Multinational Enterprises Programme

Working Papers

Research on Employment Effects
of Multinational Enterprises

Working Paper No. 16

Technology choice and employment creation: A case study of three multinational enterprises in Singapore

by Linda Lim and Pang Eng Fong,

Economic Research Centre,

National University of Singapore.

Geneva, International Labour Office, 1981

This is one of the working papers prepared for an ILO study on the development by multinational enterprises of appropriate technology for maximum employment creation in developing countries, undertaken by the ILO's Multinational enterprises programme. Responsibility for the opinions expressed in the working papers does not constitute an endorsement by the ILO of the opinions expressed in them. The working papers are intended to provide elements for further discussion of the subjects treated.

TECHNOLOGY CHOICE AND EMPLOYMENT CREATION: A CASE STUDY OF THREE MULTINATIONAL ENTERPRISES IN SINGAPORE

I. INTRODUCTION

This paper analyses the experiences of three multinational enterprises (MNEs) in the electronics industry in Singapore, a city-state with a rapidly industrialising economy. Using data from interviews and secondary sources, it examines the factors that shape the choice of technology in each MNE and the impact of this choice on direct and indirect employment creation. Its objective is to understand how MNEs of different nationalities adapt to rapid changes in the world electronics industry and in the Singapore labour market. By focussing on the particular experiences of three MNEs, we hope to highlight aspects of Singapore's industrial experience that may contain lessons for MNEs and policymakers in other developing countries.

II. ECONOMIC DEVELOPMENT AND LABOUR MARKET CHANGES IN SINGAPORE

In the late 1950s, Singapore's economic outlook was grim. Entrepot trade, the source of Singapore's prosperity since its founding as a British settlement in 1819, was stagnating, and unemployment was widespread and rising. To create jobs and diversify the economy, Singapore adopted an industrialisation programme. In the early 1960s, the programme emphasised import-substituting industries that had access to a domestic market including Malaysia which Singapore joined as a constituent state in August 1963. When Singapore separated

from Malaysia in 1965, the rationale for an import-substituting industrialisation strategy disappeared. From 1965 onwards, Singapore pursued instead an export-oriented industrialisation strategy led by foreign capital. This strategy was remarkably successful, thanks to the influx of foreign firms attracted by Singapore's political stability and low-wage labour, and to the booming world economy. From 1966 to 1973, the Singapore economy expanded at over 13% a year. The world recession that followed the quadrupling of oil prices in 1973 flattened this growth to 4% in 1975. Since 1975, Singapore's economy has expanded at a growing rate, and in 1980 achieved a 10% growth rate, its first double-digit performance since 1973. While manufacturing has grown the most rapidly, other sectors like banking, commerce, communications, construction and services have also boomed.

Rapid growth since 1965 has diversified the economy and greatly transformed the labour market in Singapore. Unemployment grew to more than 10% of the labour force in the early 1960s because job creation failed to keep pace with the growing number of job seekers and the inflow of people from Peninsular Malaysia. (Until 1965, movement of people between Singapore and Peninsular Malaysia was unrestricted.) In the late 1960s, job opportunities began expanding faster than the growth in labour supply. Consequently, unemployment fell steadily. By the early 1970s, the backlog of unemployment was wiped out and full employment prevailed. In 1974 and 1975, unemployment rose marginally because of the world recession. Since 1975, the labour market has tightened with the inflow of new labour-intensive manufacturing firms into Singapore leading to labour shortages, rising wages and the

import of foreign labour. This full employment situation is expected to continue into the 1980s, given the sharply declining rate of population and domestic labour force growth, and continued rapid growth in all sectors of the economy.

III. RECENT GOVERNMENT POLICY ON TECHNOLOGY AND EMPLOYMENT

The Singapore government has developed a variety of policies and institutions to promote the upgrading and restructuring of the Singapore economy, particularly the manufacturing sector.[1] The aim is to phase out low-wage, low-skill, labour-intensive industries, and to encourage the establishment of high value-added, skill- and capital-intensive industries.

The Economic Development Board (EDB) offers generous investment incentives to "deserving" foreign and local manufacturing firms. Established tax incentives are pioneer status, granting complete exemption from the 40% corporate income tax for 5 to 10 years; export incentive, allowing 90% tax exemption on profits derived from export sales for 3 to 5 years; and an investment allowance granting tax exemption based on the size of fixed investment. A revised capital allowances scheme allows most types of equipment to be completely written off in 5 to 10 years. In addition, various measures have recently been instituted to encourage development of new products and processes. They include: double deduction of R and D expenditure, accelerated depreciation over 3 years for all plant and machinery for

---

[1] For details, see Singapore Economic Development Board, Annual Report 1979-80, pp. 20-28.

R and D, investment allowance of up to 50% of the capital investment in R and D, initial allowance of 25% and annual allowance of 3% for R and D buildings, capitalisation and writing-off of lump sum payments for manufacturing licences for a period of 5 years. A Product Development Assistance Scheme (PDAS) has been established for local firms.

Many innovations have also been introduced in the area of manpower policy, administered by the Ministries of Trade and Industry, Labour, and Education. After years of restraining wage increases to maintain competitiveness in labour-intensive export industries, the National Wages Council (NWC), a tripartite body set up in 1972 to ensure orderly wage changes, embarked on a wage correction policy in 1979 to "bring wages to their proper market level" over a period of three years. The aim is to curb the growth of unskilled jobs in labour-intensive activities, and to reduce Singapore's dependence on foreign workers. Wage increases of approximately 20% a year, have been instituted for 1979 to 1981, they appear to be effective. In 1980, jobs expanded by 4% compared with 6% in 1979, and productivity growth doubled to 5%.

Training of skilled manpower for industry has been intensified through a growing number of overlapping industrial training schemes and institutes. Grants are available from the EDB to finance on-the-job and formal training of workers locally and overseas. In addition to the courses offered by the Vocational and Industrial Training Board (VITB), joint industrial training centres have been established by the EDB with three international companies (Rollei,

Philips and Tata), and three foreign governments (France, Fed. Rep. of Germany and Japan) to provide specialised training. In 1979 a Skills Development Fund (SDF) was established, to which all firms are required to contribute 4% of the total wage bill of employees earning less than $750 per month. From this fund, grants are awarded to firms to defray training costs incurred in upgrading workers' skills, including the retraining of workers made redundant by economic restructuring. Existing institutions of higher learning - the Singapore Polytechnic, Ngee Ann Technical College, and the National University of Singapore - are being expanded, and a new Nanyang Technological Institute is to be established - all with the aim of increasing the supply of production engineers, skilled technicians and R and D scientists for what has been called a "Second Industrial Revolution". Plans are also under way to provide continuing education and training programmes for workers.

Government policy thus operates on both the demand and the supply sides of the labour market. Investment incentives aim to increase the demand for skilled labour while manpower policies aim to increase its supply. They are the crucial components of an industrial restructuring policy based on attracting capital-intensive, high-technology industry which will upgrade jobs in the manufacturing sector.

IV. CHARACTERISTICS OF THE INTERNATIONAL ELECTRONICS INDUSTRY

Electronics has been a "priority" industry of the Singapore government since the late 1960s. It is a complex and diversified industry whose dynamic technological and market

characteristics fit peculiarly well with the changes in the Singapore manufacturing sector, making it a particularly good example of changing "appropriate technology" and employment creation in a rapidly industrialising developing country.

The electronics industry can be divided into three major sectors by end-use: civil and military equipment, industrial electronics, and consumer electronics. These are served by a large intermediate components sector. Technology in all sectors is characterised by short product life-cycles, constant innovation, and rapid obsolescence. Innovations over the past 30-odd years have been both capital-saving and labour-saving. Miniaturisation and better design have progressively reduced the number of components and amount of material used, while dramatically improving product performance and capabilities, and saving energy. Automation has reduced labour use and contributed to better product quality, but many processes and assemblies remain labour-intensive because they are too complex or too costly to mechanise.

Technological changes in the industry are largely responsible for rapidly falling costs and prices, and correspondingly rapidly growing markets. Electronic technology has seemingly endless applications to daily life and work, so new products and markets are being constantly developed. Industry structure is oligopolistic where R and D expenditures are large and innovation crucial, as in the semiconductor sector. It is more competitive where a mature technology is easily acquired and applied, as in transistor radios and watches. In both cases, market competition is keen, sometimes including "cut-throat"

price competition, because of substantial economies of scale: as output increases by cutting prices, production costs fall off sharply, facilitating further price cuts, etc. Markets are rapidly expanding but volatile, with frequent sharp recessions due to competition and oversupply on the one hand, and high income elasticity of demand and sensitivity due to the macroeconomic business cycle, on the other.

In the 1960s, technological and market changes in electronics led to worldwide sourcing and the multinationalisation of the industry.[2] Electronics manufacturers developed an international division of labour, in which labour-intensive products and processes were located in low-wage developing countries, while R and D, and more skill- and capital-intensive production were retained in the developed countries which were the home markets of the parent companies. The developing countries of East and Southeast Asia became the favoured offshore manufacturing locations of electronics MNEs from North America, Western Europe, Australia and Japan. Over time, this international division of labour within the vertically integrated MNE and between the different host and home countries has changed to reflect changing comparative advantages. Increasingly complex and skill- and capital-intensive stages of production are being moved offshore to countries

---

[2]For details, see the following: Y.S. Chang, The Transfer of Technology: Economics of Offshore Assembly, the Case of the Semiconductor Industry, UNITAR Research Report No. 11, New York, 1971; Richard Moxon, "Offshore Sourcing in Less-Developed Countries: A Case Study of Multinationality in the Electronics Industry", The Bulletin, New York University Graduate School of Business Administration, Institute of Finance, Nos. 98-99 (July 1974); UNCTAD, International Subcontracting arrangements in electronics between developed market-economy countries and developing countries, TD/B/C.2/144/Supp.1, New York, 1975.

like Hong Kong, Rep. of Korea and Singapore, while the simpler and more labour-intensive stages are being phased out from these countries and moved to Indonesia, the Philippines, India, Sri Lanka and Bangladesh.

As technology increasingly becomes the major determinant of production costs and quality, and market success in the 1980s, R and D activities become even more crucial for industry leadership. The capital- and skill-intensity of R and D, together with the intensifying political struggle for access to developed country markets, firmly establish the electronics industry's "centre of gravity" in the developed countries, though many production activities are dispersed throughout the developing countries. Japanese firms are rapidly emerging as the industry leaders in semiconductors as well as in the consumer products market which they have dominated for over a decade. Their superior access to adequate capital financing and technically-skilled human resources has enabled them to virtually close the technological gap with leading American semiconductor firms.[3] At the same time, Japanese overseas investment in the electronics industry has in the last few years been increasingly oriented towards market centres like Europe and the United States, rather than to production centres in the developing Asian region.

---

[3]For an analysis of the rise of the Japanese semiconductor industry, see Lenny Siegel, "Delicate Bonds: The Global Semiconductor Industry", Pacific Research (First Quarter 1980), pp. 20-22.

V. THE ELECTRONICS INDUSTRY IN SINGAPORE[4]

In 1965, the electronics industry in Singapore consisted of one local firm assembling television sets and radio kits for the small, protected domestic market. In 1968, attracted by the plentiful, low-cost, disciplined labour then available, and by generous tax incentives offered to labour-intensive export manufacturers, American semiconductor multinationals began establishing offshore plants in Singapore. This marked the start of a period of phenomenally rapid growth up to early 1974, with Japanese and European consumer and component electronics multinationals following the American lead. Most major electronics multinationals in the world established a subsidiary in Singapore to produce for the world market - from the US came Texas Instruments, National Semiconductor, Hewlett Packard, Fairchild and General Electric of the USA; from Japan, Hitachi, Toshiba, Matsushita and Sanyo; from Europe, Philips, Siemens, Thomson and SGS/Ates.

By 1974, the electronics industry in Singapore employed over 46,000 workers, or over one-fifth of the total manufacturing work-force, and accounted for S$1.6 billion or 12% of total manufacturing output (Table 1). Then the severe world recession of 1974-75 caused a fall in output and a drop in employment of 14,000 workers, or nearly one-third of total industry employment by the end of 1975. Recovery

---

[4]For details, see Pang Eng Fong and Linda Lim, The Electronics Industry in Singapore - Structure, Technology and Linkages, Economic Research Centre Monograph Series No. 7, University of Singapore, 1977; Linda Y.C. Lim, Multinational Firms and Manufacturing for Export in Less-Developed Countries: the Case of the Electronics Industry in Malaysia and Singapore, Ph.D. dissertation in Economics, University of Michigan, 1978; Pang Eng Fong and Augustine Tan, Employment in the Singapore Electronics Industry , paper prepared for the ILO Asian Regional Team for Employment Promotion (ARTEP), Singapore, April 1981.

TABLE 1

AGGREGATE DATA ON THE ELECTRONICS INDUSTRY[1] IN SINGAPORE, 1970-1979

Year	No. of Establishments	No. of Workers	% of Mfg Workforce	Output ($m)	% of Mfg Output	Output Per Worker ('000)	Value-Added Per Worker ('000)	Average Remuneration Per Employee ($'000)	Direct Export As % of Total Sales	Direct Export As % of Total Mfg Direct Export
1970	35	11,251	9.3	212.8	5.5	18.9	8.8	2.1	73.9	9.3
1971	49	15,874	11.3	319.0	6.8	20.1	8.9	2.7	84.8	11.3
1972	53	27,270	16.0	616.8	10.8	22.6	10.5	2.9	93.0	16.0
1973	64	39,210	19.7	1,096.8	13.8	28.0	10.8	3.3	92.8	19.7
1974	91	46,247	22.4	1,603.6	12.0	34.7	14.5	3.9	92.4	17.5
1975	95	32,026	16.7	1,457.9	11.6	45.5	14.8	5.2	90.9	16.7
1976	105	43,718	21.1	1,987.8	13.0	45.5	14.6	5.0	91.0	21.1
1977	115	46,441	21.2	2,322.7	13.3	50.0	15.2	5.4	90.6	21.2
1978	135	53,440	21.9	2,821.9	14.3	52.8	16.7	5.6	89.5	21.9
1979	168	66,844	24.8	4,092.7	15.5	61.2	19.1	6.3	86.5	20.2

Source: Singapore, Department of Statistics: Census of Industrial Production, 1970-1979

Note: The classification scheme used in the Census of Industrial Production is based on the Singapore Standard Industrial Classification of All Economic Activities (Revised 1969), which is adapted from the International Standard Industrial Classification (ISIC) of All Economic Activities (Revised 1968) of the United Nations. In order to maintain confidentiality of information of individual establishments, it is occasionally necessary to combine data of two or more industries or industry major groups in the presentation.

[1]The electronics industry covers codes 38211/12, 38321, 38322, 38329.

began in 1976, and by 1979 industry output had grown to S$4 billion (US$2 billion), or 15% of total manufacturing output and 20% of manufactured exports (both second only to petroleum refining). Electronics remains the largest employer in the manufacturing sector, with 66,844 workers, or 25% of the total manufacturing workforce, in 1979. Between 1970 and 1979, output in the industry grew at the average rate of 42% per year, while employment rose at 28% per year. Since 1976, nearly S$1 billion of new capital has been invested in the industry, which remains heavily export-oriented. There are now 200 large and small, domestic and foreign electronics manufacturing firms in Singapore, with at least 120 other firms in supporting industries.[5] Multinationals from the USA, Japan and Europe dominate all sectors of the industry in terms of output, exports, capital investment and employment.

Table 2 presents disaggregated data on the electronics industry. The largest sector in both employment and output is component manufacturing - the manufacture of semiconductors and other electronic components, and communications equipment and apparatus (Industrial Code* 38322 until 1974 and 38329 since 1975). Employment in this sector nearly quadrupled between 1970 and 1974, fell sharply between 1974 and 1975, and since 1975 has been rising, though at a much slower rate than in the early 1970s. The second largest sector comprises firms manufacturing radio and television sets, sound reproducing and recording equipment (Industrial Code 38321). Employment changes in this consumer electronics sector are less dramatic than in the component manufacturing

---

[5] Electronic Firms in Production in Singapore (February 1980), Economic Development Board listing; Singapore Electronics Buyers' Guide 1980/81, published by the Science Council of Singapore, Economic Development Board, and Association of Electronic Industries in Singapore.

*Singapore Standard Industrial Classification of All Economic Activities (Revised 1969).

TABLE 2

PRINCIPAL STATISTICS ON SECTORS ON THE ELECTRONICS INDUSTRY IN SINGAPORE, 1970-1979

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Code 38211/12										
Manufacture and Repair of Data Processing Equipment and Office Machinery, Except Photo-copying Machines										
Number of Establishments	-	-	-	-	10	12	12	9	12	12
Number of Workers	-	-	-	-	3,897	3,427	4,150	3,594	4,887	5,507
Value-Added ($m)	-	-	-	-	120.2	86.1	79.5	114.1	96.5	140.4
Value-Added Per Worker ($'000)	-	-	-	-	30.8	25.1	19.2	31.8	19.7	25.5
Total Sales ($m)	-	-	-	-	220.0	180.0	186.3	213.2	207.5	289.9
Direct Export as Percent of Total Sales ($m)	-	-	-	-	95.8	96.0	94.7	96.9	94.2	95.4
Capital Spending/Employee Remuneration	-	-	-	-	0.67	0.70	0.57	0.50	0.48	0.24
Code 38321										
Manufacture of Radio and Television Sets, Sound Reproducing and Recording Equipment										
Number of Establishments	7	9	11	14	19	22	20	21	23	39
Number of Workers	2,917	3,851	7,245	9,565	11,226	9,995	11,486	13,470	15,165	22,343
Value-Added ($m)	12.2	25.9	56.1	65.3	88.7	104.2	108.4	155.7	170.7	301.5
Value-Added Per Worker ($'000)	4.2	6.7	7.7	6.8	7.9	10.4	9.4	11.6	11.3	13.5
Total Sales ($m)	43.6	80.1	162.0	209.7	323.7	378.7	516.2	597.9	781.5	1,332.7
Direct Export as Percent of Total Sales ($m)	53.0	76.6	88.4	89.5	91.5	89.2	90.0	88.4	89.2	86.4
Capital Spending/Employee Remuneration	-	-	-	-	0.61	0.28	0.24	0.42	0.38	0.48
Code 38322[a]										
Manufacture of Gramophone Records, Radio, Television and Communication Equipment and Apparatus (including semi-conductors n.e.c.)										
Number of Establishments	28	40	42	50	62	5	6	8	11	13
Number of Workers	8,334	12,023	20,025	29,645	31,124	261	298	550	1,004	1,131
Value-Added ($m)	86.9	115.3	230.5	359.4	314.5	3.7	6.1	8.6	15.5	19.5
Value-Added Per Worker ($'000)	10.4	9.6	11.5	12.1	10.1	14.3	20.5	15.6	15.4	17.2
Total Sales ($m)	165.2	235.9	441.9	904.8	1,042.6	11.5	14.4	22.3	42.0	52.5
Direct Export as Percent of Total Sales ($m)	94.8	93.6	94.5	93.5	91.9	46.4	50.0	45.1	20.1	35.5
Capital Spending/Employee Remuneration	-	-	-	-	0.37	0.40	0.97	0.38	0.89	0.41

TABLE 2 (CONT'D)

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Code 38329										
Semi-conductors and Other Electronic Components and Communications Equipment and Apparatus										
Number of Establishments	-	-	-	-	-	56	67	77	89	104
Number of Workers	-	-	-	-	-	18,343	27,784	28,827	32,384	37,863
Value-Added ($m)	-	-	-	-	-	280.9	443.6	426.6	610.6	812.1
Value-Added Per Worker ($'000)	-	-	-	-	-	15.3	16.0	14.8	18.9	21.4
Total Sales ($m)	-	-	-	-	-	864.4	1,304.9	1,465.5	1,769.5	2,264.2
Direct Export as Percent of Total Sales ($m)	-	-	-	-	-	91.2	91.3	91.3	90.7	86.6
Capital Spending/Employee Remuneration	-	-	-	-	-	0.37	0.36	0.41	0.50	0.72
TOTAL										
Number of Establishments	35	49	53	64	91	95	105	115	135	168
Number of Workers	11,251	15,874	27,270	39,210	46,247	32,026	43,718	46,441	53,440	66,844
Value-Added ($m)	99.1	141.1	286.7	424.7	523.5	475.0	637.7	705.0	893.3	1,273.6
Value-Added Per Worker ($'000)	8.8	8.9	10.5	10.8	14.5	14.8	14.6	15.2	16.7	19.1
Total Sales ($m)	208.8	316.0	603.9	1,114.6	1,586.3	1,434.6	2,021.7	2,298.9	2,800.5	3,939.3
Direct Export as Percent of Total Sales	73.9	84.8	93.0	92.8	92.4	90.9	91.0	90.6	89.5	86.5
Capital Spending/Employee Remuneration	-	-	-	-	0.46	0.38	0.36	0.42	0.47	0.60
Electronics Employment as Percentage of Manufacturing* Employment	9.3	11.3	16.0	19.7	17.5	16.7	21.1	21.2	21.9	24.8

[a]For the years 1970-1974, code 38322 includes the manufacture of semi-conductors and other electronic components and communications equipment and apparatus.

*Excluding rubber processing.

Source and Note: As Table 1

sector, with less labour being shed in the 1974-75 recession. Since then, employment in this sector has risen more rapidly than that in the component sector, now amounting to half that in the component sector compared with one-third in 1974. Both sectors export between 85% and 90% of their output. The other two sectors - manufacture of gramaphone records (Industrial Code 38322 since 1975) and data processing equipment and office machinery (Industrial Code 38211/12) - are fairly small.

Between 1968 and 1979, the electronics industry created over 55,000 new jobs or roughly one-third of the employment expansion in Singapore's manufacturing sector. Most of these jobs have been for unskilled or semi-skilled female production operators,[6] who account for 80% of total employment in the industry, compared to 53% of the total manufacturing workforce in 1979. Thus employment creation in the electronics industry in Singapore has contributed more to the rapid increase in the female labour force participation rate, than to the reduction of the predominantly male unemployment problem of the 1960s. The female intensity of employment in this industry has remained fairly constant over time, while average remuneration in the industry has remained about 20% below the average for the manufacturing sector as a whole. Male and skilled workers comprise only a small proportion of workers in electronics.[7]

---

[6] For an analysis of the reasons employers prefer female workers in electronics assembly, see Linda Y.C. Lim, "Women Workers in Multinational Corporations: the Case of the Electronics Industry in Malaysia and Singapore", Michigan Occasional Papers No. IX, Fall 1978, Ann Arbor, Michigan.

[7] A survey in 1977 by the Vocational and Industrial Training Board showed that operatives formed 87% of the workforce in electronics firms, supervisors 3%, technicians and engineers 5%, and other workers 5%.

Besides this direct employment creation, the electronics industry has also generated many new jobs indirectly through the purchase of inputs from both local and foreign-owned supporting industries. It buys 58% of its input locally, 25% from Japan, 9% from Hong Kong and the remaining 8% from other countries including the United States.[8] By one estimate, the number of indirect new manufacturing jobs created by the electronics industry in supporting firms which sell mainly to it is at least 12,000, while if firms in both the manufacturing and service sectors that depend partly on the industry for their sales are included, this figure would exceed 20,000 new jobs indirectly created since 1968.[9]

But though it has directly and indirectly created probably over 75,000 new jobs and buys over half its material inputs locally, the Singapore electronics industry, dominated by multinational firms, has not developed many linkages with locally-owned supporting firms. A significant proportion of locally-bought inputs are purchased from foreign-owned subsidiaries in Singapore, set up by American and Japanese multinationals to supply parts to their subsidiaries and other customers in Singapore and neighbouring countries. Other inputs are purchased locally from traders, dealers and agents of foreign manufacturers who import them from abroad. Inputs produced in Singapore by locally-owned supporting firms are often not competitive in price, range, quality and delivery with imported inputs or inputs manufactured by foreign subsidiaries: this is because of the smaller scale and shorter industrial experience

---

[8] Applied Research Corporation, Singapore, A Study of Electronics Supporting Industries, preliminary report, mimeographed, August 1979.

[9] Pang Eng Fong and Augustine Tan, op. cit., pp. 15-16.

of local firms. However, the market for domestic inputs is growing as the electronics industry becomes more integrated locally, and with financial support from the Economic Development Board and technical assistance from multinational customers, local supporting firms are likely to develop further.

Now a major regional and world manufacturing centre for the international industry, the electronics industry in Singapore has undergone many changes in recent years. Labour-intensive operations still predominate, and productivity as measured by value-added per worker is still lower than the average for the manufacturing sector as a whole. But rapid growth and the very high rate of employment creation in this export-oriented industry have contributed to the tightening of the labour market and rising wages through the 1970s. Average remuneration per employee has quintupled since 1968, though it remains below the manufacturing average. Wage increases were particularly large in 1973 and 1974, and in 1979, following National Wages Council guidelines of double-digit percentage increases. Employment growth in the industry in the late 1970s has been slowed both by a serious shortage of female workers, necessitating the import of foreign workers, and by rising wage levels.

Labour productivity has been increasing at 4% a year since 1975 (when labour productivity rose sharply because of the large fall in employment caused by the recession). Value-added per worker more than doubled in ten years. As shown in Table 2, component manufacturing firms, which are generally more capital-intensive, generate higher value-added per worker than firms producing consumer electronics products. Over the years, the electronics industry in Singapore, led

by the multinationals, has been upgrading its activities into higher-value, more skill- and capital-intensive, technologically complex products and processes. In the last few years, both local and foreign electronics manufacturers have begun transferring labour-intensive assembly activities out of Singapore, where their comparative advantage has been declining, to Malaysia and other neighbouring countries. Processes remaining in Singapore have been increasingly automated and mechanised, while newer, higher-value products have been introduced, both of them more in response to world product market competition than to local labour market forces.

A few of the larger multinationals have invested heavily in local product design and development engineering, but research and technology are still largely acquired from foreign parent companies. A major new development in the semiconductor industry in 1981 is the announced investment of two multinationals - Texas Instruments and SGS/Ates - in local wafer fabrication, the very heavy, capital- and technology-intensive "front end" of semiconductor manufacture.

Changes in the electronics industry have paralleled changes in the Singapore manufacturing sector in general. Wages and productivity in electronics, though they have risen considerably in absolute terms, have remained since 1975 at 81% to 85% of the total manufacturing averages. The capital-labour ratio (as crudely measured by the ratio of capital to labour expenditures) rose from .38 to .60 in electronics between 1975 and 1979, and from .52 to .68 in all manufacturing. In 1979, the capital-labour ratio in the semiconductor sector was .72, higher than the average for all manufacturing. Thus while electronics in general remains less capital-intensive than the

manufacturing sector as a whole, the differential is fast narrowing.

VI. TECHNOLOGY, EMPLOYMENT AND LINKAGES: THE EXPERIENCES OF THREE MULTINATIONAL ENTERPRISES

1. Profile of Firms

We will analyse and compare the practices with respect to technology choice and employment creation of three electronics MNEs of different nationalities. All three manufacturing subsidiaries have been established in Singapore from 8 to 13 years, and all have been previously interviewed by us, in 1976 and 1979. Thus we can follow their experiences through a period full of changes in both the international industry and the host country environment. The firms are among the largest in the Singapore electronics industry, together accounting for some 15% of total electronics employment, and are all subsidiaries of leading multinationals in the international industry. Besides being acknowledged leaders in the Singapore industry, they are also favourably regarded by government agencies and other observers as good corporate citizens and valued contributors to the Singapore economy.

Company A is the subsidiary of a major American semi-conductor manufacturer which also has subsidiaries in all the other Southeast Asian countries. It has the largest sales value and machinery and equipment investment, but the smallest total employment, of the three firms (see Table 3). Company B is the subsidiary of a major European consumer electronics multinational which has several factories in Singapore: we are concerned here only with the consumer electronics divisions which account for the bulk of the company's local output and

TABLE 3

COMPARATIVE COMPANY INDICES ON TECHNOLOGY AND PRODUCTIVITY, 1980

	Company A	Company B	Company C
Size			
Sales Value (Q) S$m	760.0	454.6	238.2
Machinery and Equipment (K) S$m	40.7	26.3	12.5
Total Employees (L)	2,736	4,089	2,761
Technology			
Capital Stock Per Worker (K/L) S$'000	14.9	6.4	4.5
Capital Expenditures Per Worker (R/L) S$'000	12.3	5.5	2.1
Output-Capital Ratio (Q/K) S$	18.7	17.3	19.1
Ratio of Capital to Labour Expenditures (R/W)	.71[a]	.58	.35
Productivity			
Output Per Worker (Q/L) S$'000	277.8	111.2	86.3
Value-Added Per Worker (VA/L) S$'000	136.4	88.7	19.6
Average Remuneration Per Worker (W/L) S$'000	10.1	9.6	6.0

Source: Annual company returns for the Singapore, Department of Statistics, Census of Industrial Production, 1980

Notes: Q = Output, measured by sales value (annual)

K = Machinery and equipment, valued at cost, end of year

L = Total employees, mid-year

R = Total capital expenditure, sum of new capital expenditure plus depreciation (annual)

W = Total remuneration, including all benefits (annual)

VA = Value added, measured by sales value less inputs consumed (annual)

[a]1979 figure.

employment. Company B is the largest employer of the three firms. Company C is the largest of several Singapore subsidiaries of a giant Japanese conglomerate: consumer electronics products accounted for 85% of its output and employment in 1979, and will soon account for nearly 100%. All three firms export over 90% of their Singapore output.

Table 3 compares the three firms by various indices on technology and labour productivity in 1980. Company A, the American semiconductor manufacturer, is the most capital-intensive by most indicators, with capital stock per worker, capital expenditures per worker, and the ratio of annual capital to labour expenditures all two to three times larger than those of the two consumer product firms. Labour productivity, as measured by output per worker and value-added per worker, and average remuneration per worker, are also higher. This conforms to the industry-wide data presented in Table 2, which show that component manufacturing firms, including semiconductor firms, are more capital-intensive and have higher labour productivity than consumer product firms.

Among the two consumer electronics firms, Company C, the Japanese firm, which is less capital-intensive than Company B, the European firm, in terms of output-capital ratio, capital stock per worker, capital expenditures per worker, and the ratio of capital to labour expenditures, also has a lower labour productivity in terms of output per worker and value-added per worker.

2. The Experiences of An American MNE (Company A)

a. Activities and performance

Company A is the subsidiary of one of the largest semiconductor companies in the world, headquartered in the U.S. but with virtually all its assembly manufacturing done overseas, especially in Asia. Offshore assembly was started in the late 1960s as part of the company's strategy of aggressive competition to establish itself as a leader in the industry. The parent company provides all R and D, technical back-up and the heavy capital-intensive end of products such as front-end wafer fabrication. It was attracted to Singapore in the late 1960s by low production costs afforded by the availability of cheap labour and tax incentives like Pioneer Certificate and Export Enterprise tax exemption. The parent company was described as being "always on the lookout for new locations offering cheaper labour and tax holidays", and after Singapore, new plants were established in all the other ASEAN countries and further afield, with Singapore serving as the regional headquarters. Rapid growth in the industry created the demand for more and more assembly capacity.

By 1976, the multinational was already practising a division of technology and products among its offshore plants. The Singapore plant handled three product lines: 1) hermetic chips, metal can linear integrated circuits, and hybrids, which were only manufactured in Singapore, 2) watch and calculator modules and finished modules - the parent company had then just entered the consumer electronics field hoping to benefit from the higher value-added of final products, 3) final

testing of 4-K random access memories (RAM). Singapore also served as the multinational's regional headquarters, providing centralised financing and shipping services for all the Southeast Asian plants. Sixty percent of its exports went directly to U.S. customers, the rest mostly to Europe.

By 1976, company A's Pioneer tax holiday had expired. Although there were complaints about the high cost and difficulty of hiring labour during the industry's period of recovery, the company then had 3,000 workers, exceeding its pre-recession peak, and double the 1,500 employed at the depths of the recession in 1975. It prided itself on having avoided heavy losses in the recession by quick retrenchment, but it also earned a "bad reputation" as an unstable employer. Labour turnover was low except in periods of new hiring, because the company paid the second highest operator wages in the industry. Because labour costs in Singapore were the highest in Southeast Asia, higher-value products were located here. With the introduction of testing facilities, labour-intensity of the plant's operations declined.

Three years later, in 1979, the Singapore plant was still considered "labour-intensive", but it was slightly more capital-intensive than the other Southeast Asian plants and had a level of technology "several years ahead" of them. The same integrated circuits were being manufactured as in 1976, with the addition of LCD modules. But watch modules and finished LED watches and calculators had been dropped - they were first moved to a plant in Malaysia, but then the parent company dropped out of the consumer business entirely due to fierce Japanese competition. Testing activities had been expanded,

with the Singapore plant testing all locally-made circuits and the more advanced circuits manufactured elsewhere in the region. Labour-intensive products were being progressively shipped out to neighbouring areas of cheaper labour, while high-reliability and LSI circuits for military and industrial uses were being shipped to Singapore because of its high wages and increasing levels of production skill and expertise. In addition to centralised financing and shipping for the region, in 1977 centralised purchasing for the regional plants was introduced in Singapore.

b. Employment and technology

Employment had declined from 3,000 in 1976 to 2,400 in 1979, as part of a declared company policy to reduce the workforce through extensive and intensive automation, revision of work methods, and the shifting out of labour-intensive operations. Even so the company was short of 150 workers, and was paying great attention to reducing its already low labour turnover, and to new hiring incentives such as the offering of monetary rewards to workers who introduced their friends to the plant. Earlier strict educational requirements and dexterity tests for operators had been abandoned, because "the (labour market) situation is so bad that anyone with two hands will do". Still, worker productivity in terms of output per unit time was considered higher than that in the U.S. Three rotating shifts are worked.

The direct to indirect labour ratio had declined from 4:1 in 1976 to 2.5:1 in 1981. Adjustment to conditions in the Singapore labour market included the following examples of automation.

1) There was a shift from manual to mechanical stamping of integrated

circuit carrier cans, with one girl working on three machines producing the output per unit time of 50 girls. 2) Manual bonding continued, but the company had just bought automatic Japanese bonding machines which were eight times faster and ten times more accurate. About half of all equipment in use in the plant was automated. All R and D continued to be done in the U.S., but as in 1976, all production engineering was handled by local engineers.

In 1981, assembly of hybrids, a parent company specialty continues in Singapore. Testing of simpler integrated circuits's has moved out, and testing of more complex linear integrated circuits and memories like the 16-K RAM and high-reliability military products now accounts for more than half of the total value produced by the Singapore plant, which is the only one doing such testing outside of the U.S. The company's role as the central purchasing and warehousing station for the region has become more important. Backward integration into wafer sorting and scribing - "the first stage of the front end of semiconductor manufacture" - has just begun, but there are no plans to introduce wafer fabrication, because of the lack of a local market, and human and raw material resources. The U.S. is still the major market for the plant's output, followed by Europe, but about 5% of exports are now going to the Asian region, including Japan. At the time of interview (in March 1981), the market and output were "flat" but labour was being fully utilised.

Employment was down to 2,200, and no new hiring was being carried out. The company pays the highest wages in the industry, and productivity has been increasing with new machines and an increase in

skills. The direct to indirect labour ratio is now nearly 1:1. All testing is automatic, but in assembly, some manual lead-bonding continues because of the shift in product mix from simple standardised operations and products to complex, custom-made, more expensive products. New products and processes are transferred to Singapore within a year of their development in the U.S., and because of economies of scale, the same technology is used in all locations for a given product. Product life-cycles are short (2 to 3 years), so local engineers visit the parent company frequently to observe new trial production which they then adapt to mass production in Singapore. There are 40 test engineers and 10 assembly engineers, and a few more are needed. As early as 1976, there have been only two or three American expatriates employed in the plant, in management functions.

The trend to increasing capital-intensity and declining labour use is verified by the data in Table 4. Between 1977 and 1980, company A's output nearly tripled, but employment declined about 25% from the 1976 peak of 3,000 workers. Output and value-added per worker increased about 2½ times, while wages nearly doubled. Capital stock (machinery and equipment in use) per worker tripled, while capital expenditures per worker increased nine times in the four years. The output-capital ratio declined, and the ratio of capital to labour expenditures rose from 24% to about 75%. Together with the decline in the ratio of direct to indirect labour from roughly 4:1 to nearly 1:1, the proportion of female workers employed fell from 88% in 1977 to 75% in 1980.

This rise in capital-intensity is due to two major factors:

TABLE 4

COMPANY A: KEY INDICATORS, 1977–1980

	1977	1978	1979	1980
Size				
Sales Value (Q) S$m	270.3	454.2	446.9	760.0*
Machinery and Equipment (K) S$m	12.6	16.0	30.5	40.7
Total Employees (L) Mid-Year	2,502	2,689	2,449	2,736
End Year	2,523	2,584	2,693	2,131
Technology				
Capital Stock Per Worker (K/L) S$'000	5.0	6.0	12.4	14.9
Capital Expenditure Per Worker (R/L) S$'000	1.4	3.8	6.0	12.3
Output-Capital Ratio (Q/K) S$	21.5	28.4	14.7	18.7
Ratio of Capital To Labour Expenditures (R/W)	.24	.73	.71	1.2*
Productivity				
Output Per Worker (Q/L) S$'000	108.0	168.9	182.5	277.8*
Value-Added Per Worker (VA/L) S$'000	64.6	121.2	136.4	241.2*
Average Remuneration Per Worker (W/L) S$'000	5.6	5.2	8.4	10.1*

Source: Company annual returns for the Census of Industrial Production, 1977–1980.

Notes: See Notes to Table 3.

*Estimated from interview data.

1) The shift in product-mix in the Singapore plant from labour-intensive to capital-intensive products, 2) The shift from manual to automated processes, such as automatic bonding and testing. Of these, the first is probably more important, since technology tends to be product-specific. Since the parent company is a multinational operating plants in many different countries, it distributes its product lines among them according to local labour market and skill conditions.

Thus rather than technologies being adapted or varied to suit local factor endowments and relative prices, it is the technologically-fixed labour-intensity of a product that determines where it is produced. Choice of technology for a particular location is determined by the choice of product for that location, which in turn is influenced by local labour market conditions, as well as by world market demand for that product. Company A began adjusting product and technology choice to Singapore's tightening local labour market <u>before</u> the introduction of the government's wage correction policy in 1979 - a policy that this firm believes has already pushed wages above their market levels. It is also likely that automation was motivated more by the need to compete with Japanese semiconductors, which are more reliable because they are produced by automated assembly facilities. Company A's parent company in the U.S. is reported to have spent about US$150 million "to reduce human error by automating assembly lines in Southeast Asia and switching to computer-controlled manufacture in a Texas plant".[10] Automation alone, however, does not make it economic to shift assembly back to the U.S.

---

[10] <u>Wall Street Journal</u>, 7 November 1980.

The data in Table 4 suggest that the secular trend of increasing capital and decreasing labour use is overlaid by cyclical fluctuations. While capital investment is "lumpy" and often lagged in its effect, output can be increased in the short run by increasing employment and continuing with labour-intensive manual production methods which still co-exist alongside automation. In a tight labour market, employers may also be tempted to "hoard" labour especially under volatile market conditions such as characterise the electronics industry. This probably explains the bulge in employment between 1979 and 1980, a boom period for the industry, with subsequent attrition and retrenchment towards the end of 1980 as the market stabilises and earlier than planned investments in capital equipment become functional.

c. Vertical linkages

While total direct employment in Company A fell by nearly 30% between 1976 and 1981 as technology became more capital-intensive, indirect employment creation rose. Total remuneration for employees more than doubled in nominal terms during the five years, and increased in real terms, suggesting a greater multiplier effect from expenditure out of the income created. More importantly, the company's local input purchases increased, especially after the centralising of regional purchasing in Singapore in 1977. This move was made both to save freight costs from the U.S. by locating purchasing closer to production centres in Southeast Asia, and to take advantage of lower labour costs here. The proportion of inputs locally purchased by Company A and its sister plants in Southeast Asia has increased through

buying more inputs locally and transferring the production of more inputs to the region. Such local purchases are planned to increase by 20% to 30% per year.

Indirect employment creation by the Singapore plant is difficult to estimate. The value of local purchases for this plant rose from S$9.6m in 1977 to S$48m per year in 1980, a five-fold increase. There are now more than 200 local suppliers, including trading agents, outlets of overseas manufacturers, and local manufacturers. A few of the larger suppliers have about 100 employees each, but many - as in carpentry, tooling and stationery - employ only five or six people. Not all of these employees work on contracts for Company A, whose purchasing policy is not to account for more than 30% to 40% of the business of any one supplier, and to have at least two suppliers for any item - which is not always possible. About 30% of all inputs purchased locally are imported, while about 70% undergo some degree of local processing or manufacture.

A further problem in estimating indirect employment creation by the Singapore plant alone is presented by central purchasing. Part or all of some locally sourced inputs go not to the Singapore plant but to the other plants in the region. However, if centralised purchasing is viewed as a specific function of the Singapore company, then all local employment created by local purchases represents indirect employment creation by it. In any case, fixed costs and economies of scale mean that indirect employment creation may not vary much whether or not non-Singapore plant purchases are included. Only if the other plants in the region have different input requirements from the Singapore plant is

additional employment generated in Singapore that would not have existed without centralised purchasing.

Only one of Company A's local suppliers employs as many as 100 workers on its contracts, and depends almost entirely on the company for its business. Two other firms employ between 20 and 30 workers each on Company A contracts. For the rest of the local suppliers, a handful or fewer workers are employed on Company A contracts, though the company is the largest local purchaser in the semiconductor industry. If we estimate that on average each of the 200 local suppliers employs five workers on Company A contracts - for most of them, an over-estimate - total indirect employment generated would be 1,000. This represents a direct:indirect employment creation ratio of 2.2:1, which is likely to decrease with more local purchases over time.

Many of the local suppliers of Company A are agents or subsidiaries of foreign-owned manufacturing companies. Of its top ten suppliers by value of purchases, only four are local Singaporean firms, the others being subsidiaries of Japanese, American or European companies. Nevertheless, Company A makes an effort to stimulate and support locally-owned firms. Its largest local supplier is a local plastics manufacturer which Company A encouraged to invest "a large sum of money" in producing a plastic part designed by a local engineer for the company, in return for its guaranteed business. Company A also helps local businessmen to start up agencies for foreign manufacturers e.g. by recommending them, and otherwise helps to develop local suppliers. It assists its own supporting industries with detailed specifications and technical write-ups for parts, occasional expert help from the U.S., and with quality control.

3. The Experiences of A European MNE (Company B)

a. Activities and performance

Company B is the local consumer electronics subsidiary of a European multinational manufacturer of electrical and electronic products. It was established in Singapore in 1970 as part of the parent company's global strategy to geographically diversify manufacturing plants to supply the world market. The availability of cheap labour was only one of the factors that attracted the parent to Singapore, others being generous Pioneer and Export Enterprise tax holidays, and good infrastructure. Products and processes initially located in Singapore were two to three times more labour-intensive than operations in the parent company. Radios, monochrome TV sets, and cassette tape decks were manufactured for export, mainly to EEC markets.

Company B expanded and diversified its operations in Singapore throughout the 1970s, notwithstanding the 1975 recession, which did not affect it, and a growing local labour shortage. In the latter 1970s, new product lines were introduced in response to growing market demand; some were more technologically sophisticated, high-value products, like colour TVs and stereo cassette recorders, while others were simple, labour-intensive products like clock radios and car audio equipment. Market demand also determined the phasing out of other products like reel-tape radio recorders. Monochrome TV production was scheduled for phasing out, but is being temporarily sustained by large orders from the People's Republic of China. Beginning in 1980, some of the more labour-intensive products, mainly pocket radios, are being transferred

to a new manufacturing plant in Malaysia.

b. Employment and technology

Meanwhile, employment has been growing steadily; there was no retrenchment during the 1975 recession. At the time of interview in 1981, employment was over 4,000 workers, with vacancies for a few hundred more. Female production workers are scarce, though the company claims to pay "above average" wages (but below American rates) for the electronics industry, and only one shift is worked. Turnover rates are very high among newly hired workers. Over time, educational requirements for workers have been reduced from mid-secondary to lower-primary level, and even literacy is no longer necessary. Tests which used to be conducted on job applicants, such as dexterity tests, have been completely dropped. The majority of female production workers are still young, below the age of 30, but an increasing proportion, now close to one-quarter, are married. Although wages have risen, especially with recent large National Wages Council (NWC) increases, they are still only one-sixth of wages in Europe, and constitute only a small proportion - less than 20% - of total production costs. The personnel manager believes that the NWC stabilises wages and that without it a wage war would result leading to a sharp rise in wages, since "the ability of MNEs to pay higher wages is not in question".

Automation has been introduced, for example in the full or partial mechanisation of assembly functions like soldering, cutting, testing, insertion and inspection, but this has been motivated largely by the need to improve quality for competitive reasons. Automation reduces

human error and reject rates, thereby increasing productivity and product performance. The reduction of manual labour content to save labour costs is only a secondary reason. Indeed, automation may well increase production costs. For example, mechanisation is sometimes carried out "to get rid of monotonous tasks and those with a high accident rate", and in tasks where turnover of workers is very high, even if the cost is unjustified by existing or projected wage rates.

The parent company has some fully automated machines in use in Europe which have not yet been introduced into Singapore. The transfer of more product lines to Singapore is hampered by political factors in Europe, specifically by union resistance to employment reduction even in "absolutely unprofitable" European plants, and to industrial restructuring involving the relocation of production to Asia.

Since Singapore is the major production centre for the parent company's audio division, all designing and development of audio equipment for the parent is done here,[11] and then applied in the local plant and other manufacturing plants in Asia. Recently two new stereo products were developed locally, embodying microprocessor technology. Some design and development is also done of video products, though the main video R and D unit is located in Europe. Expansion is planned for the local design and development team which already numbers some 150 persons, and has a budget totalling 7% of turnover.[12] Most of the design

---

[11] There is also a counter-tendency in the industry to locate R and D facilities close to the final market. While this market is primarily in the Western nations, the company expects the Asian regional market to become more prominent as automation and relocation progressively increase unemployment and reduce the market in Europe, and market growth continues in Asia.

[12] This includes R and D for an electrical appliances division in Singapore as well as the consumer electronics divisions.

engineers are locals who have been trained by the company in the parent country or locally by parent company expatriates. In 1980 the company invested $25m in a new building to house the R and D division and manufacturing facilities to produce CKD (completely knocked down) TV kits for export to assembly plants in other developing countries.

Changes in technology and employment are shown in Table 5. Between 1976 and 1980, output increased six-fold, while employment grew by 73%. Output per worker increased three and a half times, total remuneration increased 2.7 times, and average wages per worker rose by 50% over the five years. The proportion of female workers fell slightly from 81% to 78%, and the ratio of direct to indirect labour also fell slightly to about 3.3:1. Machinery and equipment per worker tripled, but the output-capital ratio fluctuated from year to year with a slightly rising trend. Capital expenditures per worker more than tripled, if expenditures on the new building completed in 1980 are included. The ratio of capital to labour expenditures more than doubled if the building expenditures are included, but rose only slightly (from .26 to .28) if they are not. In general, despite cyclical fluctuations, there has been a slight tendency to increased capital-intensity, most of it during 1980 when new automatic equipment was introduced, and the new video factory building completed.

The introduction of more capital-intensive products and processes in Company B has been accompanied by increased employment and rising labour productivity. This is because of the growth in market demand and the corresponding larger scale of production. Higher-value products, and automation, have been introduced in Singapore in response

TABLE 5

COMPANY B: KEY INDICATORS, 1976–1980

	1976	1977	1978	1979	1980
Size					
Q S$m	75.0	164.8	196.5	337.8	454.6
K S$m	4.9	9.6	14.3	18.6	26.3
L Mid-Year	2,363	2,773	3,594	4,307	4,089
End Year	2,877	2,790	3,594	4,240	4,326
Technology					
K/L S$'000	2.1	3.5	4.0	4.3	6.4
R/L S$'000	n.a.	1.7	1.2	2.0	5.5
Q/K S$	15.3	17.2	13.7	18.2	17.3
R/W	n.a.	.26	.22	.28	.58
Productivity					
Q/L S$'000	31.8	59.4	54.7	78.4	111.2
VA/L S$'000	n.a.	15.0	11.0	24.2	88.7
W/L S$'000	6.2	6.5	5.4	6.9	9.6

Source and notes same as Table 4

to world market factors such as changing consumer preferences and competition based on product quality and performance, rather than in response to rising local labour costs. Indeed, until the introduction of the Singapore government's high-wage policy and large NWC wage increases beginning in 1979, average wages were fairly stable in this company, probably due to large new recruitments. Because of the low level of wages, and the small proportion they form of total costs, the company had no difficulty absorbing the 1979 and 1980 NWC raises, and will probably have no difficulty absorbing an equally large increase in 1981. It complains about the "second-tier" NWC payment of merit increases to "above average" workers, which supplants the company's own established internal merit reward system, and has demoralised workers and increased quit rates. The competitiveness of exports from the Singapore plants is not threatened by increased wage costs but rather by the rapidly appreciating exchange rate for the Singapore dollar and inflation in other local costs, particularly housing costs and overheads.

c. Vertical linkages

As direct employment by Company B has increased, so has indirect employment creation, both from the multiplier effect of expenditure out of wage incomes of additional workers, and from the increase in local purchases of material inputs. The established policy of the parent company is to "do for itself only what others cannot do". It tries to buy as many of its parts as possible from external suppliers, though it also makes purchases from internal suppliers or sister plants,

and backward integrates to manufacture parts for which technology is proprietary or suitable external suppliers cannot be found. In every country, the parent company tries to buy as much as possible of its external supplies locally, even at initial price premiums. Convenience and cost are reasons for preferring suppliers located close to the production point.

In Singapore, Company B actively helps to set up and develop local supporting industries. Firms are encouraged to start supplying to the company by promises of guaranteed sales, and by technical help including training and advice by local and expatriate engineers and others specially flown out from Europe. Years of training are invested in some suppliers to help them reach the required standards. When new products and materials are introduced, the suppliers have to be retrained. Financial assistance is sometimes given e.g. for one supplier, by partially deducting the cost of a machine from deliveries over five years. Or, the company itself buys the machines and hires them out to the supplier. The company also recommends satisfactory local suppliers to other regional sister plants, and introduces and recommends them to new customers, including buyers in Europe, which helps them to expand their export markets. The suppliers' success benefits the company itself because it ensures that its suppliers are more viable, less dependent on it, and perhaps can produce cheaper inputs because of economies of scale. It also encourages them to upgrade, integrate and automate their activities.

In 1975, the company already had 180 suppliers and subcontractors in Singapore. By 1981, it was purchasing 25% of its external supplies locally, a total of 8,000 items costing $75m a year,

from 440 suppliers. Most of these inputs go to the consumer electronics division. The company prefers not to account for more than 30% of any particular supplier's business, but in some products it has to buy more. About 100 of the 440 companies themselves subcontract to other companies, with the buyer's permission. The company estimates that more than 3,000 persons are indirectly employed by it in supplier companies, about 80% or some 2,500 producing inputs for the consumer electronics division. Despite its preference for locally-owned companies, only four of the top eight suppliers are local, the rest being subsidiaries of foreign companies manufacturing parts in which the technology is too sophisticated, the capital investment too high and/or the scale of production too large for local companies. Supply and quality problems with local suppliers are often caused by the high turnover of skilled workers and technicians they employ.

4. The Experiences of A Japanese MNE (Company C)

a. Activities and performance

Company C is the largest overseas consumer manufacturing subsidiary of a multinational Japanese conglomerate. It was established in Singapore in the early 1970s as an export base for the parent company, particularly to take advantage of GSP tariff preference in European markets, and to make use of the cheap, productive labour locally available. Both these attractions have since disappeared. Consumer electronic products account for the bulk (85%) of the company's production and will account for even more when two other local divisions are completely phased out

by 1982. 92% of output is exported, most of it to the U.S.A. and to Europe, where it faces some protectionist moves. Company C operates as a "profit centre" of the parent company, and makes its own production and financing decisions, though it relies entirely on the parent for technology and for the forwarding of most customer orders.

In it first few years of operation, Company C faced stagnant export markets because of the 1974/75 recession, subsequent market restrictions on its exports of TV sets to the U.K. and U.S.A., and the loss of GSP in several markets. In the late 1970s, market demand expanded and with it the firm's production capacity. This was due to large monochrome TV orders from the People's Republic of China, and to the introduction of new products with strong new market demand. Current production strategy involves a transfer of production lines out of and into the Singapore plant. Simpler, more labour-intensive products like radios and clock radios have been phased out, and electronic components, which embody proprietary technology but are labour-intensive, are being moved to a new export-oriented plant in Malaysia. More high-value products, like stereo cassette recorders, are being transferred to Singapore as a response to severe price and cost competition among Japanese manufacturers world-wide. There will also be greater concentration of production on fewer items in order to achieve greater economies of scale and minimise problems posed by local manpower shortages. Because it is operating at capacity, the firm has refused parent company requests to start production of new "three-in-one" music centres which are the latest products in the audio consumer market. Capacity is being expanded at sister plants in Malaysia and the U.S.A., but not in Singapore.

b. Employment and technology

Employment has increased from 1,200 in 1976, after the recession during which there was no retrenchment, to 2,600 at the time of interview in 1981 with fifty vacancies for production workers. This is down from a peak of 2,800 in 1980. There are two weekly rotating day shifts, and a permanent night shift. Capacity employment is about 2,500, so the firm hopes to maintain its existing workforce and achieve further increases in output through new machinery and increased productivity. Labour released from the two divisions being phased out will be redeployed in the expanding audio and video divisions. About half the production workers have been with the company for more than two years, and form a stable workforce, but turnover rates are very high for newly hired workers. All the production workers are young females, mostly unmarried, and mostly from the surrounding residential new town and resettlement area. They are expected to have completed primary schooling but usually have no working experience. Wage changes follow closely NWC guidelines. Wage levels are acknowledged to be "on the low side" for the national labour market. Labour costs constitute 10% of the value of the plant's output.

The Singapore plant was and is still more labour-intensive than the parent company's factories in Japan, but this is due mainly to the product lines it carries. Products requiring more automated methods are usually produced in Japan because labour there is more expensive, about double the wages of Singapore labour. Capital-intensity is also higher in Japanese plants because many labour-intensive parts and processes are subcontracted to other firms, whereas in Singapore

the lack of supporting industry requires the plant to manufacture and perform many of these jobs itself in-house. The shift to Singapore of more sophisticated products, and the development of local supporting industries, should increase the capital-intensity of the Singapore plant over time.

Because of competitive market pressures, new products and designs are introduced as quickly as possible, with trial production being carried out in Singapore as soon as the new design is completed in Japan. New products often require new machinery. Automation has been introduced into many assembly processes in recent years - these include automatic soldering (but some manual soldering still continues), component insertion, cutting and, most recently, inspection and alignment. The aim of automation is to improve quality for competitive reasons, particularly to minimise the reject rates from manual operations, which are high for the inexperienced operators who predominate in periods of expansion and high turnover. Automation also saves labour: for example, ten automatic insertion machines introduced in 1980 substitute for 50 workers each, or a total 500 workers. The same machines introduced into Singapore have also been introduced into a sister company in the U.S.A. which manufactures the same consumer electronics products as Company C. Productivity, which is determined mainly by the machinery and designs in use, has been increasing at about 5% per year and is now about 75% to 80% of the Japanese level.

Company C is completely dependent on its Japanese parent for technology. There are about ten expatriate engineers in the plant, and others come from Japan to help set up new products and processes.

A design group was started in the Singapore plant in 1977, but the local engineers sent for training at the parent company to run it have since resigned and new ones have to be trained.

The data in Table 6 cover too short a period - only 3 years - to show a reliable secular trend. The company's output doubled during this period, and employment increased by 60%. Output and value-added per worker also increased. But despite the introduction of higher value products and automation, all the indices in Table 6 show a declining capital-intensity of production during this period. Machinery and equipment per worker fell by 80%, and total capital expenditure increased only slightly, by 23%. The output-capital ratio more than doubled, and the ratio of capital to labour expenditures declined. Wages increased only by 30% despite the mandated NWC increases of 40% per year from 1979. These figures are explained by the very large increase in employment over the period, overwhelming the increase in capital spending. New machinery and equipment employed in the consumer electronics divisions was partly offset by the reduction of machinery and equipment in the two other divisions being phased out. Because of the large number of new workers, average wages were held down.

Production, technology and employment in Company C are determined largely by product market considerations, some of which may be short-term. For example, the China market, which sustains the bulk of the black-and-white TV production, originally scheduled to be phased out, is uncertain. The parent company has established a subsidiary in China itself to handle part of all future demand. Long-run market prospects are not strong enough to warrant capacity expansion which is

TABLE 6

COMPANY C: KEY INDICATORS 1978–1980

	1978	1979	1980
Size			
Q S$m	121.0	188.5	238.2
K S$m	13.9	12.5	12.5
L Mid-Year	1,721	2,673	2,761
End Year	2,319	2,828	2,761
Technology			
K/L S$'000	8.1	4.7	4.5
R/L S$'000	2.7	2.5	2.1
Q/K S$	8.7	15.1	19.1
R/W	.59	.55	.35
Productivity			
Q/L S$'000	70.3	70.5	86.3
VA/L S$'000	4.7	14.8	19.6
W/L S$'000	4.6	4.5	6.0

Source and notes same as Table 4.

going on in other overseas subsidiaries of the parent company. The firm is expanding production of its traditional products - black-and-white and colour TVs - and some new ones, for example, stereo cassette recorders, by increasing employment and redeploying labour from other profitable divisions which are being phased out for competitive reasons. But the newest audio consumer product - the music centre - is not being introduced because of lack of capacity. The lack of local designing capacity, and a shortage of engineering and skilled personnel now limit further technological upgrading. Though there has been substantial automation, employment is maximised subject to the constraints of plant capacity and the tight local labour market. Subsequent increases in output are to be achieved by increased machinery rather than labour inputs, and by greater productivity. It is likely that the parent company's global strategy has shifted to locating overseas plants in final markets - such as the U.S.A. and China - making further capacity expansion in Singapore unlikely.

c. Vertical linkages

Indirect employment creation by Company C has increased over the years, especially with the development of local supporting industries. In 1980 the company purchased $144m worth of inputs locally from over 100 suppliers - about 70% to 80% of its input requirements. Data from the 24 major manufacturing suppliers - including three sister companies in Singapore - indicate that Company C contracts account for the employment of about 1,200 workers in these firms alone. Other suppliers are mostly trading firms and import agents, so the total

secondary employment creation through the company's local purchases is probably about 1,400. When Company C was first set up, many of its Japanese suppliers also came to Singapore to continue supplying it locally. Japanese firms are preferred suppliers because of their technology, quality, and reliability. Sixteen of the 24 major manufacturing suppliers are Japanese firms and only four are local; of the six firms which rely on Company C for most or all of their business, five are foreign (including four Japanese) and one local. Suppliers make parts according to the company's specifications and drawings, and the company sends teams out regularly to check on their quality.

VII. TECHNOLOGY CHOICE AND EMPLOYMENT CREATION: THE THREE COMPANIES COMPARED

A. Determinants of Technology Choice

The three companies share certain characteristics by virtue of belonging to the same industry. The international electronics industry is perhaps unmatched in the manufacturing sector for its dynamic growth and rapid rate of technological innovation. The parent companies located subsidiaries in Singapore in the late 1960s and early 1970s as part of the trend of multinationalisation in the industry. They were attracted by a combination of cheap labour, good local infrastructure, and tax and tariff incentives such as Pioneer Status and GSP. All the companies are export-oriented: Company A is an offshore plant producing intermediate components mainly for export to the parent company in the home country, while Company B and Company C are export bases for their parent companies, producing consumer products for export to world markets

in third countries.

All three parent companies practise an international division of labour amongst their various plants in different countries, with different technology, capital- and skill-intensities in each location. The Singapore plants originated as production bases for labour-intensive products and processes, but have since been progressively upgraded to occupy an intermediate position in each multinational's international hierarchy. In all three cases this has occurred in two ways: the shift of product lines away from labour-intensive and towards more sophisticated, higher-value products, and the introduction of automated methods of production. The increase in capital-intensity has been greatest in the dynamic, technology-intensive semiconductor sector, and less so in consumer electronics where an essentially mature and standard technology is in use for established products.

1. Product Market

The major determinant of the nature of technology employed in each of the three companies is the product market. The choice or allocation of product line determines the product-specific technology to be used, while the size of the market determines the scale of production and also the technology: for example, automation is more feasible for large volumes of standardised products, while manual processes may be necessary for small batches of customised products. The choice of automated techniques where manual techniques exist and have been used is motivated mainly by the better quality and performance yielded by the former, and only secondarily by cost, including labour cost, factors.

In the highly competitive product markets for both semiconductors and consumer electronic products, quality and reliability of product are more important for market success than marginal cost or price differentials.

2. Labour Market

The choice or allocation of product lines between locations, which determines the technologies employed, depends on local labour market conditions, and other factors peculiar to the host locations, such as infrastructural support. Labour-intensive products requiring simple skills and technologies have been moved out of Singapore to neighbouring countries with cheaper and more abundant labour as wages have risen and labour shortages appeared in Singapore. At the same time, the accumulated skills and experience (or "human capital" invested) in the Singapore plants has encouraged the transfer to them of more technologically-sophisticated, higher-value, capital- and skill-intensive products (and their accompanying technologies). Though market wages have risen rapidly in Singapore, they remain a fraction of wage costs in the parent countries, including Japan, and form only a small proportion - less than 20% and sometimes less than 10% - of the total production costs of the local plants. Labour productivity has also risen more than wages. Thus labour costs alone are not a sufficient indicator of comparative advantage: higher productivity, lower infrastructural costs, and the lesser riskiness of operating in Singapore compensate for its high labour costs compared with its neighbours.

Competitive quality reasons aside, automated techniques

have been introduced even where economically unjustified (i.e. they have higher per unit costs than the labour-intensive techniques they replace), where the high labour turnover rates characteristic of tight labour markets reduce the quality of manual operations since reject rates are always higher with new workers. Difficulty of getting labour at the prevailing wage rates (which may thus be considered too low) also favours automation particularly of routine, monotonous tasks and those with high accident rates, which are unpopular with workers.

3. Host Government Policies

The Singapore government has introduced a "corrective" wage policy of large annual wage increases in 1979 through 1981, "to bring wages up to market levels" and to encourage capital-labour substitution to alleviate the nation-wide problem of labour shortage. This policy was introduced after the three firms under study had begun upgrading their activities in the desired directions, and up to 1980 has had little impact on their production decisions and operations. Shifting of product lines and introduction of automation began during and after the 1974/75 recession, a period of slack labour markets, and accelerated especially in 1977 and 1978 when labour shortages began to appear while wages were held down by modest NWC increases from 1976 through 1978. Large wage increases since 1979 may have made it easier for firms to hire in the tight labour market, and remain minor in relation to other costs of production and the effect of rising exchange rates for the Singapore dollar on export competitiveness. On the other hand, the NWC second-tier wage increment aimed at increasing labour productivity

seems to have had some adverse effect in increasing labour turnover due to demoralisation.

All three companies have seen their initial Pioneer Certificate tax holidays expire, but continue to enjoy some tax relief from the Export Enterprise Certificate. They benefit from the capital allowances scheme allowing most types of equipment to be completely written off in 5 to 10 years but this facilitates rather than motivates new capital investment. Most of the more recent capital incentives, such as accelerated depreciation for R and D equipment and buildings, are enjoyed only by Company B, which has invested heavily in expanded capacity and R and D activities. The other two companies do no local R and D, and have not expanded their plant capacities since the early 1970s. Among the government's manpower training schemes, the new Skills Development Fund (SDF) is seen as an added tax on labour rather than a benefit to the firms, none of which has recouped from it even a fraction of the amounts they have paid in, and all of which say it has not influenced their own training schemes.

For these three companies, then, host government policies to encourage and accelerate the upgrading and restructuring of the manufacturing sector, though acknowledged as steps in the right direction for the national economy as a whole, have not been a significant influence on their choice of technology.

In general, technology choice by these MNE subsidiaries is determined primarily by industry and product market factors, and only secondarily by local labour market factors and marginally by host government policies. In these circumstances there seems to be little opportunity for

discretionary company-specific policies.

B. Employment Creation and Linkages

The technology choices of the three companies has influenced the number of direct and indirect jobs they have created as well as the linkages they have developed with local suppliers. Table 7 shows the changes in both direct and indirect employment associated with the three companies and the number of local suppliers they have. By its very nature, indirect employment creation by MNEs is hard to estimate. Lall has suggested that instead of trying to develop precise estimates of indirect employment generation, which can be misleading, effort should be directed at tracing the linkages developed by MNEs.[13] But estimates of indirect employment creation and the linkages forged by MNEs are not mutually exclusive. In what follows, we present estimates of the indirect employment impact of the three companies as well as the linkages they have with local suppliers. Employment creation by MNEs is the sum of the following effects.

1. Direct Employment Creation

This refers to the number of jobs directly created in the enterprise. Of the three companies, only one, the American semi-conductor company, experienced a decline in direct employment creation over the last five years, although the capital-intensity of production increased with mechanisation, automation and the shift to more capital-intensive products in all three companies. The two consumer electronics

---

[13] Sanjaya Lall, The Indirect Employment Effects of Multinational Enterprises in Developing Countries, Multinational Enterprises Programme Working Paper No. 3 (Geneva, ILO, 1979).

TABLE 7

SURVEYED MINES: LOCAL PURCHASES, NUMBER OF SUPPLIERS AND EMPLOYMENT CREATION

	Value of Local Purchases ($m) (1)	Number of Local Suppliers (2)	Direct Employment (3)	Indirect Employment (4)	Total (3)+(4)	Employment Multiplier (3)+(4)/(3)
1. Company A						
1976	10[a]	50[a]	3,000	500[a]	3,500	1.2
1977	12	60[a]	2,800[a]	600[a]	3,400	1.2
1980	48	200+	2,200	1,000	3,200	1.4
2. Company B						
1976	40[a]	180[a]	2,200	1,000[a]	3,200	1.4
1979	65[a]	300[a]	4,500	2,500	7,000	1.6
1980	75	440	4,200[b]	2,500[a]	6,700	1.6
3. Company C						
1973	50	35	1,200	400[a]	1,600	1.3
1977	79	50	1,800	600[a]	2,400	1.3
1980	144	104	2,800	1,400	4,200	1.5

Source: Company data, partly obtained through interviews by authors.

[a]Author's estimate.

[b]Excludes 200 vacancies.

companies both increased their direct employment creation in spite of capital-labour substitution in technology, because of the vastly increased scale of production and output - in the case of the Japanese company, the increase in employment exceeded the accompanying increase in capital expenditure, leading to decline in plant-level capital-intensity. Since consumer products employ largely mature and standard technologies, there is less scope for dramatic capital-labour substitution in their production than there is in the technologically dynamic semiconductor production. Capital-intensity has increased much more rapidly in the semiconductor sector than in consumer electronics throughout the Singapore industry in general as well as among these three companies in particular.

2. Direct Employment Displacement

Direct employment creation should be measured net of any horizontal displacement effect in the local labour market. This net effect is the direct number of jobs created in the three enterprises less the number of jobs or employment loss elsewhere in the economy due to their competing workers away from other enterprises. Since the three companies were established at a time of general labour surplus in the Singapore economy, and since the bulk of their employment is of female production workers without prior working experience, this displacement effect is small. Even where the MNEs may have competed experienced workers away from local enterprises, these enterprises have made up the loss by employing more marginal members of the labour force e.g. older housewives, illiterates, etc. There is a displacement effect at the level of skilled, especially technical, labour, but no indication

that any local firms have been forced to close down as a result of losing such labour to MNEs. Indeed, in some cases technical labour trained in MNEs have left their employment to set up their own workshops and supporting factories, thereby creating more indirect employment.

3. Indirect Employment Creation Through The Multiplier Effect

The expenditure out of wage incomes of workers directly employed by the MNEs creates additional jobs through the multiplier effect. We do not have estimates of the size of the multiplier as this would entail detailed studies of workers' expenditure patterns. However, since the majority of workers in the industry are low paid relative to workers in other industries and elsewhere in the economy, we would expect their marginal propensity to consume, and hence the multiplier effect, to be high, or higher than the national average. On the other hand, given the openness of the Singapore economy and the high import content even of low-income consumption (e.g. for basic necessities like food and clothing), the multiplier is diminished by substantial leakages. This affects the composition as well as the scale of employment created by workers' expenditure. It is likely that most of the employment thus created will be in the trade and services sectors - such as import and retail trade - rather than in manufacturing. For all three companies studied, both the total wage bill and workers' average wages rose substantially in the last five years - even in the company where direct employment creation declined - so that indirect employment creation through this multiplier effect has probably risen.

4. Indirect Employment Creation Through Domestic Linkages

The largest indirect employment creation by these MNEs occurs through their local purchases of material inputs from supporting industries. With the development of these supporting industries in Singapore, with the early encouragement of GSP provisions requiring a certain proportion of local input content in addition to labour value-added, and with the increased preference of parent companies for local sourcing to save on input costs, the value of local input purchases by these companies has increased dramatically. Much of these purchases are made not from local manufacturers, but from import agents, local representatives of overseas manufacturers, etc., serving a large number of customers in Singapore, so that the employment indirectly created by each MNE's orders is negligible, and occurs in the commercial rather the manufacturing sector. Even where inputs are directly procured from locally-based manufacturers, in most cases the employment attributable to any one MNE is very small, since these manufacturers serve many companies. However, each of our three companies has a few suppliers who are heavily dependent on it for orders, and employ as many as over 100 people each on its contracts alone (see firm discussions above). In total, we have estimated that indirect employment creation through local input purchases amounted to between 40% and 60% of direct employment creation by each of the MNEs in 1980.[14] As Table 7 shows, the employment multiplier (the ratio of total employment to direct employment) has increased over the years in all three companies. Hence, there has been

[14]The employment multipliers of the three companies are similar to those found by Jo Sung-Hwan in his Korean Study quoted in Lall, ibid, p. 28.

a major increase of indirect employment creation since the firms were established, when almost all inputs were directly imported. Indirect employment creation through local input purchases increased even in the case where direct employment creation decreased (Company A). It accompanied the direct employment increase in the other two companies.

As in the case of technology choice, product characteristics are the major determinant of how much is sourced locally. Thus the nature of the products of the consumer electronics firms, and the fact that they mostly employ a standard technology, make local input purchasing more feasible. Proprietary technology, if it is employed, is embodied mainly in the design of the product, and in the integrated circuit it uses. The physical bulk of the product - metal and plastic parts and wires, TV cabinets, dials, displays, etc. - can be and is subcontracted and purchased separately for final assembly. For the semiconductor firm, on the other hand, the product is an intermediate component - an integrated circuit - embodying proprietary or sophisticated technology and parts which are difficult or impossible to obtain from local supporting industries. Because of technological, skill, material and market limitations, and because of the scale and capital-intensity of "front-end" operations, backward integration cannot proceed very far in the semiconductor industry, and does not generate as much additional employment as in the consumer electronics industry.

Parent company nationality is not a strong determinant of local sourcing preferences. Differences between the firms in local sourcing decision often has more to do with individual rather than national corporate philosophy. Local purchasing policy did not differ

much between the European and the Japanese consumer electronics companies: both preferred to buy as much of their inputs locally as possible. This is the normal practice in Japan, where the Japanese firm's parent company subcontracted much of its input manufacture, especially the more labour-intensive inputs, to local supporting industries. In Singapore, the subsidiary was forced to be more integrated than it wished until local supporting industries developed. Japanese MNE subsidiaries have a strong preference for supplies from established Japanese supporting industries, many of which followed their customers to Singapore to serve them locally, and all of which provide better technology, quality and delivery than do local Singapore firms. The European MNE was more concerned to develop locally-owned supporting industries, perhaps partly because there is no supporting industry from its own home country equivalent to that of the Japanese, but mainly because of its corporate philosophy to help develop local industries wherever it invests, and because of the strong nationalist sentiments of its long-time local purchasing manager. Although the American company could buy less of its input needs locally, it too was aggressively developing local suppliers.

Local government policy has also not been an important factor in stimulating the growth of local supporting industries. No incentives are provided by the government to manufacturers to purchase locally, nor are they required or encouraged to do so. This reflects the government's economic philosophy of minimum interference with market forces, and no protection for local industries. There are financial and technical schemes to aid the development of locally-owned supporting

industries but these tend to be underutilised either because many small local manufacturers are not aware of them, or because the requirements for qualifying for the schemes are too stringent for most of them. Thus the development of local linkages has been due mainly to market pressures influencing company policies, and not to government policies and programmes.

MNE subsidiaries in developing countries have many choices to make in obtaining supplies.[15] The first of these decisions is between importing inputs or procuring them locally. Initially, most firms were forced to import inputs as they were not available locally; some were also locked into parent company centralised purchasing and intra-subsidiary purchases. Over time, however, cost pressures have begun to strongly favour local procurement, at least for those inputs, increasing in number, which can be more cheaply made in the host country than in the parent or sister companies overseas or by their overseas suppliers. Even where purchasing remains centralised by the parent company, it has been relocated to production centres in the developing world, as in the case of the American semiconductor company in Singapore. The award of GSP based on local content proportions provided an additional incentive to source locally, but for most Singapore-based manufacturers the importance of this has long since evaporated, as GSP quotas for the country have been surpassed.

Once the decision is made to procure inputs locally, the firm has to decide whether to make them itself, or to purchase them from other suppliers. Whereas initially there is a tendency to prefer in-house

---

[15] For a discussion of the factors that influence an MNE's decision on supplies, see Lall, op. cit., pp. 40-59.

manufacture - due to the lack of external suppliers - over time this is maintained only for parts embodying proprietary technology. The firms in our study show a marked preference for more outside sourcing over time, preferring to use their plant capacity and labour skills to make high-value final products.

Finally, when the firm resorts to external suppliers, several arrangements are possible, and all are found in our sample. It can wait till an established manufacturer of particular parts - sometimes an established supplier overseas - establishes a subsidiary in Singapore, as many Japanese supporting industries have done. It can purchase the inputs from trading agents and overseas manufacturers' representatives, who have previously imported them. These two channels presently account for the bulk of local input purchases by our three MNEs. The companies have also taken the initiative in developing locally-owned suppliers, both agents and manufacturers, to whom they provide technical assistance, guaranteed contracts, marketing contacts, introductions to other customers, and sometimes even financial assistance. One of the companies, the European consumer electronics firms, said it was willing to pay a price premium for new suppliers who might have higher initial costs. This suggests that it has a long-term perspective on its manufacturing activities in Singapore.

VIII. LESSONS FOR HOST COUNTRIES AND MNEs

Our analysis of the technology choices and employment impact of three MNEs in Singapore suggests several lessons for host countries as well as MNEs in other developing countries.

1. Lessons For Host Countries

(i) MNEs are extraordinarily responsive to competitive pressures on product price and quality. Product market and industry factors, and not host country policies, are the major determinants of the production technology they use. The production technology in turn determines the level and pattern of direct and indirect employment created by MNEs. A host country can only indirectly influence MNE production technology by providing incentives and the infrastructure support to attract the MNEs it wants. But once the MNEs establish themselves, they will respond primarily to market and industry factors.

(ii) A host country should not be too concerned with the employment contribution of MNEs when they first began operating. It should concentrate on developing infrastructure support and finding ways to improve the efficiency of its institutions. Institutional efficiency and good infrastructure reduce costs and uncertainty and encourage MNEs to take a long-term perspective. Because of market and industry factors, MNEs may adopt initially technologies inappropriate to a country's resource endowments. But as they grow, their employment impact will increase too, even though they may become more capital-intensive, because the increase in production and scale of operation will likely overwhelm the employment effect of rising capital intensity. This suggests that a host country should take a fairly long-term view of the contribution that MNEs can make to its development. Attempts to maximise the short-run contribution

of MNEs by requiring them, for example, to buy locally from protected suppliers, can be counter-productive. They would likely encourage MNEs to take a short-term view and reduce their commitment to the country.

(iii) Our study suggests that wage costs are not a reliable indicator of comparative advantage. Singapore's wage costs are many times those of its neighbours, but they are still much lower than those in Europe, U.S. and Japan. Despite rapidly rising wages, MNEs continue to set themselves up in Singapore while others already in Singapore continue to upgrade their operations. This is because Singapore's competitive advantage - the product of its many attractions including excellent infrastructure, social and political stability, institutional efficiency - has increased rather than decreased with development. A host country need not fear that rising wages alone will retard employment growth or erode its competitive position. However, it must ensure that the general environment supports MNE expectations that profit opportunities will continue to be available.

(iv) Even in labour-intensive industries, labour costs form but a small proportion (10-20%) of total costs. Other costs - materials costs, freight and fuel costs, utilities, housing for expatriates, etc. - are much greater. A country's exchange rate also heavily influences both the prices of imported inputs and exports of its MNEs. Our study suggests that a host country must pay attention to factors that influence non-wage costs of production if it wants to maintain a competitive advantage in attracting MNEs.

2. Lessons for MNEs

(i) Our study suggests that given an economically liberal environment, MNEs are not primarily concerned with short-run labour costs in the host country. They are interested mainly in raising productivity by shortening learning curves and increasing capital investment. Like the host country, MNEs must take a long-term view with regard to the development of human resources in their plants. They must plan for a skilled, stable workforce that would permit them to introduce new technology and processes in response to changing market conditions.

(ii) Though local suppliers are initially inefficient compared with foreign producers, MNEs must try to assist them in various ways. Their commitment to local purchases is important for the development of an adequate supporting industry, and to the creation of indirect employment. The Singapore experience suggests that a well-developed local supporting industry can help diversify supply sources for MNEs.

IX. CONCLUDING REMARKS

Our case study of three MNEs in Singapore's electronics industry highlights the importance of market and industry factors as major determinants of technology choice. It suggests that a host country cannot directly influence technology choice in MNEs without limiting their flexibility in adjusting to market and cost pressures. However, it can attract MNEs by developing a competitive, predictable economic environment that encourages MNEs to take a long-term view. Our interviews

with three firms of different nationalities also suggest that nationality is not important in determining technology choice. In all three companies, international competitive pressures on product price and quality and rising labour costs push them towards high-value products and increased capital intensity. Because of greater output following increased capital investments, this push did not reduce their aggregate employment contribution. Rather, it created better paid jobs for a larger number of workers.

Our case study indicates that the indirect employment effect of MNEs is fairly large, and has been increasing over the years. Equally important, MNEs have played a significant role in promoting the growth of local suppliers. Indeed, their role in improving the performance and technical capabilities of local suppliers is larger than that of the government which sensibly has not tried to force MNEs to buy a minimum proportion of their inputs locally, or to protect locally-owned industries by tariffs and quotas. Such protection would have deterred MNEs from assisting local firms to expand and improve themselves.

NOTES

1. Applied Research Corporation: A study of electronics supporting industries, Preliminary report (Singapore, August 1979, mimeographed).

2. Y.S. Chang: The transfer of technology: Economics of offshore assembly, the case of the semiconductor industry, UNITAR Research Report No. 11 (New York, 1971).

3. Economic Development Board: Electronic firms in production in Singapore (Singapore, February 1980).

4. Economic Development Board; Annual Report 1979-80 (Singapore).

5. Sanjaya Lall: The indirect employment effects of multinational enterprises in developing countries, Multinational Enterprises Programme Working Paper No. 3 (Geneva, ILO, 1979).

6. Y.C. Linda Lim: Multinational firms and manufacturing for export in less-developed countries: The case of the electronics industry in Malaysia and Singapore (University of Michigan, 1978, Ph.D. dissertation in Economics).

7. Y.C. Linda Lim: "Women workers in multinational corporations: The case of the electronics industry in Malaysia and Singapore", in Michigan Occasional Papers (Ann Arbor, Michigan), No. IX, Fall 1978.

8. Richard Moxon: "Offshore sourcing in less-developed countries: A case study of multinationality in the electronics industry," in The Bulletin (New York University Graduate School of Business Administration, Institute of Finance), Nos. 98-99, July 1974.

9. Pang Eng Fong and Augustine Tan: Employment in the Singapore electronics industry, Paper prepared for the ILO Asian Regional Team for Employment Promotion (ARTEP), Singapore, April 1981.

10. Pang Eng Fong and Linda Lim: The electronics industry in Singapore - structure, technology and linkages, Economic Research Centre Monograph Series No. 7, (University of Singapore, 1977).

11. Lenny Siegel: "Delicate bonds: The global semiconductor industry", in Pacific Research (First Quarter 1980).

12. Science Council of Singapore, Economic Development Board and Association of Electronic Industries in Singapore: Singapore electronics buyers' guide 1980/81.

13. UNCTAD: International subcontracting arrangements in electronics between developed market-economy countries and developing countries (New York, TD/B/C.2/144/Supp. 1, 1975.

14. Wall Street Journal, 7 November 1980.

15. Susumu Watanabe: Multinational enterprises and employment-oriented "appropriate" technologies in developing countries, Multinational Enterprises Programme Working Paper No. 14 (Geneva, ILO, 1980).