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Thailand's Manufacturing Competitiveness:
Promoting Technology, Productivity and Linkages

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THAILAND'S MANUFACTURING COMPETITIVENESS: Promoting Technology, Productivity and Linkages

by

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FOREWORD

The financial crisis sparked by the flotation of the Thai Baht in July 1997 quickly spilled over to the real economy, where it exacerbated severe structural deficiencies. The manufacturing sector contributing, at that time, nearly one-third to the creation of domestic wealth was particularly hard hit.

The escalating crisis took most observers and policy-makers by surprise. Indeed, Thailand had enjoyed decades of robust, and seemingly sustainable, economic expansion: GDP had grown between 1987 and 1995 at an annual compound rate of 9.1 percent, fuelled by successful forays of Thai goods into international markets. Inflation was moderate, the exchange rate of the domestic currency was remarkably stable, public finances enjoyed a comfortable surplus, foreign reserves were accumulating, standards of living appeared set on a steady rise, and Thailand was hailed as an example of a developing economy successfully managing its integration into the global marketplace.

Warning signals, such as a burgeoning current account deficit went unheeded in the overall euphoria, as foreign funds appeared more than eager to flow in and obliterate what could easily be taken for a temporary, cyclical downturn of foreign trade. In 1996 however, exports of manufactures (accounting for about 80 percent of total exports) ground to a halt. Between 1985 and 1995, manufacture exports had soared by a staggering 23.9 percent per annum, on average. From 1995 to 1996, the growth rate had collapsed to 0.2 percent, before turning to a negative 1.9 percent between (last semester) 1996 and (first semester) 1997.

The financial crisis highlighted severe structural deficiencies in the economy, in particular in the manufacturing sector. Thailand's manufacturing industry is made of a few large companies, created under the import-substitution regime that prevailed until the early 80s—in effect cashing in a rent afforded by a cosy relationship with public sector and local banks—and a multitude of small firms with basic technology and limited access to capital. This state of affairs left little room for much-needed technological deepening to keep pace with regional and international shifts in best practice frontiers.

In an effort to stem the contraction of the manufacturing sector, the Government unveiled in 1998 an ambitious Industrial Restructuring Plan (IRP) built on the premises that, since exports of manufactures had driven economic growth prior to the crisis, a prompt recovery required the restructuring of export-oriented industries. Thirteen such industries were identified and diagnosed, and an array of eight programmes was designed to correct observed constraints and set the sector on the path to sustainable growth.

Some of the overriding objectives of the IRP were: (i) upgraded technologies and increasingly sophisticated product lines; (ii) greater productive efficiency, thanks to improved processes and stronger management capabilities; (iii) a better-trained workforce, conducive to the technological deepening of the domestic industry, and (iv) stronger internal linkages and strategic alliances with external partners.

At the same time, the Thai Government initiated research on an early-warning system that would help foresee—and possibly defuse—impending crises. The National Economic and Social Development Board together with the Ministry of Finance and the Bank of Thailand reviewed alternative specifications of leading indicators, analysed their respective merits in anticipating economic downturns, and designed a composite indicator tracking essentially macro-economic variables and monetary indices.

A similar exercise was undertaken by the Office of Industrial Economics (Ministry of Industry) and UNIDO, focussing this time on "real"—as opposed to financial and monetary—aspects of growth, with emphasis on the manufacturing industry. The project *Tracking Manufacturing Performance: Towards an Early-Warning System of the Real Economy* was launched in June 2000; it set to circumscribe measurable indicators that either individually, or as a composite variable, can help anticipate turning points in domestic business cycles.

The approach was derived from that pioneered in the 70s by the National Board of Economic Research in the US, but customized to reflect data availability constraints in Thailand. The coincident indicator was taken as the Manufacturing Production Index, and short-term early-warning properties were shown in such variables as imports of intermediate products and raw materials, exports of manufactures, real effective exchange rates, domestic wholesales of manufactured goods and net flows of foreign direct investment (see P. Tinakorn & P. Charoenporn, 2001 for details, or the consolidated report of S. Tambunlertchai, 2002).

However, the basic phenomena that together shape industrial growth typically exhibit long-term maturities: in its analysis of the determinants of technological capabilities, UNIDO's *Industrial Development Report 2002/2003* highlights the importance of learning and innovation, and the particular forms of industrial organization that bolster these clearly long-term processes.

The present paper contributes to the design of an early-warning system for Thailand by adopting the long-term perspective of structural issues such as the composition of industrial output and manufactured exports, underlying productivity fundamentals in relation to skills and wages, industrial linkages, and the institutional infrastructure for technology development. The research combines the analysis of time-series in Thailand as well as, whenever warranted, international comparisons of performance in a spectrum of industry-related variables. It concludes with a set of recommendations to the policy-maker in the form of *"earlier"* warning signals, or indicators tagged to relatively slow processes of resource accumulation which ought to be closely monitored, for they bear the ferments of long-term industrial progress.

CHAPTER I:

Introduction

Thailand's manufactured exports grew by 38 per cent per year in the second half of the 1980s, and 23 per cent per year in the first half of the 1990s, but then failed to register any growth in 1996, at least one year before the East Asian crisis. This sent shock waves to policy makers of one of Asia's most export-oriented countries, where exports accounted for around 60 per cent of GDP. All aspects of the competitiveness of the Thai manufacturing sector came under scrutiny, including macroeconomic factors such as the appreciating domestic currency, rising labour costs, industrial structure, business environment, technological capabilities of Thai firms, adequacy of the physical infrastructure, adequacy of industrial skills, and impact of the government technology infrastructure. The 1997-98 financial crisis added momentum to the search for factors responsible for the alleged loss of competitiveness of Thai industry, and encompassed corruption, the operation of financial institutions, and corporate governance.

Manufacturing competitiveness indeed depends on a host of factors, such as the ones just mentioned. The government took several initiatives to improve the country's competitive environment. These included bringing forward the implementation of the 0-5 per cent import tariff ceiling of the ASEAN Free Trade Agreement (AFTA) by one year to 1 January 2002 to spur competition and enlarge the regional market, the abolition of local content requirements in the auto industry in 2000, two years ahead of the WTO deadline, launching the public-private Industrial Restructuring Plan (IRP) 1998-2004, reorganizing and redefining the missions of several departments of the Ministry of Industry and the Ministry of Science and Technology, and setting up new autonomous technology institutes in key industries, including food, textile, electronics, auto, and metal and machinery.

As a further sign of its commitment to spur manufacturing competitiveness, the government initiated a series of collaborative programmes with international and bilateral agencies. Thus, in collaboration with the World Bank, it launched a Country Development Partnership for Competitiveness Programme (CDPCP) in 2000, targeting five key areas: (i) macroeconomic stability, including inflation control, public debt management and improved tax collection; (ii) financial reforms and corporate restructuring, including bankruptcy laws and mergers; (iii) improving the knowledge base, including education and training, information technology, and science and technology capability; (iv) regulatory framework for private sector involvement in physical infrastructure and in state-owned enterprises; and (v) business environment, including corporate governance, competition laws and trade and investment reforms. In addition to this ambitious agenda, the government is spending considerable effort and resources to promote small and medium scale enterprises, in collaboration with the Japanese Export and Trade Organization (JETRO), the Asian Development Bank, the World

Bank and other bi-lateral and multi-lateral agencies. Finally, wage policy and labour competitiveness were investigated in collaboration with ILO in 1999.

Given the wide-ranging efforts currently underway, this UNIDO study focuses on three key areas where the Ministry of Industry can play a catalytic and facilitating role for the private sector. These are in promoting productivity, industrial linkages and technology development in industrial firms. The study makes use of previously unpublished data of the latest 1997 manufacturing census and the 1998 manufacturing survey, which it hopes can contribute to the current policy formulation in the above key areas.

The premise of the paper is that Thailand wishes to continue its industrialization drive in order to generate additional industrial employment and incomes, and to raise general living standards through linkages with other sectors, particularly agriculture and services. This is stated at the outset to counter the alternative view that Thailand does not necessarily have to compete in the manufacturing arena, and that it can specialize in the production of agricultural commodities and in tourism, where it has a definite comparative advantage in relation to emerging industrial exporters such as China.

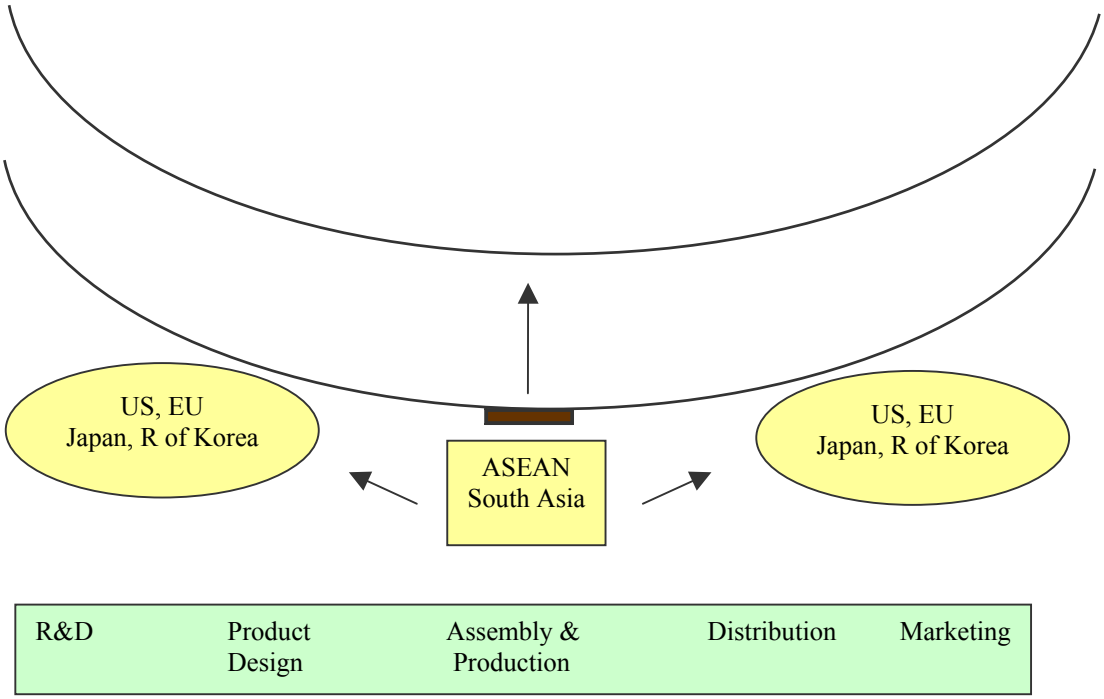
Michael Porter defines competitive advantage as follows:

> "There are two basic types of competitive advantage: lower cost and product differentiation. Lower cost is the ability of a firm to design, produce and market a comparable product more efficiently than its competitor. At prices at or near competitors, lower cost translates into superior returns. … Differentiation is the ability to provide unique and superior value to the buyer in terms of product quality, special features, or after-sale service. … Differentiation allows a firm to command a premium price, which leads to superior profitability provided costs are comparable to those of competitors. …Competitive advantage of either type translates into higher productivity than that of competitors. The low-cost firm produces a given output using fewer inputs than competitors require. The differentiated firm achieve higher revenues per unit than competitors." (Porter, 1990:37).

> "Pure cost advantages are frequently less sustainable than differentiation. One reason is that any new source of lower costs, even one less sophisticated, can nullify a firm's cost advantage. If labour is cheap enough, for example, even much higher efficiency can be nullified, unlike the case with differentiation advantages which normally must be matched to be exceeded. In addition, pure cost advantages are more vulnerable because new product designs or other forms of differentiation can eliminate a cost advantage in delivering the old ones." (Porter, 1990:50).

Figure 1 illustrates the above by plotting value-added per employee on the vertical axis, and by plotting on the horizontal axis various activities starting from research and development, product design, assembly and production, distribution, and finally marketing. For any particular product, the highest value-added per employee is achieved by undertaking R&D and marketing, usually in order to produce and sell differentiated products. It is lowest at the assembly and production stages, or manufacturing proper, where the emphasis is on productive efficiency and producing at costs that are lower than competitors. In other words, higher value-added per employee can be achieved by moving left and right along the curve. Nevertheless, value-added per employee can be increased even in manufacturing proper by manufacturing technologically more advanced products, where the number of competitors is still limited, i.e., by shifting to a higher production curve. To achieve such a capability must also require firms to engage in several forms of technology development, including process development, product specification and design, and reverse engineering.

Figure 1 Value Chain (Value-Added per Employee)



Porter distinguishes four broad determinants of national competitive advantage: factor conditions such as skilled labour and infrastructure, home demand conditions, supplier and related industries that are internationally competitive and firm strategy, structure and rivalry. These four attributes are mutually reinforcing (Porter, 1990:71):

> "Sophisticated buyers will not translate into advanced products unless, for example, the quality of human resources is sufficient to act on meeting buyer needs. Selective factor disadvantages will not motivate innovation unless rivalry is healthy and company goals support sustained investment. At the broadest level, weaknesses in any one determinant will constrain an industry's potential for advancement and upgrading." (Porter, 1990:129). "… Sustained competitive advantage in an industry grows out of the self-reinforcing interplay of advantages in several areas, creating an environment which is difficult for foreign competitors to replicate." (Porter, 1990:131). "… A consequence of the system of determinants is that a nation's competitive industries are not spread evenly through the economy but are connected in what I term *clusters* consisting of industries related by links to various kinds." (Porter, 1990:131). "… The influence and reinforcement of the determinants leads to the phenomenon of clustering, and to the prevalence and importance of geographic concentration." (Porter, 1990:174).
>
> "At its core, the system of determinants of national competitive advantage I have described is a theory of investment and innovation." (Porter, 1990:173). "… Gaining advantage in the first place requires a new approach to competing, whether it is perceiving and then exploiting a factor advantage, discovering an underserved segment, creating new product features, or changing the process by which a product is made. Sustaining advantage requires still further improvement and innovation to broaden and upgrade the sources of competitive advantage through advancing the product, the production process, marketing methods, and service." (Porter, 1990:173).

The government's role in national competitive advantage is in influencing (and be influenced by) the four determinants (p.127):

> "Government has an important influence on national competitive advantage, though its role is inevitably *partial*. Government policy will fail if it remains the only source of national competitive advantage. Successful policies work in those industries where underlying determinants of national advantage are present and where government reinforces them. Government, it seems, can hasten or raise the odds of gaining competitive advantage (and vice versa) but lacks the power to create advantage itself." (Porter, 1990:128).

As noted earlier, the government has taken several initiatives to improve the competitive environment under which Thai firms operate, especially those concerning the legal framework and trade policy. However, most of these have been directed at principally one determinant of national competitive advantage, namely competition and healthy firm rivalry. This study focuses on two other determinants of national competitive advantage, namely factors conditions and supplier and related industries. The final determinant, home demand conditions, is outside the scope of this study.

The outline of the study is as follows. Following a brief survey of recent developments in Thai manufacturing and foreign trade in section two, section three discusses the improvement of factors of production and productivity, while section four takes up the challenges of promoting linkages and supplier industries. Section five addresses the 'core' of the system of determinants, namely innovation and the industrial technology development system. The final section six offers conclusions and draws policy implications. It recognizes the government's influence on competitive advantage, but as facilitator in gaining advantage, not as a creator or the only source of competitive advantage itself.

A statistical annex is provided at the end of the document. Additional information such as a description of Thailand's Industrial Restructuring Plan 1998-2004, a list of studies commissioned by the Board of Investment, and an expanded list of bibliographical references on the subject of manufacturing competitiveness in Thailand can be obtained from the authors (sdhanani.unido@undp.org; pscholtes@unido.org).

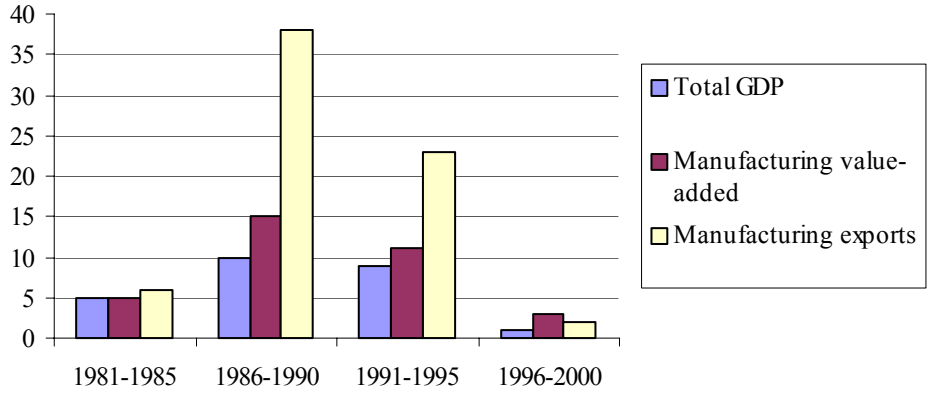
CHAPTER II:

Overall Industry and Trade Developments

A. Manufacturing Value-added and Exports

The growth rate of manufacturing value-added accelerated from 5 to 15 per cent per year between the first and second half of the 1980s, and continued to grow rapidly by 11 per cent per year in the first half of the 1990s (Figure 2). This was due primarily to the growth of manufacturing exports, which surged from 6 to 38 per cent year between 1980-85 and 1985-90, and which continued to grow by 23 per cent per year during 1990-95. As a result, manufacturing's contribution to overall GDP increased rapidly, from 23 to 31 per cent between 1980 and 1995. This performance came to an abrupt halt in 1996, when manufacturing exports declined for the first time (Figure 3). In the period 1996-2000, manufacturing value-added and exports grew by an average of just 3 and 2 per cent per year.

Figure 2 Manufacturing Performance, 1981-2000, (Average annual growth rates)



Source: Economic & Financial Statistics, BOT (tables 44 & 84)

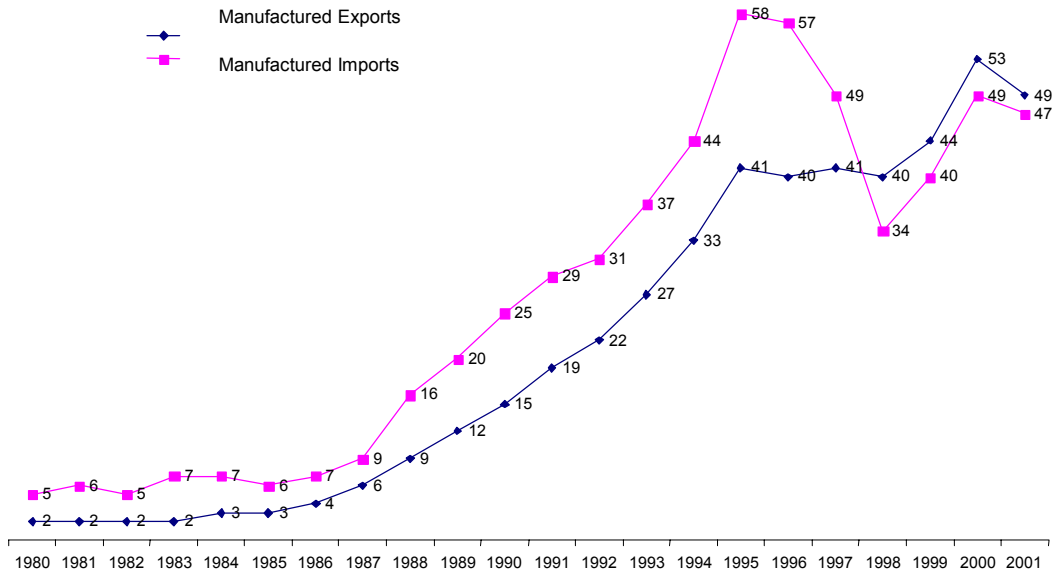
Manufacturing exports continued to stagnate in the following two years 1997 and 1998, before growing again in 1999 and 2000 by respectively 10 and 20 per cent, due to the information technology investment boom in the US, and the demand for electronics. Exports declined by 7 per cent in 2001, when this boom came to an end.

B. Trade Balance and Net Exports

Trade balance

Despite its impressive performance, the Thai manufacturing sector did not generate net foreign exchange earnings throughout the sixteen-year period 1980-1996 before the crisis. Thailand experienced a persistent deficit in the balance of trade of manufactured goods throughout this period. From a relatively stable US$ 3 billion deficit per year in the period of slow manufacturing growth of 1980-1987, the gap widened rapidly to around US$ 7 billion in 1988, which saw the beginning of rapid growth, and to US$ 10-11 billion during 1990-94 (Figure 3). In the last two years of rapid growth before the financial crisis, this deficit increased further to US$ 17-18 billion per year in 1995 and 1996.

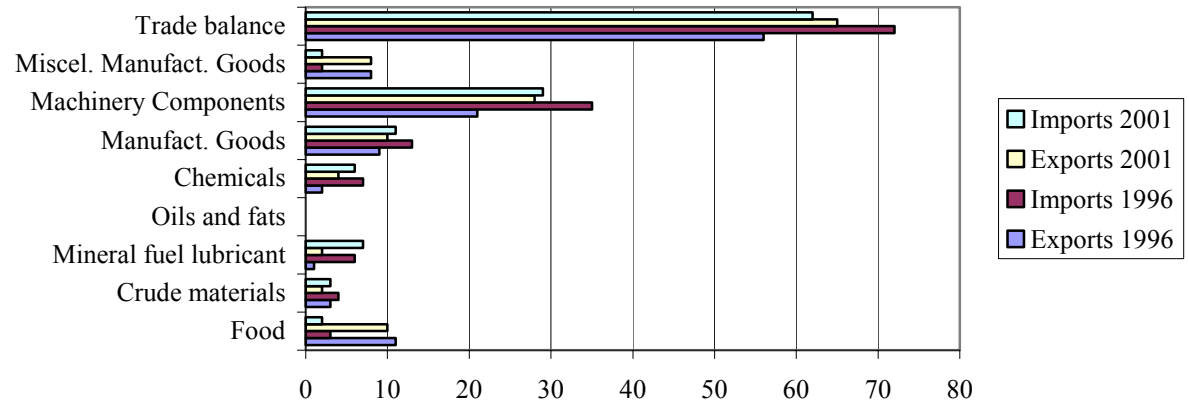
Figure 3 Manufactured Exports and Imports, 1980 – 2000 (US$ billion/year)



Source: Same as Table 4 (Table 44, categories 7-10, harmonized code) based on Customs Department

The deficit in manufacturing goods was a large component of the country's recurrent overall trade balance, amounting to US$ 16 billion in 1996, and its current account deficit (Figure 4). Only food and crude materials posted a surplus. Chemicals and manufacturing goods both displayed deficits; the machinery and component category displayed the largest gap between exports and imports or around US$ 14 billion. The nature of Thailand's rapid industrialization, with its heavy and persistent reliance on imported capital goods, intermediate inputs and technology, was a major contributor to the widening trade deficit in manufactured goods, in overall exports and in the current account.

Figure 4 Trade Balance by SITC categories, 1996 and 2001 (US$ billion per year)



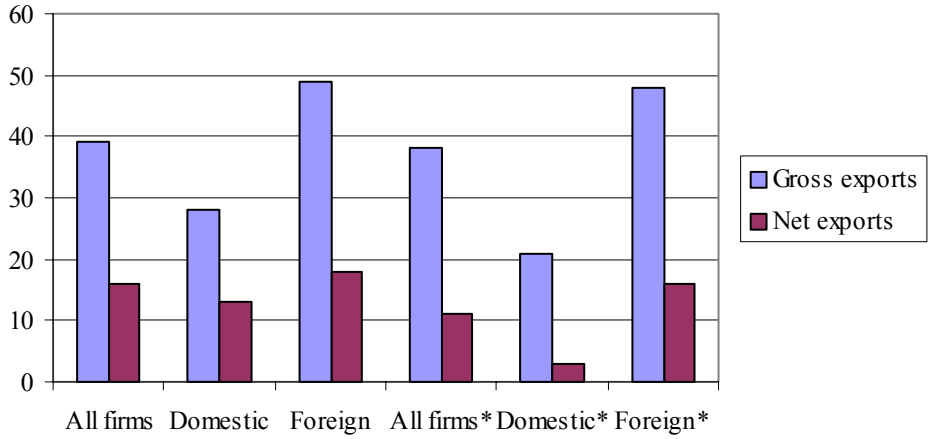
Source: Economic & Financial Statistics June 2001 (Table 44), Bank of Thailand
(Based on data from Customs Department)

The current account deficit in the pre-crisis period was offset by substantial capital account surpluses accruing from external borrowing and private investment inflows, amounting to some US$ 20 billion per year in 1995 and 1996. Also, after the onset of the crisis in the years 1998-2000, the current account deficit was transformed into a sizeable surplus due to the sharp collapse of imports. However, this surplus all but disappeared by 2001. There is reason to believe that the deficit in manufactures will reoccur as Thailand emerges from the crisis, and as firms increase investment and production, thereby resuming large-scale imports of capital goods and components. The major difference between the pre- and post-crisis period will be as a result of the severely constrained prospects for public and private capital inflows, and much reduced inflow of foreign direct investment. Thus, in contrast to the pre-crisis situation, the country's future growth pattern may exhibit significant balance of payments deficits, unless the import-dependent pattern of industrialization is seriously addressed.

Gross and net exports

According to the 1997 census of manufacturing industries, the manufacturing sector exported nearly 40 of its total production (Figure 5a and Table 1). However, as noted, this sector relied to a large extent on imported intermediate inputs. So the net export intensity was just 16 per cent, a proportion declining to just over 10 per cent if the resource-based food and rubber products are excluded. Foreign firms produced about two thirds of total manufactured exports, while domestic firms accounted for the remaining third. Excluding food and rubber products, foreign firms accounted for nearly 80 per cent of total exports. These figures suggest that policy makers and analysts should pay as much attention to trends in gross exports as to trends in net exports.

Figure 5 Gross and Net Exports, 1996 (Per cent of Gross Output)



Source: Census of Manufacturing Industries 1998, NSO
Note: *Excluding food and rubber

In fact, if the import of capital equipment used in the production of manufacturing goods is included, the manufacturing sector as a whole was a net user of foreign exchange. An export-oriented strategy, which is overly reliant on industrialization based on increasing volumes of imported inputs, equipment and technology, is likely sooner or later to impose serious pressure on the balance of payments.

Table 1 Gross and Net Export Intensity of Manufacturing Sector, 1996

	Domestic		Foreign		All Firms	
	Gross	Net	Gross	Net	Gross	Net
All Manufacturing						
Baht billion	411	198	884	332	1,295	530
Per cent of gross output	27.8	13.4	48.7	18.3	39.3	16.1
Per cent share	31.7	37.3	68.3	62.7	100.0	100.0
Excluding food & rubber						
Baht billion	206	33	771	251	977	284
Per cent of gross output	20.8	3.3	48.2	15.7	37.7	11.0
Per cent share	21.1	11.7	78.9	88.3	100.0	100.0

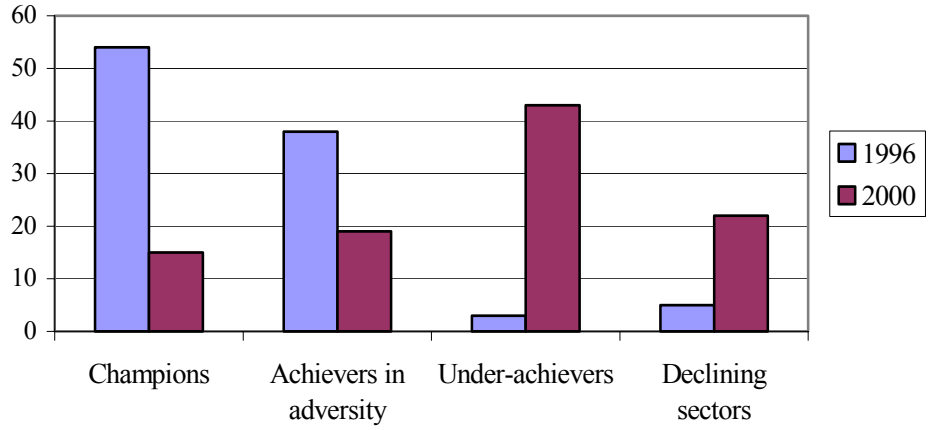
Source: Census of Manufacturing Industries 1997, National Statistical Office (special tabulations produced by the Office of Industrial Economics, Ministry of Industry). See Annex Table A.1.

C. Export Market Positioning and Diversification

Market positioning

Market positioning shows how a country's exports are placed for growth in the world markets. It relates product-level market shares to the dynamism of exported products in world trade. A country is considered competitive in products in which it is increasing its world market share, and an export product is considered dynamic in world trade if it is growing faster than the average for all products. Ideally, the highest share of exports should be in the 'champion' category, where the country gains market share in fast-growing products. The majority of Thailand's exports were in this category in 1996 (54 per cent), but this share fell to 15 per cent by 2000 (Figure 6). Some of the country's major electronic export products did not grow apace with the rapidly expanding world market for them, thus losing market share, and shifting to the 'under-achiever' category. This latter's share increased from 3 to 43 per cent of total exports. So Thailand did not do as well as its major competitors during the 1996-2000 boom in electronic exports.

Figure 6 Market Positioning of Exports, 1996 and 2000



Source: see Table 2 and 3

Table 2 Market Positioning of Thai Exports, 2000

HS Code Rev. 0.		US$ mill. 2000	Export Share %	Trend 1996-00, % p.a. Thailand	Trend 1996-00, % p.a. World	World Market Share %, 2000
	All goods (mirror statistics)	52,371	100.0	5	5	0.0
	Champions	7,955	15.2			
1605	Crustacean prepared, preserved	1,100		9	4	29.2
2709	Petroleum and other oils, crude	431		12	7	0.1
2710	Petroleum and other oils, o/t crude	869		24	7	0.7
3907	Polyacetal, polyether, etc.	367		62	5	2.1
6110	Jerseys, pullovers, cardigans	736		19	8	2.4
7113	Jewellery	1,152		5		8.4
8501	Electric motors & generators	693		8	5	3.8
8529	Parts of 85.25 - 85.28	500		22	11	1.5
8540	Thermionic, cold cathode valves, tubes	358		14	3	2.2
8704	Motor vehicles for transport of goods	1,253		79	6	2.4
9401	Seat convertible into bed & parts of	496		15	11	1.9
	Achievers in adversity	10,187	19.5			
1604	Prepared & preserved fish	627		-1	-2	11.3
1006	Rice	1,299		-6	-6	26.5
2523	Portland cement, aluminou	371		59	0	8.8
3903	Polymers of styrene, primary form	557		49	3	4.9
4001	Natural rubber, etc.	1,689		-9	-13	39.4
4015	Rubber clothing articles	438		15	1	19.9
4202	Trunks, suit-cases, handbags	520		8	2	2.7
6204	Women's' suits, jackets, dresses, skirts	412		8	4	1.4
8414	Air, vacuum pumps & fans	399		13	2	1.7
8415	Air conditioners, motor-driven fans	956		7	3	7.7
9009	Photocopiers	371		10	-5	3.0
	Transport services, credit	2,548		2	1	0.8
	Under-achievers	22,703	43.4			
8471	Auto. data process machines, etc.	6,173		-2	8	3.0
8473	Parts of 84.69 - 84.72	3,123		8	12	2.3
8504	Electric transformers, converters	807		5	9	2.2
8528	Television receivers	1,171		4	7	4.7
8517	Electrical apparatus for line telephony	1,328		17	18	1.6
8541	Diodes, transistors, semiconductor devices	843		12	12	2.6
8534	Printed circuits	374		10	17	2.1
8542	Integrated circuits & micro-assemblies	3,879		12	12	1.8
8544	Insulated wire, conductors	521		1	7	1.4
9403	Other furniture & parts of	602		8	8	1.8
9999	Special transaction trade	876		2	8	0.5
	Other services, credit	3,006		-12	4	0.5
	Losers in declining markets	11,526	22.0			
0306	Crustacean in shell	1,647		0	3	12.0
1701	Cane or beet sugar	432		-19	-11	6.3
2008	Fruits, nuts	412		-2	-1	10.0
6403	Footwear	455		-3	-1	1.7
7102	Diamonds, not mounted or set	494		-9		1.0
7103	Precious, semi-precious stones	401		-5		21.3
8522	Parts of 85.19 - 85.21	400		-6	3	3.8
	Travel, credit	7,285		-5	2	1.7

Source: Trade Map, International Trade Centre, UNCTAD/WTO (www.intracen.org), based on partner country statistics.
Note: Above classification available for $53.5 billion out of total exports of $64.7 billion in 2000 (83%).

Table 3 Market Positioning of Exports of Selected Countries, 1996

(% of total manufactured exports)

Country	Rising Stars	Falling Stars	Lost Opportunity	Retreat
Thailand	54.1	37.8	2.8	5.3
Malaysia	72.7	23.8	0.6	2.8
Singapore	68.6	15.2	5.3	10.9
Taiwan, Province of China	50.9	20.6	20.1	8.4
China	47.4	46.5	0.7	5.4
The Republic of Korea	41.6	39.7	8.9	9.8
Indonesia	34.7	47.4	16.3	1.6
India	19.3	65.6	7.6	7.6
Pakistan	14.6	71.0	5.0	9.4

Source: Lall S. 'Forward' in ECLAC/World Bank (2000), TradeCan: Database and Software for a Competitiveness Analysis of Nations - User Guide 1999 Edition, Washington: World Bank.

Note:

Share of Country's export in world trade	Share of Product in World Trade: Rising (dynamic)	Falling (stagnant)
Rising (competitive)	Rising stars	Falling stars
Falling (non-competitive)	Lost opportunity	Retreat

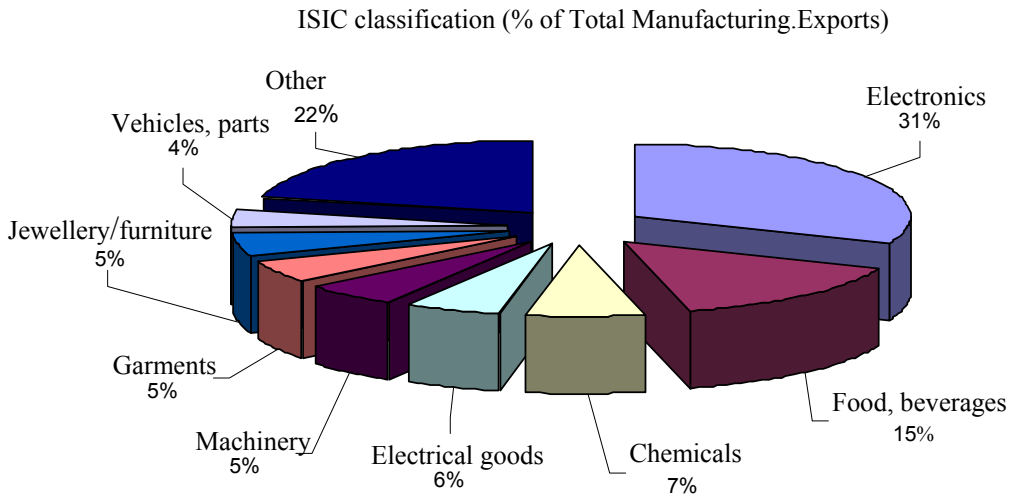
The country's main export product, automatic data processing machines, with a value of nearly US$7 billion in 2000, declined by 2 per cent, while its world market expanded by 8 per cent between 1996 and 2000 (Table 2). Two other major export products, integrated circuits and electronic parts (HS code 8473), grew rapidly at respectively 12 and 8 per cent per year but at a lower rate than the world market, so their market share stagnated.

This was a very different situation from that of 1996. Then, Thailand's share of 'champions' or 'rising stars' was exceeded only by Malaysia and Singapore (73 and 69 per cent); the Kingdom enjoyed a better market positioning than the Republic of Korea and Taiwan, Province of China (42 and 51 per cent). Only 3 per cent of Thailand's exports fell in the 'lost opportunity' or 'under-achiever' category, a performance comparable to China and Malaysia (less than 1 per cent). This is the least desirable category, since it means losing market share in dynamic products. Taiwan, Province of China and Indonesia had the highest share of 'lost opportunity', losing market share in dynamic products. Finally, a large proportion of Thailand's exports, 38 per cent, fell in the 'falling star' or 'achiever in adversity' category, where they gained market share in stagnant declining products. Thailand shared this less desirable outcome with China, Indonesia, India and Pakistan (47-71 per cent).

Product and market diversification

Product diversification. Based on the ISIC 2-digit classification, electronics constituted Thailand's top export category (31 per cent of manufactured exports), followed by food and beverages (15 per cent), chemicals, including plastic products (7 per cent), electrical goods (6 per cent), machinery, garments, jewellery and furniture (5 per cent each) and vehicle and parts (4 per cent). These four product categories accounted for 50 per cent of the country's manufactured exports (Figure 7 and Table 4).

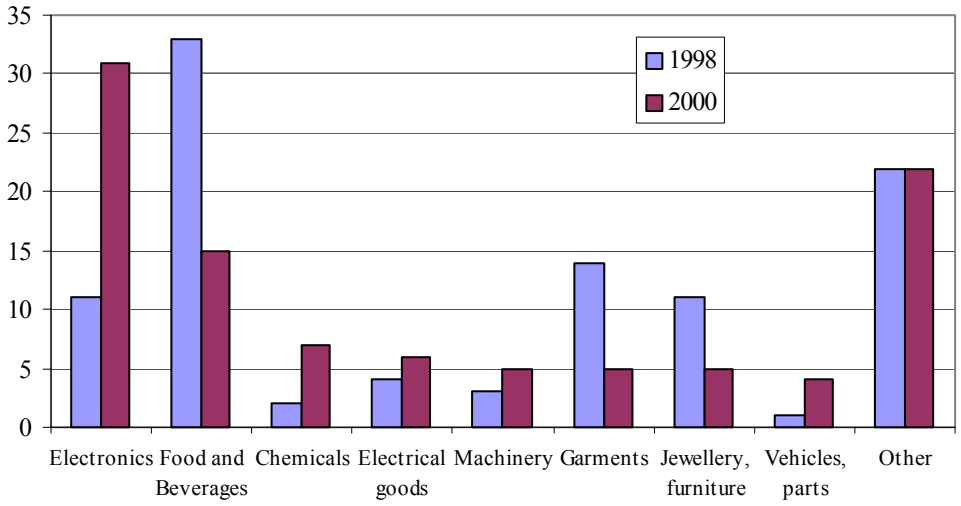
Figure 7 Top Eight Manufacturing Exports, 2000



Source: Table 4

The top five and eight export categories accounted for respectively 64 and 78 per cent of total manufactured exports. The country's reliance on the original top five export products diminished in the 1988-2000 period (50 to 45 per cent of the total), particularly its reliance on labour-intensive food, garments, and jewellery and furniture (Figure 8). In their place, chemicals, including plastic products, vehicle components and machinery emerged as significant new export categories. However, the country's reliance on its top exports, electronic products, increased significantly (11 to 31 per cent). Manufacturing exports formed 86 per cent of the country's total exports of US$ 70 billion (table 4).

Figure 8 Top Eight Exports, 1988 and 2000 (% of total)



Source: Customs Department (converted to ISIC by OIE, Ministry of Industry)

Table 4 All Manufactured Exports by 2-Digit ISIC Classification 1988 – 2000

(US$ billion)

ISIC	Category (2-digit)	Value				Share				Growth rate (p.a.%)		
		1988	1990	1995	2000	1988	1990	1995	2000	88-90	90-95	95-00
15	Food, beverages	4,310	5,413	10,132	9,593	32.6	26.7	19.4	14.9	12.1	13.4	-1.1
16	Tobacco	1	1	3	13	0.0	0.0	0.0	0.0	11.5	19.3	36.1
17	Textiles	780	952	2,011	1,891	5.9	4.7	3.9	2.9	10.5	16.1	-1.2
18	Garments, furs	1,850	2,707	4,371	3,335	14.0	13.4	8.4	5.2	21.0	10.1	-5.3
19	Leather, footwear	670	1,231	3,033	1,717	5.1	6.1	5.8	2.7	35.6	19.8	-10.8
20	Wood and products	193	206	416	605	1.5	1.0	0.8	0.9	3.5	15.0	7.8
21	Paper and products	58	49	326	762	0.4	0.2	0.6	1.2	-7.9	46.1	18.5
22	Publishing, printing	17	17	272	57	0.1	0.1	0.5	0.1	-0.8	74.5	-26.9
23	Coke, petroleum prod.	39	89	291	1,654	0.3	0.4	0.6	2.6	51.4	26.6	41.6
24	Chemicals and prod.	211	414	2,051	4,392	1.6	2.0	3.9	6.8	40.1	37.7	16.4
25	Rubber, plastic prod.	362	554	2,915	1,989	2.7	2.7	5.6	3.1	23.7	39.4	-7.4
26	Other non-metallic prod.	152	227	774	1,187	1.1	1.1	1.5	1.8	22.1	27.8	8.9
27	Basic metals	307	267	750	1,509	2.3	1.3	1.4	2.3	-6.6	22.9	15.0
28	Fabricated metal prod.	140	286	743	1,096	1.1	1.4	1.4	1.7	42.8	21.0	8.1
29	Machinery, equipment	419	784	2,684	3,477	3.2	3.9	5.1	5.4	36.7	27.9	5.3
30	Office, comp. machinery	521	1,567	5,716	8,850	3.9	7.7	11.0	13.7	73.4	29.5	9.1
31	Electrical machinery	556	574	2,547	3,701	4.2	2.8	4.9	5.7	1.5	34.7	7.8
32	Radio/tv, electr. compnts	878	2,054	6,751	11,340	6.6	10.1	12.9	17.6	53.0	26.9	10.9
33	Precision equipment	118	308	1,005	1,143	0.9	1.5	1.9	1.8	61.7	26.7	2.6
34	Motor vehicles, parts	139	191	409	2,438	1.1	0.9	0.8	3.8	17.4	16.4	42.9
35	Other transport equip.	31	59	1,038	476	0.2	0.3	2.0	0.7	38.4	77.4	-14.4
36	Jewellery, furniture	1,475	2,306	3,937	3,266	11.2	11.4	7.5	5.1	25.1	11.3	-3.7
	Total manuf. exports	13,226	20,258	52,174	64,491	100.0	100.0	100.0	100.0	23.8	20.8	4.3
	Excluding commodities			46,442	59,765							5.2
	Top 5 manuf. exports	6,895	10,805	29,882	41,353	52.1	53.3	57.3	64.1	25.2	22.6	6.7
	Top 8 manuf. exports	10,359	16,010	38,598	50,391	78.3	79.0	74.0	78.1	24.3	19.2	5.5
	Total exports	16,018	23,134	56,672	69,524	-	-	-	-	20.2	19.6	4.2

Source: Customs Department (converted to ISIC by Office of Industrial Economics, Ministry of Industry)

Table 5 Top Manufactured Exports, Bank of Thailand Classification, 1993 – 2000

(US$ million per year)

Export product	1993	1994	1995	1996	1997	1998	1999	2000	2001
Value (US$ million)									
Electronics	5,840	8,265	10,973	12,578	13,728	14,062	15,020	18,803	16190
Electrical goods	2,163	3,272	4,170	4,333	4,742	3,946	4,615	5,504	5,300
Garments	3,551	4,018	4,110	3,156	3,118	2,980	2,906	3,133	2,911
Plastic products	1,566	1,211	2,505	1,252	1,577	1,712	2,002	2,784	2,543
Canned food	1,705	2,010	2,149	2,264	2,339	2,281	2,645	2,593	2,478
Vehicle, parts, accessories	525	796	659	747	1,064	1,323	1,977	2,535	2,776
Base metal products	764	987	1,384	1,426	1,505	1,565	1,628	2,327	1,919
Top five manufactured exports	14,826	18,775	23,907	23,584	25,503	24,980	27,188	32,817	29,422
Total manufactured products	29,855	36,851	46,442	45,646	48,182	44,857	49,273	59,673	55,532
Total exports	37,126	45,430	56,725	55,984	58,431	54,460	58,468	69,775	65,379
% Share, total manuf. exports									
Electronics	19.6	22.4	23.6	27.6	28.5	31.3	30.5	31.5	29.2
Electrical goods	7.2	8.9	9.0	9.5	9.8	8.8	9.4	9.2	9.5
Garments	11.9	10.9	8.8	6.9	6.5	6.6	5.9	5.3	5.2
Plastic products	5.2	3.3	5.4	2.7	3.3	3.8	4.1	4.7	4.6
Canned food	5.7	5.5	4.6	5.0	4.9	5.1	5.4	4.3	4.5
Vehicle, parts, accessories	1.8	2.2	1.4	1.6	2.2	2.9	4.0	4.2	5.0
Base metal products	2.6	2.7	3.0	3.1	3.1	3.5	3.3	3.9	3.5
Top five manufactured exports	49.7	51.0	51.5	51.7	52.9	55.7	55.2	55.0	53.0
Total manufactured products	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Growth rate (% p.a.)									
Electronics		41.5	32.8	14.6	9.1	2.4	6.8	25.2	-13.9
Electrical goods		51.2	27.4	3.9	9.4	-16.8	17.0	19.3	-3.7
Garments		13.1	2.3	-23.2	-1.2	-4.4	-2.5	7.8	-7.1
Plastic products		-22.7	107.0	-50.0	25.9	8.6	16.9	39.2	-8.7
Canned food		17.9	6.9	5.4	3.3	-2.5	16.0	-2.0	-4.4
Vehicle, parts, accessories		51.7	-17.2	13.2	42.5	24.3	49.4	28.2	9.5
Base metal products		29.2	40.2	3.0	5.6	4.0	4.0	42.9	-17.5
Top five manufactured exports		26.6	27.3	-1.4	8.1	-2.1	8.8	20.8	-10.3
Total manufactured products		23.4	26.0	-1.7	5.6	-6.9	9.8	21.3	-6.9
Total exports		22.4	24.9	-1.3	4.4	-6.8	7.4	19.5	-6.3

Source: *Economic and Financial Statistics*, Table 49, Bank of Thailand (based on data collected by the Customs Department)

The ranking of manufactured exports using the Bank of Thailand (BOT) classification, commonly used by researchers in Thailand, is shown in Table 5 for comparison. It is interesting to note that the BOT classification appears to underestimate the role of food and beverages in Thailand's exports. Because food exports are broken down into sub-categories such as canned food, they do not appear on the list of the seven most important export categories, while they formed the second largest category in the ISIC classification, enjoying a share of 15 per cent of total exports.

According to this data, after a fall of 7 per cent in dollar terms during the crisis year 1998, Thailand's manufactured exports regained their pre-crisis level in 1999, before jumping by

nearly 20 per cent to a record US$ 60 billion in 2000. Manufacturing exports fell again by 7 per cent in 2001.

Table 6 Exports of Electronic and Electrical Products, 1993 – 2000

(US$ million)

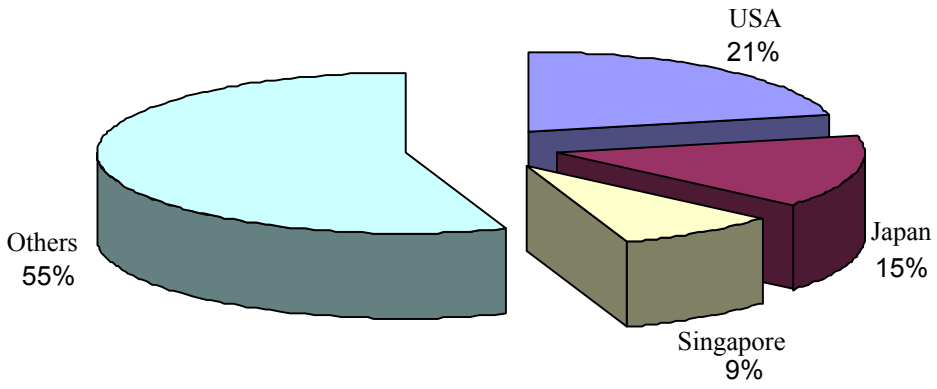
Export product	1993	1994	1995	1996	1997	1998	1999	2000	2001
Value (US$ million)									
Computers and parts	2,489	3,678	5,179	6,550	7,274	7,694	7,923	8,501	7,749
Integrated circuits and parts	1,410	1,809	2,346	2,319	2,481	2,255	2,942	4,485	3,510
Other electronic products	1,207	1,885	2,474	2,623	2,823	2,913	3,171	4,281	3,637
Other electrical appliances	1,038	1,618	1,809	1,608	1,804	1,435	1,626	2,028	1,804
Electrical white goods	713	1,008	1,365	1,531	1,470	1,279	1,454	1,781	1,865
Transformers, generator, motors	412	646	995	1,194	1,468	1,232	1,535	1,695	1,633
Consumer electronics	733	893	975	1,086	1,150	1,200	984	1,536	1,294
Total manufactured products	29,855	36,851	46,442	45,646	48,182	44,857	49,273	59,673	55,532
% Share, total manuf. exports									
Computers and parts	8.3	10.0	11.2	14.4	15.1	17.2	16.1	14.2	14.0
Integrated circuits and parts	4.7	4.9	5.1	5.1	5.2	5.0	6.0	7.5	6.3
Other electronic products	4.0	5.1	5.3	5.7	5.9	6.5	6.4	7.2	6.5
Other electrical appliances	3.5	4.4	3.9	3.5	3.7	3.2	3.3	3.4	3.2
Electrical white goods	2.4	2.7	2.9	3.4	3.1	2.9	3.0	3.0	3.4
Transformers, generator, motors	1.4	1.8	2.1	2.6	3.0	2.7	3.1	2.8	2.9
Consumer electronics	2.5	2.4	2.1	2.4	2.4	2.7	2.0	2.6	2.3
Total manufactured products	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Growth rate (% p.a.)									
Computers and parts		47.8	40.8	26.5	11.0	5.8	3.0	7.6	-8.8
Integrated circuits and parts		28.3	29.6	-1.1	7.0	-9.1	30.4	52.4	-21.7
Other electronic products		56.1	31.3	6.0	7.6	3.2	8.9	35.0	-15.0
Other electrical appliances		55.8	11.8	-11.1	12.2	-20.4	13.3	24.9	-11.1
Electrical white goods		41.4	35.4	12.1	-4.0	-13.0	13.7	22.5	4.7
Transformers, generator, motors		56.7	54.2	20.0	23.0	-16.1	24.6	10.4	-3.7
Consumer electronics		21.8	9.1	11.4	5.9	4.4	-18.0	56.1	-15.8
Total manufactured products		23.4	26.0	-1.7	5.6	-6.9	9.8	21.3	-6.9

Source: *Economic and Financial Statistics*, table 49, Bank of Thailand (based on data collected by the Customs Department)

Market diversification. Thailand was dependent on just three countries for nearly half of its exports in 2000, namely the US (21 per cent), Japan (15 per cent) and Singapore (9 per cent, Figure 9). It was therefore vulnerable to the economic situation in these countries, as vividly illustrated by the decline in exports following the end of the information technology investment boom in the US in 2001.

Though desirable from the point of view of market positioning and faster growth of dynamic products, as noted above, the reliance on electronics exports increased the country's vulnerability to products sold mainly in the above three countries. Another drawback of this emerging trend is the considerable reliance of electronic products on the assembly stage of imported inputs. An indication of the latter was the 30 and 52 per cent growth of integrated circuits and parts, which could only have been possible on the basis of corresponding imports of sub-components (Table 6).

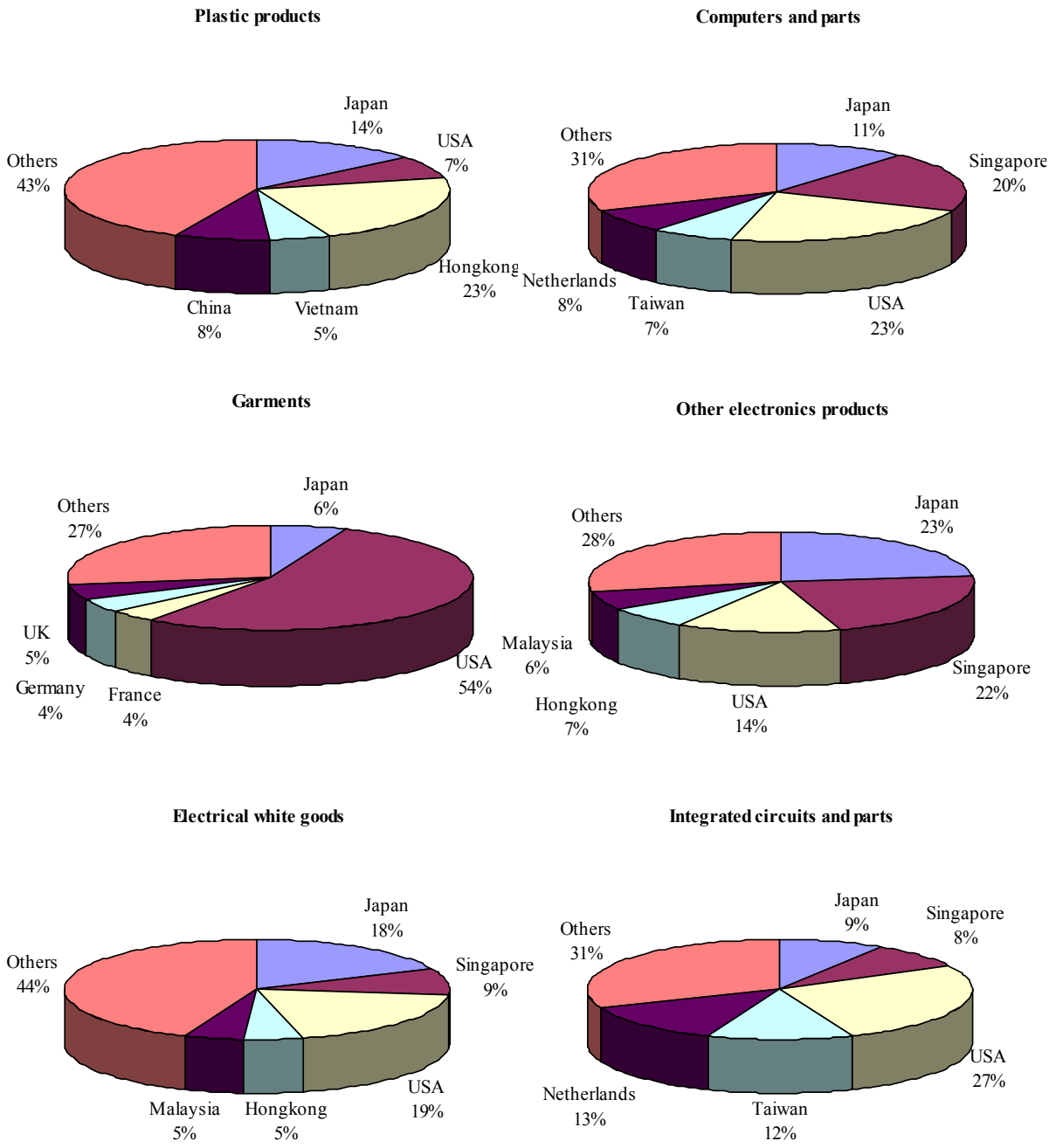
Figure 9 Country Share of Total Exports, 2000



Source: Economic and Financial Statistics, Table 49, Bank of Thailand
(based on Customs Department)

In electronic products such as computer parts, integrated circuits and other electronic products, the five major markets accounted for 70 per cent of the market of Thai exports (Figure 10). The above three countries accounted for half of the market. The market for Thailand's garments was equally narrow, with the USA alone accounting for 54 per cent of the total market. Other exports, including electrical white goods and plastic products, were also concentrated, though to a less extent; the top five importers accounted for about 55% of the total market. Exports markets thus need to be diversified to lessen the vulnerability, and therefore competitiveness of Thai exports during economic downturns in countries with large market shares such as the USA, Japan and Singapore.

Figure 10 Major Destinations of Six Top Export Products, 2000



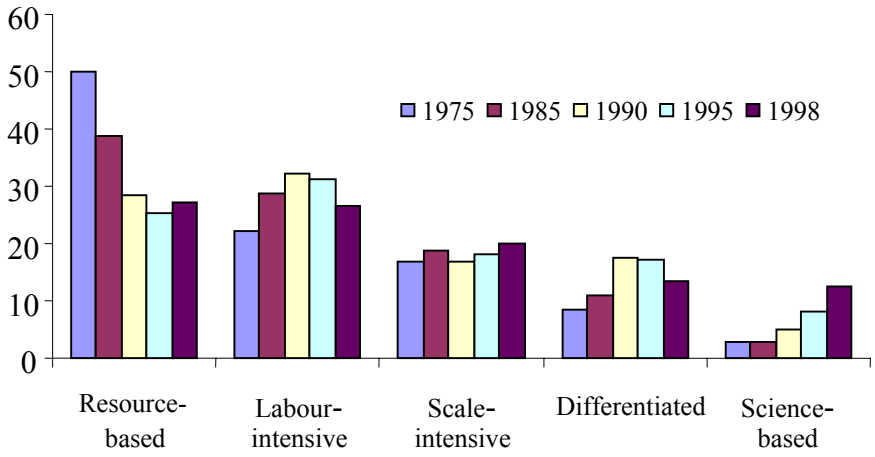
Source: Department of Business Statistics, Ministry of Commerce

D. Technology Level of Production and Exports

Technology level of manufacturing output

The Thai manufacturing sector made significant progress in upgrading its technology profile during the past twenty-five years. The share of resource-based industries, including food, wood and paper resources, halved from 50 to around 25 per cent of total manufacturing value-added between 1975 and 1998 (Figure 11). Labour-intensive industries, mainly textile, garments, footwear, furniture and jewellery, increased their share from around 20 to 30 per cent until 1990, then declined to around 25 per cent by 1998. The share of scale-intensive industries, including basic chemicals, fertilizer, refineries, cement, and iron and steel, remained stable at 18-19 per cent. The technologically more-advanced differentiated industries, including machinery, consumer electronics and motor vehicles, doubled their share from 8 to 17 per cent by 1995, while the share of science-based industries, including medicines, office and computing equipment, and precision goods, increased their shares the most rapidly, from 3 to 8 per cent by 1995, and to 13 per cent by 1998.

Figure 11 Technology Level of Manufacturing Output, 1975-1998 (% of Value-Added)



Source: Input-Output Tables, NESDB

However, it is important to point out that the above classification may exaggerate the technological capabilities of a country. Because it is based on the technology level of the final product, this classification does not distinguish between simple assembly and the more technologically demanding production of components and parts. In Thailand's case, as will be shown in more detail in section four, the import content of differentiated and science-based industries, including electronic goods, was relatively high, indicating a specialization in the assembly rather than the production stage of manufacturing.

Another indication of the lack of depth of the Thai manufacturing sector is the relatively small machinery sub-sector. Though it grew from 2 to 3 per cent between 1975 and 1998, it was far below other countries (Table 7 and Figure 12). Since most production equipment was imported, capital goods accounted for a large part of total manufacturing import bill.

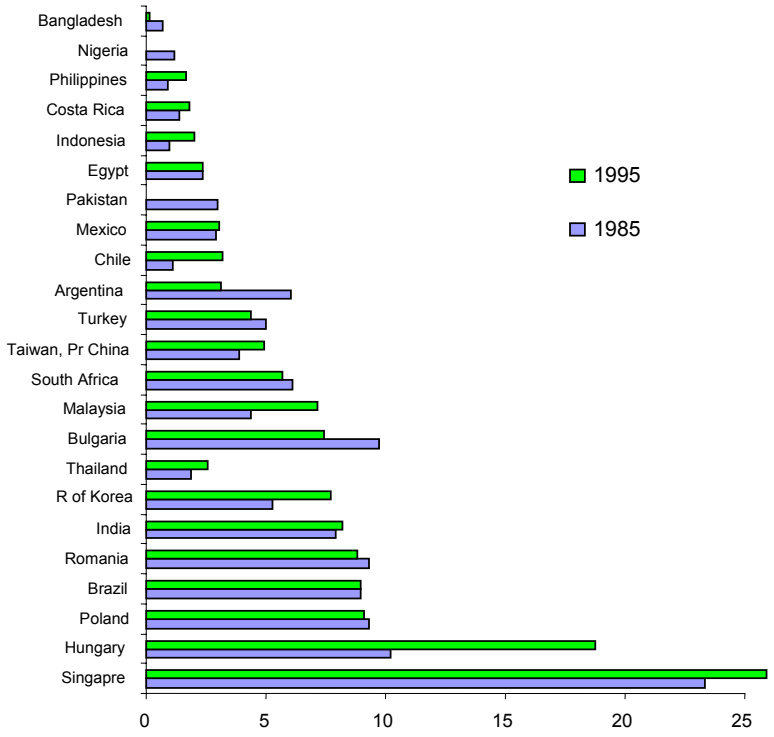
Table 7 Value-Added in Machinery Sub-Sector, 1975 – 1998

(% of total Manufacturing Value-Added)

	1975	1985	1990	1995	1998
1. Engines and turbines	0.15	0.50	0.82	0.49	0,26
2. Agricultural machinery & equipment	0.27	0.33	0.07	0.07	0.07
3. Wood & metal working machines	0.08	0.12	0.17	0.13	0.14
4. Special industrial machinery	1.10	0.79	1.26	1.05	0.96
5. Electrical industrial machinery	0.29	0.13	0.22	0.85	1.31
Total	2.11	1.87	2.59	2.59	2.74

Source: Input-Output Tables (sectors 112 –115, 117), NESDB

Figure 12 Per cent Share of Machinery in MVA (ISIC 382)



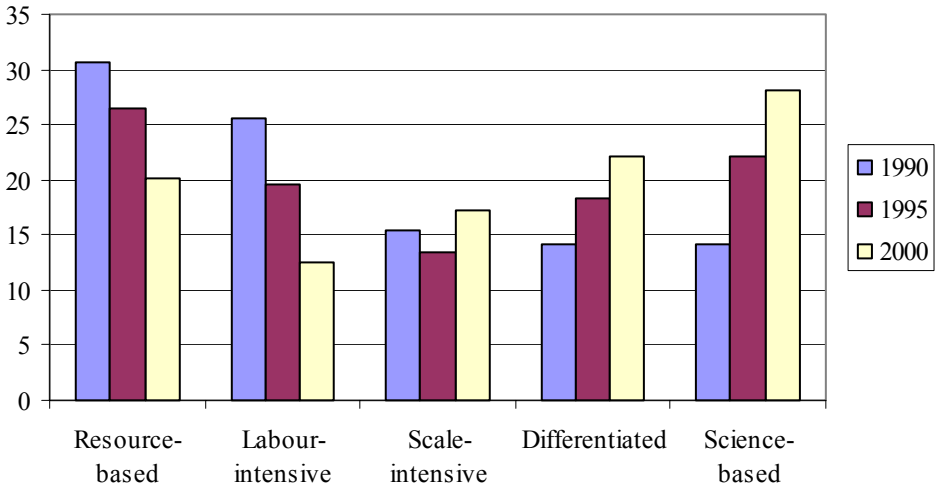
Source: System of Industrial Development Indicators, UNIDO
Input-Output Tables for Thailand (see Table 6)

The production of capital goods played a much more important role in the economies of China, India and Brazil (8–9 per cent), and of Malaysia (7 per cent). Capital goods production occupies a special place in industrial development because it engages firms in developing manufacturing capabilities through activities such as reverse engineering and adapting foreign technology to domestic markets, products, conditions and scales of production. It also provides the technological base for further industrial diversification and the deepening of production. In particular, interaction between equipment suppliers and manufacturing firms is important for innovation, as discussed later (Section 4.1).

Technology level of exports

In line with the shifts in the technology profile of manufacturing output above, the export of resource-based exports, such as food, and labour-intensive exports, such as garments and furniture, declined in importance, in favour of more differentiated and science-based exports including electronics (Figure 13 and Table 8). The technological profile of exports was higher than for production in general, indicating Thailand's relative specialization in the export of technologically more advanced goods.

Figure 13 Technology Level of Exports, 1990-2000 (Per cent of total)



Source: Table 8: based on data from Customs Department
(Converted into ISIC categories, Office of Industrial Economics, Ministry of Industry)

Table 8 Technology Level of Exports, 1990 – 2000 (US$ million per year)

	Value			Share			Growth rate (% p.a.)	
	1990	1995	2000	1990	1995	2000	1990-95	1995-00
Resource-based	6,224	13,792	12,963	30.7	26.4	20.1	17.2	-1.2
Labour-intensive	5,176	10,158	8,039	25.6	19.5	12.5	14.4	-4.6
Scale-intensive	3,140	7,034	11,079	15.5	13.5	17.2	17.5	9.5
Differentiated	2,856	9,613	14,320	14.1	18.4	22.2	27.5	8.3
Science-based	2,861	11,577	18,090	14.1	22.2	28.1	32.3	9.3
Total	20,258	52,174	64,491	100.0	100.0	100.0	20.8	4.3

Source: Customs Department, converted into ISIC categories, Department of Industrial Economics, Ministry of Industry. See Annex Table A.2.

E. Recent Institutional and Policy Developments

A great many changes in institutions and the policy environment have taken place in the past ten years. These changes have accelerated in the past five years, and will have far-reaching consequences for the competitive environment of Thai manufacturing firms. As noted in the introductory section one, some of these changes were ushered in due to growing concerns about the loss of competitiveness of manufacturing firms before the crisis, while other changes were thrust upon by the East Asian crisis. Recent institutional and policy developments are briefly described under the following headings: public-private consultation; trade policy; investment policy; business environment; science and technology initiatives; and small and medium industries.

Public-private consultation

A National Industrial Development Committee, with its secretariat in the Ministry of Industry, and with members from the public and private sectors as well as academics, prepared an Industrial Restructuring Plan or IRP after a long consultation process requiring some 30 meetings and involving 2,400 participants. The cabinet approved the IRP in January 1998 with an original budget of US$ 1.2 billion for a five-year programme and a portfolio of some 440 projects. An important outcome of this process was the opportunity for dialogue, and increased understanding of the challenges facing the industrial sector, as well as overall vision building.

Projects approved by the cabinet in the first year included subsidized loans to entrepreneurs for equipment purchase as well as for the relocation of labour-intensive industries (through the Industrial Finance Corporation of Thailand and the Small Industry Finance Corporation), and funds for industrial skills development. However, in later years, the resources available to implement the IRP were greatly scaled back, and concentrated on subsidizing relatively routine training activities of government departments and technology institutions.

Trade policy

One the most significant developments in the trading environment of Thai manufacturing firms was the adoption, on 1 January 2002, of the 0-5 per cent tariff band on 85 per cent of tariff line items from other ASEAN countries to spur competition and enlarge the regional market. Another measure was the abolition of local content requirements in the auto industry in 2000, two years ahead of the WTO deadline, to attract foreign direct investment in auto assembly and component manufacturing. This last measure was instrumental in the decision by General Motors to select Thailand as its ASEAN manufacturing base in preference to other countries such as Indonesia, in combination with the presence of a large number of established auto parts manufacturers.

The Customs Act was amended in March 2000 to allow the introduction of WTO agreements on customs valuations, in order to increase transparency in the process of import valuation. The introduction of an electronic documentation system for claim submission, and an ex-post auditing system based on importers and exporters' custom records, is intended to reduce customs clearance time and cut logistical costs.

Investment policy

FDI has progressively being allowed in service industries, particularly in the financial and communication sectors. The 25 per cent limit on foreign equity participation has been lifted in banking and other financial services, except insurance. New insurance licenses have been granted to foreign firms to introduce more competition in the domestic market, while insurance laws are being amended to allow higher foreign equity participation.

In August 2000, the Board of Investment introduced a new FDI policy containing the following key measures: (i) 100 per cent foreign shareholding in all activities are now allowed, with the exception of those listed under List One of the Foreign Business Act; (ii) claims for investment incentives must be accompanied by evidence of performance; (iii) projects above Baht 10 million are required to obtain a quality certificate such as ISO 9000; (iv) SMIs with an investment of Baht 1 million are now eligible for investment incentives of the Board of Investment; and (v) the debt-equity ratio has been reduced from 4:1 to 3:1 to encourage financial prudence. Finally, the Board of Investment has commissioned a series of industry studies to identify investment opportunities in promising fields.

Business environment

The Business Competition Act and the Price of Goods & Services Act were enacted in 1999 to ensure fair competition, provide consumer protection and combat monopoly practices. A competition policy authority was established, and twelve committee members appointed. Other pieces of legislation or amendments included the Foreign Business Act, the Patent Act (introducing the principle of national treatment and elimination of the requirement that products under a patent must be manufactured locally), the Law on Property Leases for Commerce and Industry, and amendment to the 1991 Trademark Act. Since 1997, the Thai industrial standards are now systematically based on international standards to enhance product quality and increase the acceptability of Thai products in international markets (World Bank, 2001a:13). An Intellectual Property & International Trade Court was established in 1997 to try civil and criminal cases involving intellectual property rights violations (World Bank, 2001a:16).

Since weak corporate governance may have contributed to the crisis, the Public Companies and Securities and Exchange Acts are being amended, albeit slowly, to increase shareholders' rights and the ease with which they can exercise those rights, improve the accountability of boards of directors and officers, and improve enforcement of sanctions and violation of law. An Institute of Directors was established, offering governance training to executives. Accounting and auditing standards and practices are being improved. The Accounting Professional Act is also being amended to allow the establishment of the Thai Financial Accounting Standards Board (World Bank, 2001a:12).

A programme of privatization of state-owned enterprises was launched, starting with the legal framework in the form of the Corporatization Act and the amendment of the Alien Business Law. Detailed restructuring plans for the telecommunication and energy sectors have been produced, as well as plans for institutional reform, privatization and restructuring of the transport sector. The sale process of some high-profile State-owned enterprises (SOEs) has begun.

Science and technology capability

Three aspects of science and technology have received particular attention: information technology, skills development, and science and technology infrastructure. Thailand is in the process of developing a comprehensive information technology strategy, called IT 2010, with three major aims: (i) to facilitate access to information technology to different segments of the society; (ii) to promote the diffusion of e-commerce; and (iii) to optimize service delivery, participation and governance through electronic government. A National Information Technology Committee, under the Prime Minister' Office, is coordinating these tasks (World Bank, 2001a:7).

Institutional changes in skills development include reforming the Vocational Education Act, the Joint Public & Private Sector Committee for Occupational Development Act, and the Skills Development & Promotion Act. They also include strengthening the organizational structure, financing mechanisms and medium-term strategy for specialized institutes.

The institutional structure for industrial technology development is currently undergoing a comprehensive review, including the role of the National Agency for Science and Technology Development (NSTDA) and the effectiveness of technology institutes in delivering satisfactory services to target clients while attaining financial independence. A plan to establish a National Science and Technology Policy Committee has been submitted to the cabinet.

In the meantime, a number of long-awaited and autonomous technology institutes, under the overall supervision of the Ministry of Industry, were established in key industrial areas such as food, textiles, auto and electrical and electronics in 1998. A master plan for the development of the electronics industry was produced. The challenges and implications of the recent developments in the industrial technology system are discussed in greater detail in Section 5 below.

Small and medium industries

The SME Promotion Act was enacted in February 2000. An SME Promotion Committee, chaired by the Prime Minister, and an Office of Small and Medium Sized Enterprise Promotion (OSMEP), were established. An SME Promotion Fund was created. An SME development master plan was produced in 2001 with the assistance of JETRO. The Department of Industrial Promotion of the Ministry of Industry was reorganized to deal exclusively with small and medium industries.

Summary

While by no means exhaustive, the above review of institutional and policy changes, already undertaken and under consideration, indicates the government's commitment to undertake a comprehensive reform of economic laws to strengthen the legal framework as well as enforcement mechanisms. These efforts aim to sustain economic recovery and meet the challenges of globalization and trade liberalization.

Nevertheless, with the exception of projects to improve the education system and studies to improve science and technology capabilities, most concrete measures to date appear to target one determinant out of the four determinants of the 'diamond' of national competitiveness, namely promoting firm rivalry and injection of more competition in the domestic economy. While this is commendable and necessary, it is not sufficient. The improvement of national competitiveness also requires action on two other important determinants of competitiveness, namely the improvement of factor conditions, the development of supplier and related industries, as well as addressing their 'core', the innovation system. These three areas are now addressed in turn in Section 3, 4 and 5.

CHAPTER III:

Productivity

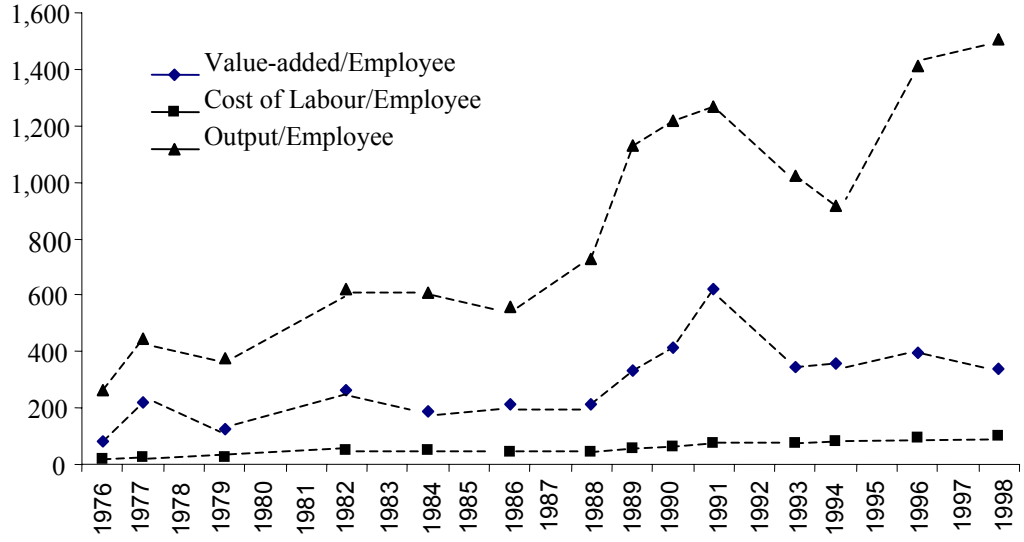
A. Impact of Rising Wages on Competitiveness

Did labour costs rise faster than labour productivity?

The lack of reliable data on wage trends has hampered the study of labour costs and labour productivity in Thailand. Researchers have been forced to use wage data from one source, and production data from another source, usually secondary data such as national accounts. This paper uses the manufacturing establishment census and surveys undertaken by the National Statistical Office (NSO) almost every two years, and covering establishments employing at least ten workers. It attempts to provide an estimate of the relationship between wage and labour productivity changes using internally consistent data for the manufacturing sector, though even this source displays considerable year-to-year variations, and inconsistent movements in gross output and value-added. For instance, gross output per employee rose significantly, but value-added per worker stagnated in the periods 1986-88 and 1997-98. The opposite is shown for the period 1993-94, where gross output per employee fell but not value-added per employee (Figure 14)

Figure 14 Value-added, Gross Output and Cost of Labour per employee

All Manufacturing, 1976-1998 (Current Baht 000/year)



Source: same as Table 9

Bearing the above data problem in mind, Thailand's manufacturing growth can be divided in two periods, 1976-1986 and 1986-1996 (Table 9). Between 1976 and 1986, the cost of labour increased somewhat faster than labour productivity in real terms (3.3 *vs* 2.5 per cent per annum), though this was mainly due to declining output per employee in the first half of the 1980s. As a result, the cost of labour increased from 7.5 to 8.2 per cent of gross output in this period (Figure 15). However, in the following ten years of rapid manufacturing growth, the growth in gross output per worker outpaced the rise in labour costs (5.2 *vs* 3.3 per cent), leading to a corresponding decline in the cost of labour from 8.2 to 6.8 per cent during 1986-96.

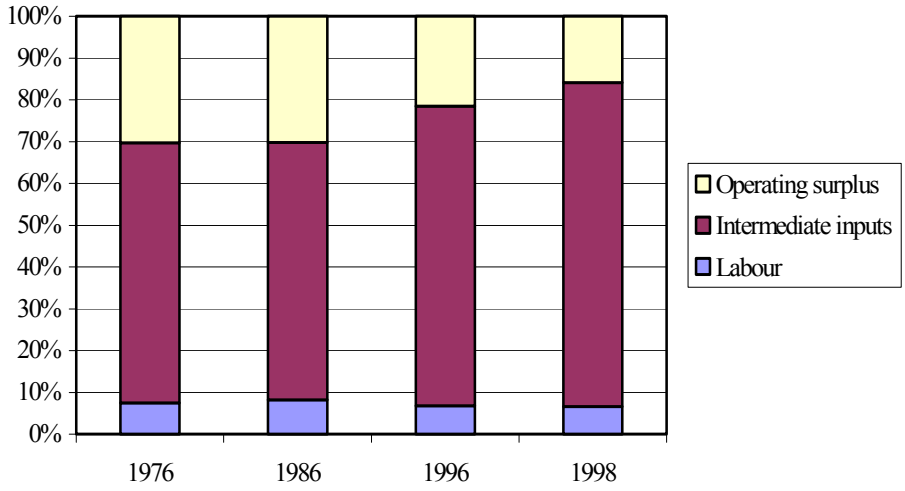
Table 9 Trends in Gross Output/Employee, Labour Cost/Employee and Labour

Share in Gross Output, 1976 – 1998 (Current Baht per year)

	Gross output/ Employee (% p.a.)			Cost of Labour / Employee (% p.a.)			Labour costs/Gross output (%)			
	76-86	86-96	96-98	76-86	86-96	96-98	1976	1986	1996	1998
Labour-intensive										
Textiles	8.4	9.2	-2.5	8.1	7.7	6.8	11.5	11.2	9.7	11.6
Garments	7.9	7.4	23.7	11.9	8.7	-3.9	12.8	15.0	17.0	10.3
Footwear	17.5	10.6	17.4	8.8	11.0	2.7	31.7	14.7	15.4	11.8
Furniture	4.3[2]	8.8	-6.5	9.1	4.5	1.1	10.2	15.0[5]	13.1	15.3
Plastic products	9.4	12.2	-4.0	13.9	9.4	2.0	9.4[4]	13.6	10.5	11.9
Capital-intensive										
Food	5.1	6.0	-0.7	5.2	6.3	0.7	5.1	5.2	5.3	5.5
Chemicals	14.6	7.9	8.0	14.9	6.8	1.9	6.7	6.9	6.2	5.5
Rubber products	13.5	3.9	-9.4	7.7	3.6	4.4	7.5	4.5	4.3	5.8
Fabricated metals	6.7	5.0	-3.0	8.9	8.5	-0.1	6.3	5.7	7.9	8.4
Machinery	4.3[7]	8.4[3]	0.8	12.2	8.7	2.7	5.6	7.8[6]	8.3	8.6
Elect./electronics	13.1	7.6	20.7	17.0	6.9	2.6	10.1	7.3	6.8	4.9
Transport	7.7	13.2[3]	-12.4	12.0	8.7	11.0	5.3[4]	5.4[6]	3.1	5.0
All manufacturing [1]	7.9	9.7	3.2	8.7	7.8	1.8	7.5	8.2	6.8	6.6
Wholesale price index	5.4	4.5	8.7	5.4	4.5	8.7	-	-	-	-
Real growth rate	2.5	5.2	-5.5	3.3	3.3	-6.9	-	-	-	-

Source: Manufacturing census and survey data in UNIDO *International Yearbook of Industrial Statistics*, various years; Wholesale price index: Department of Business Economics, Ministry of Commerce.
Note: Excludes cottage and household industries employing less than 10 or 20 workers per establishments.
Gross output used instead of value-added because more stable, less noise due to underreporting of intermediate inputs in certain sectors, particularly motor vehicles and electronics.
Wholesale price index: [1] All manufacturing excluding beverages, tobacco printing and publishing, petrol refineries, coke products, due to inconsistent series (ISIC 313, 314, 342, 353 and 354).
[2] 1975-86. [3] 1988-96. [4] 1977. [5] 1984. [6] 1988. [7] 1976-84.

Figure 15 Major Components of Gross Output (% of total)



Source: same as Table 9

For the manufacturing sector as a whole, the cost of labour amounted to just 6.8 per cent of the total value of gross output in 1996[1]. Raw materials, components and other intermediate inputs and energy accounted for 72 per cent, while operating surplus or gross profit accounted for the remaining 21 per cent of the total value of gross output. Due to its rather small share relative to intermediate inputs, wage rises can have only a moderate impact on the cost structure of the manufacturing sector in general.

However, labour costs varied from industry to industry, from a low of 3 to 5 per cent of gross output in the transport equipment, rubber product and food industries, to a high of 15 to 17 per cent in the footwear and garment industries. During the high growth period 1986-96, the cost of labour as a proportion of gross output declined in most industries, indicating faster productivity growth relative to earnings. Only two industries out of twelve shown in Table 1 displayed rising labour cost shares, namely garments (from 15 to 17 per cent) and fabricated metal products (from 6 to 8 per cent). This share remained relatively stable for other labour-intensive industries including textiles, footwear and furniture. Following the economic crisis, the cost of labour declined from 17 to 10 per cent in the garment industry, and from 15 to 12 per cent in the footwear industry during 1996-98. That of the electrical and electronic industry also fell from 7 to 5 per cent. The cost of labour of most other industries remained relatively unchanged between 1996 and 1998.

In sum, labour productivity increased more rapidly than wages in the rapid manufacturing growth period 1986-1996 before the crisis. Given the considerable investment in new production facilities and the rapid development of capital-intensive and higher value industries such as chemicals, machinery, electrical and electronics and transport equipment industries, and the associated economies of scale in larger plants, it would have been surprising if labour productivity had not kept pace with wage rises during this period. The financial crisis and the Baht devaluation reduced the labour cost share in gross output significantly in labour-intensive industries.

[1] The last year before the crisis, when concerns about rising labour costs were particularly acute. Note that the picture in this respect was not fundamentally altered by the crisis.

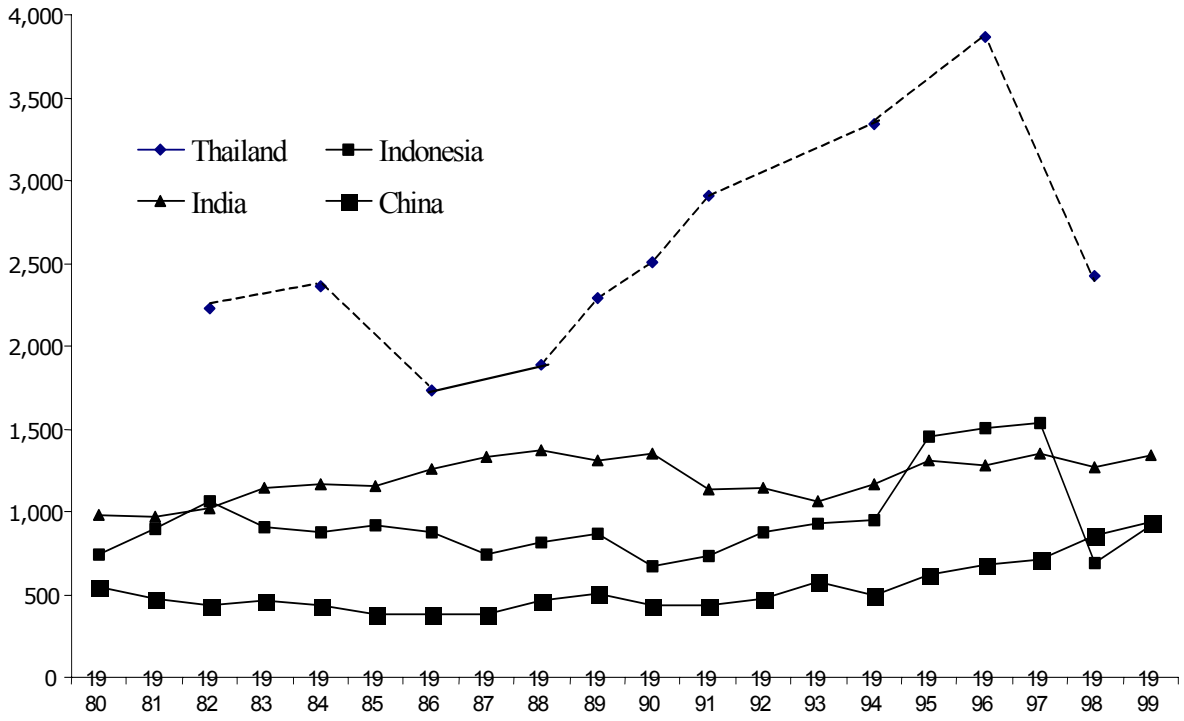
Cost of labour in selected countries in US dollars

In 1998, the cost of labour in Thai manufacturing was US$ 2,400 per employee per year (Figure 16 and Table 10). Before the sharp devaluation of the Baht in 1997 at the start of the crisis, it had reached nearly US$ 4,000 in 1996. To put this in comparative perspective, countries with higher labour costs than Thailand included Poland and the Czech Republic (one-and-a-half time higher), Malaysia (double), Mexico, Turkey and South Africa (three times higher) and Brazil (four times higher). Countries where labour costs per employee were similar included Pakistan, the Philippines and Egypt. Finally countries with lower labour costs per employee than Thailand included China, Indonesia and Sri Lanka (one third) and India (one half).

The variation in labour costs per employee in current US dollars notwithstanding, the cost of labour per unit of gross output was remarkably similar across countries, varying in a narrow band of 6-8 per cent in 1997/99 for countries as different as Malaysia, Indonesia, India, Mexico and Turkey. The exceptions were Brazil, Poland and Egypt, where they were higher at 10 to 12 per cent, and South Africa where this ratio climbed to 18 per cent.

In US dollar terms, the Thai labour costs per employee increased by 8.4 per cent per year in the 1990s before the crisis, compared with 3.3 per cent in constant Baht. However labour costs in dollars also increased rapidly in several other countries including Brazil, China, Malaysia and pre-devaluation Mexico (8.8-9.1 per cent a year), and Indonesia and Egypt (8.2-8.4 per cent per year). The increases in labour costs were much smaller in South Asian and other countries, ranging from 0.5-1.0 per cent in Nepal and Turkey to 2.1-2.6 per cent per year in India and Pakistan.

Figure 16 Cost of Labour per Employee, 1980 - 1999 (US$/year)



Source: same as Table 9

In Thailand, a major factor in the rapid rise of the cost of labour per employee in dollar terms in the 1990s was the pegging of the Baht to the US dollar. Nominal wages increased by 7.8 per cent, wholesale prices rose by 4.5 per cent per year, and thus real labour costs in Baht terms increased by just 3.3 per cent per year between 1986 and 1996. The fixed exchange rate policy appears to have led to a loss of labour competitiveness of Thai industry relative to countries undertaking drastic devaluations of their currency in this period. For instance, the Chinese currency depreciated by 30 and 45 per cent in 1990 and 1994, while the Mexican currency depreciated by 90 per cent in 1995. Indonesia and Philippines implemented a gradual depreciation of their currency of around 5 per cent per annum to compensate for their higher domestic inflation. Nevertheless, the increase in capital investment in existing industries in Thailand may have more than compensated for the relative over-valuation of the Thai currency, since labour costs as a percentage of gross output declined in most industries, or increased only moderately in some labour-intensive industries.

Following the crisis and the 60 per cent devaluation of the Baht, the gap between Thailand and lower labour costs countries such as China and India narrowed, while it widened relative to higher labour-cost countries such as Malaysia and Mexico. However, in relation to many Southeast Asian countries which also devalued, such as Indonesia and Philippines, the gap in labour cost per employee remained almost the same in dollar terms. Annex Tables A.3 to A.9 compare the labour costs and other characteristics of several countries in the following industries: textiles, garment, footwear, machinery, electrical and electronic industry and transport equipment industry. In general the situation described for the manufacturing sector as a whole applied to these industries.

Table 10 Labour Costs, Gross Output and Value-Added per Employee

Selected Countries, 1990-99 (Current US$): All Manufacturing

	Year (LY)	Labour Costs (LC), Gross Output (GO) and Value-added (VA) per Employee, 1999 or Last Year (LY)									Establishment size (Employees/ Establ.)		Operating Surplus (VA-LC)/GO %		Labour costs/ Gross Output (%)		
		U$ 000/year			Index Thailand = 100			Change, 1990-1999 or LY [1] (% p.a.)									
		LC	GO	VA	LC	GO	VA	LC	GO	VA	1990	97/99	1990	97/99	1990	1997	1999
Thailand	1998	2.4	36.1	8.2	100	100	100	8.4	10.7	7.3	158	168	28.7	21.5	8.2	6.7	6.7
China	1999	0.9[2]	14.3[3]	3.7[3]	38	39	45	9.0	10.1	10.0	116	146	19.3	19.6	4.8[4]	-	-
Malaysia	1999	4.8	72.8	19.1	200	202	233	9.1	9.2	9.9	123	-	18.6	19.7	7.0	6.9	6.6
Philippines	1997	3.0	43.1	17.7	125	119	216	7.4	10.1	12.0	93	88	28.2	34.2	8.2	6.9	-
Indonesia	1999	0.9	14.7	5.8	38	41	71	8.2	8.2	10.5	160	182	31.0	31.1	6.0[5]	6.1	6.2
India	1999	1.3	23.1	4.3	54	64	52	2.1	4.4	5.1	67	68	10.9	12.6	6.9	5.9	5.8
Bangladesh	1992	0.6	4.9	1.6	25	14	20	-	-	-	41	-	19.4	-	11.7	-	-
Pakistan	1996	2.1	34.3	10.5	88	95	128	2.6	5.2	5.4	130	126	22.5	24.7	7.0	6.0	-
Sri Lanka	1995	0.8	9.3	4.1	33	26	50	5.3	0.8	2.5	100	-	33.6	35.5	6.8	8.4	-
Nepal	1996	0.4	5.2	2.1	17	14	26	0.5	4.2	4.4	66	52	31.4	32.5	9.5	7.4	-
Mexico	1999	7.4	114.3	44.1	308	317	538	4.5	7.2	6.9	313	275	31.5	32.0	8.2	6.5	6.5
Brazil	1995	10.5	92.9	49.0	438	257	598	8.8	8.7	8.3	143	142	42.6	41.5	11.3	11.3	-
Turkey	1996	6.9	90.7	34.2	288	251	417	1.2	3.3	2.4	177	-	30.9	30.0	8.6	7.7	-
Poland	1999	4.0	34.1	10.4	167	94	127	13.7	9.3	3.5	522	437	43.3	18.8	8.2	11.7	11.7
Czech Rep.	1998	3.7	20.2	3.1	154	56	38	-	-	-	-	-	-	-	-	-	-
South Africa	1999	7.8	43.0	16.1	325	119	196	0.1	-0.5	0.7	63	-	16.6	19.4	17.1	18.0	18.1
Egypt	1999	2.6	27.4	7.4	108	76	90	8.4	9.8	8.5	130	117	18.3	17.7	10.4	9.5	9.4

Source: UNIDO International Yearbook of Industrial Statistics 2001 and previous years (based on manufacturing establishment census and surveys). ILO Yearbook of Labour Statistics 2000 (Table 5B) for Chinese earnings data.

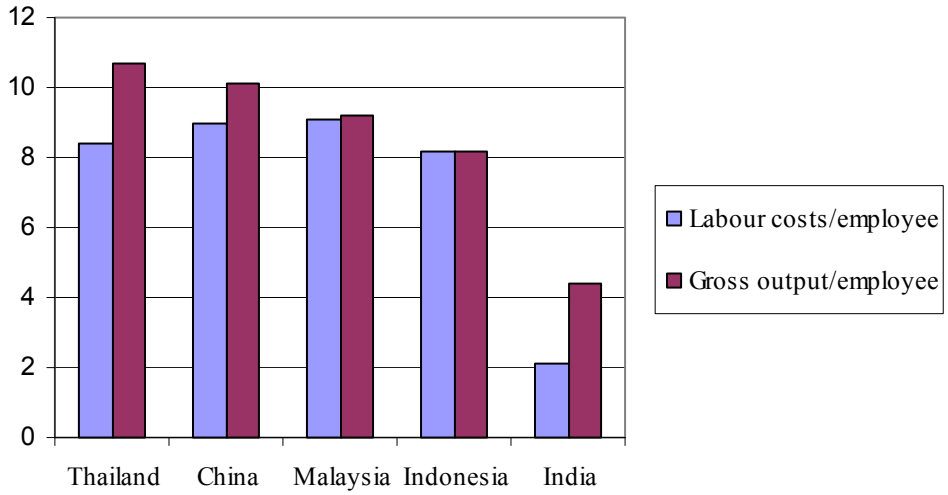
Note: The scope of the manufacturing censuses and surveys varies from country to country (but exclude cottage and household industries in most cases) as follows: Mexico, Brazil and South Africa, all registered establishments; Pakistan and Sri Lanka, all establishments employing at least 5 persons; Thailand, Philippines, Nepal and Turkey, all establishments employing at least 10 persons; Indonesia and India, all establishments employing at least 20 persons; China, all establishments with sales of at least 5 million Yuan; Poland, all establishments with at least 50 persons, Bangladesh, not known.

Operating surplus includes depreciation and indirect taxes, and also interest on loans.

[2] Average earnings in manufacturing. [3] 1998. [4] 1986. [5] 1996.

Figure 17 Labour Cost - Labour Productivity Relationship before Crisis, 1990-1997/9

(Per cent per year, Current US$)



Source: UNIDO International Yearbook of Statistics, ILO Yearbook for China's labour costs
Note: Thailand: 1986-96, China: 1990-98 Malaysia/Indonesia: 1990-97, India: 1990-99

Before the crisis, Thailand was one of the few countries where labour productivity growth outpaced rapid wage rises (2.5 per cent per year), together with China (1.1 per cent, Figure 17). In Malaysia and Indonesia, they both grew at about the same rate. In India, labour productivity grew more rapidly than labour costs per employee (2.3 per cent), but the rates were significantly lower.

Summary

The decline in the value of manufactured exports registered in 1996 was taken as evidence of a loss of competitiveness of the Thai industry. This cannot be attributed to higher wages in the 1990s for the following reasons. First, labour forms only a minor component of total production costs (6.8 per cent in 1996), and labour costs increases contribute only partially to cost increases. Second, labour productivity increased more rapidly than the cost of labour in the 1990s, resulting in a decline in the cost of labour relative to the value of manufacturing production. Third, as pointed out by ILO (1999), Thailand's capital-intensive exports, where labour costs are even lower than on average, also fell. Fourth, erosion of competitiveness through wage costs should happen gradually, not suddenly as in 1996. And fifth, 1996 saw a sharp decline in world trade growth.

In general, the higher the cost of labour per employee in a country, the higher the gross output per employee and value-added per employee. The high gross output or value-added per worker in turn reflected the combination of economies of scale (indicated by establishment size), more equipment per worker, and higher value of production, using more expensive raw materials and intermediate inputs. The causality between the cost of labour and higher labour productivity may well run in both directions: more expensive labour encourages investment in mechanization and a shift to higher value production, while higher availability of capital per worker in the economy as a whole raises wages.

A 1997 BOI survey revealed that labour costs were the most important inward investment factor for the majority of respondents (ILO, 1999), suggesting that investors still viewed Thailand in terms of a labour-intensive, rather than technologically more diverse production base. This would appear inappropriate to Thailand's level of economic development. The perception of the importance of labour costs as an investment decision-making factor in Thailand needs changing.

B. How Relevant are Total Factor Productivity Estimates for Thailand?

Policy makers, academics and other policy analysts in Thailand have become quite familiar with measures of Total Factor Productivity (TFP) in discussions of competitiveness. Despite often quite different TFP estimates for Thailand in the literature (Table 11), the consensus in policy circles seems to be that TFP growth was insignificant in Thailand, and may have declined sharply in the years leading to the crisis. For instance, the World Bank attributed the decline in GDP growth of 2 per cent in the two years before the crisis to a sharp drop in TFP from around 3 per cent per annum in 1986-90 to 0.1 per cent in 1991-95 (World Bank 2001a:2). The World Bank now produces annual TFP estimates to gauge economic growth and overall competitiveness, and treats TFP as a component of GDP, on par with investment and exports. Thus it explained that '…Capital accumulation fell by almost two thirds, and TFP growth dropped by close to 10 per cent, leading to a large contraction in GDP [in 1998] (World Bank, 2001b:1).

Table 11 Selected Total Factor Productivity Estimates for Thailand, 1960 – 1996

Source	Time Period	Whole Economy		Manufacturing		Remarks
		TFP	% Contr.to GDP growth	TFP	% Contr.to GDP growth.	
World Bank (1993)	1960-90	2.5				Full sample
		0.5				High-income
Marti (1996) [1]	1970-90	1.6	43			
Tinakorn & Sussangkarn (1996)	1978-90	2.7	36	-0.4	-4	1972 prices
		(1.2)	(16)			(Adjusted)
	1981-90	3.1	39	0.9	9	1972 prices
		(2.5)	(32)			(Adjusted)
	1981-90	2.8	37	1.6	15	1988 prices
		(2.2)	(29)			(Adjusted)
Tinakorn & Sussangkarn (1998)	1981-95	2.1	26	1.1		Unadjusted
		(1.3)	(16)	(-0.1)		Adjusted
	1986-90			3.8		Unadjusted
				4.0		Adjusted
	1991-95			-0.6		Unadjusted
				-3.1		Adjusted
Sarel (1997) [1]	1978-96	2.0	39			
	1991-96	2.3	35			

Source: Various studies cited above. Studies marked with [1] from Tinakorn and Sussangkarn (1998).

Another widely quoted study attributed just 16 per cent of the rapid economic growth of Thailand during 1978-90 to TFP, the remaining 84 per cent being accounted for increased use of factor inputs (Tinakorn and Sussangkarn, 1996). Repeating this exercise with revised data for the period 1980-95, the authors found TFP's contribution to GDP to be around 20 per cent, declining to just ten per cent in the manufacturing sector (Tinakorn and Sussangkarn, 1998). These researchers however rightly cautioned that TFP estimates were obtained as residual in their growth accounting framework, and thus were quite sensitive to differences in methodology, time periods and data sources. For instance, TFP growth doubled from 1.2 to 2.5 per cent per year by changing the starting year from 1978 to 1981. Corresponding figures for manufacturing were –0.4 to 0.9 per cent.

In contrast, two other studies indicated quite respectable TFP growth for Thailand. Sarel (1997) estimated TFP growth for the whole economy at 2 per cent in the 1978-96 period, and rising to 2.3 per cent in the 1991-96 period. The result for the last five years before the crisis is particularly noteworthy, because the corresponding figure of Tinakorn and Sussangkarn (1998) was just 0.4 per cent and even negative for the manufacturing sector (-0.6 and –3.1 per cent respectively for unadjusted and adjusted for education). A World Bank study in the wake of the crisis found that total factor productivity in manufacturing firms rose by 25 per cent between 1994 and 1996 (Dollar *et al*., 1998:4).

There are at least five reasons for such diverging TFP estimates, In addition to methodology, data sources and time periods, the other two reasons are capacity utilization and neoclassical assumptions of constant returns to scale and perfect competition. Taking methodology first, there are as yet no international standards and methods for calculating it, unlike the strict guidelines provided by the UN international standards for GDP and GNP calculations. So depending on the specification used, TFP often measures different things in different cases. Some specifications include several labour categories at various education levels as independent variables, while others have only one labour variable. Some specifications even include intermediate inputs as one independent variable. Second, TFP computation is quite demanding on the need for reliable time series data on capital stock, preferably by sector, data that are pretty hard to come by even in developed countries. Third, the sensitivity of TFP estimates to time periods has been well documented in Thailand and Indonesia, but not elaborated enough as to the factors responsible for such sensitivity.

Fourth, capacity utilization is often ignored, and may be particularly important in manufacturing. In the short-term and in a very dynamic context such as Thailand in the early 1990s, capacity utilization and business cycles greatly influence TFP estimates. Thailand benefited from large inward investments and rapid accumulation of capital in the late 1980s and early 1990s. The 1995 Plaza Accord resulted in the realignment of major currencies, including the strengthening of the Japanese yen, and rising manufacturing costs in Japan, the Republic of Korea and Taiwan, Province of China. These in turn produced a massive restructuring of manufacturing capacity in East and Southeast Asian, with lower-cost Malaysia, Thailand and Indonesia attracting many Japanese companies, particularly in the consumer electronics and automotive industries. This move was facilitated by the liberalization of the Japanese financial markets and government assistance in relocation for enhanced markets and cheaper production costs. While these investments continued to flow into the country during the 1990s, they were followed towards the late 1980s by labour-intensive garment and footwear firms from, Taiwan, Province of China, Hong Kong and Singapore, whose rapidly expanding export-oriented economies led to higher current-account surpluses, higher currency values, labour shortages and rising production costs.

Much manufacturing investment consisted of modern, large-scale production facilities. Due to the lumpiness of such investments, some excess capacity was probably inevitable at the earlier years of commencing production. Nevertheless, economies of scale in such facilities were probably responsible for the significant labour productivity increases noted earlier. Interpreting such productive investments as excessive accumulation on account of diminishing returns, as suggested by Tinakorn and Sussangkarn (1998:390), would appear to be premature considering the long-term nature of such investments. The implication, that capital investment in manufacturing was inefficient and should be reined in, is also counter-intuitive, considering its contribution in raising labour productivity and its central role in technology transfer embodied in machinery, and considering the authors' own finding that the growth of capital had the largest influence on TFP.

And finally fifth, many TFP specifications assume constant returns to scale and perfect competition, two neoclassical assumptions that do not obtain in many developing countries. In fact, economies of scale in modern and large-scale production facilities are a major source of productivity growth. Market power has also been found to be quite important. Together, the latter factors have been shown to double the estimated average productivity growth in Singapore, compared with the conventional approach (Kee, 2002). Thus, a great deal of circumspection is required in interpreting TFP estimates for monitoring the economy and for proposing policy recommendations.

A recent World Bank cross-country study of determinants of productivity growth found that, for low-income countries, investment was the most important determinant of productivity growth; it continued to play an important role in middle-income countries, but additional effects resulting from technological change also emerged; investment ceased to have a significant effect on productivity growth in high-income countries (Ahmed and Miller, 2002). In sum, investment in modern, large-scale and best-practice manufacturing production facilities should be welcomed to take advantage of the latest, best-practice production and process technology, to benefit from the division of labour and economies of scale, and to raise labour productivity faster than market-determined real wages. In turn, market-determined wages should be allowed to rise to improve living standards and domestic consumption, and to expand the home market for manufacturing production.

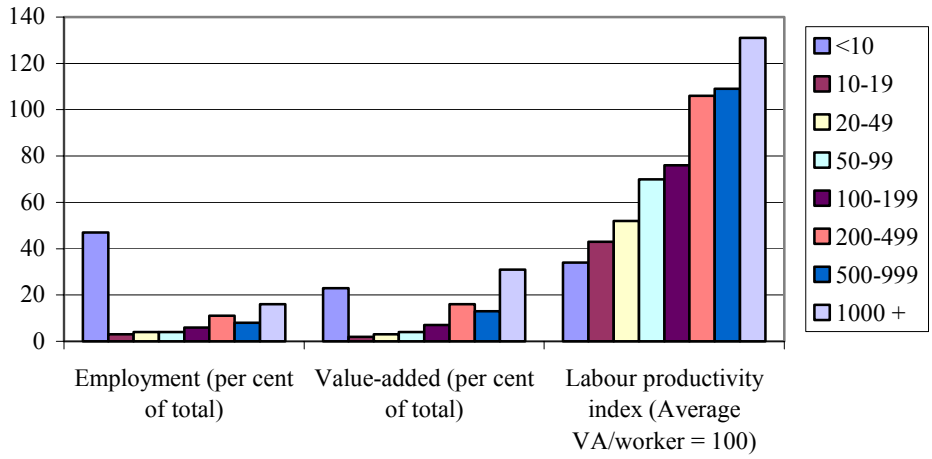
C. Small and Medium Industries

It is often claimed that small and medium enterprises accounted for a large share of jobs and output in Thailand (see for instance World Bank, 2001:3). As far as the manufacturing sector is concerned, the situation is quite the reverse. As shown below, large-scale establishments, employing more than 200 workers each, were responsible for 60 per cent of total manufacturing value-added and employed 35 per cent of all manufacturing employment. Though cottage and household industries, employing less than 10 workers each, accounted for nearly half of total manufacturing employment, SMIs (employing 10-200 workers) employed a third of total employment and produced less than 20 per cent of value-added in the organized manufacturing sector. This is elaborated further below.

The Thai manufacturing sector can be divided into four size segments: household and cottage industries (1-9 workers), small-scale industries (10-49 workers), medium-scale industries

(50-199 workers) and large industries (employing more than 200 workers each). According to the 1997 census of manufacturing establishments covering all size categories except the household sub-sector, the small, medium and large-scale establishments accounted for respectively 13, 20 and 67 per cent of the total employment of 2.43 million workers (Figure 18 and Table 12). Since the labour force survey counted a total of 4.63 million workers in the manufacturing sector in that year, the household segment can be roughly estimated to employ the difference of 2.20 million workers, although some of these may have been employed in small-scale establishments which are likely to have been under-reported in the census.

Figure 18 Employment, Value-Added and Productivity by Size, 1990



Source: Table 12

Table 12 Employment and Value-Added by Establishment Size, 1996

Workers/ Establishment	Employment		Value-added		Value-added/worker		
	Persons	%	Baht million	%	Baht 000s	Index (Avge = 100)	
						GDP	Census
Less than 10	2,198,416	47.5	305,256	23.4	139	49	34
10-49	327,503	7.1	65,501	5.0	200	71	49
10-19	126,922	2.7	22,287	1.7	176	62	43
20-49	200,581	4.3	43,215	3.3	215	77	52
50-199	484,623	10.5	145,684	11.2	301	107	73
50-99	204,119	4.4	58,385	4.5	286	102	70
100-199	280,504	6.1	87,298	6.7	311	111	76
200+	1,619,458	35.0	786,959	60.4	486	173	118
200-499	487,495	10.5	211,445	16.2	434	154	106
500-999	389,634	8.4	175,083	13.4	449	160	109
1000+	742,329	16.0	400,430	30.7	539	192	131
10+ (Census)	2,431,584	52.5	998,144	76.6	410	146	100
Total	4,630,000	100.0	1,303,400	100.0	282	100	69

Source: Manufacturing Census 1997, Table 2 (NSO); Economic & Financial Statistics, Bank of Thailand (Tables 82 and 89).
Note: Employment and value-added in establishments of less than 10 workers: Obtained as residual between Labour Force Survey/GDP and 1997 Census.

Unlike other countries such as Indonesia however, small and medium manufacturing establishments were engaged in all sectors including the fabrication of rubber, plastic and metal products. Though there is still a long way to go, SMIs in Thailand were relatively more integrated into the whole manufacturing chain than in neighbouring countries. SMIs cannot be developed in isolation. Since most of the manufacturing production takes place in larger establishments, SMIs can best be developed through forging linkages with larger establishments, a topic discussed in Section 4 below. Also, encouraging SMIs to invest in modern production facilities can increase both labour productivity and product quality.

D. Industrial Skills Development

There are two rationales for requesting the government to intervene in industrial training (Arnold *et al*., 2001). The conventional reason is the market failure argument facing individual firms, giving rise to under-investment in training, not from the firm's point of view, but from a social point of view, due to externalities. This constraint may operate even more severely in the case of small and medium firms. The second rationale takes the perspective of a group of firms in particular industries or value-chains. This is based on the significant flow of skills between firms, such as strong ones undertaking training for other firms, and contributing to the overall efficiency in the use, creation and allocation of knowledge resources. This rationale leads to optimizing investment in the system as a whole, not investment in training by each individual component firm in the system. Examples of this system include the knowledge diffusion system of the multi-firm *Keiretsu* groups in Japan in the 1950s and 1960s, and the Korean provision of incentives to larger firms to undertake a disproportionately large share of an industry's training activity, especially for in-plant training, or when training institutions are under-developed or where the training would be would quite expensive.

To date, Thailand has few policy measures designed to stimulate firms' investment in training and skill development. One such scheme at present is the 150 per cent tax deduction for eligible training expenditures, i.e., firms can claim tax deduction of up to on one and a half times their expenditures on training activities. However, this scheme is little used by firms because it is not well known, and because of the arduous administrative procedures and hurdles in gaining access to this facility. It is therefore primarily used by subsidiaries of MNCs, which would have undertaken training in any case without the tax deduction facility. Yet, building the capabilities to enter into design, engineering and R&D may often require initial investment in training and experience acquisition.

A new Skills Development Act was going through parliament at the time of writing. Firms that do not undertake a minimum amount of worker training, as determined by the Ministry of Labour, would incur a levy of up to one per cent of their wage bill. The idea is to penalize companies that do not undertake training. Programmes funded by the Skills Development Fund (SDF) would engage large firms and SMIs in collaborative training, and private training providers. Training schemes would range from basic literacy to technical, craft and managerial skills. Some funds would be targeted at priority sectors and technologies, while some would be used for accrediting training providers (Turpin *et al*., 2002). Funds would be available on a soft loan basis, at one per cent interest rate, not in the form of grant.

The proposed Thai scheme is different from levy-grant schemes operating in neighbouring countries. In the Republic of Korea (since the mid-1970s), Singapore (since the early 1980s) and Malaysia (since the early 1990s), all firms contribute a levy to a central fund from which they can secure a grant to reimburse training costs. The mandatory levy sets a disincentive for not investing in training, not merely an incentive to do so. The schemes for administrating and implementing the training have differed in these countries. The Republic of Korea's basic mechanism was to use large-firm training organizations to provide certified basic skills to SMIs, while both Singapore and Malaysia developed schemes to address the SMI needs more directly, such as group training schemes.

Experience in other countries indicates that larger firms are generally more able to benefit from levy-grant schemes than SMIs. Only a portion of the latter register and, of those, only few claim reimbursement for training activities. Arnold *et al*. (2001) and Turpin *et al*. (2002) have made a number of suggestions for encouraging SMIs to join and benefit from the Thai scheme as follows:

- MNCs and larger companies should be encouraged to become actively involved in training through: (i) financial incentives to become training suppliers for SMIs, (ii) representation on the SDF board, and (iii) involvement in collaborative training arrangements.
- The SDF should be involved in developing the "training industry" by offering cash contracts or grants to training suppliers – which could be larger firms, universities or government research institutes – to set up training courses.
- The SDF should allocate significant resources to provide SMIs assistance with training needs analysis, development of training programmes, and identification of appropriate training providers. In other words, it should create an effective demand for training.
- The SDF board, in close collaboration with the private sector and the National Competitiveness Committee, should identify priority areas in which training funds should be concentrated.

In addition to the above suggestions, it is important for Thai policy makers involved in industrial skills development, both in the Ministry of Labour and the Ministry of Industry, to closely study the schemes already in operation in neighbouring countries, and to learn from them in order to avoid repeating some of their mistakes.

CHAPTER IV:

Promoting Linkages

Linkages between foreign and domestic firms, between larger and smaller firms, and between manufacturing firms and equipment suppliers are crucial to the competitiveness of domestic firms. The latter can gain a foothold in international production networks, while foreign firms can be fully embedded in the host economy. For foreign firms, local procurement can lower production costs, allow greater specialization and flexibility, and better adaptation of technology and production to local conditions. Domestic suppliers can raise their output and employment. In the process, knowledge and skills can flow between the linked firms, with beneficial impacts on production efficiency, productivity growth, technological and managerial capabilities and market diversification. Finally for the host country, linkages can stimulate economic activity and, where local inputs substitute for imported ones, benefit the balance of payments. The increased manufacturing capabilities of suppliers can in turn spill over to the rest of the economy.

Porter describes the advantages of supplier industries in the following way:

> "The presence of internationally competitive supplier industries creates advantages in downstream industries in several ways. The first is via efficient, early, rapid and sometimes preferential access to the most cost-effective inputs. … More significant than access to machinery or inputs is the advantage that home-based suppliers provide in terms of ongoing coordination … [and] in the process of innovation and upgrading. Competitive advantage emerges from close working relationships between world-class suppliers and the industry. Suppliers help firms perceive new methods and opportunities to apply new technology. Firms gain quick access to information, to new ideas and insights, and to supplier innovations. They have the opportunity to influence suppliers' technical efforts as well as serve as test sites for development work. The exchange of R&D and joint problem solving lead to faster and more efficient solutions. Suppliers also tend to be a conduit for transmitting information and innovations from firm to firm. Through this process, the pace of innovation within the entire national industry is accelerated. All these benefits are enhanced if suppliers are located in proximity to firms, shortening the communication lines." (Porter, 1990:101-13).

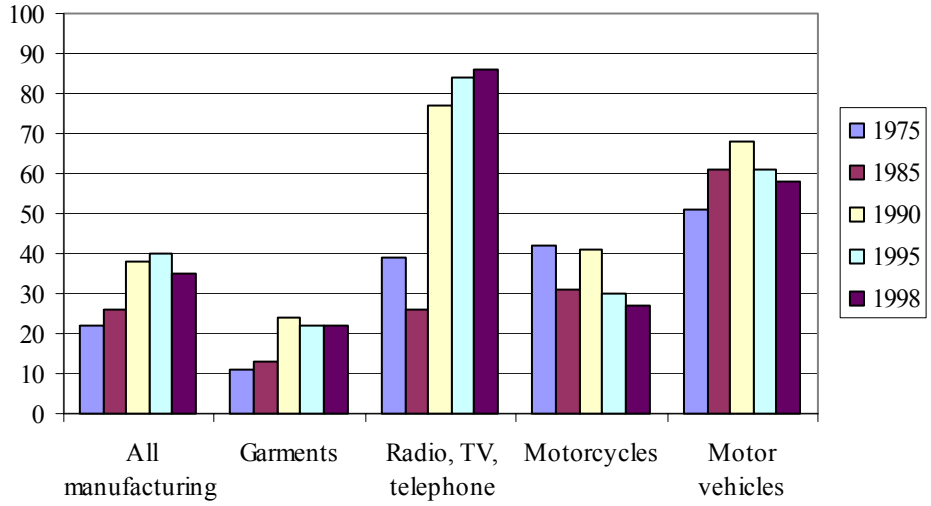
Linkages developed in competitive environments and accompanied by efforts to enhance the suppliers' capabilities are likely to be technologically more beneficial and dynamic, and can foster suppliers who can survive international competition (UNCTAD, 2001:xxi). This section examines the trends and patterns in the development of supplier industries, before discussing the past role and future challenges of industry associations in promoting linkages.

A. Trends and Patterns

Overall trends

Increased manufacturing capability of Thai firms would imply their ability to supply a progressively higher share of intermediate inputs to other firms. Yet, before the crisis, the opposite occurred. The imported content of intermediate inputs increased from 22 to 26 per cent between 1975 and 1985, and increased even more rapidly to 38 per cent between 1985 and 1990, a period of rapid inflow of foreign direct investment. It continued to increase to 40 per cent between 1990 and 1995, and only declined to 35 per cent during the financial crisis and the ensuing Bath devaluation (Figure 19 and Table 13).

Figure 19 Import Content of Intermediate Inputs, 1975-98, 1975-98 (% of total)



Source: Input-Output Tables, NESDB

At least three factors may have contributed to this trend. First, the production structure of manufacturing sector evolved from producing largely labour-intensive products, which used less imported inputs, to more technologically advanced products such as electronics, motorcycles and motor vehicles, which utilized a higher proportion of imported inputs. Second, foreign firms have a higher propensity to import than domestic firms, as discussed below, and the role of foreign direct investment in the Thai economy increased sharply after 1985. And third, manufacturing became more export-oriented, requiring higher quality intermediate inputs, not yet available from domestic firms, to produce final products destined for the world market. As a result, the overall reliance on imported intermediate inputs increased.

The increase in import content took place in virtually all industries, ranging from labour-intensive textile, garments and footwear, to resource-based paper and fertilizer industries, and to fabricated metal, electrical and electronic and transport equipment industries. Notable exceptions were the plastic goods industry, following the discovery and exploitation of natural gas in the Gulf of Thailand, and in the motor vehicle and motorcycle industries where

the important content declined after 1990, assisted by the local content policy and the local procurement policies of the Japanese auto manufacturers.

Imported inputs and FDI

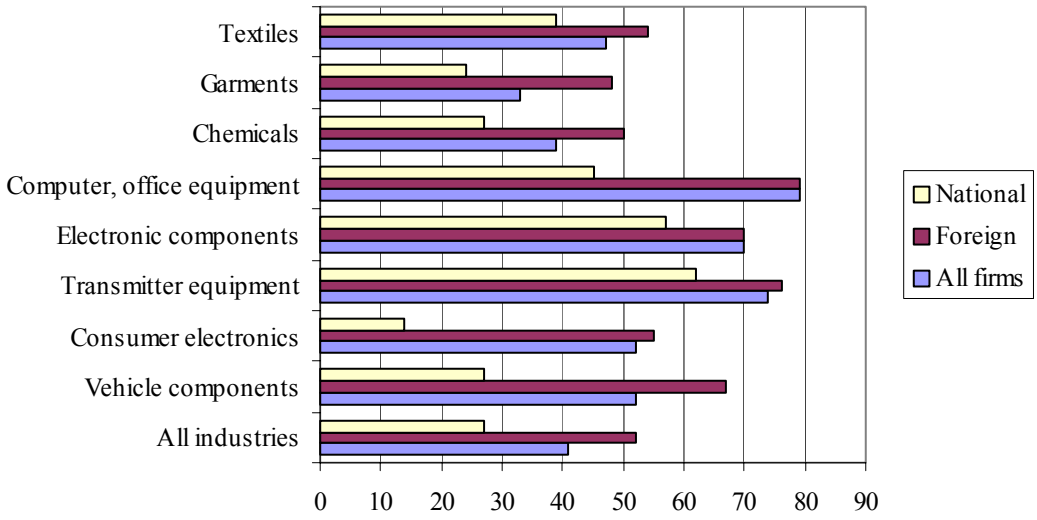
According to the 1996 census, manufacturing establishments imported 41 per cent of their intermediate inputs (Figure 20). This percentage was twice as high in foreign establishments as in domestic ones (52 vs. 27 per cent). The import content also increased with the technological level of industries, being lowest in garments, chemicals and textiles (33, 39 and 47 per cent), and highest in electronic components, transmitter equipment and computer and office equipment (70, 74 and 79 per cent). Consumer electronics and vehicle components occupied the middle range (52 per cent). In all industries, foreign firms imported more of their intermediate inputs than domestic firms. In industries dominated by foreign firms such as electronic components and computer and office equipment, their import content was virtually undistinguishable from the import content of the whole industry.

Table 13 Import Content of Intermediate Inputs, 1975 – 1998 (% of Total)

I/O No.	Industry	1975	1985	1990	1995	1998
	All Manufacturing	21.9	26.4	38.4	40.4	34.6
69	Textile bleaching, finishing	24.5	38.8	54.4	52.8	44.6
70	Made-up textile goods	10.8	12.5	23.8	22.0	21.8
77	Footwear	6.3	8.1	13.6	25.4	40.9
81	Pulp, paper and paperboard	38.5	53.3	57.4	62.7	47.6
84	Basic industrial chemicals	34.0	52.0	52.5	53.7	19.8
85	Fertilizer and pesticides	43.3	59.8	68.6	70.0	35.8
86	Synthetic resins, plastics	15.3	31.0	26.8	25.1	18.2
88	Drugs, medicines	42.4	39.5	48.6	51.7	47.1
89	Soaps, cleaning preparations	33.7	40.3	43.0	42.8	25.8
96	Tyres and tubes	27.5	18.0	25.9	31.9	29.4
98	Plastic wares	61.2	55.1	45.0	38.0	40.7
110	Structural metal products	40.6	51.9	65.9	63.7	71.9
112	Engines and turbines	50.1	34.9	32.7	52.4	65.1
116	Office machinery, appliances	42.9	50.2	79.5	57.5	36.7
117	Electrical machinery	40.0	47.7	51.7	68.1	58.3
118	Radio, Television, telephones	39.1	25.6	77.1	84.4	86.3
119	Household electrical appliances	19.2	18.2	39.4	49.6	35.0
125	Motor vehicles	51.4	61.0	67.5	60.8	58.1
126	Motorcycles and bicycles	42.0	31.0	40.8	30.2	26.9
131	Watches and clocks	18.0	29.3	32.8	26.3	43.5
132	Jewellery and related articles	41.5	45.1	56.9	43.7	40.7

Source: Input-Output Tables, National Economic and Social Development Board (NESDB).

Figure 20 Import Content of Intermediate Inputs, 1996

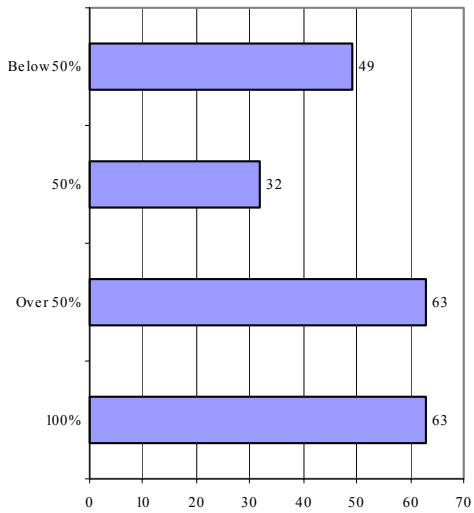


Source: Census of Manufacturing Industries 1996, NSO

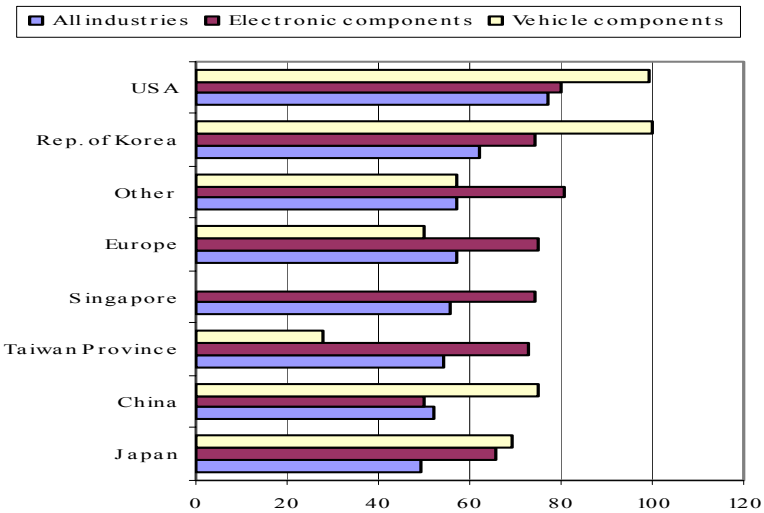
The propensity to import also varied with the degree of ownership and the origin of the foreign firms. Firms with 50 per cent foreign ownership or less imported less than those with more than 50 per cent foreign ownership (32-49 per cent vs. 63 percent, Figure 21a). Past that stage, there was no difference between firms with more than 50 per cent and 100 per cent foreign ownership. As for country of origin, Japanese, Chinese and Taiwanese firms relied less on imports than firms from Singapore, Europe, the Republic of Korea and USA (50-55 vs. 57-58 per cent), while firms from The Republic of Korea and USA were the most import dependent (62-77 per cent). This ranking generally held at the industry level, for instance in electronics and vehicle component manufacturing (Figure 21b).

Figure 21 Import Content of Intermediate Inputs in Foreign Firms, 1996

(a) Foreign firms by ownership share



(b) Foreign firms by country



Source: Census of Manufacturing Industries 1997, NSO
(special tabulations prepared by OIE, Ministry of Industry)

Although foreign firms have an interest in creating and strengthening local linkages, they may be unaware of the availability of viable suppliers, or they may find it too costly to use them as sources of inputs. Well-designed government policies can raise the benefits and reduce the costs of using domestic suppliers. The role of policy is particularly important where there is an 'information gap' on the part of both buyers and suppliers about linkage opportunities, or where there is a 'capability gap' between buyer requirements and supplier capacity, and where the costs and risks for setting up linkages or deepening them can be reduced. The technological and managerial capabilities of domestic firms determine to a large extent the ability of a host country to absorb the knowledge that linkages can transfer. Weak capabilities of domestic firms increase the chances that foreign affiliates source the most sophisticated and complex parts and components either internally or from a preferred foreign supplier within or outside the host country.

B. Industry Associations

Industry associations in the evolving competition scenario

Trade liberalization has made competition more intense in the global economy, raising new challenges for industry associations, and requiring them to extend their activity beyond their traditional lobbying role. Trade liberalization provides the impetus for firms to seek improvements in production organization, with faster delivery schedules and lower stock costs. It also requires them to develop design capabilities, improve quality and access new markets that have yet to be targeted by lower-waged producers. Finally global standards are increasingly gaining importance in international trade, which are in many ways new forms of non-tariff barriers. Associations can play a catalytic role in enabling the process of industrial upgrading and adopting global standards, in addition to sharpening their lobbying function. Thus, not only firms but also industry associations need upgrading, because joint action and cooperation are increasingly required by domestic firms to face the challenges of the new competition (Nadvi, 1999:19).

Several researchers have drawn attention to the potential benefits of industry associations. Doner and Schneider (1998:11) stressed the associations' role in providing horizontal coordination among producers, vertical coordination of upstream and downstream linkages, setting and enforcement of product standards, and the provision of information and technical training. Porter (1998:258) noted that, in addition to providing a neutral forum for identifying common needs, constraints and opportunities, associations could serve as focal points for efforts to address them. Moore and Hamalai (1993:1897) mentioned political voice, the provision of concrete business services such as seminars, information and library services, exhibitions and trade fairs, foreign contracts, contract adjudication, specialized legal advice and assistance, and certification of documentation and of product quality, an arena for social contact between members, an arena and 'cover' for cartel arrangements, and participation in framing or implementation of public policy, including the performance of regulatory duties.

In the context of SMI clusters, Nadvi (1999:9) found a clear relationship between support through the association and a cluster's overall competitiveness. In each of the four clusters studied (three shoe manufacturing clusters in the Sinos Valley, Brazil, in Guadalajara, Mexico, and Agra, India, and one surgical instrument cluster in Sialkot, Pakistan), the

majority of sampled firms reported that they had experienced a rise in the level of joint action with their respective trade associations following the onset of the particular crisis that their cluster faced. In addition, in a number of these clusters there appeared to be a relationship between increasing joint action through the business association and improved firm performance.

However, Moore and Hamalai (1993:1895) warn that business associations often act more in the interest of their own staff and organizers than in those of their members. The potential for 'unproductive' rivalry and conflict between competing associations is high. The more effective associations are those not financially dependent primarily on membership fees, and which can offer specialist services. Business Associations (BAs) are often numerous, because they charge relatively small fees, and face no opposition from employees.

Organizers belong to two categories. They are either administrative employees of the associations, whose salaries, status and career prospects and opportunities for supplementary remuneration are perceived to be linked to the success of the organization in terms of its financial turnover, the volume of its activities, and the extent to which it can command the attention of influential external agencies, notably government and perhaps aid agencies. Alternatively, organizers could be businesspeople, who view office-holding as an opportunity to enhance their own status, to make valuable business contacts with politicians, bureaucrats and other businesspeople, to advance their own political careers, or to promote particular causes with which they identify closely. Organizers may often have more interest in the existence and activities of BAs than members, and may have considerable autonomy to manage BAs. This helps explain why they are so numerous, but also why they often have overlapping formal areas of jurisdiction and actively compete, in the same sphere, for members and for recognition from the state.

Thailand's earlier experience with industry associations

Laothamatas (1993:49-51), in a comprehensive study of business associations, noted that trade associations, chambers of commerce and their apex organizations have been active in Thai public policy-making since the early 1980s. Though industry-specific associations such as the Thai Textile Manufacturing Association, the Thai Printing Association and the Bangkok Rice Millers Association had long existed, the Association of Thai Industries was founded in 1967 by leading industrialists who felt that the government had not done enough to facilitate industrial development. In addition they perceived the Thai Chamber of Commerce (TCC) and the Board of Trade to be only representing agricultural exporters. In 1988, a new law was enacted to elevate the association to the status of the Federation of Thai Industries (FTI). There are other non-registered apex organizations, such as the National Federation of Thai Textile Industries, whose membership consists of five associations dealing with respectively with synthetic fibres, textile manufacturing, weaving, garment and silk.

Sino-Thai businessmen dominated the majority of trade associations in Bangkok. While all the chambers of commerce and apex organizations were active, viable and concerned with public policy affecting them, the majority of trade associations were not. A large number of them functioned as social clubs or venues for the welfare-oriented activities of their members. Some associations did not have permanent staff. Meetings, planned activities, and elections were rarely held. Often, the leaders alone bore virtually al the administrative and financial burdens of the organizations that they represented. Trade associations consisted of agricultural export associations (rice, tapioca, maize) concerned mainly with export

regulations. There were relatively few trade associations in the provinces. The most active were the export-oriented ones.

There were some fifty industry associations in Bangkok in 1987. Some focused on the improvement of the technological and managerial capability of their members so as to help them meet the stringent demands of the international market. This was achieved through a variety of means such as publishing journals, holding seminars and conferences, seeking technical assistance from academics, and inspecting the manufacturing facilities of their members (Laothamatas 1993:53).

Associations representing large-scale, domestically oriented industries were also active, focusing less on technical and managerial assistance to their members, and more on public policy. For example, the Pharmaceutical Products Association and the Thai Pharmaceutical Manufacturers Association opposed the government procurement policy favouring state-owned pharmaceutical companies. The Thai Petrochemical Association opposed the removal of the import surcharge on products competing with their locally made products. The Palm Oil Refiners Association fought for a ban on the export of crude palm oil needed for the domestic industry (Laothamatas, 1993:56).

The decisive support of the Thai Auto Parts Manufacturing Association (TAPMA) for the government's local content policy illustrates the positive role that industry associations can play in industrialization. The establishment of a world-class domestic auto parts industry was due to the local content policy pursued by the government in the motor vehicle industry over many years, and initially opposed then supported by the larger Japanese assemblers such as Toyota. Nevertheless the local content policy could have been easily defeated by the assemblers, were it not for the successful lobbying of the industry associations representing domestic parts manufacturers (Doner, 1991, Poapongsakorn, 2001). The members of TAPMA first established themselves as producers of spare parts for the after-sale service sector.

In addition to lobbying for specific supportive public measures, some export-oriented associations undertook some economic activities to improve the performance of their members in the world market. For instance, the Thai Printing Association sent delegates to book fairs to exhibit Thai products. A trade organization called IPEC was created to seek printing service contracts from abroad, to be allocated among members. The Thai Fishery and Frozen Product Association and the Thai Plastic Industries Association published newsletters and journals containing information on technology and the market situation. The Thai Plastic Industries Association held regular seminars on technology and techniques needed to improve domestic plastic products, and opened a technical library for its members in the late 1980s The Thai Fishery Association organized conferences on the quality control of processed seafood required to satisfy foreign importers and inspecting agencies. It also made regular contributions to improve the efficiency of the public agencies responsible for the inspection of exported processed foods, e.g., a computer for the Department of Medical Science to be used for the inspection of its products (Laothamatas, 1993:128-129).

Profile of selected industry associations

The Thai Federation of Industries (TFI). As already mentioned, the Thai Federation of Industries was founded in the late 1960s to facilitate industrial development, and to represent their views better than the Thai Chamber of Commerce (TCC) and the Board of Trade, who

were seen as representing agricultural exporters only. It is located on the second floor of the main exhibition hall of Bangkok and consists of several industrial committees, known as clubs, and a network of provincial branches.

TFI has been very active and successful in both lobbying government and providing concrete services to its members. For example, it houses a well-stocked bookshop selling and disseminating books and video-cassettes on productivity topics such as just-in-time management, quality control, quality circles and human resource development. TFI also undertakes trade missions abroad, as well as hosting visiting missions from other countries to Thailand. Its financial independence is safeguarded by revenues generated in holding the sole right to issue supermarket bar codes. TFI is also quite established as a formal member of numerous government committees and councils.

Toyota Motor Thailand's suppliers association. Toyota Motor Thailand (TMT) intends to procure all parts and components locally (meaning in ASEAN countries) by 2003, from an estimated 70 per cent at present, in anticipation of the ASEAN Free Trade Area and the resulting high competition with other motor vehicle companies. The Toyota Cooperation Club (TCC) is a major channel for attaining this goal, and presently consists of 92 first-tier suppliers out of a total of 575 first-tier suppliers (134 core part suppliers and 441 suppliers of materials and facilities), many of whom are Toyota-related companies and Japanese joint ventures. Second, third and fourth-tier suppliers are likely to number some 1,500 suppliers. TCC is a good example of fostering linkages and upgrading domestic firms through cooperative action (UNCTAD, 2001:146).

Membership of TCC requires suppliers to have an annual sales volume with TMT of five million Bath and a three-year relationship. In return, TCC organizes annual conferences, executive committee meetings, quality assurance Kaizen (steady improvement) activities, cost Kaizen activities, quality control circle activities, and lectures. The lectures and testing facilities are open to all suppliers. Though established by TMT, key suppliers play the leading role in the TCC executive committee. Members of the latter organize various activities in their companies to diffuse the Toyota production system, including seminars and training courses, and study groups on plant operation. TMT and Toyota Japan provide technical advice and guidance, and encourage suppliers to make their own efforts to improve their operations and competitiveness, as well cooperation among suppliers to implement just-in-time delivery and just-in-sequence production. An important contribution is the 'Supplier Centre' set up at the TMT office headquarters to provide all necessary information for its suppliers, including prototypes of all major parts, lists of suppliers and their performance every month, and information on specifications of major parts and components. Finally TMT encourages first-tier suppliers to similarly work with and develop second and third-tier suppliers.

International Drive Equipment and Manufacturers' Association (IDEMA Thailand). The Thai branch of this international association, founded in the USA in 1986, was formed in 1999 to develop Thailand as a centre of excellence in the hard disk drive and related industries. Its management committee included leading HDD companies such as Seagate, Read-Rite, Fujitsu and IBM, together with representatives of the Board of Investment (BOI), Asian Institute of Technology (AIT) and the National Electronic and Computer Technology Centre (NECTEC).

Two sub-committees have been formed to focus on critical needs of the industry, namely human resource development, and automation infrastructure development. IDEMA and AIT developed the Certificate of Competence in Storage Technology, and trained around 500 industry professionals in 2000. In addition, three symposia on storage technology and numerous tea talks brought together world-renowned experts in the HDD industry. IDEM produces a regular magazine and disseminates information on markets and new technologies to its members. Finally, IDEMA has produced a basis for a Thailand Storage Industry White Paper to strengthen relationships between all key partners in the storage industry area, including industry, academia and government, and to map out critical directions for human resource development, automation infrastructure development, and supplier industry development.

C. Linkages, FDI and SMIs

Linkage programmes should be seen as part of Thailand's broader set of policies regarding foreign direct investment and the development of small and medium industries. The next generation of promotion policies should target foreign investors at the level of industries and firms and using clusters. In fact the more linkage promotion policies go hand-in-hand with FDI promotion and SMI promotion, the more successful these policies are likely to be. The challenges facing Thailand in developing supplier industries will be examined after reviewing the current situation.

Policy instruments traditionally used to foster linkages, such as local content requirements and investment performance requirements, are now less relevant or subject to multilateral rules, such as WTO agreements and Trade-Related Investment Measures (TRIMs). In this new policy environment, well-targeted incentives to support the creation and deepening of linkages are required which work with the market. Measures to improve the enabling environment for linkage formation include provision of information and matchmaking (as in the Board of Investment Industrial Linkage Development Programme or BUILD); encouraging foreign firms to participate in programmes aimed at the upgrading of domestic suppliers' technological capabilities, including training; promoting the establishments of supplier associations or clubs; and schemes to enhance domestic suppliers' access to finance. The role of industrial associations in promoting linkages in particularly important, and is discussed in Chapter 6 below.

As for industry associations, promoting joint action may be difficult given that in many cases the producers are often also local rivals. The possibilities of external economies and the free rider gains can also discourage cooperation among local agents. This is often mentioned as a crucial constraint in Thailand. Nevertheless, if these constraints can be overcome, as in some other countries, industry associations can potentially offer a range of valuable services to their members. These include representing the interest of their members to government, undertaking coordination and regulatory tasks, and providing members with a wide range of producer services such as: (i) technical and managerial advice, and information to help link local producers with distant markets, including data on markets, prices, competitors, trade policies as well as general trade information; (ii) technology support to help local producers upgrade, both in process and product technologies as well as moving up the value chain into areas such as design and research and development; (iii) linking of local producers to local and global trade fairs to gain exposure to foreign designs and products while bringing

external buyers; (iv) benchmarking services to help local producers compare their performance with global best practice; and (v) technical assistance to meet new global standards and the development of local quality labelling (Nadvi, 1999:6).

CHAPTER V:

Industrial Technology Development System

A. Technology Acquisition and Development[2]

Industrial technology development is not just concerned with research and development (R&D) activities. In fact R&D form a minor component in the range of technological development activities, often accounting for just 20 per cent of total expenditure even in industrialized countries. The remaining 80 per cent are spent on non-R&D activities such as design, engineering, and reverse engineering. One can distinguish ten types of technological activity falling into three groups as follows (Arnold *et al*., 2000):

Technology acquisition:

1. New units of equipment or machinery in existing plants
2. New materials and components for existing designs and specifications
3. Turn-key plants
4. New product technology embodied in existing designs and specifications

Design and engineering activities:

5. Engineering-based incremental improvement in process technology
6. Incremental improvement in product specifications and designs
7. Continuous improvements in logistics and supply chain with existing suppliers
8. Design and reverse-engineering, and linkages with new suppliers of equipment and materials

Research and development:

9. Technology search and research close to the international frontier
10. Technological R&D, plus design and engineering for new products and processes.

In the first group, the common characteristic of the four types of technology acquisition is that they involve the introduction of standard designs, specifications and machinery already used elsewhere. Industrializing countries such as Thailand acquire rather than develop their technology, and the sources of capital equipment and product technology are usually located in industrialized countries. However, industrial growth relying on technology acquisition only, without some of the other six types of technology development, which typically have to be located in the domestic country, may miss out on an important source of enhanced productivity growth and other forms of competitiveness.

[2] Sections 5.1 and 5.2 rely heavily on a comprehensive completed review of the industrial technology system in Thailand for NSTDA and funded by the World Bank, by Arnold *et al.* (2000).

A technologically shallow path of industrial growth is one of limited investment by industry in the capabilities required to undertake activities in categories five to eight. However, it is important to stress that the first two groups of activities, namely technology acquisition and design and engineering development are not substitutes for each other, but complements. Thus Thailand's reliance on categories one to four has not been too great; rather, firms have invested too little in categories five to eight. Finally, activities under categories nine and ten are less important for the majority of industrial firms in Thailand. Yet this is where the available public resources for technology development, which are considerable, appear to be allocated.

In some models of technology development, including that of NSTDA, industrial firms are described as the 'demand side', while the 'supply-side' is provided by technology institutes and universities. In fact the industrial firms not only generate the demand for technology, but also account for a very large part of the supply as well. In industrialized countries, the vast majority of technology development takes place in industrial firms. They supply much of the new technology they use themselves, especially of types 5-10, and they also supply a very large proportion of the technology used by other firms. Estimates from OECD countries put this proportion at 60 to 70 per cent, the remaining 15-20 per cent and 10-15 per cent being respectively accounted for by the higher education sector and the government sector. These proportions are likely to be higher for industrial R&D. Furthermore, knowledge flows between firms and their suppliers and customers dominate the structure of knowledge flows in the technology development system; over 50 per cent of firms considered this as relevant in recent surveys. Finally, the movement of people between firms also contributes to the knowledge flows, ranking as an important source of technology by a quarter of firms in a Korean survey, more important than licensing and technical assistance from foreign sources.

Two areas of policy are addressed in this section: measures to strengthen support institutions in undertaking scientific and technological activities on behalf of industrial firms, and measures to strengthen the capabilities and activities of firms concerned with undertaking their own technology development.

B. Technology Institutions

Current situation

A number of industry-related institutions have been established since the 1950s, and these have undergone changes and evolution until the late 1990s. The major ones are the three centres of excellence managed by the National Science and Technology Agency (NSTDA), a specialized agency of the Ministry of Science and Technology (MOST), and a series of sectoral technical institutes under the Ministry of Industry (MOI). In addition, the Applied Scientific Research Corporation of Thailand, later renamed the Thai Institute for Scientific and Technological Research (TISTR), was established in the late 1970s and incorporated into MOST, to undertake R&D activities. The Department of Science, first under MOI, and later transferred to MOST and renamed the Department of Science Services (DSS), carries out testing and analysis work, as well as applied technology research. The National Research Council of Thailand (NRCT) was set up in the 1960s under the Office of the Prime Minister to establish a national science policy and provide inputs into five-year plans, as well as funding some R&D in universities. The Thailand Research Fund (TRF) was established in

1993 under the Office of the Prime Minister to fund R&D in universities and public sector institutes, and to a limited extent, in the private sector.

NSTDA was formed in 1991 as a specialized agency under MOST, allowing higher salaries and greater budgetary flexibility outside the standard government bureaucracy. It incorporated the ministry's national centres of excellence for biotechnology (BIOTEC), metals and materials technology (MTEC) and electronic and computer technology (NECTEC) established in the 1980s. NSTDA performs several other important functions. It funds R&D in universities, and manages and funds national human resource development programmes on behalf of MOST. It is responsible for developing and managing the Science Park and the Software Park outside Bangkok. It is responsible for managing private sector support programmes under its Department of Industrial and Techno-Business Development. And finally, by hosting the secretariat for the newly established Science and Technology Policy Committee, it plays a major role in policy analysis, policy advice and overall planning for the Office of the Prime Minister. This last role puts NSTDA in a privileged role in accessing public funds for R&D and other technological activities for its own centres and departments.

The first MOI institutes were established in the 1970s under the Department of Industrial Promotion (DIP), and covered textiles, metalworking and other areas. In the second half of the 1990s, these were re-invigorated while several of its divisions and centres were made autonomous, including the Food Institute, the Textile Institute, the Electrical and Electronics Institute, and the Thai Productivity Institute, primarily through the relocation of some research and laboratory testing functions. These were established outside the bureaucratic structure to provide better support services including training, consultancy, testing and laboratory services, and provision of market information. As autonomous institutes, they were able to pay higher salaries to attract private sector managers and professionals, and given flexible budgetary arrangements. However, they were also given five years in which to become financially self-supporting.

Selected MOI technology institutes

The Thai Productivity Institute. The Thai Productivity Institute (TPI), a non-profit independent foundation overseen by the Ministry of Industry, was established in 1994 and began operations in 1995. For over 40 years, it was a division of the Department of Industrial Promotion, but today its management and staff are no longer civil servants. TPI has two aims. The first one is to be the national body in charge of promoting general awareness and understanding of productivity through lectures, training of lecturers, publications, the media, activities and exhibitions, and through exchange of information with organizations in other countries as, for instance, the Thai member of the Asian Productivity Organization (APO) located in Japan. The second one is to provide direct consultancy and training services in quality assurance and productivity to individual companies in all sectors, including manufacturing, trade and other services, and in the private sector as well as in government agencies. The government recently evaluated TPI with funding from the World Bank, and reached the following key conclusions.

TPI is facing a number of challenges arising from its wide mandate. Its first aim to promote awareness of productivity in general, and to be contact point for APO, is in the nature of a public good. It is producing a newsletter with a circulation of 5,000, and has provided

training for 5-6,000 participants in seminars and courses. However, it does not work with industry associations to raise their capacity to address productivity issues of their members.

Its second aim, to provide direct productivity enhancing services in return for a service fee, has received the bulk of its attention and resources, due to the government-set target of becoming financially self-sufficient after five years of operation. However, TPI is not focused on any particular sector of economic activity such as manufacturing. Even within manufacturing, the characteristics and needs of firms vary enormously between sub-sectors such as food, garments, chemicals, motor vehicle manufacturing and electronic component manufacturing. Beyond general principles of marketing, financial and human resource management, the technical issues of quality control, and product and process development arising in firms in specific sub-sectors can perhaps best be addressed by specialized, sub-sectoral productivity agencies. In fairness, TPI was established several years before the government recognized the need for specialized institutes, such as the National Food Institute and the Electrical and Electronic Institute, and established these in 1998. TPI's current focus on the provision of ISO 9000 and ISO 14000, which accounted for two thirds of TPI's customers, also needs reconsideration, due to the presence of several private sector players providing similar services.

TPI's own productivity in providing consulting services was relatively low. In 1998/99, it undertook some 30 projects per quarter with a total staff of 155 people, 61 per cent of whom consisted of service delivery personnel, i.e., consultants, trainers and other staff who provide services directly to customers (Nexus Associates, 2000:62). Since a typical project lasted about three months, the staff to customer ratio was 5 to 1 overall, and 3 to 1 for delivery service personnel.

Now that industry-specific institutes are being established, TPI could focus on its first aim of productivity awareness and boosting productivity throughout the economy. Being an apex organization, TPI could become the Thai Productivity Organization (TPO), and collaborate closely with industry associations, the latter becoming the intermediate link between TPI and individual firms. TPI could direct its resources to strengthen and build the capacity of industry associations, which are presently quite weak. A focus on this 'public good' function, at the exclusion of 'private good' direct service provision, for which it can charge a fee, will however clash with that of becoming financially self-sufficient through service fees. Government funding of the organization will therefore continue to be required to fulfil its non-income generating mandate.

The National Food Institute. The National Food Institute (NFI), overseen by the Ministry of Industry, was established in 1996 and began operations in 1997, taking over the government personnel and laboratories previously directly under the Ministry of Industry. Its aims of improving the quality and safety of food products, as well as becoming self-supporting financially, are implemented through: (i) fee-paying laboratory services (chemical, microbiological and physical testing), (ii) consulting services related to the adoption of Hazard Analysis and Critical Control Point (HACCP) practices; (iii) training seminars and workshops, contract research for the government, particularly those related to international trade; and (iv) publications on food safety and quality.

Its full-time staff of 72 people consisted of 42 service delivery personnel (59 per cent), while the remaining were administrative and sales employees, handling about 150 new customers for HACCP and laboratory services in the first half of 2000 (Nexus Associates, 2000:17).

Service delivery personnel spent about half of their time directly with customers, and the half on marketing, staff development and various administrative matters. Most of the customers at present are large-scale food industries requiring HACCP factory certification. The scope for the latter remains large, since only 1,000 factories have been certified, out of 3,300 medium and large-scale food establishments recorded in the 1996 census of manufacturing industries, and 12,000 establishments registered with the Ministry of Industry.

There are a number of public and private organizations providing HACCP services and certification, including the Department of Fisheries, the Thailand Industrial Standard Institute, the Department of Medical Sciences, the Department of Livestock Development, and SGS Thailand. Similarly, the Thailand Institute of Scientific and Technology Research (TISTR), the Department of Science Service, the Department of Livestock Development, the Overseas Merchandize Inspection Company (OMIC), the SGS Testing Laboratory and Advantage Company Limited also provided laboratory services (Nexus Associates, 2000:20).

The Food Industry Club of TFI strongly lobbied the government to establish The NFI to provide a research facility to address non-tariff barriers erected by importing countries to protect their own food industries. With its present focus on fee-generating laboratory testing services, the NFI, according to the Food Industry Club, has not lived up to this task. Because NFI's leadership comes from the Ministry of Industry, the Food Industry Club has not been successful in influencing or redirecting NFI's activities. Furthermore, NFI should ideally avoid overlap in testing services with other public and private agencies. NFI's comparative advantage may thus lie in focusing its efforts on research, non-tariff barriers and other trade issues, and redirect its laboratory services to small and medium-scale industries. However this may clash with the government's wishes for NFI of becoming financially self-supporting within five years of operation.

The Thai-German Institute. The Thai-German Institute (TGI), overseen by the Industrial Development Foundation and the Ministry of Industry, began operation in January 1998, primarily as a training institute, but also to offer consulting services, in the metalworking industry. Its staff of around 90 persons, supplemented by a team of five German technical specialists and one German co-director funded by GTZ, offered 60 hands-on training courses of three to five-day duration. Approximately 40 people or 48 per cent of the staff were service delivery staff, and about a quarter of the time of the latter was actually spent on direct service delivery.

The participants came from 100-200 small and medium metalworking industries each quarter of 1999. Some participants were admitted free of charge with funding obtained from the Myazawa programme. Nevertheless, most of the participants came from a relatively small number of well established foreign and joint venture companies, and about 10 per cent of the customers generated 50 per cent of TGI's revenues. A large number of training courses, over 100, were run for just one participant at a time, while another 100 courses were run for two or three participants, indicating the need to better market the training courses to a larger clientele. The remaining one third of TGI funds was spent on consulting and technical services to companies lasting a few hours to a day, and involving prototype development, product testing and the production of jigs, fixtures, dies, moulds and parts.

Though well received as indicated by the large number of customers returning for service, TGI appears to operate well below capacity. Most courses have room for more participants without additional instructors or equipment. Once again, the target of financial self-

sufficiency in an institute devoted to training and benefiting many small and medium-scale industries which otherwise would not have the means to train their technical staff, may make an excessive demand on TGI to raise the cost of its services and focus on larger customers. Indirect support in the form of grants to SMIs may be part of the solution.

C. Firm-based Technological Development

Current situation

R&D Incentives. Current R&D incentives include tax allowances and soft loans. There are two channels for providing tax allowances for firms undertaking R&D, one by the Board of Investment (tax allowances and non-tax incentives), and the other by the Ministry of Finance (accelerated depreciation for machinery and equipment purchased for R&D purposes, plus combined 200 per cent tax credit for R&D expenditures). As in other countries, tax schemes to date have had a very limited impact on technological activities of firms. This is because the arduous operational and administrative requirements, and the lack of confidence in the ability of tax auditors, to draw consistent distinction between R&D and other expenditures, have often acted as an effective deterrent for making claims, which have to be verified by NSTDA. More importantly however, they have not addressed the main challenge facing Thai industry at their stage of technological development, namely the need to deepen technology development at the lower boundary of design and engineering-based capabilities.

Firms have also had access to soft loans for technology development such as the Research and Technology Development Revolving Fund operated by MOST, the NSTDA soft loan facility and the Bank of Thailand soft loan facility for R&D projects. These schemes have been relatively small, channelling over a period of ten years no more than half of the budget available to just one agency NSTDA on an annual basis. The lack of demand for such credits was due to several reasons, including the need for R&D projects to demonstrate a viable rate of return, the fact that R&D projects, narrowly defined, were not a priority for Thai firms whose technological development involved support for more mundane design and engineering activities, and perhaps even then may not be a financial priority for firms.

Direct and flexible grant-based systems are likely to be more effective than tax incentives. Due to concerns about corruption and misuse of grant funds, such schemes have not been implemented except on a pilot basis, while others which were once implemented—such as that run by NSTDA, have been discontinued. It is thus important to explore how grant-based mechanisms can be put in place which can focus on the early stages of technology development activities, and which would be available to individual firms for a limited period of time and for a small number of projects. Thereafter, firms would be expected to 'graduate' to meet the eligibility conditions required by modified R&D tax and soft loan schemes.

Firm-based technology development initiatives in Thailand. Aware of the role of firm-based technology development for developing manufacturing capabilities in domestic firms, NSTDA and the Department of Industrial Promotion (DIP), MOI, initiated a series of pilot projects offering consultancy services in the early 1990s, together with financial assistance, to firms requesting assistance. At least a dozen such projects were in existence by 2001, six under NSTDA, two in DIP, and six in autonomous institutes under MOI (Table 14). However most of them have remained relatively small. The total number of delivery staff can be

estimated at around 300, or a fraction of the combined staff of MOI, NSTDA and MOI, while the total number of firms visited can be estimated at 600 in 2001, or just 2.5 per cent of the 24,000 medium and large manufacturing establishments in the 1997 census.

The above firm-based technology development projects faced a number of problems. The overriding constraint was the inadequate recognition by policy makers of their critical role for technology development in relation to R&D activities for firms at their current stage of development, and their consequently limited size and budget, which was moreover subject to change and uncertainty from one year to the next. With the exception of the recent *Invigorating Thai Business* project, which is targeting 2,600 firms in 2002, all other projects were relatively small, reaching perhaps 14-75 firms per year in the case of the NSTDA projects, and 120-175 firms per year in the case of the MOI projects. Their field advisers were mostly inexperienced in industrial matters, and their services were usually limited to the Bangkok area.

Table 14 Firm-based Technology Development in Thailand, 2001

	Programme	Acronym/ year launched	Firm-based services	Other activities	Core delivery staff	Firms/year (2001)	Firms/ staff
	NSTDA				26	146	
1	Industrial Technology Assistance Programme (with IRAP of Canada)	ITAP/2001 (ICS, 92)	Diagnosis, identif. of specialists		15 ITAs	75	5
2	Standards, Testing and Quality Control	STQC/1993	ISO 9000 consultancy	TFQS Research	7 Analysts	57	8
3	Company Directed Technology Development Programme.	CD/1992	Low interest R&D loans		4 Analysts	14	4
4	National. Centre for Genetic Engineering & Biotechnology	BIOTEC		R&D			
5	National Metal & Materials Technology Centre	MTEC		R&D			
6	National Electronics & Computer Technology Centre	NTEC		R&D			
	Dept. of Promotion, MOI				85	175	
7	Consultancy Fund Project (previously in Northeast only)	CFP/1997	Consultancy		85	175	2
8	Invigorating Thai Business (with Thai- Japanese Assoc.)	ITB/2002	Consultancy			(2,600)	
	Autonomous, under MOI				193	240	
9	Thai Productivity Institute	TPI/1995	ISO 9000/14000 trg	Training	61	120	2
10	Electrical/Electronics Inst.	EEI/1998		Training, testing			
11	National Food Institute	NFI/1997	HACCP certification	Lab & tstg services	42	40	3
12	Thai Textile Institute	TTI		Testing, training	(30)	80	
13	Thai Automotive Institute	TAI	Group and individual consult.	Testing, training	(30)		
14	Thai-German Institute	TGI/1998	Company visits	Training	(30)		
	Total				304	561	

Source: NSTDA (2002) Building Technological Capability in Thailand's SMEs, interviews.
Note: figures in brackets are estimates.

Two of the above programmes, the Standards, Testing and Quality Control programme of NSTDA and the Thai Productivity Institute offered mainly ISO certifications, accounting for two thirds of the latter's customers, a service which is increasingly provided by the private sector. The Canadian Industrial Research Assistance Programme (IRAP) is currently assisting the NSTDA Industrial Technology Assistance programme (ITAP) in its reorganization and field adviser training. The various NSTDA firm-based technology development projects may be consolidated into a larger and more flexibly managed programme.

In the wake of the Asian financial crisis, the MOI's Industrial Restructuring Programme (IRP) offered consultancy services to some 500 firms per year over two years. The *Invigorating Thai Business* project, which was launched in 2002 with a budget of 2 billion Baht, is a continuation of this project. It is implemented by DIP in collaboration with the Thai-Japanese Association (TJA) as follows:

- Firms fill an application form for technical and financial help from DIP or from technical institutes under MOI.
- TJA undertakes a preliminary assessment of firms' applications, followed by an interview of a company's senior official in Bangkok.
- If the application is successful, a team of consultants, from a pool of 1,800 such specialists from the private and public sectors registered with TJA, visits the plant to undertake a diagnosis lasting four to ten days. A diagnosis report, together with an action plan, is prepared.
- On the basis of the diagnostic report, a second team of consultant prepares a project proposal requiring 25-60 person days of consultant input.
- If approved, this second team of consultants implements the project.
- ITB pays 80-90 per cent of the cost of the projects averaging US$20,000 per project.

The ITB project appears to be modelled on similar programmes in other countries. However, it is heavily reliant on consultants, many of whom from universities and institutes, and who have limited practical industrial experience. Its ambitious target of reaching 2,600 firms in one year will put added strain on identifying suitable consultants and specialists, on which the programme's success will ultimately depend. Furthermore, unlike the ITAP programme, this is a crisis-related project, and so is not geared to building a long-term relationship with the enterprises.

It is important to note that all the current firm-level technology programmes in Thailand rely on firms coming to the institutes and service providers. As argued below, these firms are likely to be a minority, while the majority of them do not know what they need in terms of technology development, or even if they did, would not know where to go.

Need for expanding firm-based technology development

At the current stage of Thailand's development, the most important thresholds of technological capability that firms need to cross are not concerned with formally organized R&D activities. For most large firms and a few SMIs, they are about building their design and engineering capabilities as a basis for starting significant technology development activities. Only for a few firms that have already built that level of capability is the relevant threshold about deepening it further to R&D activities. For the majority of SMIs, especially

in the more traditional industries, the most important capability thresholds are concerned with increasing the efficiency with which existing technologies are acquired, used and operated.

According to a recently completed review, for over 40 years, Thailand's industrial technology development system has relied almost exclusively on public institutions as suppliers of technology on behalf of industrial firms (Arnold *et al.*, 2000). Other countries, such as the Republic of Korea, Taiwan, Province of China, Singapore, and to a lesser extent Malaysia, have developed a dual structure which, alongside public institutions, have promoted firms themselves, not just as users of technology and skills, but as the creators of technology and the generators of skills and capabilities. In these countries, as well as in more technologically advanced countries, firms now account for the larger proportion of industrial technology development. A large part of the process of technology development does not involve R&D. It is generated by design and engineering activities. Firms draw much of their knowledge from other firms, and knowledge flows embodied in people are very important.

In Thailand, most resources continue to be concentrated on the capabilities and resources of scientific, technological and training institutions, which are intended to undertake technological activities for the firms, primarily the Ministry of Science and Technology and its specialized agency, the National Science and Technology Development Agency (NSTDA). On the other hand, there are almost no effective resource allocation or mechanism designed to increase firms' abilities to implement their own technological learning, strengthen their own design, engineering and other technological development capabilities or undertake their own innovative activities.

Thai firms' demand for technology

Several of the more technologically advanced industrializing countries, especially in Asia, have made the transition from a phase where most scientific and technological capabilities were located in public institutes, as in Thailand today, to a situation where firm-level innovative activities and capabilities have been built quite rapidly. However, transition towards a firm-centred structure of technology development does not take place automatically as time passes and industry grows. Many industrializing countries have experienced industrial growth for long periods without any significant change in this direction. Substantial demand for technology development at the level of individual firms is needed, even when strong government policies are in place, as in Brazil or India. This demand can be stimulated by at least four factors: competition, effective demand from firms aware of the incidence of technology on competitiveness, structure of production and foreign direct investment.

First, competition generates the pressures and opportunities in both the domestic and export markets and stimulates investment in technology development. Industries exposed to international competition have made the most striking transition such as the Republic of Korea, Taiwan, Province of China and Singapore. Trade liberalization in Thailand has almost certainly contributed to encouraging some firms towards deepening their technological capabilities and activities. However, it is less evident that the new market opportunities have had the same positive effects. In particular, even in domestic markets, firms have been very slow to exploit opportunities to supply more technologically demanding goods and services to the expanding automobile and electronic industries.

The second is awareness of firms of the role of technology development for competitiveness. This ranges from firms who do not realize or recognize the need for change and do not know where and what they might improve ('do not know what they do not know'), to firms which recognize the need for change but are unclear about how to go about it ('know they do not know, but do not know what'), firms with active demand who know what has to be done but which do not know where and how to obtain the relevant new technology ('know what, but do not always know where and how'), and finally firms with effective demand ('high capability and absorptive capacity'). Firms in the last category are the minority in any industrial sector, and more so in industrializing countries. An emphasis on competition as both a necessary and sufficient condition to stimulate technology development implicitly assumes that all firms are in this category. In reality, most firms fall in the first and second categories, and need a prior learning process before they can generate effective demand for technological change. Yet most technology suppliers assume that most firms want to change.

The third factor is related to changes in the structure of industrial production. Sectors differ in the intensity of their technology development activities. Sectors such as pharmaceuticals and aerospace engage more intensely in R&D than footwear and steel in industrial countries. However, cross-sectional observations such as this do not easily translate into policy prescriptions over time, though it is commonly believed that it does. Thus the import-substitution strategies of the 1950s and 1960s, the domestic production of capital goods in the 1970s, the location of electronic industries in the 1980s, and particular parts of the electronic industries such as wafer fabrication in the 1990s, brought the manufacturing production capabilities to industrializing countries but not the associated innovative activity, which remained behind in the industrial countries. Similarly the use of IT systems in the 'new economy' of the 2000s, though an important change in production activities and competitiveness, is unlikely to lead automatically to the deepening of innovative capabilities and activities in industrialising countries.

Nevertheless, there are links between manufacturing production and innovation. First, domestic manufacturing production of more technologically advanced products and processes is the base necessary, though not sufficient, upon which to build incremental design and engineering changes to adapt and improve. Technology development has to be undertaken in close proximity to where production and marketing operations are located. Second, entry into industries which are growing rapidly in the world economy offer greater opportunities for deepening local technological development capabilities. In both cases, appropriate policies must be in place to stimulate and support firms' awareness for technology development and response capability, and to turn such opportunities into practical realities through incentives and support mechanisms.

The fourth factor is the role played by foreign direct investment. In both industrialized and industrializing countries, the roles and strategies of MNC subsidiaries and joint venture partners seem to be shifting towards a greater localization of technology development activities. In Thailand too, MNC subsidiaries are now playing a positive technology development role, and this appears to generate significant spillovers to the rest of the economy. This opens up the potential for linking this process more strongly to local institutions and for increasing the spillovers generated within the economy.

Examples from selected countries

In many programmes around the world, field agents, enterprise counsellors or advisers approach firms to help recognize and identify the need for change. In some cases, a grant-based scheme is combined with this outreach approach in the following way, to fund two phases:

- A first one to fund consultants to prepare an initial audit identifying opportunities for the company's future manufacturing and business strategy, and
- A second phase to prepare an action plan tailored to the client's needs, whether in the area of design, marketing, quality, manufacturing or business planning, or a combination of these. Recommendations on improving manufacturing techniques would include purchase of capital equipment on a cost-benefit basis, opportunities for cost reduction and productivity improvement, improved product quality, reduction of inventory and minimization of waste, and long-term company development.

This is essentially the design of the very successful Enterprise Initiative in the UK, which assisted some 60,000 businesses employing less than 500 employees each. Other successful schemes include the National Technology Audit Programme of Ireland, targeted at manufacturing firms employing 50 or fewer employees, IRAP Canada, MEP in USA, CIM centres in Switzerland and TEKES in Finland (see boxes 1 to 4 below for a brief description of some of these programmes).

D. Summary

The government research and technology institutes in Thailand appear, on the one hand, to be working below capacity, while on the other, they do not have a clear mandate to provide technology services at the firm level. The latter is partly due to the low demand for technology services from the firms themselves. Since it is in the long-term interest of the firms to upgrade their technological capacities to remain competitive, a major task of the technology institutes should be to raise awareness at the firm level, and raise their demand for technology services. The governments of most developed countries actively pursue this task by deploying a network of industrial technology advisers who visit firms, provide initial diagnostic services, prepare a plan of action for productivity and technological upgrading, and put manufacturing firms in touch with specialist service providers and technical consultants. They also contribute financially, either in full or in part, for such services.

Thailand urgently needs to recruit and deploy a large network of industrial technology advisers who can raise the awareness of domestic firms. By nature, such services need to be subsidized. Keeping in mind the goal of financial self-sufficiency, the Ministry of Industry should enter into contracts with technical institutes, under which the institutes would undertake to provide technical advisory services to an agreed number of firms every year. In order for the institutes to recruit and retain professionally educated and experienced industrial technology advisors, the contracts should be of a long-term nature.

It should be noted that the demand for technology services is greatly influenced by the competitive environment, and removal of tariffs and other trade barriers can spur

competition. Furthermore, relative prices, which alter the price of inputs and final products, also influence technology development. For instance, the absence of tariffs on machinery and computers, but tariffs on parts and components, can raise the price of locally assembled products, and slow down technology development in Thailand.

Finally, the Ministry of Industry should develop a greater awareness of technology development, and take a more direct responsibility in policy and resource allocations designed to support industrial technology development. The design and implementation of that role can draw on the successful experience of organizations such as the Economic Development Board of Singapore, the Ministry of Commerce, Industry and Energy in the Republic of Korea, and several similar agencies in European countries like Ireland, UK and the Netherlands. In addition, industry associations should be encouraged, as stakeholders, to increase their direct involvement in industrial technology development strategies, priorities and programmes.

Box 1 Firm-based Technology Development Initiatives in the UK

Enterprise Initiative
This programme of the Department of Trade and Industry (DTI) ran for seven years from 1998 to 1995, and assisted some 60,000 businesses. It was one of the most successful programmes ever devised, and was responsible for the UK's lead in ISO 9000 certification. It provided consultancy services to SMEs in six areas: design, marketing, quality, manufacturing and business planning. Its distinguishing features included:

- A television and press campaign to launch the programme nationwide.
- Interested businesses could request a simple application form through free phone lines.
- Enterprise counsellors – recently retired industrialists with broad business experience – were subcontracted to visit the firms who had applied and, if consultancy was needed and agreed with the company CEOs, prepare a report on their requirements and sent to consultancy contractors; if not, the ECs would identify other sources of assistance.
- The consultancy contractor would identify a suitable consultant or consultancy organization and, in agreement with the client, prepare a proposal tailored to the client's needs.
- Once approved by both, the consultant would undertake the assignment. On conclusion of the project, the client would pay his share, 50 per cent of the consultancy, directly to the consultant, while the contractor would pay the remaining 50 per cent on behalf of DTI, after quality checks. Consultancy fee rates were based on a daily figure inclusive of expenses.
- The original Enterprise Counsellors would visit the client about two months after the conclusion of the project, and sent a visit report to the contractor.
- Clients were entitled to a single consultancy project of up to 15 person-days spread over a maximum of 16 weeks, forcing the consultants to work efficiently.

United Kingdom Benchmarking Index (UKBI)
This DTI initiative, aimed to give access to comprehensive, low cost benchmarking information to all SMEs (manufacturing and services), to raise the awareness of the importance of measures as a way to improve performance, and to encourage the transfer and adoption of good practice. Based on a questionnaire completed by the SME, a private contractor prepares a PC-based computerized reply, which is edited by personal business advisers and innovation and technology counsellors, and which shows the comparative performance of the SME in relation to its chosen comparator. Benchmarking covers three areas, viz., financial, managerial and business excellence. Its value lies in the improvement of activities identified.

Other schemes include:

- The DTI *Small Firms Merit Award for Science and Technology* (SMART), which provides funds on a competitive basis for technical and commercial feasibility study for projects involving the application of new technology
- The *Engineers to Japan* programme which places young engineers with management potential in Japanese host companies for a period of 9-12 months, and managed by the Royal Academy of Engineering for DTI.
- The *Innovation Vouchers* scheme for allocating up to four small vouchers for small businesses to fund the cost of external advice, based on the recommendation on innovation counsellors of the Business Link network,. One voucher may purchase the cost of half a day of advice from a local consultant or technology organization. The scheme is administered by a private contractor.

Source: Arnold *et al.* (2002)

Box 2 Firm-based Technology Development Initiatives in the UK (*Continued*)

The UK *Government' Manufacturing Strategy* (2002) intends to implement the following schemes.

Partnership Fund
Establish up to 150 projects promoting innovation in the workplace. Support a more strategic approach supporting at least eight sector based projects aiming to improve business performance by focussing on people at work, leading to a step change in relationships.

Industry Forum (IF)
The Government plans a further 6 sector projects, linking where appropriate to the Partnership projects by 2004, with an anticipated take up of 3000 companies. Potential sectors include healthcare equipment, construction and food processing. Based on results from previous IF programmes, new IFs will achieve the following Quality, Cost, Delivery (QCD) improvements (or similar, using agreed sector measures):

- Non-right first time: 35%
- Delivery schedule achievement: 40%
- People productivity: 30%
- Stock turns: 50%
- Overall equipment effectiveness: 20%
- Value added per person: 40%
- Floor space utilisation: 40%

Manufacturing Advisory Service
The service will provide information and advice to 15,000 manufacturers per year; to proactively undertake 2,500 diagnostic visits to small and medium-sized companies a year through the Regional Centres of Manufacturing Excellences; to undertake 500 follow-on consultancy projects per year; to inform, through the MAS website, 25,000 manufacturers/users per year on all aspects of manufacturing. Specific measures of success will be put in place.

Source: The Government's Manufacturing Strategy, www.dti.gov.uk

Box 3 Firm-based Technology Development Schemes in Ireland

The *National Technology Audit Programme* (NTAP) was targeted primarily at manufacturing SMIs with 50 of fewer employees. It focuses on appropriate technology and recommends how existing technology can be improve to increase profitability. However, this placed in the context of other areas such as finance, quality, marketing and management. This programme, which was fully funded by the government, was very popular with Irish industry, producing 630 phase one and 250 phase two audits since its launch in 1989. Follow-up visits reported an average of 50 per cent of recommendations being implemented within 6-12 months after the audit, and a further 25 per cent of recommendations at a later stage. Profits were reported to be up by around 40 per cent, employment by 5 per cent, turnover per employee by 12 per cent and turnover by 18 per cent. The key features of the NTAP programme were as follows:

- In Phase one, a report identified opportunities which form the basis for the company's future manufacturing or business strategy.
- Phase two produced an action plan which recommends improved manufacturing techniques, including purchase of capital equipment on a cost/benefit basis, opportunities for cost reduction and productivity improvement, improved product quality, reduction of inventory, minimization of waste, and long-term company development.
- Projects were undertaken by a team of experienced consultants, sometimes augmented by technical specialists.
- Each audit involved a half-day of interviews with key personnel, and two to five days of on-site assessment of methods and procedures. Off-site investigations and report preparation of a detailed report takes a further five-seven days.
- A follow-up visit is made six to twelve months after the completion of the initial audit.

Other initiatives included:

- The *Techstart* scheme, which placed some 300 young technical graduates in companies, in addition to additional training and consultancy associated with the recruitment of the graduates to support the project that they are working on. Some 80 per cent of the graduates elected to stay with the company after the first year.
- The *Techman* scheme, operated in partnership with the *Techstart* scheme, placed a senior technical project manager to realize a technical project in some 30 companies for a period of up to three years, with larger company contributions in years two and three.
- The *R&D Management* scheme provides training for companies in different technological competencies in four modules to educate R&D managers.
- The *Programme in Advanced Technology* (PATS) was initiated to exploit university-generated technology in industry.

Source: Arnold *et al.* (2002)

Box 4 Firm-based Technology Development Schemes in Canada

The *Industrial Research Assistance Programme* (IRAP) has its roots in 1947, when the National Research Council established a Technical Information Service to convert military technology into peacetime commercially useful applications. IRAP now has some 260 Industrial Technology Advisors (ITAs) who assist over 12,000 SMEs per year. Its characteristic features include:

- The ITAs are engineers and scientists experienced in technical and industrial matters. They do not just provide information, but are pro-active advisers and problem-solvers. Their commitment to help, coupled with their technical competence as well as that staff of associated organizations, has made IRAP into a most respected and highly popular programme.
- IRAP has established two fundamental and complementary concepts: networking and technology transfer. Networking has allowed it to respond to the diverse needs of the clients effectively and in a multi-disciplinary manner. Technology transfer has allowed firms to build on existing knowledge rather than to re-invent the wheel.
- IRAP has developed a network of over 130 public and private research and technology-based organizations, consisting of universities (60), research institutes and technology centres (32), industrial and professional associations (24), provincial research organizations (8), business centres (6), regional and municipal agencies (2) and others (9).
- The ITAs are located in 150 locations across the country. Over 70 per cent of them are directly employed by the network member organizations, including industry associations, while the balance are NRC employers.
- The ITAs can recommend financial assistance for cost sharing of the technical projects. These include the use of consultants for specific problems, the use of technical students to work on well-defined projects, and assistance with small and larger R&D projects. IRAP can contribute to small projects up to a maximum of C$15,000, this funding constituting 40-50 per cent of the eligible project costs (labour, travel, sub-contracting, consultant fees). Larger scale projects can receive cost-sharing funding of up to C$350,000 over three years.
- IRAP has delegated disbursement authority at the local and provincial level of up to C$100,000, and has established local review and decision committee. Due to quality and professionalism of ITAs and network staff, IRAP has achieved high administrative efficiency, and is known to respond quickly to the SMEs.

Source: www.nrc.ca/irap

CHAPTER VI:

Conclusions and Policy Implications

A. Increasing Productivity

Labour productivity and capital investment. The decline in the value of manufactured exports registered in 1996 was taken as evidence of a loss of competitiveness of the Thai industry. However, this cannot be attributed to higher wages in the 1990s because of the following reasons.

1. In the high growth period 1986-96, output per worker increased faster than wages, resulting in a decline in the cost of labour as a share of manufacturing gross output in most industries.

2. Labour costs formed less than 7 per cent of total production costs, so labour costs increases contribute only partially to cost increases.

3. Thailand's capital-intensive exports, such as electronics, where labour costs are lower than on average, also fell.

4. Increasing wage costs would result in a gradual erosion of competitiveness, not a sudden fall as was experienced in 1996.

The increase in manufacturing labour productivity observed in medium and large-scale manufacturing survey data were probably due to heavy capital investment, a result of the relocation of productive capacity from Japan and the NICs in the late 1980s and early 1990s, as well as other FDI, and the rapid development of more capital intensive industries such as chemicals, machinery, electrical and electronics and transport equipment industries, as well as economies of scale in larger plants. Rather than blame heavy investment in the manufacturing sector for low total factor productivity, such investments in modern facilities should be welcomed to promote best-practice production facilities, technology transfer, economies of scale and further increases in labour productivity.

Nevertheless, many investors still view Thailand in terms of a labour-intensive, rather than technologically more diverse production base. The government, and particularly the Board of Investment, should promote a change in perception of the importance of labour costs as an investment decision-making factor in Thailand.

Small and medium industries. Labour productivity in small and medium industries was only half that of larger industries. Since most manufacturing production takes place in larger establishments, SMIs can be developed in the following way.

1. Forging linkages with larger establishments in the form of supplier arrangements, including transfer of technical and marketing know-how and training.

2. SMI productivity can be greatly increased by encouraging them to invest in new equipment and modern production facilities, possibly as a result of new business linkages with larger firms.

3. SMI cannot be developed effectively in isolation; SMI promotion measures should be integrated into programmes that promote linkages with larger firms, with foreign firms, and with measures to attract FDI.

Industrial skills development. Given the urgent need for Thailand to develop industrial skills, it is important to pursue two avenues of training. The first should address the under-investment in training in individual firms, while the second one should mobilize the training capabilities of larger firms to serve the interests of industries, clusters and value-chains within which they are located.

1. Thailand can learn from the many schemes already in place in other countries in the region, and design its own levy-grant system based on the overall structure of industrial skills and corresponding training needs on one hand, and size of firms on the other.

2. The levy scheme would recognize the widespread experience of non-compliance by small firms, and exempt firms employing less than 100 employees from it. On the other hand the grant scheme would include small firms or subsidize them for training undertaken in vocational training institutes or technology institutes.

3. The grants can also incorporate an element of subsidy, *i.e.*, more than 100 per cent of reimbursement for training in priority skill categories, and compensate firms for the higher levels of labour turnover that would be likely in these areas.

4. To reduce the extent to which the grants will simply compensate for funding training that firms would provide in any case, larger firms would not be eligible for reimbursement of training in basic operating skills and general management skills, and would be encouraged to invest in higher skills.

5. Higher levels of grant payments could be allowed in particular situations where firms agreed to act as training suppliers for an industry, its suppliers and customers.

6. The grants would also support high-priority training in areas of advanced technology, the development and operation of collective training schemes for groups of firms, along the lines of the Penang Skill Development Centre in Malaysia, surveys of training needs in firms in particular industries or value-chains, the design and development of training packages, and short periods of overseas training or experience acquisition in priority areas, as included in Singapore.

7. Consideration may be given to supporting learning-intensive technology development projects in advanced technology areas.

8. In defining the details of a comprehensive training support system, considerable efforts should be made to avoid the bureaucratic costs of inflexible and over-extended aspects of schemes in other countries, while capturing those aspects of good practice and experiment that have contributed most to strengthening skills and capabilities. Finally, the government should consider the possibility of establishing one scheme combining financial incentives to support advanced level training and learning, technology development at the design and engineering level and more formally organized R&D.

B. Promoting Linkages

Supplier industries. Intermediate inputs accounted for 72 per cent of gross output, while labour costs account for seven per cent in the 1996 census of manufacturing establishments. Of these, 41 per cent of the raw materials, components and other intermediate inputs were imported. As the manufacturing sector has gradually produced technologically more advanced products, and has become more export-oriented, especially by attracting more foreign players, its reliance on imported intermediate inputs has increased. The experience of China indicates that there is scope for reducing the cost of intermediate inputs in price-sensitive products. Competitive advantage also emerges from close working relationships between world-class suppliers and industry. Suppliers, including equipment manufacturers, can help firms perceive new methods and opportunities to apply new technology. Firms can gain quick access to information, to new ideas and insights, and to supplier innovations.

A long-standing linkage programme, the Board of Investment's Unit for Industrial Linkage Development (BUILD) has just eight full-time staff at present and a budget of Baht 5 million (2 per cent of BOI annual budget). It was launched some ten years ago, however the resources allocated to this important programme have not increased significantly. It has three major programmes at present, a 'Vendor Meet Customers' Programme (VMC), the ASEAN Supporting Industry database (ASID—www.asidnet.com), and the BOI Joint Venture Programme. All three programmes should be expanded significantly.

Industry associations. Many industry associations exist in Thailand, however their function has been limited to being a social forum and a lobby group. Many do not employ full-time staff and are relatively informal. The potential of industry associations in building competitiveness has hardly been realized in Thailand, with rare exceptions (Plastics, TAPMA, IDEMA and Toyota Cooperation Club). In the new competitive environment, not just firms, but also industry associations need to upgrade. The following is suggested.

1. TPI can take the lead in upgrading industry associations. The government should play a role in ensuring that the potential for industry associations for promoting joint actions is not missed. The government also need to understand the specific challenges faced by individual sectors.

2. As a first step, a detailed survey of industry associations should be undertaken to map out their staffing, range of services provided, key challenges and constraints faced, and their sub-sector specific needs. USAID assistance was provided for private sector

institution building in the 1980s to develop the provincial chambers of commerce. A similar undertaking should receive consideration for industry associations.

C. Industrial Technology Development System

Competitiveness increasingly depends on technology development and its underlying knowledge, skills and organizational arrangements. Because of the long history of limited technology deepening, Thai industry runs the risk of further competitiveness weakness as liberalization proceeds. The Thai government has recognized this, and has taken a number of concrete steps in recent years to upgrade and extend its institutional structure for technology development. This includes the establishment of several new autonomous sectoral institutes under the umbrella of the Ministry of Industry, and the establishment of the National Science and Technology Policy Committee. These changes notwithstanding, the basic approach and structure has remained the same and is unsuitable for the quantum change needed. A fundamental change in policy is needed in Thailand now, because it takes a considerable time to deepen technology development capabilities in industry. There are at least six elements of policy which require urgent action.

1. For the last 30-40 years, Thailand has opted to develop a structure of public and semi-public institutions to deliver technological services to firms, and has neglected the need to strengthen technological development capabilities within the firms themselves. This should be rectified to produce a balanced dual structure as in most technologically advanced countries in Asia, Europe and North America.

2. Related to the first point, the current emphasis on stimulating the supply of technology by external institutes rather than by industrial firms themselves has led to the neglect for stimulating the demand for technology development on the part of industrial firms. This can be achieved by requiring the public institutes to explicitly incorporate activities directed at stimulating demand in firms. This is not about marketing to firms the technologies developed by the public institutes; rather, it is about gaining an understanding of the existing capabilities of the firms and their business strategies, and then to assist them in an open-ended process of learning. Of the total resources currently allocated to science and technology development, the government should aim to allocate a minimum amount—say, at least 15 per cent—to firm-based industrial technology development.

3. A comprehensive training support system should be quickly established to build a stronger body of technology-using and assimilating skills to underpin the deepening of technology development capabilities. A simple and flexible grant-based subsidy scheme, drawing on the wide range of experience available from other countries, should be designed and implemented to assist firms in investing in training concerned with design, engineering and R&D. Furthermore, the current tax incentives for R&D should be reviewed to include design and engineering activities, as well as R&D activities with a significant training component.

4. A new phase of institutional rationalization should be carefully considered, including institutional specialization, the separation of the conflicting roles of funding and executing technology development programmes and projects, the fostering of

competition for funding between institutions, strengthening the links between the institutes and industrial firms, including the rotation of staff between institutes and industry, and financial arrangements to improve the performance of the institutes without jeopardizing the wider benefits of their activities to industrial firms in the process of learning to develop their technological capabilities.

5. The Ministry of Industry should play a more important and direct role in policy and institutional support for industrial technology development. One practical area is the promotion and administration of a one-stop-shop for subsidy and industry-support programmes designed to stimulate the demand by firms for technology development, and to support advanced level training and learning, technology development for design and engineering, and more formally organized R&D. Such an integrated structure should also incorporate the administration of mechanisms designed to enhance local technology development by the subsidiaries of MNCs, and for generating externalities by their activities.

6. In considering new arrangements for the design and administration of a radically re-balanced structure of industry-oriented technology policy and development, industry associations, and other less formally organized groups and clusters, should not just be seen as clients of the new system. They should be empowered to increase their involvement in shaping the direction of institutional development, and the orientation of strategies and priorities, including sitting on the boards of technology institutes.

More specifically, there are four main issues and challenges facing the institutes, namely, links with industry, the lack of institutional specialization and duplication, limited role of economic ministries in policy-making and resource allocation for industrial technological development, and financial pressures to become self-supporting.

1. There have been few studies to gauge the links of these institutes with industry. A World Bank survey in 1997-98 indicated that only 3-5 per cent of the 1,200 firms surveyed had used the services of the science and technology programmes. Most of the users are likely to have been for laboratory testing facilities. There were similarly limited linkages between universities and industrial firms, consisting mostly of short-term training and ad hoc use of consulting services, rather than long-term extensive relationships.

2. The brief description of existing science and technology institutions here, while far from complete, provides an idea of duplication and lack of institutional specialization. For instance R&D funding is undertaken by at least three agencies, TRF, NRCT and NSTDA. Strategic and basic research is undertaken by universities and NSTDA. Applied technology development and transfer is carried out by TISTR, DSS and NSTDA, while technical and support services are provided by the MOI institutes, DSS and NSTDA. This may be the result of the inability of successive governments over 50 years to rationalize and integrate existing institutions before creating new ones, such as the NSTDA. Instead of progressive specialization as in other countries, this has led to the opposite, namely a dilution of competences. Thailand can ill afford these levels of multiplicity and limited specialization.

3. The above institutional set-up also reveals the limited role of the Ministry of Industry in policy-making and allocation of resources for industrial technology development. This

is in contrast to other countries, where the role of economic ministries has been instrumental in technology policy. For instance, the Economic Development Board of Singapore and the Ministry of Commerce, Industry and Energy in the Republic of Korea, and other agencies in Ireland and the UK, have played a very important role in this regard, and in promoting technology development by industry and capability building in industry. As noted in the previous section, these areas have been rather neglected in Thailand.

4. MOI's goal of self-supporting sectoral institutions within five years may be counter-productive to the aim of upgrading firms, particularly small and medium ones. Their current emphasis on fee-paying testing and laboratory services is leading to the relative neglect of other services such as factory-level visits and advice, consulting services and technical and market information dissemination. In addition, training courses with the greatest relevance to small and medium firms were not affordable. In order to avoid closing down unprofitable activities, the government could issue contracts, under which the institutes would undertake an agreed output of services per year (firm visits, trained personnel). These contracts should be of a long-term nature, to allow the institutes to recruit and retain professionally educated and experienced industrial technology advisers and staff. In other countries, subsidized programmes to stimulate technology development capability, particularly in SMIs, have been shown to be quite valuable. MOI needs to maintain pressures for efficiency and high performance, but needs pragmatic mechanisms to do so to achieve the broader aims upgrading firms' technological capabilities.

D. Concluding Remarks

Although this paper has focused on industrial productivity, linkage and technology issues, it has raised a number of other issues requiring attention.

1. Product and market diversification should receive high priority. The country's reliance on its top export items, electronic products, has increased significantly in recent years. Its vulnerability to its major market, the US, and by association Singapore, was forcefully brought home by the recent down-turn in exports to these markets following the end of the IT investment boom.

2. Policy makers should pay as much attention to gross manufactured exports, which accounted for 40 per cent of manufacturing production, as to net exports, which were only about 10 per cent (excluding food and rubber).

3. The government should closely monitor the impact of import-dependent industrialization on the balance of payments. The manufactured trade surplus, which appeared in the wake of the financial crisis, had all but disappeared by 2001, indicating the prospect of a return to pre-crisis manufacturing trade deficits in the near future.

4. Policy makers should explore ways to expand the home market for manufactured products, by allowing market-determined wages to increase naturally, and not being tempted to restrain them in the name of competitiveness. Home market is the fourth

determinant of national competitiveness, besides factor conditions, supplier and related industries and firm rivalry.

5. Technology development programmes are by nature of a long-term nature. Thailand needs to learn from other countries such as the UK, Ireland and Canada how they manage to support such programmes, and how their bureaucracies avoid the stop-start problems and constraints associated with the annual government development budget process.

6. The importance of manufacturing production and exports for the Thai economy merits a professional approach to industrial data collection and publication. Most researchers would agree that the availability, frequency and quality of industrial statistics are quite poor for a country at Thailand's stage of development. This may partly be due to the rather ad-hoc approach taken, which has been to disperse data collection among non-statistical agencies such as the Office of Industrial Economics, Ministry of Industry, the Industrial Finance Corporation Limited (for the monthly production index), the Board of Investment (for promoted industries) and other agencies. This paper relied on the NSO manufacturing surveys and census to study many industrial characteristics, demonstrating their usefulness for industrial policy analysis, despite their many known weaknesses. National resources would be better spent on building the capacity of the National Statistical Office to produce an annual or bi-annual survey of medium and large-scale industries containing consistent data on establishments, employment, wages, labour costs, value-added, gross production, investment, energy use, exports, and use of domestic and imported intermediate inputs.

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ANNEX:

Statistical Overview

Table A.1. Gross and Net Exports by 2-Digit ISIC Classification, 1996 (Baht)

	ISIC Category	Domestic					
		Total Production	Exports	%	Imported Inputs	Export-Imports	%
15	Food	408,617,353,839	156,263,928,668	38.2	36,349,225,759	119,914,702,909	29.3
16	Tobacco	38,617,293,203	8,269,657,600	21.4	1,426,457,079	6,843,200,521	17.7
17	Textiles	69,828,593,045	18,908,748,056	27.1	14,961,874,643	3,946,873,413	5.7
18	Garments	47,620,772,936	24,341,189,871	51.1	6,025,362,788	18,315,827,083	38.5
19	Leather products	30,793,093,451	16,024,990,524	52.0	7,779,479,373	8,245,511,151	26.8
20	Wood and products	32,739,928,256	7,997,949,621	24.4	7,954,852,193	43,097,428	0.1
21	Paper and products	72,521,754,848	6,165,761,838	8.5	6,907,312,953	-741,551,115	-1.0
22	Printing, publishing	44,257,487,040	321,907,008	0.7	3,131,900,994	-2,809,993,986	-6.3
23	Refinery products	66,395,215,530	15,693,787,178	23.6	27,764,829,925	-12,071,042,748	-18.2
24	Chemicals	88,044,607,445	14,095,364,711	16.0	13,483,936,790	611,427,921	0.7
25	Rubber, plastic products	132,294,443,750	61,507,514,710	46.5	11,776,730,468	49,730,784,243	37.6
26	Other non-met. prod	129,806,949,475	14,789,419,145	11.4	6,461,007,992	8,328,411,153	6.4
27	Basic metals	58,412,351,997	6,580,719,041	11.3	22,783,052,151	-16,202,333,111	-27.7
28	Fabricated metal prod	54,075,667,678	7,051,692,788	13.0	11,193,462,763	-4,141,769,975	-7.7
29	Machinery and parts	36,169,430,008	9,813,282,968	27.1	5,294,961,834	4,518,321,134	12.5
30	Computer, office equip.	1,796,633,761	582,950,637	32.4	303,608,039	279,342,598	15.5
31	Electrical products	23,801,479,769	7,430,674,112	31.2	7,795,499,324	-364,825,212	-1.5
32	Electronics and parts	14,163,269,344	3,038,358,490	21.5	2,305,115,026	733,243,465	5.2
33	Precision equipment	2,978,395,422	1,499,205,631	50.3	401,615,645	1,097,589,986	36.9
34	Motor vehicles, parts	58,733,945,757	4,733,434,823	8.1	8,528,306,149	-3,794,871,326	-6.5
35	Other transport equip.	10,081,359,133	805,246,370	8.0	1,228,085,666	-422,839,296	-4.2
36	Furniture, other	56,679,902,298	24,868,166,607	43.9	9,268,653,258	15,599,513,350	27.5
37	Recycling	556,632,960	6,480,000	1.2	1,715,993	4,764,007	0.9
	Total	1,478,986,560,945	410,790,430,395	27.8	213,127,046,802	197,663,383,593	13.4
	Rubber products	77,170,981,521	48,159,556,487	62.4	3,535,620,269	44,623,936,218	57.8
	Total without food, rubber	993,198,225,585	206,366,945,240	20.8	173,242,200,774	33,124,744,466	3.3
	in US$ million	39,727,929	8,254,678		6,929,688	1,324,990	
	Share						
	All manufacturing	44.9	31.7		27.9	37.3	
	Without food, rubber	38.3	21.1		25.0	11.7	

Table A.1. ***Continued***

	ISIC Category	Foreign					
		Total Production	Exports	%	Imported Inputs	Export-Imports	%
15	Food	162,007,271,225	80,591,241,919	49.7	26,449,022,476	54,142,219,444	33.4
16	Tobacco	1,992,662,596	1,767,662,461	88.7	151,112,187	1,616,550,274	81.1
17	Textiles	99,426,641,856	38,792,741,382	39.0	25,998,460,879	12,794,280,503	12.9
18	Garments	26,421,253,093	19,428,579,342	73.5	7,242,481,467	12,186,097,876	46.1
19	Leather products	15,192,090,811	12,905,517,099	84.9	5,912,024,197	6,993,492,902	46.0
20	Wood and products	9,899,312,158	6,559,382,896	66.3	1,588,578,597	4,970,804,300	50.2
21	Paper and products	59,775,757,928	16,134,900,529	27.0	2,629,730,718	13,505,169,811	22.6
22	Printing, publishing	6,037,073,371	627,677,016	10.4	1,647,050,255	-1,019,373,240	-16.9
23	Refinery products	80,002,673,092	19,408,020,699	24.3	50,968,427,023	-31,560,406,325	-39.4
24	Chemicals	102,287,376,016	30,423,797,821	29.7	24,909,025,506	5,514,772,315	5.4
25	Rubber, plastic products	84,041,956,767	46,643,743,506	55.5	13,454,369,656	33,189,373,851	39.5
26	Other non-met. prod	47,259,290,483	9,098,127,414	19.3	5,355,864,257	3,742,263,157	7.9
27	Basic metals	25,103,383,769	3,461,701,444	13.8	9,740,789,343	-6,279,087,899	-25.0
28	Fabricated metal prod	93,440,165,588	27,449,481,328	29.4	46,797,179,674	-19,347,698,346	-20.7
29	Machinery and parts	120,922,394,181	76,172,524,756	63.0	34,415,675,904	41,756,848,852	34.5
30	Computer, office equip.	131,254,624,619	120,729,533,329	92.0	83,453,541,512	37,275,991,817	28.4
31	Electrical products	102,256,119,760	64,916,789,837	63.5	33,470,017,803	31,446,772,034	30.8
32	Electronics and parts	181,899,786,027	147,641,330,064	81.2	74,550,789,652	73,090,540,412	40.2
33	Precision equipment	19,878,774,212	17,416,354,762	87.6	4,417,238,912	12,999,115,851	65.4
34	Motor vehicles, parts	386,910,695,365	98,303,150,759	25.4	77,822,213,766	20,480,936,993	5.3
35	Other transport equip.	6,794,912,587	1,907,994,207	28.1	1,573,340,384	334,653,824	4.9
36	Furniture, other	51,581,053,433	43,475,390,237	84.3	18,789,281,531	24,686,108,707	47.9
37	Recycling	20,444,394	0	0.0	0	0	0.0
	Total	1,814,405,713,331	883,855,642,804	48.7	551,336,215,693	332,519,427,110	18.3
	Rubber products	54,645,042,320	32,459,645,479	59.4	4,934,534,014	27,525,111,465	50.4
	Total without food, rubber	1,597,753,399,786	770,804,755,405	48.2	519,952,659,204	250,852,096,202	15.7
	in US$ million	63,910,136	30,832,190		20,798,106	10,034,084	
	Share						
	All manufacturing	55.1	68.3		72.1	62.7	
	Without food, rubber	61.7	78.9		75.0	88.3	

Table A.1. ***Continued***

ISIC Category	All establishments					
	Total Production	Exports	%	Imported Inputs	Export-Imports	%
15 Food	570,624,625,064	236,855,170,587	41.5	62,798,248,235	174,056,922,353	30.5
16 Tobacco	40,609,955,799	10,037,320,062	24.7	1,577,569,267	8,459,750,795	20.8
17 Textiles	169,255,234,901	57,701,489,438	34.1	40,960,335,522	16,741,153,916	9.9
18 Garments	74,042,026,029	43,769,769,213	59.1	13,267,844,255	30,501,924,958	41.2
19 Leather products	45,985,184,262	28,930,507,622	62.9	13,691,503,570	15,239,004,053	33.1
20 Wood and products	42,639,240,414	14,557,332,517	34.1	9,543,430,790	5,013,901,728	11.8
21 Paper and products	132,297,512,776	22,300,662,366	16.9	9,537,043,671	12,763,618,696	9.6
22 Printing, publishing	50,294,560,411	949,584,024	1.9	4,778,951,249	-3,829,367,226	-7.6
23 Refinery products	146,397,888,622	35,101,807,876	24.0	78,733,256,949	-43,631,449,073	-29.8
24 Chemicals	190,331,983,461	44,519,162,531	23.4	38,392,962,296	6,126,200,236	3.2
25 Rubber, plastic products	216,336,400,517	108,151,258,217	50.0	25,231,100,123	82,920,158,094	38.3
26 Other non-met. prod	177,066,239,958	23,887,546,559	13.5	11,816,872,249	12,070,674,310	6.8
27 Basic metals	83,515,735,766	10,042,420,484	12.0	32,523,841,494	-22,481,421,010	-26.9
28 Fabricated metal prod	147,515,833,266	34,501,174,115	23.4	57,990,642,436	-23,489,468,321	-15.9
29 Machinery and parts	157,091,824,189	85,985,807,724	54.7	39,710,637,738	46,275,169,986	29.5
30 Computer, office equip.	133,051,258,380	121,312,483,966	91.2	83,757,149,551	37,555,334,415	28.2
31 Electrical products	126,057,599,529	72,347,463,949	57.4	41,265,517,126	31,081,946,823	24.7
32 Electronics and parts	196,063,055,371	150,679,688,554	76.9	76,855,904,678	73,823,783,877	37.7
33 Precision equipment	22,857,169,634	18,915,560,393	82.8	4,818,854,556	14,096,705,837	61.7
34 Motor vehicles, parts	445,644,641,122	103,036,585,581	23.1	86,350,519,914	16,686,065,667	3.7
35 Other transport equip.	16,876,271,720	2,713,240,577	16.1	2,801,426,050	-88,185,473	-0.5
36 Furniture, other	108,260,955,731	68,343,556,844	63.1	28,057,934,788	40,285,622,056	37.2
37 Recycling	577,077,354	6,480,000	1.1	1,715,993	4,764,007	0.8
Total	3,293,392,274,276	1,294,646,073,198	39.3	764,463,262,495	530,182,810,703	16.1
Rubber products	131,816,023,841	80,619,201,966	61.2	8,470,154,283	72,149,047,683	54.7
Total without food, rubber	2,590,951,625,371	977,171,700,645	37.7	693,194,859,978	283,976,840,668	11.0
in US$ million	103,638,065	39,086,868		27,727,794	11,359,074	
Share						
All manufacturing	100.0	100.0		100.0	100.0	
Without food, rubber	100.0	100.0		100.0	100.0	

Source: *Manufacturing Census 1997*, National Statistical Office.
Special tabulations produced by the Office of Industrial Economics (OIE), Ministry of Industry.

Table A.2. Technology Level of Exports, 1988 – 2000 (US$ million)

ISIC		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Per cent Share			
															1988	1990	1995	2000
	Resource-based industries	4,923	6,319	6,224	7,496	8,465	9,413	10,794	13,792	12,498	12,452	11,849	12,365	12,963	37.2	30.7	26.4	20.1
151	Meat, fish, fruit, vegetables, oils	2,155	2,563	3,035	4,002	4,215	4,458	5,341	5,687	5,471	5,464	5,290	5,646	5,875	16.3	15.0	10.9	9.1
152	Dairy products	11	9	12	12	14	21	36	37	42	42	39	41	51	0.1	0.1	0.1	0.1
153	Grain mill products, animal feeds	1,624	2,080	1,436	1,631	1,904	1,769	2,120	2,593	2,693	2,775	2,694	2,586	2,332	12.3	7.1	5.0	3.6
154	Other foods	502	908	901	844	1,060	829	1,152	1,709	1,907	1,570	1,125	1,092	1,214	3.8	4.4	3.3	1.9
155	Beverages	17	23	30	40	52	68	92	107	140	141	91	116	121	0.1	0.1	0.2	0.2
160	Tobacco products	1	1	1	2	7	4	5	3	7	12	13	13	13	0.0	0.0	0.0	0.0
201	Wood saw milling and planing	50	51	53	58	62	63	79	104	102	96	81	135	161	0.4	0.3	0.2	0.2
202	Wood products	142	155	153	169	190	239	274	311	300	303	331	387	444	1.1	0.8	0.6	0.7
210	Paper and products	58	67	49	64	76	82	169	326	235	398	568	664	762	0.4	0.2	0.6	1.2
251	Rubber products	178	216	258	284	364	454	515	830	753	804	869	875	1,052	1.3	1.3	1.6	1.6
252	Plastic products	184	246	296	390	520	1,425	1,011	2,085	850	847	748	810	937	1.4	1.5	4.0	1.5
	Labour-intensive industries	3,441	4,291	5,176	6,537	6,921	7,433	8,953	10,158	8,266	8,058	7,461	7,438	8,039	26.0	25.6	19.5	12.5
171	Spinning, weaving & textile finish.	579	612	709	862	952	1,001	1,167	1,405	1,293	1,376	1,199	1,166	1,202	4.4	3.5	2.7	1.9
172	Other textiles	184	201	221	281	341	401	463	516	513	507	461	524	564	1.4	1.1	1.0	0.9
173	Knitted, crocheted fab., articles	17	21	23	38	55	55	68	90	98	94	90	108	126	0.1	0.1	0.2	0.2
181	Wearing apparel	1,849	2,365	2,707	3,556	3,585	3,740	4,271	4,365	3,383	3,313	3,173	3,112	3,333	14.0	13.4	8.4	5.2
182	Fur articles	1	0	0	0	1	1	2	6	1	1	0	1	1	0.0	0.0	0.0	0.0
191	Leather tanning and products	286	342	438	490	562	641	777	866	856	840	758	803	878	2.2	2.2	1.7	1.4
192	Footwear	383	528	793	937	1,013	1,108	1,567	2,167	1,329	1,133	935	861	839	2.9	3.9	4.2	1.3
281	Structural metal products	33	75	103	116	107	105	148	167	179	162	140	160	193	0.3	0.5	0.3	0.3
289	Other fabricated metal products	107	146	183	258	306	382	490	576	613	633	704	703	903	0.8	0.9	1.1	1.4

Table A.2. ***Continued***

ISIC		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Per cent Share			
															1988	1990	1995	2000
	Scale-intensive industries	2,097	2,685	3,140	3,706	4,203	4,942	5,599	7,034	7,329	8,429	7,356	8,343	11,079	15.9	15.5	13.5	17.2
221	Publishing	14	10	14	21	29	39	90	178	45	61	71	54	43	0.1	0.1	0.3	0.1
222	Printing	3	3	3	4	5	16	29	94	9	16	12	14	13	0.0	0.0	0.2	0.0
231	Coke oven products	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
232	Refined petroleum products	39	69	89	130	203	313	237	291	702	1,109	656	908	1,654	0.3	0.4	0.6	2.6
241	Basic chemicals	81	110	145	253	246	316	363	704	853	1,331	1,453	1,887	2,977	0.6	0.7	1.3	4.6
243	Man-made fibres	26	72	88	106	107	134	220	307	312	316	293	344	430	0.2	0.4	0.6	0.7
261	Glass and products	46	49	53	85	132	156	176	202	212	187	185	209	295	0.4	0.3	0.4	0.5
269	Other non-metallic products	105	150	174	209	263	404	492	571	581	681	618	794	892	0.8	0.9	1.1	1.4
271	Basic iron and steel	187	171	148	178	174	244	294	535	498	566	623	622	1,012	1.4	0.7	1.0	1.6
272	Basic precious, non-ferrous	120	195	119	74	92	79	120	215	242	822	768	493	497	0.9	0.6	0.4	0.8
361	Furniture	238	261	303	401	456	541	656	708	701	679	606	767	925	1.8	1.5	1.4	1.4
369	Jewellery, sports goods, games	1,237	1,595	2,003	2,246	2,495	2,701	2,923	3,228	3,174	2,660	2,071	2,250	2,340	9.4	9.9	6.2	3.6
	Differentiated Goods	1,303	1,904	2,856	4,023	4,917	6,293	8,105	9,613	9,998	10,516	10,120	11,558	14,320	9.8	14.1	18.4	22.2
291	General purpose machinery	224	272	416	594	755	1,170	1,241	1,707	1,819	1,713	1,525	1,783	2,098	1.7	2.1	3.3	3.3
292	Special purpose machinery	62	59	96	127	172	262	270	340	389	410	514	377	483	0.5	0.5	0.7	0.7
293	Domestic appliances n.e.c.	133	212	271	355	414	458	529	637	657	618	594	690	896	1.0	1.3	1.2	1.4
311	Electrical motors, generators, etc.	47	82	118	195	257	412	646	996	1,194	1,447	1,239	1,547	1,687	0.4	0.6	1.9	2.6
312	Electrical distribution equipment	11	37	27	52	79	122	182	380	436	403	396	584	708	0.1	0.1	0.7	1.1
313	Insulated wire, cable	27	49	74	119	145	184	176	206	198	207	216	247	256	0.2	0.4	0.4	0.4
314	Batteries and cells	15	20	24	33	42	49	49	69	80	94	94	91	95	0.1	0.1	0.1	0.1
315	Lamps and equipment	39	130	164	158	150	117	137	145	154	142	137	152	173	0.3	0.8	0.3	0.3
319	Other electrical equipment n.e.c.	418	210	167	149	235	543	772	751	586	530	557	614	781	3.2	0.8	1.4	1.2
322	TV and radio transmitters	9	104	199	346	391	426	490	579	702	748	769	792	1,060	0.1	1.0	1.1	1.6
323	TV, radio, video equipment	96	441	861	1,214	1,543	1,569	2,237	2,465	2,336	2,562	2,340	2,227	2,952	0.7	4.2	4.7	4.6
333	Watches, clocks	53	95	189	291	332	279	380	459	437	396	342	256	293	0.4	0.9	0.9	0.5
341	Motor vehicle assembly	83	59	55	86	57	133	126	138	242	656	748	1,340	1,809	0.6	0.3	0.3	2.8
342	Motor vehicle body	15	48	90	127	137	135	90	92	68	16	26	16	9	0.1	0.4	0.2	0.0
343	Motor vehicle components	40	41	47	57	64	211	410	178	172	218	297	425	619	0.3	0.2	0.3	1.0
351	Ship building, repair	6	5	7	65	32	17	78	75	139	19	13	73	50	0.0	0.0	0.1	0.1
352	Railway equipment	0	0	0	0	0	0	0	0	0	0	0	2	1	0.0	0.0	0.0	0.0
359	Motorcycle, bicycle, other	23	40	52	57	111	207	292	395	388	336	315	342	348	0.2	0.3	0.8	0.5

Table A.2. ***Continued***

ISIC		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Per cent Share			
															1988	1990	1995	2000
	Science-based industries	1,463	2,065	2,861	3,723	4,780	6,010	8,558	11,577	13,020	13,639	13,671	14,933	18,090	11.1	14.1	22.2	28.1
242	Other chemical products	104	124	180	288	353	530	651	1,041	695	769	713	835	985	0.8	0.9	2.0	1.5
300	Office, acc., computing machinery	521	1,075	1,567	1,963	2,417	2,833	4,148	5,716	7,053	7,406	8,091	8,278	8,850	3.9	7.7	11.0	13.7
321	Electronic components	772	770	994	1,271	1,647	2,064	2,834	3,707	3,907	4,222	4,157	5,136	7,328	5.8	4.9	7.1	11.4
331	Medial, measuring equipment	28	30	49	86	118	167	193	235	271	306	300	280	348	0.2	0.2	0.5	0.5
332	Optical, photographic equipment	36	58	70	110	165	183	234	311	387	381	378	381	502	0.3	0.3	0.6	0.8
353	Aircraft, spacecraft	2	7	1	5	81	232	498	567	707	555	32	23	77	0.0	0.0	1.1	0.1
	Total Manufactured Exports	13,226	17,264	20,258	25,485	29,286	34,091	42,009	52,174	51,111	53,094	50,458	54,637	64,491	100.0	100.0	100.0	100.0
	Total Exports	16,018	20,167	23,134	28,543	32,568	37,307	45,414	56,672	55,896	57,992	53,902	58,867	69,524				

Source: Customs department, converted to ISIC classification by Office of Industrial Economics (OIE), Ministry of Industry.

Table A.3. Import Content of Intermediate Inputs, 1996

ISIC		Domestic Establishments			Foreign Establishments			All Establishments		
Vers. 3		All Inputs	Imported	%	All Inputs	Imported	%	All Inputs	Imported	%
	2-Digit									
15	Food	227,882,113,735	36,349,225,643	16.0	90,766,092,690	26,449,022,430	29.1	318,648,206,425	62,798,248,073	19.7
16	Tobacco	7,337,701,803	1,426,457,079	19.4	1,371,657,996	151,112,187	11.0	8,709,359,799	1,577,569,266	18.1
17	Textiles	38,282,180,875	14,961,874,553	39.1	48,131,098,995	25,998,460,830	54.0	86,413,279,870	40,960,335,383	47.4
18	Garments	24,833,896,390	6,025,362,734	24.3	15,243,217,651	7,242,481,435	47.5	40,077,114,041	13,267,844,169	33.1
19	Leather products	16,892,513,340	7,779,479,302	46.1	8,597,754,381	5,912,024,190	68.8	25,490,267,721	13,691,503,492	53.7
20	Wood and products	17,376,031,651	7,954,852,143	45.8	5,247,804,285	1,588,578,588	30.3	22,623,835,936	9,543,430,731	42.2
21	Paper and products	39,943,512,324	6,907,312,930	17.3	10,501,389,352	2,629,730,710	25.0	50,444,901,676	9,537,043,640	18.9
22	Printing, publishing	13,759,660,287	3,131,900,925	22.8	2,650,679,876	1,647,050,250	62.1	16,410,340,163	4,778,951,175	29.1
23	Refinery products	38,371,547,959	27,764,829,924	72.4	63,132,724,619	50,968,427,021	80.7	101,504,272,578	78,733,256,945	77.6
24	Chemicals	50,047,633,903	13,483,936,657	26.9	49,491,789,205	24,909,025,439	50.3	99,539,423,108	38,392,962,096	38.6
25	Rubber, plastic products	81,926,648,536	11,776,730,348	14.4	47,203,049,944	13,454,369,610	28.5	129,129,698,480	25,231,099,958	19.5
26	Other non-met. prod	38,850,948,010	6,461,007,948	16.6	16,857,134,086	5,355,864,242	31.8	55,708,082,096	11,816,872,190	21.2
27	Basic metals	38,406,145,047	22,783,052,112	59.3	14,449,170,010	9,740,789,330	67.4	52,855,315,057	32,523,841,442	61.5
28	Fabricated metal prod	31,985,859,248	11,193,462,641	35.0	62,814,136,099	46,797,179,634	74.5	94,799,995,347	57,990,642,275	61.2
29	Machinery and parts	18,361,812,382	5,294,961,750	28.8	81,091,560,317	34,415,675,865	42.4	99,453,372,699	39,710,637,615	39.9
30	Computer, office equip.	681,996,175	303,608,037	44.5	105,154,760,264	83,453,541,500	79.4	105,836,756,439	83,757,149,537	79.1
31	Electrical products	15,126,188,015	7,795,499,283	51.5	48,568,270,418	33,470,017,765	68.9	63,694,458,433	41,265,517,048	64.8
32	Consumer electronics	7,191,474,389	2,305,115,011	32.1	115,873,211,148	74,550,789,616	64.3	123,064,685,537	76,855,904,627	62.5
33	Precision equipment	1,162,664,533	401,615,628	34.5	5,858,316,218	4,417,238,899	75.4	7,020,980,751	4,818,854,527	68.6
34	Motor vehicles	36,383,177,911	8,528,306,086	23.4	238,328,910,808	77,822,213,744	32.7	274,712,088,719	86,350,519,830	31.4
35	Other transport equip.	5,173,050,039	1,228,085,643	23.7	3,492,037,121	1,573,340,377	45.1	8,665,087,160	2,801,426,020	32.3
36	Furniture, other	30,832,026,573	9,268,653,142	30.1	30,593,667,031	18,789,281,479	61.4	61,425,693,604	28,057,934,621	45.7
37	Recycling	288,313,576	1,715,992	0.6	3,372,278		0.0	291,685,854	1,715,992	0.6
Total		781,097,096,701	213,127,045,511	27.3	1,065,421,804,792	551,336,215,141	51.7	1,846,518,901,493	764,463,260,652	41.4

Table A.3. ***Continued***

ISIC		Domestic Establishments			Foreign Establishments			All Establishments		
Vers. 3		All Inputs	Imported	%	All Inputs	Imported	%	All Inputs	Imported	%
17	Textiles	38,282,180,875	14,961,874,553	39.1	48,131,098,995	25,998,460,830	54.0	86,413,279,870	40,960,335,383	47.4
18	Garments	24,833,896,390	6,025,362,734	24.3	15,243,217,651	7,242,481,435	47.5	40,077,114,041	13,267,844,169	33.1
24	Chemicals	50,047,633,903	13,483,936,657	26.9	49,491,789,205	24,909,025,439	50.3	99,539,423,108	38,392,962,096	38.6
30	Computer, office equip.	681,996,175	303,608,037	44.5	105,154,760,264	83,453,541,500	79.4	105,836,756,439	83,757,149,537	79.1
321	Electronic components			57.0			70.2			69.8
322	Transmitter equipment			61.8			75.8			73.9
323	Consumer electronics			13.8			55.4			52.0
343	Vehicle components			27.1			67.3			51.7
Total	All industries	781,097,096,701	213,127,045,511	27.3	1,065,421,804,792	551,336,215,141	51.7	1,846,518,901,493	764,463,260,652	41.4

Source: *Manufacturing Census 1997*, NSO. Special tabulation produced by the Office of Industrial Economics (OIE), Ministry of Industry.