, but also on blending new technologies with traditional processes. Finally, an essential element would be to undertake regular technology assessment and forecasting, to assess new technological trends and their implications for national economies and examine alternative remedial measures. Technology planning in the 1990s would inevitably be a very dynamic and continuing process, which will need to be undertaken in developing economies at various stages and levels of industrial and technological growth.

Human resource development

With rapid changes in the demand for new products and processes, the requirements of technical personnel must be reviewed, and education and training programmes reoriented to meet changing needs. With new technological applications, new categories of technical personnel will need to be trained such as computer engineers, technicians and operators, systems designers and specialists in microelectronics, microbiologists and researchers in biotechnology; energy specialists and other such categories, the demand for which will multiply as the usage of new technologies increases in these countries. The demand for new categories of skilled and semi-skilled personnel must be effectively met and this would necessitate considerable

reorientation in technical education facilities. A greatly-expanded technical education and training programme may face obvious resource constraints in several countries but must be considered an essential prerequisite. Such training programmes should be related to projected requirements of personnel in various specialized categories, both by governmental agencies and by the private sector. Specialized training programmes are also necessary for development of entrepreneurial and management capability in developing countries. Management technology is emerging as a major new field, and absorption and adaptation of latest management techniques is essential, as in the use of automated office equipment, and in the co-ordination of flexible manufacturing techniques, just-in-time production operations, and achievement of optimum production standards.

Technological information

The importance of access to technological information cannot be over-emphasized in a period characterized as an information revolution. Firstly, information must be collected and analyzed with respect to new technological trends in sectors of special interest in particular countries. Secondly, institutions and enterprises in developing countries and institutions should have knowledge regarding alternative technologies and sources in various fields, together with experience of operations of such technologies. The international technology market is highly imperfect and, for most standard technologies, several alternative sources can be identified. Even with respect to certain categories of new technologies, such as production of computers and peripheral equipment, technology can be obtained from several alternative sources and information on such sources would be valuable for negotiations and acquisition of such technologies. A national technology information system should be developed for priority sectors, which would have linkages with external databases and sources for information on alternative technologies. Information on technology costs and contractual conditions are more difficult to obtain. One valuable source is the Technology Information Exchange System (TIES), which is operated by United Nations Industrial Development Organization (UNIDO), Vienna, and which can provide very useful information on costs and contractual aspects of industrial technologies to countries participating in this programme.

Technology service capability

It is necessary to develop increased capability for various technological services in developing countries. Such services range from macro-level industrial planning to micro-level project feasibility, plant specifications, engineering and plant design, civil construction, machinery installation and plant commissioning, start-up and operation. There is considerable inadequacy in several developing countries with respect to national consulting engineering capability, particularly plant designs and engineering. It is necessary to identify the gaps in technological service capability for each country and for priority sectors in each economy. The development of national consultancy firms to perform such functions requires that such firms be given special incentives and preferential treatment. Norms and guidelines should be determined regarding the preferred use of nationally-owned consultancy firms and organizations.

Foreign direct investment and technology inflow

An essential objective of technology planning should be to ensure adequate inflow of foreign technology in various priority sectors. With the close relationship between foreign investments and technology inflow in certain fields, particularly those involving new technological developments, policies on foreign investment also assume considerable relevance since it is possible that such inflow may only take place through TNC subsidiaries or foreign-controlled affiliates or through joint ventures with minority foreign holdings. While there has been much greater reconciliation of interests between TNCs and host developing countries in various sectors during the 1980s than in the previous two decades, the need for increased technology flows may necessitate varying degrees of review of policies on FDI and the exercise of greater flexibility in this regard by host countries.

With increased specialization, including in the use of new technologies, TNCs undoubtedly provide an important source of both mature and new technologies. A greater number of alternative technological sources are also generally available for more established technologies, where patent validity has expired. While there may be considerable proprietary technology or trade secrets involved in particular products and processes in established and mature technologies, the terms and conditions with respect to such technologies are generally known and negotiations can take place within a fairly well-defined framework. In the case of new technologies, particularly microelectronics and biotechnology, the terms may, however, prove more difficult to negotiate. Unlike well-established manufacturing or resource-based industries, there are less factor advantages in knowledge-based and research-based new technologies, except cheap labour and local markets. The advantage of cheap labour in most developing countries has also become greatly reduced because of increased automation. It may be necessary for host developing countries to adjust their policies on foreign investment and technology to ensure that effective TNC technological participation does take place in one or other form, ranging from TNC subsidiaries and affiliates to non-affiliate licensing. In certain technologies, the insistence on foreign minority holdings may need to be relaxed, in the interests of inflow of essential technologies. In cases of minority foreign holdings, it may be necessary to provide for measures to protect foreign investors. At the same time, even for new technologies, the number of alternative sources is increasingly rapidly and, despite a high degree of product differentiation by major foreign manufacturers, it should be possible to identify foreign companies for financial and technological participation on terms acceptable to host developing countries.

The issue of technology choice also assumes considerable importance in this context. With a growing range of technological alternatives, appropriate technology choice has become increasingly complex. The suitability of particular technology must be judged in relation to the objectives and factor conditions in the country where it is utilized. The use of computer-aided designs for ready-made garments for exports to industrialized countries may be quite appropriate, even in countries with relatively cheap labour as it enables quick and flexible response to changing demand. Similarly, numerically-controlled machine tools, or even robots, may be quite essential in developing countries for production of parts and components which require a high degree of accuracy and precision. At the same time, technology choice

should also be linked to available local materials and skills, as far as possible, since latest production techniques can depend heavily on continuing imports of components and processed materials. While technology choice may be of little relevance in the case of TNC investments, which would normally use the technology available from the parent corporation, nationally-owned enterprises should search for suitable technology partners from various alternative sources that may be available.

With the need for increased technology inflow, it is necessary for developing countries to review the institutional arrangements for screening foreign technology contracts and the guidelines on contractual terms and conditions where such guidelines have been prescribed. As pointed out in the second chapter, existing trends in technology policies are towards greater liberalization and flexibility in several countries where such reviewing procedures and guidelines were set up during the 1970s. The trend is likely to be further accentuated in most other developing countries, particularly in the context of new technologies where contracts may otherwise be more difficult to negotiate. This is largely because of the increased privatization with respect to new technologies through intellectual property rights, particularly patents and proprietary knowhow in microelectronics and biotechnology, and copyrights on new computer software. The situation on industrial property rights in new technologies is still in the process of evolution and the interests of developing countries may also need to be safeguarded both through national legislation on patents and copyrights, and through appropriate revision of international conventions and agreements in this regard.

It is likely that in developing countries where institutions have been set up to review technology contracts, these will continue. Their role, as also the guidelines under which they function are, however, likely to become increasingly flexible and pragmatic, and negotiations will be largely left to the enterprises concerned. This will be particularly necessary in the case of new technologies. For example, royalty rates in contracts involving microelectronics technologies may be higher than the traditional percentage of net sales that is usually provided for supply of mature technologies to developing countries. With respect to other terms and conditions also, such as duration, warranty, access to improvements, export rights, tie-in conditions, training, governing law, settlement of disputes, etc, norms and guidelines on contractual provisions relating to new technologies will need to be more flexible, partly owing to the nature of new technologies and partly because their implications are often difficult to assess.

It is important that the role and functions of technology regulation agencies, where these are set up, or continue to exist, is clearly defined in relation to technology inflow. In place of a regulatory and restrictive approach, a promotional approach may be necessary on the part of such organizations and such technology as is essential for a country's development, should be encouraged for acquisition and absorption. While licensee enterprises in developing countries should not be exploited through unfair or restrictive agreements, it is important to secure a proper balance between the need for foreign technology inflow, and flexible norms and guidelines which would safeguard the basic interests of recipient countries and their licensee enterprises.

Absorption and adaptation

Technological absorption and adaptation has to be conducted at two levels, firstly, in the production facilities and secondly, in the specialized research institutions at national or regional levels. There must be close co-operation and realtionship betwen the two. It is particularly necessary for national research institutions to shift their emphasis to applied research and to new technological applications, specially technology blending in sectors of priority in particular countries.

Policies on new and emerging technologies

The import of new technologies, particularly microelectronics, new materials and biotechnology, is likely to be very far-reaching for most economies and requires to be specifically considered and assessed. Firstly, with reduced demand for minerals and traditional exports of non-processed or semi-processed commodities, alternative export products will need to be identified or imports suitably scaled down. Since the latter may not be possible beyond a certain extent in most developing economies, increased non-traditional exports of goods and services will become essential for most of these economies. The extent to which foreign investments or transfer of new technologies can bring this about is difficult to determine and has to be assessed on a case by case basis. There are, however, several instances where this has already been achieved as in textiles, garments, shoes, electronic components, engineering goods, and for several services, and the range of such products and services can be substantially expanded.

The impact of new technologies on production processes would obviously vary from country to country. In countries where a fairly substantial level of industrial growth has been achieved, such as Argentina, Brazil, India, and Mexico, apart from the rapidly expanding South-East Asian economies of Singapore, Hong Kong, Taiwan Province, the Republic of Korea, Malaysia and Thailand, it would be necessary to upgrade technological processes and products through the introduction and adaptation of new technologies, particularly microelectronics. This may require major adjustments in sectoral growth patterns and new investments on technology and equipment, without which existing production processes and products may become increasingly obsolescent. This would be particularly true with respect to a wide range of machinery and equipment produced in developing countries. Such equipment may continue to be utilized in local markets and in other developing countries, but these machinery products may not find adequate demand in international markets where products based on new technologies are being increasingly used. In these countries, therefore, there is urgent need for additional inflow of new technologies and processes and blending of such techniques with existing production processes. This may necessitate new inflow of technology and the acquisition and absorption of such technologies in different fields. In the case of less-industrialized developing countries, new industrial investments and technology transfer arrangements should take into account the various technological developments that are relevant to particular subsectors and products. In a few instances, technological leap-frogging may be easier in some of these countries. In petroleum-exporting countries, for example, increased automation and the use of latest technologies may not present the difficulties that would be faced in countries where major technological changes in existing industry may be necessary.

At the global level, the impact of new technologies will undoubtedly present difficult problems of adjustment for developing countries to global competitive conditions. The advantage of cheap labour will be greatly reduced in future years. The rapid technological changes required in each sector may also call for greater financial resilience and flexibility than is often available with developing-country enterprises. TNC subsidiaries and affiliates would be in a more advantageous position in this regard, since their operations, following those of parent corporations, may be more adjusted to technological change.

The role of national governments in bringing about structural technological changes in industry would be significant in most developing countries. Apart from policies on TNC investments and transfer of technology, which need to be more flexible and adjusted to rapidly changing conditions, national authorities can directly assist the process of technological change through procurement policies and incentives and subsidies for various activities such as retraining of personnel, enterprise-level research in technology blending, and other aspects of technological absorption and adaptation.

Technological changes would also necessitate changes in the organizational structure of industrial enterprises in most developing countries. The industrial success of certain South-East Asian countries has been, in substantial measure, due to adjustments in organization and management of industrial operations. Irrespective of the overall form of management, several aspects of industrial organization and management would require much greater attention on the part of policy planners and institutions in these countries.

Technology assessment and forecasting

It is of growing importance, at the national level, to assess and forecast the impact of new technological developments on national economies. This is a field of increasing complexity because of the rapid pace of technological change. The monitoring of technological change is also of major importance in developing countries and must be considered an integral aspect of national technology planning. It is only through assessment and forecasting that the implications of technological change can be effectively monitored and dealt with, whether these relate to impact on raw material exports or on production and exports of manufactured goods or specific measures required by way of policy guidelines and promotional incentives or legislative and administrative measures.

Technology assessment is receiving a great deal of attention in several industrialized countries. In the United States, the Office of Technology Assessment (OTA) periodically reviews the implications of new technological developments, together with the National Science Foundation and several other bodies and organziations. A number of studies have also been conducted by private bodies such as Batelle, Stanford Research Institute (SRI), Rand Corporation and by industry associations and consultancy bodies. In West Europe, the EEC has initiated a regional programme for Forecasting and Assessment of Science and Technology (FAST), while joint high-technology research is being undertaken through the EUREKA (European Research Coordination Agency) and ESPRIT (European Strategic Program R+D in Information Technologies) programmes, covering microelectronics and informatics, robotics,

new materials, marine technologies and environmental protection. At national level, technology assessment in West European countries is being done both by governmental agencies and departments or by universities and non-governmental bodies. In Japan, certain special bodies have been created such as the Science and Technology Authority, the Industrial Technology Council, and the Council of Science and Technology. In the centrally-planned socialist economies in Eastern Europe also, the concept of technology assessment is being given considerable emphasis, particularly in electronics, automation, nuclear energy, and new materials.

For developing countries, technology assessment, monitoring and forecasting could provide valuable inputs for technology planning and management. Such assessment should be made with respect to the potential of alternative technologies in meeting objectives and priorities. It may be necessary to define specific goals regarding the expansion of the scientific and technological base and of applied research capability to bring about increased adaptive and innovative applications in each economy. Since technological innovations will inevitably result in major transformation in several manfucturing and service sectors, the nature and impact of such innovations must be assessed and their application extended and adapted to the requirements of developing economies. Technology assessment at national level should also provide an evaluation of different patterns for technological development in terms of strategies for effective utilization, absorption and adaptation of alternative technologies in specific fields. These should be directly related to the process of development and to the socio-economic objectives and priorities in particular countries. Despite inadequacies in information systems and data availability in most developing countries, technology assessment and forecasting can serve as a valuable tool for integrated technology planning and management.

The experience of technology assessment and forecasting in certain developing countries has been very valuable. In the Republic of Korea, the Korean Institute of Science and Technology (KIST), as also the Advanced Institute (KAIST) undertook extensive studies to identify strategic or "champion" technologies. Malaysia utilizes technology assessment in its economic planning process. Varying degrees of technology assessment and forecasting are also implicit in the economic planning process of several developing countries such as Brazil, China, India, Indonesia and others; particularly with respect to high-technology sectors as microelectronics and biotechnology. More extensive use of the mechanisms for technology assessment is, however, necessary. It is also important that technology assessment studies are not limited to governmental departments and agencies in their particular spheres. A fairly detailed assessment should be made, at interdisciplinary level, of the impact and trends of technological developments, and what implications and potential these may have on each developing country. Such assessment should be viewed as a continuing process and involves constant monitoring and updating of technological trends and developments.

The appropriate mechanism for technology assessment may differ from country to country but the basic objective of assessing and forecasting new technological developments and their impact on the respective national economy is of vital importance and should be effectively achieved and acted upon, in these countries, as also at regional and subregional levels.

Technology blending

Several reference have been made in this study to the concept of integration, or blending, of new technologies in traditional sectors and processes. It is obvious that various technologies will have to co-exist. At the same time, innovative applications will need to be extended at all levels, from large industrial enterprises to small rural communities. The concept of technology blending is important for the management of technological pluralism and involves varying levels of integration of new technologies with traditional economic activities. The basic rationale for technology blending is that, through applications of microelectronics, biotechnology and other new technological deelopments, traditional products, processes and techniques can be substantially upgraded, and their productivity and efficiency significantly increased. In developing countries, in particular, the introduction of new technologies that are integrated with traditional products and processes may have better prospects for local absorption, adaptation and innovation than entirely new technologies, which may not only have a negative impact in terms of employment but also provide less opportunity for local absorption and adaptation.

Research and development

The development of applied research capability must also be given greater emphasis in developing countries. The very large outlays on research in new and emerging technologies in developed countries through governmental allocations and by the production sector cannot be emulated in most developing countries. What is, however, possible is to link endogenous research to local technological applications through blending, as also to concentrate on technological developments directly related to local needs such as tissue culture, biomass energy and other such fields. It is also necessary to provide major incentives for enterprise-level research, including by TNC affiliates, in new technologies and applications.

Comprehensive technology policy framework

It is necessary to develop a comprehensive policy framework on technology, dealing with various aspects, extending from assessment of global trends to the development of national capability for production, research and technological adaptation and innovation. This may not always be practicable in certain developing countries. Nevertheless, the critical role of technological development must be defined within the broader framework of a country's development goals and priorities. This should then be related to specific policy options and the formulation of programmes for development of necessary capability in research, adaptation and production in different sectors. A suitable policy framework has to be structured within basic development strategies, including those of export promotion or import substitution or an effective mix of the two. It has also to be related to overall perspectives and policies on foreign direct investment and the role of TNCs and their affiliates in developing countries. It is obvious, however, that technological infrastructure will need to be significantly developed and that the potential for specific applications of different technologies is assessed and determined, both in priority production sectors and to meet the requirements of rural regions and small-scale production activities.

International technological co-operation

International programmes designed to promote technological growth in developing countries can take various forms of inter-country co-operation between developing and developed countries and among developing countries. Such co-operation can range from greater exchange of information, experience and assessment regarding alternative technologies to commercial arrangements for equity participation and increased technology transfer between institutions and enterprises in different countries.

It is necessary that South-South co-operation should be maximized with respect to technology exchange and transfer. This may necessitate the development of an effective information network and linkages between developing countries. Information on country experiences need to be pooled, with a view to assess the potential, as also the problems and hazards posed by various technological processes. Closer linkages also need to be established between universities and research institutions in developing countries with respect to technological research and applications. Although such linkages are increasing, these are still very inadequate, particularly in the context of new information technologies. Measures for receiving, storing and disseminating scientific and technological information in developing countries need to be substantially improved. There is also substantial scope for increased commercial relationships between production enterprises in developing countries through technology transfer contracts. While such relationships would be largely determined at enterprise level, governmental agencies in developing countries can significantly assist in this process by defining norms and guidelines for technology transfer and development among these countries, in accordance with changing needs and priorities.

The role of UNIDO with respect to technological development may also need to be substantially enhanced and strengthened so that its activities can be more catalytic for the development of national capability in this field. So far, UNIDO has concentrated on the broader aspects of technology development and transfer, including the implications of new technologies in various sectors. Technical assistance programmes of UNIDO with respect to technology policy and technological advisory services may, however, need to be expanded at national and regional levels.