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RECENT DEVELOPMENTS IN THE MACHINE TOOL INDUSTRY:
THE PROSPECTS FOR FOREIGN DIRECT INVESTMENT
WITH PARTICULAR REFERENCE TO
ASIAN DEVELOPING COUNTRIES *

Prepared by the

Regional and Country Studies Branch
Studies and Research Division

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P R E F A C E

The report presented here was prepared by Mr. Peter O'Brien as UNIDO consultant in close cooperation with staff of the Regional and Country Studies Branch. It is part of the Economic Research Services programme that the Branch has developed in response to frequent requests for analyses and information of immediate relevance to industrial policy-making in individual developing countries.

Through this programme, the Branch has been regularly assisting policy-makers in developing countries to monitor pertinent developments at the national and regional levels, in particular as concerns industrial policies and programmes in other countries, emerging technological trends, prospective demand changes in national and international markets, as well as relevant corporate strategies.

The report assesses the current international machine tool (MT) market, underlining its highly competitive nature, the enormous increase in Japan's role and the general trend towards an 'Asia centred' market, the diffusion of electronic-based control technology, and the persistence of a small group of industries (especially the automotive cluster) as the principal source of demand. The report then proceeds to ask whether the international character of the industry as evidenced by the relatively high ratios of exports to production and imports to consumption for most of the leading producer nations is paralleled by a similar emphasis on FDI. Up till now the answer is firmly negative; however, in view of the growing pressures to limit MT imports to the US market as shown by the US administration's partially successful attempts to obtain Voluntary Export Restraints the report goes on to consider whether and in what ways that answer might be modified in the future.

Specifically, the report looks into the status and prospects of some Asian 'newcomers' in the international MT industry, the nature of cooperation arrangements concluded so far with Asian partners and the significance of incentives as investment determinant. The report concludes with an assessment of the preconditions for MT-related investment in Asian developing countries.

Prefatory comments would be incomplete without the caveat that the report is based on a short period of desk research only. In particular no interviews and plant visits with developed country-based companies were carried out. Hence, there is a clear need for follow-up work at the company level to gain further insights into relevant sub-markets and into the driving forces and characteristics of technology transfer arrangements and FDI that have taken place so far. To complement the report presented here, the Regional and Country Studies Branch has initiated further research along these more disaggregated lines. The results will be published in a second report with a stronger focus on the specific preconditions of MT-related investment in Asian developing countries.

TABLE OF CONTENTS

	<u>Page</u>
Preface	ii
List of Tables	iv
List of Abbreviations	vi
Summary	vii
Chapter 1: An Overview of the Machine Tool Industry	1
1.1. Defining the Subject	1
1.2. Machine Tool Production	2
1.3. Machine Tool Consumption	9
1.4. International Trade in Machine Tools	11
Chapter 2: Foreign Direct Investment - A Response to Competitive Pressures?	20
2.1. Machine Tools and Foreign Direct Investment	20
2.2. Foreign Direct Investment and the Ongoing Reorganisation of Machine Tool Production	25
2.3. The International Horizons of Newcomers	33
2.4. The Nature of Cooperation Arrangements in Asia	37
2.5. The Significance of Investment Incentives	43
Chapter 3: The Prospects for Asian Developing Countries	46
3.1. The Asian Context	46
3.2. Foreign Direct Investment in Cheap Labour Countries?	50
Appendix: Main National Machine Tool Associations	54
Bibliography	56

LIST OF TABLES

	<u>Page</u>
1. Machinery and Equipment Industries within the Manufacturing Sector, Selected Countries, 1982-1984	3
2. Estimated World Machine Tool Production, 1986	4
3. Indicators of Growth and Fluctuation in World Machine Tool Production, 1976-1986	5
4. Japan: Metalcutting Machine Tool Production by Type, 1985	7
5. Production and Use of NC Machine Tools in Selected Countries, 1985	7
6. Country Shares of Total OECD Production of CNC Lathes, by Value and Volume, 1976, 1980 and 1984	8
7. Unit Production and Average Price of NC Metalcutting Machines in Selected Countries, 1984	9
8. Estimated Apparent Consumption of Machine Tools, 1986	10
9. Indicators of International Specialisation in Machine Tools, 1986	12
10. USA Imports of Machine Tools by Country of Origin, 1976, 1981 and 1985	14
11. Japan: Regional Breakdown of Machine Tool Exports, 1985	15
12. EEC: Regional Breakdown of Metalworking Machine Tool Exports, 1985	15
13. Switzerland: Regional Breakdown of Machine Tool Exports, 1986	16
14. Average Value per Metric Ton of Metalcutting Machine Tools Produced by Leading European Countries, 1981 and 1985	17
15. USA: Direct Investment Abroad, 1985	20
16. Japan: Direct Investment Abroad, Stock at end 1985	21
17. FRG: Direct Investment Abroad, Stock at end 1984	21
18. UK: Outflow of Foreign Direct Investment, 1980-1984	22
19. FRG: Features of Outflow of Foreign Direct Investment in Machine Tool and Related Production, 1961-1983	24
20. Republic of Korea: Direct Investment Abroad, Stock 1984	34

	<u>Page</u>
21. Taiwan, Province of China: Direct Investment Abroad, Stock 1985	34
22. Singapore: Foreign Direct Investment of Local Firms by Type of Investment and Recipient Country, 1985 Position	36
23. Some Examples of Cooperation between Asian Countries and Foreign Partners in the Machine Tool Industry, 1984-1986	38
24. Summary of Foreign Investment Incentives Available in ASEAN Countries, 1986	45
25. Japan: Foreign Direct Investment in Developing Asia, 1985	47
26. Some Characteristics of the Machine Tool Industry in ASEAN Countries, 1985	48
27. Average Hourly Wages and Average Hourly Labour Costs in Export Processing Zones and World Market Factories in Selected Developing Countries, 1983	51
28. Projected Change in Investment Costs as Measured in Dollars and Yen in Selected Asian Countries, end 1985 to end 1987	52

LIST OF ABBREVIATIONS

AGV	Automated Guided Vehicle
ASEAN	Association of South East Asian Nations
CECIMO	Comité Européen de Coopération des Industries de la Machine-Outil
CNC	Computer Numerically Controlled
EDM	Electric Discharge Machine
EEC	European Economic Community
ESCAP	Economic and Social Commission for Asia and the Pacific
FDI	Foreign Direct Investment
FRG	Federal Republic of Germany
GDR	German Democratic Republic
HMSO	Her Majesty's Stationary Office (UK)
ISIC	International Standard Industrial Classification
JETRO	Japanese External Trade Relations Organisation
JMEA	Japanese Machinery Exporters Association
JMTBA	Japan Machine Tool Builders Association
JV	Joint Venture
LC	Local Content
MITI	Ministry of International Trade and Industry (Japan)
MT	Machine Tools
MTTA	Machine Tool Trades Association
MVA	Manufacturing Value Added
NC	Numerically Controlled
NIC	Newly Industrialising Country
OECD	Organisation for Economic Cooperation and Development
SITC	Standard International Trade Classification
UNIDO	United Nations Industrial Development Organisation
VER	Voluntary Export Restraint
VW	Volkswagenwerk AG (FRG)

SUMMARY

This study has three basic objectives: first to provide an analytical overview of recent trends in the production, consumption and trade of machine tools (MT) worldwide (chapter 1); second to review the actual scope and prospects for foreign direct investment (FDI) in the MT industry in general (chapter 2) and third to assess in particular the potential of developing countries to attract FDI in this central field of capital goods production (chapter 3). While the study leads to fairly general results and implications it has a special focus on trends in the Asian region which - largely but not exclusively due to the emergence of Japan as a major MT producer - has developed into a key area on the global MT map.

As shown in chapter 1, MT output and employment is but a tiny portion (rarely above 2%) of machinery and equipment industries in the world's main industrialised countries. Yet it is a pivotal branch, being the provider of key capital goods. Demand for its output is therefore closely linked to investment cycles in major industry sectors of the OECD. Over the past decade 3 phases are clearly discernible viz. 1976-1980, 1981-1983 (sharp contraction) and 1984 - 1986; there are good reasons for assuming another sharp change is now occurring but this time with different structural features than in the past.

The present decade has witnessed a dramatic rise to the top of Japan as a producer and exporter, due to sustained domestic economic growth, the MT demand generated by the country's FDI (above all in automotive) and the speed with which it has innovated in numerically controlled (NC) and computer numerically controlled (CNC) production. While USA has remained very much the key open market it has, in the 1980s, suffered an astonishing set-back as a domestic producer. The speed of import penetration appears to have brought matters to a crisis point and voluntary export restraints (VER) negotiations have been partly concluded with major sellers. The ramifications of the immense competitive strains are several including (in addition to trade controls) problems of overcapacity, falling profits, possible relocation of production through FDI and/or technology transfer arrangements, and product choice (what items to specialise in).

Since MT manufacture today requires much greater skills than the traditional areas of metallurgy and mechanics, drawing heavily on electronics in the vital area of control systems, and many products are made by highly automated processes which utilise quite intensively the skills of the information sciences, there is a virtual rupture with the metalworking sector. For small to medium size countries placing considerable emphasis on export oriented industrialisation as a main plank of development, yet still lacking a wide industrial base and without adequate domestic demand to sustain one, the natural temptation is to ask whether the present conjuncture could offer the chance to link up with MT production through FDI.

Chapter 2 assesses the significance of foreign investment in this branch and the factors influencing developments in the rest of the 1980s.

It reveals that MT has so far not been an industrial branch notable for FDI, whether measured in relation to other branches or its own production. There are, however, distinct signs that a major change may be taking place. At the moment the critical movements centre on the leading OECD countries with the weaker producers, USA and UK, the targets for Japanese FDI. Part of the investment in USA is the beginning of a reaction to a VER regime and another part is tied to linkage investments with the Japanese automotive firms that have set up production in USA in the 1980s. Foreign investment in UK is making use of that country's membership of the EEC to employ the country as a platform for exports to elsewhere in the region. In both recipient countries the long tradition of MT production as well as the existing infrastructure have been important pull factors for investment, along with the local and regional markets. Prospects for FDI in developing countries are not great save for the handful of nations which are large industrial producers and/or already relatively advanced in MT. Cheap labour to undertake assembly activities is not a prime consideration for firms: current trends point to a marked shift away from labour intensive production and a sharp upgrading of skills for those remaining in MT employment. For the present the few MT producers from leading developing countries investing abroad also focus on USA and are unlikely to look at other locations for quite some time. Examination of some cases of recent collaborations involving main Asian developing countries shows a prevalence of licensing deals, especially from firms in USA, an absence of Japanese operations, an emphasis on production for local markets with some export to the region, and the beginning of FDI reverse in OECD locations. Finally, there is no evidence to suggest investment incentives have any positive impact on a country's chances of attracting investment - at best they put the country on an enterprise's list of possible sites.

Chapter 3 deals in greater detail with the situation of Asian developing countries, above all in ASEAN. It shows that at present the status of MT production proper in these countries is rather embryonic. Furthermore, it is argued that the attraction of FDI in this branch is not primarily dependent upon wage cost advantages but essentially requires further assets related to the existence of relatively advanced industrial systems. It is a clear result of the present study that MT-related FDI tends to require both a sophisticated supply network (in terms of material inputs and human capital) and the existence of a large enough domestic market to reduce the high risks of FDI in this particular branch.

Chapter 1

AN OVERVIEW OF THE MACHINE TOOL INDUSTRY

1.1. Defining the Subject

More than most industrial branches machine tools (MT) are defined in different ways according to the purpose at hand. The Japan Machine Tool Builders Association (JMTBA) simply describes MT as "machines for making other machinery equipment"^{1/}. A UNIDO analysis tries to be much more precise stating "A machine tool is a power-driven tool, non-portable while in operation, used for carrying out, individually or in combination, the operations of machining, forming and electrochemical processing of metals, wood, glass, plastic and similar materials."^{2/} It goes on to note the wide range of MT encompassed by the definition, ranging from simple drilling machines and lathes to machining centres with tool changers and flexible machining systems, and the set of operations involved in metal cutting and metal forming that give rise to hundreds of different kinds of MT. Quantitative studies usually confine themselves to ISIC major groups 381 and 382 and/or divisions 71-74 of SITC, though sometimes the apparent rigour is weakened by references to non-electrical machinery. Whatever the details the points to be kept in mind are (i) MT are tools for making machines and/or components of machines, (ii) their power source can be mechanical or electrical, (iii) although mostly references are to working on metals, the materials so fashioned can be quite diverse, and (iv) the huge differences in complexity of manufacture and operation mean that MT can be made in highly advanced factories or in simple workshops.

Nowadays the production of an advanced MT (itself made by using other MT) draws not only on the traditional (yet ever more sophisticated) disciplines of metallurgy and mechanics but increasingly on electrical science and above all electronics. Indeed, the chairman-designate of Brown Boveri has recently indicated that the electrical-electronic component in MT manufacturing costs is in the region of 30%.^{3/} This shift in the nature of the product is, within the main OECD countries, altering the character of the industry and the activities of the firms within it. Leading firms now engage in substantial buying-in of components, especially electronic control systems, must use large teams of design engineers including computer software specialists to solve problems for their clients (packaged solutions), make sizeable R and D expenditures, and produce a wide range of items (coverage of product series seems to be a key factor in market success). Yet the industry still retains remarkable heterogeneity with respect to firm size and technological vintage of production methods and outputs - which suggests that any country trying

1/ JMTBA, Machine Tool Industry Japan 1986.

2/ UNIDO, Technological Perspectives in the Machine Tool Industry and their Implications for Developing Countries, UNIDO/IS.333, 30 July 1982.

3/ See Financial Times, "Machine Tools: Rich Pickings in Specialisation," 27 April, 1987.

to attract foreign direct investment (FDI) in the branch has many different segments to look at. Where it concentrates its efforts will depend on what kinds of items it wants to manufacture, for which markets, and capitalising on which local resources.

MT output does not represent more than a small fraction of manufacturing value added (MVA) in any country. Table 1 illustrates this point using 7 major countries. It shows that machinery and equipment industries account for just under one-half of MVA in the leading OECD countries as against just under 30% in the leading developing countries; that about two-fifths of machinery output tends to come from metal products and non-electrical machinery; and that, as indicated by the figures for Japan in the footnote to Table 1, MT output is usually not more than about one-tenth of the latter category. In relation to MVA, therefore, the share of MT is probably around 2% for the leading OECD countries and from 1-1.5% for the leading developing countries. In absolute terms MT is a much smaller activity than most of those which have been in the forefront of FDI during the past decade and its importance, as is well known, derives from the strategic nature rather than the absolute value of its output. The strategic significance, in its turn, stems from the pivotal role played by the branch in relation to other major industries within the producing countries. Up till now there is no instance of a country which has engaged in notable MT production without having a sizeable and diversified industrial structure.

1.2. Machine Tool Production

The overwhelming majority of world MT output originates in some 35 countries - Table 2 summarises the 1986 data (in dollar terms, the highest ever recorded value of production). Total output is around \$29 billion of which some 77.5% stems from cutting tools. Seven countries, 5 OECD and 2 Eastern Europe, produce in excess of \$1 bn. each and together they account for 79% of the global total - the 8 leading developing countries, including China, only manufacture just over 5% of the global figure. Combining table 2 with table 3 demonstrates that, while concentration of world production is on the increase, there has been a dramatic shift in the relative strength of different producers. In 1976 some 57% of the aggregate figure came from the 4 chief producing countries whereas by 1986 their share was just over 64%. In the former year, however, each of the other leaders produced more or less double the Japanese figure (then around 8% of world output); by 1986 Japan manufactured more MT than the USA and USSR combined. Even when allowance is made for the large rise in the value of the yen during the latter year, Japan still remains clearly ahead of both countries individually (though not combined).

The world production map has now become multi-centred but with striking tendencies in the shifts in the balance of power. Four areas are currently high profile producers: (i) the 12 European members of CECIMO, providing around 37% of global output - within which FRG is by far the dominant entity and Switzerland and Italy, both specialist suppliers, rank next; (ii) Asia, with some 30%, of which Japan provides four-fifths but China, Taiwan (Province of China), Republic of Korea and India also each produce about 1% of the world total; (iii) Eastern Europe, with close to one fifth the global figure, mainly from USSR and GDR; and (iv) USA and Canada, around 11% of the total. That spread of output is radically different from the mid 1970s and even from the start of the present decade as Japanese production has expanded enormously

Table 1: Machinery and Equipment Industries within the Manufacturing Sector,
Selected Countries, 1982-1984

Country	Share of MVA by Country					
	All Machinery and Equipment Production	Metal Products	Non-Electrical Machinery	Electrical Machinery	Transport Equipment	Precision Instruments
<u>A. OECD Countries</u>						
Japan	45.9	6.6	12.6	14.1	10.8	1.8
USA	47.0	7.3	14.2	10.1	11.6	3.8
FRG	50.9	6.2	14.7	13.1	14.5	2.4
<u>B. Latin American Countries</u>						
Brazil	32.5	5.3	11.2	7.1	8.1	0.8
Mexico	28.8	6.9	5.4	6.4	9.2	0.9
<u>C. Asian Developing Countries</u>						
India	29.8	3.4	8.9	8.0	8.8	0.7
Republic of Korea	28.0	4.4	4.0	10.0	8.5	1.1

Source: UNIDO, Handbook of Industrial Statistics 1986, Vienna 1986

Notes: Figures are the average for 1982-84. All machinery and equipment industries correspond to ISIC 38; the figure in this column is the sum of the following five columns which correspond to ISIC 381, 382, 383, 384 and 385 respectively. Machine tools, tightly defined, are a sub-category of 381 and 382; in Japan, for example, they account for less than one-tenth of ISIC 381+382, i.e. less than 2% of MVA.

Table 2: Estimated World Machine Tool Production, 1986
(US\$ mn.)

Country	Total	Cutting	Forming	% of World Total
A. <u>Leaders (>\$1 bn)</u>				<u>79.1</u>
Japan	7082	5728	1354	24.2
FRG	5210	3642	1568	17.8
USSR	3657	2943	714	12.5
USA	2830	2110	720	9.7
Italy	1645	1162	483	5.6
Switzerland	1439	1269	170	4.9
GDR	1074	1064	230	4.4
B. <u>Significant OECD</u>				<u>6.7</u>
UK	728	580	148	2.4
France	693	569	124	2.2
Spain	365	286	77	1.1
Sweden	295	169	126	1.0
C. <u>Principal Developing Countries</u>				<u>5.3</u>
Brazil	370	280	90	1.1
China	364	303	61	1.1
Taiwan (Province of China)	351	321	30	1.1
India	250	160	90	0.9
Rep. of Korea	242	207	35	0.9
Singapore	34	31	3	0.1
Mexico	18	15	3	0.1
Hong Kong	1.3	0.1	1.2	negligible
D. <u>World Total</u>				<u>100</u>

Source: American Machinist and Automated Manufacturing, February 1987.

Notes: (i) World total is based on 35 reporting countries; in value terms they certainly account for 99% of aggregate output.

(ii) Though figures are estimates, experience of preceding years suggests any subsequent revisions of either individual country data or the global total would be most unlikely to exceed 5%.

(iii) Exchange rate conversions based on average rates reported by IMF during first 9 months and bank transfer rates for last 3 months. Where currencies are controlled the conversions employed were: USSR, 70% of official rate; GDR, 65% of the FRG rate; and China, the IMF commercial rate.

Table 3: Indicators of Growth and Fluctuation in World Machine Tool Production, 1976-1986

A. World Output

Value of Production (\$ bn., current prices and exchange rates)

1976: 13.5
1980: 26.7
1986: 29.2

Annual % Changes in Production

1976-1980: +11.9 +26.5 +20.0 +16.6
1980-1986: - 1.1 -15.1 -13.0 + 2.0 +10.0 +33.3

B. Leading Producers

Japan

Value of Production

1976: 1.1 1980: 3.7 1986: 7.1

Annual % Changes in Production

1976-1980: +36.3 +53.3 +27.2 +35.7
1980-1986: +26.3 -20.8 - 8.0 +28.6 +17.7 +32.8

USA

Value of Production

1976: 2.2 1980: 4.8 1986: 2.8

Annual % Changes in Production

1976-1980: +14.3 +25.0 +33.3 +20.0
1980-1986: + 6.3 -25.5 -44.7 +14.0 +12.0 + 3.7

FRG

Value of Production

1976: 2.4 1980: 4.7 1986: 5.2

Annual % Changes in Production

1976-1980: + 8.3 +26.0 +21.2 +17.5
1980-1986: -17.0 -10.3 - 8.6 -12.5 +14.0 +64.0

USSR

Value of Production

1976: 2.0 1980: 3.0 1986: 3.7

Annual % Changes in Production

1976-1980: +10.0 +18.2 +11.5 + 7.1
1980-1986: - 6.5 + 0.5 + 6.9 -10.0 + 7.1 +16.1

Source: American Machinist, various issues; own calculations

(some six and one-half times measured in current exchange rates and about 5 times at constant rates) and US output has dropped from a peak of close to \$5 bn. in 1980 to a total less than \$3.0 bn. in 1986. How can these changes be explained and what do they imply?

Japan's move to dominance is the result of macroeconomic and MT specific factors. The macroeconomics of sustained growth at home plus huge export demand abroad have fuelled consumption of MT - the character of demand has been strongly oriented, both within Japan and elsewhere (especially USA), to items whose production processes depend heavily on MT investment. Outstanding among these branches has been automotives: "The industry and its related contractors and sub-contractors account for up to 50% of the output of machine tools in Japan."^{1/} Export sales of automobiles, along with direct exports of MT, have ensured that a large part of the demand for Japanese MT production has come, directly and indirectly, from abroad: taking this along with persistent high rates of growth at home within an economy strongly oriented to industry as the leading sector has provided a constant and powerful impetus on the demand side. Yet this factor alone is insufficient to explain the force of Japan's MT production surge - due to the successful incorporation of technological advances emanating from electronics, the quality of output has changed dramatically over the past decade.

More than any other country in the world, Japan has emphasised production of numerically controlled (NC) MT and particularly computer numerically controlled (CNC) items. A few quantitative indicators underline the extent of Japan's commitment to improved production quality. Table 4 describes the principal kinds of MT production in Japan in 1985 and shows how total output and NC output were distributed by type of MT. NC production was two-thirds of the total and within the NC column machining centres and lathes absorbed 69% of the aggregate, with electric discharge machines (EDM) and special purpose items pushing the total up to around 90% of all NC products. These are precisely the kinds of equipment in heavy demand throughout the OECD in the current era of revolutionising the factory, of custom-made large-scale output. Tables 5 and 6 illustrate Japan's concentration on NCMT as compared with other countries. In Table 5 the flow and stock position in 1985 is set out for the 3 leading OECD producers and 2 key developing countries in Asia. On an annual output basis Japan puts a far larger share of its resources into NC production than do any of the other countries - at the moment two-thirds by value of MT manufacture in Japan is NC while in both FRG and USA the share is not above 30%. That the high proportion has been maintained for some years is demonstrated by the stock data (computed on a unit basis) in the right-hand column of Table 5 which shows that, as the Japanese producers themselves say, the country is now in the 'one in four' period - a quarter of all MT installed are of the NC type. Although no reliable data for FRG and USA could be found, there can be little doubt that the shares in these countries are far below the Japanese figures.

1/ Far Eastern Economic Review, "Rationalisation is on the Cards for a High Flyer," 18 December 1986.

Table 4: Japan: Metalcutting Machine Tool Production by Type, 1985
(% of Output based on value)

Type of Machine	Total Production	NC Production
Machining Centres	25.4	37.9
Lathes	25.3	31.3
Grinding	12.5	2.5
Special Purpose	11.0	7.0
Electric Discharge Machines	8.9	12.7
Milling	7.0	5.4
Boring	2.4	1.2
Drilling	1.5	0.5
Others	6.0	1.5
Total	100.0	100.0

Source: JMTBA, Machine Tool Industry Japan 1986, Tokyo, July 1986.

Notes: In 1985 NC production was 67% of the Japan total, a proportion reflected in the shares of machining centres which must, by their nature, be NC items.

Table 5: Production and Use of NC Machine Tools
in Selected Countries, 1985

Country	NC Production as Share of Total (%)	NC Share of Total Installed (%)
Japan	66.9	25.7
FRG	30.0	n.a.
USA	28.0	n.a.
Rep. of Korea	10.2	n.a.
India	3.7	0.1

Sources: Metalworking, Engineering and Marketing, September 1986; IMTMA, Machine Tool Industry India, 1986; Korean Machine Tool Manufacturers Association, Machine Tool, December 1986; "Deutsche Werkzeugmaschinen sind Spitze", Süddeutsche Zeitung, 30 March 1987, reporting on a study by the Boston Consulting Group carried out on behalf of VDW (Vereins Deutscher Werkzeugmaschinenfabrik).

Notes: Production data on value basis; stock data on units basis.

Table 6 highlights the position with regard to one of the most important sets of MT developed in the past years, CNC lathes. Using 3 areas, Japan, USA and the leading West European countries (excluding only Switzerland among significant producers), the table sets out the shifts in their relative production shares, by value and volume, over the years 1976-1984. From a mid 1970s position where Europe and USA dominated in value terms and Japan's output was worth less than a fifth of the total, the rise of Japan to 1984 could scarcely have been more rapid. At that date over one-half of the value of CNC lathes production (measured at current exchange rates) came from Japan; even with currency conversion at 1976 rates, the 5 West European countries together (with a market around 250 million people) were only barely in advance of Japan. On a volume basis Japan has always been in the forefront; nevertheless, it has continuously increased its share of world output to reach close to three-quarters by now.

Table 6: Country Shares of Total OECD Production of CNC Lathes, by Value and Volume, 1976, 1980 and 1984

A. Value (US\$ mn.)

Year	Shares at 1976 Exchange Rates			Shares at Current Exchange Rates		
	Japan	Europe	USA	Japan	Europe	USA
1976	17.8	40.8	41.2	17.8	40.8	41.2
1980	31.8	38.3	29.3	35.3	39.4	25.2
1984	42.1	44.2	13.7	53.8	32.2	14.0

B. Volume (Units)

Year	Japan	Europe	USA
1976	41.0	32.8	26.1
1980	60.4	25.8	13.8
1984	72.3	21.0	6.7

Source: Staffan Jacobsson, Electronics and Industrial Policy, London 1986.

Notes: Europe defined as FRG, France, Italy, UK and Sweden. Shares according to value calculated according to base year and current exchange rates to show sensitivity of the percentages to currency fluctuations.

It can legitimately be argued that the disparity between value and volume figures is appreciable; Table 7 gives average \$ prices in 1984 for NC cutting machines and shows US made items selling at double Japanese prices and FRG machines at one and a half as much again compared with Japan. While exchange rate alterations over the past 18 months along with a relative upgrading of Japanese production have certainly narrowed the average price differentials, it is still most probably true that the US and FRG figures exceed those for Japan. Now the relevance of price comparisons is this: for MT, relative prices are fairly closely correlated with relative quality (price tends to reflect weight, and weight itself is a fair approximation for machine power).

Table 7: Unit Production and Average Price of NC Metalcutting Machines in Selected Countries, 1984

Country	Units Delivered	% of Total Cutting Machine Production (measured by value)	Average Price (US\$, current exchange rates)
Japan	38036	67	65,000
USA	5163	39	131,000
FRG	9966	49	99,000
UK	2630	50	n.a.
Italy	1520	20	n.a.
France	1294	58	n.a.

Source: American Machinist, February 1986.

The mix of Japanese NC output is thus towards smaller items than those made by its competitors: within Japan itself, and above all internationally, the thrust has been towards the less than top size NCMT and this market segment seems to have been very large. To a considerable degree, Japan has created it and captured it.

Thus the contours of the present world production structure. But are the developments of recent years likely to be a reliable pointer to the remainder of the decade? As with some other, related, industrial branches a crucial element affecting the competitive struggle in the near future is the trade situation between Japan and USA. Since about 14% of the former's production is sold in the American market, application of sharp trade limitations could shift market shares and encourage reactions by Japanese firms. Foremost among those responses would most probably be FDI: Chapter 2 will examine the evidence on this point. Production relocation is, however, only part of the picture. The size and geographical origin of demand, as well as the fluctuations in it, will have a major influence on production shares. MT are producer durables purchased as part of the investment decision in other branches: the sustainable annual rate of demand is therefore a function of investment cycles, the economic life of MT (which in periods of rapid technical progress depends as much on the real productivity of new vintages of equipment as on physical wear and tear) and the prospects of extending MT use into completely new areas. To explore these issues a little further the following sub-section looks at consumption trends.

1.3. Machine Tool Consumption

Table 8 sets out apparent consumption (production less the trade balance, thus leaving aside any movement in stocks) in 1986 for the 6 major markets (sales in excess of \$1 bn.), the 4 leading developing countries in Asia as well as Brazil and Mexico. The world's top 4 industrial countries stand out on this index - they absorb some 60% of global output. The inversion in the rankings as compared with production for USA and USSR on one side and Japan

and FRG on the other reflect the trade patterns for the countries, as will be shown in the next sub-section.

Table 8: Estimated Apparent Consumption of Machine Tools, 1986
(US\$ mm.)

Country	Apparent Consumption
A. <u>Main Markets (>\$1 bn.)</u>	
USSR	5072
USA	4470
Japan	4400
FRG	3181
UK	1256
Italy	1028
B. <u>Asian Developing Countries</u>	
Rep. of Korea	532
China	479
India	396
Taiwan, Province of China	177
C. <u>Other Developing Countries</u>	
Brazil	379
Mexico	216

Source: American Machinist, February 1987.

Notes: Apparent consumption measured as production plus imports less exports. Exchange rate conversions as for 1986 world production table.

Demand for MT is strongly cyclical in character. In the absence of adequate time series for sales the changes in world output, set out in Table 3 above, can be taken as a proxy. They show that the past decade splits into 3 sub-periods. From 1976 to 1980 the year on year shifts were all positive and generally well in excess of 10% (the simple average was +18.7%); 1980-1983 was a phase of output falls averaging close on 10% per year; while the last 3 years recorded another upswing, above all in 1985-1986 when output rose by one-third. The annual absolute shifts (i.e. ignoring the sign of the change) varied substantially among the leading countries, averaging around 29 percentage points in Japan, 20 each in FRG and USA, and a bit over 9 in USSR. Three of the four had 8 rises and 2 falls while for FRG the split was 6:4 so the evidence of quite sharp annual changes is pretty clear (even at constant exchange rates the Japanese figure would be high as witnessed by the fact that the latest annual shift, the 12 months in which the biggest alteration in the \$ to Yen rate has occurred, is not much above the average).

An industry with these features is very likely to exhibit periods of over and under capacity in production, accompanied by pronounced swings in utilisation rates, and probably by big changes in stocks and occasional price wars. These points will certainly be put into sharper relief when product quality is altering rapidly due to technical change - an ongoing process of major industrial reorganisation is found within as well as among the top producers. While complete evidence, in the form of detailed series of figures by country, is hard to come by, illustrative data abound. In Japan the slowing down of new plant investments (abroad as well as at home) and model retooling by the automotive producers, along with the trade tensions vis-à-vis the US, are taking their toll. An end 1986 survey by the Japan Machinery Exporters Association (JMA) revealed that some 76% of the firms interviewed were finding the present situation hard to handle, with the scope for further reductions in operating costs very limited. Big MT firms such as Mori Seiki, for whom exports to USA have on occasion reached 60% of output, as well as many smaller ones drawn into production during the boom years, will all find the situation tough. It was reported by MITI at end 1986 that orders were 20% down as compared with a year earlier and a large-scale reorganisation of the branch seems unavoidable.

FRG producers had an extremely difficult time during the first half of the present decade, when many collapsed completely. The companies which have done well have been forced into massive (relative to output) investments and highly selective product strategies often involving an effective withdrawal from the volume end of MT production. Deckel, for example, which has around 50% of the FRG market in its principal products (universal milling and boring machines) tripled capital spending from 1984 to 1986 and has pushed the NC proportion of its output to 85% today as against some 30% at the start of the decade. The story in the UK is one of massive shifts which are by no means finished. For CNC lathes, of which the UK market is about 1800 units per annum, more than 100 companies offer products but one firm, TI, currently makes above half the total. Yet the early 1987 opening of the Yamazaki plant at Worcester bodes an immense upheaval in that market. When full scale production is achieved (scheduled for early 1988) 1200 CNC lathes and machining centres per annum are expected and TI, despite taking record orders of some \$38 mn. in 1986, is already indicating the likelihood of selling off the whole MT business. Since the Yamazaki plant managers nevertheless say that about 50% of output will be exported, the shock waves will spread to other EEC markets and will probably cause price wars in what increasingly becomes a cut-throat competition.

The preceding comments have made no reference to upheavals within USA where MT demand has been strong yet domestic output is well down on the levels attained at the beginning of the decade. To understand this better and indeed obtain a full map of competitive tensions in the industry an examination of trade patterns is required.

1.4. International Trade in Machine Tools

The earlier sections of this chapter have brought into relief the striking changes in production and consumption, driven by investment cycles and technological innovation, which continue to redraw the world MT map. International trade flows are the clearest index of the relative positions of countries - Table 9 brings together, for the main producing countries listed in Table 2, the 1986 ratios of exports to production, imports to apparent

Table 9: Indicators of International Specialisation in Machine Tools, 1986

Country	Exports as % of Production	Imports as % of Apparent Consumption ^{a/}	Net Trade as % of of Gross Trade ^{b/}
A. Leaders			
Japan	41.0	5.6	+84.4
FRG	60.0	34.9	+47.8
USSR	6.9	32.9	-73.7
USA	19.4	49.2	-59.4
Italy	56.9	32.0	+48.4
Switzerland	88.5	67.9	+58.6
GDR	(100) ^{c/}	n.a.	+87.9
B. Significant OECD			
UK	51.2	71.7	-41.4
France	45.8	60.6	-29.1
Spain	50.0	36.0	-21.5
Sweden	71.2	74.0	-7.1
C. Principal Developing Countries			
Brazil	10.5	12.7	-10.3
China	2.1	25.7	-87.8
Taiwan (Province of China)	69.6	39.5	+55.4
India	8.4	42.2	-77.7
Rep. of Korea	10.3	59.4	-84.7
Singapore ^{d/}	()	()	()
Mexico	5.6	92.1	-100.0

Sources: Calculations from data in American Machinist, February 1987, and Financial Times, 27 April 1987.

Notes:

- a/ The computation is imports divided by production plus imports less exports.
- b/ The difference between exports and imports divided by their sum; a positive sign indicates a positive balance of trade.
- c/ "As usual, the East German export figures are higher than production...it has sometimes been explained by the differences between GDR marks (in which production is measured) and valuta marks (in which trade with Comecon countries is conducted). This time, the explanation is reported to be mainly that there were exports of unsold stocks of machine tools". American Machinist, op. cit., p.66.
- d/ The importance of re-export, and the difficulty of separating this entrepot trade from local production based trade, renders the share calculations for Singapore too imprecise to warrant inclusion in the table.

consumption, and the trade balance to the sum of exports and imports. Looking at the first column shows that for all the main OECD and East European countries (with the exception of the Soviet Union) the share of output sold abroad is high by any standards. The proportion is lowest in the USA yet even there is close to one-fifth; for the rest it ranges from a little more than two-fifths (Japan) up to nearly 90% (Switzerland). By combining the second column with the first the extent to which MT is characterised by intra-trade can be seen. With the exception of Japan, where imports meet approximately one-twentieth of local demand, the import to apparent consumption share exceeds 30% for every country of weight in the OECD and Eastern Europe. For the smaller producers of specialist items (Switzerland, Sweden) import shares are about 70%; the UK and France are not much different; and foreign produced MT now account for almost one-half of US consumption.

The trade balance in relation to overall trade brings out the significance of these shares. Among the world's top 7 production locations, the USSR and USA are very heavy importers while the rest have strong positive balances (ratios from near 50% to above 80%). The negative balance picture carries over to UK and France and is even marginally the case for Sweden, generally reckoned as a quite successful specialist manufacturing base and a quite rapid innovator and user of foreign innovations. Given that a major part of East European trade tends to be within the region, the USSR and GDR figures largely cancel out each other; consequently the present pattern within the OECD emphatically points to USA as the dominant absorber of exports stemming from the 4 producers with high positive ratios of net to gross trade. As this development has become particularly pronounced within the past 2 - 3 years it is not surprising that the current position is fraught with tensions.

Where do the developing countries stand in trade? For the 7 key countries listed the findings reveal a very mixed set of situations. On the export to production and net trade to gross trade indicators, Taiwan (Province of China) is distinct from the rest. It exports \$7 in every \$10 produced and, notwithstanding an import/consumption ratio that is not small, has a positive balance that compares very favourably with the leading OECD exporters. All other countries have negative balances: Brazil has an overall participation in trade that is low compared with any other country listed (even the Soviet Union) but the rest have large negative accounts. For India and Republic of Korea their industrialisation thus makes relatively heavy use of imported MT despite the stress laid by both countries, albeit in different ways, on strengthening domestic production capabilities. These data suggest that the trade picture raises rather separate questions for the developing countries and the OECD. In the former case the problem is how to use imports to reinforce local capabilities whereas in the latter the current emphasis is towards not only developing an export industry but also ensuring domestic output will meet the demands posed by a total reorganisation of manufacturing. This sub-section looks first at the OECD situation and then the position of the developing countries.

Just as in automobiles, so in MT the key market towards which all producers in this strongly trade-oriented branch have been pulled is USA. Earlier tables have shown how the aggregate value of US imports has risen; Table 10 provides a breakdown by origin for benchmark years over the past decade. There is both continuity and change. In 1976 FRG and Japan dominated as sellers - during the next 10 years their grip has been strengthened but

with a major reversal of roles as Japan alone has, since the start of the 1980s, taken close to half the US import market. This does not mean that the product composition of Japanese exports has been unaltered. As of now, for

Table 10: USA Imports of Machine Tools by Country of Origin, 1976, 1981 and 1985

Share in Total Value of Imports (%)			
Country	1976	1981	1985
Japan	21	49	49
FRG	29	14	14
UK	10	11	5
Switzerland	9	6	8
Italy	5	4	6
Taiwan, Province of China	4	7	7
Others	22	9	11

Sources: UNIDO, World Non-Electrical Machinery: An Empirical Study of the Machine Tool Industry, New York 1984; Metalworking Engineering and Marketing, September 1986; American Machinist, February 1987.

example, Japan has a more than 70% share of the whole US market (i.e. including domestic output) for NC lathes and machining centres and about a 45% share of the market for punching and shearing tools. In 1981 the percentages were 50 and 19 respectively - the Japanese trade thrust has switched rapidly and decisively to NC items. The UK share is now down to half of its 1976 level while Switzerland and Italy, having lost ground through the 1970s, are now slightly stronger than a decade ago: Taiwan, Province of China, has now reached fourth place among foreign suppliers, enough to give it the double-edged distinction (as will be seen below) of joining Japan, FRG and Switzerland as VER targets.

To look at OECD trade flows from the other side, Tables 11, 12 and 13 provide the 1985/1986 breakdowns by destination of MT exports for Japan, EEC and Switzerland respectively. Japan is both much more dependent on the US market than other exporters and yet more diversified in the destinations of its trade. Two thirds of foreign sales go to the OECD with the US/Europe ratio standing at 2:1. For EEC producers there is first the fact that few exports go to Japan (certainly less than 5% of the total), second that 15% only go to North America as a whole, and third that intra-trade among Community members, at just under one-third of total exports, is perhaps less intense than might be expected. Indeed Switzerland, selling half its exports to the EEC, is the trader with by far the heaviest reliance on the EEC: its relative sales to USA are at about the same level as those of the Community.

Although a fully disaggregated country breakdown could not be obtained, the evidence indicates that Asian countries probably absorb around 17-18% of Japanese MT exports and perhaps some 13% of those from EEC. Given the current

Table 11: Japan: Regional Breakdown of Machine Tool Exports, 1985

Region	Share (in %)
North America	44.9
Western Europe	22.5
Far East	10.3
Eastern Europe	9.3
South East Asia	6.0
Oceania	3.8
Others	3.2

Source: JMTBA, Machine Tool Industry Japan 1986, Tokyo July 1986.

Table 12: EEC:^a Regional Breakdown of Metalworking^b Machine Tool Exports, 1985

Region	Share (in %) ^c
Intra-EEC ^d	31.0
North America ^e	15.0
USSR	7.0
EFTA ^f	10.0
China	4.0
India	2.0
Others ^g	31.0

Source: CECIMO, Statistical Survey Machine Tools 1985, Brussels August 1986.

Notes:

- a/ Less Greece, Ireland and Portugal.
- b/ This category comprises the vast majority of machine tool exports.
- c/ Rounded to nearest whole number.
- d/ Defined to include all 12 EEC members.
- e/ USA 13%, Canada 2%.
- f/ Switzerland, Sweden and Austria.
- g/ Partial evidence suggests the Asia share (excluding China and India) could have been 6-7%.

Table 13: Switzerland: Regional Breakdown of Machine Tool Exports, 1986^a

Region	Share (in %)
FRG	28.0
Other EEC	22.0
USA	12.0
Japan	5.0
Others	33.0

Source: Financial Times, 27 April 1987.

Notes:

a/ January to September.

boom in world MT trade the absolute size represented by those shares is by no means negligible; and if most forecasts of comparative regional growth rates for industry over the next few years are to be believed, that market is likely to be one of the fastest expanding. The question that will be tackled in the next chapter will relate to the Asian countries as a production location rather than only an export market and thus to the possibility that they could be employed as sites from which to assemble and export MT to other countries as well as increasing domestic self-sufficiency (measured in the crude sense of locally manufactured MT to total consumption). But if the OECD market for exports becomes still tighter the Asian countries (excluding Japan) would probably become a major arena for competition amongst manufacturers and a flurry of activities, ranging from trade through FDI to technology transfer arrangements of various kinds, might well be on the cards. Where those deals would be located and what they would comprise is very much an open question.

The data on trade patterns hints at another aspect of MT market behaviour on which only sparse information could be obtained yet which may be of appreciable importance. Japan's rise in the US market over the past decade, along with the mix of regions to where foreign sales have been directed, demonstrates that a successful internationalisation of its activities has occurred. But that success is due not only to performance as a producer - in MT, as elsewhere, the global reach of marketing has been great. Marketing has been handled not only by producer companies themselves but also by the famous trading houses: while it is true that the 10 largest Japanese MT manufacturers account for about one-half of output, are strongly export oriented and probably do most of their own marketing, the aggregate export bias of the industry means that a sizeable share of exports must come from small to medium size firms which draw on the Soga Shosha as marketers. A good part of the opening up of markets, particularly to relatively small and maybe 'one-off' buyers, must certainly be put to the credit of the trading houses. Furthermore, as mentioned earlier, the last 5 years have seen substantial automotive FDI by Japanese firms, especially in USA, and this has brought MT exports through the well established ties in Japan itself of the automotive

producers and MT suppliers. The demonstration effects of these plants have not been confined to the much vaunted management and organisation abilities of Japanese producers (c/f the Honda plant in Tennessee) but have spread also to being showcases for Japanese MT. This form of advertising, by exhibiting the product in action, has certainly added to the marketing impact. Allied to the powerful network of JETRO offices to be found in all major and a large number of (as of now) minor markets, the FDI in associated branches along with the efforts of the trading houses offer extensive opportunities for even fairly small producers to find export opportunities. Given that some 69% of the 113 JMTBA members are small to medium size firms (as measured by employees),^{1/} the multi-dimensional marketing effort is probably a major factor in export sales.

Switzerland has been a successful exporter with a similar production structure (108 producing firms, few multinationals, an average payroll of less than 130 employees) but without other aspects of the recent Japanese push. But in this case the emphasis on highly specialised MT has certainly been an advantage. In 1986 the average price per metric ton of exported MT was above SFr. 50,000 as against an import price of SFr. 24,000 while Table 14, using comparative 1981 and 1985 data, shows Switzerland to be very much the high price bracket producer. Undoubtedly the country's general image as a top quality supplier of all goods and services has assisted marketing and contributed to the willingness of buyers to accept even long lags in delivery - at end 1986 there were various instances of 14 to 18 month quoted lags being accepted by foreign firms wishing specifically to buy Swiss MT. For a top quality producer and a quality volume producer, therefore, the marketing dimension almost certainly plays a powerful role in the internationalisation process.

Table 14: Average Value per Metric Ton of Metal Cutting Machine Tools Produced by leading European Countries, 1981 and 1985
('000 of Swiss Francs)

Country	1981	1985
FRG	29	37
Switzerland	41	48
UK	n.a.	14 ^{a/}
Italy	20	22 ^{a/}
Sweden	11 ^{a/}	21 ^{a/}
France	30	42

Source: CECIMO, Statistical Survey of Machine Tools, April 1983 and August 1986 issues.

Notes:

a/ Figure refers to export market alone.
Current exchange rates applied against the Swiss franc each year.

1/ The size distribution in 1985 was as follows: less than 49 employees, 11.2%; from 50 to 99, 17.8%; from 100 to 299, 40.1%; from 300 to 499, 10.3%; from 500 to 999, 13.1%; and above 1000, 7.5%.

As mentioned briefly earlier on in this chapter, the trade position may now be at a turning point due to developments in the US market. In 1985 that country alone absorbed about 23% of world imports (excluding USSR) - and towards the end of that year demanded introduction of VER by Japan, FRG, Switzerland and Taiwan, Province of China. The accent was on rolling back market shares. Specifically, Japanese sales of NC lathes and machining centres were to be put back to the 1981 level of 50% and shearing and punching equipment back to 19%, with the pact to last 5 years. Similar product targetting can be found in the 5 year agreement with Taiwan, Province of China. For conventional lathes the market share would be limited to 24.7% (as against a recorded figure of 29.7% in 1985): for NC lathes, 3.2%; for conventional milling machines, 19.3%; and machining centres, 4.7%. These figures are indeed revealing. Not only are ceilings introduced against sales of conventional products where low cost, efficient production has been built up, but there is advance protection against 'quota hopping' in more sophisticated MT i.e. efforts by Japanese and other producers to relocate to Taiwan, Province of China, as a device for reducing the impacts on themselves of a VER regime. Certainly this does not prevent production relocations elsewhere but the US calculation is presumably that other sites would be a good deal less attractive (meaning, among other things, that production of the more advanced MT is unlikely to be a footloose activity).

It appears that Japan and Taiwan, Province of China, have accepted the VER and negotiations with FRG may have been partially successful. But Switzerland has categorically refused to come to any arrangement. "Berne turned the request down point-blank and subsequently said it would not consider a proposed ceiling on numerically-controlled cutting and punching units as binding and threatened to 'take steps' if Washington acted unilaterally to restrict deliveries."^{1/} The impact of the VER policy is unclear and that for several reasons. First, the restraints are set in terms of shares of the US market and the overall behaviour of that market is hard to predict. Second, experience with VER where shares are computed in relation to numbers of units sold shows that the scope for upgrading of product quality is normally well used by exporters. Third, the extent to which VER will actually be observed is open to considerable doubt. Fourth, there remains space for production relocation, both to USA and elsewhere, which could ensure that import shares of the American market continue to rise. What the VER approach does signify, however, is a strong warning to foreign producers; their future production and investment strategies will certainly not rely so heavily on sales to USA. The FDI implications will be examined in the next chapter.

The trade circumstances of the leading developing countries are quite different. In Latin America the foreign exchange shortages must certainly have contributed to limiting imports as well as curtailing local output (shortages of components): thus in Mexico, despite the very high import to consumption ratio, the current level of new investment in MT is extremely low while in Brazil apparent consumption has been severely squeezed and imports kept to a low share of the aggregate. But in Asia the position differs enormously as the leading developing countries have pressed on with industrial investment and sought to upgrade their MT stock. In Taiwan, Province of China, MT was designated a 'strategic industry' in the early 1980s and received development subsidies from the government along with increased tariff protection in those areas where it was felt local firms could improve their

1/ Financial Times, "Machine Tools: Rich Pickings in Specialization", 27 April 1987.

capabilities quickly if some limited (in extent and duration) protection could be given against low cost imports.¹ India launched a decade long plan for sectoral development in 1984 aimed strongly at the CNC segment of the industry. But it was clearly foreseen that intensified imports would be necessary to assist improvement of local capabilities as well as to fill the multifarious gaps in existing local production; in arranging its policy this way India was following its traditional approach towards reinforcing local skills (an approach which, however, has had mixed results in other industrial branches).² An attempt to diversify imports by source has been made but the suppliers list does not differ so markedly from that of OECD countries: i.e. in 1984 around two-thirds by value of all imports came from FRG and Japan with Switzerland, USA, UK, Czechoslovakia and GDR as the other significant sources. Grant of import licences is gradually veering to NC/CNC items though in the main categories of import the shift is not especially quick. Thus a disaggregation of 1984 MT imports by volume and value of each product shows that 289 grinding machines were imported of which 9 were NC/CNC, 181 lathes were purchased of which 93 were NC/CNC, 124 presses of which 5 were NC/CNC, 97 boring machines of which 12 were NC/CNC, and 87 milling machines with 5 of them being NC/CNC.

With the exception of Taiwan, Province of China, the crucial questions of trade for developing countries pertain to import strategies rather than export markets. But the growing conflicts over world markets, along with the price cutting now taking place and the pressures for reorganisation, both of industrial structure and production location, mean that the developing country situation is affected by the fierce competition among leading firms. This is why a fairly complete account of that competition has been necessary.

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- 1/ For a few details see Martin Fransman, "International Competitiveness, Technical Change and the State: The Machine Tool Industry in Taiwan and Japan," World Development, December 1986.
 - 2/ The Perspective Plan schedules a 1992 production of 800 NC/CNC machines, equivalent to 25% of total output for that year; in 1985 local manufacture was 65.

Chapter 2

FOREIGN DIRECT INVESTMENT - A RESPONSE TO COMPETITIVE PRESSURES?

2.1. Machine Tools and Foreign Direct Investment

This report began by emphasising the small size of the MT branch in relation to engineering industries as a whole. It would, therefore, not be surprising if FDI in MT were but a small fraction of overall external investment by the leading countries. In fact available data are generally not sufficiently disaggregated to permit MT investments as such to be identified; instead, figures usually relate to the much broader categories of machinery and, to encompass metalworking, fabricated metals. Tables 15-18 set out the pertinent information for USA, Japan, FRG and UK respectively. For both USA and Japan the 1985 stock position could be obtained, for FRG the 1984 stock and for UK the cumulative investments for the 5 years 1980-1984 inclusive; in addition Table 15 also provides 1985 net flow data for USA.

Table 15: USA: Direct Investment Abroad, 1985

Stock, end 1985

All Sectors:	\$232.7 bn.
Manufacturing:	\$ 95.6 bn., equal to 41.1% of all FDI
of which:	
Primary and Fabricated Metals:	\$ 5.5 bn., equal to 5.8% of manufacturing
Machinery, except Electrical:	\$ 18.7 bn., equal to 19.8% of manufacturing

Of Primary and Fabricated Metals total, stock in Developing Asia \$130 mn. equal to 2.4% of branch, Canada and EEC stock \$3.8 bn.

Of Non-Electrical Machinery total, stock in Developing Asia \$421 mn. equal to 2.8% of branch, Canada and EEC stock \$14.4 bn.

Net Flow 1985

All Sectors:	\$18.7 bn.
Manufacturing:	\$10.5 bn.
of which:	
Primary and Fabricated Metals:	\$410 mn., equal to 3.9% of manufacturing
Machinery, except Electrical:	\$4.3 bn., equal to 41.0% of manufacturing

In both branches, investment in Developing Asia was negligible.

Source: Computed from US Dept. of Commerce, Survey of Current Business, August 1986.

Table 16: Japan: Direct Investment Abroad, Stock at end 1985

World

All Sectors:	\$82.8 bn. (\$47 bn. in 1981-1985)
Manufacturing:	\$24.0 bn. (\$11.7 bn. in 1981-1985), equal to 29.2% of all investment
Machinery:	\$1948 mn. (\$1077 mn. in 1981-1985), equal to 8.1% of manufacturing

Asia

All Sectors:	\$19.3 bn. (\$7.5 bn. in 1981-1985)
Manufacturing:	\$7.4 bn. (\$2.9 bn. in 1981-1985), equal to 38.6% of all sectors
Machinery:	\$571 mn. (\$307 mn. in 1981-1985), equal to 7.6% of manufacturing, 29.8% of branch

Source: MITI, The Second Basic Survey on Japanese Firms Activities Abroad: Statistics on Investment Abroad, August 1986

Notes: The data are based on the benchmark survey carried out in 1983 supplemented by data for the last 3 years. Totals are the sum of approved investments from 1965-1985 inclusive: Japanese sources do not say whether approvals are actually realised. It is therefore probable that the above figures overstate real investments from Japan itself. Indirect investments are, however, excluded.

Table 17: FRG: Direct Investment Abroad, Stock at end 1984

All Sectors:	DM 145.4 bn.
Manufacturing:	DM 62.7 bn., equal to 43.1% of all FDI
of which:	
Mechanical Engineering:	DM 5.7 bn. equal to 9.1% of manufacturing, of which US 1.7 bn., EEC 1.4 bn. and Brazil 1.1 bn.

Source: Deutsche Bundesbank, Monatsbericht, February 1986.

Notes: The aggregates include direct and indirect investment. Branch classification according to that of the recipient firm. In the case of Mechanical Engineering the difference in branch total is considerable as compared to a branch division according to investor firm, where the figure is DM 9.0 bn. However neither classification yields a significant figure for Developing Asia: DM 76 mn. on recipient basis, DM 147 mn. on investment basis.

Table 18: UK: Outflow of Foreign Direct Investment, 1980-1984

Aggregate Foreign Investment 1980-1984

All Sectors:	£19.6 bn.
Manufacturing:	£8.96 bn., equal to 45.7% of all FDI
of which:	
Metalworking:	£342 mn., equal to 3.8% of manufacturing
Mechanical Engineering:	£728 mn., equal to 8.1% of manufacturing

Investment in Developing Asia

Manufacturing:	£473 mn., equal to 5.6% of world total
Metalworking:	£4.0 mn., equal to 1.3% of world total
Mechanical Engineering:	£23.5 mn., equal to 3.2% of world total

Source: HMSO, Business Monitor, May 1986.

The tables highlight several key points. First, manufacturing FDI is notably less than half the total for all 4 major investors, lying in the 40-45% range for USA, FRG and UK and below 30% for Japan with its well-known concentration on securing access to natural resources via FDI. Second, the stock of FDI in the broad category of machinery industries (or mechanical engineering in the cases of FRG and UK) is not a large share of the manufacturing total; the US figure at almost 20% is more than double the shares in each of the other 3 investors where the proportion is in the 8-9% range. Given that MT is but a part of the machinery industries the supposition must be that, on a stock basis, the US is the only country where past FDI in MT may have been more than one or two per cent of the manufacturing aggregate. Third, the shares of machinery investment going to developing Asia have been small save for investments from Japan; while close to 50% of that country's FDI in machinery has gone to its neighbours, the Asia figure for the others is around 3% or less. Fourth, the combination of the 3 preceding points strongly suggests that, up till now, MT has not been a sector notable for FDI and that, within such MT investments as may have occurred, Asia has not been a major recipient (the likelihood is that the EEC may have been the key area). Fifth, the bracketed figures in each row of Table 16 are revealing about Japan's FDI. On a global basis around half of the investments were made during the first half of the present decade yet for Asia the proportion tended to be around 40% (although it did exceed one-half specifically in the machinery sector). On the whole, then, the trend in recent years is away from Asia. The 1985 flow data for USA, presented in Table 15, tend to reinforce the point as they note that, though net machinery investments abroad were at the comparatively high rate of 41% of all manufacturing (double the same ratio for existing stock), FDI in developing Asia was negligible.

Information released for 1986 FDI flows of FRG points in a similar direction. It shows net worldwide FDI of DM 11.2 bn. (some 18% down on

1/ See Süddeutsche Zeitung, "Deutsche Investoren meiden die Entwicklungsländer", 9 April 1987.

1985) with only 6.1% going to developing countries (as recently as 1983 their share had been 30%); although a precise figure for developing Asia is not available, the data do allow a 'ceiling' to be put on the share - it could not have exceeded 2%. On a sector basis the engineering industry share was only just over 5%, a finding of particular interest since vehicle manufacture, at almost 20%, was much the most important sector. It may be that the purchase of MT to support FDI in vehicles was reflected in FRG exports - at the moment the evidence points to an MT trade effect rather than an MT investment effect of the automotive international investment process.

The evidence so far has concentrated on MT investments in relation to other industrial branches and shown them to be tiny. However, it might reasonably be argued that a better measure of the industry's 'propensity to invest' is a comparison of FDI with total investment or total output in the branch, calculated on an annual basis. As comparable numbers of this type could not be obtained the best that can be offered is a very rough approximation drawing on such figures as do exist. For Japan in 1985 production of metal cutting MT was of the order of 10% of output of all industrial machinery: if the same proportion holds for FDI then about \$220 mn. was invested globally in metal cutting MT by Japanese firms in 1985. In the same year Japan produced \$4.4 bn. of metal cutting MT; taken together these figures would put the FDI to current output ratio at about 5%. Using similar computations for USA that same ratio comes to around 4.8% so we might take a 4.5 to 5% figure as being about the right order of magnitude for the relation between FDI and current output in MT at the moment. Compared with the automotive industry of the first half of the 1980s this ratio is low as it is against data for most branches of electronics and electrical equipment, not to mention areas which have traditionally been at the core of FDI in manufacturing e.g. textiles, garments and food processing.

Some further evidence on the role of FDI in MT up till now is given in Table 19, which tries to ascertain what has been the FDI behaviour of German firms drawing on information for the whole period 1961-1983. Though the definitions employed in the basic data bank are not as precise as they might be, the material suggests that 3.2% of all recorded cases of FDI were related to MT. Less than one-tenth of these (13 cases) were in developing Asian countries while about three-quarters went to the 4 countries traditionally important to the FRG i.e. USA, Brazil, Austria and Switzerland. The data show that in one-half of the instances wholly owned affiliates were formed and in only 20% of the cases did minority owned JVs result. There is some evidence of an acceleration in FDI during recent years with an annual rate of some 8 or 9 cases prevailing since 1976. Although no monetary figures to measure firm size are given, the data on employees exhibits a clear inverse trend - the larger the firm the fewer the number of investment cases. Interestingly enough the tendency is pronounced for USA but not so for Brazil (by far the major developing country recipient of FRG investments). Using the same cross-comparisons the relative incidence of minority owned JV is much higher in developing country FDI than in USA but, importantly, the frequency of investments in the 1980s is considerably greater for USA.

Admittedly the evidence on patterns of FDI in MT by the leading OECD producers leaves plenty of gaps and tentative conclusions could be overturned by more adequate information. That said a sketch of the situation would be as follows. MT is only a tiny sector in absolute terms for FDI and the bulk of that investment has been emphatically towards EEC and USA; very little has gone to developing Asia. The propensity to foreign investment of MT producers suggests the sector has, up till now, not been strongly oriented in this dimension. There is, in short, a dramatic contrast between the internationalisation of MT as measured by the degree of intra-trade among

Table 19: FRG: Features of Foreign Direct Investment in Machine Tool and Related Production,^a 1961 - 1983

1. <u>Machine Tool Investment within the Total</u>							
Total Recorded Cases of Investment 1961-1983							3,899
Cases of Machine Tool Investment: ^a							124
Machine Tool as Share of Total							3.2%
Number of Machine Tool Industry Firms:							71
2. <u>Destinations of Machine Tool Investment</u>							
USA	Brazil	Austria	Switzerland	Developing Asia ^b	Other		
34	40	9	7	13	21		
3. <u>Dates of Establishment of Firms Abroad</u>							
Up to 1970 ^d	1971-1975		1976-1980		1981-1983		
26	14		41		26		
Unspecified							
17							
4. <u>Equity Share in Foreign Firm (%)^e</u>							
100		50-99		0-49		Unspecified	
61		33		25		5	
5. <u>Size of Foreign Firm (number of employees)^f</u>							
Up to 30	31 - 100		101 - 250		251-500		501 Upwards
51	31		21		12		9
6. <u>Type of Machine Tool Production^g</u>							
General Machine Tool Production	Pumps	Machine Building	Swaging	Lathe Production	Drilling	Milling	Other
38	19	8	6	6	5	4	38
7. <u>Some Gross Comparisons</u>							
(a) Machine Tool Investments in 1981-1983 period:							
USA: 15		Brazil: 6		Developing Asia: 1			
(b) Investment in Small Firms (up to 30 employees):							
USA: 22		Brazil: 9		Developing Asia: 5			
(c) Number of Minority Joint Ventures (up to 49% Equity Holding)							
USA: 2		Brazil: 10		Developing Asia: 5			

Source: Computed from data given in Folker Frobel, Jurgen Heinrichs and Otto Kreye, Umbruch in der Weltwirtschaft, Reinbeck 1986, Table III-A1.

- Notes:
- a/ The basic source classifies investment into 10 areas of economic activity (excluding finance and trade). The cases classified as machine tool in the table given above are so defined on the basis of the items actually produced in the foreign affiliate.
 - b/ There were 2 instances of firms established and subsequently closed: they are not included in the cases used here.
 - c/ India, Singapore and Republic of Korea account for all except one case (Pakistan).
 - d/ Includes 2 firms set up prior to 1961.
 - e/ The original data source does not specify if the equity shares given are the initial ones or the actual ones (if different).
 - f/ The original source does not specify whether this is initial or actual employment.
 - g/ The product breakdown was the fullest that could be made given the available information.

producers and the still circumscribed extent of FDI. The partial data currently available further indicate biases towards the OECD main centres (excluding Japan) in recent investments along with a tendency to put cash into wholly owned affiliates there of small size. By any measure developing Asian countries have been on the margin in activities of the last few years; such fragments of information as can be assembled strongly suggest that, within developing countries as a whole, the preferred areas for foreign investors would be those countries already having strong industrial structures and a clear commitment towards upgrading of technologies i.e. Brazil, Republic of Korea, Taiwan (Province of China), Singapore and India.

From this picture two key questions can be discerned. Are there any reasons to assume that FDI in MT will become a major factor in reorganisation of the sector on an international scale? If FDI did assume significance, could developing countries which lack any substantial local capital goods production enter into the production network through becoming sub-contractors of one kind or another? The next section of this chapter tackles these issues.

2.2. Foreign Direct Investment and the Ongoing Reorganisation of Machine Tool Production

Though internationalisation has to date mostly shown itself through the expansion of trade, future patterns of competition could exhibit other forms of cross-border penetration. That the branch will retain its international character seems virtually assured: whatever the trade conflicts or disparities in rates of innovation and diffusion, no country in the next few years will either want or be able to erect and maintain crippling barriers to MT involvement in its market from other countries. The reasons are easy enough to enumerate. First, although industry as a whole has moved far from the metal-mechanical base it had when the original MT branch was the core of industry, the movements in MT itself have been just as fast. Its incorporation of microelectronics, supported by the internal advances in design, have given modern MT such precision and flexibility that they are now a vital element in the new industrial revolution. No country which wants to keep its industrial sector competitive can therefore afford to bypass the use of the most recent vintages of MT even if the country is not producing them. Second, the nature of competition in the sector is such that, notwithstanding the number of differentiated products, prices are kept down quite firmly, thereby limiting investment costs for other branches. Consequently an attempt to cut out cross-country transactions would not only impose costs on the domestic MT sector but also worsen the production costs elsewhere. Third, all big to medium size producing nations have thus far managed to keep a foothold in one or more niches of the foreign markets so that, even where net trade balances are strongly negative, no producing country is trying to eliminate trade altogether. Fourth, corporate strategies are strongly geared to international business since so many customers are themselves firms with international dimensions. To secure purchase orders in one country may well be a step towards obtaining them elsewhere and may imply future international trade, FDI or some form of licensing arrangement.

If the international reach of the MT industry is now firmly established the evidence so far presented in this report points to a highly conflictive process with the relative roles of trade, investment and licencing deals quite unclear. The factors which would encourage production tie-ups of one form or another are these. First, the imposition of trade barriers in one or more markets. Such obstacles could lead to FDI in the countries imposing them, to FDI in other major markets to pre-empt similar moves there, and to FDI in locations which, while not important markets themselves, might offer cost or

other advantages rendering them suitable sites from which to export to the original market. Second, the need to remain close to good customers at home who, through FDI, are relocating a large part of their production abroad. Third, the prospect of obtaining easier access to key production components, human or material, whose use could improve real productivity and/or product quality. Fourth, the opportunity to reinforce control over relevant parts of the international production network, through building up a local presence in those locations. To what extent is each of these factors likely to operate in the current MT struggle?

The push to FDI based on trade barriers has 2 different strands in today's MT market; one relates to firms setting up in the USA and the other to investments in EEC. The obvious country to start looking at for FDI in USA is Japan, given the size of its exports there (almost 45% of all exports, roughly 14% of total output), the VER explicitly negotiated, and the prevailing atmosphere of trade tensions between the two countries. According to a commentary appearing at the same time as the VER was agreed (November 1986) the Japanese "machine tool makers have moved slowly over the past few years to establish some assembly operations overseas. Most are in the US and only produce a small number of units."^{1/} That the examples are limited is not surprising if we keep in mind both how new the trade thrust is and how different MT often is as a production and marketing process. Unless producers have solidly founded reasons for anticipating severe trade barriers they are most unlikely to invest in advance of their imposition - and will (in the absence of other driving forces) only invest subsequent to them if the profit is high enough and it is not possible to maintain aggregate exports by switching sales to other markets. Now whether or not Japanese sellers could have been expected to engage in anticipatory investments is open to question. The precedents of the automotive industry (VER since 1983), steel and semiconductors were, it is true, already there but those branches, especially automotive, were areas where Japan had for some time been the sole target. In MT other countries have also been in the forefront and Japanese producers could be forgiven for caution. But the argument justifying a slower approach acquires greater force in the context of MT production and marketing. In all producing locations (not just Japan) proximity is of vital importance to MT manufacturers - proximity to suppliers of high quality materials and components, proximity to a labour-force to some extent trained by the MT industry itself, and proximity to buyers, many of whose orders are of a 'custom-made' type. These are system requirements, external economies which can be reaped by the firm without it having to pay many (or often any) of the costs of developing them.

As will be seen later, a major barrier to extensive FDI in most developing countries is the absence of these system advantages. Certainly the US possesses the system attributes: but it is not the Japanese system and adaptation to it requires significant shifts from well established modes of behaviour. Japanese MT producers are accustomed to close relations with and support from government (especially MITI) to a tightly knit producers association, to specific links with suppliers and buyers which facilitate economies on inventories, and to labour relations and a type of plant level hierarchy still rare in USA. These difficulties of adaptation are certainly not insurmountable but the conditions for overcoming them probably are along the following lines: being a fairly large firm (about 35 MT companies in

1/ Far Eastern Economic Review, "Rationalization is on the Cards for a High Flyer", 18 December 1986.

Japan employed 300 or more people in 1985),^{1/} having a product range with a significant chunk of items that can be sold 'off the shelf', possessing sufficient experience in US deals to know where to buy as well as sell, and being willing to invest heavily in training a labour force that is maybe not only unfamiliar with Japanese methods but also relatively unskilled in the most modern production systems. For a Japanese company possessing those attributes FDI either in a 'greenfield' plant or in a takeover of a US company could both be interesting although a JV, especially of the minority type, might not be too favourable as it would probably complicate rather than smooth the adaptation process. These arguments add up to a fairly limited field of likely candidates for engaging in FDI and even within them a further push could be decided by the particular way VER is distributed among exporting firms (assuming it is adhered to). In the automotive sector, for example, MITI has regular discussions with the producers and publishes annual lists of the units each company will be permitted to sell in the US market. Although the leading firms have in fact invested in USA, they were undoubtedly helped in at least the details of their decisions by knowledge of the export figures. Most probably the MT situation is a good deal more complicated for the two simple reasons of many more firms and many more types of products - and until the real impact of trade restraint is clarified there may continue to be lags in the foreign investment process.

Investment with the EEC, unlike USA, raises issues of past as well as current responses to trade barriers. Enquiries to the relevant MT associations in the EEC, and through CECIMO itself, did not yield any solid data that would permit a mapping of FDI within the community so evidence is necessarily very sketchy regarding the presence of foreign companies.^{2/} It

1/ The top 10 firms in both Japan and USA account for 50% of output in each country, while in FRG the same number of firms produce 26% of the output.

2/ In the context of enquiries made directly to national associations regarding the incidence of FDI here are some of the responses (quotations from the correspondence). CECIMO: "Our Committee does not possess information regarding investment by machine tool builders of member countries of CECIMO, whether referring to investments in their European headquarters or investments abroad. But it is possible that some information may be available with member associations of CECIMO...". MITTA of UK noted: "You will appreciate that a number of machine tool companies have developed close distributor relations with countries and companies in South East Asia but the only direct investment of which we are aware has been made by Bridgeport Machines Ltd. This company has established a successful manufacturing plant in Singapore." SYMAP of France stated that information could not be provided due to its confidential nature. NMTBA of USA wrote: "Unfortunately, no such information exists. We cannot track such practices because US machine tool builders are generally privately held firms who do not report such activity to any central authority. We are aware of a few firms with foreign joint ventures etc. but do not have a complete listing." The Korean Institute for Economics and Technology indicated: "No Korean firm is found who has an experience of foreign investment to other Asian countries in this industry. One Korean firm, Doo-Son Machinery Co. Ltd., exported a production technology for radial drilling machines to India early in this year (1987). Doo-Son has developed its own model for a radial drilling machine and exported them to South-east Asian countries since 1982. Royalty for the technology transfer was 3.1% of total net sales for 5 years." The National Council of Applied Economic Research in India noted that interviews with Indian MT firms would be necessary to obtain information regarding FDI; some material may be provided through the ongoing study of technological development in the CNC MT industry in India.

seems probable that the leading US firms have been installed in some EEC countries for several years now. Cincinnati Milacron, the top American company, has subsidiaries in FRG, UK and France while Ex-Cell-O, Litton, Textron, Duplomatic, Teledyne Landis and quite possibly several others have plants in UK. Within the EEC, notice again the US focus on the countries already famous for their own MT industries (limited investment in Italy seems to be the exception); Ireland, a country renowned for offering outstanding facilities to foreign investors, has been ignored by MT firms and of the most recent entrants Spain is the only one that might attract firms. Though in most industrial sectors cross-penetration of EEC countries by investment in each other has been a principal feature of corporate strategy to utilise the wider market, the scanty information on MT suggests this has certainly not been the case for the branch. On the contrary, there would appear to have been little FDI worth the name; of the 124 cases of FRG investment examined in Table 19 above not a single one took place in an EEC member (the handful in Spain and Greece date from at least a decade prior to those States joining EEC) while a listing of member firms of MTTA in UK provides only one or two enterprises where investment from elsewhere in the Community seems to have occurred. Earlier tables have shown that intra-EEC trade in MT has been intensive enough and it is quite likely that internal barriers to trade have been low (with a high degree of concordance among industrial standards). Hence the incentives to FDI by firms from member States may not have been sufficient given that other ways of exploiting the market were available.

But what of the current situation and in particular the behaviour of Japanese producers? There is one major investment to go on which, nevertheless, crystallizes the possibilities and conflicts of the present context. Yamazaki, supported by a direct UK government grant of £5.2 mn., has set up a £35 mn. non-unionised factory in Worcester, UK, to produce, at full capacity output (scheduled to be achieved in Spring 1988), 1200 CNC lathes and machining centres per annum. This production is to be reached with a plant workforce of 180 and there are currently 65 Japanese staff, mainly engineers, on site though they are eventually to be reduced to 9. Of major significance are the following aspects of the plant (which began production in early 1987). First, the aggregate production at full capacity would be around one-half of all UK output of CNCMT. The company says that 80% will be exported, chiefly to other EEC members, yet even so claims that its shares of UK machining centre and lathe markets will be approximately doubled from their present levels of 15 and 10% respectively. These figures suggest major tussles in several EEC countries, not only UK. Second, it appears that some European firms have bitterly opposed this FDI: "West German producers - such as the big lathe maker Gildemeister - which have been in a pitched battle with the Japanese on their home turf, fought tooth and nail to prevent Yamazaki setting up in West Germany".^{1/} While the balance of interests may favour Japanese FDI in USA the European environment is different and indeed the FRG/UK split may be indicative of an overall contrast of outlook. Whereas FRG remains a top line producer with major technologies of its own and does not want either outward or inward investment (recall the total absence of FRG controlled MT plants elsewhere in EEC) the UK structure is a reflection, on a minor scale, of events in USA. Investments by Japanese companies will be indeed conflictive but are likely to be encouraged by both the government and traditional MT producing regions where imports have already done much damage.

1/ Financial Times, "Machine Tool Makers Face Cut-Throat Competition, 24 April 1987.

Third, as with other products made in the EEC, the thorny problem of local content (LC) exists in this area. Yamazaki claims it will quickly achieve 60% LC defined on a broad basis encompassing wages and factory operating costs, and that is the threshold figure to satisfy EEC rules of origin and therefore qualify for tariff free sales within the region. Intriguingly enough, even as dispute about Yamazaki's extent of LC persists, there is evidence that UK firms themselves may not satisfy the criterion. Thus "many British machine tool manufacturers use a great many Japanese components. A greater proportion than ever build machines from Japanese kits."¹ Even Bridgeport, which has the largest turnover of any UK located maker of machining centres, has its horizontal machines designed by Yoruda and makes them mainly from EEC components while TI recently began assembling Takisowa vertical machining centres.

In sum, the Yamazaki investment is more than a pretty thick end of what could turn out to be a big Japanese FDI wedge, for the controversy surrounding it has brought into the open various of the forces now moulding the shape of things to come in Europe. Thus there are powerful European firms and groups working against as well as for external investment in MT; market shares can be dramatically shifted even by a single investment suggesting that the long lived structure of many small and medium size firms could be giving way to much more concentration, and that transformation could be fast; and FDI is clearly not the only route which is being used for Japanese market penetration - the assembly system for high value advanced technology items has already taken root. Product heterogeneity in MT cautions against uncritical extrapolation of these findings to the whole sector but enough evidence exists to hazard the guess that the EEC may be changing even faster than USA.

Since MT is a capital goods industry, whose demand emanates from a quite small set of major industries (primarily automotive, aircraft and military related production) that are dominated by a relatively limited number of large firms in each of the main OECD countries, the extent and location of MT output is strongly influenced by shifts in the what and where of production by those firms. Over the years the crucial industry in this respect has been automotive: US firms have engaged in substantial output abroad for a long time and VW has been active since several years. But it is the Japanese automotive industry's international spread during the present decade which generates the most interest regarding MT investment. Toyota, Honda, Nissan and Mazda have all set up, jointly with US car producers or on their own, large plants in USA, they all have big facilities producing key components in Mexico as a result of FDI in the present decade, and some of them plus Mitsubishi and, to a lesser extent, Suzuki and Isuzu, have made appreciable investments in the EEC (UK), in East Asia (Taiwan, Province of China; Republic of Korea) and in ASEAN countries (Malaysia, Philippines, Thailand). All these investments set up large initial (at factory establishment) demand for MT plus a lower continuous demand to support ongoing production (this latter type is not to be equated with the demand for automotive components, which is much bigger in terms of volume though not necessarily value). The circumstantial evidence strongly suggests that the Japanese auto producers have sourced the overwhelming majority of their MT purchases (probably, in fact, all MT for most of the FDI) from Japanese firms (this holds true even for the principal JV i.e. the Toyota/GM plant at Fremont, California). To date it appears that the MT companies have met the orders through export but this pattern may be subject to change - what factors are at work?

1/ Financial Times, "Machine Tool Makers Face Cut-Throat Competition, 24 April 1987.

On the plausible supposition that the major wave of automotive FDI from Japan has already spent itself it might be thought that MT producers no longer have (at least from this perspective) any incentive to invest abroad; that conclusion, however, would be too hasty. First, the demonstration effect of these plants working almost entirely on the basis of Japanese MT is certainly the best advertisement for these products in the US market and should lead (other things being equal) to enhanced demand from US producers in automotive and other heavy capital investment industries. That demand is better satisfied from local manufacture rather than export from Japan because the Japanese producer is involved not only in manufacture but also design work and problem solving jointly with the US company purchasing the MT. For this kind of market, there are appreciable advantages to be gained from producing within it.^{1/} To put the point a little differently: exploitation of the market edge obtained by showing yourself to be a first-class provider of numerous more or less custom-made items fitting together into a coherent advanced production system means making yourself available permanently, on the spot, to other clients of the same kind. This was not such an imperative with the original Japanese auto investors because they and the MT producers had already been working together for a long time in the Japanese context. Second, the Japanese MT producer stands to benefit, in its own right, from a production presence in a major location because that widens the range of tasks to be confronted and therefore capabilities to be developed. If MT competition on the international scale has hitherto been conducted chiefly through trade, that framework is altering. To remain on the frontier is not only, not even primarily, a question of paring down costs and prices for standard products - it is still more a matter of exhibiting a wide range of design and problem solving abilities tailor-made to meet specific demands in all key markets. FDI is required to do this. Third, the prospects for profitable JV arrangements in various international locations between MT producers and their clients seem to be on the increase, again due to shifting demand patterns. Once more the demonstration of detailed knowledge of and experience in each environment, assets acquired from producing and not just selling, is a critical element towards becoming a good partner in such deals. Fourth, the maintenance of sales over time, as opposed to 'one-off' orders, may be affected by LC requirements. Just as Toyota, for example, has to show it is a US producer, so Toshiba Machine may have to demonstrate growing degrees of LC. This means, of course, not only local production but also local provision of the materials for that production. If large firms have usually been able to keep down the pressures for rising LC in fairly small and less industrialised countries, the likelihood of so doing in major countries of the OECD is not so great.

The third possible reason for FDI given earlier in this section refers to the prospects of increasing productivity through obtaining access to cheaper and/or better human and material resources for production through relocation.

1/ The point has been put succinctly by the Vice-President for Corporate Planning of Honda, USA. Noting that when production began in 1982 the decision "obviously didn't make economic sense" she stressed that it did "make philosophical sense" and stated "When you begin to market products in a country and enjoy success you should think about manufacturing there as soon as possible. We don't spend much time in this company discussing the bottom line: the profits will come in the end if you satisfy customers." Financial Times, "Beware the Simple Solution," 18 May 1987.

For MT it is unequivocally the leading OECD countries plus a few developing countries in Asia viz. Republic of Korea, Taiwan, Province of China, Singapore and India, along with Brazil, which offer the system supports for effective MT production capable of meeting international and local demand. Other nations may provide cheap labour but the value of this asset depends on how much the production process can be broken down into labour-intensive segments, on the importance of labour cost in total changes, and the significance of transport costs between locations involved in the production network. What can be said on these issues in relation to MT?

A distinction has to be drawn between NC and non-NC-MT, for the simple reason that the former incorporate a substantial electrical/electronic component while the latter do not. This means, in turn, that NCMT firms may have to buy in a big part of their production inputs, even more so if the NC items are made with special quality steels and/or other relatively new materials. As the Chairman of Acme-Cleveland, an important MT manufacturer in USA, has succinctly put it: "Industries are moving away from the idea of taking big chunks of steel and machining away the scrap."^{1/} To the extent that cheap labour supplying developing countries become effective sub-contractors in electronics and the units made go into MT produced in OECD locations then the indirect labour content from developing countries may be appreciable - yet that still does not answer the direct labour issue. Two possible activities in developing countries would seem to be metalworking and machining as such, and assembly. In the former activity it would be a case of finding a sufficiently experienced work-force to undertake the tasks allocated. Since the cheap labour countries under consideration here by definition exclude places where a reasonably extensive, sophisticated and long established MT branch exists, there is a conflict between the monetary cost of the labour and its suitability. A training period would be necessary with the benefits accruing subsequently in terms of enhanced real productivity. The absence of detailed breakdowns of the metalworking/machining steps needed for the manufacture of standard MT, the relative unit costs of carrying out these steps by human input as against machines, and the differences in real labour costs (assuming people rather than machines were carrying out the steps) between, say, Japan and Sri Lanka, militate against giving any hard and fast assessment of the prospects for this type of FDI. Fairly informed guesswork, nevertheless, can offer some useful pointers. To justify the investment a foreign firm would need to be producing a fairly large batch of an item (probably of a standard kind) for sale either in its home base or in a third market since production mainly oriented towards sale in the country carrying out the contracted tasks is most unlikely to find sufficient outlets. This does mean, however, that quality standards will be high relative to those in the developing country; hand setting and hand gauging of tools, for example, will probably be inadequate. The inexorable tendency is to shift semi-skilled operating tasks of that nature onto machines and thus reduce the need for human labour. So the scope is probably restricted and becoming narrower at a rapid rate; for any one country to succeed in enticing and keeping FDI of this type is a daunting task in the present context.

At first blush assembly activity may seem more promising, especially since assembly work is precisely what has been the focus of so much FDI to cheap labour countries in the past two decades. Automotives, garments and electronics have all been prime targets; but does assembly in MT have the

1/ Financial Times, "Beware the Simple Solution", 18 May 1987.

same meaning and relevance as in these other branches? Basically assembly labour is of two sorts - putting together whole kits (the automotive case) and putting together subcomponents at the same time as carrying out several of the specific production operations on the way (a process reaching its fullest expression in garment manufacture where the foreign firm supplies the cloth, the designs and then undertakes marketing). Common to the two sorts is the emphasis on large-scale manufacture directed almost exclusively (save for some automotives) to export markets. MT appears to stand in an intermediate position. Recent commentary on the UK industry emphasises the relevance of assembly and, as mentioned above, points to the growing portion of machines built in the UK from Japanese kits. Yet this assembly is handled by relatively skilled and experienced workers and the products are frequently (probably in most instances) directed at the UK market itself i.e. the purpose of the importing enterprise has nothing to do with earning foreign exchange (on the contrary it is a net user) and everything to do with hanging onto a place among domestic suppliers. Moreover, assembly in MT cannot be a big volume activity: all the figures quoted in this report for units of output are way below those normally cited in other industrial branches. There may, of course, be many assembly steps yet both these and parts handling in general are to an even greater degree taken over by such advanced equipment as automated guided vehicles (AGV) and computer operated stacker cranes. So in this dimension, too, there are few grounds for optimism about attracting FDI from OECD to cheap labour sites.

Observations on the cheap labour argument for FDI would be incomplete if they failed to stress again the extent to which the more advanced countries and enterprises are shifting away from labour and, where they do use it, towards a different type of labour. The massive shakedown in USA since 1981 has witnessed the demise of 300 out of 800 MT companies and an overall employment reduction from 100,000 in 1981 to 70,000 in 1986: even Cincinnati Milacron, one of the foremost companies with strong international links, cut its workforce from 14,000 to 9,000 in the 1980-1986 period. On labour quality and corporate strategy the approach of Deckel, the major FRG producer of universal milling and boring machines, is most instructive. The company employs some 2,300 people - and investment in them has been a critical part of its overall investment during the past 5 years. Given the sharp move to NC products, in-house training has become the cornerstone of personnel development. "About 30% of its apprentices (120) go through a double or triple programme, which adds electrical and electronics skills to mechanical training. For those doing all three, the learning time is doubled to at least six years, with wages, instruction and equipment costing Deckel some DM200,000 per person."^{1/} As the company Chairman emphasises: "You can't go out in the open market and find these people. Its clear we had to make this commitment."^{2/} All in all, the chances are not great that MT producers of any weight will look for cheap labour oriented FDI locations - they are investing more in homebase staff, not trying to cut costs by going abroad.

The final reason for FDI stated earlier was reinforcement of control over the international production network. In essence this means locating

1/ Financial Times, "Deckel specialises as it fights back," 10 April 1987.

2/ idem.

manufacturing plants and key managerial staff in countries possessing one or more of the following: big markets, natural resources required for the manufacturing process, highly innovative enterprises within or without the MT branch from whom the investing firm can learn. Undoubtedly this pull to FDI partly overlaps with others, especially the tariff barriers argument and the linkage with big firms at home in related industries. Undoubtedly also the key countries named more than once in this report and around whom the world MT market rotates these days are also the only locations which would be seriously examined for this kind of strategic investment. No developing country outside of that small set of countries will be considered. If the chances of attracting FDI for the preceding three reasons are slim, the prospects for this last reason are virtually nil.

The emphasis throughout this section of the chapter has been on investment by major firms and countries. A fully rounded picture compels some reference to three other issues viz. the possibility of FDI by some leading Asian developing countries (the so-called NICs), the nature of cooperation arrangements and the role of incentives and competition among different countries in attracting FDI. These points are briefly dealt with in the following sub-sections.

2.3. The International Horizons of Newcomers

After the inclusion of a few of the large to medium size Latin American countries in the category of NICs in the 1970s, the focus seems to have returned to the four Asian countries 'founder members' of the group, i.e. Republic of Korea, Taiwan, Province of China, Singapore and Hong Kong. Of these the last will formally revert to becoming part of China in a decade's time and is of less interest for purposes of this report. But the other three have all shown definite emphasis on strengthening their domestic capital goods capability (less so Singapore, a much smaller country physically and population wise than the other two) and systematically incorporating ever more advanced technology, as well as extending the international reach of their firms through FDI. Consequently the three countries, and above all Republic of Korea and Taiwan, Province of China, have progressively devoted more attention to MT production and its very international dimensions. How should the global picture be modified to take account of their presence?

Tables 20, 21 and 22 set out what is known about FDI behaviour of Republic of Korea, Taiwan, Province of China and Singapore respectively. For the first two countries there are estimates (at then prevailing exchange rates) of the US\$ value of the stock of FDI partially disaggregated by recipient area and sector, while in the case of Singapore Table 22 classifies the ownership pattern of investments (almost entirely in Asia) and the footnote gives some of the figures for value of investments in other ASEAN nations. These tables permit the following comments. To begin with, the stocks are certainly tiny compared with those held by the leading OECD members. The fairest yardstick is Japan, being an Asian country, the closest to the NICs in terms of income per head and the latest starter in foreign investment. A summation of investment stock for the three countries as of the mid-eighties yields a figure of the order of \$2.5-3.0 bn., or not much above 3% of the Japanese total. As for Japan the priority areas of destination are USA and Asia, while fragments of information confirm that Korean and Taiwanese investments in USA, like those made there by Japan, are mostly of post 1980 establishment. On a sectoral breakdown there are divergences, especially

between Republic of Korea and Taiwan, Province of China. The former has the Japanese sectoral profile though to a still more pronounced degree: the search has been for natural resource investments (mining plus forestry approaching 55% of the total) with only one-sixth directed to manufacturing. The Taiwanese case is totally different showing by far the greatest orientation to manufacturing of all countries for which FDI data exist - almost 90% of the total. Within manufacturing a very crude approximation to the importance of engineering goods is given by adding the last 2 columns of Table 21 (basic metals and machinery and equipment) and comparing them with the manufacturing aggregate. The combined total of \$7.7 mn. is some 4% of all manufacturing; within this, basic metals accounts for the large majority and nearly half the basic metals total represents FDI in Malaysia. In the machinery branch almost all the investment is in USA, suggesting once more the concentration on that country in trade and investment. Only the Singapore data (Table 22) provide information regarding ownership patterns and they reveal a very marked preference for JV arrangements: of the cases examined only 16% were wholly owned subsidiaries while minority JVs were virtually two-thirds of the total. The bits and pieces of available information relating to the other countries tend to corroborate this finding: FDI from the NICs normally is channelled into JV arrangements and these are usually of the minority type. There is inadequate data to determine whether the deviations from the overall contours are pronounced for individual branches but there is at least no solid evidence against setting up JVs in the engineering branches including MT.

Table 20: Republic of Korea: Direct Investment Abroad, Stock 1984

All Countries and Sectors (\$ mn.)	444.7
Regional Breakdown (%)	
North America	32.5
Asia	22.8
Oceania	18.4
Sectoral Breakdown (%)	
Mining	37.9
Manufacturing	16.3
Forestry	13.0
Trade	12.6
Others	20.2

Source: Yoon-Doe Euh and Sang H. Min, "Foreign Direct Investment from Developing Countries: The case of Korean Firms", The Developing Economies, June 1986.

Notes: Data are based on Bank of Korea information. Figures do refer to realised investments but include real estate purchases and loans. The real estate share of the total is 4.5%.

Table 21: Taiwan, Province of China: Direct Investment
Abroad, Stock 1985^{a/}

Recipient Country	All Sectors	Investment ^{b/}		
		Manufacturing ^{c/}	Basic Metals	(\$ mn.) Machinery, Equipment and Instruments
USA	113.3	96.0	0.7	0.8
Indonesia	24.8	24.6	0.4	-
Philippines	10.1	10.0	-	-
Thailand	9.5	8.9	0.8	-
Singapore	9.3	8.9	0.8	-
Malaysia	7.3	7.2	3.2	0.1
Others	35.7	26.7	0.8	0.1
World	209.9	182.3	6.7	1.0

Source Che-Hung Chen, "Taiwan's Foreign Direct Investment", Journal of World Trade Law, November-December 1986.

Notes:

- a/ The figures refer to all approved investments from 1959 to September 1985 as published by the Investment Commission of the Ministry of Economic Affairs. \$150.7 mn., almost three-quarters of the total, were approved in the period 1980-1985.
- b/ There are major discrepancies between the figures reported here based on Taiwanese official sources, and those appearing in publications of recipient countries. Indonesia, for example, gives Taiwanese investment over the period 1967-1984 as \$132.1 mn., more than 5 times the figure given above. Were this factor to hold for all kinds of investment (i.e. country and sector) the total for basic metals and machinery would be around \$40 mn.
- c/ The dominant branches have been electronic and electrical appliances, and chemicals, which together accounted for around 60% of all manufacturing (mostly going to USA).

What, then, is the state of MT production in these countries and what might they wish to accomplish abroad? In the Republic of Korea the 1986 production of \$350 mn. (c/f Table 2) stemmed officially from 110 registered firms. Many of these, however, are very small and a large share of the total comes from only a few companies of which Daewoo Heavy Industries, Tongil and Swachon are the most significant. Their current technological level is, in global terms, only moderate but they are extending continually into more advanced items, using a mix of foreign technology and locally developed know-how. Thus Daewoo incorporates Fanuc controllers in its products while trying to design and produce its own (a process the company estimates may require another 3 to 5 years). By drawing on key foreign components and

Table 22: Singapore: Foreign Direct Investment of Local Firms by Type of Investment and Recipient Country, 1985 position

Country	Wholly owned subsidiary	Majority owned joint ventures	Minority owned joint ventures
ASEAN	11	8	36
China	-	-	11
Hong Kong	3	4	7
Sri Lanka	-	-	3
Others	2	7	9
Total	16	19	66

Source: Pang Eng Fong and Rajah V. Komaran, "Singapore Multinationals", The Columbia Journal of World Business, Summer 1985.

designs (both obtained mainly from Japan) some quite advanced manufacture takes place but there is clear recognition by the government that more LC is necessary; this must come on the material side as well as from design. Till now Korean firms have been notably less successful in MT exports than in most other industrial branches, a striking indicator of 'relative failure' being the fact that it has not been necessary to negotiate a VER for the US market. Government indicative targets for 1987 include a doubling of exports (as compared with 1986) to \$55 mn. and an expansion of domestic output to \$450 mn. The fragmentary data on the markets which are earmarked to receive these exports suggest that Korean output may be switched quickly towards Europe (currently over half the total goes to USA) where it is obviously felt they may have more scope. A summary assessment of the trade situation recently published concludes: "Korean machine tools have so far presented little threat to indigenous European producers. However in open markets with a relatively weak domestic industry, like that of the UK, low-cost Korean as well as Taiwanese products have tended to disturb prices at the bottom end of the market."^{1/}

The picture for Taiwan, Province of China varies from that for Republic of Korea in that the former seems to be technically more advanced, with greater exports (and a proportionately large trade surplus in MT) encompassing a higher quality product mix. Though the data of Tables 20 and 21 do not permit specific statements on FDI in MT to be made, it seems a fair assessment to say that whatever investment abroad has occurred has probably come from Taiwan, Province of China. The preferred destination has been USA as

^{1/} Financial Times, "Machine Tool Makers Face Cut-Throat Competition", 24 April 1987.

Taiwanese producers have sought to improve both knowledge about and traderelations with USA. Could, however, Taiwanese and Korean firms look for production bases say elsewhere in Asia? Keeping in mind the discussion about reasons for FDI presented in the previous sub-section there is one important difference when comparing the NICs with their Asian neighbours - at prevailing exchange rates the wage differentials are small. Thus while wages in Republic of Korea might be around double those in several other Asian countries, this gap is not of too much significance when measuring any of these nations against say Japan. It follows that, unless there were trade barrier reasons to relocate production e.g. quota circumvention, the cost advantages would surely not warrant any FDI. In the near future i.e the next year or so, the only reasons for altering that conclusion would therefore be a change in trade barriers or a realignment of exchange rates. The latter does indeed seem quite likely: USA has been exerting considerable pressure on both Taiwan, Province of China and Republic of Korea to revalue their currencies against the \$ by a sizeable margin.^{1/} The pressure is due to the trade surpluses both countries have with USA and the constant efforts by that country to be seen as an industrial workshop rather than an industrial fair where everything can be bought. A shift in the cross rates just referred to would mean, other things being equal, devaluation of other Asian currencies against those of Taiwan, Province of China and Republic of Korea. Consequently the other countries would become more interesting as production locations though the exchange rate shift might not in itself be decisive (c/f the Japanese automotive experience where for some time the exporting companies did not modify \$ prices in USA but instead accepted lower unit profits themselves; the switch of behaviour occurred as the appreciation of the Yen became too great and the VER regime came in). On balance, however, it is not likely that currency changes will be enough to encourage FDI on any scale from the Asian NICs - from this direction also there is unlikely to be much impetus to MT output elsewhere in the region.

2.4. The Nature of Cooperation Arrangements in Asia

The references to the experience of Asian NICs in terms of their MT production and FDI have explicitly signalled their use of foreign expertise though this has rarely been through FDI. Despite the paucity of data, then, there does seem to be a good deal of foreign collaboration of one kind or another taking place in the industry. To provide a view of what is going on Table 23 summarises, on the basis of news items appearing in trade journals, some instances of collaboration arrangements involving Asian countries in the period 1984-1986. The countries selected are the two main ones of the preceding sub-section plus the three largest nations; the choice was dictated by the fact that the five countries listed embrace a wide range of technological situations, all either have or explicitly plan to have quite big MT industries by the early part of the next decade, and by the pragmatic yet nonetheless illuminating consideration that industry sources rarely mention any other Asian countries.

Perhaps it is not a surprise that, of the 15 cases listed, US partners predominate; 4 cases involve Cincinnati Milacron and 3 Cross and Tracker,

1/ Taiwan Province of China has large foreign exchange reserves, currently estimated in excess of \$50 bn.

Table 23: Some examples of cooperation between Asian Countries and Foreign Partners in the Machine Tool Industry, 1984 - 1986

Asian Country	Year	Foreign Firm (country)	Local Firm	Nature of Arrangement	Product	Main Market	Other Remarks
1. <u>China</u>	1986	Cross and Trecker (USA)	Kumming Machine Tool	Joint Production	Coordinate Measuring Machines	China	
	1986	Cincinnati Milacron (USA)	Wuxi Machine Tools	Licence Arrangement	Internal Grinders	China	Royalty Payments expected to start 1988
	1985	Trumpf Maschinen-fabrik (FRG)	n.a.	Import of know-how, equipment to start production	CNC Metal plate processing machines	China	
	1985	Flow Systems (USA)	n.a.	Licence Arrangement	Cutting machines	China: US firm has right to sell Chinese made machines in Asia	5 years duration; \$2.5 mn.
	1984	Auto Numerical (USA)	Peking No. 1 Machine Tool Plant	Takeover of US firm by Chinese firm			50/50 Purchase deal with Susanto Group (Hong Kong)
	1984	Ex-Cell-O (USA)	Ningjiang Machine Tool Company	Licensing to build one of US firms products	n.a.	China, other Pacific	Royalties to be paid for 10 years

Table 23 (cont'd)

Asian Country	Year	Foreign Firm (country)	Local Firm	Nature of Arrangement	Product	Main Market	Other Remarks
2. <u>Rep. of Korea</u>	1986	Cincinnati Milacron (USA)	Hyundai Motor	Supply of final product	NC lathes	USA	5 year agree- ment: 300 units per year, supplies value at \$10 mn. per year
	1986	Cincinnati Milacron (USA)	Hyundai Motor	Licence arrangement	Small CNC turning centres	R. of Korea	US firm buying parts for Turning centres from Hyundai as part of worldwide sowing
	1986		Tongil		Own develop- ment of CNC to be incor- porated in lathes and machining centres	Export	
	1985	Heiligenstaedt (FRG)	Tongil	Acquiring majority ownership of FRG firm	CNC Turning machines and profile mill- ing machines		Turnover of FRG firm was DM 100 per annum
3. <u>Indonesia</u>	1985	Metalexport (Poland)	n.a.	Joint venture	Machine tools	Indonesia	\$10.5 mn. venture 75% parts import initially, 100% local content scheduled for 1990
	1985	Leadwell CNC Machines (Taiwan Province of China)	Tools Indonesia	Plant con- struction	Machine tools	Indonesia	

Table 23 (cont'd)

Asian Country	Year	Foreign Firm (country)	Local Firm	Nature of Arrangement	Product	Main Market	Other Remarks
4. <u>India</u>	1986	Cross and Trecker (USA)	Mysore Kirloskar	Joint venture	Universal Turning machine lines	India, later other Asia	
	1985	Beaver Machine Tool Sales (UK)	Mysore Kirloskar	Licence arrangement	Vertical and horizontal machining centres	India	UK firm supplies components and assemblies
5. <u>Taiwan, Province of China</u>	1986	Cross and Trecker (USA)		Considering establishment of 100% affiliate	Low cost machine tool components	US and Asia	

Sources: Industry journals, financial press.

along with further examples bringing in Flow Systems, Auto Numericals and Ex-Cell-0. The material presented earlier in this chapter pointed towards a greater degree of internationalisation (in the sense of deals abroad other than exports) by US firms than those of other countries - what Table 23 does is to give some substance to the notion. Licensing arrangements occur frequently, especially when Cincinnati Milacron is the American producer, while Cross and Trecker seems ready to enter JV deals (and in 3 different countries). The products subject of these arrangements are heterogeneous yet with surprisingly few of NC/CNC variety (in fact all contracts in Republic of Korea focus on NC/CNC lathes and the only other CNC arrangements have been concluded in China by Trumpf of FRG and in India by Beaver of UK). There is clearly a strong drive by various OECD firms to collect returns quickly on their technological assets, probably menaced by the prospect of rapid obsolescence and encouraged by the prospect of selling equipment and components without committing cash of their own. Indeed the current picture is in several respects a classic one. Companies located in the OECD markets most severely strained by imports and actual cum impending FDI are finding not only their market shares falling at home but their exports too subject to a severe battering: with falling sales, especially in an industry where job orders are not easy to organise, a liquidity problem is bound to arise for firms. Funds for FDI are thus not easy to find, while the competitive strains increase the temptation to increase cash flow through 'renting' intangible assets. Although Table 23 is only illustrative and makes no pretence whatsoever at a comprehensive picture the evidence is fully consistent with the classical pattern: licensing by US and UK firms, not one case of licensing by a Japanese company, and a heavy concentration of product sales from these arrangements in the home markets of the Asian countries.

The table has some other, less obvious, features that merit a comment. A Chinese firm (Peking No. 1 Machine Tool Plant) and a Korean one (Tongil) have invested themselves via takeovers of an American and a German firm respectively. Both investments involved less than full ownership, as the Chinese company shared its purchase with Susanto group of Hong Kong and Tongil acquired majority ownership. In each case the aim seems to have been rapid and full access to NC and CNC technologies and products. This 'reverse FDI' may well be a coming trend as the heavily committed but less advanced Asian countries seek to widen their technical command and product range. It is sometimes easier to do this by investing yourself rather than being invested in or paying for use of a technology that is never owned and may become obsolete quite fast. Obviously investment of this kind is best done through a takeover rather than a 'greenfield' operation and, given limitations on financial resources, will usually be directed at no more than medium size businesses in the OECD countries. Hence there is a clear contrast between Japanese and other Asian FDI in the OECD - the former aims mostly at using its own technology, can often be 'greenfield' and on a big scale, and extends an international network, while the latter is trying to have access to other people's technological assets, will be of the takeover type and that on medium scale, and is probably as much concerned with raising quality for home and external markets as with any kind of international network. Tongil, for instance, is known to be keen on expanding European sales of machining centres (target exports of about \$13 mn. for 1988 in Europe) and no doubt sees the acquisition of Heiligenstaedt as a prime route to achieve the target.

There appears to be one case of a turnkey operation and, intriguingly enough, the seller is a company based in Taiwan, Province of China (though it

may be the Taiwanese affiliate of a US firm). In general MT is not a branch where turnkey operations would be expected to be frequent: whereas in chemical engineering (to take the turnkey sector par excellence) so much of the final product performance is dependent on plant design, in MT the product design has hitherto been overwhelmingly the key factor with much output taking place in simple workshops or larger but still quite crude factories. Admittedly the relationship between plant design and sophistication of the product may be altering with quantum leaps in the latter compelling huge advances in the former. Nowhere is this better evidenced than in the Yamazaki plant in Worcester, UK (mentioned earlier in this report) where the production technology updates that used in the company's home Minimoto plant and in its 1982 established facility in Kentucky, USA. The plant area covers 16,500 square metres and, to meet the complexity of the CNC lathes and machining centres produced there, includes features such as: isolation of the floor in the superfinishing section to minimise vibration; a fully automated underfloor pipe system to handle the coolant supply for the production machines; an overhead monorail to transport replacement tools; a buffer store in the central aisle of the plant; and of course a precision machining area which is entirely computer controlled. Layout in such a plant is clearly of the utmost importance yet even so there is a heavy demand for internal transportation which includes 5 AGVs and 14 computer controlled stacker cranes. Such a plant necessitates intense involvement of the MT producer in its design and perhaps even in actual construction and it could be that a business will begin to grow in the plant design and erection area. In this sense, the Indonesian operation of the same Taiwanese firm may thus be the forerunner of a series of activities in those Asian countries where there are extensive plans for raising MT output qualitatively as well as quantitatively and countries wish to maintain substantial national ownership of the facilities.

Product marketing is firmly oriented towards the producer countries themselves but there are some instances where sales may be extended to elsewhere in Asia and a couple of cases where US itself is also targeted. The mix fits well with current conditions and most forecasts for the next few years: the biggest Asian countries aim to expand MT output to meet growing domestic demand, industrialisation is expected to continue extending itself, and there will be a constant effort to combine import substitution with export growth. Collaboration arrangements will reflect these objectives - while smaller Asian nations, and particularly those where the absolute size of the industrial sector is tiny by international standards, may try to obtain a marginal linkage with some MT suppliers, the bigger States will go for accords that maintain a degree of independence for themselves and where they can constantly dangle access to their markets - as a bait to foreign producers.

Finally, Table 23 has the germ of one longer term collaboration of an international nature viz. the link between Hyundai Motor and Cincinnati Milacron. The Korean firm (already 15% owned by Mitsubishi) is the major automotive producer in the country, manufacturing 420,000 cars in 1986, with mid-1987 capacity of 600,000 and a scheduled end-1987 capacity of 750,000. But the North American axis of its operations is vital: in 1986 exactly 40% of output was sold in USA and the target range for this year is an increase somewhere between one-fifth and one-half of total US sales. This leap into USA has inevitably raised questions of possible VER imposition and therefore FDI in North America by Hyundai: "The company is building a 100,000 a year car plant in Canada, due to come on stream in 1988 and has said that it will

decide within the next year or two whether to set up in the US."^{1/} In that context a close link with one of the world's specialist MT producers, based in USA, is entirely understandable and mutually beneficial. Cross fertilisation of markets and products can take place with Hyundai strongly dependent on activities in North America and Cincinnati Milacron undoubtedly interested in securing as 'captive customer' one of the major industrial firms in one of the most important and fastest growing Asian countries. Further ventures of this kind might well be a feature of future developments in MT.

2.5. The Significance of Investment Incentives

This chapter so far has concentrated entirely on the fundamental forces at work, macroeconomically in the OECD countries and in the MT branch itself, which influence foreign investment decisions. Below, a brief comment on the role of investment incentives within this context is provided - what value if any are institutional, legislative and financial actions within prospective recipient countries?

The current international economic environment is characterised by the following features in relation to overall FDI. First, the annual rate of FDI is falling in all major OECD nations except Japan where, on the contrary, the recent period is the boom time. Second, USA now accounts for around 30% of the world's FDI, well down from the 46% at the start of the 1970s. Third, that same country is now the major recipient of FDI with a share probably approaching one-third of the total; in the year 1 April 1985 to 31 March 1986 about 45% of Japan's FDI was directed to USA while in the calendar year 1986 some 30% of the FRG aggregate went to the same country. In 1985, of the 912 cases of major inward investments as classified by the Commerce Department approximately 24% were Japanese. Fourth, the economic crisis which continues to assail much of the Third World has led to a fair degree of disinvestment there, though admittedly Asia has been the region least affected by this trend. Even where disinvestment has not occurred the accent is firmly on conserving the parent company's finances; in Latin America, for example, around two-thirds of FDI from US companies stems from reinvestment of profits by subsidiaries already established there and risk capital represents only a quarter of the funds obtained by affiliates, and this while there has been but a slight drop in profit remittances in the very period when production by affiliates has fallen considerably. Fifth, a major thrust, backed not only by the international finance houses but also by the World Bank as part of its policy advice, is on dynamising credit markets in developing Asia. The idea is to mobilise local risk capital and access to it will be available to companies setting up in those countries - here too the results will be to reduce the proportion of foreign sourced capital in an FDI transaction.

It is in this setting that developing countries are trying to encourage FDI - they are clearly confronted with an uphill task. So stress is often placed on setting up a battery of incentives; their effectiveness, however, is limited and that for simple enough reasons. All countries in the business tend to institutionalise more or less similar packages which put them, as it were, in the same starting blocks but without giving any one a particular

1/ Financial Times, "Confident Industry Aims for Middle Size Slot", 14 May 1987.

advantage. As an example Table 24 brings together, under 5 sections, 26 conditions which investors usually consider favourable and looks at their occurrence in the 5 main ASEAN countries. In 10 instances all countries have the same situation and in 4 others there is only one country differing from the rest. On what are regularly cited by OECD firms (and their governments) as 'sensitive' issues the table is eloquent: on guarantees against expropriation and nationalisation, and for repatriation of earnings and capital; patent protection, employment of foreign staff, and protection of competition against imports (the Singapore divergence here counts little given its special trading position); exemptions from tariff on imported capital goods and raw materials; corporate tax deductions for reinvestment of profits; and special incentives to exporters, on all these there is unanimity. The essential ingredients of the incentives code are present throughout the sub-region, only the decorations vary among the cooks. In effect the institutionalisation of all these incentives does little else than put a country's name on the list as a possible candidate for receiving FDI - it does not give the country any special position. The more countries as a group try to compete against each other the worse off they are each likely to be i.e. they will be playing a negative sum game in which each one comes out a loser. One analysis of the Latin American situation has concluded: "Questionnaire surveys among transnational firms show that the incentives to foreign investment have, with the exception of protection against competing imports, little or no influence on investment decisions, particularly as regards production for the domestic market. In any case the effects of incentives specific to foreign investment are uncertain and lose their effectiveness the more complex they become and the more often they are modified."^{1/}

The preceding remarks thus show that incentives certainly do not, of themselves, persuade firms to make investments which they would not do otherwise and they also are most unlikely to have much influence on location since in today's world (at least in Asia) there is considerable harmonisation (conscious or otherwise) of legislation. Decision making is made in response to the fundamental macroeconomic conditions and the evolving patterns of the international industrial structure - what is done legislatively and institutionally by individual countries hoping to attract FDI is of little sway.

^{1/} Eduardo White, "Las Inversiones Extranjeras y la Crisis Económica en América Latina," Comercio Exterior, October 1986, p.862.

Table 24: Summary of Foreign Investment Incentives
available in ASEAN countries, 1986

Type of Incentive	Indonesia	Malaysia	Philippines	Singapore	Thailand
<u>I. Basic Rights and Guarantees</u>					
Against Expropriation	X	X	X	X	X
Against losses due to:					
Nationalisation	X	X	X	X	X
War damage	X	X	X	-	-
Inconvertibility for currency	X	-	X	-	-
Repatriation of:					
Earnings	X	X	X	X	X
Capital	X	X	X	X	X
<u>II. Protection and Priorities</u>					
Employment of aliens	X	X	X	X	X
Patent protection	X	X	X	X	X
Preference for government loans	-	X	X	X	X
Protection against competition from:					
Imports	X	X	X	-	X
Government	-	-	X	-	X
Local	X	X	X	-	X
Real estate ownership	-	X	-	X	X
<u>III. Exemptions from Taxes and Tariffs</u>					
Capital gains	-	X	X	-	-
Corporate income	-	X	-	X	X
Imported capital goods	X	X	X	X	X
Imported raw materials	X	X	X	X	X
Royalties	-	X	-	X	X
Interest on foreign loans	X	-	X	X	-
<u>IV. Deductions from Taxable Corporate Income</u>					
Accelerate depreciation	-	X	X	X	-
Export allowances	-	-	X	X	X
Reinvested profits	-	-	-	-	-
Investment allowances	-	X	X	X	-
<u>V. Special Incentives</u>					
To TNCs	-	-	X	-	-
To exporters	X	X	X	X	X
Other laws benefitting foreign investors	-	X	X	X	X

Source: Data assembled by Asean Committee on Industry, Minerals and Energy, December 1986.

Chapter 3

THE PROSPECTS FOR ASIAN DEVELOPING COUNTRIES

3.1. The Asian Context

The report has underlined the gravitation of the world's industrial economy towards Asia and the particular weight which primarily Japan, and to a lesser degree Republic of Korea and Taiwan, Province of China, have rapidly gained in the MT market. In this context the smaller Asian countries outside of the Pacific, of which Sri Lanka is the principal case, are in serious danger of marginalisation. To describe the Asian context requires some further exploration of the investment situation. It appears reasonable to begin with Japanese investment since this is the country located in the region, the world MT leader and now showing the highest marginal propensity for FDI. Table 25 describes the country composition of its investments in Asia during fiscal year 1985 (i.e. to 31 March 1986). Ten countries are listed explicitly and to them more than 98% of all FDI to the region is committed. However, the general figures here do not tell the whole story. Some of the stronger commentaries argue that Asia has been left aside by the boom in FDI from Japan. Thus one recent assessment commented that "except for significant increases in investment in Singapore, South Korea, Taiwan and to a lesser extent India, the Japanese are leaving Asia high and dry"^{1/} and "As Japan moves into the information revolution, it has also lessened the need for South East Asia's raw materials its survival once depended upon."^{2/} The figures for the past couple of years vary sharply from the pattern of the late 1970s and early 1980s, especially for the ASEAN countries. From 1977-1983 the annual average growth rate of Japanese FDI in manufacturing was 18.7% globally but a superior 20.6% in ASEAN (corresponding world and ASEAN statistics for 1976-1983 were for USA 6.6% and 13.3%, for FRG 12.2% and 12.8%).

A more detailed picture in relation to FDI can be gleaned from some other recent research. Looking once more at the ASEAN countries (less Singapore and Brunei) Japanese FDI is far more concentrated on manufacturing than is investment from USA: 1983 data show the share of manufacturing in the US total to range from around 4.5% for Indonesia and Thailand to some 35% for Philippines, whereas the corresponding span for Japan runs from 27.5% in Indonesia to 75% for Thailand. Within manufacturing Japan put close to one-third of the total into metals and metal products against just one-seventh for USA. A failure to make an impression on Japan would thus mean that investment in the MT and metalworking areas would have to be sought in bits and pieces from firms located in countries that are either not at the core of the branch or are losing their position in the core group. Since, moreover, the labour intensity of Japanese investments in machinery industries is high relative to those made by other countries (1983 figures put employment per US\$1 mn. of Japanese assets in the machinery sector in Asia at 59 people while the corresponding figure for USA is about 15% lower), the employment effect as well as the foreign exchange effect is significant.

1/ South, "The Rising Sun: Cutting Out Asia", February 1987, p.58.

2/ idem.

Table 25: Japan: Foreign Direct Investment in Developing Asia, 1985^{a/}

Country	Amount (\$ mn.) ^{b/}	Change on Previous Year (%)
Indonesia	408	+9
Singapore	339	+51
Rep. of Korea	134	+25
Hong Kong	131	-68
Taiwan, Province of China	114	+75
China	100	-12
Malaysia	79	-44
Philippines	61	+33
Thailand	48	-60
Brunei	1	-80
Others	20	-5
Total	1435	-12

Source: The Economist, 25 October 1986, drawing on MITI data.

Notes:

a/ Fiscal year, i.e. 1 April 1985 to 31 March 1986. Figures refer to all sectors.

b/ Converted at current exchange rates: the aggregate fall from 1984 to 1985 measured in dollar terms would therefore be greater measured in yen due to the rising value of the yen against the dollar in the latter half of fiscal 1985 (i.e. subsequent to the G5 accord of September 1985).

The report has suggested that the ASEAN countries may be the most obvious investment targets in the region, in the sense that they are actively seeking foreign collaboration and do not (with the exception of Singapore) yet have sufficiently strong domestic industries of their own. Table 26 brings together some characteristics of the MT industry in 5 countries (excluding Brunei). No satisfactory estimates of the overall value of output could be obtained but other aspects of branch structure and the approach of governments to MT could be ascertained; the main findings can be summarised as follows. First, the number of producing firms is small, around 10 to 15 - the higher number for Malaysia includes quite a few metalworking and woodworking enterprises whose elimination would certainly reduce that country's total to the same range as elsewhere. If this number, unweighted for size of employment or value of output, is compared with numbers in other countries, then the ASEAN average is not much more than 10% of the industry size in, say, Japan or Republic of Korea. Second, there is an absence of leading firms i.e. enterprises which have a powerful investment and production base. Thus in Indonesia commentary in 1986 on the plans to enhance the branch stated "The government has authorised 11 companies to expand and develop their machine tool activities. Until now firms have only been small and have not been able

to compete with imports."1/ There does not, furthermore, appear to be evidence of a State sector firm of significant size operating in any of the countries. Third, and closely related to the preceding point, all ASEAN countries recognise a dearth of investment in MT notwithstanding the importance assigned to it in national planning. As described in the last section of Table 26, the inherent risks of MT production tend to be accentuated in the developing country context: whereas events of the present decade have been as an earthquake in several OECD countries, bringing down many firms and forcing others to be rebuilt on totally different structural bases, in ASEAN they have acted as a brake on getting the industry off the ground.

Table 26: Some characteristics of the Machine Tool Industry in ASEAN Countries, 1985

Number of Producers:

Indonesia:	13
Thailand:	13
Singapore:	10-15
Philippines:	5-10
Malaysia	47 (incl. metalworking and wood working)

Nature of Product:

Metal Forming rather than Metal Cutting (except for Singapore)
Intermediate level (except for Singapore), including reconditioning and rebuilding of imported machines (particularly in Philippines)

Nature of Production Method:

Old machines (except for Singapore), frequently more than 10 years
Job order rather than continuous production
Heavy reliance on imported raw materials, particularly special steel alloys

Investment and Ownership:

Lack of investors (domestic and foreign) despite high priority given to Machine Tools in all countries' investment plans. Risks seen as volatile demand, advanced and changing technology, and weak support industries.

Current ownership is mainly national

Source: Derived from material collected by Technonet, Singapore, published in UNIDO, The Machine Tool Industry in the Asean Region: Options and Strategies, Main Issues at Regional Level, May 1986.

1/ Nachrichten fuer Aussenhandel, "Branchenbild: Die Werkzeugmaschinenindustrie in Indonesien", 3 February 1986.

Reports from specialised industry sources emphasise both the continued wish of countries to enhance MT production and their recognition that FDI offers the most promising route for achieving the aim. Thus a 1985 analysis stated "Although a country that can now produce 1550 machine tools a year, Indonesia's newest 5 year plan calls for production of 21,000+ metalworking machines per year by 1989...Present facilities could manage 3,600 units per year by then, and the rest will have to come from new facilities from joint ventures and foreign investment. Indonesian technology officials have announced they would prefer to get the capital and knowhow from the US machine tool industry."¹ Moreover, in early 1986 the import duty on MT was raised by some 15% with the purpose of encouraging greater domestic output; thus far, however, there is scant evidence that FDI has actually occurred. In the case of Thailand there was an undisguised 1986 initiative by the Board of Investment to encourage US metalworking and machinery firms to locate plants in the country. Thus: "Thailand has moved into a better position to compete for US manufacturing operations in the wake of rising labour costs elsewhere in Asia, including Hong Kong, Malaysia, Taiwan and South Korea. It has a sizeable pool of engineers and technicians and its assembly line workers make less than US\$4 per day. Going wage rates for skilled workers range up to US\$6 per day, while typical salaries for technicians and engineers are US\$150-250 per month and US\$300-500 per month respectively. Benefit packages usually come to about 50% of wages and salaries. Standard government incentive packages include investment guarantees, up to 8 years of corporate income tax and business tax exemption, duty free import of machinery, equipment and basic raw materials and components."² In the Thai case also the impacts of this drive to encourage FDI have yet to be realised. Obviously there are 3 kinds of time lag in this process viz. the information lag from Government to potential investor, the approval lag for acceptance by the Board of Investment of any proposed FDI, and the gestation lag for turning an accepted proposal into an actual production operation. Together these lags are quite sufficient to account for the absence of actual start-ups till now. The passage of time could well lead to a marked reduction of the information lag and possibly some cutback of the approval lag. Yet the gestation lag is always likely to be present, especially in an industry as volatile as MT: market conditions can alter between the date a proposal is put together and the time the investment is ready to begin.

Returning to Table 26 the fourth point to underline, and one of considerable importance, concerns the type of product and production technology prevailing in ASEAN. Singapore stands apart from the other 4 nations with a profile resembling the advanced OECD countries i.e. emphasis on metal cutting equipment of recent vintage and certainly with some export orientation. But the 4 largest ASEAN countries are in a quite different context. Although they have roughly the same number of firms as Singapore, what these firms actually do is by no means comparable. To begin with their concentration of activity is towards metal forming, using machinery of no more than an intermediate kind and often obtained second-hand. The average age of machinery is therefore high relative to the stock found in more advanced production locations (this statement can be made with some confidence due to

1/ American Metal Market, "Indonesia: Toolmakers Wanted", 14 January 1985, p.16.

2/ Iron Age - Metal Producing Management, "Thailand asks US Firms to Locate There", 17 January 1986, p.16.

the introduction of new technologies) and the equipment is being used to produce for specific orders rather than large batches. Now it is true that MT demand anywhere has a substantial job order component but a stronger sector where firms have more flexible production equipment can usually manage (except in phases of very limited demand) to keep low rates of machine downtime and reasonably high and stable levels of capacity utilisation. These indices are definitely unfavourable for the ASEAN countries and must lead eventually to higher product prices and/or lower company profits than would prevail in a situation where the sector was stronger. The reliance on imported raw materials accentuates the problems not so much in the familiar sense of the risk that foreign exchange will be unavailable (though this might be a difficulty on occasion, especially in Philippines and Indonesia) but because of the disjuncture between material quality and equipment vintage. There is currently a contradiction between the declared aims of augmenting MT quality and the tools at the disposal of the industry to achieve that objective. In ASEAN the sector is thus awaiting its own definition - how to combine the simpler, lower grade requirements for many branches of local output with the undoubtedly essential introduction of progressively more advanced technologies to support the modern industries. Each of the 4 countries (leaving aside Singapore) will have a different response due to the varied industry mixes they possess and as of now there is no sign of any elements of a common approach.

3.2. Foreign Direct Investment in Cheap Labour Countries?

The major shifts in production cost structures and levels now sweeping through the industrial sectors of the OECD countries are particularly pronounced in the MT and engineering branches where the combination of the electronic with the mechanical has totally altered the nature of processes (allowing a felicitous mix of batch and custom-made production) and drastically changed the skill requirements for staff. Production in cheap labour countries is highly vulnerable to these developments and that creates real tensions around investment decisions. Much time is required to build marketing channels and establish long term customers: even if original investment costs can be recouped relatively quickly, medium to long term profitability is a function both of continuing cost efficiency and quality maintenance (variables which depend, among other things, on whether significant technological changes are occurring) and the ability to retain a marketing grip. The problem in countries with a cheap labour edge is that this asset is constantly liable to erosion (or even a sudden landslide) due to technological changes. Consequently the single advantage of labour cost is not enough: what is required is at least a second asset, preferably of a system kind, which can provide some cushion against technological improvements (at least within a range). It is the long term building of that asset which has to be the focus not only of policy, seen as a succession of manoeuvres, but of strategy. This is not the same as economic planning as it has been conventionally understood and widely castigated. It is a social cum economic process of integration which recognises that domestic entrepreneurship devoted to long term profit making through industrial production (as opposed to financial speculation and trading) is essential to improving not only the wealth of the economy but also its resilience in the face of external shifts. That entrepreneurship will only flourish if public sector support is available and if the public sector is committed to creating a well defined type of economic structure. The common feature of the economically successful Asian countries has been precisely the sharpness and insistence of that definition.

Developing Asian countries trying to attract FDI from the MT sector are thus pursuing a high risk option. What in fact is the relative position of countries on the wage scale? Table 27 brings together, for the latest year for which a sizeable sample of countries on a comparable basis could be obtained, data on hourly wages and labour costs in export production. The numbers tell their own story: Sri Lanka is by far the cheapest location with costs of half to one-third those prevailing in Philippines, Thailand and India. The table shows vividly how (and recall these are 1983 data) Hong Kong, Singapore and Republic of Korea have become, in the Asian context, high labour cost locations and have therefore been driven to seeking other advantages to sustain their export thrust. On any assessment, and especially when the discipline, skill and literacy levels of the Sri Lankan labour force are kept in mind, that country is unquestionably the cheap cost site.

Table 27: Average hourly wages and average hourly labour costs in Export Processing Zones and World Market factories in Selected Developing Countries, 1983
(\$US)

Country	Average Hourly Wages	Average Hourly Labour Costs
Sri Lanka	0.11 - 0.15	0.15 - 0.25
Philippines	0.25 - 0.70	0.30 - 0.90
Thailand	0.35 - 0.50	0.40 - 0.60
India	0.40 - 0.75	0.50 - 0.80
Taiwan, Province of China	0.40 - 1.25	0.50 - 1.50
Malaysia	0.50 - 0.70	0.65 - 0.90
Singapore	0.60 - 1.25	0.90 - 1.80
Rep. of Korea	0.60 - 1.20	0.75 - 1.50
Hong Kong	0.90 - 1.65	1.12 - 2.10

Source: Folker Fröbel, Jürgen Heinrichs and Otto Kreye, Umbruch in der Weltwirtschaft, Reinbek 1986, p.470.

Notes: Labour costs differ from wages through including social payments.

Since the latter half of 1985 there has been a major realignment of exchange rates, especially in the \$/Yen parity. This has altered investment costs in different countries according to the behaviour of their currencies; the results likely for the 2 year period to end 1987 are given in Table 28. The only countries, as compared with Sri Lanka, which are becoming cheaper for investors both in \$ and Yen are Indonesia and Philippines with the numbers for Malaysia not much different. At one level this confirms the view expressed earlier that it is the ASEAN countries and Sri Lanka which are the main competitors: they have the lowest labour costs (fragmentary information for Indonesia suggests that could it have been included in Table 27, its rates would have been closest to those for Sri Lanka) and their exchange rates are all fairly weak. But taken from a different angle, the available evidence also leads to the conclusion that nothing much is to be gained for any country by any further attempts at competitive devaluations, cuts in wage rates or efforts to improve incentives for foreign investors. Not only are they likely to backfire, in that neighbouring countries will probably modify policies

Table 28: Projected change in investment costs as measured in Dollars and Yen in Selected Asian Countries, end 1985 to end 1987

Country	Change in Yen (%)	Change in Dollars (%)
Rep. of Korea	-12.1	+17.5
Taiwan, Province of China	-5.3	+26.0
India	-26.4	-1.7
Indonesia	-43.5	-24.5
Philippines	-31.6	-8.5
Thailand	-18.7	+8.7
Malaysia	-29.6	-5.9
Sri Lanka	-30.2	-6.8

Source: Business Asia, 16 March 1987.

Notes: Percentages calculated comparing actual end 1985 rates with projected end 1987 rates; the basis for the projection is not explained. It is not clear whether full allowance has been made for possible shifts in costs other than exchange rates e.g. alterations in government policies towards foreign investment.

to neutralise the shifts, but they would seriously call into question the net benefits to that country of an export oriented manufacturing thrust. Due to the absence of data this report has been unable to present net export earnings estimates but they are certainly not that substantial due to the import content of export directed manufacturing production. Any further policies allowing part of the benefits to be taken away would leave the country with little to show for its efforts.

To sum up, what then are the overall prospects for Asian developing countries to attract MT investment from abroad? As a basis to answer this question the quintessential features of FDI in this branch are reiterated below:

- FDI in MT has not so far taken place on a large scale (both compared to overall MT production and compared to FDI ratios in other branches of manufacturing). However, it has recently shown an increasing tendency.
- MT-related FDI clearly is among the most demanding types of FDI, both in terms of supply as well as demand conditions. On the supply side, i.e. concerning the investment preconditions relating to factor availabilities, it presupposes the existence of highly skilled labour resources, a network of specialized input supplies and a sophisticated supporting service sector (such as local computer software specialists). On the demand side a large domestic market has shown to be of key importance. FDI has either sought primarily to maintain access to a protected domestic market (e.g. investment in USA triggered off by the threat of VERs) or at least to combine export production with production for the host country market within a strategy of risk control. Nowhere has FDI in MT been utilized so far just as an export platform.

These characteristics obviously imply that for those Asian developing countries outside the core group of NICs the prospects to attract MT investment are not particularly bright. This is not to say, however, that the potential is non-existent. What follows is rather the need to design a clear long-term strategy in this area. The available evidence demonstrates that in no case has MT production developed in isolation from the overall industrial sector. Being a branch with strong backward and forward linkages it can only prosper as integral element of a larger industrial system.

Hence, chances to attract MT investment appear to be best in those countries with a strong industrial policy commitment to develop and upgrade their metalworking and engineering industries. Moreover, within this overall strategy they would have to define themselves those specific MT product groups of critical importance to the country's industrial progress and subsequently would have to approach potential investors. Targeted investment promotion activities thus assume critical importance and, as pointed out above, it is not so much a façade of fancy investment incentives but rather the long-term market prospects that will cause potential investors to respond. Further detailed research would seem to be required, however, to ascertain at the company level the various determinants of corporate strategies in general and of investment behaviour in particular.

APPENDIX

MAIN NATIONAL MACHINE TOOL ASSOCIATIONS

<u>Country</u>	<u>Name and Address of Association</u>
<u>Europe (CECIMO Members)</u>	
Austria	Fachverband der Maschinen und Stahlbauindustrie Osterreichs, Wiedner Hauptstrasse 63, Postfach 430, A-1045 Vienna
Belgium	Syndicat des Constructeurs Belges de Machines-Outils (also CECIMO headquarters) pour le Travail des Métaux, rue des Drapiers 21, B-1050 Brussels
Denmark	Foreningen AF Danske Vaerktojsmaskinfabrikanter, Norrevoldgade 34, DK-1358 Copenhagen K
Federal Rep. of Germany	Verein Deutscher Werkzeugmaschinenfabriken e.V., Corneliusstrasse 4, D-6000 Frankfurt 1
France	Syndicat de la Machine-Outil, de l'Assemblage et de la Productique Associée, 150 boulevard Bineaux, B.P. 117, F-92203, Neuilly sur Seine Cedex
Italy	Unione Costruttori Italiani Macchine Utensili, Viale Fulvio Testi, 128, I-20092 Cinisello Balsamo (MI)
Netherlands	Vereniging Voor de Metal - en de Elektroteknische Industrie, Bredewater 20, Postbus 190, NL-2700 AD, Zoetermeer
Portugal	Centro de Cooperaçao dos Industriais de Máquinas e Ferramentas, Rua Manuel Pinto de Azevedo 439, P-4100 Porto
Spain	Asociación Española de Fabricantes de Máquinas-Herramienta, Edificio Oficinas Lorea, Apartado 907, Avda. de Zarauz 82, E-20009 San Sebastián
Sweden	Föreningen Svenska Verktygsmaskintillverkare, Box 5506, S-114 85 Stockholm
Switzerland	Verein Schweizerischer Maschinen-Industrieller, Kirchenweg 4, Postfach, CH-8032 Zurich
United Kingdom	Machine Tool Trades Association, 62 Bayswater Road, GB-London W2 3PH

Asia

- India Indian Machine Tool Manufacturers Association, 82 Jolly
Maker Chambers 2, 225 Nariman Point, Bombay 400 021
- Japan Japan Machine Tool Builders' Association, Kikai Shinko
Building, 3-5-8 Shibakaen, Minato-Ku, Tokyo 105
- Republic of Korea (Contact Person) Mr. Kim Kee Hyo, Assistant Director,
Precision Machinery Division, Ministry of Commerce and
Industry, Seoul

North America

- USA National Machine Tool Builders' Association, 7901 West
Port Drive, McLean, Virginia 22102

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