THE ELECTRONICS MANUFACTURING SECTOR OF HONG KONG AND TAIWAN: A FIRM LEVEL COMPARISON AND ITS POLICY IMPLICATIONS

by

Kheng Leong Cheah

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Signature of Author: _____
Department of Civil & Environmental Engineering
May 9, 1997

Certified by: _____
Professor Alice H. Amsden
Ellen Swallow Richards Professor of Political Economy
Thesis Supervisor

Accepted by: _____
Professor Richard de Neufville
Chairman, Technology and Policy Program

Accepted by: _____
Joseph M. Sussman
Chairman, Departmental Committee on Graduate Studies

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KHENG LEONG CHEAH

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ABSTRACT

For the past few decades, the electronics industry has been a major driving force of rapid industrialization and economic growth FOR both Hong Kong and Taiwan. The success of these two countries in using the electronics industry to gain technical capabilities and export earnings should be an example and model for other late industrializing countries. Special focus will be placed on analyzing how government policies (or the lack of), affects the type of firm, firm performance and firm strategy.

Hong Kong and Taiwan are chosen as comparisons because of their similarities in firm structure, specifically with regards to the presence of family-owned small-and medium-sized firms. Both countries also have a large electronics sector, and focus on export-oriented manufacturing. However, the role of the state in the process of industrial development presents an interesting contrast. Hong Kong has a weak industrial policy that stays away from direct intervention while Taiwan has a government that took an active role in the promotion of local industry.

The aim of this thesis is to compare the performance of the two development strategies with specific focus on the electronics industry and to provide policy recommendations tailored to the respective countries that will help the continual growth of the manufacturing sector.

Thesis Supervisor: Professor Alice H. Amsden
Ellen Swallow Richards Professor of Political Economy

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Chapter 1 Introduction

1.1 Overview

The rapid economic growth and industrialization of the East Asian countries have prompted much discussion on the "East Asian Economic Development Miracle". The Electronics sector has been one of the most important manufacturing industry that drives these economies.

In the early 1970s, Hong Kong and Taiwan's electronic sector were very similar in firm structure and type of electronic exports. However in the late 1970s and 1980s, the Taiwanese government with an active industrial policy have been effective in creating an environment that supports the growth of firms in the electronics sector, creating new clusters of firms in the personal computers (PC) and semiconductor industry. Hong Kong, with a weak industrial policy, left its electronic industry to be shaped by market forces. The difference in state intervention significantly affects the performance of firms in the two countries, particularly on how these firms obtain technology and compete in the global market. This thesis will focus on how the presence and absence of government policies have on the performance of the industry and firms in the electronics sector.

This thesis will not only be of interest to policy makers in Hong Kong and Taiwan, it will also be helpful to other less developed countries thinking of developing an electronics industry in their countries. An understanding of the evolution and policy implications of the electronics industry in Hong Kong and Taiwan will help these countries avoid pitfalls in the development of the industry.

1.2 Hypothesis

If we have two countries with equal access to factors that are critical to the development of the electronics manufacturing industry - skilled labor, capitals market, technology, entrepreneurs and access to global consumer market but differ in that one has a supportive state with institutions that can mobilize resources and execute strategies to support its manufacturing industry, then we should be able to see that the supportive state will have a healthier industry and growth in the number of firms.

1.3 Methodology

This research is based on 70 interviews on 26 companies as well as government agencies and academic institutions in Hong Kong and China performed by the author. The government agencies interviewed were the Labor Department, the Vocational Training Center (VTC), Universities Grants Council, Industry Department (HKID), Trade Development Corporation (TDC), Hong Kong Productivity Council (HKPC), Industrial Technology Development Center Corporation (ITDCC), Hong Kong Electronics Association, Chinese Manufacturers Association, Hong Kong University Engineering Department, Chinese University Sociology Department[1], and lastly Hong Kong University of Science and Technology (HKUST) engineering department. The companies interviewed were chosen as randomly as possible to include electronics firms of various sizes and in different product sectors. However, due to the limited number of the sample and the difficulty in obtaining interviews with the smaller firms, the sampling is not unbiased.

Companies were interviewed using a number of open ended discussion guides to gather information on the origin of the company, sources of technology acquisition, cost structure, manufacturing activity locational considerations, government interactions and future plans. Table 1.1 gives a profile and capability summary of the 26 electronic firms interviewed. Among those firms, there were 7 small and medium sized firms (see table 1.1 for classifications), 11 large local enterprises, 6 multinational corporations and 2 Chinese firms. The manufacturing capabilities noted on table 1.1 will be discussed in more detail in Chapter 3.

Taiwan's electronics sector is chosen as a comparison to Hong Kong because of certain similarities in firm structure, which includes a significant presence of family-owned small- and medium-sized firms, having a large electronics sector, and export-oriented manufacturing. The two countries also differ significantly in government policy towards developing its industry. Hong Kong has a weak "non-interventionist" industrial policy that stays away from direct intervention while Taiwan has an interventionist government that takes an active role in supporting the electronics sector. The materials on Taiwan are based on secondary sources, as such, firm discussions and policy recommendation will be more focused on Hong Kong than on Taiwan.

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[1] Chiu W. K. Stephen and Lui Tai-lok, Sociology Department, Chinese University of Hong Kong, author of, Hong Kong: Unorganized Industrialism, Dimensions of Corporate Strategy.

1.4 Organization of thesis

There are a total of 5 chapters in this thesis. Chapter 1 gives an overview of the research. Chapter 2 introduces the electronics industry, the different types and characteristics of manufacturing firms that will be used to describe the case studies in later chapters and factor conditions that affects the electronics industry of the two countries. Chapter 3 talks about the history and the performance of the electronics industry in Hong Kong. There will also be case studies of firms, discussions on present government policies as well as policy recommendations for Hong Kong. Chapter 4 is similar to chapter 3 in organization but the content will be on Taiwan. Chapter 5 will be the conclusion.

Table 1.1 Capabilities and profile of electronic firms interviewed in Hong Kong

Company	TI	PI	PD	Mfg	Mkt/Dist	ISO	Class
China Aero.	L	L	L	L	OBM	9002	Chinese
Hua Ko	L	L	L	L	OE/BM	-	Chinese
ACL	L	L	M	M	OBM	9002	SME
Avantec	L	L	L	M	OEM	-	SME
Lafe	L	L	L	M	OEM	9002	SME
Primatronix	L	L	L	M	OEM	-	SME
Silcon Elec.	L	M	H	M	OE/BM	9001	SME
Tec-Hill	L	L	L	M	OE/BM	-	SME
Wing Sang	L	L	M	M	OE/BM	9002	SME
Albatronics	L	M	M	M	OEM	-	LLE
ALCO	L	L	M	H	OEM	-	LLE
GP	M	H	M	H	OBM	-	LLE
Elec & E.	L	M	M	M	OBM	9002	LLE
Johnson Ele.	M	M	H	H	OBM	9002	LLE
Meadville	L	M	M	M	OBM	-	LLE
QPL	H	M	H	M	OBM	9002	LLE
Team Conc.	M	H	H	H	OE/BM	9001	LLE
Varitronix	M	M	H	H	OBM	9001	LLE
Vitelic (HK)	L	L	L	L	OE/BM	-	LLE
Vtech	M	H	H	H	OE/BM	9002	LLE
Wong's	M	M	M	H	OBM	9002	LLE
ASM	H	H	H	M/H	OBM	9001	MNC
Epson	M	H	H	H	OBM	9002	MNC
Mabuchi	M	H	H	H	OBM	9002	MNC
Motorola	H	H	H	H	OBM	9002	MNC
NEC HK	M	H	H	-	OBM	9002	MNC
Phillips	M	H	H	H	OBM	9001	MNC

TI: technology innovation (low, L; middle, M; high, H)
PI: product innovation (L, M, H)
PD: product design (L, M, H)
Mfg: manufacturing capability (L, M, H, -, not applicable)
Mkt/Dist: marketing/distribution.
ISO: quality certification (9001 = design and manufacture, 9002 = manufacture only)
Class: Chinese = PRC company, MNC = multinational, SME = <500 employees or revenues <HK$1,000 million, LLE = >500 employees or revenues >HK$1,000 million
Source: Authors own research and interviews

Chapter 2 Introduction to the electronics industry

2.1 The importance of electronics in the economic growth of Hong Kong and Taiwan

The electronics sector constitute an important part in the GDP growth of Taiwan and Hong Kong in the last few decades. Electronics is the largest manufacturing sector in Taiwan, accounting for more than 19 percent of the total exports in 1993 as shown on table 2.1. In Hong Kong, the electronics sector is the second largest manufacturing sector after textiles accounting for 14 percent of gross output in 1994, and employing nearly 10 percent of total manufacturing employment. As shown on Table 2.2, the importance of the domestic export of electrical and electronics from Hong Kong is declining. From 1986 to 1994, the export of electrical and electronics products have dropped from 17 percent to 14 percent while the export of machinery, equipment, apparatus, parts and components has risen in importance from 6 percent to 14 percent. By looking at the number of electronic firms in Hong Kong and Taiwan in table 2.3, we can see that from 1980 to 1989, Hong Kong's electronic firms remain stagnant at 1300 establishment while the number of electronics establishment in Taiwan increased from 1400 to 3500.

Table 2.1 Exports of Taiwan by major products 1983-93

Product Group	% Share	
	1983	**1993**
Electrical & Electronics	**16.3**	**19.2**
Chemicals & Plastics	13.0	13.2
Non-electrical Machinery	10.1	12.6
Transport Equipment	5.1	8.2
Others	55.1	46.8
total	100	100

Source: Industry of Free China (Wong[2] 1995)

[2] Wong Poh-kam, 1995, Competing in The Global Electronics Industry: A Comparative Study of the Innovation Networks of Singapore and Taiwan, Journal of Industry Studies, Volume 2, Number 2.

Table 2.2 Domestic exports of Hong Kong by major products, 1986-1994

Product Group	% Share	
	1986	**1994**
Electrical & Electronics	**17.7**	**14.7**
Textiles, Including knitting	20.2	21.4
Wearing apparel, except footwear	21.2	18.6
Machinery, equipment, apparatus, parts & components	6.0	14.5
Others	44.9	30.8
Total	100.0	100.0

Source: General Economic Survey Section, Census and Statistics Department 1995.

Table 2.3 Number of electronic establishments in Hong Kong and Taiwan 1980-1990

	Hong Kong	Taiwan
1980	1316	1400
1984	1569	2100
1985	1304	2200
1986	1243	2500
1987	1395	3000
1988	1380	3250
1989	1358	3500

Source: ERSO for Taiwan, Census & Statistics Department for Hong Kong.

2.1.1 Comparative economic indicators

To justify using Taiwan as a comparison with Hong Kong, we will first look at the two countries in terms of its economic indicator. Taiwan is about four times larger than Hong Kong in terms of population, and has a larger domestic market. Taiwan, however, has a GNP of only slightly twice that of Hong Kong as shown on table 2.4. The US remains the largest export market. The share of manufacturing in GDP also remained quite high for the two countries in 1988 at 22 and 38 percent but recent 1995 figures of the share of manufacturing in GDP of Hong Kong has dropped to 11 percent[3]. This figure created a lot of concern in Hong Kong about the hollowing out of the manufacturing industry. The GDP figures, however, did not take into account the reclassification of manufacturing firms that relocated its factories in China. Neither does it take into account "Made By Hong Kong" products that are manufactured in China. "Made By Hong Kong" products are products manufactured by Hong Kong firms manufacturing in China. We will see in Chapter 3 that for electronics, these "Made By Hong Kong" products could account for nearly four times the domestic exports of Hong Kong. In both Taiwan and Hong Kong, the growth of the electronics sector has significantly contributed to the Gross National Product (GNP) averaging at 6 to 8 percent a year in the past three decades.

[3] Hong Kong Industry Department Electronics sector roundtable meeting, July 1996.

Table 2.4 Economic indicators of Taiwan and Hong Kong

	Taiwan	Hong Kong
GNP US$ billion , 1990	162	70
Per capita GNP US$,000 1991	6.5	14.4
Population millions 1990	20.2	5.8
Major export trade partner	US	US
Major import trade partner	Japan	China
Share of manufacturing in GDP (1988)	38	22
Inflation rate (1990)	4.6	9.7
Hourly compensation cost for production workers in US dollars 1990 figure	3.95	3.20
Literacy	91.2	88.1
Stock market capitalization US$ billion (1991)	131	113

Source: Hourly compensation data from Asia's New High Tech Competitors NSF 95-309, All other data from Hobday[4]

[4] Hobday Michael, 1995, Innovation in East Asia, The Challenge to Japan, Edward Elgar Press, England, pp. 16.

2.2 Types of electronic firms

In this thesis I have chosen to look at four categories of firms in Hong Kong; the Chinese based electronics firms which have located subsidiaries in Hong Kong, Small-and Medium-sized Enterprises (SME), Large Local Enterprises (LLE) and Multinational Corporations (MNC). These categories are chosen because firms tend to adopt certain strategy to compete based on the industry, and its competitive assets. Often these competitive assets are determined by the size, scope and ownership of the firm. Chinese based electronic firms in Hong Kong are interesting because not only are they the third largest group of foreign firms in Hong Kong, their major objective of being in Hong Kong is different from the other MNC which we will discuss in a later section. In the case of Taiwan, I have chosen to look into SME, LLE and MNC. Chinese based electronic firms are not present in Taiwan.

2.2.1 Small and Medium-sized Enterprises

More than 95 percent of the enterprises in Hong Kong as well as in Taiwan are small and medium-sized enterprises. From Table 2.4, we can see that the contributions of SME to Taiwan's and Hong Kong's economic development in terms of shares in number of firms, shares in the number of employees and output are quite significant. Manufacturing SME are manufacturing establishments employing less than 100 persons[5]. In Taiwan, the definition of SME are firms with a maximum amount of capital of less than NT$40 million or US$1.5 million (1991)[6]. SME are characterized by relatively little specialization in management, close personal contacts, handicaps in obtaining capital and credit, services on a limited scale, and a backwardness in production technologies and management know-how. SME are also at a disadvantage compared to MNC and Large Local Enterprises (LLE) in that they do not have the option of exploiting a global strategy, lacking in economies of scale and scope, and difficulty in obtaining finance from financial institutions[7].

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[5] The Chinese Manufacturers Association, 1996, Survey on Small and Medium-sized Enterprises, The Business Journal, April 1996

[6] Chiang Su-hwa Susan, 1994, The Chinese Family Firm in Taiwan, Patterns of Development, Masters thesis at MIT Sloan School of Management.

[7] Tsay Ching-lung, 1994, Taiwan: Labor Shortage, Dimensions of Corporate Strategy.

Table 2.5 SME statistics on electrical machinery & appliance industry

	Taiwan	Hong Kong
SME/total industry in Number of establishment	98.0%	98.5%
Manufacturing Industry* share of Number of employees in SME	79.6%	62.2%
Electronics Industry share of output of SME	39.4%	28.6%

Note : Taiwan data are based on 1992 statistics, Hong Kong data based on 1993 statistics.

* Compares Manufacturing industry

Source: White Paper on Small and Medium-sized Enterprises, Ministry of Economic Affairs, 1992 for Taiwan. Report on 1993 Survey of Industrial Production, Census and Statistics Department Hong Kong for Hong Kong.

Among the most critical obstacles that the SME faces are finance, technology acquisition and management skills. Not only is it difficult for SME to obtain financing from banks, the structure of the loans are different from the large companies. Table 2.6 reveals that 22 percent of SME loans comes from the shareholders as against 4 percent in the case of large enterprises. The table also shows that SME have a significantly smaller percentage of long-term loans from the financial institutions[8].

Table 2.6 Loan structure of SME in Taiwan Unit: %

	SME	Non-SME
Short-term loan from financial institutions	65.54	71.48
Equity and shares	21.88	3.55
Long-term loan from financial institutions	11.68	24.64
Others	0.90	0.33

Source: Chang, Wang and Liu, adapted from Shea and Yang.

The advantage of SME lies in their quick reaction to market signals. The survival of SME depends, to a great extent, on the productive effects of learning by doing. The ability to respond quickly to market changes, however, makes it unnecessary for any SME to be an innovator. As a result, SME are often found to lack incentives to invest in R&D or to enjoy economies of scale in mass production or economies of scope in product diversification[9].

[8] Shea Jia-Dong and Yang Ya-Hwei, 1994, Taiwan's Financial System and the Allocation of Investment Funds, M E Sharpe.

[9] Kao Yueh-shi Carol and Liao Huei-Chu, 1994, The Development of Small and Medium-sized Enterprises in the Republic of China, Industry Free China, Mar, 1994.

Hong Kong SME have the advantage that the small size of the firm does not hinder it from exploiting locational manufacturing cost advantage usually only available to larger firms. In a report conducted by the Federation of Hong Kong Industries in 1992 on the industrial investment in the Pearl River Delta by Hong Kong firms, it was found that 40 percent of firms investing in the PRD region had capital of less than HK$5 million (US$0.6 million)[10]. This finding suggests that the strategy of going offshore is by no means confined to larger firms in the case of Hong Kong. The fact that Hong Kong is close to China has allowed its SME to take advantage of cross border lower cost production despite their size.

2.2.2 Large Local Enterprises (LLE)

Large firms in Hong Kong and Taiwan are firms that grew from family owned SME discussed in the last section. LLE usually keep their home base in Hong Kong or Taiwan where the owner entrepreneur resides but would have the ability to have a global strategy that is similar to the MNC.

Vtech, an electronic toy and telecommunications company from Hong Kong does its own marking and gathers information on market need and consumer trends globally. It has a team of R&D engineers stationed in Canada and another team in The United Kingdom to tap into the high technology labor pool and resources in these countries. Vtech has its corporate head office in Hong Kong with a team of over 250 engineers. Its main manufacturing facility which employs over 10,000 production workers is located in Dongguan, China, where the average wage is US$2 a day.

Appendix 2 and 3 shows the largest electronic companies in Taiwan and in Hong Kong respectively. The major activities of the top Taiwanese firms are in computers, computer peripherals, office automation equipment, semiconductor industry, telecommunications, and parts and components for these industries. The top electronic companies in Hong Kong manufactures consumer electronics, telecommunication equipment, toys and parts and components.

[10] Chiu W. K. Stephen and Lui Tai-lok, 1994, Hong Kong: Unorganized Industrialism, Dimensions of Corporate Strategy.

2.2.3 Multinational Corporations (MNC)

MNC are large firms which conducts its business globally. MNC has the option of placing different activities of the firm in different parts of the world depending on their global strategy. MNC can choose to assemble products, fabricate components, or conduct R&D wherever the advantage of doing the activity lies. For example Motorola has Semiconductor manufacturing plants in Tienjin, the first of its kind in China, to cater to the Chinese market. It also has manufacturing plant in Hong Kong, Singapore, Taiwan, Malaysia and India to serve other Asian market needs. Motorola's research and development is located in Silicon Valley and Japan to tap into the best technical skills the world has to offer.

Foreign firms in Taiwan accounted for some 20 percent of the country's export between 1974 and 1982. This fell to 16 percent in 1985 as local firms assumed more importance. In the electrical and Electronics appliance sector, FDI accounted for around one third of Taiwan's total FDI up until 1974 and for some 36.3 percent of total investment in 1987. FDI in electronics and electrical products in Hong Kong amounted to 39.8 percent in 1994. A survey conducted by the Industry department of Hong Kong found that many of the MNC in the electronics industry provided technical assistance, on-the-job-training and provision of proprietary technical information to local staff.

MNC played a key part in the industrialization of Taiwan and Hong Kong. Not only did the MNC brought technology and capital to the manufacturing sector of Taiwan and Hong Kong, it provided a training ground for engineers and managers for the local industry. MNC also raise the standard of the manufacturing industry in the host country up to international standards and bring with it markets for the products. MNC frequently prefer to deal with suppliers of products and services based in their home nation, particularly in the early years of dealing abroad but often long after their international position has been established. This helped Taiwanese and Hong Kong electronics products get a foothold and gain recognition in the international markets. Taiwan has also been very successful in persuading the MNC to transfer technology to local manufacturers - Philips has transferred its CMOS technology to TSMC, and HP formed joint venture with Nan Ya Plastics to produce minicomputers and automation software[11].

[11] Hobday Michael, 1995, Innovations in East Asia, Edward Elgar Press, England, pp. 162.

Table 2.7 Taiwanese companies with technology source from MNC

Firm	Start Date	Sector	Source of Senior staff, technology and Training
Microelectronics Technology Inc.	1983	Telecom	HP, Harris, TRW
United Fiber Optic Communications Inc.	1986	Telecom	Sumitomo, Philips, AT&T, STC
Macronix	1989	Semiconductor	Intel, VLSI-tech.
Windbond Electronics Corp.	1987	Semiconductors	RCA, HP
TECOM	1980	Telecom	Bell Labs, IBM
TSMC	1987	Semiconductor Foundry	Harris, Burrows, RCA, Philips, IBM

Source: Hobday, 1995, pg 118.

There are, however disadvantages in relying on MNC to develop the local electronics industry. The first disadvantage of having a local industry that is dominated by MNC is that often, only part of the manufacturing value chain remains in the host country. Philips Hong Kong which is a part of the Sound and Vision division of Philips International only deals with a small part of the design and manufacturing of a division. Employees in Philips Hong Kong plant might not get exposure to the other parts of the manufacturing value chain like R&D, marketing and sales which are done in other locations. The second disadvantage is that MNC are thought to be "foot-loose". Philips Hong Kong is shutting down its Hong Kong operations and moving it to Shanghai as the conditions in Shanghai like labor availability and incentives given by the Chinese government are better than Hong Kong[12].

[12] Interview Philips Human Resource manager, Hong Kong.

2.3 Higher value added in electronics

In economies where the wages are increasing like Hong Kong and Taiwan, manufacturing can only prosper if the productivity of employees increases commensurably. Firms can increase productivity in a variety of ways but all of them require that the firm raise the value added of its product on a per employee basis.

2.3.1 Improving manufacturing processes

What constitutes higher profitability and higher value added for electronics product? Low labor cost is important in lowering the product cost but it is not the only factor or is it sustainable in the long run. US electronic manufacturers moved their manufacturing facilities to lower labor cost countries in Asia in the 1960s when faced with high relative labor cost at home. This response led to labor cost parity instead of upgrading the source of competitive advantage like a higher quality product or automation. Japan on the other hand faced with higher labor cost at home set out to automate, improve manufacturing processes and reduce the number of components. This improved quality, reduced labor

cost and made Japanese products more competitive. In fact Japanese products became so competitive that Japanese electronic firms were soon manufacturing in the US[13].

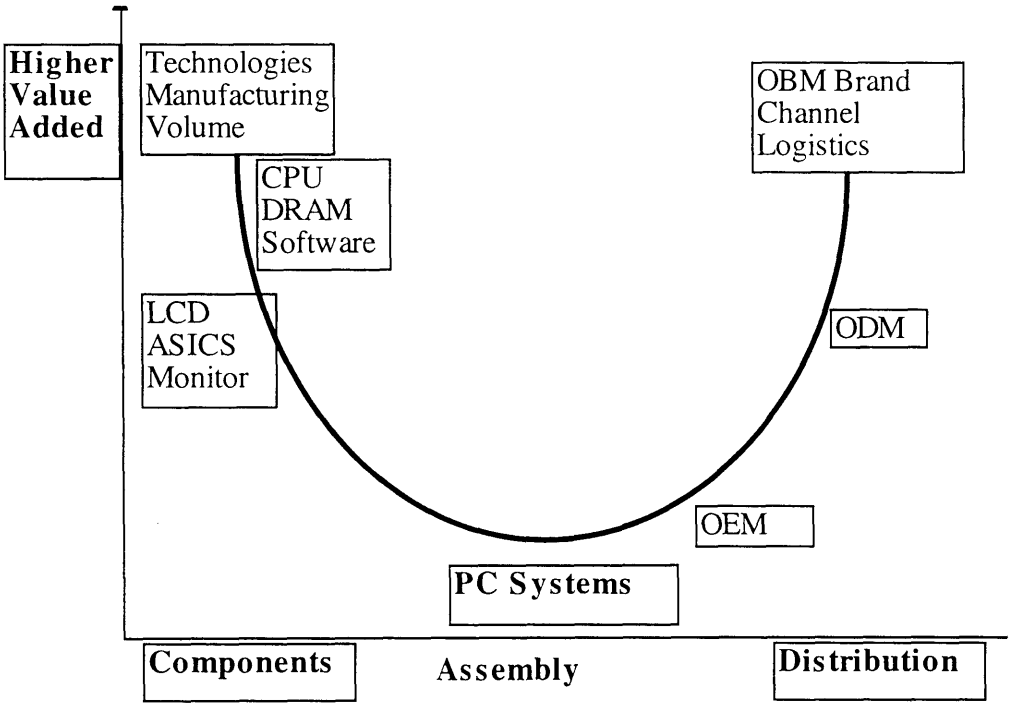
York Liao, the CEO of Varitronics Hong Kong during an interview said that "In the manufacturing of Liquid Crystal Display, it is not how many patents that you hold that matters but it is a race in improving manufacturing processes." This is not only true for LCD but also true for many other manufacturing sectors in Hong Kong and Taiwan where mature products are being produced.

2.3.2 Moving up the product value curve

At the Harvard Asia Pacific Business conference organized by Harvard Business School in January 1997, the CEO of Sun Moon Star Corporation (a Taiwanese PC parts manufacturer), Donald Wang, talked about how to increase value added for PC assembly manufacturers (see figure 2.1). PC assembly manufacturing is a low entry barrier, low profit margin industry. The figure shows that to increase value-added and profitability of the company, firms have to either enter the specialized components industry or to develop its own brand name and distribution channels.

[13] Porter Michael E., 1990, The Competitive Advantage of Nations, The Free Press.

Figure 2.1 How PC industry manufacturers can increase to higher value added product.



Source: Sun Moon Star Corporation CEO Donald Weng, Authors own compilation.

The high value added components industry includes Central Processing Unit (CPU), Dynamic Random Access Memory (DRAM), Software development, Liquid Crystal Display (LCD) and Application Specific Integrated Circuits (ASICS). To get into these higher value added products, a firm would need to invest in enabling technology, manufacturing capabilities and to get enough volume production to be competitive. Taiwanese companies in this category are Taiwan Semiconductor Manufacturing Company (TSMC) and United Microelectronics (UMC), both in the semiconductor industry. Hong Kong companies in this category are Varitronics, which manufactures LCD and Quality Plated Limited (QPL) which is in the business of the final process of IC manufacture.

Going up on the other side of the value added curve, a PC assembly firm can go on to a higher value added, higher profit margin position by investments in distribution. The retail price of an electronic product can be as much as 30 to 70 percent above the manufacturing costs due to sales and distribution expenses. Although most of the Taiwanese and Hong Kong electronic firms are SME, some are growing big enough to invest in their own brand names and building a distribution channel for their products. The smiley curve model described here for the PC industry is also true for the electronics industry where higher

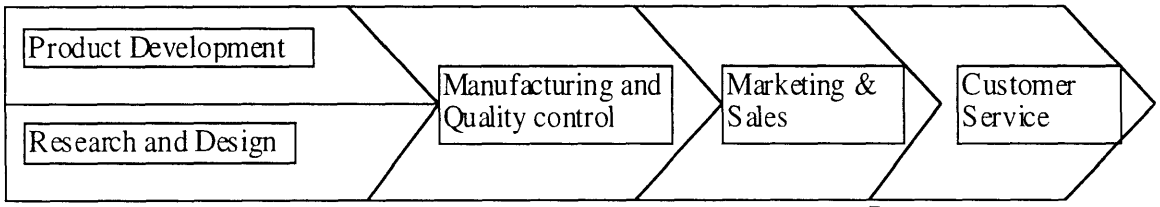
value added products are either specialized products that require higher technology and manufacturing capability, or they are investments in own brand and distribution. Taiwanese companies that are successful in doing this are ACER and Tatung in PC and Compeq in printed circuit boards (PCB). Hong Kong companies that have a brand recognition are Vtech in toys, Gold Peak in batteries and Johnson Electric in micro-motors manufacturing.

SME often find that they do not have the access to technology to go up the technology capability development side of the curve, neither do they have capital and human resources to go up the distribution curve.

2.3.3 From OEM to OBM

In this section we will talk about how electronic firms add value to their products by investments in distribution and brand recognition as shown in figure 2.1. Original Equipment Manufacturer (OEM) are firms that specializes in only the manufacturing portion of the manufacturing value chain (see figure 2.2). OEM products do not carry the brand name of the manufacturer but the brand name of the contract company. OEM are low entry barrier stage where the firm learns assembly process for standard, simple goods. Firms in the OEM stage typically do not have capabilities in other manufacturing value chain like product prototyping, distribution and after sales service. Products are supplied to foreign MNC or distributors which provides the design, product specifications and quality control standards. By selling the products under well-known foreign brand names, the OEM firms avoid the need for heavy investments in marketing and distributions.

Figure 2.2 Manufacturing value chain



Profit margin for OEMs are not high, typically at only 4 to 10 percent of the cost of manufacture. Material cost and operating cost are generally fixed. Labor cost, however, is a variable cost. Table 2.8 shows the breakdown of the production cost of various products sectors within electronics industry. With slim profit margin, labor cost is a critical issue

for OEMs. OEMs cannot command a higher profit margins by raising the sales price because entry barrier to the OEMs are low and brand holders usually keep several OEMs as their suppliers. If an OEM tries to raise its price, the brand holder will switch to other suppliers.

Table 2.8 Product cost of manufacturing industry in Hong Kong

	Labor %	Materials %	Operating %	Profit before tax %
Electronics Industry	**11**	**72**	**8**	**9**
Watch & Clocks	9.2	77.1	6.2	7.5
Electronics Security Product	13	59	11	17
Electrical Appliances	13	62	11	14
Machinery Industry	16	60	10	14
Computer Products Industry	7	78	6	9

Source: Hong Kong Trade Development Council.

Note: Electronics Security Product includes modular security units. Electrical Appliances includes kitchen appliances, home care appliances and personal care products. Machinery Industry includes injection molding, die-casting, robotics arms, DC motors, electrical transformers, static converters. Computer Products Industry includes mother boards and complete sets of computer systems.

Hong Kong firms like Avantec who manufactures corded phones for K-mart and Wing Sang Bakelite who manufactures electric curlers for Vidal Sasson are typical OEMs. As these OEMs grow bigger and gain more manufacturing and design capabilities, they will try to explore more profitable activities in the upper stream and lower stream of the value chain (see figure 2.2), for example providing their own designing services to customers. This is the second stage where the firm is now an Original Design Manufacturer (ODM). ODM are still weak in brand recognition and distribution but does more than pure manufacturing. Entry barrier and value added to ODM is higher than OEM but prices are still controlled by foreign buyers. Taiwanese companies like Sun Moon Star company and Hong Kong company like Albatronics are ODM.

Finally, firms gain enough capabilities in designing and manufacturing the product and start to conduct their own Research and Development and invest in their own sales and marketing of the products. This is the third stage where the firm is an original brand manufacture firm (OBM). OBM that gain strength in upper and lower streams of manufacturing value chain can now subcontract out the manufacturing process and

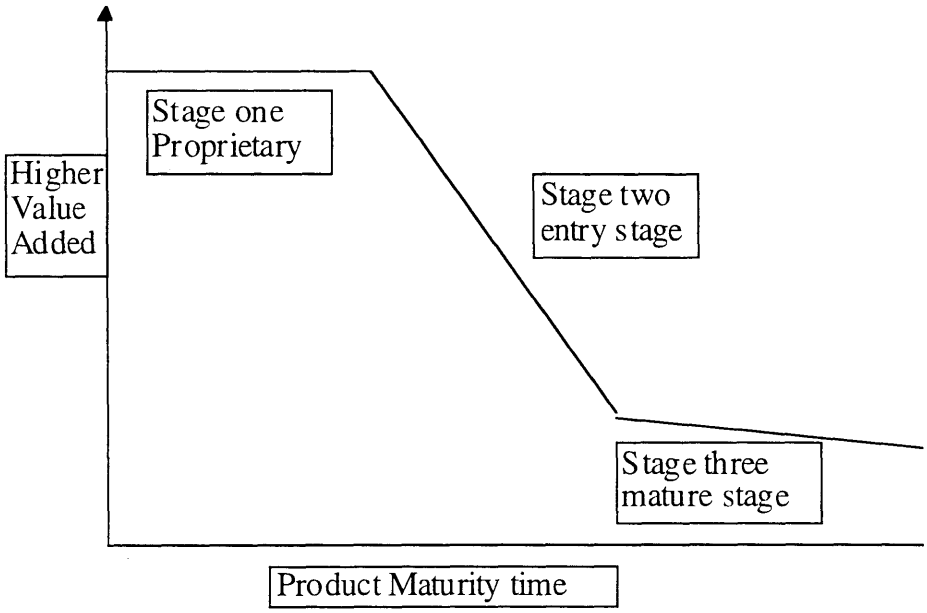
concentrate on new product development and stay in the technology frontier. Acer of Taiwan and Vtech of Hong Kong are in the OBM category although they still have some ODM and OEM contracts with MNC.

Vtech of Hong Kong, a manufacturer of electronic toys that invests in building brand recognition in its markets, finds that having its own brand helps it get market information which is crucial in the electronic toy business. Gold Peak Industries acquired Clipsal, a well known brand name for electrical switches and sockets in Asia to gain access to the brand name. Brand acquisition and marketing investments are options open to bigger companies like Gold Peak and Vtech. However, this is a very difficult endeavor for SME.

2.3.4 Electronics product life-cycle

In terms of life-cycle, the electronic products goes through three stages. Figure 2.3 shows the three stages of electronics products. The first stage is when a new product is being developed. In this stage the developer of the new technology or product has sole proprietary right to manufacture. This stage gives a high profitability for the company that holds the rights. An example of this is Sony's Walkman which became a huge success and was very profitable. The second stage is when the key technologies of manufacturing the products are available to other manufacturers as well. The product goes through a rapid fall in prices as new entrants enter the market. This stage is where the faster the firm follows the leader and puts its product to the market, the more profit the firm reaps. The third stage is when the product becomes a commodity, with many manufacturers and minimal proprietary content. This is the kind of product where the only way to survive in the market is to compete on lowering the cost of production, most of the Hong Kong SME visited were in this category.

Figure 2.3. Stages in electronics product life-cycle

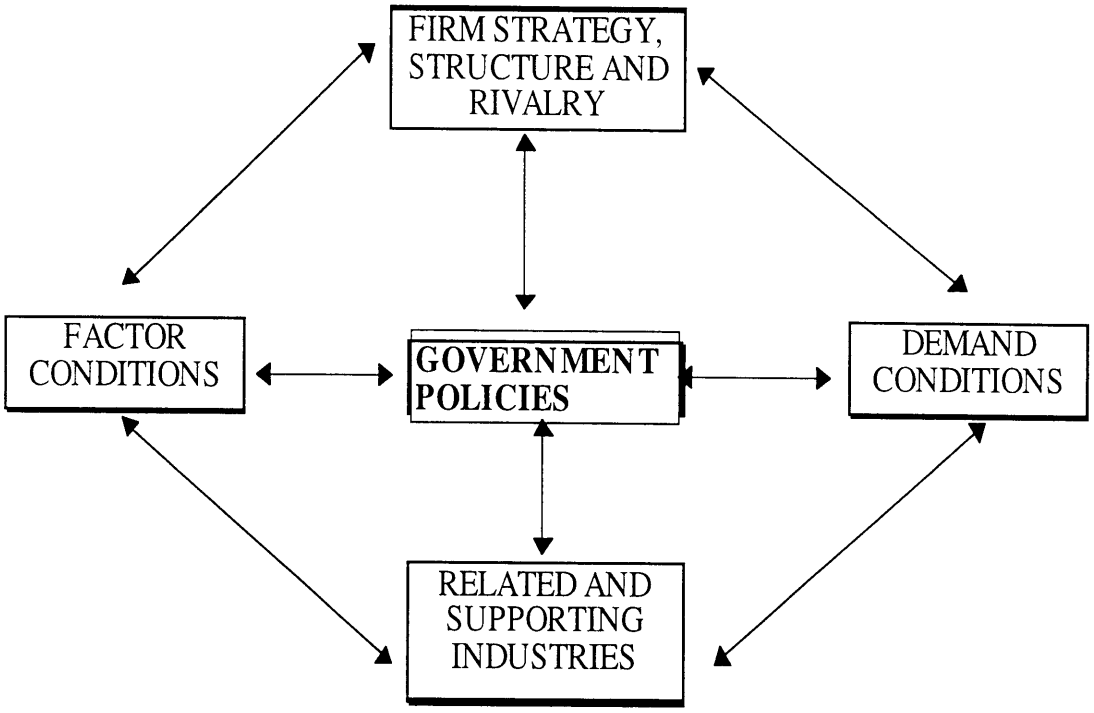


Source: Authors own research

Taiwanese and Hong Kong electronic firms are in the manufacturing of product in the second and third stages. In these stages, managerial and technological competence requirements are less of a barrier. Certain industries, however, experience periods of rapid technological change where innovation-related skills in management and technology are needed, like the PC and semiconductor industry. Taiwanese firms have been able to retain its position and even grow in these highly innovative industries through a combination of steadily evolving and gradually growing private and public sector research and development support. Hong Kong firms which have a longer lag time to market is left at the third stage and lower end of the second stage, see table 3.5 for explanations.

2.4 Drivers of competitive advantage

Figure 2.4 The determinants of national advantage



Source: Michael Porter, The Competitive Advantage of Nations, 1990

In this section we will look at factors that might affect the electronics manufacturing industry in Hong Kong and Taiwan. The reason is to see if there are any shortages of major factors that might influences the industry besides a supportive state between Taiwan and Hong Kong. We will make use of the framework developed by Michael Porter to look at individual factors. According to "the diamond of national advantage" suggested by Porter, we can analyze the electronics industry in Taiwan and Hong Kong in four aspects, (1) factor conditions, (2) demand conditions, (3) related and supporting industry and (4) firm structure, strategy and rivalry.

2.4.1 Factor conditions

Factor conditions are inputs necessary to compete in an industry such as natural resources, labor, capital and infrastructure. Appendix 7 lists the favorable and unfavorable factor conditions of Hong Kong and Taiwan. The three major factor conditions that are important

for the development of electronics industry is availability of skilled labor, capital and infrastructure.

Natural resources and labor

Both Hong Kong and Taiwan are island states that have very little natural resources. Land prices in both countries are expensive but in Hong Kong, land is the most expensive in the world. Hong Kong has been the recipient of immigration of skilled and unskilled laborers from China during various times in history. Taiwan has inherited some skilled labor and manufacturing infrastructure from the Japanese colonizers after the second world war. She also received a large number of immigrants from China in the late 1940s. Taiwan however, has a better supply of skilled production workers with its bigger population and larger concentration of electronics firms on the island compared to Hong Kong. Taiwan also has a larger student population studying in the US and other countries compared to Hong Kong. Many of these students took up positions in their host countries before returning to Taiwan. The returning students, numbering a few thousand each year, often find employment in government agencies, manufacturing industries, and new start-up companies. Appendix 8 shows that the number of returning students has been increasing to substantial numbers especially from the late 1980s onwards.

Capital Market

Although Hong Kong has a well developed financial system, there are no venture capital activity for new start-ups. Investment capital tend to be short term. This has created a need to finance new start-ups with curb market which explains the large number of family owned business. In Taiwan, it is also true that venture capital and long term loans for small firms are difficult to obtain. In a survey of the domestic borrowing of the private enterprise in Taiwan, it was shown that the larger the firm, the easier it was to get financing from both financial institutions and the money and bond markets (see table 2.9). The smaller the scale of assets, the greater the dependence on the curb market financing. The survey also shows that public enterprises are favored over private and secured loans are preferred over innovative investment plans that promises high returns.

Table 2.9 Source of Domestic Borrowing by Private Enterprise in Taiwan
1983, by Scale of Assets (%)

Source of domestic borrowing	Scale of Assets (NT$ million)							
	<1	1-5	5-10	10-40	40-100	100-500	500-1,000	>1,000
Financial Institutions	10.50	31.05	44.09	50.90	59.27	66.41	65.80	70.10
Money and Bond Mkt.	0.00	0.00	0.00	0.26	1.04	4.42	15.94	19.61
Curb Mkt.	89.50	68.95	55.91	48.84	39.69	29.17	18.26	10.29
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

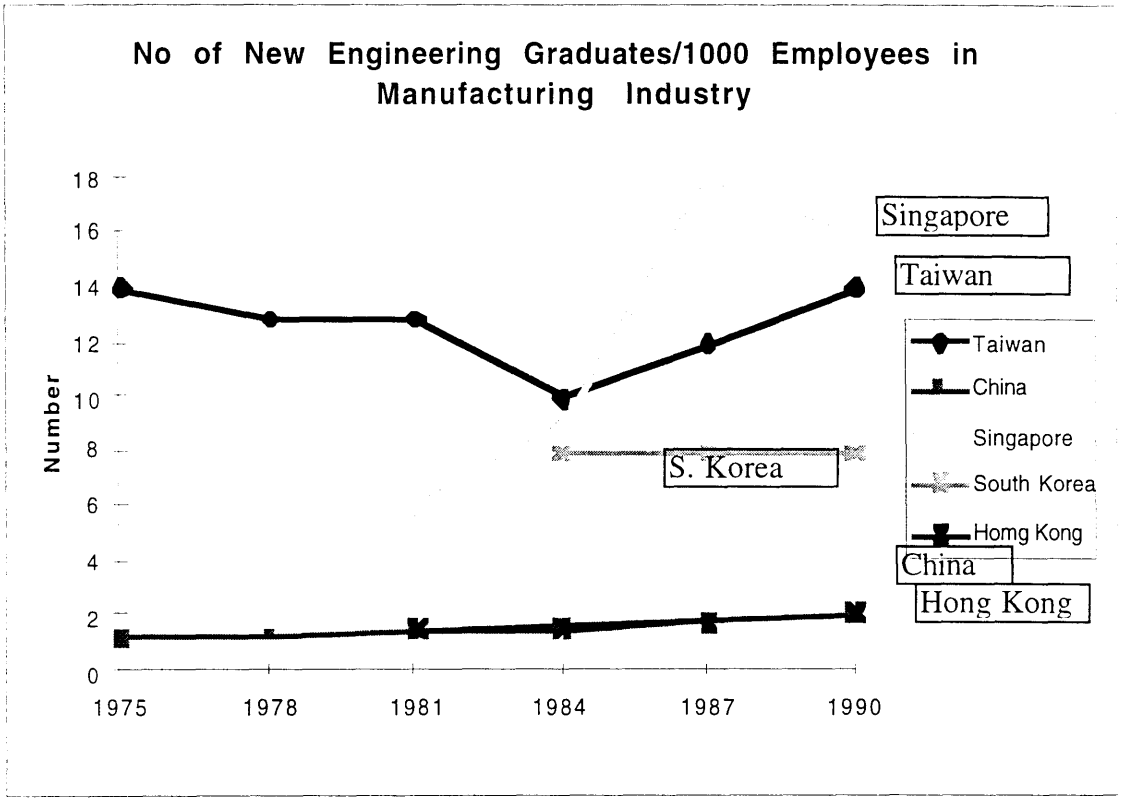
Source: From Shea[14] 1994, pg. 213. Compiled from CBC's 1983 Survey on the Financial Condition of Private Enterprise in the Taiwan Area

Infrastructural development and R&D spending

Hong Kong has excellent infrastructure especially in transportation and telecommunications. Taiwan's infrastructure is good especially in the FTZs and Science Park. In basic research and technical capability, Hong Kong is way behind Taiwan in strength. This has been attributed to the fact that not only is the government spending on R&D low, firms in Hong Kong spend very little on hiring technical staffs. Figure 2.5 shows that while Hong Kong companies only hire less than 2 new engineering graduates over 1,000 new employees hired, Taiwanese firms hires on average 14 new engineering graduates. The number of engineering graduate over total number of employees in Hong Kong is also way below that of Singapore as well as Korea and is at the bottom together with China.

[14] Shea Jia-Dong and Yang Ya-Hwei, 1994, Taiwan's Financial System and the Allocation of Investment Funds, M E Sharpe, New York.

Figure 2.5 Number of new engineering graduates over total employees hired in various Asian countries



Source: Government statistics from Hong Kong, Taiwan, China, Singapore, Korea, various years[15].

Spending on research and development in the electronics sector is important due to the nature of the industry with short life-cycle, quick product-related process modification and competitive market. Table 2.10 shows that on R&D spending, Hong Kong spends a dismal 0.1 percent of GDP compared to 1.12 percent for Singapore, 1.78 percent for Taiwan and 3.00 percent for Japan in 1995. Hong Kong's low investment in R&D is believed to be due to the government's reluctance to provide subsidies and incentives in this area. In contrast, the Taiwanese government has supported R&D extensively. R&D spending by Taiwanese government in 1984 amounted to 63.3 percent of the total amount spent on R&D. This figure has dropped to 48.2 percent in 1994 while the investment in this sector have been taken over by the domestic private sector.

[15] Boston Consulting Group, 1994, Report on Techno-Economic and Market Research study on Hong Kong's Electronics Industry 1993-1994, Volume 2, pp. 263, Hong Kong Industry Department, Hong Kong.

Table 2.10 Spending on R&D as percentage of GDP

Country	% of GDP investment in R&D
Japan	3.00
USA	2.77
Germany	2.48
South Korea	2.08
Taiwan	**1.78**
Singapore	1.12
China	0.62
Hong Kong	**0.10**

Source: World Competitiveness Report 1995, Far Eastern Economic Review, December 21 1995, pp. 51.

FDI

Taiwan and Hong Kong's reliance on foreign investment by comparison to other industrializing countries is shown in Appendix 9. Foreign Direct Investment (FDI) contribution to Taiwan's capital formation is small compared to Malaysia, Hong Kong or Singapore. From 1965 to 1985, it accounted for between 1.4 percent and 4.3 per cent of total capital formation and between 2.5 percent and 5.47 percent of private capital formation. In Hong Kong, FDI amounted to about 18 per cent of Hong Kong's total capital formation during the period 1976 to 1987. The reliance on foreign manufacturing investment in Hong Kong is high relative to countries like Taiwan, South Korea and India, but low compared to Singapore, Malaysia, and recently China[16].

2.4.2 Demand conditions

Hong Kong has a small but sophisticated local demand for electronics products. More than 90 percent of the manufactured electronics products are for the export market. Hong Kong's largest trading partner for electronics is China, followed by the United States. Hong Kong's electronics manufacturers have good access to Chinese markets especially in the Pearl River Delta (PRD) region with over 40 million people. Hong Kong as a British colony also enjoyed relatively free access to European as well as US markets. Industrialist in Hong Kong hoped that with the integration of Hong Kong into China under the "One

[16] Amsden Alice H., 1997, Manufacturing Capabilities: Hong Kong's New Engine of Growth?, Oxford University Press.

country two system" policy, Hong Kong will enjoy the best of both worlds in that it will still be able to maintain its free access to the western market while its manufactures are favorably treated as local products in China. At present, products manufactured in Hong Kong are treated as foreign import when it enters China.

Taiwan has a population of 21 million and a growing domestic market for electronics due to rising living standards. It also has a diversified economy with a good demand for industrial electronics and components. The domestic market for electronics products in 1984 was US$4.2 billion with domestic producers supplying US$1.6 billion and the rest imports. The small domestic demand in Taiwan and Hong Kong has made these countries look at export market early on in its manufacturing history. This has been a major competitive advantage for the electronics manufacturing firms in these countries as local firms have to raise the quality standards of their products to international standards in order to compete.

Table 2.11 Share of Taiwan and Hong Kong in total world export of electronic products unit: %

	85	87	89	91
Taiwan	3.8	3.8	4.1	4.7
Hong Kong	2.6	1.9	1.9	1.8

Source: Hong Kong Trade Statistics, Census and Statistics Department, Taiwan data from, Wong[17], 1995.

Table 2.12 shows that the global share of electronics exports from Taiwan is growing while that from Hong Kong is shrinking. This data however does not take into account "Made By Hong Kong" electronic products in Pearl River Delta. Recent 1995 data from Hong Kong shows that the total export value of electronics which includes re-export of electronics products from China is more than five times the domestic exports. It is however arguable whether how much of these re-export from China benefits Hong Kong in terms of repatriation of profits and creation of jobs.

[17] Wong Poh-kam, 1995, Competing in The Global Electronics Industry: A Comparative Study of the Innovation Networks of Singapore and Taiwan, Journal of Industry Studies, Volume 2, Number 2.

2.4.3 Related and supporting industries: supporting industry for electronics sector

The supporting industry and infrastructure for the electronics sector is both a barometer for a healthy local electronics sector as well as an indicator of how well the local industry has internalized the technology. A strong supporting infrastructure plays an important role in high-technology industries. The absence of adequate support in this area will prevent the introduction of a higher technology industry to the local industry. The availability of certain supporting industry is particularly crucial for new start-up companies and small and medium companies where funds are limited to provide the support in-house. The strengths in technical infrastructure is also a strong determinant of the ability of the local economy to capture new products and new market opportunities as they develop.

Three manufacturing supporting areas were looked into: materials technology, design and manufacturing support and semiconductor support. Taiwan came out strong in all three areas of supporting industries whereas Hong Kong has came out from satisfactory to strong in the first two but was found weak in semiconductor support.

Materials Technology

Both Hong Kong and Taiwan are strong in plastic injection molding and machine tool industry. Plastic injection molding products are widely used in the electronics industry. In 1991 there were 4,377 plastic manufacturers employing 41,526 people in Hong Kong. One third of the plastic output goes to the electronics industry. Chen Hsong, a local Hong Kong plastic injection molding machine manufacturer is a global leader in this sector. It has 8 factories each in Hong Kong, and China, and 4 factories in Taiwan.

Machine tools are used to cut or grind metal in ways that shape it into all desired forms, sizes, and precision surfaces. Almost all industries from computers, automobiles, to electrical engineering uses machine tools as the basic production tool. Machine tool industry is well developed both in Hong Kong and in Taiwan, although Taiwan manufactures and exports more than Hong Kong does. Machine tools were developed in-house in some of the larger manufacturers like Gold Peak and Johnson Electric Company in Hong Kong. There are 1,068 machine tool manufacturers in Taiwan employing 17,520 employees in 1986[18]. Taiwanese machine tool companies like Leadwell-CNC Machine

[18] Tsai, D. H. Stephen, 1994, The Development of Taiwan's Machine Tool Industry, M. E. Sharpe, New York, pp. 151-171.

Manufacturing Company and Taichung Machinery Works Company are very competitive in the global machine tools industry.

Design and manufacturing support

Computer Aided Design (CAD) and Computer Aided Manufacture (CAM) are software designed to help manufacturers up-grade their design and manufacturing processes. The Hong Kong Productivity Council (HKPC) has been actively promoting the use of these tools in the industry as early as 1983. This has resulted in the wide use of CAD/CAM in Hong Kong's manufacturing industry. In Taiwan, CAD/CAM is also widely used in the industry. In 1991 the demand for CAD/CAM in Taiwan is about US$140 million.

Maintaining high quality standards for products manufactured in a country is important to the overall image and acceptance of the product in the global market. The HKPC and the Hong Kong Industry Department (HKID) have been actively promoting total quality manufacture (TQM) and International Organization for Standardization (ISO) among the manufacturing firms in Hong Kong. These efforts have met with certain degree of success but as the majority of firms in Hong Kong are SME (more than 80% has less than 20 employees), subscribing to these high levels of international standards are very difficult. For example only 10 out of 300 watch and clock manufacturing firms in Hong Kong are accredited by ISO. TQM and ISO are also promoted in Taiwan through the Industrial Technology Research Institute (ITRI). As with Hong Kong, Taiwan has many small and medium firms which find it hard to subscribe to international standards.

Semiconductor support

Semiconductor can be considered as the heart and brain of an electronics product. It is a substantial portion of the materials cost of the electronic product and is found in almost all electronics products from watches to rice cookers. The semiconductor chip is important as it controls the functions and adds features to the products.

Semiconductor industry started in Hong Kong in the early 1980s, the same time as Taiwan. Today, Hong Kong only has 4 IC design shops. Motorola, which has excellent design capability is the leader in the industry. The three others are Hua Ko, Vitelic and RCL. The three are all very weak in design capabilities compared to other newer facilities available in Taiwan. The main products of the three IC design shops are lower end producers like melody card chips and watch IC chips catering to the electronic toy manufacturers and watch and clock industry. There are 55 IC design shops in Taiwan including Silicon

Integrated Systems, Syntek Design Technology, Holtek Semiconductor and Vitelic Taiwan. These companies are technically very competitive in the global semiconductor design market and are capable of manufacturing higher end 4M DRAM, 256K high-speed SRAM, and BiCMOS 64K SRAM[19]. In 1995, the total production output of semiconductors from Hong Kong was US$59 million while the production for Taiwan in the same year was US$4,200 million.

There are 3 mask production companies in Taiwan: Taiwan Mask Corp., Innova and TSMC. All 3 possess 0.8u photo masking technology while Hong Kong's only IC masking service provider, Pacific Mask still employs old 1.5u technology. IC packaging and assembly is the final process of manufacturing. Motorola, Swire and ASAT (a subsidiary of QPL), are companies in Hong Kong that does IC packaging. ASAT is in fact the world's largest IC packaging company although most of its activity is done in Europe and its clientele global. Taiwan has more than 30 companies engaged in chip mounting, and more than 20 in IC packaging. Appendix 10 gives a summary of the supporting industry for the electronics sector in Hong Kong and Taiwan.

2.4.4 Firm Strategy and Structure

The determinants of this category of competitive advantage is how firms are created, its ownership, goals, strategy and the nature of domestic rivalry.

Firm strategy

The competitive strategy of Taiwanese and Hong Kong firms can be described as "early follower strategy", based on low cost and narrow product focus. These firms do not pioneer new products, and enter the market only after Japanese or American firms have proved their potential. "Early follower" firms benefit from the leader's experience, from not having to invest in own R&D, and from free riding on available market responses. For example, Acer only introduces a new product after the leader's product have been well received by the market. Time lag from the leader in the "early follower" strategy is crucial in determining the profitability of the firm, it is also a measurement of a firm's technological capability. In a survey done on the personal computer products, it was found that both Hong Kong and Taiwan's time lag to market narrowed in reference to US from 5 years to less than a year (see table 2.13). The same study also shows that Hong Kong

[19] Dataquest, 1994, Report on Techno-Economic and Market Research Study on Hong Kong's Electronics Industry 1993-1994, Volume 3, Hong Kong Industry Department, Hong Kong, pp. 116-132.

firms have a longer time lag than Taiwan for all products from seven months in 1982 to three months in 1990[20].

Table 2.12 Time lag for PC products: USA, Taiwan, Hong Kong

Products	USA	Taiwan	Hong Kong
Apple II Products	1977/4 (0)	1982/1 (+56)	1982/8 (+63)
IBM PC Development	1980/8 (0)	1983/4 (+32)	n.a.
IBM (8088)	1981/8 (0)	1983/9 (+25)	1984/3 (+31)
IBM/AT (80286)	1984/8 (0)	1986/7 (+23)	1986/12 (+28)
Intel 80386	1985/5 (0)	1986/12 (+19)	1988/1 (+32)
IBM/PS/2	1987/4 (0)	1988/1 (+9)	n.a.
486AT	1989/4 (0)	1989/10 (+6)	1990/1 (+9)

Source: USA and Taiwan from ERSO; Hong Kong, from The Study, May 1991, Adapted from Tuan and Ng, 1995.

Note: Figures n table denote year and month; figures in parentheses the lag time in months, n.a.: not available in manufacture.

Organization of firms

Over 95 percent of Hong Kong and Taiwanese firms SME which have been discussed in earlier sections. Another common characteristic of Hong Kong and Taiwanese firms are that they are run as family firms and business groups. Family firms are firms where the family members owns and manages the operations of the firm. On a smaller scale, owner-management can be an advantage in the sense that it creates strong cohesion among employees and a high level of commitment to the business. As the family business firm increases in scale however, family management can bring risk such as uncontrolled management decisions by owners, the placing of personal interest above the company, ad hoc diversification into unfamiliar businesses on the basis of family ties, insider trading and real estate speculations. Family firms get around this problem by getting the company listed on the stock exchange and to allow professional managers to keep investments in-check. Gold Peak and Chien Hsiong both cited that the major reason for the company to list on the Hong Kong Stock Exchange was to have professional managers within the board.

[20] Tuan Chyau and Ng FY Linda, 1995, Evolution of Hong Kong's Electronics Industry under a Passive Industrial Policy, Managerial and Decision Economics, Vol. 16, 509-523

Business groups, which is another form of dominant organizational structure in the two countries, are network of firms controlled by a single family. When a family business becomes successful, the pattern of investment for family firms is not to attempt vertical integration but rather to start a series of separate firms in less closely related or unrelated businesses. Firms in a business group are usually family members or relatives that branch out to start a new firm within the group or staff members from the family firm who obtained help from the owners who provided capital[21]. An example of a family owned business group is illustrated by Wong's International of Hong Kong. Wong's started as a printed circuit board manufacturer in 1962. As the business grew, new firms were formed within the group. When the eldest son of the founder Johnny Wong took control of the PCB business, the second son formed a new company, Wong's KK. Wong's KK's core business is to provide chips-on-board service that forward integrates the PCB business to include components assembly on to the PCB and quality inspection of the final product. Wong's International now includes over 11 firms (see appendix 11) within the group with 4 family member of the Wong family on the board of directors.

Ownership of firms

Firms in Hong Kong are mostly listed public companies or privately owned companies. Taiwan on the other hand has a strong presence of public enterprise and government participation in the industry, see table 2.14. When the Kuomintang (KMT) party of Chiang Kai-Shek regained Taiwan in 1945, the industries that they inherited from the Japanese were made into public enterprises[22]. These public enterprises together with the government investments constitute about half of Taiwan's gross capital formation and about a quarter of the total GDP of Taiwan in 1951. In the 1950s government and public enterprises have played a significant role in shaping Taiwan's economy, especially in providing employment and stabilizing the local economy.

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[21] Chiang Su-hwa Susan, 1994, The Chinese Family Firm in Taiwan, Patterns of Development, Masters thesis at MIT Sloan School of Management, Cambridge, pp. 33.

[22] Amsden Alice H, 1991, Big Business and Urban Congestion in Taiwan: The Origins of Small Enterprise and Regionally Decentralized Industry (Respectively), World Development, Vol. 19, No. 9, pp. 1121-1135.

Table 2.13 Taiwan's Gross Capital Formation and GDP by sector

Sector	1951	1970	1990
Gross Capital Formation	1,779	57,886	942,609
NT$ million			
Private enterprises	44.9%	60.0%	52.5%
Public enterprises	43.1%	28.6%	23.7%
Government	12.0%	11.4%	23.8%
Gross Domestic Product	12,328	160,859	4,245,685
NT$ million			
Private enterprises	71.9%	70.9%	77.4%
Public enterprises	17.3%	17.6%	12.7%
Government	10.9%	11.5%	9.9%

Source: Statistical Abstract of National Income, Taiwan Area, ROC

Rivalry

Clustering of electronic manufacturers of similar products increases the competitive advantage of the sector in many aspects. Clustering of manufacturers increases the demand for similar parts and components and thus lowers the cost price. It also increases the pool of skilled workers in the sector and attracts buyers to locate their offices in the region. Firm rivalry in clusters can accelerate the technological improvement within the cluster. Hong Kong has a few clusters of electronic producers in the sectors of electronic toys, telecommunications, clock and watches. Taiwan has several clusters of electronics producers in semiconductors, PCs and consumer electronics.

Chapter 3 Analysis and recommendation for Hong Kong's electronics industry

3.1 Overview

3.1.1 The history of electronics manufacturing industry

In order to better understand the present structure of the electronics sector in Hong Kong and to recommend policies that will strengthen its industrial future, we need to first understanding its historical past. Hong Kong was the recipient of capital and labor flight from China at different times. From 1937 to 1941, Hong Kong received an influx of Chinese civilians and capital from the mainland as a result of the outbreak of hostilities by the Japanese invasion. The second influx was after the Japanese surrender. Chinese civilians who had fled the Japanese during the war returned. The third influx was during the years of 1947 to 1950 during China's civil war. By mid 1950s, the population of Hong Kong had swelled to an estimated 2.2 million. The new immigrants brought with them the best of the Chinese entrepreneurs who started many of Hong Kong's manufacturing firms. Electronics companies started by these immigrant entrepreneurs includes the Yu family (leather merchants) of ALCO, Tang family (textiles) of Meadville, Chang family (porcelain) of Varitronix and the Ng family (buttons manufacturer) of Gold Peak.

The first electronics factory in Hong Kong was started in 1959 by a local Chinese assembling transistorized radios. Small business owners helped by large British trading companies who supplied designs and specifications moved into labor intensive industries including plastic goods, toys, low grade electronics, watches and clocks. Hong Kong's electronics industry also had some help from the Japanese in the late 1950s and early 1960s when a small number of Japanese transistor radio producers came to take advantage of low cost labor and low taxation rates. The British government, eager to avoid unemployment laid out some policies that were more favorable to industry including the easing of leases on

land for industrial uses[23]. In 1960s, many multinational corporations especially the electronics components manufacturers were attracted to Hong Kong. Companies such as Fairchild, Ampex, Teledyne Semiconductor and almost every large US consumer electronics and semiconductor manufacturer have established manufacturing in Hong Kong. These multinationals provided a training ground for engineers, middle managers and technicians. Some Hong Kong companies are run by engineers who had training at these multinationals, these includes Vtech's Allan Wong from NCR, Albatronic's Fukumori Nakahara from NEC, and ACL's Michael Oswald from Motorola.

During the 1970s, local Hong Kong entrepreneurs saw the growing opportunity in the electronics industry and new manufacturing companies started in large numbers (see table 3.1). Local companies went into manufacturing cassette tape recorders, electronic watches and clocks. The total number of electronic establishment mostly local, grew from 4 in 1960, to a peak of 1,569 establishments employing 111,491 persons in 1984. In 1994 there were 803 electronic establishments in Hong Kong employing 38,422 persons[24]. The decrease in the number of establishments in the electronic sector from 1987 to 1994 is not industry specific, numbers in parentheses in table 3.1 shows that the share of electronics in total manufacturing sector establishments has remained fairly constant at around 2.4 to 2.8 percent. The decline in total number of firms is attributed to the general decline of the manufacturing industry in Hong Kong. The decline is also caused by the re-classification of establishments formerly having manufacturing activities in Hong Kong which have since moved to China. There are few foreign firms that still maintain manufacturing facilities in Hong Kong. In 1994, there were only 76 foreign electronics manufacturing establishment in Hong Kong.

Some may argue that Hong Kong does not need the manufacturing industry when the service sector is showing such strong performance[25]. The counter argument is that without the manufacturing sector, the service sector will have no customers to serve. It is said that for every $1 manufacturing produced, there is $1.80 of service business coming with it[26]. There is also a classification problem where Hong Kong firms that have moved its manufacturing facilities to China while maintaining other activities of manufacturing in

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[23] Hobday Michael, 1995, Innovations in East Asia, Edward Elgar Press, England, pp. 162-185.
[24] Industry Department Hong Kong, 1995, Hong Kong's Manufacturing Industries.
[25] Enright Michael, Scott Edith, West Jonathan, Dodwell David, The Hong Kong Advantage, Harvard Business School, Cambridge, July 1996.
[26] Liu, James, 1995, Development Strategy of Hong Kong Industrial Technology, Hong Kong Industrial Technology Center Corporation.

Hong Kong are classified as service industry according to Standard Industrial Classification (SIC) system used. This kind of classification will distort the actual number of firms that are involved in manufacturing in Hong Kong although the extent of the distortion is hard to determine.

Table 3.1 Number of establishments and persons engaged in the electronics industry of Hong Kong, 1960-1994

Year	No. of Establishments	No of Persons Engaged
1960	4 (0.1)	183 (0.1)
1965	35 (0.4)	5013 (1.5)
1970	230 (1.4)	38454 (7.0)
1975	490 (1.6)	53833 (7.9)
1980	1316 (2.9)	93005 (10.4)
1984	1569 (3.2)	111491 (12.3)
1985	1304 (2.7)	86115 (10.1)
1986	1243 (2.6)	87244 (10.0)
1987	1395 (2.8)	91355 (10.4)
1988	1380 (2.7)	94684 (11.2)
1989	1358 (2.7)	84702 (10.5)
1990	1303 (2.7)	71779 (9.8)
1991	1129 (2.4)	59341 (9.1)
1992	1009 (2.4)	50933 (8.9)
1993	960 (2.4)	43980 (8.7)
1994	803 (2.4)	38422 (8.8)

Notes: Figures in parentheses denotes the percentage share of all manufacturing industries in the respective years.

Sources: Figures for 1960-1970 from Employment Statistics, Labor Department. Figures for 1975 onwards from Reports of Employment, Vacancies and Payroll Statistics, Census & Statistics Department.

3.1.2 Current status of electronics industry in Hong Kong

In 1984, a significant portion of the manufacturing industry in Hong Kong was for finished products like watches and clocks, radios and computers. In transistor radio and cassette recorder manufacturing, output was 17.3 percent in 1984 but it was almost non existent in the output from Hong Kong in 1994. These labor intensive activity have since moved to other areas especially to Pearl River Delta. Table 3.2 shows the shift in output from Hong Kong in the past 10 years. Parts and components have taken the place of finished product as the main output of Hong Kong's electronics sector.

Table 3.2 Structure of Hong Kong's electronic industry 1984-94

Industry major group	**1984**		**1994**	
	Output HK$mn	Output %	Output HK$mn	Output %
Parts and components	**6654**	**21.3**	**40262**	**69.3**
Watches and clocks	6318	20.2	7799	13.4
Computers and peripherals	1459	4.7	1372	2.4
Telephones	2194	7	777	1.3
Transistor radios & cassette recorders	**5385**	**17.3**	**182**	**0.3**
Calculating & similar machines with electronic memory	596	1.9	129	0.2
Electronic toys	494	1.6	73	0.1
Other finished products	8113	26	7191	12.9
Total	31213	100	58091	100

Source: Hong Kong Trade Statistics, Census & Statistics Department 1995.

Parts and components manufacturing in Hong Kong has grown over 600 percent in the past 10 years in dollar terms. This was partly due to the expansion of semiconductor assembly by Motorola and strong performance by Wong's International (PCB), Varitronix (LCD) and QPL (IC lead-frames). The strong performance in the parts and components sector in Hong Kong is consistent with manufacturing firms that were able to move up the value added curve by specializing in higher technology, capital intensive components manufacturing. Table 3.3 shows the ratio of the Chinese employees over Hong Kong employees. Although the overall ratio of the companies surveyed shows that on average

Hong Kong electronic firms hire 10 employees in China to one Hong Kong employee, a closer scrutiny shows that parts and components manufacturers (micro-motor manufacturers aside) have a higher ratio of Hong Kong employees to Chinese employees. Companies like ACL (PCB), Wong's, Meadville (PCB), Varitronix and QPL have nearly as many Hong Kong employees as Chinese employees. Chinese conglomerate, China Aerospace, had 15,000 Chinese employees to 50 Hong Kong employees with a China/HK ratio of 300. As this was not representative of a Hong Kong manufacturing firm but a "listening post", it was not included in the list.

Table 3.3 Distribution of employment between Hong Kong and China 1996
(Partial sample of electronic firms)

Sector	Company	HK	China	China/HK
P/C	ACL	350	0	0
P/C	Elec & Eltek	670	2100	3.1
P/C	Meadville	700	1040	1.5
P/C	Wong's Circuit	1130	600	0.5
P/C	Varitronix	350	500	1.4
P/C	Vitelic (HK)	210	0	0
P/C	QPL	800	0	0
P/C	Mabuchi Industry	400	30000	75
P/C	Johnson Electric	560	12530	22.4
CE	Albatronics	250	3000	12
CE	ALCO	1400	14000	10
CE	Vtech	1000	16000	16
CE	Avantec	25	300	12
CE	Epson	540	12000	22.2
CE	Gold Peak	1300	10000	7.7
CE	Wing Sang Bakelite	52	1000	19
CE	Lafe	292	5000	17.1
CE	Silicon Electric	30	150	5
CE	Team Concepts	250	2000	8
CE	Primatronix	75	1500	20
PE	ASM	800	1500	1.9
SW	Valence Semiconductor	27	0	0
	Mean	**509**	**5146**	**10**

Source: Company Data

Note: CE=consumer electronics, P/C=parts and components, SW=software,
PE= Precision Engineering

The shift in manufacturing of finished product from Hong Kong to Pearl River Delta can be seen in table 3.4, which shows in percent the share of domestic exports to total exports from Hong Kong. The difference between domestic and total exports is the re-export of electronics products from China through Hong Kong. The total exports of electronics products from Hong Kong in 1995 was HK$379,313 million while the total domestic exports of electronics from Hong Kong for the same year is only HK$65,900 million.

Major electronic products manufactured in Hong Kong in 1995 includes electronic watches (10.8%), parts and accessories for computers (16.7%), parts and accessories for radio telecommunications (8.4%) and integrated circuits (19.9%). Watches are still being manufactured by Hong Kong's 300 watch manufacturers with the labor intensive manufacturing done in China and the designing, marketing and other activities are done in Hong Kong. Watches can be considered more of a fashion goods than consumer electronics where knowledge of consumer trends is a major competitive advantage. Parts and accessories for computers and radio telecommunications are mostly difficult parts and components that could not be done in China and are manufactured by Hong Kong firms for assembly operations in China. Vtech, Epson and ALCO for example designs and manufactures complicated parts and components in Hong Kong for their China plants. The high number for IC manufacturing in Hong Kong is due to the expansion in production of Motorola Hong Kong.

Major electronic products from Hong Kong and PRD as a whole are radios (9.3%), Electronic toys (8.2%), electronic watches (7.0%), IC's (10.7%), parts and accessories for computers (12.0%) and radio telecommunications (5.6%). Radios and electronic toys typifies the majority of labor intensive assembly manufactured products manufactured in PRD and exported through Hong Kong.

Table 3.4. Hong Kong's percentage of total and domestic exports of electronic end products and components, 1995

	SHARE (total exports)	SHARE (domestic exports)
End Product	**HK$201,579 mln**	**HK$18,616 mln**
	53.1%	**28.2%**
Calculators	1.2%	0.3%
Photocopying apparatus	1.2%	4.2%
Computers	3.6%	2.3%
Television receivers	3.1%	0.4%
Radios	9.3%	0.3%
Video recording/reproducing apparatus	1.1%	-
Sound reproducing/recording apparatus	2.2%	-
Telephone sets	1.4%	0.2%
Hi-Fi equipment	2.0%	-
Transmission apparatus	3.0%	1%
Electronic watches	7.0%	10.8%
Electronic toys	8.2%	2.1%
Components total	**HK$177,734 mln**	**HK$47,284 mln**
	46.9%	**71.8%**
Parts & accessories for		
computers	12.0%	16.7%
telephones & telegraphic apparatus	1.0%	1.5%
radio telecommunications	5.6%	8.4%
all kinds of recorders	3.1%	3.5%
Static converters	1.8%	2.1%
Printed circuits	1.6%	5.3%
Color TV picture tubes, cathode ray	1.2%	
Transistors (excl. photosensitive)	1.3%	3.4%
Digital monolithic integrated circuits	7.3%	10.6%
Non-digital monolithic integrated circuits	3.4%	9.3%

Source: International Exhibition in Electronics and Electrical Products (Biannual publication), July 1996, Hong Kong TDC.

3.1.3 Pearl River Delta (PRD) as part of Hong Kong's manufacturing industry

With the development of the Hong Kong economy and the rise of wages in the early 1980s, Hong Kong has lost its cost competitiveness in the labor intensive electronics assembly manufacturing. Instead of improving its production processes by increasing in investment of automation and product quality, Hong Kong manufacturers found it more profitable to shift production to China without committing to capital investment for production. Over 90 percent of Hong Kong's electronics manufacturers have manufacturing facility in PRD. PRD refers to the region surrounding the Pearl River which includes the provinces of Guangzhou, Shenzen, Zhuhai, Dongguan, Zhongshan, Foshan, Huizhou and Jiangmen (see appendix 16). It is estimated that there are between 4 to 6 million workers in Pearl River Delta working in Hong Kong related companies, nearly twice the total work force of Hong Kong itself.

To understand why Hong Kong's electronic firms made the move to PRD, we can make a back of the envelope calculation on the manufacturing cost savings in moving production to PRD, labor cost as a proportion of total cost of production is about 5-10 percent. If we assume the median of 8 percent and that the labor cost in Hong Kong is ten times the labor cost in PRD, then the difference in manufacturing costs between the two areas would be about 72 percent. Typically, companies manufacturing in PRD achieve a gross margins of about 8-18 percent on sales. This would make the difference in labor costs between Hong Kong and Pearl River Delta to be more than four times larger than the gross margin. Another costs saving that can be exploited from moving production to PRD is material cost. Material costs constitute about 70-80 percent of the total cost of production of electronics finished products (see table 2.7). Philips for example, helps their components suppliers relocate their manufacturing facilities to PRD with the explicit intention of lowering the material cost of its suppliers.

Some electronic firms from Hong Kong have been able to make use of cheap labor in the PRD to lower production cost while maintaining product design and marketing activities in Hong Kong. The extent to which these manufacturers have adopted this strategy could not be determined. Some manufacturers have totally moved their production sites overseas and have only trading functions in Hong Kong. Table 3.5 summarizes the location and the intensity of manufacturing activities that is done in Hong Kong and in PRD. PRD is where almost all of Hong Kong's manufacturing activity is located. Product design and

development is still done in Hong Kong but is increasingly being done in PRD as well. Companies like ALCO, Vtech and Philips are training more and more Chinese engineers to perform engineering and other managerial functions in factories in China. Not only are wages for Chinese engineers a third that of Hong Kong, industrialists claims that Chinese engineers are more stable in terms of turn over rate. Hong Kong engineering graduates tend to shun manufacturing jobs, opting to go into service industries, as they are attracted by higher pay and cleaner working environment.

Table 3.5 Activities in Hong Kong's electronics industry

Activity	Intensity	Location
Technology Innovation	Low	Hong Kong
Product Innovation	Low	Hong Kong
Product Design	Medium	Hong Kong
Manufacturing	High	PRD
Marketing	High	Hong Kong
Distribution	High	Hong Kong

Source: Authors own interviews and research

3.2 Electronic firms in Hong Kong

This section is based on interview conducted on Hong Kong firms. Results on the capabilities of firms in Hong Kong in terms of its ability in technical innovation, product innovation, product development, manufacturing process capability, marketing/distribution capabilities, quality assurance (ISO9000) and size are summarized in table 1.1. This sampling of companies is biased in that it does not contain an exhaustive list of companies in Hong Kong but nevertheless it represents a varied number of MNC, LLE and SME. MNC are strong in all categories of capabilities. Hong Kong LLE are stronger in product development, manufacturing and distribution than in product and technology innovation. SME are generally weak in all capabilities except manufacturing. A rule of thumb among the electronic firms investigated appears to be that (1) they do not invest in R&D but follow the industry leaders closely (see Gold Peak case study), (2) they invest in hard automation only when it is forced by buyers or to conform to quality standards (firms, especially the SME prefer to rely on cheap labor than automation for flexibility), (3) firms compete on cost (ALCO manages its employee dormitories in China, a task that is usually done by Chinese partners, to save cost), (4) relocates any activity that can be relocated to China.

3.2.1 MNC

ASM Pacific Technologies

ASM Pacific Technologies (ASMPT) has been in Hong Kong for 20 years since 1977 and is a subsidiary of ASM International of Holland. ASMPT manufactures die bonders, wire bonders and trim/form systems. These machines are expensive precision machines used in semiconductor industry. In the first 10 years since the beginning of its operation, the designing, the manufacturing of the parts, the assembly and the final testing of the machines were performed in Hong Kong. In the mid 1980s, Hong Kong firms were experiencing a shortage of labor and high land prices. Electronic firms were forced to offer cash incentives to workers to introduce new workers to the company. Many companies including ASM moved their manufacturing facilities to PRD. ASMPT's move to relocate its labor intensive parts manufacturing operations to PRD strengthened its Hong Kong operation instead of weakening it. In 1986, ASMPT's total sales revenue was US$35.5 million, employing 400 employees. In 1995, total sales revenue increased to US$202.6 million with 800 staff working in Hong Kong. Most of the Hong Kong employees were on higher paying jobs like R&D engineer, skilled craftsmen for tooling machines, quality

inspection workers, as well as administrative and marketing staffs. The PRD plant has 1,500 employees mostly production workers working on fabrication of parts.

ASMPT as an MNC has been able to utilize the competitive advantage of Hong Kong. (1) With the shrinking of its manufacturing industry, Hong Kong has an abundant supply of skilled and experienced production workers especially in the watch and clock, toys and electronics industry. ASMPT has been able to tap into the pool of skilled workers in Hong Kong to make machine tools. This allows new products to be quickly implemented without costly training and retraining and ensure a high quality standard. (2) Hong Kong's close proximity to cheap labor source in PRD has allowed ASMPT to exploit low cost manufacturing for parts with ease of coordination with its main assembly and marketing office in Hong Kong. (3) The excellent telecommunications in Hong Kong allows the flow of information to be managed efficiently between ASM's global operations and its China plants. (4) Efficient physical infrastructure allows imports, exports and re-exports to be done efficiently. (5) Hong Kong being a cosmopolitan city is a congenial place for the foreign expatriates working in the MNC to live and work. (6) Low corporate tax and ease of expatriating profits from Hong Kong.

ASMPT's reason for locating its manufacturing operations in Hong Kong is based on comparative advantage of Hong Kong. In an interview, asked whether ASMPT needs any government assistance, the general manager said that he does not feel that there is anything that the Hong Kong government can do to help their business. In the case of ASMPT and in many other MNC in Hong Kong, the decision to locate in Hong Kong is free from expectations of assistance from the state. With other countries like Singapore, Malaysia and China offering better and better incentives to MNC to locate in their shores, Hong Kong would have to reevaluate its strategy to attract MNC.

3.2.2 LLE

Gold Peak Industries

The owner entrepreneur of Gold Peak (GP) had a factory in Guangzhou but lost everything after the war in China in the late 1940s. In 1950s he came to Hong Kong and started manufacturing bulbs for flashlight. In 1964 he started GP as a tiny back room operation manufacturing 9 volt batteries for transistor radios. From this humble beginning, GP has grown to become a medium sized MNC. In 1994, GP employed over 12,000 people with a turnover of US$369.5 million. 50 percent of the sales are from Asia, 26 percent from

Europe, and the balance from North and South America. Table 3.6 shows the group structure of GP industries separated into 4 business units. Batteries accounted for half of the revenues while the other half is split between automotive electronics and electrical installation products. In 1994, GP was the world's top 10 manufacturer of consumer batteries and wiring devices.

GP went from being a family business to a listed public company in 1984 when the company went public on the Hong Kong Stock Exchange. The listing helped to finance growth of the company as well as provided money to family members to shift control of the company to non-family members. Victor Lo, the youngest of four brothers is the only family member that still remains at the helm of the company today.

Table 3.6 Group Structure of GP

Gold Peak Industries (Holding) Limited			
• GP Batteries	• Clipsal Industries	• GPE Industries	• Strategic Investment Div.
59.73%	50.50%	59.25%	Distribution Co in Asia
Singapore Listed	Singapore Listed	Singapore Listed	Mfg. of loud-speakers, precision parts
Battery Mfg.	Mfg. of electrical installation product 50% ownership of Gerard Ind. (Aust.)	Mfg. of automotive electronics and cable products	

Source: Corporate Information 94/95 GPI.

Firm Strategy

GP has a clear firm strategy to focus on industries where they have strength to become market leader and to concentrate on developing sales in Asian markets. GP's strategy is "first to follow". Its products are usually 2 to 4 years behind technology frontier and are

priced 10 to 20 percent below the market leader. GP is able to undercut the price of the market leader as they do not spend money on R&D.

GP was an OEM until 1987 when it decided to invest in developing its own brand name. When GP decided to have its own brand name, it had to acquire its own technology and distribution network as well. From table 3.7, we can see that GP started to acquire technology by acquiring Bowden of Australia. It then acquired Clipsal of Singapore for its brand name. This was followed by a series of acquisitions, technology licensing and joint ventures.

Table 3.7 GP Industries business strategy milestones

Year	Event
1964	Established in Hong Kong manufacturing layer-build batteries for radios
1984	Listed in the Hong Kong Stock Exchange
1985	First joint venture factory in Xuzhou, China. (Chinese partners)
1987	5 more joint ventures established in China
	Acquired 50% of Bowden Industries and Clipsal Asia in electrical and electronics
1989	Acquired 15.3% of Canadian power supply technology company
	Acquired 36.4% of Australian electrical wiring and accessories company
1991	GP Batteries International listed in Singapore Stock Exchange
	Acquired Alkaline Batteries A/S of Denmark
	Acquired 50% of Clipsal, a Singapore based electrical manufacturer
1993	Technology Licensing from Ovonics of US to develop battery for electric vehicle
	Acquired 50% of Gerard Industries of Australia, manufacturer of electrical wiring
	Joint venture with Toshiba Battery of Japan for manufacture and sales in China
1994	Acquired 80% of China Auto Parts, manufacturer of automotive wireharness
1995	Acquired LTK Industries, a wire and cable manufacturer in China & Hong Kong
	Acquired 15% of NAD Electronics and 50% stake in joint venture of distributing 'NAD' and 'Onkyo' products in Hong Kong and China
	Acquired 60% of PWE Industries of Malaysia, manufacturer of electrical wiring accessories and low voltage switch-gears

Source: Company Data

GP invests heavily in developing distribution and markets in Asia, especially in China. With the experience of investing in China, GP started to target suppliers and market leaders, offering to help them set up joint venture plants in China in exchange for alliance

and new technology. GP provided assurance for the foreign partner in local strategic support and would send its strong managers over to help. This move has helped GP set up more than 20 joint ventures in the Huizhou area alone. GP sees China as a cheap manufacturing base as well as a market for its products. GP is one of the earliest and biggest investor in Huizhou and had secured a good deal with the local government which includes a 20 year lease on factory land. The joint venture with the local government allows GP to sell 30 percent of the car audio system and 50 percent of its batteries in China.

The interaction between GP and the state is minimal, if at all. GP's strategy resembles that of a MNC - manufacturing is done where it is cheapest (China), financing is done globally (listing in Singapore), and technology is obtained through alliances and acquisitions (Gerard of Australia, Toshiba of Japan, Ovonics of US). LLE like GP which has grown global is less affected by government policies than SME which has fewer locational choices for its manufacturing activities.

3.2.3 SME

Wing Sang

Wing Sang Bakelite Electrical Manufacturing Limited was established in 1960 mainly in manufacturing bakelite electrical components. It later developed to be a manufacturer of consumer electronics like curlers, hair dryers, car electronics and kitchen-ware. It is a family owned business started by two brothers. Wing Sang exhibits the typical pattern of an OEM where all its technology source is from its customers. Its major line of business now is as the OEM supplier for Helen of Troy (Vidal Sasson), where 80 percent of their business are with this one single customer. Wing Sang is one of the 10 OEMs for Helen of Troy.

Table 3.8 Wing Sang Milestones

Year	
1960	Established in Hong Kong
1967	Established factory in San Po Kong, Kowloon, Hong Kong
1970	Expanded product range to cover auto accessories and fluorescent product
1974	Started hair care product line
1988	Moved factory to China
1989	Collaboration with Hong Kong Polytechnic University on application of Information service/IT to support production planning and control
1994	Obtained ISO9002

Source: Company Data

In 1996 the company employed 1,000 people in China and 52 people in Hong Kong. Its Hong Kong work force was engaged as follows:
5 engineers on 'R&D' who work with customer designs;
9 people in materials planning and control;
9 people in tooling;
8 people in three teams concerned with new projects for specific products;
2 people in marketing and sales;
4 people in accounting;
15 support staff.
Even though the company does all the manufacturing processes besides manufacturing in Hong Kong, it has managed to keep its ratio of China/Hong Kong staff to 20/1, half that of industry average. The ratio of engineering graduates in Wing Sang is also very low at less than 10 percent of the total employees in Hong Kong.

Recently the running of the company was transferred to the two sons of one of the founders. Eager to expand their business, the young entrepreneurs found that it needed to enter the OBM market. The company, however, did not have the skilled employees who could do the testing, designing and who has the knowledge of international standards and marketing to penetrate mature markets in Europe and US. All these functions have been done by the customers under the OEM contracts. It can also be argued that the lack of managerial and technical capability is due to the company not willing to invest in human resources as can be seen in the high China/HK employee ratio.

In Wing Sang's case, as in many other family-owned SME in Hong Kong, the jump from small scale OEM to ODM and to OBM is not so easy. Firms are faced with constraints in financing, managerial skills, marketing skills, technical skills and in product development skills. Small Hong Kong companies like Wing Sang experienced an increase in profitability when they exploited low wage production in China in the mid 1980s to early 1990s. This was a lucky circumstance rather than a successful strategy by Hong Kong firms. This comparative advantage, however is diminishing. As wages in China rises and new entrants in less developed countries increase product quality, Hong Kong SME will need to find a new competitive advantage.

Tec-Hill

Tec-Hill is an excellent example of a SME that thrives on Hong Hong's existing competitive advantage. The company was started in 1993 as a family business trading and manufacturing computer add-on chip. The founder had worked for Hitachi for 10 years and knows the business well. The business relies on knowing the latest market demands and to have flexible turn around time to take advantage of changing consumer demands. The company has 22 employees working from an office space of about 1000 square feet.

Tec-Hill relies on the excellent telecommunications infrastructure in Hong Kong to get up-to-date information on the price of DRAM (its most expensive component) and the demand of the add-on cards. This information will determine the production schedule of the day. The manufacturing is done by a highly skilled and flexible work force that is willing to work shifts and overtime when the demand is high. Time to market is extremely important in determining the price of the product in the business. Tec-Hill claims that it can customize its products and deliver it to clients anywhere in the world in 2 days. This can only be done in a location like Hong Kong where it is a major hub for international flights.

Asked whether they need any assistance from the government, the managers replied, "No, the business environment is perfect as it is." Tec- Hill is an example of a SME that relies on Hong Kong's comparative advantage to remain competitive. The nature of its business is however less of pure manufacturing but a combination of commodities trading (in IC chips) and manufacturing.

3.2.4 Chinese Firms in Hong Kong

Hua Ko

Hua Ko is one of the three IC fabrication plant in Hong Kong. It is 100 percent owned by China Resources (Hua Rong), a conglomerate from China. Hua Ko typifies Chinese investments in Hong Kong's manufacturing industry; Chinese state-owned enterprises and Chinese conglomerates using Hong Kong as a training ground for its engineers and to act as a "listening post" for new technology and market information.

Before COCOM (a body that regulates the transfer of technology to countries hostile to the United States) was disbanded, China could not import high technology machinery like those used in wafer fab for manufacturing ICs. Hong Kong was used as a window to technology that was banned from entering China. Now that COCOM has been disbanded and it is not prohibited to import these machines into China, the Hong Kong plant is used to train managers and engineers on management skills and quality control which is still lacking in China.

There are 150 employees in Hua Ko;
70 fabrication engineers,
20 design engineers,
20 process engineers,
20 testing engineers,
8 quality assurance engineers
Most of the employees are staff transferred from their Chinese holding company for a two year training stint in Hong Kong. Compared to other Hong Kong firms, Hua Ko has a very high ratio of engineers to total employees. This is in line with using Hong Kong as a training ground for its engineers from China.

Another Chinese conglomerate, China Aerospace, also uses Hong Kong as a place to source for technology and new designs to complement its manufacturing facilities in China. China Aerospace has 15,000 employees in China manufacturing telecommunication products, satellite application (GPS), car alarm, PCBs and LCDs. It has 40 employees in Hong Kong and 60 in Shenzhen acting as an R&D center for new product development. Dr. Wang, the CEO of China Aerospace, stresses the need for the Hong Kong government to put more emphasis on building a high tech industry in Hong Kong. This he says will help attract more Chinese companies like China Aerospace to locate in Hong Kong.

All the Chinese firms in Hong Kong interviewed mentioned that they have received no help from the Hong Kong government or its agencies. Chinese firms that come to Hong Kong to source for technology and market information is a mirror to the labor intensive Hong Kong investments across the border. The Hong Kong government should not overlook the potential to develop these investment which could benefit Hong Kong as well as China.

3.3 Current government policies

3.3.1 Government policies on the electronics industry

Hong Kong government has since the 1970s adopted a policy towards its industry called "passive industrial policy" or "positive non-interventionism". To understand what Hong Kong's "passive industrial policy" is, we should first have to define what "industrial policy" is. "Industrial policy" can be used broadly to include;
(1) Direct government intervention in the R&D activities of industries that affects industry supply, which includes subsidized R&D activities, financing, manpower planning and training, and technical support.
(2) Creating markets for products in the demand side, which includes creating market demand and facilitating trade.
(3) Facilitating favorable business environment for industries which includes providing scientific or technical related infrastructure, innovation incentives, and direction of innovation[27].

Industrial policies for Hong Kong's manufacturing industry includes;
(1) a manpower policy for planning and training (under the VTC),
(2) a trade facilitating policy for setting standards for products and provision of trade and technology information (under TDC),
(3) an economic infrastructure for providing a scientific or technological infrastructure and innovation incentives to include patents and rewards (under HKPC),
(4) the promotion of FDI investment to enhance the business environment and facilitate trade activities (under HKID).
In the context explained by Rothwell and Zegveld, Hong Kong's "industrial policy" does include to a certain degree business-environment policies, supply-side and demand-side policies. These policies are however indirect industrial policy, that does not propel the local industry to the track of industrial upgrading. It can be said that the "non-interventionist", indirect subsidies worked really well in the 1960s and 1970s but judging from the contraction of the Hong Kong electronics sector from the 1980s, the state has not been flexible in changing its strategy in response to the changing needs of its industry.

[27] Rothwell R and Zegveld W., 1981, Industrial Policies and Structural Change, New York, St. Martin's Press.

3.3.2 Government agencies assisting the development of the electronics sector

In institutional support, government expenditure is spent mainly on financing the work of the Industry Department (HKID), the Hong Kong Productivity Council (HKPC), Trade Development Corporation (TDC), Industrial Technology Development Center Corporation (ITDCC) and the Vocational Training Center (VTC). The Government maintains its detachment from subsidizing any one industry and from directly assisting any particular industrial activity in terms of R&D and other matters related to technological development.

Hong Kong Productivity Council (HKPC)

HKPC is a statutory body established in 1967 to increase industrial productivity and the use of more efficient methods for local firms. HKPC is funded partly by government subvention and partly through fees from its consulting services. In the late 1970s it promoted the application of microprocessors, and in the 1980s it promoted the support scheme for PCB and ASICS technology. HKPC has also been supporting and promoting the adoption of international standards like ISO9000 for the local industry.

HKPC and its subsidiary companies employs more than 600 consultants and staff trained in engineering, science, business administration and management. In 1993 it provided a multitude of services to over 4,000 companies, operated around 500 training courses and assisted about 50 firms to gain ISO9000 accreditation. The HKPC assists SME through subsidized training programs and consultancy by making available equipment and machines used for quality test and product development.

Even though the Hong Kong Productivity Council (HKPC) provides consulting services to local electronic firms, SME often would not use them as the fees are too high. As industrialist puts it, "We only use them (HKPC) as a last resort." More funds should be channeled to help lower the fees of these government agencies, especially fees charged to SME.

The Hong Kong Industrial Technology Development Center Corporation (ITDCC)

ITDCC is a statutory body set up by the Hong Kong government in 1993 as part of its policy to stimulate the growth of high tech industry. ITDCC received an initial grant of HK$250 million, a 5,700 square meter land grant and HK$188 million in low interest

loans to fund 20 local high-tech start-up companies under its incubation program. Incubatees are provided low interest loans, subsidized office rent and management advice for the first three years.

The VTC is a statutory organization which operates eight technical institutes and two industrial training centers, providing crafts and engineering courses in electronics and related industries. The VTC provides short training courses in machine shop and metal working, plastics, precision tooling, CAD/CAM and other subjects. The TDC is responsible for promoting overseas trade by organizing trade fairs, computerized trade inquiry service and providing product information by company for local and overseas buyers. Finally, the HKID promotes industrial investment by providing prospective investors with information on suitable industrial locations, labor searches, and other investment factors. HKID is also the prime mover for the Hong Kong Science Park project.

3.4 Policy recommendations for Hong Kong's electronics sector

In the next few sections, we will discuss various policy recommendations for assisting the growth of the electronics sector in Hong Kong. Policies recommendations on labor, land, capital and technology will be discussed.

Picking winners, picking losers

Industrial policy has various interpretations. Hong Kong has performed well in industrial policy aimed at investing in infrastructure and human capital that benefited all sectors. The main disagreement is whether the Hong Kong government should adopt an industrial policy of "picking winners". A practice which has been pursued by other NIEs like Taiwan and Singapore. The fact that laissez faire Hong Kong does not have as many new technology-intensive industries is a consequence of the absence of such a policy. In other words, the market has chosen not to have these advanced industries, to have them one must actively encourage them through the public provision of additional incentives. What then if the industrial targeting turned out to be "picking a loser"? What makes the government such an expert in picking winners? Singapore's biotech industry and Taiwan's automobile industry has certainly not been winners. In Chapter 4 we will see that Taiwan's semiconductor and PC industry grew from the state support.

Investment in new and technology intensive industry involves long term investment with high risk which private investors are reluctant to undertake. It is true that the state does not have the propensity to pick winners, but it is also true that it is the state which has the capability to see beyond short term capital gains and can take investment risk in long term projects that might have greater social and economic returns to investment.

Subsidizing human resource development

SME in Hong Kong invest very little in training of their employees. Often training for new employees lasts only three days. Big multinationals like Motorola allocate 40 hours a year on training for employees. Tax and other incentives should be used to encourage companies especially the SME's to provide better training for their workers. In this respect the VTC can play an active role in providing the necessary training programs targeted at improving the skills of the workers. To ensure that subsidies for the training of workers are not siphoned off by the SME on some ill-devised training program, the VTC can also act as a watch dog to perform periodic checks on the training programs and on the skill improvements of the workers.

Increasing and attracting skilled personnel and experts

The electronics industry has been asking the government to increase the number of local and foreign engineers. Recommendations have been made to even subsidize the housing for foreign experts invited to help develop the local industry. As discussed in chapter 2, for every 1,000 manufacturing employees, Hong Kong's industry employs only 2 graduate engineers while Taiwan employs 14 and Singapore 16. Clearly there is a lack of investment in technically skilled personnel in Hong Kong's manufacturing industry. I suspect that this is a demand side decision rather than a lack of supply in engineers. As discussed earlier, Hong Kong electronic firms' strategy is based on competing on cost and minimal investment in R&D. Subsidizing the import of skilled personnel will not have a big positive impact on the electronics industry. Firms interviewed often complain that they have difficulty in retaining engineers but on the other hand firms are unwilling to pay a salary comparable to the service sector.

On the supply side, the government has recently increased the number of universities by raising the status of polytechnics and expanded the graduate level curriculum. This has increased the pool of supply of engineers in Hong Kong. The demand for high-paying technical jobs, however, has not increased. The government should push to develop a demand for high-paying technical jobs concurrently with the increase in supply. This is the only way to increase high-paying manufacturing jobs in Hong Kong.

Affordable industrial land

Land and labor cost are very expensive in Hong Kong. Industries that are land and labor intensive will not have a chance to thrive. The expansion of existing industry and the growth of new start-up companies should not be severely constrained by high land costs. Affordable office space and industrial land should be made available to manufacturers and new start-up companies. Hong Kong now has three industrial estates, Tai Po, Yuen Long and Tseung Kwan O, with a total land area of over 200 hectares. The new proposed Science Park will provide an incremental 22 hectares for high tech companies. This increase in industrial land provided by the Science Park is considered inadequate. Furthermore the land is priced too expansive for new start-up companies. A large scale subsidy in land price for the industry might, however, bring about protests from other sectors wanting similar treatment. A major portion of the Hong Kong government's revenues comes from land sales and land-related property taxes. The major concern of the

government is that an ill proposed land subsidy to the industry will harm the property market.

Science Park

The Hong Kong government has recently approved the plan to build a Science Park (similar to the Taiwan Hsin Chu Science Park) in Pak Shek Kok, Tai Po. The Science Park which is situated near the Tai Po industrial park and the Chinese University is supposed to house high technology firms and link them to the local university and other research centers. The park is to bring in a net present value (NPV) of HK$1.1 billion over a 15 year period assuming a zero opportunity cost for the land. This is however a misleading figure. Because if the land is used for medium density residential housing, the NPV is negative HK$8.5 billion[28]. This figure shows the ridiculously high price for residential land in Hong Kong. The figures also did not factor in other benefits of having a Science Park like an improved international image for Hong Kong, stronger links between universities and technology intensive firms, spill-overs to the industry. A well managed science park with vibrant high tech companies will definitely benefit the local electronics industry. Skeptics however feel that the park will be just another industrial park with a different label.

Venture capital and a Second Board on the Hong Kong Stock Exchange

Venture capital for technology investment is not readily available in Hong Kong. Venture investors in Hong Kong faces the problem of having to compete with other non-manufacturing sector like property market in Hong Kong (a highly profitable sector in terms of return on investment) for money. Hong Kong also lacks liquid exit instruments like NASDAQ in the US for new start up companies to obtain capital. A second board similar to the ones in Japan should be created to help new start up companies avoid the stringent criteria in getting listed presently required by the Hong Kong Stock Exchange. More channels to facilitate venture investment in high technology companies needs to be developed. Low interest industrial loans should be made available to companies showing promising business plan but have no collateral. This role has been partially filled by the ITDCC but with only 20 slots available every 3 years, the effort is far from adequate. Care should be given to monitoring the allocation and the use of the loans to prevent misappropriation of funds.

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[28] Segal Quince Wicksteed (Asia) Ltd, 1995, Hong Kong Science Park Study Stage 2, Final Report Executive Summary.

Establishing an Industrial Bank of Hong Kong

The banking system has been the pillar of the development of manufacturing industries in East Asia. Under the state's selective credit policy, banks in Japan, Korea and Taiwan channeled large amounts of funds to their industrial sector. Hong Kong does not have an active partnership between banks and industry, characteristics that was inherited from the system of its British colonizers. Share of loans and advances from local Hong Kong financial institutions to the manufacturing industry accounted for less than 20 percent in 1960s and declined further in the 1970s and 1980s. This situation is especially inadequate towards SME who often had to rely on self financing. Most banks prefer short term working capital financing instead of long-term financing. The lack of long term funding may explain to some extent (the other reason being easy access to cheap labor) why industrial automation has progressed so slowly in Hong Kong. Loans to the industry should be done with long term cost benefit analysis. The use of funds in the firms should also be closely monitored to prevent them from being channeled for other uses.

Facilitating Chinese investments into Hong Kong

Hong Kong can be very attractive to Chinese companies looking to get a foothold in expanding its business abroad. It can also be a "listening post" for Chinese firms in upgrading technological and market information capabilities. We have seen examples of how Chinese firms have been using Hong Kong to complement their manufacturing activities by locating high paying R&D and marketing/data gathering jobs in Hong Kong. Accumulative foreign investment numbers show that China is Hong Kong's third largest foreign investor after US and Japan. The Hong Kong government should play an active role in encouraging Chinese firms to broaden and locate their high value added manufacturing activities into Hong Kong. Chinese firms gain by locating in Hong Kong-advantages related to product development capabilities, administrative skills, distribution services, and so forth. With such investment, Hong Kong may be expected to benefit as well.

Link between academic and industry

All Hong Kong universities provide an industrial liaison office to link their academic research with the industry. Many of them have even started their own companies to engage in high technology product development in order to facilitate technology transfer, like Hong Kong Polytech which has just recently spun-off Hong Kong Supernet, the first internet service provider on the island. The link between academicians with the industry is however, weak. For instance, research professors who engage in industrial technology are

not credited by the present university system. University professors are also not allowed to hold advisory positions in the industry like in the US. Lowering the barrier for professors to serve as advisors and to have business links will increase the number of new start-up companies and also strengthen the technology base of Hong Kong companies. The Science Park will also increase the interaction between the industry and the academic institutions.

Policies on technology acquisition and transfer

LLE and MNC in Hong Kong do not face the same obstacle as SME in technology acquisition. Individual SME will find it hard in manpower and resources to acquire technology to improve product and manufacturing processes. Companies like Vtech, Gold Peak and Motorola can rely on their internal R&D or use acquisition and licensing of technology to acquire technology. SME like Wing Sang has to rely on technology acquired through OEM contract with customers. This arrangement has limited the growth of Hong Kong SME to being low cost producer with second rate technology. Hong Kong government should increase the role of HKPC and HKID to include roles similar to ITRI and ERSO (see chapter 4) of Taiwan in acquiring and disseminating technology to SME.

Subsidizing manufacturing automation

Hong Kong firms have been slow to invest in factory automation, preferring to use cheap labor in China instead. This has given Hong Kong electronics firms greater flexibility to change the production line quickly but the product quality and yield suffer. Companies like ALCO and Vtech have found the optimum balance in automating their factories in China, balancing quality with the flexibility. Other SME like Avantec has relied on practically no production automation. Many SME are either financially or technically not able to automate when it is clearly more profitable to do so. The government agencies like HKPC should provide both advice and long term loans to SME to upgrade their production processes where necessary.

Helping local producers overcome trade barriers

Local SME often do not have the experience to export to new markets. The TDC has been successful at creating a database of local manufacturers so that foreign buyers can easily locate local producers but there is still a need to help local manufacturers especially SME to locate buyers overseas. Entering a mature market like US, Japan or Europe is a daunting task for SME. Products often could not pass stringent quality checks. Europe for example has a strict requirement for electronic products that emit electro-magnetic waves. The TDC

and the HKPC should provide more support for local SME abroad and also actively provide consultation on how to meet international standards.

Promoting trade between Hong Kong and China

China has a population of 1.2 billion people, the largest in the world. It also has an annual GDP growth rate of 10% for the past 15 years, the fastest growing economy in the world. Hong Kong has a definite advantage when it comes to trade with China. Hong Kong businessman has the advantage of language, culture and connections through years of experience of investing in China. Hong Kong products are also viewed as being of higher quality than local Chinese products. Hong Kong government through the TDC can coordinate the efforts of Hong Kong firms to penetrate the Chinese market by setting up trade offices at all major Chinese cities. Hong Kong government should also negotiate for a lower tariff on Hong Kong products entering Chinese market after the integration of Hong Kong into China. Hong Kong products entering China are now being treated the same as foreign imports.

Strengthening Hong Kong's product identity

Hong Kong can increase its product brand identity through increasing overall national quality standards like what has been done by Japan in the 1970s. A coordinated national effort to raise the national product image is very important as it is difficult for the individual manufacturer to increase the overall image without cooperation from other manufacturers. Silcon Electronics' CEO during the interview raised the issue that the company finds it difficult to raise the quality of its watches like what the Swiss did with their watches as the local parts suppliers are of low quality. Although Hong Kong is the worlds largest producer of watches in terms of quantity, less than 1 percent of watch manufacturers in Hong Kong has the ISO9000 certification of quality. The HKPC and TDC should increase their effort in increasing the quality of the local SME.

Strengthening production process and product innovation

Hong Kong companies both LLE and SME are very quick in following industry leaders in production process and product innovation. New products often takes only months to appear in local production lines after introduction. The major limitation here is the availability of key components. A local electronic toy manufacturer, Team Concepts, says that the toys that they make are constrained by the parts that are available. The government can help by periodically publishing the best practices of the industry and by helping to establish a stronger parts and components industry in Hong Kong. The HKID can also act

as a medium to disseminate new technology for production process and product innovation advances to the local firms.

More technologically competent people in the government

Government officers in the Hong Kong civil service are very often from the arts but not trained in the sciences. Even fewer of the officers have working experience in the manufacturing industry. Industrialists are calling for more government officials to have a better understanding of the workings of the industry.

Creating a private information storage

Having an information storage in Hong Kong on talents will help prevent the replication of investment in technology acquisition. It will also help the patenting of industrial and academic findings. This is helpful for both Hong Kong and foreign industries to access technological information.

Helping the components and parts industry

With most of the Hong Kong assembly manufacturers moving production to China, most of the electronics manufacturing that is left in Hong Kong is in high value added parts and components manufacturing like PCB, LCD and ICs. These high value added products are less dependent on labor cost constraints. Hong Kong could provide incentives to parts and components MNC for locating manufacturing facilities in Hong Kong. Hong Kong would be an attractive site for locating parts and components manufacture for its proximity to the huge Chinese market. The clustering of parts and components manufacturer in Hong Kong will also provide spill-overs and help stimulate the growth of the local industry.

Establishing semiconductor industry in Hong Kong

Hong Kong's first IC fabrication plants were set up in the early 1980s, about the same time as Taiwan's and before Singapore's. Taiwanese and Singaporean governments, seeing high-tech manufacturing as the wave of the future, promoted the domestic industry in the form of incentives and equity investment. Hong Kong's semiconductor industry with no support from the government did not take off. Table 3.9 shows that Hong Kong's production in semiconductor is way behind Taiwan and Singapore. In 1994, its total production in semiconductor industry was only US$59 million, only about 1 percent of the production of Taiwan and 6 percent that of Singapore.

Table 3.9 Semiconductor Industry's market share, 1994

Country	Production in US$ million
US and Europe	68,900
Japan	60,660
South Korea	15,600
Taiwan	**4,200**
Singapore	940
Hong Kong	**59**
Asia Others	569
Total	151,000

Source: Dataquest, Far Eastern Economic Review August, 1996.

Does Hong Kong need a semiconductor industry? Yes[29], semiconductor is the brain of the electronic product and often is also the most expensive component. It is very difficult to have a strong electronics sector without having a strong semiconductor industry to support it. Hong Kong's electronics manufacturers relies on foreign semiconductor for their supply. In times of high demand, Hong Kong manufacturers might find that they are shut out of the market like what happened in 1987 when firms in the respective home country of Taiwan, Korea and Japan were given priority to the supply of ICs shutting Hong Kong manufacurers out[30]. Relying on foreign semiconductor industry will also handicap the time to market for local manufacturers. In a rapid developing area like electronics, product life cycle is very short, the lag in time to market will weaken the industry.

Semiconductor industry is an industry where it is high risk, high cost and uncertain return as the technology changes so fast. In Taiwan and Singapore, the government took away some of the risk by subsidizing the industry and providing direct equity investment. In an interview with Far Eastern Economic Review recently, Carlos Genardini, corporate vice-president of Motorola's Asia Pacific Semiconductor Products Group said that "Singapore and Taiwan offer research and attractive benefits." Indeed, any Motorola plan to set up a fab in Hong Kong "is going to dictate a lot of government support." Hong Kong however has the advantage in the growth of the Chinese market[31]. In an industry where the technology changes every few years, it might be to Hong Kong's advantage to enter the

[29] Reif Rafael, Director MIT Microelectronics Lab, in answer to the CEO of Vtech on whether Hong Kong needs semiconductor industry, during a lunch meeting in Hong Kong.
[30] Comment by CEO of Sintek of Hong Kong during an interview at ITDCC.

market at a later stage than its competitors as it is able to build the industry on the latest technology available.

[31] Thornton Emily, 1996, Silicon Stone Age, Hong Kong is Missing Asia's Chip-making boom, Far Eastern Economic Review, August 22, 1996, pp. 66.

3.5 Critical assumptions about Hong Kong post 1997

On July 1, 1997, Hong Kong will return to Chinese rule. Under the new rule, China has proclaimed the "One Country Two Systems" policy where Hong Kong will maintain more autonomy than any other region in China. This Joint Declaration was signed between China and the United Kingdom on 19 December, 1984. It provided that the post 1997 Hong Kong Special Administrative Region (HKSAR) will be directly under the authority of China's central government.

Policy recommendations for Hong Kong in the previous sections are based on a few critical assumptions. The first assumption is that Hong Kong will have the autonomy to implement policies on its own after its hand-over to China after June 1997. The major issue here is how much autonomy the HKSAR will have. The second assumption is that under the "One Country Two System" policy, it is uncertain whether Hong Kong will still be able to maintain its current status in international trade and dealings with other countries without losing its independent membership in the WTO. The major concern is that if the Chinese borders were pushed further to include Hong Kong, China might impose import taxes on goods flowing into Hong Kong. This action will threaten Hong Kong's position as an international trade Mecca and trans-shipment center. The third assumption is that Hong Kong will have control over immigration. A large influx of Chinese immigrants will cause social problems and cripple Hong Kong's economy. The fourth and final assumption is that China will not enact new laws on its trade with Hong Kong, or interfere in the financial system of Hong Kong. Many people fear that after the integration, China will interfere or enact policies that would harm Hong Kong's interest.

Chapter 4 Analysis and recommendation for Taiwan's electronics industry

4.1 Overview

In just over four or so decades after World War II, the Republic of China (ROC) transformed itself from an agricultural economy into a newly industrialized economy. Although it lacks natural resources, the ROC has achieved an annual economic growth rate of nine percent since the 1950's. As a result of sustained rapid economic growth, the average per capita income rose from less than US$200 in 1950s to more than US$10,000 in 1992[32]. Through these years of rapid economic growth, the electronics sector has played a leading role in its economic development.

4.1.1 History of electronics industry

During the late 1940s, Taiwan implemented development strategy of import substitution in labor-intensive light industry. Over the past four decades, the total volume of exports increased substantially, from US$120 million in 1952 to US$76 billion in 1991. Taiwan's approach to development was by way of "nourishing industry with agriculture and strengthening agriculture with industry". Agriculture exports earned foreign exchange which was used to purchase the capital goods required by import-substituting industries. Meanwhile the government targeted labor-intensive industries for development. It was during this time that saw the beginning of Taiwan's electronics industry.

In the early 1950s, small scale private family-run businesses began to assemble radios using imported parts from Japan. Firms transferred from mainland were making simple electrical equipment such as transformers, wire and light bulbs. With the government investing heavily in the improvement of electrical and communication facilities, business flourished. Besides restriction on the import of finished goods to protect infant industries, the government also adopted a multiple exchange rate system to keep down essential imports[33].

In the late 1950s multinationals began searching abroad for cheap labor locations. With its historical link as a former colony of Japan, Taiwan was a natural choice for Japanese MNC

[32] Kao Yueh-shi Carol and Liao Huei-Chu, 1994, The Development of Small and Medium-sized Enterprises in the Republic of China, Industry Free China, Mar, 1994.

like Sony, Sharp, Matsushita, and Hitachi. The skilled labor force, government incentives and US aid programs favored US MNC like General Instruments, Texas Instruments, NCR and DEC to set up a manufacturing base in Taiwan. During this time, the Taiwanese government implemented many government policies such as the first "Four Year Economic Development Plan", the "Land to the Tiller" program, the privatization of state-run industries and import substitution that helped spur the Taiwanese economy.

In the early 1960s, the Taiwanese government introduced a series of incentives to promote exports and to encourage private savings and investments. This reflected a policy shift from passive import restriction to active export promotion. The export promotion measures included the setting up of Free Trade Zones (FTZ). The first FTZ was built by the port of Haohsiung followed by Taichung and Nantze. By 1986, the zones had attracted 96 electronics producers employing 45,000 people. During 1960-70s the annual real growth rate for gross production of manufacturing industries reached 17.1 percent. However, the source of Taiwan's explosive growth in electronics industry was not the MNC but the local companies. Between 1966 and 1971, Taiwanese electrical and electronics exports together grew at an average rate of 58 percent per annum. The MNC provided opportunities for local firms to do sub-contract and other manufacturing services. Many of the new start-up companies were former employees of the MNC and relied heavily on foreign firms for training and licensing agreements. Between 1952 and 1988 the government approved 3,000 such agreements; many were for technology transfers in electronics[34].

The major products from Taiwanese firms were home electrical appliances, radios in the mid-60s, then turned to TV and TV games. In the 1970s Taiwan moved away from general incentives toward industrial targeting of specific industries. The growing political and military insecurity with the US normalizing relations with China pushed Taiwan to emphasize on developing technological self reliance and to deepen its industrial structure. Both the computer industries and semiconductor industries were being actively promoted by the government. During this period, the government also emphasized the promotion of capital-intensive industries and imposed more export and local content targets on foreign

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[33] Chang Fenghau Chang, 1988, Historical and Social Factors Leading to Rapid and Equitable Industrialization in Taiwan, Masters Thesis, Department of Economics, MIT.

[34] Dahlman, C. J. and Sananikone, O., 1990, Technology Strategy in the Economy of Taiwan: Exploiting Foreign Linkages and Investing in Local Capability. Preliminary Draft, Washington DC, The World Bank.

companies. Higher value-added production was encouraged by the lowering of taxes on selected technology imports[35].

The 1980s saw large numbers of SME entering the electronics sector making computers, sub-assemblies, monitors, printed circuit boards (PCBs), printers and keyboards. This period also saw Taiwan's wages rise substantially. Taiwan had progressed from cheap labor to low-cost, productive high-quality engineering. The PC industry took off in the 1980s as IBM, Wang, Hitachi and others purchased huge quantities of finished goods and sub-assemblies. In the latter part of the 1980s, companies increased their exports of precision engineered goods such as hard disk drives, color display terminals, video graphic adapters and computer peripherals. Taiwanese firms were increasingly competing in the earlier phases of product life cycle (see 2.3.1). In semiconductor design and manufacture, Philips together with the Taiwanese government formed a joint venture in 1987, forming the Taiwanese Semiconductor Manufacturing Corporation (TSMC) to make specialist circuits for local design firms[36]. Other private firms like Acer formed partnership with TI to manufacture semiconductors to complement its computer productions. Mitac, another private computer and peripherals manufacturer partnered with Intel .

Like Hong Kong, many Taiwanese manufacturing enterprises moved production offshore in the late 1980s due to rising wages and labor shortages in the labor intensive manufacturing sector. Outward investment from Taiwan increased from US$56 million in 1986 to US$1,552 million in 1990. The move offshore has helped the local electronics sector especially in the consumer electronics to overcome the chronic labor shortage by having offshore plants concentrate on low-end and labor-intensive parts, freeing the Taiwan operations to concentrate on R&D activities, high-end production, procurement and marketing. Table 4.1 shows that exports of electronics from Taiwan increased nearly four fold from 1985 to 1990 despite the rise in local wages. The difference between Taiwanese outward migration of low end electronics manufacturing jobs with the case of Hong Kong is that new high paying skill intensive jobs in semiconductor industry and computer industry were being generated in Taiwan while in Hong Kong the sector was still manufacturing mostly OEM-labor-intensive consumer electronics manufacturers. There were no new high-tech manufacturing industry to replace the low wage manufacturing jobs that went offshore from Hong Kong.

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[35] Meaney Constance Squires, 1994, State Policy and the Development of Taiwan's Semiconductor Industry, ME Sharpe Press, New York, pp. 170-193.

Table 4.1 Exports of Electronics in Taiwan

Year	Exports US$ billions
1970	0.2
1974	1.2
1980	4.1
1985	4.9
1987	10.6
1990	17.2

Source: Ministry of Finance, MOEA and Taiwan Electric Appliance Association, Cited in Hobday pp. 99.

4.1.2 Current status of electronics industry in Taiwan

The electronics sector in Taiwan has diversified from low end consumer electronics to IT-related industrial electronics in 1990s as can be seen from the broad categories of consumer electronics, industrial electronics and components in table 4.2. IT-related hardware products have been the fastest growing sector in Taiwan in the last ten years. Table 4.3 shows that by 1993, Taiwan has become the world leader in the manufacturing of IT-related products like monitors, PCs, motherboards, mouse and keyboards. The growth of Taiwan's computer industry has been largely driven by medium-sized new entrants.

Table 4.2 Composition of Taiwan's electronics production unit: %

Year	Consumer Electronics	Industrial Electronics	Parts & Components
1976	39	3	58
1980	38	4	58
1985	29	33	38
1990	13	52	35
1992	12	52	36
1994	12	55	33

Source: Taiwan 76-85 EIU; 90-92 Elsevier; 94 Dept of Statistics, Taiwan MOEA, Industrial Production Monthly, April 95, cited in Wong[37] 1995 pg 43.

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[36] Wu Se-Hwa, 1992, The Dynamic Cooperation Between Government and Enterprise: The Development of Taiwan's Integrated Circuit Industry, ME Sharpe Press, New York, pp. 171-193

[37] Wong Poh-kam, 1995, Competing in The Global Electronics Industry: A Comparative Study of the Innovation Networks of Singapore and Taiwan, Journal of Industry Studies, Volume 2, Number 2.

Table 4.3 Taiwan's Leading Computer Products 1993

Product Item	Production (million of units)	Market Share % World
Monitors	17.5	51
Desktop PCs	2.3	8
Notebook PCs	1.3	22
Motherboards	12.3	83
Cathode Ray Tubes	1.4	24
Graphic Cards	7.1	31
Switching Power Supplies	21.2	30
Image Scanners	1.0	55
LAN Cards	3.8	27
Mice	22.1	80
Keyboard	18.8	49

Source Institute for Information Industry, Market Intelligence Center data, cited by Hobday, pp. 102

Taiwan has in recent years established itself in the semiconductor industry with a significant number of indigenous players across the entire value chain of IC design, fabrication and assembly (Table 4.4). IC output has been growing at 24 percent a year from 1989 to 1993. In the early stages, only foreign firms invested in the packaging firms that made up Taiwan's semiconductor industry in the 1970s. Later the government of Taiwan invested in the construction of demonstration factory through ITRI. This success later brought about the forming of the United Microelectronics Corporation (UMC). The forming of UMC was followed by a large amount of capital investment by the government together with Philips to establish TSMC. The private sector financial groups were influenced by the success of the semiconductor industry and one after another invested in the industry. Table 4.5 shows that of the 9 IC companies in Taiwan during the late 1980s, three of the largest ones are controlled by government agencies or spin-off from government agencies (UMC, TSMC and Winbond).

Table 4.4 Taiwan's IC Industry Growth, 1989-93

	Output Value in US$ millions					
	1989	1990	1991	1992	1993	% growth p.a. 89-93
IC Design	204	219	272	341	443	21.4
IC Fabrication	284	337	626	931	1572	53.4
IC Assembly	977	1018	1000	1108	1401	9.4
Total IC Output	1465	1574	1898	2380	3416	23.6
(Percentage)						
Proportion IC Design	13.9	13.9	14.3	14.3	13.0	
Proportion IC Fabrication	19.4	21.4	33.0	39.1	46.0	
Proportion IC Assembly	66.7	64.7	52.7	46.6	41.0	
	100	100	100	100	100	

Source: Information Industry Yearbook, 1993, cited in Wong 1995 pg.45

Table 4.5 Taiwan's IC companies

Company	Capital US$ mil.	Employee	Management
Shin-Tin	3	100	Family
HMC	50	275	Family
Philips	100	2,949	Philips
TSMC	551	690	Philips/ITRI
UMC	200	887	Former ITRI
Windbond	150	530	Former ERSO
Taiwan Mohsi	16	15	US Company
Chunghua Design	3.8	35	Hong Kong
Motorola	74.8	1,770	Motorola

Source: Cited by Se-Hwa Wu, The Dynamic Cooperation Between Government and Enterprise: The Development of Taiwan's IC Industry 1994.

4.2 Electronic firms in Taiwan

4.2.1 MNC

Philips

Philips of Holland is one of the largest MNC in Taiwan. In 1991, sales were about US$970 million. Philips began operations in Taiwan in 1961 taking advantage of the cheap labor in the labor intensive packaging operations. In 1966 it opened its major facility in the Kaohsiung FTZ manufacturing resistors, capacitors and simple ICs. In 1970, Philips began manufacturing cathode ray tubes in Taiwan. In 1975, it purchased a black and white TV set assembly factory from a US firm in Taiwan and began color picture tube production in 1978.

Up until 1987, Philips Taiwan was just one of the 40 branches that manufactures consumer electronics and semiconductors for Philips International. In 1987, however, Philips integrated into Taiwan's industrial structure with an agreement to form a joint venture with Taiwanese government (TSMC) to transfer produce specialist chips for both local and Philips internal use. Under the venture, the government through ERSO/ITRI pumped in US$400 million while Philips with US$100 million controlled 35 percent. Philips was to transfer its static random access memory (SRAM) technology to TSMC. 200 personnel from ERSO, mostly engineers were sent for training with Philips. These personnel later formed the core personnel that spun-off from ERSO and started TSMC.

TSMC was set up with two leading-edge fabrication lines, both located at Hsinchu Science Park. It is one of the first companies in the world to offer foundry-only services, mostly for Silicon Valley and Taiwanese chip design companies. TSMC provides services in ASIC design, mask making, VLSI wafer manufacturing, wafer probing, assembly and testing. By 1991, TSMC employed around 770 staff. In 1992 it expanded further by allocating around US$1 billion for new chip plant, making it one of the largest

semiconductor companies in Taiwan. 1995 sales of TSMC exceeded US$1 billion employing 3412 employees[38].

In the case of TSMC, we see the role of the Taiwanese government being actively involved as an initiator and facilitator of technology transfer with MNC. Even though the FDI's contribution to capital formation in Taiwan has been low (see chapter 2) compared to countries like Singapore or Hong Kong, Taiwan has been very successful in maximizing the flow of foreign technology into the local economy. The case of Philips Taiwan is a good example where the government MNC partnership has worked well for both parties.

4.2.2 LLE

Acer

Acer is interesting because it is a latecomer corporation in Taiwan that resembles a Silicon Valley start-up company. Acer was established in 1976 by Stan Shih and 11 engineers (mostly US trained) under the name Multitech International Corporation. By 1994 sales revenues had reached US$3.2 billion and over US$205 million in earnings (see table 4.6) making Acer is the world's seventh largest PC company. 70 percent of its sales are from computer manufacturing operations, and the remainder from its computer-related trading and publishing activities.

Table 4.6 Acer's performance 1989, 1994

	1989	1994
Revenue	0.688 billion	3.22 billion
Net Earnings	5.8 million	205 million
Total Assets	598 million	2.08 billion
# of employees	5,540	9,700
Rev./Employee	260,000	381,000

Source: Acer company report

Before starting his own company, Mr. Shih had been the vice president of Qualitron, the largest Taiwanese manufacturer of hand-held calculators. In trying to turn the company into a mini-conglomerate in the early 1970s, Qualitron's founder diverted the profits from his calculator business into other investments. Deprived of necessary reinvestment, the

[38] Hobday Michael, 1995, Innovations in East Asia, Edward Elgar Press, England pp.95-133.

company eventually failed. Seeing this, Shih invited two of qualitron's key personnel to join him in starting a new company. With this modest beginning, Multitech operated as a distributor of electronics products which consisted mostly hardware and software products for PCs. In 1983, Multitech started to manufacture IBM-compatible PCs both as an OEM and OBM where the OBM was mostly for Taiwanese and Asian market. Through its OEM arrangements, Multitech gained access to core technologies and market outlets.

Shih however, realized that Multitech could not continue to grow if it continued to be a follower in technology and rely on well known brand names for market access. In mid 1980s, Multitech increased its spending on R&D to about 5 percent and opened sales offices around the world. Multitech which was later renamed Acer acquired Counterpoint Computers as well as Altos of the US, it also set up sales and joint ventures in Japan, Germany and South America. By 1989, 32 percent of the company's total sales came from Europe and 31 percent from North America. Exports were sold to 70 different countries through a retail network of around 100 distributors. Offshore manufacturing plants were set up in US, Holland, Malaysia and China[39].

Acer's success has come largely from production of standardized products (mainly a line of IBM-compatible PCs). It used its design skills to clone rapidly, and even improve upon standardized products. It has leveraged its design skills by installing a modern, highly efficient manufacturing facility. Acer's transition from OEM to OBM was not without any problems. Faced with a loss of US$90 million between 1990 and 1993, Acer retreated from OBM to return to OEM and ODM sales. In 1993, the group reported a profit of US$30 million partly as a result of this strategy. Acer was investing too heavily on marketing and distributions needed to increase OBM sales. By focusing on OEM/ODM sales, Acer was able to increase output, gain economies of scale and customer-led quality improvement[40].

[39] Hayes, H. Robert, 1991, Acer Incorporated, Harvard Business School, Rev, April 2, 1993.
[40] Wei C. Richard, 1994, The Acer Group: Vision for the Year 2000, Harvard Business School, Rev, Sept., 1994.

Table 4.7 Acer Milestones

Year	Event
1976	Founded as Multitech International Corporation, with registered capital of US$25,000 and 11 employees.
1980	Introduced the Dragon Chinese-language CRT terminal, which subsequently received Taiwan's most prestigious design award.
1981	Established the Third Wave Publishing Corporation.
1984	Introduced the first 16-bit Multitech PC.
1985	Established international branches in Japan and Germany.
1986	2nd company (after Compaq ahead of IBM) to announce a 32-bit 386-based PC.
1988	Changed name to Acer and was publicly listed in Taiwan Stock Exchange (TSE). Acquired Counterpoint Computers, a US developer and manufacturer of minicomputer systems.
1989	Joint Venture with TI and the Taiwanese government to construct a semiconductor fabrication facility producing DRAM. Purchased a 50% share in CeTec Data Technology GmbH, distributor of Acer products in Germany. Acquired Kangaroo Computer BV in the Netherlands, the site of Acer's European manufacturing, technical support, and logistics center.
1990	Acquired multi-user systems leader Altos Computer Systems for US$94 million. Restructured into Regional and Strategic Business Units along product and territorial lines to allow for decentralized control and increased efficiency. Joined German aerospace firm Messerschmitt-Bolkow-Blohm, a Daimler-Benz subsidiary, in forming Ambit, a hybrid microelectronics device designer manufacturer
1991	Introduced ChipUpTM technology, the first single-chip 386-486 CPU upgrade.
1992	Developed the first 64-bit RISC-based desktop PC. Acquired 19% interest in Computec de Mexico, Acer's Mexican distributor.
1993	Acer Peripherals and Acer Sertek preparation for separate listing on the TSE. Licensed ChipUpTM technology to Intel Corporation.
1994	Formed joint venture marketing company between Acer Computer International and Technical Systems Distribution, South Africa's top distributor. Formed joint venture company and fifth regional business unit, merging Acer Latin America and Computec de Mexico.
1995	Acer Computer International Ltd. launches IPO Total Revenues top US$5 billion.
1996	The Acer Aspire receives PC Magazine's editors' Choice Award.

Source: Corporate publications, Acer 1997

4.2.3 SME

Mycomp

Taiwan Mycomp (TMC) is a medium sized computer peripherals manufacturer. It was established in 1983 to participate in the then nascent PC compatible business. In 1995, sales revenues were US$100 million, employing 350 people worldwide. TMC has its corporate headquarters and manufacturing operations in Taiwan with affiliated companies in US, Canada, New Zealand, Germany and UK handling sales and after-sales support functions. TMC also has a small research center with 7 engineers in the US as a "listening post" for new technology. TMC's major line of products are motherboards, industrial CPU cards, and interface cards. It has 35 engineers, 28 in Taiwan and 7 in the US. 15 of them specialize in hardware design, 5 in CAD/CAM, 4 in Basic Input Output System (BIOS) design and 11 in software.

TMC benefited from many of the Taiwanese government programs during its start-up phase. First the PC industry marked as one of Taiwan's strategic industries is privileged to receive various financial assistance in R&D spending, procurement of machinery and equipment, and construction of factories. Second it benefited from technical and marketing information provided by the Institute for Information Industry (III), which was founded in 1979 by the government. Third, TMC acquired the technology to produce IBM PC8088 (its first product) for free as IBM was trying to penetrate the PC market in 1982-83 and disclosed the architecture of its PCs to promote clones. Fourth, for its subsequent products like the IBM PC/XT's, TMC received help from ITRI who cooperated with IBM to disseminate the technology to the local manufacturers.

With the help of government agencies like ITRI and III, TMC and other SME have been able to keep abreast with the technology leaders in getting their products out before competitors in other countries like Hong Kong. By shortening the lag time behind market leaders, Taiwanese manufacturers can increase profitability and capture more market share ahead of its competitors. This had helped to create a powerful competitive advantage to Taiwanese firms in the 1980s. Mycomp has taken advantage of this government subsidized technology transfer. Despite its small firms size (350 employees in 1995), Mycomp has been able to keep abreast with the technology frontier. It was the first company to ship out a number of IBM PC products even in the mid 1980s (see table 4.8).

Table 4.8 Mycomp milestones

Year	Event
1983	Established
	Shipped 8088 IBM compatible PC systems
1985	Designed, manufactured and exported IBM PC compatible add-on cards
1986	First company in Taiwan to ship PC MFM disk controllers
1986	Evolved into a motherboard manufacturer
1987	First company in Taiwan to ship passive backplane CPU cards and EGA cards
1987	Set up a new product development center in USA
1992	Set up Germany sales office in 1989 and UK sales office
1992	Installed the 1st Surface Mounting Device (SMD) line
1994	Installed the 2nd SMD line
1994	Certified ISO9002
1994	First company in Taiwan to ship Pentium motherboards

Source: Company Data.

4.3 Current government policies

The Taiwanese government policy since 1960s was to create favorable conditions for exporters: single depreciated exchange rate, removal of import controls for exporters and low interest rates. In the earlier stages of development, Taiwan adopted a strategy that aimed to sustain export-led growth through expanded manufacture of standardized products in selected sectors like calculators, watches and color TVs[41]. In the late 1970s and 1980s the Taiwanese government played an active role as an initiator and facilitator of programs in research and development, education, and economic restructuring.

Taiwan has a very focused industrial development strategy. Its goal is to attain the status of a fully industrialized nation by the year 2000. To achieve this goal, it is targeting 10 key industries including telecommunications, information technology, consumer electronics and semiconductors. The specific programs targeted towards semiconductor and information technology (IT) and telecommunications sector will be discussed in detail in the following sections. The government, through the use of quasi-government institutions, is extremely directive. It has identified in detail key technologies within each industry and is working to ensure Taiwan develops the necessary expertise. Taiwan offers a wide range of programs focusing on upgrading high potential industries, enhancing quality and design capabilities, developing technically skilled personnel and strengthening public and private sector R&D.

General government programs that favors the industry includes;

- Science Park and export processing zones.
  - 74 industrial zones completed.
- Tax incentives for upgrading industrial production capability.
  - Loans, subsidies, and tax credits to help industries upgrade to newer technologies and processes.
- R&D tax credits and regulatory incentives on mergers.
  - Funding and loans to SME involved in leading products.
- Tax reduction on international marketing effort to establish brand recognition.
- Training tax credit and subsidies.
  - 60 percent matching grants for on-the-job and pre-employment training programs.

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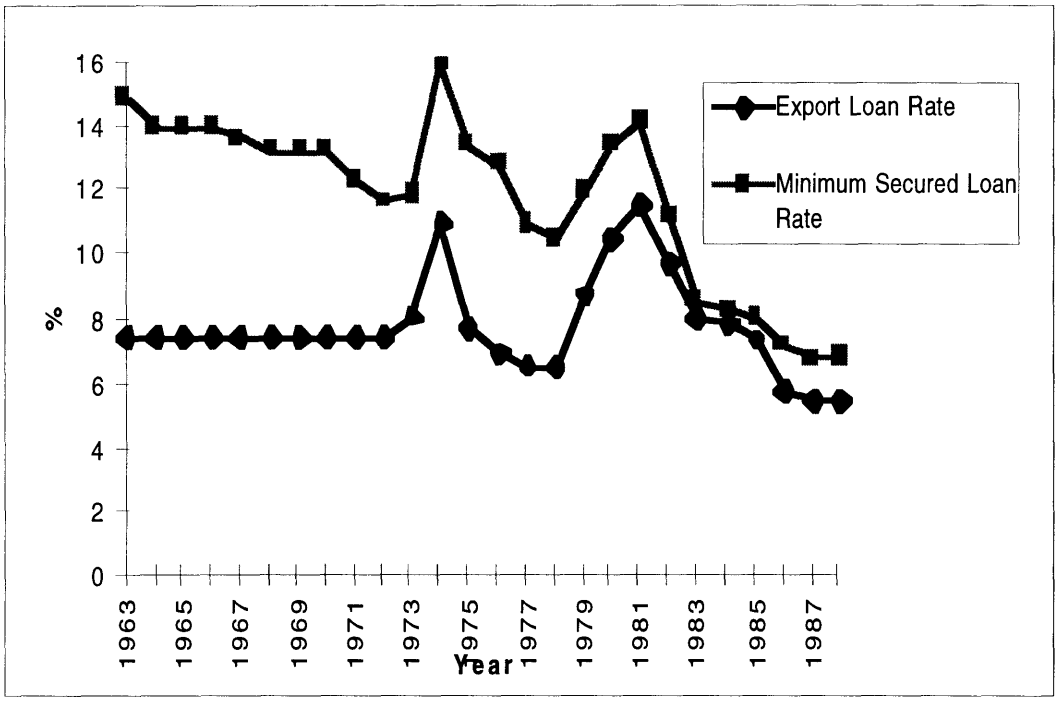
[41] Mody Ashoka, 1990, Institutions and Dynamic Comparative Advantage: The Electronics Industry in South Korea and Taiwan, Industry of Free China, Aug., 1991.

- 5 year plan to develop professional manpower.
- Tax reduction on investment on key technologies.
- Funding of quasi-government institutions like ITRI and ERSO.
    - Consortium R&D led by ITRI.
    - Provision of consulting services, help with labor and management relationships.

Taiwan also has a series of financial policies geared towards strategic industries. Firms which belongs to the strategic industries, including the electronic industry, was provided with special medium and long-term interest loans. The interest rate difference between the strategic loans and the prime rate has been around 1.72-2.75 percent. In addition to the strategic industries loans, the Taiwanese government through the Central Bank of China (CBC) provides low interest loans for export activities. The low interest loans are to provide pre-shipment production financing and funds for importing raw materials. The difference between the export loan rate and the minimum interest rate for secured loan is illustrated in figure 4.1. The effectiveness of these direct government subsidies to specific industries are difficult to determine but a study conducted by Yang, Jen, and Chou[42] in a 1989 based on survey results on the impacts of preferential loans on strategic industries concluded that the effects of preferential loans in reducing capital costs, investments, and stimulating investments were not significant, nor were the preferential loans an important factor affecting firms' operational efficiency.

[42] Yang, Y. H. Jen, L. C. Chou, R. C., 1989, An Evaluation of the Effects of Preferential Policies for Strategic Industries. Chung-Hua Institution for Economic Research (in Chinese).

Figure 4.1 Export interest subsidy in Taiwan



Source: Central Bank of China, Financial Statistics Monthly, Taiwan District, ROC, 1988, Cited in Shea.

4.3.1 Government agencies assisting the development of electronics sector

ITRI

The Industrial Technology Research Institute (ITRI), is an independent non-profit R&D organization. It was founded in 1973 by the Ministry of Economic Affairs (MOEA), headed by former ROC premier and engineer Y. S. Sun to attend to the technological needs of Taiwan's industrial development. It was initially entirely funded by the state to support the development of high-tech industries and to enhance the competitiveness of traditional industries in Taiwan. By 1988, ITRI is 55 percent government and 45 percent private sector. ITRI devotes its resources to the R&D activities of key targeted sectors in electronics, computers, communications, consumer electronics, opto-electronics, aerospace, machinery, materials, chemicals, energy & resources, metrology, industrial safety and health.

Recently ITRI has been helping local electronic firms form technology alliances or consortium to manufacture products like laptop computers, high-definition television, video-phones, smart cards and so on. In each case, ITRI has taken the initiative in

identifying the relevant group of products, taping into the available sources of technology like licensing new designs, and inviting firms to enter into consortium for the purposes of uptake and technology improvement. ITRI has also represented the firms in complex negotiations with MNC. In the 1990s, over 30 consortia have been formed with the help of ITRI.

ERSO

With a budget of $100 million and nearly 1,600 employees, Electronic Research Service Organization (ERSO) is the largest of eight divisions under the umbrella of ITRI. ITRI has a total annual budget of $250 million. ERSO was given the job of developing key components for the electronics industry, promoting R&D in computers and coordinating the transfer of technology from companies such as IBM, Microsoft and AT&T. Beginning with the acquisition of the 7 micron CMOS technology in the mid-seventies from RCA, ERSO has provided technical leadership to Taiwan's IC business. One of ERSO's successes has been the growth of a number of electronics companies established by local entrepreneurs to manufacture products developed by and licensed from ERSO at below-cost rates. Sometimes project teams were spun off and became pillars of industry in short order, such as United Microelectronics Company (UMC), Winbond and Taiwan Semiconductor Manufacturing Company (TSMC). ERSO officials claim that their transfer of PC technology alone have brought more than $1 billion in export revenue to Taiwan.

Recently however, the Taiwanese government is cutting back on its spending on electronics R&D as it thinks that the electronics industry in Taiwan has become established. With over 3,500 electronic firms in Taiwan in 1989, most of them SME, the cut back in government R&D funds will force them to invest more in their own R&D or be pushed out of the industry[43].

CCL

R&D work on computers, communications, and consumer electronics (the "3C") is carried out at the Computer and Communication Research Laboratories (CCL). CCL and its antecedent institutions have been a cornerstone for Taiwan's computer industry since the early personal computer days. In 1994, Taiwan produced 11.5 billion US Dollar worth of computer related goods, and is the world's leading producer of motherboards, mouse devices, and scanners. The activities cover hardware, software, as well as systems

[43] Agarwal Robin, 1990, Taiwan's Electronics Industry must now pick up the R&D tab, Electronics Business, May 14, 1990.

engineering. A major undertaking is to bring together Taiwan's industrial sector, academia, other R&D institutes, and government agencies to build Taiwan's National Information Infrastructure (NII). Solid relations have also been developed with prominent foreign companies such as AT&T, David Sarnoff, IBM, Intel, and Motorola, in technology transfer and joint technology and product development. Many of these alliances were formed with exploring the Asia Pacific market in mind.

Many of CCL projects have been instrumental in the continuing growth of Taiwan's computer industry. In the early 1990s, CCL organized a notebook PC consortium and a SPARC workstation consortium that have achieved considerable technical and commercial success. In 1993, CCL helped initiate the Taiwan New PC (TNPC) Consortium through collaboration with IBM and Motorola, to develop and promote a new series of PC's and workstations.

III

The Institute for Information Industry (III) was established in 1979 with government funds. Its principle objectives include software development, assistance in computerization, collection, analysis and dissemination of technical and marketing information on the IT industry. III frequently sponsors "information week" exhibitions that promotes the industry.

MBBT

The Medium Business Bank of the ROC (MBBT) was incorporated on July 1, 1976. The main purpose of the MBBT is to provide financial and managerial assistance to SME. More than 70 percent of MBBT's loans goes to SME.

SMBCGF

The Small and Medium-sized Business Credit Guarantee Fund (SMBCGF) was founded in July 1974 with funds donated by government agencies and related financial institutions. The aim of the SMBCGF is to render credit guarantee services to SME so that it will be easier for them to obtain financial support from financial institutions.

SBIAC

The Small Business Integrated Assistance Center (SBIAC), strives to assist SME in providing financial diagnosis and securing financing. It also helps SME in strengthening management structure and developing of a sound accounting system.

Start up Loans for Young Entrepreneurs

From 1968 to 1992, a total of US$211 million was loaned in response to 7,600 applications filed by 10,491 young entrepreneurs between the age of 20 to 45.

4.3.2 Government programs towards developing the semiconductor industry

Beginning in 1975, the government of Taiwan has been promoting the development of the IC industry. Entering the semiconductor field was part of a comprehensive vision that involved the upgrading of Taiwan's industrial structure to make it a center for high-tech industry. As a result, sales volume of IC's from Taiwan grew from essentially zero in 1976 to US$4.2 billion in 1994. The Taiwanese government channels a major part of its industrial development funds to the semiconductor industry. In 1994, it allocated 35.4% of its funds allocated to this industry.

Table 4.9 Milestones for government involvement in the IC Industry

Year	Event
1975	ITRI and MOEA agreed to develop the Semiconductor industry
1976	RCA was chosen to transfer CMOS technology to Taiwan
1979	Successful completion of the demonstration factory by ERSO
1980	United Microelectronics Corporation (UMC) was established to receive technology from ERSO
1987	Taiwan Semiconductor Manufacturing Company (TSMC) was established by ERSO with the partnership of Philips.
1989	The government partners with Acer and TI to manufacture DRAM

Source: Own compilation

The development of the semiconductor industry in Taiwan can be totally attributed to state targeting, planning, transferring technology from a foreign source, developing the product and transferring the experience and manpower to the local industry. At no time in these initial process was there any private investor who ventured into the sector. Only with the success of UMC and TSMC (both established with substantial government help), was private capital attracted into the IC field, in the form of semiconductor companies and design houses. The government acted as a catalyst to jump start the semiconductor industry as the private capital were reluctant to undertake the risky investment.

4.3.3 Government programs towards developing the IT and telecommunications sector

The IT-Telecommunications sector is the second largest sector subsidized by the Taiwanese government. In 1994, the government allocated 33.6% of its total development funds allocated to the industry to develop the information technology and telecommunications sector in Taiwan. Assistance to the industry comes in many forms. ERSO takes an active approach in developing crucial technologies, then transfers these to the local PC firms. III helps to disseminate technical and market information on the information technology sector to the local industry. The industry is also given low interest loans, favorable tariff rates for imported components, investment tax credits, and accelerated depreciation for capital expenditures. The state also ensures a steady supply of engineers and scientist by providing the best educational environment for cultivating engineers and technicians, by encouraging returnees from overseas, and by encouraging engineers from ERSO/ITRI to join the industry[44].

Table 4.10 Milestones for government involvement in the IT-telecommunications industry

Year	Event
1974	ERSO was founded to concentrate on the R&D of electronics technologies
1979	Institute for Information Industry (III) was founded to develop and promote the local information industry
1982	Information industry was chosen as a strategic industry
1982	ITRI together with 8 local firms developed IBM compatible PCs
1983	ITRI partnered with 5 local PC manufacturers to develop IBM PC/XT compatible products
1984	ITRI together with local companies developed IBM PC/AT compatible products
1993	ITRI/CCL together with local manufacturing firms formed Taiwan New PC Consortium to develop and manufacture products around Motorola's PowerPC chip

Source: Authors Own Compilation

An example of how the Taiwanese government agencies help local SME acquire technology is illustrated in a recent government sponsored initiative called Taiwan New PC

[44] Chang Chung-Chau, 1992, The Development of Taiwan's Personal Computer Industry, ME Sharpe Press, New York, pp. 193-215.

Consortium[45]. In June 1995, at the New York Personal Computer Expo, IBM unveiled the first PC it has designed using its new PowerPC microprocessor. Backing this processor is an alliance between IBM, Motorola and Apple Computer, in the hope of challenging Intel's Pentium chip. One day later a group of 30 Taiwan firms unveiled a set of their own products based on the PowerPC chip. This technology feat by Taiwan came about through an innovation alliance formed in 1993 called the Taiwan New PC Consortium. Driving this consortium is the Computing and Communications Laboratory (CCL), a division of the Industrial Technology Research Institute (ITRI). CCL identified the PowerPC as a candidate for technology and represented the Taiwan firms in negotiating with IBM and Motorola. This consortium has allowed Taiwanese SME to tap into sources of technology that is only available to world class companies through strategically targeted cooperation orchestrated by government agencies.

[45] Mathews John and Poon Shuk-ching Teresa, 1995, Technological Upgrading through Alliance Formation: The Case of Taiwan's New PC Consortium, Industry of Free China, 1995.

4.4 Policy recommendations for Taiwan's electronics industry

Intervention policy measures, such as price control and direct subsidies if not tied to improved performance of the firms might weaken the competitiveness of the firm in the global market. State interventions in Taiwan has so far worked well to develop the local electronic firms. This has been attributed to fierce rivalry among local firms and performance (targeted industry and export performance) tied incentives[46] offered by the government. The policy recommendation for Taiwan would be to slowly remove the crutches from industries that are no longer "infant industries". Institutional policies should be flexible enough to response to changing opportunities that arises. As infant industries matures, a different set of policies that increases rivalry and competition among firms might work to increase firm performance.

Government research and development subsidy

Probably the largest state intervention, especially in the late 1970s and 1980s, that shapes the electronics industry in Taiwan is government subsidies on Research and Development (R&D). As shown on table 4.11, the Taiwanese government contributed to over 60 percent of the total R&D expenditure in the early 1980s and average about 50 percent in recent years. In 1994, the government spent over US$2 billion on R&D alone, 72 percent of the R&D expenditure were made in the field of engineering. Also in the same year, 85 percent of research were on applied Research and experimental Development (Taiwan Statistical Year Book, 1996). These figures indicate that the Taiwanese government is substantially subsidizing applied R&D of its industry.

Many proponents of the free market question the relative benefits of government involvement in civil R&D. Stiglitz and Dasgupta[47] for example argued that inappropriate policy measures implemented by the government may result in the miss-allocation of R&D resources due to information barriers. This argument stems from the fact that firms and industries would have more information than the government on markets and product development. The Taiwanese government goes around this information barrier problem by having quasi-government institutions that operates hand in hand with the industrial

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[46] Shea Jia-Dong and Yang Ya-Hwei, 1994, Taiwan's Financial System and the Allocation of Investment Funds, M E Sharpe, New York.

[47] Stiglitz, J. and Dasgupta, P. 1980, Industrial Structure and the Nature of Innovation Activity, Economic Journal, Vol. 90, pp. 226-93.

entrepreneurs and academic scholars[48]. Proponents of government interventions in R&D argues that left by themselves, Taiwanese industry which are majority family owned SME will not have the incentive to upgrade their technology capability through investments in R&D. Furthermore the government can (1) evaluate cost benefit of the investment in a long term perspective, (2) pull resources to enjoy cost advantage, and (3) bridge the gap between private and social returns.

Taiwanese government should, however, decide when an industry is no longer at its "infant" stage and slowly reduce the subsidies to prevent firms from free riding on government subsidies on R&D and allocate less to R&D than they otherwise might.

Table 4.11 Taiwan's R&D expenditure by source of funds Unit: NT$ million

	Total		**Government**		**Private**			
					Domestic		Foreign	
Period	amount	%	amount	%	amount	%	amount	%
1984	22,444	100	14,197	63.3	8,041	35.8	205	0.9
1985	25,397	100	16,141	63.6	8,978	35.4	278	1.1
1986	28,702	100	17,253	60.1	11,301	39.4	148	0.5
1987	36,780	100	18,701	50.8	17,868	48.6	211	0.6
1988	43,839	100	24,793	56.5	18,922	43.2	124	0.3
1989	54,789	100	26,127	47.7	28,393	51.5	269	0.5
1990	71,548	100	32,772	45.8	38,659	54.0	117	0.2
1991	81,765	100	42,574	52.1	37,977	46.4	1,214	1.5
1992	94,828	100	49,509	52.2	44,803	47.3	516	0.5
1993	103,617	100	51,292	49.5	52,219	50.4	106	0.1
1994	114,682	100	55,286	48.2	59,235	51.6	161	0.1

Source: Taiwan Statistical Yearbook, 1995

Assistance in finance

Taiwan has a lower prime rate of lending than Korea or US but higher than Japan. A country which has a lower prime rate means that firms are able to finance their operations at a lower cost. Local financial institutions are, however, criticized for over emphasizing on collateral over profitability in granting loan; favoring public enterprises and large firms over private businesses and SME. There are various institutions set up to help the SME get

[48] Wang Jiann-Chyuan, 1992, Should Government Intervene in Civil Research and Development? -The Case of Taiwan-, Industry of Free China, Oct. 1992.

financing like the Medium Business Bank of Taiwan and The Small and Medium-sized Business Credit Guarantee Fund to help alleviate this situation but due to lack of sufficient funds, most SME still have to rely on family funds.

Improving labor shortage problem

The problem of rising real wages and chronic labor shortages is a pressing problem for the local electronics industry. Table 4.12 shows that for the past two decades, unemployment rate in Taiwan has been under 2 percent, lower than even Japan. As a result of labor shortage, many firms who have relied on low wage labor in Taiwan have moved their labor intensive production offshore. Unlike Hong Kong firms which has easy access to cheap Chinese labor in PRD, relocation of production facilities offshore poses as a bigger problem for Taiwanese firms. This is especially true for the smaller firms. The government can help ease the labor shortage by facilitating investments overseas, especially direct investment in China. The government can also ease the problem in the short term by relaxing the restriction on using foreign workers in Taiwan.

Table 4.12 Taiwan's unemployment rate Unit: %

	1951	1960	1970	1980	1990	1994
Unemployment rate	4.5	4.0	1.7	1.2	1.7	1.6

Source: Monthly Bulletin of Manpower Statistics, the Republic of China, 1995.

Manpower training and supply

Despite the low unemployment rate in Taiwan, there is under-employment among graduates of higher education (Kao[49]). This can be seen as a failure in the part of the government in matching the needs of the industry with the supply of manpower. One of the major reason is the lack of coordination between the various government agencies that oversee manpower training in Taiwan.

1. The Ministry of Education sets education policies and oversees the activities of all the education institutions.
2. The Vocational Training Bureau (VTB), is involved in technology transfer and acquisitions of special skills in precision tools and equipment.
3. A manpower group in the council of Economic Planning and Development coordinates the manpower portion in the national economic forecast.

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[49] Kao, Y. S. Carol, 1995, Adjusting to Internationalization: Labor Market Dynamic of the Republic of China, Industry of Free China, Aug., 1995, pp. 71, Taiwan.

4. The National Science Council (NSC) and the Ministry of Economic Affairs (MOEA) are concerned at the high end of the R&D program and technology transfers with helping the business and academic communities acquire specialists from abroad.
5. Finally the National Youth Commission helps returning students from abroad find employment in Taiwan.
These agencies and groups should work together to ensure that the needs of the industry is met. Specific recommendations that could keep the supply of manpower in-tune to the needs of the industry includes having students in engineering and management perform internships in the industry, gearing the course-work and academic research topics towards more practical industry concerns.

Policies on demand conditions

In the past decades, the United States has been the principal market for Taiwan's electronics products. Recently Taiwanese firms have begun to divert their promotional efforts to other markets like Europe and China. The Taiwanese government should help facilitate the smooth entry of Taiwanese firms into these markets by easing trade restrictions with China and giving advice to SME which are weak on international marketing.

Chapter 5 Conclusions

Hong Kong and Taiwan's electronics industry were very similar in firm structure and type of electronics products manufactured in the 1960s and 1970s. There were no shortage of skilled labor, capital market, entrepreneur or access to technology and consumer markets for these two countries. Both countries had similar firm structure, mostly SME family owned firms that relied on cheap local labor to manufacture consumer electronics. Both countries subsidized the local electronics industry through different methods. Taiwan subsidized the local electronics industry through subsidized export loans, low import tariffs on materials used for manufacturing exports and tax shelters. Hong Kong subsidized the industry by having low taxes and subsidized public housing. These subsidies worked well in keeping manufacturing costs low and exports in the electronics sector thrived.

In the late 1970s and 1980s the Taiwanese government headed by former premier Y. S. Sun put in place a set of policies to develop the local industry towards a higher value added manufacturing[50]. Ten target industries were selected with semiconductor and personal computer industry among them. The Taiwanese government interventions, especially through subsidized R&D and technology dissemination worked well in moving its electronics sector from mostly labor intensive assembly manufacturing to a higher value added, technology intensive manufacturing. The change in Taiwanese government policies on the electronics sector attracted many new entrants into technology intensive sectors of the electronics industry. These new firms were reliant on the government as a source of technology and other support especially in the innitial stages. Mycomp for example, received substantial help from ITRI in technology assistance. State support has enabled it to compete on the technology frontier and sell under its own brand name despite being a small company of only 350 employees.

Hong Kong government on the other hand did not change its policy towards its industry. Hong Kong's electronic firms left to fend for their own and shaped by the free market did not evolve into the high value added or technology intensive end of the electronics industry. Instead these firms shifted its manufacturing activities to China and expanded production of the same product that they manufactured before. The competitive advantage of these firms were mostly based on them being able to exploit cheap manufacturing labor in China. These cost advantages have been diminishing with the rise in wages in China.

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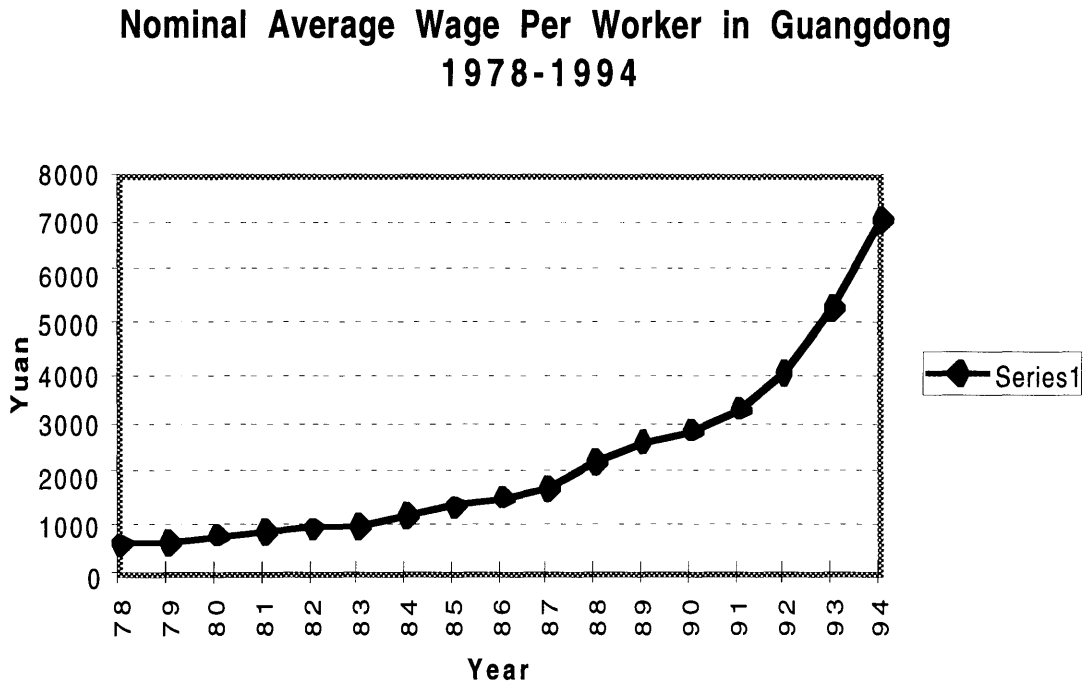
[50] Meaney Constance Squires, 1994, State Policy and the Development of Taiwan's Semiconductor Industry, ME Sharpe Press, New York, pp. 170-193.

Table 5.1 shows that the nominal wage in Guangdong Province where most of the Hong Kong electronic factories are located is increasing at nearly 20 percent a year in nominal terms for the past two decades. Hong Kong's electronic firms are also facing tough competition from entry of new competitors in the form of Chinese enterprises. In the past 5 years for example nearly 50 new Chinese Liquid Crystal Display (LCD) manufacturing firms have entered the market selling at prices way below Hong Kong LCD manufacturers[51].

Hong Kong electronic SME relies on customer driven technology, this has limited the ability of Hong Kong SME to break out of doing OEM to building their own brand name. Wing Sang for example finds its ability to expand its business limited by its lack of technical and managerial capability. Despite having three times the employee size of Mycomp, Wing Sang still could not leave its dependant on its customers for upstream and downstream activities of manufacturing. Hong Kong and Taiwan LLE are less affected by the locational disadvantages of manufacturing activities. GP for example manufactures in China, designs in Hong Kong, was listed in Singapore and acquired technologies from Australia and the United States.

[51] Chang C. C., Director Varitronix Hong Kong, Interview.

Table 5.1 Wage rise in Guangdong province



Source: Statistical Yearbook of Guangdong 1995

The surprising fact was that in 1994, "Made By Hong Kong" electronics products which includes Chinese exports made by Hong Kong firms in China was five times the total domestic exports or equals the total electronics exports of Taiwan. Therefore in terms of value of electronic products produced, Hong Kong firms have been able to maintain a strong position through manufacturing in China but in terms of raising local firms to produce higher value added products and keeping high wage R&D jobs in the country, Taiwan has done much better than Hong Kong.

The majority of Hong Kong electronic firms, especially the SME interviewed did not show substantial strength in technical innovation, product innovation or product design. The majority had very flexible, low cost manufacturing capabilities and are strong in marketing and distribution of the products. The Taiwanese government have been very successful in supporting the local industries in all manufacturing activities from technology innovation to marketing and distributions. Hong Kong government should put industrial policies in place with the example of Taiwan of how government policies can help to keep high paying manufacturing jobs in Hong Kong.

Appendix

Appendix 1 Average annual rates of growth of real GNP

Country	1960-69	1970-79	1980-88	1988	1991	1992	1993
Hong Kong	**10.0**	**9.4**	**8.0**	**10.5**	**3.9**	**5.2**	**5.5**
Singapore	8.9	9.5	7.0	10.0	6.7	5.6	9.9
Taiwan	**9.5**	**10.2**	**7.5**	**9.5**	**7.0**	**6.7**	**5.9**
China	2.9	7.5	9.2	10.2	4.6	12.0	10.0
Canada	5.7	4.7	3.1	4.3	-0.2	0.3	2.8
Japan	10.9	5.2	5.3	5.1	3.1	0.9	0.1
USA	4.1	2.8	2.6	3.6	0.4	2.2	2.5

Source: IMF for 1993, Data for all economies 1960-88 (Hobday 1995, p 14), Far East Economic Review.

Appendix 2 Leading local electronics companies in Taiwan

Ranked by 1994 Electronics Revenue

	Sales Revenue US$mn		
Company	**1993**	**1994**	**Major Activities**
ACER	1883.3	3202.2	Computers, Peripherals, Semiconductors
Tatung Co.	1202.0	1370.0	Computers & Consumer Electronics
Mitac Group	626.4	821.7	Computers, Peripherals
Taiwan Semiconductor Mfg.	467.2	731.0	Mfg. Services & Semiconductors
First Int'l Computer	447.9	628.5	Computers, Peripherals
United Microelectronics	379.1	576.3	Semiconductors
GVC	232.0	521.1	Communications & Computers
Kinpo Electronics	362.6	485.0	Consumer Electronics
Chuntex Electronics Co.	307.7	373.3	Peripherals
Delta Electronics	312.5	342.5	Components, computers, Peripherals
Advanced Semiconductor Eng.	220.6	358.8	Mfg. Services & Semiconductors
ADI Corp	321.1	421.0	Computers, Peripherals
Compal Electronics	334.7	336.4	Computers, Peripherals
Winbond Electronics	188.0	321.9	Semiconductors
Nan Ya Plastics	2451.6	2925.9	Components
Mosel Vitelic	238.4	285.1	Semiconductors
Hong Hai Precision Ind.	148.1	243.9	Components
Liton Electronics	171.8	242.2	Components
Teco Electric	539.4	645.1	Consumer Electronics
Macronix Int'l	147.0	207.0	Semiconductors
Sampo Technology	212.2	196.9	Consumer Electronics
Behavior Tech Computer	111.7	144.0	Computers, Peripherals
Compeq Mfg. Co.	141.6	137.1	Components
Microtek Int'l	89.0	113.2	Peripherals
Taiwan Kolin	262.1	235.5	Consumer Electronics
Silicon Integrated Syst	61.7	98.6	Semiconductors
Microelectronics Technology	81.5	97.9	Communications
Siliconware Precision Ind.	68.5	95.4	Mfg. services and Semiconductors
Picvue Electronics	77.1	95.1	Components
D-Link	68.1	92.0	Communications

Source: Electronic Business Asia, Sept. 1994, Sept. 1995 (Wong 1996)

Appendix 3 Leading listed local electronics companies in Hong Kong

Ranked by 1994 Sales Revenue	Total Revenue US$mn		
Company name	**1993**	**1994**	**Major Activities**
Semi-Tech (Global) Co. Ltd.	1260.5	835.9	Consumer electronics
The Grande Hdlg. Ltd.	711.7	770.3	Consumer electronics
Vtech Hdlg. Ltd.	565.0	532.2	Electronic toys, computers, telecom
Tomei International Hdlg. LTD	408.5	515.6	Consumer electronics
Kong Wah Hdlg. Ltd.	348.8	387.3	Consumer electronics
Great Wall Electronic International Ltd.	326.5	370.8	Consumer electronics
Legend Hdlg. Ltd.	231.8	311.2	Computers, Peripherals
Gold Peak Industries Hdlg. Ltd.	255.6	289.4	Battery, audio system, car audio
Wong's International Hldg. LTD	254.7	279.6	Printed Circuit Board
Alco Holdings Ltd.	139.2	255.6	Audio, Telecom.
South China Industries Ltd.	192.8	239.9	OEM Toys
China Aerospace Int'l Hldg. Ltd.	194.1	230.4	Consumer Electronics
Albatronics (Far East) Co. Ltd.	117.6	224.5	Audio, Telecom.
QPL International Hldg. Ltd.	193.1	215.6	Assembly and leadframes of ICs
Shell Electric Mfg. Hldg Co. Ltd.	164.6	213.6	Consumer Electronics
Hanny Magnetics (Hldg) Ltd.	128.5	208.3	Video cassette
Johnson Electric Hldg. Ltd.	189.5	193.1	Micromotors
Wong's KK International Hldg. Ltd.	181.5	191.9	Assembly/OEM
Stone Electronic Technology Ltd.	169.7	187.4	Industrial controllers
Applied International Hldg. Ltd.	127.8	181.2	Security Systems
China Everbright Technologies Ltd.	141.9	173.5	Consumer Electronics
ASM Pacific Technologies Ltd.	132.1	160.9	Semiconductor Machine tools
Starlight International Hldg. Ltd.	172.2	158.6	Audio, Telecom
Recor Hldg. Ltd.	144.7	151.4	Consumer Electronics
S. Megga International Hldg. Ltd.	125.1	139.0	Telecoms
Elec & Eltek International Hldg. Ltd.	134.5	134.9	Printed Circuit Board
Shougang Concord Intl. Ent. Co. Ltd.	135.5	134.2	Consumer electronics
Herald Hldg. Ltd.	126.4	134.1	Toys, Computer Peripherals
HB International Hldg. Ltd.	66.7	133.7	Telecom
Kosonic International Hldg. Ltd.	93.6	124.7	Consumer Electronics

Source: Thornton, Guide to Hong Kong Companies 1996[52].

[52] Thornton, 1996, Guide to Hong Kong Companies, Edinburg Financial Publishing (Asia) Limited.

Appendix 4 Factors considered greatly important in determining international locations (all industries)

	% Rate of Respondent
Accessibility of Target Consumer Population	75
Favorable Local Government Attitudes	64
Modern Energy/ Communication Systems	61
High Quality Local Labor Pool	58
Low Lease Rates	42
Well-developed Port/Airport	41
Existing Highway network	34
Low Corporate and Business Tax Rate	32
Accessibility of Suppliers	31
Low Property Costs	31
Low Overall Production Costs	31
Low Labor Costs	26
English Spoken Widely	25
Overall Cost of Living	25

Source: The Ernst and Young's Kenneth Leventhal Real Estate Group, Annual Global Strategies Survey, 1996.

Appendix 5 Worldwide 1992 electronics market

	1992 Revenues US$ Billion
Computers and Peripherals	192
Consumer Electronics	133
Parts and Components	117
Telecommunications	105
Industrial Equipment	92
Military/Civil Aerospace	79
Packaged Software	54
Transportation	30
Total	802

Source: Hong Kong Government Industry Department, Report on Techno-Economic And Market Research Study on Hong Kong's Electronics Industry 1993-1994, page 67.

Appendix 6 World wide electronics consumption by region 1992

	Consumption US$ billion	% of world consumption
US	320	40.0
Europe	236	29.5
Japan	143	17.9
Rest Of The World	101	12.6
Total World	800	100

Source: Compiled from Hong Kong Government Industry Department, Report on Techno-Economic And Market Research Study on Hong Kong's Electronics Industry 1993-1994

Appendix 7 Factor conditions for Hong Kong and Taiwan

Hong Kong

Favorable factor conditions

1. Excellent infrastructure
2. Access to cheap labor in China
3. Locational advantage at the center of Asia
4. Well developed financial system
5. Access to technology and market information
6. Easy access to huge Chinese market
7. Flexible work-force

Unfavorable Factor Conditions

1. High Land Costs
2. Venture capital for new start-ups are rare and investment capital tend to be short term
3. Weak basic research and technical capability
4. Limited supply of skilled labor
5. High wages and turnover
6. Worries about political instability with Chinese rule

Taiwan

Favorable factor conditions

1. Skilled production workers
2. Clustering of firms in computers and semiconductors, diversified economy
3. Location favorable for central and North coast of China
4. Strong and improving technology
5. Strong government support for the industry
6. Taiwanese electronics products known to be reliable

Unfavorable Factor Conditions

1. Not so well developed financial market
2. Lacking in infrastructure
3. Rising labor costs
4. Direct trade and investment barriers with China
5. Political instability on relationship with China

Source: Authors own compilation.

Appendix 8 Students returned from abroad and employment Unit: Person

Year	Total	Employed by Government	Employed by Industry	Teacher/ Academic	Others
1952-62 Ave.	48	12	9	10	17
1963	63	13	17	12	21
1964	95	18	13	26	38
1965	96	16	17	25	38
1966	120	25	13	43	39
1967	136	29	21	37	49
1968	184	38	20	50	76
1969	226	65	49	89	23
1970	407	69	70	221	47
1971	320	42	67	119	92
1972	355	78	69	133	75
1973	445	53	99	194	99
1974	486	64	124	208	90
1975	569	82	127	261	99
1976	722	81	123	303	215
1977	624	42	132	289	161
1978	580	48	109	219	211
1979	478	104	99	185	90
1980	640	71	72	162	335
1981	937	132	123	229	453
1982	1106	109	408	270	319
1983	1257	161	100	361	635
1984	1329	124	136	447	622
1985	1350	164	357	453	377
1986	1583	191	437	473	482
1987	1920	214	577	522	607
1988	2296	258	696	585	757
1989	2462	279	728	623	832
1990	2863	325	855	705	978
1991	3264	373	977	789	1125
1992	5157	472	1530	918	2237
1993	6172	194	935	897	4146
1994	6510	142	1317	812	4237
1995	6272	69	1200	611	4392

Source: ROC National Youth Commission

Appendix 9 Foreign direct investment (FDI) inflows as share of gross fixed capital formation Annual average %

Country	71-75	76-80	81-85	86-90	91-93
Brazil	4.20	3.90	4.30	1.70	1.47
China	-	-	0.90	2.10	10.37
Hong Kong	**5.90**	**4.20**	**6.90**	**12.90**	**5.70**
India	0.30	0.10	0.10	0.30	0.63
Korea	1.90	0.40	0.50	1.20	0.63
Malaysia	15.20	11.90	10.80	11.70	24.57
Singapore	15.00	16.60	17.40	35.00	37.40
Taiwan	**1.40**	**1.20**	**1.50**	**3.70**	**2.60**
Thailand	3.00	1.50	3.00	6.50	4.70

Note: FDI Inflows comprise: equity capital, reinvested earnings, and intra-company loans.
Source: United Nations Council on Trade and Development, World Investment Report, New York, 1992 and 1995, as cited in Amsden and Mourshed, 'Scientific Publications and Capabilities of Late Industrializers, 1997'.

Appendix 10 Supporting industry for electronics manufacturing in Hong Kong and Taiwan

	Hong Kong	Taiwan
Materials Technology		
Plastic Injection Molding	High (4377 companies, Chen Hsong)	High (Well-developed, high quality)
Machine Tool Industry	Medium (Well developed, in-house)	High (1068 companies, high quality)
Design and Manufacturing Support		
CAD/CAM Services	High (In-house)	High (Advanced technology, strong growth and support)
Manufacturing & Quality Services	Medium (HKPC, HKID)	Medium (ITRI)
Semiconductor Support		
IC Design Shops	Low (Motorola, Vitelic, Hua Ko and RCL)	High (55 circuit design companies, strong capabilities)
IC Mask-Making Companies	Low (Pacific Mask)	High (Taiwan Mask, Innova, TSMC)
IC Packaging & Assemblies	Medium (Swire, Motorola, ASAT)	High (30 companies in chip mounting, 20 in IC packaging, strong technology)

Source: Dataquest, Hong Kong Government Industry Department Report 1994, Tsai "The Development of Taiwan's Machine Tool Industry" 1992, Authors own interviews.

APPENDIX 11 Outward investment in Taiwan by industry, cumulative amount (1992-1995)

Industry	Amount US$ million
Electronics & Electrical	**1646 (16%)**
Chemical	1116
Foreign Trade	776
Services	718
Textiles	553
Basic Metal & Metal Products	535
Others	4910
Total	10254

Source: Taiwan Statistical Yearbook 1995.

Appendix 12 Group structure of Wong's International (Hldg) Ltd.

Wong's International (Holdings) Limited

Manufacturing Companies	**Marketing and Service Centers**
Wong's Circuits (P.T.H.) Limited	Wong's International (USA) Corporation
Wong's Circuits (P&E) Limited	Wong's International Limited (U.K.)
Wong's Electronics Co., Limited (KK)	Wong's Industries (Toronto) Limited
Season Industries Limited	Wong's International Japan Inc.
Wong's Polyfoam Company Limited	
Wong's Circuits (Huizhou) Limited	
Lomber (Huizhou) Limited	
Welco China Limited	
Dongguan Luen Yip Electronics Co., Limited	
WISRS (Malaysia) Sdn. Bhd.	

Source: Company Data.

Appendix 13 Profitability (ROCE) of Hong Kong electronic companies versus manufacturing 1988-1992

	Electronics Industry	Consumer Electronics	Parts and Components	Computers and Peripherals	Telecommunications
1988	23%	N.A.	N.A.	N.A.	N.A.
1989	20%	24%	18%	13%	13%
1990	12%	10%	16%	18%	22%
1991	13%	11%	17%	18%	10%
1992	14%	12%	19%	14%	12%

Note: Profitability measured by ROCE (operating profit as % of shareholder's equity plus long term debt)

Source: Report on Techno-economic and Market Research Study on Hong Kong's Electronics Industry 1993-1994, Hong Kong ID.

Appendix 14 Development plan for Taiwan's semiconductor industry

Objectives	Contents	Results
1. To increase the global share of Taiwan's semiconductor industry from 1.58% in 1991 to 3.4% in 1996.	1. LCD Technology development plan.	1. Developed core technologies in data storage and PVDF.
2. Decrease the dependency of Taiwan on imported ICs from 87% in 1991 to 65% in 1996.	2. Development plan to increase technology capabilities of core electronics parts and components.	2. Raised the submicron technology to 0.8u, completed the development of 256K SRAM and 4M DRAM manufacturing capability.
3. To make Taiwan one of the 5 leaders in semiconductor manufacturers in the world.	3. Development plan to develop sub micron technologies.	3. Generated 92 patents, 18 copy rights and 70 cases of technology improvements.
4. Developing Taiwan's capabilities in manufacturing LCD and other electronics components for self sufficiency.	4. Development plan for microelectronics components.	4. Installed ERDAS in 15 manufacturers to increase product quality and reduce cost.
	5. Running labs for the certification of international electronics products standardization.	

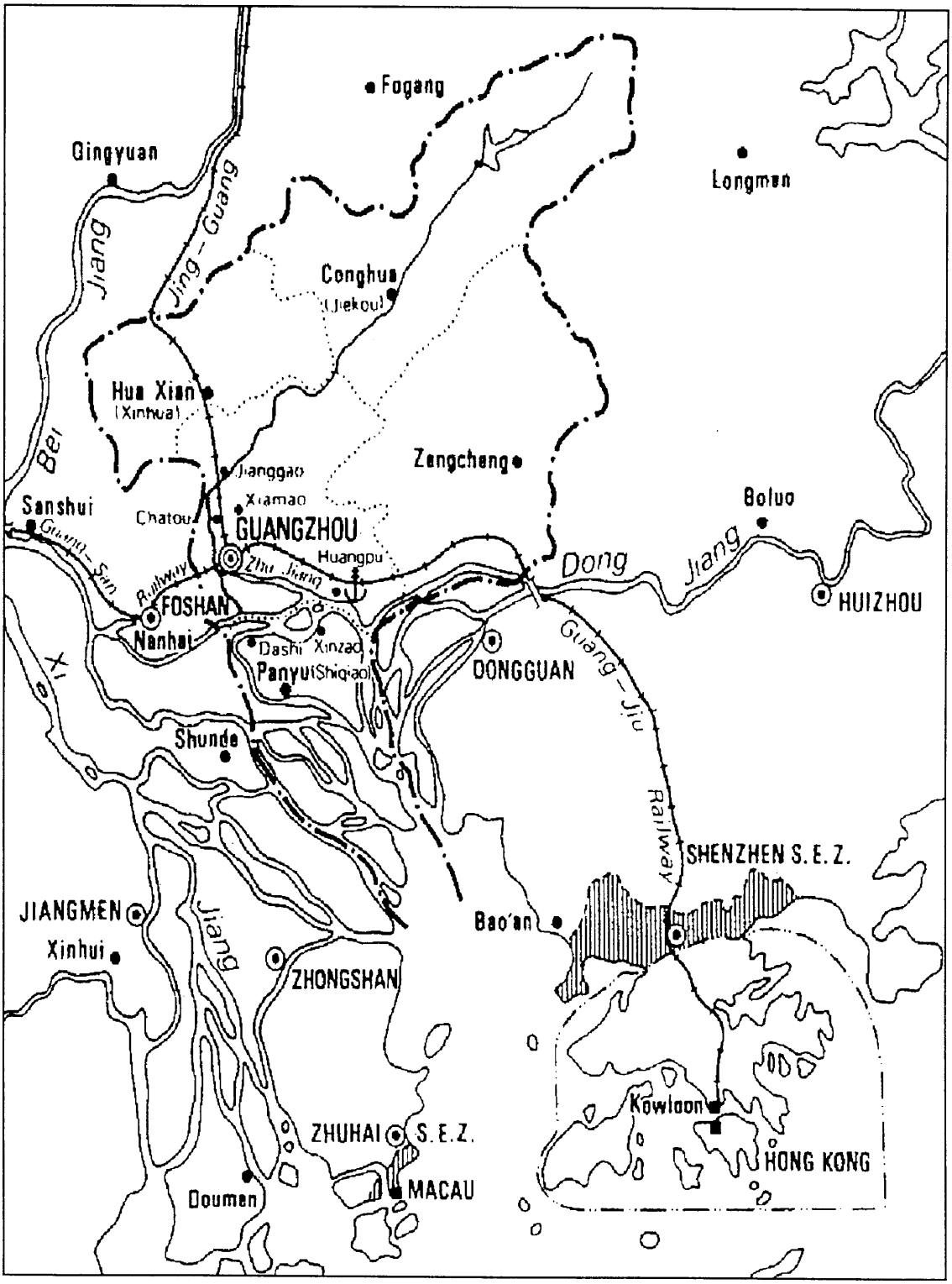
Source: Industry Free China June 1993 (In Chinese)

Appendix 15 Development plan for Taiwan's IT and Telecommunications Sector

Objective	Content	Results
1. Promote value added development of the internet, increase database development and usage technology. 2. Assisting the development of high value added consumer electronics. 3. Promote the development of parts and components used in telecommunications. 4. To increase the production of telecommunications product global market share from 1.6% in 1990 to 7% in the year 2000. 5. To increase the world wide ranking of Taiwan in telecommunications manufacturing from 13 in 1990 to 7 in the year 2000.	1. Development plan for developing electronic circuitry technology. 2. Development plan for multi media system in computers. 3. Development plan for imaging technology. 4. Development plan for scatter system in computers. 5. Development plan for high definition telecommunication systems. 6. Development plan for information system. 7. Development plan to disseminate database service and internet usage. 8. Development plan for telecommunications systems and engineering research. 9. Developed plan for developing instrumentation and manufacturing technology. 10. Development plan for electronics telecommunications. 11. Development plan for wireless communication technology.	1. Obtained 73 patents, 75 copy rights and developed 211 new technologies. 2. Local Area Network (LAN) and factory automation technology transfer. 3. Facilitated the transfer of CDMA technology to 5 factories. 4. Developed CASE software for manufacturing. Helped in the development of PC and peripherals in Taiwan. 5. Formed the alliance for the development of high definition telecommunications which developed 6 technological break through. 6. Transfer of LCD and TAB technologies to local manufacturers.

Source: Industry Free China June 1993 (In Chinese)

Appendix 16 Map of Pearl River Delta and Hong Kong



Source: Unverified source

Bibliography

1. Agarwal Robin, 1990, Taiwan's Electronics Industry must now pick up the R&D tab, Electronics Business, May 14, 1990.

2. Amsden Alice H, 1991, Big Business and Urban Congestion in Taiwan: The Origins of Small Enterprise and Regionally Decentralized Industry (Respectively), World Development, Vol. 19, No. 9, pp. 1121-1135.

3. Amsden Alice H., 1997, Manufacturing Capabilities: Hong Kong's New Engine of Growth?, "Made By Hong Kong", Oxford University Press, New York.

4. Berger Suzanne, 1997, Introduction, "Made By Hong Kong", Oxford University Press, New York.

5. Boston Consulting Group, 1994, Report on Techno-Economic and Market Research Study on Hong Kong's Electronics Industry 1993-1994.

6. Chang Chung-Chau, 1992, The Development of Taiwan's Personal Computer Industry, ME Sharpe Press, New York, pp. 193-215.

7. Chang Fenghau Chang, 1988, Historical and Social Factors Leading to Rapid and Equitable Industrialization in Taiwan, Masters Thesis, Department of Economics, MIT.

8. Chiang Su-hwa Susan, 1994, The Chinese Family Firm in Taiwan, Patterns of Development, Masters thesis at MIT Sloan School of Management.

9. Chiu W. K. Stephen and Lui Tai-lok, 1994, Hong Kong: Unorganized Industrialism, Dimensions of Corporate Strategy.

10. Dahlman, C. J. and Sananikone, O., 1990, Technology Strategy in the Economy of Taiwan: Exploiting Foreign Linkages and Investing in Local Capability. Preliminary Draft, Washington DC, The World Bank.

11. Dataquest, 1994, Report on Techno-economic and Market Research Study on Hong Kong's Electronics Industry 1993-1994, Hong Kong Industry Department, Hong Kong.

12. Hayes, H. Robert, 1991, Acer Incorporated, Harvard Business School, Cambridge, Rev, April 2, 1993.

13. Hobday Michael, 1995, Innovation in East Asia, The Challenge to Japan, Edward Elgar Press, England.

14. Industry Department Hong Kong, 1995, Hong Kong's Manufacturing Industries, Industry Department, Hong Kong.

15. Kao Yueh-shi Carol and Liao Huei-Chu, 1994, The Development of Small and Medium-sized Enterprises in the Republic of China, Industry Free China, Mar, 1994, Taiwan.

16. Kao, Y. S. Carol, 1995, Adjusting to Internationalization: Labor Market Dynamic of the Republic of China, Industry of Free China, Aug., 1995, pp. 71, Taiwan.

17. Liu, James, 1995, Development Strategy of Hong Kong Industrial Technology, Hong Kong Industrial Technology Center Corporation, Hong Kong.

18. Mathews John and Poon Shuk-ching Teresa, 1995, Technological Upgrading through Alliance Formation: The Case of Taiwan's New PC Consortium, Industry of Free China, Taiwan, 1995.

19. Meaney Constance Squires, 1994, State Policy and the Development of Taiwan's Semiconductor Industry, ME Sharpe Press, New York, pp. 170-193.

20. Mody Ashoka, 1990, Institutions and Dynamic Comparative Advantage: The Electronics Industry in South Korea and Taiwan, Industry of Free China, Taiwan, Aug., 1991.

21. Porter Michael E., 1990, The Competitive Advantage of Nations, The Free Press, New York.

22. Rothwell R and Zegveld W., 1981, Industrial Policies and Structural Change, New York, St. Martin's Press.

23. Segal Quince Wicksteed (Asia) Ltd, 1995, Hong Kong Science Park Study Stage 2, Final Report Executive Summary, Hong Kong.

24. Shea Jia-Dong and Yang Ya-Hwei, 1994, Taiwan's Financial System and the Allocation of Investment Funds, M E Sharpe, New York.

25. Simon Denis Fred, 1992, Taiwan's Strategy for Creating Competitive Advantage: The Role of the State in Managing Foreign Technology, pp. 97-123, M. E. Sharpe, New York.

26. Stiglitz, J. and Dasgupta, P. 1980, Industrial Structure and the Nature of Innovation Activity, Economic Journal, Vol. 90, pp. 226-93.

27. The Chinese Manufacturers Association, 1996, Survey on Small and Medium-sized Enterprises, The Business Journal, April 1996, Hong Kong.

28. Thornton Emily, 1996, Silicon Stone Age, Hong Kong is Missing Asia's Chip-making boom, Far Eastern Economic Review, August 22, 1996, pp. 66.

29. Thornton, 1996, Guide to Hong Kong Companies, Edinburg Financial Publishing (Asia) Limited, Hong Kong.

30. Tsai DH Stephen, 1994, The Development of Taiwan's Machine Tool Industry, M. E. Sharpe, New York.

31. Tsay Ching-lung, 1994, Taiwan: Labor Shortage, Dimensions of Corporate Strategy.

32. Tuan Chyau and Ng FY Linda, 1995, Evolution of Hong Kong's Electronics Industry under a Passive Industrial Policy, Managerial and Decision Economics, Vol. 16, 509-523.

33. Wang Jiann-Chyuan, 1992, Should Government Intervene in Civil Research and Development? -The Case of Taiwan-, Industry of Free China, Oct. 1992, Taiwan.

34. Wei C. Richard, 1994, The Acer Group: Vision for the Year 2000, Harvard Business School, Rev, Sept., 1994, Cambridge.

35. Wong Poh-kam, 1995, Competing in The Global Electronics Industry: A Comparative Study of the Innovation Networks of Singapore and Taiwan, Journal of Industry Studies, Volume 2, Number 2.

36. Wong Poh-kam, 1997, Technological Capability Development Strategy of Firms from Asian NIEs, and Possible Lessons for Malaysia, in press.

37. Wu Se-Hwa, 1992, The Dynamic Cooperation Between Government and Enterprise: The Development of Taiwan's Integrated Circuit Industry, ME Sharpe Press, New York, pp. 171-193

38. Yang, Y. H. Jen, L. C. Chou, R. C., 1989, An Evaluation of the Effects of Preferential Policies for Strategic Industries. Chung-Hua Institution for Economic Research (in Chinese).