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Growing with Global Production Sharing:

The Tale of Penang Export Hub

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Abstract

Global production sharing—the division of production processes into geographically separated stages—is a central feature of economic globalization. This study seeks to broaden our understanding of global production sharing, and to explore policy options for developing countries to engage effectively in production networks through a case study of the export production hub in the State of Penang, Malaysia. The findings uphold Penang as a unique example of marrying national development strategy with emerging opportunities for international specialization within global production networks. The state government of Penang has not only attracted major multinational enterprises in global electronics industry but also helped them become deeply rooted in the economy through a well-design investment promotion strategy, infrastructure development, skills development and vocational training, and promoting a domestic vendor network around the branch plants of MNEs.

Key words: production sharing, production fragmentation, foreign direct investment, multinational enterprises

JEL classification: F14, F20, F23

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Introduction: Purpose and scope

Global production sharing—the division of production processes into geographically separated stages—has been an increasingly important facet of economic globalization over the past few decades.[1] With a modest start in the electronics and clothing industries, multinational production networks have evolved and spread into many industries such as sports footwear, automobiles, televisions and radio receivers, sewing machines, office equipment, power and machine tools, cameras and watches, and printing and publishing. At the formative stage, production sharing involved assembly of small fragments of the production process in a low-cost country and re-importing the assembled parts and components to be incorporated in the final product. Subsequently, production networks began to encompass many countries engaged in the assembly process at different stages, resulting in multiple border crossings by product fragments before they were incorporated in the final product. As international networks of parts and component supply have become firmly established, producers in advanced countries have begun to move the final assembly of an increasing range of consumer durables, including, computers, cameras, televisions, and automobiles, to overseas locations to be closer to their final users and/or take advantage of cheap labour. There has been a steady rise in trade in parts and components and assembled final products – 'network trade' – in global production networks. In 2007, network trade accounted for 51% of total world manufacturing exports, with 41% of these exports originating in developing countries (Athukorala 2011).

Global production sharing in consumer goods such as garments and footwear normally takes place through arm's length relationships, with international buyers playing a

[1] Several terms have been used to describe this phenomenon, including international production fragmentation, vertical specialization, slicing the value chain, and outsourcing.

key role in linking producers and sellers in developed countries. However, the bulk of global production sharing in electronics and other high-tech industries still takes place under the aegis of MNEs. This is because the production of final goods requires highly customized and specialized parts and components whose quality cannot be verified or assured by a third party, and it is not possible to write a contract between the final producer and input supplier that would adequately specify product quality. This is particularly the case when establishing production units in countries that are newcomers to export-oriented industrialization. As the production unit becomes well established in the country and it forges business links with private- and public-sector agents, arm's length subcontracting arrangements with local firms can develop, leading to firm-level upgrading of technology and management capabilities.

This study seeks to broaden our understanding of global production sharing and explore policy options for developing countries to engage effectively in production networks as part of national development policy. The export production hub in the State of Penang, Malaysia, with over four decade as a major hub in global production networks, provides a valuable laboratory for a study of the interplay of government policies and global sourcing strategies of multinational enterprises (MNEs) in determining developmental gains from global production sharing (UNIDO 2009, UNCTAD 2010, Narayanan 1999 and 2008). A key theme of the paper is the role of public-private partnerships in Penang in the context of rapid changes in global production networks and increased competition faced by existing production locations as production networks expand to new locations with greater relative cost advantages.

The main objective of the study is to draw policy lessons from the Penang experience for other developing countries. However, the study is also of interest in its own right in informing the contemporary policy debate in Malaysia on appropriate policies and strategies for transforming the economy from middle-income to high-income status (NEAC 2009, 184). A central theme of this debate is enticing domestic firms to integrate successfully into global production networks; there is growing concern that, even though technology upgrading and moving up the value chain is happening, it is not fast enough to propel the country to high-income status.

This study uses information from three main sources:

1) Documents from Penang Development Corporation (PDC), the Penang state government organization responsible for investment promotion and public-private partnership

implementation, Invest Penang, the investment promotion arm of PDC, and the Penang state government.

(2) Interviews with senior officials of government and private sector economic facilitator organizations, senior managers of major MNE affiliates, and representatives of chambers of commerce and industry.[2] See Appendix 1.

(3) Firm-level information extracted from the unpublished returns to the Penang Industry Survey 2007 conducted by the Socio-Economic and Environmental Research Institute (SERI), Penang, and the Census of Manufacturing Industries 2005, conducted by the Malaysian Department of Statistics.

The study first provides an overview of initial economic conditions in Penang to set the stage for the ensuing analysis. Next it discusses the policy context, key elements of policy reforms and the institutional setting in which export-oriented development strategy was implemented. The Penang state government made innovative efforts to gain policy space and financial autonomy within the Malaysian federal system. Next, evolution of the export hub is discussed. Investment patterns and export performance are then examined, followed by a discussion on the economy-wide implications of export-led growth. Key findings and policy lessons are presented in the final section.

Penang: geography and history

Penang is a state located on the northwest coast of Malaysian Peninsula (see Figure 1: Map). It is divided into two parts: Penang Island (*Pulau Pinang*, in Malay), an island of 293 square kilometres located in the Strait of Malacca; and Seberang Perai (formerly Province Wellesley), a narrow hinterland of 753 square kilometers on the peninsula across a narrow channel bordered by Kedah in the east and north and by Perak in the south. Penang is the second smallest among the 13 states in area, but the eighth most populous at 1.52 million (2010 census). In terms of natural resources relative to its population, Penang is the least favorably endowed of all states of Malaysia. Until recently Penang was the only Malaysian state with an ethnic Chinese majority. In the 2010 Census, the ethnic mix changed in favour

[2] My original plan was to interview about 50 firms. This turned out to be too ambitious because of the time constraint and, more importantly, because the firms had developed 'survey fatigue' as they had been approached in connection with a number of surveys conducted by government organisations and the World Bank in recent months.

of the native Malay community (Bumiputera) (Bumiputera 43.5%, Chinese 41.0% and Indian 10.0%). However, the ethnic Chinese population (35%) is still well over the national average or the comparable figure in any other state.

Penang's modern history began with the arrival in August 1786 of Captain Francis Light to set up an East Indian Company trading post. In 1800, the East India Company secured a strip of land across the channel (Province Wellesley) as a buffer against attracts by Siamese and Thai invaders. In 1826, Penang, along with Malacca and Singapore, became part of the Strait Settlements under the British administration in India, moving to direct British colonial administration in 1867. In 1946, Penang became part of the Malayan Union, which gained independence in 1957 as the Federation of Malaya. Malaysia was created in 1963 with the merger of the Federation of Malaya, Singapore[3], Sarawak and Sabah.

Under British rule in the nineteenth century Penang became the first port of discharge of ships sailing from Europe and India to the Strait of Malacca. British order and protection drew merchants and migrants in large numbers from neighbouring countries, with Chinese immigrants soon becoming the largest community in the settlement.

Penang's status as an entrêpot significantly diminished after Stamford Raffles in 1819 created a port and military base in Singapore. Nevertheless, Penang's economic base as a free port city was strengthened in the second half of the nineteenth century by growth of tin mining and rubber industries and massive influx of Indian and Chinese immigrants to work the plantations and tin mines. Penang remained an entrêpot trade centre for the northern Malay Peninsula, Sumatra, Burma, South Thailand and the Dutch East Indies (Indonesia), after the opening of the Suez Canal in 1869.

At independence in 1957, Penang's economic status was healthier than the other Malay states and comparable to Singapore and Hong Kong. Trade-related infrastructure, including the Byan Lepas airport and the Gelugor container port and sea-cargo terminal, was better than other parts of the Federation. There were well-developed banking, insurance and freight forwarding services, water supply, electric power, telecommunication services and transport facilities. Penang had a relatively well-developed network of small enterprises evolved around entrêpot activities.

[3] Singapore left the Federation in 1965.

From the early twentieth century, Penang was a regional centre of Islamic, Chinese and English education (Andaya and Andaya 2001). The British established English-speaking schools to prepare the local population for government service. Compared to other Malaysian states, people in Penang were relatively well educated; most of them had at least 9 years of schooling, with a substantial number proficient in English (Tan 2009). When the federal government made Malay the language of instruction in the early 1970s, English schools in Penang found ways to offer instruction in English, helping to retaining the state's legacy as an English-language centre.

The early years of independence shifted the focus of economic and administrative development to Klang Valley, in particular to the new capital, Kuala Lumpur. Port Swettenham (renamed Port Klang) became the main port of the country. Penang's entrepot trade originating from Thailand, Burma and Indonesia also dwindled as each country developed its own ports. Indonesia's policy of 'confrontation' with Malaysia from 1963 to 1965 cut off lucrative trade with the Indonesian archipelago. The final blow to the entrepot trade came with the revocation its free port status (inclusion of Penang into the principal customs area of Malaysia) in 1967. Consequently throughout the 1950s and 1960s, Penang's trade-dependent economy therefore slid rapidly while the population was growing rapidly as a result of the postwar baby boom.

In the early 1960s, the Alliance Party state government attempted to avert the Penang economy's collapse through a programme of import substitution industrialization. An industrial state was set up in Perai in 1964 to produce goods for the domestic market. However, most of these industries failed within few years. By the end of 1960s, Penang's per capital income was 12% lower than the national average. The unemployment rate reached 9% (16% when underemployment is considered) and the population's general mood was rebellious. Penang was plagued by frequent strikes, social unrest and racial tension (Singh 2011, Lim 2005).

In this volatile climate revitalizing the economy was the dominant issue of the May 1969 general elections. The newly formed Gerakan Rakyat Malaysia (Malaysian People's Movement Party), led by Dr Lim Chong Eu, won with an overwhelming majority by promising to revitalize the economy and create employment opportunities through export-oriented industrialization. This new political leadership ushered in an era of policy reforms, which set the stage for the emergence of Penang export hub.

Policy reforms

In 1969, following the end of Penang's free-port status, the central government engaged Robert R. Nathan Associates, a US-based consultancy firm, to analyze opportunities and challenges facing Penang's economy and prepare a master plan for revitalizing the economy. Analysing Penang's development potential in light of the experiences of Japan, Taiwan, Hong Kong and South Korea, the Nathan Report (Penang Master Plan Study) called for a shift in economic structure through export-led growth strategy. After taking into account Penang's limited agricultural potential and lack of mineral resources, the plan called for 'plugging in' the economy into the global economy based on human resources as the only viable strategy for Penang for avoid economic stagnation, chronic unemployment and outmigration of capable young people

The Nathan Report emphasized developing an export-oriented economy, and proposed a shift of emphasis from Seberang Perai (capital of Province Wellesley) to Bayan Lepas because of better transport facilities and other logistics, and access to a large labour pool. The report foresaw the onset of an international division of labour: the electronics industries in the west were looking for cheap labour doing repetitive work. The report also saw the considerable potential for expansion of tourism and fishing, but emphasized export-led industrialization as the potential prime mover.

Lim Chong Eu embraced the Nathan Report as the blueprint for policy reforms: turning 'the socially disturbing high unemployment rate in Penang … into a socio-economic advantage through the promotion of labour-intensive industries' (Lim 2005, p. 9). He selected the electronics industry – broadly defined to include both electronics and electrical goods – as the priority sector, and the establishment of free trade zones (FTZs) as the vehicle for attracting electronics multinational enterprises (MNEs) to set up production facilities in the state. The choice of electronics as the target industry was based on two considerations: first, its labour-intensive nature and second, unlike heavier polluting industries, it was compatible with Penang's role as a centre of tourism.

Penang state government's decision to embark on export-led industrialization was followed by a major policy shift at the Federal level. In May 1969, Malaysia experienced its first major ethnic conflict. Following this traumatic event the Malaysian government

formulated a sweeping affirmative-action based national development programme, the New Economic Policy (NEP) (Leigh 1992, Jesudason 1990). The overriding objective of NEP launched in 1971 was to maintain national unity through (1) poverty eradication of among the entire population, and (2) restructuring Malaysian society 'so that the identification of race with economic function and geographical location is reduced and eventually eliminated (Government of Malaysia 1976, p. 7). For the first objective, development strategy was reformulated with emphasis on export-oriented industrialization. For the second objective, long-term targets were established for the Malay equity ownership in limited companies, and the proportion of Malays employed in manufacturing and occupying managerial positions.

The choice of export-oriented growth as a key element of the new development strategy at the national level greatly facilitated the Penang government's export-led industrialization move by avoiding possible policy conflict. However, the NEP's ethnicity-centered development policy posed a major challenge for the Chinese dominated Penang government.

Malaysia has a centralized form of federal administration (Crouch 2007). While Malaysia is technically a federation, state governments have only limited revenue-raising capabilities. The federal government monopolized taxation; state governments can only raise revenues through land acquisition and management and setting utility rates. The states have little influence on offering tax incentives and other concessions to foreign investors. The states, apart from allocating land, providing infrastructure, and some freedom in respect of collecting local taxes, have to work within the general national guidelines while devising their own projects and programmes. Moreover, there are no clear-cut rules or procedures for budgetary allocation among the states. Conflicts surface especially when an opposition party controls a state government (Jomo and Wee 2002).

Lim Cong Eu obtained autonomy and freedom of action required for the implementation of his Penang development strategy through a collaborative approach. He maintained close links with Tun Abdul Razak, then deputy Prime Minister and Director of the National Operations Council (NOC),[4] who later became the Prime Minister. Lim committed full support to Razak in restoring peace and order in Penang during the turbulent period following the ethnic riots in Kuala Lumpur. This cooperation led to the joining of the

[4] The decision-making body set up to tackle the ethnic conflict with overall authority over the armed forces, police and civil service.

Gerakan party with the federal ruling party, Alliance, to form a coalition called Barison Nasional. This well-calculated move helped to avert conflict with the federal government in implementation of policy reforms in Penang.

The reforms began with restructuring government machinery. A new statutory body, Penang Development Corporation (PDC), was formed as the principal development agency (Singh 2011). The legal status of PDC as a statutory body allowed it flexibility in fulfilling national objectives in areas where government departments faced constraints. It provided an institutional mechanism for coordinating activities of the municipal administration and the state government. Dr Lim filled the key positions of PDC with senior personnel of the federal administration who had been involved in the Penang master plan study. Of particular importance was the appointment of Chet Singh, an ethnic Indian economist from the Malaysian Civil Service and the State Financial Officer, as the first general manager of PDC. Singh played a pivotal role as Lim's right-hand man during the ensuing two decades in transforming Penang into an export-production hub with MNE participation.

Dr Lim chaired the State Planning and Development Committee (SPDC), the apex policy-making body of PDC, during his more than 20-year tenure as the Chief Minister (May 1968 – October 1990). The SPDC made all decisions relating to permission for land acquisition and development. All proposals were reviewed within three months of receipt, correspondence was replied to within seven working days, and responses to complaints were given within 21 working days. The PDC operated with the work ethic and management style of a private-sector company, with reward for employees based on productivity (Singh 2011).

In 1974, the two local authorities on Penang Island were abolished and the island was placed under a single municipal administration, the Board of Management of Penang Island. On the mainland, the three district councils were merged to form a single local authority, the Board of Management of Seberang Perai. In 1976, the two local authorities were changed to Penang Island Municipal Council and Seerang Perai Municipal Council. PDC assumed the role of coordinating activities of state government and the city council, addressing the various flows and gaps within the two levels of governance. Municipal administration reforms facilitate PDC's task of coordinating the works of the various agencies involved in approvals for new businesses.

PDC started operations with an initial grant of Malaysian ringgit (MYR) 5 million (US$ 1.6 million) from the state government. Given Malaysia's high degree of fiscal

management centralization, PDC programmes had to be implemented under severe resource constraints. In the formative years, PDC was granted autonomy to evolve a budgetary system to finance its programmes and activities from internally generated funds supplemented by loans from private institutions. An innovative feature of the PDC budgetary system was a land bank – formed through acquisitions and strategic purchases – that acted as a main source of revenue and facilitated infrastructure development.

Financial autonomy gained through this strategic move was vital for PDC's success because other Malaysian states soon followed Penang's example of creating their own development corporations and thus creating intense competition for federal funding (Hutchinson 2008). With a large number of development corporations and other government-linked companies emerging, the federal government in 1974 established a Ministry of Public Enterprises entrusted with the coordination, monitoring and evaluating the economic development corporations (EDCs) in the 13 states and other government-linked companies (GLCs).[5] In 1980, the Federal (State Legislation) Competency Act was amended to give the Ministry of Public Enterprises and the Ministry of Finance more control over the operation of statutory bodies.

An important feature of the PDC planning process under Lim Chong Eu's leadership was brainstorming sessions where officers from various departments and statutory institutions and the Chief Minister met in an informal environment. These sessions, termed 'jam-sessions', proved to be a very effective means of exchange of ideas and views (Singh 2011, p. 612).

The PDC tactfully handled the NEP employment quotas by permitting firms to recruit workers of their own choice based on response to job advertisements – that is, by requiring firms to recruit solely on the basis of advertisements rather than trying to fill the quotas. The PDC enjoyed considerable autonomy because Lim Chong Eu effectively used his political connections to cushion PDC management against influences from the federal level.

Free trade zones, industrial states and infrastructure development

[5] The term government-linked company (GLC) is used in Malaysia to refer to corporate entities in which the government owns an effective controlling interest (>50%).

Based on the Nathan Report recommendations, the Penang state government pioneered the establishment of free trade zones (FTZs) in Malaysia. Through close consultation with relevant federal agencies, in particular, the Economic Planning Unit (EPU) operating under the National Consultative Council, Penang persuaded the federal government to promulgate the Free Trade Zone Act in 1971. The Royal Customs and Excise Department opposed FTZs on the ground that they would provide Penang with a back door to regaining its free port status. However, the state government was able to jump this hurdle thanks to the intervention by Tun Razak (Singh 2011).

The first FTZ in Bayan Baru (Bayan Lepas FTZ) opened in August 1972. It aimed to attract clean industries that required the movement of materials and products by air-transport such as electronics, medical and other precision and machining industries (Lim 2005). A second FTZ opened eight years later in Seberang Perai near the shipping port to serve firms producing bulk items – high weight-to-value products such as household electrical appliances that depend on the shipping port and railways for the movement of material and products. Subsequently the original Bayan Lepas FTZ was extended in three further phases. Near the FTZs, five industrial estates were set up for supportive and ancillary industries related to FTZ firms, resource-based industries and import-substitution manufacturing activity.

Box 1

The FTZ incentive package

The Free Trade Zone Act of 1971 defines the zones to be outside of the Federation of Malaya for the purpose of custom duties and charges. All imported raw materials, components, and capital equipment directly related to production may enter the zones without payment of customs duties or other taxes. Goods manufactured in and exported from a FTZ are exempt from sales tax and excise tax. Goods may be moved from one FTZ to another without payment of duty or other taxes.

Goods purchased by FTZ firms from within Malaysia are treated as exports from Malaysia, and hence the manufacturers of such goods are eligible to claim drawback of duties on the

imported raw materials and components used in their production. The domestic seller is responsible for payment of applicable export duties and obtaining necessary export licenses. These goods are not subject to excise taxes. FTZ firms are also exempt from the payment of sales tax, excise duty and service tax.

Sales on the domestic Malaysian market of FTZ firms' products require prior government approval. Such sales are handled on a case-by-case basis and limited to 20% of a firm's annual gross output. These sales are treated as imports into Malaysia and import duties, and other taxes normally applicable to imports of these goods must be paid.

Real estate in FTZs is leased to zone firms at below market lease rates. This was the most significant subsidy in the provision of infrastructure to FTZ firms. At the initial stage of operation of Bayan Lepas FTZ some firms operated in factory buildings built and owned by the PDC. These buildings were rented as or below commercial rental rates.

These are three major (mutually exclusive) systems of tax relief for export-oriented firms in Malaysia: pioneer status, labour utilization relief, and investment tax credit. The first two entail complete exemption of company income tax for the specific period and the third involves an exception that may be complete or only partial. In addition, export-oriented firms are also eligible to deduct export promotion expenditure in calculating the taxable income. These tax incentives are not unique to the FTZ firms, but they are an important component of the FTZ incentive package.

PDC used FTZs and industrial estates for focused infrastructure development for successful global integration of the Penang economy. In addition, PDC created housing and new township to bring growth to the rural and least developed areas. Two new townships, Bandar Bayan Baru and Bandar Seberang Jaya, adjacent to the two FTZs, were established to redress the social and economic imbalances between the rural and urban populations. In the new townships, surpluses obtained from medium-cost housing units were used to subsidize low-cost units. To link the two new townships, the Penang Bridge was opened in 1985 with the support of the Federal government. PDC subsequently embarked on a major urban development programme to meet the growing demand for civic, administrative and community amenities in the George Town city centre.

Land is a scarce resource in Penang. In its development planning, PDC created a land bank through market acquisition of paddy fields and reclamation. The land bank used the rule that for every acre of industrial land, there should be four acres for development of housing, recreation, civic and social amenities and other related economic activities. Given land scarcity in Penang, the importance of land reclamation from the sea was recognized as far back as early 1970s as the most economical way of obtaining land for development, as private land is expensive. The possible total area of reclamation from the sea was estimated at the time to be about 3,800 hectares (Singh 2011).

Investment promotion

From its inception, PDC undertook promotion missions to various countries. The investment promotion campaign was designed with a help of Andy Ross, a consultant who had worked closely with Singapore electronics firms for many years. Most of these missions, in particular those to California's Silicon Valley, Germany and Japan were led by the Chief Minister. In its investment promotion campaigns, PDC successfully delivered the message that Penang people's skills and adaptability could effectively complement the needs of high-tech industries (Todd 1987).

When investors arrived in Penang, PDC provided an efficient and speedy one-stop service of investment approval and facilitation. In addition, PDC understood the importance of addressing the needs of investors already located in Penang: 'the after sales service was just as, if not more, important than the initial promotional work' (Singh 2011, p. 614). Delegation led by the PDC Chairman often called upon CEOs of companies that had invested in Penang to maintain close relationships and obtain inputs to developing the investment promotion camping in an evolving fashion.

PDC avoided organizing large investment seminars or conferences. Rather it conducted meetings with individual companies so that full attention could be paid to their specific needs in an effective manner. Over the years, PDC's approach to investment promotion was shaped by interactions and close relations with the MNE affiliates in Penang.

Fostering MNE-SME links

Fostering links between branch plants of multinational enterprises in Penang and local investors has been a key PDC priority (Grunsven 2007, Hutchinson 2008). Based on his close ties to the local business community, the Chief Minister encouraged MNE affiliates to procure components locally and forge subcontracting relationships with local firms. Promoting links between small- and medium-scale enterprises (SMEs) and MNE affiliates operating in Penang has been a priority of the Penang Skill Development Centre (PSDC), an innovative business-university-government training centre (see Box 2). PDC also encourages and provides institutional support to MNE affiliates to initiate vendor development programmes to strengthen backward input linkages with local suppliers.

At the formative stage, local firms faced two constrains in venturing into subcontracting with MNEs. First, they had to pay duties on imported inputs where as foreign firms located in FTZs were exempted from those duties. Second, being new to the industry, they were at a disadvantage compared to foreign investors. In 1986, the incentive package offered to foreign firms, including licensed manufacturing warehouse status, was also offered to local firms. In addition, at the request of the state government, the Malaysian Industrial Development Authority (MIDA, the federal investment approval body) imposed a minimum capital requirement of RM 2.5 for foreign machine tool firms seeking approval to set up operations in Malaysia in order to support smaller local machine tool firms (Rasiah 1994).

Vocational training programmes

In 1970, PDC established an Industrial Training Institute with West German assistance to offer occupational training in areas such as auto mechanics and welding. PDC, in collaboration with the City Council of Georgetown, launched a 'job-cum-training scheme' under which unemployed school leavers were employed as temporary workers, permitting half-a-day work and the rest of the work day receiving technical training in basic electronics and electrical component assembly. These trainees were the first recruits of the new electronics factories in the early 1970s. Under this training programme, MNEs could install their equipment at the centre and train their workers there. This helped reducing start-up time for new factories. PDC also liaised with the Industrial Research and Consultancy Service

Centre of the Universiti Sains Malaysia (Malaysian University of Science) to provide technical courses for SMEs.

By the late 1980s when skill shortages began to hamper expansion of the electronics industry, PDC joined with MNEs to establish the Penang Skill Development Centre (PSDC). PSDC, which inaugurated its first training programme in July 1989, has since played a pivotal role in meeting manpower requirements of electronics firms (see Box 2). In 1998, PDC launched a Young Entrepreneur Programmes to cultivate an entrepreneurial culture among high school leavers.

Box 2

Penang Skill Development Centre (PSDC)

Penang Skill Development Centre (PSDC), established in 1989, has attracted worldwide attention as an example of successful public-private partnership in human capital development. PSDC officials have gone to many developing countries to provide expertise on how to establish similar organizations.

In 1987, at an American Business Council Seminar, D.J. Hill, President of the Free Trade Zone Enterprise Association in Penang and CEO of National Semiconductor Electronics, observed that the progress of the electronics industry in Malaysia was constrained by shortage of adequately trained technicians, and requested the Penang state government to address the issue. Chet Singh, General Manager of PDC, promised to look into the matter. One month later he met with the CEOs of the three largest MNE affiliates in Penang, Motorola, Intel and Hewlett-Packard (HP), and mooted the idea of pooling training resources in a common training facility. The proposal was for a tripartite training institution, Penang Skill Development Centre, bringing together industry, academia (Universiti Sains Malaysia (USM)), and government.

Following this meeting a steering committee was formed with representatives from the Penang state government, Motorola, HP and Intel, under the chairmanship of Stephen Cooper, CEO of HP, to identify the organization's objectives and strategies. The MNE managers were generally sympathetic to the idea but they expressed two main concerns.

First, there was a fear about employee poaching by competing firms and security issues emanating from outsiders (including government official) having access to the facility. Second, MNEs were concerned that 'collaborative efforts between companies and governments have long history of lofty visions and flashy openings, but only to wither away after a few years' (PSDC 2009, p. 20).

In response to the first issue, it was decided to form a neutral training facility, run as a collaborative industry effort with the state government acting only as a facilitator. PDC agreed to be only an ex-officio member of the management council to avoid diluting industry leadership. Given the second concern, the MNEs agreed to provide trainers, money and material for a year with further support depending on an assessment of performance. The state government agreed to provide an annual grant of MYR 60,000 to cover the initial expenses and lease premises to the centre for one ringgit a year. After successful operation in the first year, the MNEs decided to contribute resources on a continual basis. PDC negotiated with the federal government to provide double-taxation relief on the firms' contribution to PSDC training programmesmes. By 1999, the PSDC was financially independent and stopped receiving the state government grant.

PSDC is a non-profit organization of firms in Penang's FTZs and industrial estates. It has three membership categories, founder members, full members and ordinary members. Founder members paid a premium and were eligible to be nominated to the management council. The founder membership list was closed in 1990 with 31 members. With effect from 1993, full members, like founder members, are eligible to vote and be nominated to the management council. As the highest authority of the Centre, the management council sets the priorities and strategic directions. It approves memberships, appoints members to the management council, and appoints the Executive Director and other senior managers.

PSDC started in 1989 with 32 courses for 559 participants; by 2010 it offered over 400 courses to 7500 participants and had trained over 90,000 workers. At the formative stage, foreign firms featured prominently in its training activities. Local firms' engagement has expanded over the years.

The curriculum was developed through a need analysis carried out by the human resources managers of member companies. PSDC management council members closely studied

MNE-government joint training initiative in Singapore before designing the initial training programme. At the beginning, PSDC's prime focus was on creating a large pool of technicians to meet the immediate needs of rapidly expanding electronics firms, particularly just-in-time measurement and precision engineering skills. Over the years, the scope and breath of the organization have expanded influenced by technological progress and the changing operational environment.

In 1996, a USAID funded study listed PSDC as one of the 10 best workforce development institutions in the world. Over the years, 11 out of the 13 states in Malaysia have embraced the PSDC concept of tripartite collaboration to set up their own skills centres.

In 2000, PSDC launched a Global Supplier Development Programme (GSDP), a vender development programme (Ruffin 2006). It aims to assist local companies become world-class global suppliers by developing their capabilities through training and forging linkages with MNEs. The training is divided into two streams: manufacturing and services. Courses are offered in three areas: core competencies, intermediate systems, and advanced systems. Core competencies cover basic business and organizational skills SMEs need to work with large companies. The intermediate system courses introduce trainees to the latest technologies used by potential partners. Once a SME has been through basic training, it is selected to enter an MNE coaching and mentoring programme. This linkage transfers additional skills and technology and monitors progress. After an agreed period of coaching and mentoring, the MNE decides whether to accept the SME as part of its supply chain.

In 2010, PSDC set up a Shared Services Centre (SSC), funded by the federal government, that houses the nation's largest electromagnetic compatibility (EMC) laboratory, i.e., an electromagnetic compliance test lab, to serve as a platform for development of local product design capabilities. PSDC expects that having local access to state-of-the-art test equipment will not only make the process of local design fabrication more economical and flexible, but also reduce the product-to-market time resulting from the need to send designs abroad for testing. Currently, Malaysian firms rely mostly on Singapore and United States laboratories for EMS testing.

SSC is planning to develop and conduct fast track training programme to accelerate the

augmentation of engineering talent. Motorola Corporation has offered to share its Quality Management Systems and train EMS lab staff and help the lab gain accreditation. For the use of testing facilities, a two-tier pricing structure will be implemented to ensure that SMEs are not disadvantaged: the lab will provide baseline capacity to SMEs at a concessionary rate and additional capacity to MNEs.

Lessons from failed projects

In the early 1970s, PDC directly invested in several fields: electronics and electrical goods, agro-based industries, construction, mushroom cultivation, precision engineering and shipbuilding. These projects failed commercially within few years. As the Nathan Report correctly predicted, given its remote location within the Malaysian Federation and the small domestic market, Penang was not a viable location for import substitution activities. Once the new projects proved to be commercial failures the state government swiftly abandoned them, without trying to make them survive through direct subsidies (Lim 2005).

This was in sharp contrast to the import substitution attempts in many other developing countries and in the rest of Malaysia, which saw perpetuation of inefficient industries become a drain on government budgets and domestic resources. Other than the short-lived, state-led industrialization attempt, the prime focus of economic policy in Penang remained committed to creating an enabling environment for private sector led growth. As already noted, in its investment promotion campaign the government did focus on electronics and electrical goods industries for legitimate considerations of employment potential and environmental impact, but there was no attempt to target specific product lines or potential investors within these industries. At the initial stage of investment promotion Penang state government focused on electronics and electrical goods industries for legitimate considerations of employment potential and environmental impact, but there was no attempt to target particular investors (firms) within these industries. The policy emphasis was on supporting 'all potential winners',[6] through the creation of an enabling environment for the operation of private enterprises, both foreign and local.

[6] As stated by Mr Chet Singh in the interview. Emphasis added.

Evolution of the export hub

The first MNE to set up an assembly plant in Penang was National Semiconductor (NS) from the United States. Chet Singh, PDC's founding General Manager[7], recalls his first encounter with NS as follows:

> The NS people arrived at PDC on a Friday evening in 1971. They had a lot of questions to ask which, in honesty, we were not able to answer immediately. I took a bold chance and asked them to let us have a copy of the questionnaire and promised that the information sought would be made available on Monday. I suggested that they enjoy a break at the beach as they have been travelling for over two weeks. We worked hard during the weekend and managed to hand over the very technical questionnaire back to them on Monday, all filled up. They were impressed. We then showed them land and other facilities we had. And they made a swift decision to come in. Filling the NS questionnaire was an invaluable experience for us. We realized that other potential investors too would also require relevant information. So we prepared an investment guide for investors based on the NS questionnaire and our answers.

The arrival of National Semiconductor was an auspicious start for the Bayan Lepaz FTZ. Charlie Sporck, the CEO of National Semiconductor, had started his career at Fairchild Semiconductor, which is considered the United States electronics industry's equivalent of 'a sycamore tree with its wing seeds' (Jackson 1997, p. 21). Two other semiconductor companies, Advanced Micro Devices (AMD) and Intel, founded by other 'Fairchild children', soon followed NS to Penang. Coming to Penang was the first step of the global spread of both these companies. The Intel plant later became the largest single employer in Malaysia.[8] National Semiconductor set up its first overseas operations in Singapore in 1968 and came to Penang in search of an additional low cost location because of rising labour and rental cost in Singapore.

[7] Interview, 19 November 2010.

[8] Intel Corporation was founded 1968 by two former Fairchild employees, Robert Noyce and Gordon Moore. In 1970, Intel invented the microprocessor, which revolutionized the electronics industry and set the stage for Intel to become the world's most powerful electronics company.

Between 1972 and 1975, five other MNEs set up assembly plants in Bayan Lepas FTZ: Osrum (a German automotive lighting manufacturer), Hewlett Packard (a United States electronics producer), Bosch (a German auto part producer), Hitachi (a Japanese semiconductor producer), and Clarion (a Japanese auto part producer). These eight MNEs, which drove the industrial transition in Penang, are known locally as the 'Eight Samurai''.

Emergence of ancillary industries

Following the entry of Eight Samurai a network of ancillary industries began to emerge to meet their requirements: stamped metal components, automation equipment, gigs and fixtures, machine tools, and molded rubber products. The MNE-SME partnerships became more prominent over time, resulting in the growth of a large pool of local tooling and equipment manufacturing firms. At the beginning these supporting industries were dominated by SMEs from Japan, Singapore and Taiwan. Subsequently, local firms began to emerge. Former MNE employees created most of the local firms. For instance, former Intel employees established LKT Engineering, Globetronics, Shinca, Shintel and Unico, and former Motorola employees set up Loshita and BCM Electronics. Other local firms such as Eng Teknologi and LKT Engineering expanded their operations benefitting from vender development programme launched by Intel (see Box 3), Motorola and other MNEs.

Box 3

Intel's vendor development programme

Having a well-developed local vendor base for the supply of jigs, fixtures and tooling services is vital for the expansion of assembly activities in the electronics and electrical industry. Local Penang tooling vendors in the early 1980s operated out of small sheds or backyard workshops and had very basic equipment suited for low precision fabrication work. There were too many vendors and cutthroat competition among them often resulted in poor product quality. This turned out to be a major hurdle to developing local supporting industries.

Intel Penang recognized the need to ensure that local tooling vendors improve their capacity to meet the factory's growing needs. This led Intel to initiate an innovative vendor development programme in 1984 (Lim 1991). The programme worked closely with a few vendors with potential for growth. It involved five steps:

- Indentify suppliers (mostly from its former employees) willing and able to meet its requirements.
- Match Intel's business needs with the capabilities of the potential suppliers and provide them with initial training, using its internal training facilities, the PSDC and the National Institute of Occupational Safety and Health for contractor safety certification training.
- Gradually allocate tasks or contracts.
- Continually refine the vendor's capabilities and promote continuous improvement though coaching, supplier briefings, contractor dialogues and business technical reviews.
- When the vendor gains maturity, help it to become a global supplier. The purpose at this stage is to assist the vendor develop a diversified customer base, without totally relying on Intel for its expansion. The mature vendor is called upon to supply solutions for Intel's technical problems, thus becoming a 'total solution supplier'. Intel also shares its 'technical roadmap' with the vendor so that it can prepare for change.

To begin implementing this programme Intel reduced its vender base to three local tooling vendors with better potential for future growth. These vendors were given a dependable volume of business at premium prices so that they could focus on product quality. The expectation was that the profits would be reinvested to upgrade the vendors' capacities and technological capabilities.

The Intel Penang Vendor Partnership programme was the first of its kind in Penang. Capabilities of participating local vendors progressed from simple fabrication of jigs and fixtures to the design of semi-automated equipment and eventually to turnkey projects requiring higher levels of hardware and software expertise. This partnership aided Intel's operations: with better vender support, quality levels improved and faster turnaround of machinery and parts was achieved. Participating vendors such as LKT and Eng have become multinational enterprises (see Boxes 4 and 5).

By the mid-1980s an export cluster with a sizable number of branch plants of major electronics and electrical MNEs and a network of supporting industries was well established in Penang. Penang had become the world's largest exporter and the third largest assembler after the United State and Japan. The international media dubbed Penang Asia's 'Silicon Island' (Todd 1986). However, during the first decade of industrial transition, electronics firms in Penang were almost exclusively engaged in simple downstream assembly processes in the semiconductor manufacturing chain. Only a few companies such as Intel and AMD had started testing facilities. Four-fifths of the workforce in the 1970s and 1980s was engaged in jobs requiring little or no skills (Narayanan and Cheah 1993).

In the mid-1980s, intense competition from Japanese firms resulted in increasing automation in electronics assembly. A number of MNEs and local firms sought to attain critical aspects of the Toyota process flow dynamics of multi-product single line production with its emphasis on zero defects and low inventory levels. Intel and other MNEs recognized the need for increased automation to improve productivity and quality. In-house automation groups were formed and potential local tooling and other component suppliers were identified as strategic partners. By the late 1990s most electronics factories had fully automated and integrated assembly and testing faculties (Lai 1995).

Ancillary industries that evolved around the major electronics and auto firms expanded rapidly adding to network cohesion during this period. Plastics, machine tools and chemicals were added to the product mix in the early 1990s. Some Penang firms became suppliers to other high-tech firms, operating both locally and overseas, in addition to supplying their MNE partners (Lai 1995). Linkages of MNEs affiliates with local ancillary factories strengthened over time due to the improved quality and reliability of local suppliers and services, rising transportation costs, and exchange rate volatility. Starting as small backyard workshops, some of these firms achieved the status of original equipment manufacturers (OEM), with substantial R&D and design capabilities (Boxes 4 and 5). Over the years, as the input-procurement practices become well established MNE affiliates have transferred expertise in fabrication, hardware and equipment controlling software to local

tooling SME partners. Some local firms such as KLT and Globatronics, after expanding their product lines, became contract manufacturers (CMs).[9]

Box 4
Eng Teknologi Holdings Berhad:
from backyard workshop to multinational corporation

Teh Ah Ba, a physician with a passion for mechanical inventions, was one of first local entrepreneurs to foresee opportunities in the nascent electronics industry in Penang. In 1974, he set up a backyard workshop, Hardware Electrical Company, behind his clinic with a start up capital of MYR 500 (US$ 217) to produce jigs and fixtures for a few semiconductor companies.

After rapid expansion during the next five years, Eng Hardware Electrical changed its name to Eng Hardware Engineering (EHE) with its core business of producing precision tooling for the semiconductor industry. By 1984, there were five Eng Hardware Engineering workshops on Penang Island. The company started automation equipment assembly in 1983. A year later Teh Ah Ba organized a pool of engineers to design, research and develop equipment automation and metal stamping.

In 1984, the company started direct exports of automation equipment to South Korea, Hong Kong, United States and Singapore. Within two years after the first shipment left for Seoul, the company built up enough export potential to become eligible for free trade zone status. In 1987 it moved to a new factory at Bayan Lepaz FTZ.

In 1988, the company began actuator production for the hard disk drive industry with a new investment of US$ 2.2 million. The same year saw the birth of Eng Teknologi Holdings Berhad (ETHB), the Eng group's investment holding company. In 1993, ETHB made a strong debut on

[9] Contract manufacturers (CMs) undertake both components production and assembly for MNCs involved in front-end activities in the production chain. CMs run large-scale, highly automated manufacturing production systems and are responsible for process innovation. Many MNCs in electronics and related industries rely increasingly on CMs to operate their global-scale production networks while limiting their role to head office functions such as product designing and marketing. This process, facilitated by standardization of components and advances in modular technology, has become a major factor in the rapid, global spread of production sharing (Sturgeon 2003, Brown and Linden 2005).

the Kuala Lumpur Stock Exchange.

ETHB went global in 1996 when its first offshore manufacturing plant, Engtek International Ltd., was set up in Dongguan, China. In the following year, a fully integrated manufacturing facility producing hard disk drive actuators and peripheral assemblies was established in Laguna, Philippines. Two production plants were set up in Thailand in 1998 and 2006. In 2003, ETHB acquired Altum Precision in Singapore, a strategic move to expand its operations to encompass innovative engineering solutions and services.

Today, the group's Integrated Engineering Centre spanning Malaysia, China, Philippines, Thailand and Singapore has floor space of 75,000 sq. metres and employs a workforce of over 5,000 skilled workers. Approximately 1,000 computer numerical control machines are strategically located in production facilities in these five countries, enabling the company to meet its global customers' specific requirements. The group's customers include Copeland, Danfoss, Eato, Emerson Climate Technologies, Fujitsu, Hitachi, IBM, JVC, Samsung, Seagate, TDK and Western Digital. In 2007, total group revenue surpassed MYR 500 million (US$ 145 million).

Within three decades of its humble beginnings, Eng Tek Group has attained global recognition as a regional powerhouse in the precision engineering, manufacturing and technology sector. It is a world-class global supplier of hard disk drive components. The group has won a several international accolades and awards including Asiamoney's Best Small Managed Company in Malaysia (1999), HSBC Asia's Leading Corporate Award (2000), Intel Supplier Recognition Award (2000), Fujitsu Distinguished Partner Award (2001), Forbes Global World's Best Small Companies (2001), Maxtor Outstanding Supplier Award (2001, 2003 and 2004), Best Local Vendor Award (2002), Emerson Thailand Supplier Award (2007) and White-Rodgers Best Supplier Award (2010).

Box 5: LKT Industrial Berhad: from humble foundry to contract manufacturing

Loh Kim Teow, a traditional metal worker, created a family-run foundry in 1948 to manufacture metal products, such as household fencing, window grills, metal doors as well as handling maintenance and part replacement service for ships arriving at the Butterworth free

port. In the 1960s, Loh Kim Teow Foundry (LKTF) diversified into making piling equipment, cement mixers and mobile cranes for the construction industry.

In the 1970s, LKTF diversified into manufacturing of precision tools and components, and fabrication of machinery parts for the semiconductor industry. In 1978, it was incorporated under the name of LKT Precision Engineering (LKTPE) Sdn Berhad. In the 1980s, LKTPE further diversified into the design and manufacturing of automation equipment, primarily targeted for the semiconductor industry. In 1988, the automation section of LKTPE was transferred to LKT Automation Sdn Berhad. The company specializes in the design and manufacture of precision automation equipment with control software. In 1989, LKTPE ventured into precision mould making, plastic injection moulding and manufacturing. These activities were then transferred to LKT Plastic Technology Sdn Berhad. Its core business is to manufacture precision engineering thermoplastic parts and components for audio, disk drive and automotive industries.

In 1994, after a restructuring of the three companies, LKT Industrial Berhad (LKT) was incorporated as the holding company. In June 1995, LKT was listed on the Kuala Lumpur Stock Exchange. LKT Wafer Technology, a company designing and manufacturing semiconductor wafer transfer systems, was set up in 2000. In the following year, Iconext Sdn Berhad was incorporated to develop software applications. The flagship products of Iconext include control and monitoring software for automated equipment quality management solutions and document management solutions. In 2007, a new 90,000 square foot plant was built to house the group's Contract Manufacturing Division. The group's integrated manufacturing network provides custom tooling fabrication, machine structure fabrication, plastic injection moulding, and computer numerical control machine and assembly solutions to customers across a variety of industries.

Today, LKT has a worldwide reputation for contract manufacturing for original equipment manufacturing for the semiconductor front and back-end industries, surface mount technology industries, disc drive manufacturing and other electronics industries. It provides solutions for equipment outsourcing, ranging from part procurement to production installation for end users.

LKT has expanded its operations across the Malaysian mainland, Singapore and Thailand. In

1999, LKT set up its first overseas affiliate, LKT Engineering (Thailand) Limited, which manufactures dies, jigs, and cutting tools for disc drive, electronic, semi-conductor and other industries. In 2001, an Industrial Product Division was established in the Kulim Hi-Tech Park in the State of Kedah for designing and manufacturing advanced storage solutions including industrial drawer cabinets, workstations and system racks. In the same year sales offices were opened in Kuala Lumpur and Singapore. The groups' revenue surpassed MYR 300 million (US$ 85 million) in 2007. Over 5,000 workers are employed in its many production plants in Penang.

In 2000, LKT won the inaugural Technology Business Review (TBR) award for commitment to continuous innovation. Its subsidiary, LKT Manufacturing Sdn Bhd, won the Enterprise 50 Award for 2006 organized by the Small and Medium Industries Development Corporation (SMIDEC) and Deloitte Malaysia to celebrate the achievements of home grown companies well-positioned for the future. In 2010, Singapore Aerospace Manufacturing (SAM) became the majority shareholder of LKT and renamed it SAM Engineering & Equipment Berhad.

From semiconductors to consumer electronics and computer peripherals

The next phase of expansion of the Penang export hub began in the late 1980s with the arrival of consumer electronics and computer peripherals. Until the late 1980s there were no firms involved in consumer electronics assembly, except Motorola, which was producing two-way radios, mobile car phones and cordless telephones. From the beginning, Motorola's Penang plant was its design centre for these products. From the late 1990s a number of MNEs, including Sony, Sanyo, NEC and Dell established assembly plants for consumer products, such as car stereos, hi fi equipment, calculators and telephones. Most consumer electronics companies are Japanese owned, while some have Taiwanese, Singaporean and Malaysian equity.

In the area of computer peripherals assembly, most significant was the arrival of disk drive firms staring in 1988. Between 1988 and 1991, most major players in this industry, including Segate, Maxtor, Hitachi Metals, Control Data, Applied Magnetic and Conner Peripherals, set up assembly plants in Penang (McKendrick, Doner and Haggard 2000, Chapter 9). With the emergence of disk drives, local industry begun to produce disk drive components, which require a high level of precision engineering technology. The industry

also engaged in improving and rebuilding machines based on imported prototype machinery for both local and regional markets.

Major foreign-owned contract manufacturing companies in the hard disk drive industry came to Penang in the late 1980s and early 1990s. Several Singapore-based entities came between 1989 and 1990 to provide manufacturing services in printed circuit board assembly (PCBA). Several United States-based companies came in the early 1990s to provide contract-manufacturing services in PCBA and flex circuit board assembly (FCBA). The development of locally owned contract manufacturing companies took place in the early 1990s. As they progressed, these firms expanded their services to include box-build and provided total solution systems for their customers. In the early days, most contract manufacturers performed on a consignment basis. By the mid 1990s, most of these companies in Penang were implementing turnkey operations, carrying out broad assembly and test, system assembly and test, and supply-based management.

Penang's notable changes

Over the past two decades, the Penang export hub has undergone notable structural transformation driven by domestic cost pressure – mainly increasing wages and rents due to land scarcity – and on-going changes in patterns of global production sharing. There has been a significant contraction in final assembly of consumer electronics and electrical goods. This has been the outcome of competitive pressure from China for final assembly, which is more labour intensive than component assembly, production and testing. Companies like Sony, Dell and NEC have significantly scaled down their operations in Penang. At the same time, firm in disk drive industry have shifted relatively more labour intensive segments in the production process to other low-cost locations in the region, in particular Thailand and the Philippines. However, for two reasons this structural shift has not resulted in a 'hollowing out' of the Penang export hub, as some observers have inferred simply by looking at those companies that are leaving or scaling down their operations.

First, electronics firms involved in component design, assembly and testing restructured their operations by moving into high-value tasks in the value chain, while shifting simple low-end assembly activities to other low-cost locations. This process has been greatly aided by the deep-rooted nature of their production bases backed by a pool of skilled

workers developed over the past three decades. A number of large electronics MNEs have shifted regional and also global headquarter functions to Penang. Manufacturing is only part of their operations. Their activities in Penang now encompass corporate and financial planning, R&D, product design and tooling, sales and marketing. Most MNEs that have shifted final assembly of consumer electronics and electrical goods perform the related trading and services activities from Penang. Some of them now use their Penang affiliates as an integral part of their global training and skill enhancement programmes.

Osrum, Motorola and Altera have regional R&D hubs in Penang. Intel, AMD, Agilent started as assembly operators but now engage in supplying global shared services within their global networks. Intel Malaysia is now responsible for the group's global shared services. AMD now has its global shared services and design centre in Penang. Intel has one of its three global R&D design centres in Penang. It designed and developed the Atom Chip, which is the core of the Netbook revolution.

Motorola's largest R&D facility, responsible for development and manufacture of all Motorola 2-way communication devices – accounting for more than 50% of market share –, is in Penang (NEAC 2010 (Part 1), Appendix 4). Penang plays a pivotal role in Fairchild's global production networks by manufacturing new products and packages, acting as a technical service centre for global customers, and providing leadership and management support for back-end manufacturing, and administrative and engineering service. Agilent Penang accounts for more than 60% of the group's turnover.

Altera's largest design centre is in Penang. It is currently designing the next generation FGPA chip. Engineers represent 94% of it current Penang workforce and they account for 60% of its worldwide engineering talent. Western Digital recently announced that it would build a US$ 1.2 billion R&D and manufacturing facility in Penang. STEC, a leading global provider of solid-state technologies and solutions for OEMs, built facility with complete design, manufacturing and logistics capabilities in the Bayan Lepas FTZ in 2007. It designs, develops and manufactures custom and open-standard memory solutions based on flash memory and DRAM technologies and external storage solutions.

Second, while the electronics industry is still the main engine of growth in Penang, in recent years the production base has begun to diversify into a number of electronics-related dynamic product lines. These include medical services and equipment, light emitting diodes (LED), and photovoltaic design and development.

International players in the LED industry have made significant inroads into the Penang export hub. With its head start in electronics, Penang could become a major global LED hub. The MNEs with production plants in Penang include Osrum Opto Semiconductors, Philips Lumileds, Rubicon Technology, Globetronics, and Dsem and IntraMas. Osrum, which came to Penang in the early 1970s to assemble general lighting, now ranks second in the world in the LED industry. It has wafer fabrication, assembly and testing operations in Penang. Osrum's largest production plant outside Germany and its global R&D centre is in Penang. Phillips Lumileds, which has assembly and testing operation in Penang, ranks fifth in the world LED industry. SILQ, a joint venture of Semileds Corporation (a LED manufacturer in the league of Lumileds and Osrum) and IQ Group Berhad, is involved in LED packaging, modules and final LED lightings in Penang. Two local contract manufacturers, Globetronics and CS Opto, have made significant inroads in to LED industry in recent years benefitting from the emergence of local LED final product design houses.

The LED industry is poised to grow, driven by increased LED penetration rates in mobile handsets, notebooks, LCD (liquid crystal display) televisions, automotive and general lighting. LED television back lighting (signs and display segment) is considered to be the most important LED growth driver over the coming years. Another important segment for rapid growth of LED lighting is general lighting: some countries have imposed environmental regulations to phase out or ban the use of incandescent lighting. Electricity consumption of LED lighting is lower than that of incandescent lighting by about six to seven times. LED has gained a new lease of life in recent years with increasing demand lighting services from the fast growing economies, in particular China and India, where providing grid electricity to the rural areas is a very difficult task (Dupuis and Krames 2008, Bhusal et al. 2007).

In the medical services and equipment industry, B. Braun, a German medical and pharmaceutical company, has been in Penang since 1980. It has a plan to invest MYR 1.75 billion in its Penang plant by 2013. This will involve expanding its production capacity 131% and increase production by 50% by 2013. In recent years a number of newcomers have entered the industry: Cardinal Health, St Judes, Accellent, Small Bone Innovation, and Symmetry Medical.

Cardinal Health (a 'Fortune 18' company) is one of the largest healthcare services providers in the world, supplying pharmaceuticals and products. Symmetry Medical is the

largest contract manufacturer of orthopedic devices for big companies such as Strykey, Johnson & Johnson, Zimmer, Bioner and Smith & Nephews. Cardinal Health also designs, develops and produces products for other segments of the medical device market, including arthroscopy, dental, laparoscopy, osteobiologics and endoscopy, and provides specialized products and services to non-healthcare markets, such as aerospace. It chose Penang because of accessibility to the major markets of China and Japan, ease of communication, a strong legal system with intellectual property protection, and the ease of integration for expatriates.

Symmetry Corporation, a provider of products to the global orthopedic device industry and other medical markets, announced in 2008 that it plans to invest US$ 20 million over the next three years to expand its Malaysian manufacturing and design and development capabilities. The company is planning to move its existing facility to a larger, new 50,000 square foot facility in Penang. This facility will house the regional design and development centre together with a regional logistics operation, and enable the parent company to bring its Total Solutions(R) business model to the Asian market.

There is a strong presence of established supporting industries ranging from sterilization services, sterile medical packaging, precision engineering and tool and die making to contract moulding and assembly and machinery fabrication in Malaysia. The availability of the supporting industries positions Malaysia as an ideal location for the manufacture of medical devices with the potential to develop into a medical device hub in Asia.

In sum, after 40 years of development, Penang export hub has a range of industries, including electronics, electrical goods, machine tools, general lighting equipment and light-emitting diodes, and medical devices. Due to domestic cost pressure and the emergence of competitive production locations Penang is no longer an attractive location for assembly of consumer electronics and electrical goods and low-end component assembly within the electronics value chain. These activities in Penang have shrunk in recent years. However, MNEs involved in the electronics design, assembly and testing activities have restructured and expanded their operations in Penang. At the same time, some new dynamic product lines, including light-emitting device, photovoltaic design and development, and medical devices, have emerged with considerable prospects for further expansion.

Investment trends and company profiles

Systematic analysis of trends in foreign direct investment in Penang is hampered by dearth of data. At the formative stage until about the early 1980s, PDC maintained continuous records of investments based on administrative records and annual surveys of firms. In recent years publically available data on realized projects are limited to surveys periodically commissioned by PDC. As the response rate varies significantly among the survey years, data from these surveys do not permit year-to-year comparisons. Moreover, the response rate to questions relating sales turnover and investment has been very poor. This section aims to provide some insights into investment trends and the profile of firms operating in Penang by piecing together information from scattered sources.

In 1975, there were seven branch plants of MNEs (henceforth referred to as foreign affiliates or foreign firms) employing around 2,000 workers in the Byan Lepaz FTZ (Warr 1987). By the mid-1980s the number of firms had increased to 59 and they employed 39.600 workers (PDC 1988). Two decades later, the 2005 Malaysian Manufacturing Census counted 203 foreign firms employing 215,517 workers (Table 1).

The data on the age distribution of these firms (Column 2, Table 1; Figure 2) are basically consistent with the growth trajectory discussed in the previous section. With a modest start in the 1970 there was a rapid expansion of MNE entry until about the mid-1990s. There has been a notably decline in the number of firms commencing commercial production in over the past 10 years. This reflect gradual erosion of Malaysia's attractiveness for low-end activities in the electronics value chain and final assembly of consumer electrical and electronics products due to increasing domestic wages and the emergence of alternative low cost investment locations within the region.

The only available continuous data come from the approval records of the Malaysian Industrial Development Authority (MIDA). These data for the past four decades are summarized in Table 2. The number of approved projects increased, albeit with some year-to-year fluctuations, in the 1980s and 1990s. As discussed, during this period Penang was very attractive to MNEs producing consumer electrical goods and electronics and computer peripherals. Following a notable decline during the Asian financial crisis in the second half of 1990s, approvals have picked up since 2000. The number of projects approved during 2000-2008 was much larger compared to the number of firms in operation belonging to

younger operational age brackets (Table 1). This difference[10] reflects that most new project proposals came from firms already with production plants in Malaysia rather than from new entrants.[11] Allowing for some erratic fluctuations, capital per worker in approved projects has increased significantly over the past two decades (last column, Table 2). This pattern points to a gradual, but persistent, shift in the production structure towards product lines characterized by greater capital intensity as the labour market tightens.

Foreign firms dominate manufacturing in Penang (Table 3). In 2007, they accounted for over 85% of total sales turnover and over 72% of total employment in the manufacturing sector in Penang, even though they accounted for only about one fifth of the total number of firms in operation. The top 11% of foreign firms in size accounted for 82% of total sales and 68% of total employment.

The size distribution (measured by employment headcount) of the top 25 foreign and local firms is depicted in Tables 4 and 5, respectively. The employment headcount of the 25 foreign firms varies from 896 to 10304, with the majority clustering at a median of around 3000 workers. These 25 firms account for over 75% of the total manufacturing employment in Penang. By contrast, employment in the top 25 local firms varies in the range of 200 to 1400 with the majority clustering at the lower end. They account for about 8% of total manufacturing employment.

In the 1970s, when the first wave of MNEs came to Penang, there was a general perception that these firms would soon prove to be 'fly-by-night' operators. However, the data on firms in operation clearly indicates that most of these firms have become deep rooted in Penang (Tables 1 and 4). Seven of the Eight Samurai are among the 25 largest foreign firms (Table 4). These Malaysian affiliates and later arrived firms have now become major players in the regional and global operations of their parent companies. United States-based MNEs are the dominant players in the Penang export hub, followed by Japanese and German MNEs (Table 6).

At the time when the first MNE arrived in the Bayan Lepas FTZ in 1972, there were only 160 registered manufacturing firms in Penang and the average firm employed only 75

[10] The difference is too large to be ascribed to the fact that not all approved projects are actually implements and the time lag involved in project implementation.
[11] This observation is consistent with our findings from interviews with firms operating in Penang.

workers.[12] The number of local firms mushroomed from the early 1980s. Some emerged out of existing small-scale operations, but most were newly created, often by former MNE employees.

Export performance

In 2009, manufactured goods accounted for 97% of total merchandise exports from Penang, up from 89% in the early 1990s. The commodity category of machinery, Section 7 of the Standard International Trade Classification (SITC), has continued to account for the lion's share of electronics components (SITC 30 accounted for almost 90% of machinery exports (Table 7). However over the past two decades there has been some modest diversification of the commodity mix. According to the data for 2005 (the only year for which we have been able to find disaggregated data for Penang) office and accounting machinery (SITC 30) and radio/TV, and medical appliances and components (SITC 32) accounted for 45% and 38.9% of total manufactured goods exports (Table 8).

In 2005, foreign firms accounted for 70% of total manufactured exports (Table 8). The export-output ratio for foreign firms was 78% compared to 33% for local firms. The lower figure for the local firms mostly reflects that most of the local firms in the electronics industry are parts and components suppliers to the foreign firms. The bulk of direct exports by local firms are concentrated in consumer electronics and electrical goods (SITC 322 and 323), which are relatively more labour intensive and technologically less sophisticated. Foreign firms' export composition is relatively more diversified, but still electronics accounts for nearly two-thirds of their total exports.

Manufactured goods exports from Penang increased from US$ 90 million in 1973 to about US$ 4.5 billion – amounting to 34% of total manufactured exports from Malaysia – in the late 1980s (PDC 1998). Export growth has continued at an impressive rate during the ensuing two decades, notwithstanding a mild slow down following the collapse of the dot-com bubble in 2000 and the onset of the global financial crisis in 2008 (Figure 3). The growth rate of exports from Penang has continuously been faster than that of total manufactured goods exports from Malaysia. Penang's share in total manufactured goods exports from Malaysia was 39% in 2009 up from about 30% a decade ago (Figure 2, Table 7). In recent

[12] Department of Statistics, *Census of Manufacturing Industries 1973*, Kuala Lumpur.

years Penang has accounted for almost half of the total machinery (electronics and electrical goods) exports from Malaysia.

Overall, the patterns revealed by the data run counter to the pessimistic view that the emergence of China as an export powerhouse has crowded out export performance of Penang. This inference is also consistent with the patterns of structural shifts in the activities of MNEs in Penang which we have observed earlier. Shifts in their operations in Penang towards high-value component design, assembly and testing in the global value chain as well as towards headquarter functions and provision of global services have been aided by the rapid expansion of final assembly in China.

To probe the role of this shift in the product mix in export expansion we compiled export value, volume and price (unit value) indices for electronics exports from Malaysia over the period 1997-2009. Separate export data are not available for Penang, but the national data are representative enough for our purpose because Malaysia's exports in this product category have predominantly originated in Penang. The indices are depicted in Figure 4. Export growth in this product category since about 2001 has been largely driven by price (unit value) increases rather than volume expansion. The value of total exports has moved in tandem with export price, while export volume has remained virtually flat during this period.

Economy-wide impact

Export-led industrialization transformed Penang from the site of sluggish primary production into an international manufacturing hub within a decade. The surplus labour pool of 80,000 workers, estimated by the Nathan Report in 1969, had already been absorbed in the manufacturing sector and related services. The state transformed into a vibrant industrial centre with electronics factories taking the lead. Growth continued unabated following a short slow down during the global recession in the mid-1980s. At a 2003 conference organized by PDC to celebrate the 30 years of industrialization in Penang, Prime Minister Mahathir summed up Penang's remarkable economic transformation as follows:

> I remember the time when Tun Razak [then Prime Minister of Malaysia] told me that Dr Lim Chong Eu had managed to attract some investors to Penang in the electronics industry. I was rather skeptical; what are we going to do with this new-fangled

> industry? We did not understand much about electronics then and soon after that … Tun Razak … told me that Penang was short of labour; the electronics industry had created so many jobs that Penang had to get workers from the mainland (Mahathir 2003, p. 15).

In the early 1970s, Penang's per capita GDP was about 10% lower than the national average. At the state level it was 70% lower than the state of Selangor, which was the prime focus of national development strategy in the post-independence period (Table 8). Rapid export-led growth elevated Penang to the status of richest state within two decades. In 2010, Penang's estimated per capita GDP was MYR 30,860 (US$ 8,700), 57% higher than the national average and 30% higher than Selangor.

A comparison based on per capita GDP exaggerates Penang's level of economic activity among the Malaysian states because, as discussed below, a larger share of income generated in Penang accrues to foreign companies as their share of profits. However, even when household monthly income is used as an indicator of economic performance, Penang ranks well above the national average. Household income is higher than that in Penang only in Selangor and the federal territory of Kuala Lumpur (Table 10).

The poverty rate –the percentage of people living below the national poverty line – has also been remarkably lower in Penang compared to the other Malaysian states (Table 10). Since the early 1990s, the unemployment rate in Penang, which has varied annually between 0.5% and 2.5%, has been much lower than the national average of 1.5% to 4.5% (SERI 2010).

Manufacturing has been the engine of growth in Penang, accounting for over 40% of GDP over the past three decades with a mild upturn in recent years. By contrast, manufacturing accounted on average for only 27% of GDP in Malaysia. Manufacturing accounted for 41% of total labour deployment in 2001. This figure declined to 36% in 2008 because of faster growth in services (Table 11). Foreign firms play a much more important role in the Penang's economy compared to other states in Malaysia (Table 12 and 13). For instance, in 2005 foreign firms accounted for over 61% of manufacturing value added in Penang compared to about 37% in the entire country.

Often-voiced criticism of export-oriented growth through global production sharing is the weak linkage effects of the export sector on the rest of the economy. In Penang, the share

of local raw material to total raw material used increased from 3% in 1976 to 11% in the early 1980s (Warr 1993). After two-and-a-half decades of manufacturing expansion, this had increased only to to about 18% by 2005.[13]

Linkage effects of firms operating within global production networks generally tend to be less than those of domestic market-oriented manufacturing firms. This is because, unlike meeting consumer requirements in domestic markets, producing for highly competitive global markets calls for imported inputs meeting exact quality requirements and specifications. More importantly, input structures within global production networks are determined largely by corporate decisions of MNEs at the global level rather than by relative-cost differential and other factors specific to a particular production location.

Despite the weak input linkages, foreign firms have significantly impacted the domestic economy through human capital development. The talent pool developed over the past four decades is now a primary attraction of Penang for MNEs for locating there upper-end activities and headquarter functions within global production networks. Most MNEs have indigenized their workforce; only 8% of CEOs in foreign companies in Penang are foreigners. Many MNEs draw on managerial and technological expertise of their Penang affiliates when expanding operations to other countries.

A major concern in the contemporary Malaysian policy debate is the slow process of technological upgrading and productivity growth in export-oriented industries (Rasiah 2010, NEAC 009, World Bank 2010, Yusuf and Nabeshima 2009). There are no robust estimates available to check the validity of this concern for Penang. However, it seems to perform better than the rest of Malaysia in R&D activities, as revealed by patent registration data (Figure 5). During 2001-06 Penang accounted for 37.2% of Malaysia's registered patients, up from 10.3% during 1976-85. In a comparative study of corporate innovative activities in Singapore, Penang and Bangkok, Diez and and Kiese (2006) conclude that 'Penang as a high-tech enclave is most certainly not representative of Malaysia as a whole' (p. 1014). They find that, despite Singapore' clear lead over Malaysia at the national level, Penang and Singapore

[13] This estimate uses the 2005 Input-Output Table, Department of Statistics, Malaysia. This figure is for the electronics and electrical industry in the entire country. The usage of local inputs in this industry could be somewhat higher in Penang because the local vendor network there is relatively well developed compared to elsewhere in the country (UNCTAD 2010).

are at a *similar stage of technological development*, and Bangkok clearly trails behind both (emphasis added).

Conclusion and policy lessons

The Penang export hub has gained maturity and consolidated its position within global production networks over the past four decades. Concerns that the Malaysian industry has 'reached a point of saturation and its survival depends on the capacity to climb up the technology ladder' (UNCTAD 2010), and that 'Malaysia's manufacturing performance has stalled over time and the sector remains at odds with the objective of "'moving up the value chain"' (NEAC 2010 Part 1, p. 181) are certainly *not* consistent with Penang's recent growth experience.

As a result of increasing domestic wages and emergence of competing low-cost production locations, Penang's attractiveness for low-end activities and final assembly within global production chains has been rapidly eroding over the past two years. But this has not resulted in a hollowing out of the Penang export hub. Firms involved in design, assembly and testing activities in the electronics and electrical goods value chain have begun to expand and consolidate their operations in Penang. More importantly, based on the early-mover advantage in electronics and the skilled labour pool developed over the years, the production base has begun to diversify into a number of electronics-related dynamic product lines with brighter growth prospects. These include medical services and equipment, light emitting diodes (LED), and photovoltaic design and development. China's rise as the premier assembly centre does not seem to have crowed out export performance of Penang. On the contrary, there appears to be a complementary relationship between China's rise as the premier assembly centre within global production networks and export performance in Penang. Rapid expansion of final assembly in China has been accompanied by a notable shift in MNE operations in Penang towards high-value component design, assembly and testing in the global value chain. Reflecting this structural shift, expansion of exports from Penang in recent years has been driven predominantly by increase in prices rather than volume expansion.

What explains Penang success? Penang started the process of export-oriented industrializations with some unique advantages. It had a long tradition of both English and

Chinese education, with a literacy rate well above the national average. From the colonial era it inherited fairly well developed trade-related infrastructure and institutions. However, these initial advantages would not have been translated into a notable economic success if it were not for a proactive state government led by Chief Minister Lim Chong Eu who embarked on a visionary strategy to unleash the island's growth potential. The strategy carefully mitigated the adverse impact of the affirmative action elements of the 1971 New Economic Policy on private-sector initiatives, while benefiting from Malaysia's long-standing commitment to an open trade and investment policy stance, and emphasis on export-oriented growth.

Penang is a unique example of government marrying its job creation policy objectives with emerging opportunities for international specialization by linking its economy to global production networks. The state government not only attracted foreign investors but also helped them become deeply rooted in the economy through a well-design investment promotion strategy including FTZ status, infrastructure development, skills development and vocational training, and forging links between local and foreign firms.

It is hazardous to make sweeping generalization from a single case study. The experience of Penang does, however, offer a number of policy insights that may be useful to policy makers in other countries in designing FDI policy, especially in the context of the ongoing process of global production sharing.

- Institutional reforms

The policy reforms began by forming a new statutory body, Penang Development Corporation (PDC) as the principal development agency independent of the formal government structure. The carefully designed autonomous organizational structure enabled PDC to perform effectively its role as the centre point of formulation, implementation and coordination of the export-oriented industrialization strategy. PDC was successful in creating in the business community an impression of a unified and cooperative team with a firm commitment to FDI promotion.

- Focused investment promotion

After the failure of initial attempts at import-substitution industrialization, the state government of Penang made a clear and decisive policy shift to export-oriented industrialization, with the electronics industry – broadly defined to include both electronics and electrical goods – as the key focus of investment promotion. Once the import substation

projects proved to be commercial failures, they were swiftly abandoned, without trying to make them survive trough direct subsidies. The choice of electronics as the priority sector nicely matched Penang's source endowment and unfolding opportunities for international specialization. The choice of electronics as the priority sector at the outset also helped designing an investment promotion strategy with an industrial cluster focus. The cluster approach in turn provided a viable setting for promoting MNE-SME linkages within the export hub, and creating a 'skill pool' which turned out to be the major attraction of Penang as an attractive location for MNEs in a wide range of industries with an electronics base.

- Effective personal involvement from the top level of government

The Chief Minister Lim Cong Eu played an active personal role in the process, sending a clear, consistent message to investors about development priorities. He chaired the State Planning and development Committee, the apex policy making body of PDC, and led investment missions to the major home countries of prospective investors. The long tenure of the Chief Minister and his top management team (for over two decades) helped assuring policy certainly and building investor confidence.

- Post-investment care

PDC created an institutional mechanism to maintain close links with both MNE affiliates and local firms operating in Penang. This helped policy makers staying abreast of investor requirements and thus continuously adapting to the changing investment climate. More importantly, this receptivity approach helped to engage the foreign firms already operating in Penang in the investment promotion campaign. PDC often used references from these firms to complement the government's commitment to investment promotion.

- Infrastructure development

PDC effectively used Free Trade Zones and Industrial estates as the vehicles for focused infrastructure development for successful global integration of the Penang economy. It successfully address the problem of land scarcity faced in accommodating foreign investors by creating an innovative land back through market acquisition of private land and reclamation.

- Vocational training and skill development

At the formative stage of the export hub, PDC played an important facilitating role in labour absorption by the newly established MNE by conducting vocational training program. When skill shortages began to hamper the expansion of electronics industry by the later 1980s, PDC joined with MNEs to establish the Penang Skill Development Centre. The federal government also helped skill development at the firm level by offering general tax deductions on MNEs contributions to PSDC schemes and their own skill development efforts.

- Fostering MNE-local firm links

From the inception, PDC placed emphasis on developing a domestic supplier network around the branch plants of MNEs. This helped increase economic impact of MNE presence on the domestic economy through a multiplier effect and was instrumental in anchoring foreign investor in the export hub through tighter and more appropriate supplier relationships. The domestic vendor networks that initially evolved around semiconductor assembly facilitated the subsequent diversification of the production base of the export hub into other product lines such as consumer electronics and computer peripherals, and more recently to light-emitting diodes and medical devices.

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Appendix 1

List of Interviewees[1]

Cheah Eng Kooi, Senior Branch Manager, Federation of Malaysian Manufacturers

Goh Ban Lee, Senior Research Fellow, Socio-Economic and Environmental Research Institute (SERI)

K. Gopalan, Vice President, Kazanah Research and Investment Strategy

O. K. Lee, Managing Director, Toray Industries (Malaysia) Sdn Bhd, and Chairman, Federation of Malaysian Manufacturer

Leong Yueh Kwong, Director, SERI

Kelvin Lew, President, Mini-Circuit Technologies (Malaysia) Snd Bhd

Khoo Cheok Sin, Vice Chairman, Federation of Malaysian Manufacturers

Seng Khoon, Engineer, Design Automation, Altera Corporation

Liew Chin Tong, Member of Parliament for Bukit Bendera and Director, SERI

Lim Mah Hui, Visiting Research Fellow, SER

Lim Po Li, Director, Total Research and Consultancy Sdn Bhd, formerly Manager, Strategic Planning and Research, Penang Development Corporation

Lim Teck Yunn, Manager, Front-end & ASIC Design Automation, Altera Corporation Sdn Bhd

Lim Wei Seong, General Manager, SERI.

Loo Chen Chin, Corporate Affairs Manager, Intel Corporation

Loo Lee Lin, General Manager, Invest Penang

Hamdan Abdul Majeed, Senior Vice President, Kazanah Research and Investment Strategy

Suresh Narayanan, Professor of Economics, Universiti Sains Malaysia

Mohd Sofi Osman, Managing Director, Advanced Micro Devices Export Sdn Bhd, and Chairman, Penang Skill Development Centre.

Phan Li Hsia, Executive, Events and Communication, Invest Penang

S. Pitchaiappan, Managing Director, Syarikat Kilang Rempa Jaya Sakti, Snd. Bhd

Chet Singh, Founding General manager of Penang Development Corporation

Wong Sean Hai, Malaysian American Electronics Association, and formerly CEO, Intel Malaysia

Noorazleen binti Suhaimi, Investment Promotion Executive, Invest Penang

Toh Kin Woon, Senior Research Fellow, SERI

Yoon Chon Leong, former Vice President of Agelant

Mark Yeoh, Chief Engineer, Altera Corporation

1. The names are listed alphabetically by family name. Interviews were conducted during 29 November – 23 December, 2010

Tables 1: Branch plants of multinational enterprises operating in Penang, 2005

Commencement year	Number of firms	Gross output		Employment	
		Malaysian Ringgit (MYR) million	%	Headcount	%
Pre-1970	8	1,054	1.5	3,452	3.6
1970-74	9	6,301	9.2	11,769	12.3
1975-79	5	215	0.3	1,061	1.1
1980-84	11	1,242	1.8	11,136	11.6
1985-89	52	7,873	11.6	23,454	24.4
1990-94	63	9,222	13.5	18,301	19.1
1995-99	32	40,435	59.4	21,273	22.2
2000-04	23	1,783	2.6	5,585	5.8
	203	68,125	100.0	96,031	100.0

Compiled from unpublished returns to the Census of Manufacturing Industries 2005, Department of Statistics, Malaysia.

Table 2: Approved investment in Penang, 1980-2008

Year	Number of projects	Employment (head count)	Investment		Capital per worker (US$)
			US$ million	Foreign share (%)	
1980	48	5,522	80.6	45.2	14,588
1981	59	3,655	47.2	39.1	12,923
1982	40	3,842	146.0	38.1	37,998
1983	61	7,275	111.6	39.1	15,345
1984	56	5,158	114.5	24.8	22,205
1985	66	8,184	139.2	33.9	17,011
1986	53	4,101	68.1	50.4	16,607
1987	59	16,662	252.3	86.4	15,143
1988	73	17,833	278.6	76.3	15,622
1989	115	27,032	436.7	87.2	16,157
1990	132	24,952	690.3	79.8	27,666
1991	125	22,455	554.6	66.2	24697
1992	119	14,295	430.3	57.0	30,099
1993	87	10,378	200.8	50.2	19,346
1994	95	15,203	356.1	70.4	23,423
1995	89	13,779	641.5	39.9	46,559
1996	97	11,993	1,266.1	65.7	105,569
1997	90	9,736	515.1	28.9	52,906
1998	104	10,911	684.3	47.5	62,713
1999	95	14,928	1,257.3	96.2	84,225
2000	132	15,327	1,173.6	79.9	76,569
2001	124	14,630	1,009.8	93.2	69,023
2002	110	13,487	631.1	82.8	46,796
2003	137	9,890	506.0	75.7	51,168
2004	144	9,235	534.3	50.0	57,854
2005	148	21,642	1,221.2	84.5	56,428
2006	156	13,539	1,458.7	73.2	107,738
2007	134	8,833	1,442.2	65.9	163,275
2008	151	22,215	2,932.0	50.1	131,981

Source: SERI database (based on investment approval records of the Malaysian Industrial Development Authority)

Table 3: Ownership structure of manufacturing firms in Penang, as of August 2008[1]

	Firms (%)	Sales (%)	Employment (%)
Foreign-owned	22.9	85.6	72.3
Large[2]	11.3	82.0	68.3
SMEs	11.6	3.6	3.9
Local	77.1	14.4	27.7
Large[2]	9.7	9.3	12.6
SMEs	67.4	5.1	15.2
	100	100	100

Notes:

1. Based on information provides by 629 of 1193 enumerated firms.
2. Companies with annual revenues of more than MYR 25 million (US$ 9 million) or more than 150 full-time employees.

Source: SERI 2008

Table 4: Top 25 foreign enterprises in Penang: employment and product lines (as at August 2008)

	Company[1]	Host country	Employment head count	Years in operation	Activities in Penang
1	Intel Technologies	USA	10,304[6]	>35	Motherboards
2	Flextronics Technology	Singapore	7,000	15-20	PCBA and system integration, Failure Analysis, Total Supply Chain solution
3	Motorola Technologies	USA	4,811	25-30	2-way radios, wireless broadband communication equipment AND accessories
4	B Braun Medical Industries	Germany	4,700	25-30	Medical and surgical equipment and related services
5	WD Media (formally Komag)	USA	4,569	15-20	Thin film magnetic disks and plated polished substrates
6	Dell	USA	4,500	12-15	Computer assembly and world-wide customer service
7	Jabil Circuit	USA	4,207	20-25	Electronic manufacturing services
8	Cannon Electronics	Japan	3,805	5-10	Magnetic heads and component cameras
9	Sony	Japan	3,750	20-25	Consumer electronics
10	Renesas Semiconductor[2]	Japan	3,700	>35	Linear and digital integrated circuits, power transistors and transistor diodes
11	Plexux Manufacturing	USA	3,389	10-15	Computer peripherals and PCBs
12	Agilent Technologies [2]	USA	3,358	>35	Microwave devices, test accessories, amplifiers, transceivers and test
13	Fairchild[3]	USA	2,980	>35	Semiconductor back-end manufacturing and admin.. and engineering services
14	Kobe Precision	Japan	2,740	15-20	Ground aluminium substrate
15	Seagate Penang	USA	2,733	20-25	Hard disk drives
16	Osrum Opto Semiconductors	Germany	2,731	>35	light emitting diodes
17	Ase Electronics	Taiwan (Province of China)	2,530	20-25	Integrated circuit packaging, testing, and turnkey services
18	Sanyo Automedia	Japan	2,080	20-25	Car radios and CD-changers
19	Robert Bosch	Germany	2,000	>35	Car parts and automotive semiconductors

20	Philips Lumiled	Netherlands	1,600	10-15	High-power LED lighting and solid state lighting solutions
21	Sanmina Science Systems	USA	1,203	10-15	PCBA and system integration
22	Linear Semiconductor	USA	1,167	10-15	Integrated circuits
23	Avago Technologies[5]	USA	961	>35	Analogue, mixed-signal and optoelectronic components and wafer fabrication
24	Altera	USA	950	15-20	R&D relating to VLSI design, layout, test and software development
25	Advanced Micro Devices	USA	896	>35	Integrated circuits

Note:

1. Ranked by employee head count.
2. Formerly Hewlett-Packard.
3. Formerly National Semiconductor.
4. Formerly Hitachi Malaysia. Renesas was established as Japan's largest semiconductor supplier in 2003 through a merger of Hitachi and Mitsubishi Electric group.
5. The semiconductor division of Agilent, which became an independent company in 2005.
6. Total employment in Penang and Kulim (in the State of Kedah) plants.

Source: SERI (2008) supplemented by information from Invest Penang (Penang Development Corporation), company websites and interviews with company managers.

Table 5: Top 25 local (Malaysian) enterprises in Penang (as at August 2008)

	Company	Employment head count	Years in operation	Activities
1	Precico	1,400	16-20	Plastic component parts
2	Aik Joo Can Factory	1,300	>20	Plastic jerry cans
3	TSDK Technologies	961	16-20	Computer peripherals, plastic containers and electronic & electrical devices
4	SDKM Technologies	833	16-20	Computer peripherals, plastic containers and electronic & electrical devices
5	LKT Precision Engineering	692	10-15	Automation equipment, precision tools and precision plastic parts etc.
6	CPI (Penang)	654	16-20	Car audio, wireless networking devices and parts
7	Pentamaster Corporation	601	16-20	Automation solutions
8	Dora Knitwear	580	>20	Knitted sweaters and knitwear
9	Dufu Industries	500	0-5	Electronics devices and parts
10	Eng Teknologi Holdings	559	>35	Data storage products
11	KESP	535	>20	Integrated circuit burn in/EMS
12	Alliance Contract Manufacturing	508	10-15	Automation-wafer/semiconductor handling equipment
13	Nationgate Technology	453	6-10	SMT projects, PCB assembly and storing, and network
14	CAB Cakaran	409	3-5	Integrated poultry products
15	Precico Electronics	330	16-20	Plastic component parts
16	Southern Pipe Industry	297	>20	Steel pipes
17	M-Pol Rubber Products	275	>20	Household and water support products
18	Eng Kah Enterprise	273	>20	Soap and cosmetics
19	Eonmetall Industries	250	16-20	Fabricate machinery for metal work
20	Double Grade Non-Woven Industries	250	16-20	PC floor covering material for industrial use
21	Asia File Products	241	10-15	Files and stationary
22	Alo Industries	210	16-20	Electronic/industrial packaging material
23	Ayza Industries	205	>20	Logistic, trucking and warehousing

24	Industrial Concrete Products	200	23	Non-metallic mineral products and concrete piles
25	Fuji Lift and Escalator Manufacturing	200	16-20	Manufacture lift parts and assemble lifts

Compiled from SERI (2008)

Table 6: Home-country profile of foreign firms in Penang (as at August 2008)

As of end 2007	Employment	%	Number
United States	53,208	46.1	45
Japan	23,643	20.5	41
Germany	12,869	11.1	14
Singapore	10,024	8.7	20
Taiwan (Province of China)	6,932	6.0	35
Netherlands	1,600	1.4	1
Indonesia	683	0.6	3
France	679	0.6	1
Finland	656	0.6	3
Italy	651	0.6	1
United Kingdom	500	0.4	1
Denmark	446	0.4	2
Hong Kong SAR	282	0.2	3
Switzerland	159	0.1	1
Other	3,153	2.7	24
Total	115,485	100.0	195

Note: Compiled from unpublished returns to Penang Industry Survey 2007 conducted by SERI in 2008 for Invest Penang

Table 7: Merchandise exports from Penang: value, composition and share of total Malaysian exports

	1990-1*	1995-6*	2000-1*	2005-6*	2007	2008	2009
(a) Exports, US$ billion	18.7	58.0	75.5	113.4	127.2	110.8	111.3
(b) Composition (%)							
Primary products	10.9	6.0	2.4	3.2	3.4	3.6	2.6
Food beverages and tobacco	3.0	1.2	0.8	0.9	1.1	1.2	1.2
Crude materials	4.3	2.7	1.0	1.6	1.5	1.7	1.1
Animal and vegetable oils and fats	3.6	2.0	0.6	0.6	0.8	0.7	0.4
Manufacturing	88.9	93.8	96.6	96.2	95.8	95.8	96.8
Chemicals	1.3	2.0	2.3	2.3	2.7	2.7	2.6
Resource-based manufactured goods	9.3	5.8	3.3	3.5	4.3	5.1	4.0
Machinery and transport equipment	56.9	74.9	82.3	80.4	77.8	76.3	78.3
Miscellaneous manufacturing articles	20.5	11.1	8.7	9.9	11.0	11.7	11.9
Miscellaneous transactions and commodities	0.4	0.2	0.5	0.7	0.7	0.6	0.5
Total	100	100	100	100	100	100	100
(c) Share in total Malaysian exports (%)							
Primary products	9.2	9.1	8.2	9.5	8.1	5.8	5.5
Food beverages and tobacco	14.6	10.8	10.3	11.4	11.9	9.4	10.1
Crude materials	6.7	10.4	11.8	16.9	15.3	14.4	13.0
Animal and vegetable oils and fats	10.7	7.2	4.4	4.0	3.6	1.8	1.3
Manufacturing	31.4	28.5	33.9	37.4	37.4	39.6	38.5
Chemicals	15.5	14.8	16.1	12.2	12.7	10.6	12.0
Resource-based manufactured goods	29.0	18.0	16.1	15.0	15.5	14.8	14.1
Machinery and transport equipment	30.6	31.4	38.1	44.0	44.8	53.0	47.4
Miscellaneous manufacturing articles	40.4	29.1	29.5	34.6	36.2	34.2	35.7
Miscellaneous transactions and commodities	20.0	3.5	15.6	11.9	14.4	1.2	18.1
Value (MYR million)	24.5	25.1	31.5	33.8	32.9	28.2	33.0

Note: * Two-year average.

Sauce: Compiled from customs returns of Penang (SERI database) and UN Comtrade database (for total Malaysian exports).

Table 8: Penang's manufactured exports: composition, export/output ratio and foreign firms' share in exports, 2005

		Composition (%)			Export/output (%)			Foreign firms' share (%)
		Total	Local	Foreign	Total	Local	Foreign	
15-16	Food, beverages and tobacco	1.7	4.9	0.3	26.2	25.2	35.2	12.9
17	Textile	0.8	0.2	1.1	72.2	27.0	82.8	92.9
18	Wearing apparel	0.5	0.5	0.5	32.4	17.0	49.9	72.1
19	Leather products and footwear	0.0	0.1	---	20.5	20.5	0.0	0.0
20	Wood products	0.0	0.0	---	6.0	6.0	0.0	0.0
21	Paper and paper products	0.2	0.5	0.0	10.7	9.4	36.2	16.1
22	Printing and publishing	0.1	0.2	0.0	6.8	6.6	52.4	3.0
24	Chemicals	3.9	2.9	4.4	61.0	34.7	78.3	77.5
25	Rubber products	1.5	2.4	1.1	34.0	28.4	41.8	51.3
26	Glass and glass products	0.1	0.2	0.0	12.4	20.6	1.6	5.5
27	Non-ferrous metal products	0.8	2.5	0.1	8.6	9.2	3.9	4.9
28	Structural metal products	1.0	1.8	0.6	33.8	23.8	72.3	44.1
29	Machinery and equipment, non-electrical	0.4	0.7	0.3	28.1	26.3	30.1	51.0
291	General purpose machinery	0.2	0.3	0.2	46.0	29.9	75.5	58.0
292	Special purpose machinery	0.2	0.4	0.2	22.2	27.3	18.4	47.2
30	Office, accounting and computing machinery	44.9	1.6	63.6	82.9	28.3	84.7	98.9
31	Electrical machinery	2.7	0.8	3.6	68.5	32.3	76.7	91.3
311	Electrical motors, generators and transformers	0.1	---	0.2	79.3	---	79.3	100.0
312	Electricity distribution and control apparatus	0.1	0.1	0.2	61.2	30.1	86.0	78.3
313	Insulated wires and cables	0.6	0.7	0.5	48.0	35.6	60.9	62.2
315	Electric lamps and lighting equipment	1.9	---	2.8	79.8	---	79.8	100.0

32	Radio/TV, medical appliances and components	38.9	75.9	22.9	81.1	90.1	70.8	41.0
321	Electrical valves, tubes etc.	32.5	58.5	21.2	85.3	90.5	79.8	45.5
322	Radio, television transmitters and apparatus	5.2	17.3	---	96.8	96.8	---	---
323	Medical appliances and equipment	1.2	0.1	1.7	26.5	4.8	29.2	98.0
33	Scientific/precision equipment	0.5	---	0.6	36.8	0.0	36.8	100.0
331	Measuring and control equipment	0.4	---	0.5	33.3	0.0	33.3	100.0
332	Optical instruments	0.1	---	0.1	69.7	0.0	69.7	100.0
35	Transport equipment	0.1	0.4	---	32.1	32.1	---	---
36	Miscellaneous manufacturing	1.9	4.4	0.8	53.9	58.7	17.6	3.8
361	Furniture	0.2	0.6	---	50.4	50.4	---	0.0
369	Manufactures not elsewhere classified	1.0	3.2	0.1	54.6	60.6	17.6	4.5
	Total	100	100	100	66.7	52.4	76.1	69.8
	US$ million	19,672	5,949	13,723				

Note: --- Zero or negligible (less than 0.05)

Source: Compiled from unpublished returns to the Manufacturing Census 2005, Department of Statistics, Malaysia.

Table 8: Per capital GDP in Malaysia and Malaysian States and Federal Territories (in MYR)

	1970	1975	1980	1995	2000	2005	2010
Malaysia	994	1431	1681	10,756	14,584	19,189	19,655
States relative to Malaysia (%)							
Johor	90.7	94.6	93.6	93.0	96.0	98.0	79.6
Kedah	67.0	54.8	53.6	59.0	61.0	63.0	50.4
Kelantan	46.6	38.1	37.5	42.0	43.0	45.0	29.7
Malacca	80.4	80.2	72.4	105.0	108.0	112.0	101.1
Negeri Senbian	98.7	91.0	88.2	84.0	88.0	91.0	103.6
Pahang	59.6	51.6	59.8	70.0	71.0	76.0	83.6
Penang	91.5	115.8	113.1	140.0	147.0	149.0	157.7
Perak	98.9	85.6	84.1	86.0	90.0	97.0	61.9
Perlis				71.0	74.0	79.0	63.8
Sabah				67.0	63.0	59.0	49.7
Sarawak				86.0	88.0	88.0	108.5
Selangor	162.9	186.0	183.4	132.0	119.0	111.0	121.4
Terengganu	59.6	51.6	59.8	154.0	158.0	154.0	71.5

Note: * At 1987 prices

Source: for 1970 and 1975 from Spinanger (1986), Table 1.3; Government of Malaysia (2001, 2006, 2010)

Table 9: Mean monthly gross household Income and incidence of poverty

	Mean household income (MYR)		Incidence of poverty (%)	
	2004	2009	2004	2009
Malaysia	3,249	4,025	5.7	3.8
States as percentage of national mean				
Johor	94.7	95.3	2.0	1.3
Kedah	65.4	66.3	7.0	5.3
Kelantan	56.3	63.0	10.6	4.8
Malacca	85.9	104.0	1.8	0.5
Negeri Senbilan	88.8	88.0	1.4	0.7
Pahang	74.2	81.5	4.0	2.1
Penang	108.7	109.5	0.3	1.2
Perak	67.9	69.8	6.3	3.5
Perlis	63.0	65.0	4.9	6.0
Sabah	73.4	77.1	23.0	19.7
Sarawak	83.9	89.0	7.5	5.3
Selangor	158.7	148.1	1.0	0.7
Terengganu	61.1	50.1	15.4	4.0

Source: Government of Malaysia (2006 and 2010)

Table 10: Composition of GDP and labour deployment in Penang

	GDP %				Employment %	
	1970	1990	2000	2008	2001	2008
Agriculture and forestry	3.2	3.2	2.4	1.2	2.4	1.6
Manufacturing	43	43.1	45.7	54	40.8	35.8
Construction	3.2	3.1	2.4	1.6	6.4	5.8
Services	50.6	50.6	49.5	42.5	50.4	56.8
	100	100	100	100	100	100

Source: SERI (2010), based on data provided by the Department of Statistics, Malaysia.

Table 11 : Foreign-ownership in Malaysian manufacturing: Penang in the national context, 2005 (percentage shares)

	Value added	Employment	Salaries and wages	Fixed assets
Foreign-owned firms share (%)				
Penang	**61.4**	**44.6**	**54.5**	**52.9**
Johor	48.5	42.0	45.3	52.6
Malacca	29.6	43.6	43.5	20.8
Selangor	42.4	33.3	35.6	32.3
Other states	21.8	20.7	25.1	21.8
Malaysia	36.6	32.5	37.5	31.8
Distribution of foreign-owned manufacturing by state(%)				
Penang	**24.8**	**17.7**	**23.8**	**17.5**
Johor	17.6	27.7	22.5	24.5
Malacca	4.7	6.6	5.2	3.0
Selangor	29.0	25.2	28.4	26.1
Other states	23.8	22.8	20.2	28.9
Malaysia	100	100	100	100
Distribution of total manufacturing by state (%				
Penang	**14.51**	**12.87**	**16.25**	**9.95**
Johor	13.12	21.36	18.54	14.13
Malacca	5.74	4.83	4.38	4.40
Selangor	24.8	24.5	29.8	24.6
Other states	41.87	36.46	31.03	46.88
Malaysia	100	100	100	100

Source: Compiled from unpublished returns to the Manufacturing Census 2005, Department of Statistics, Malaysia.

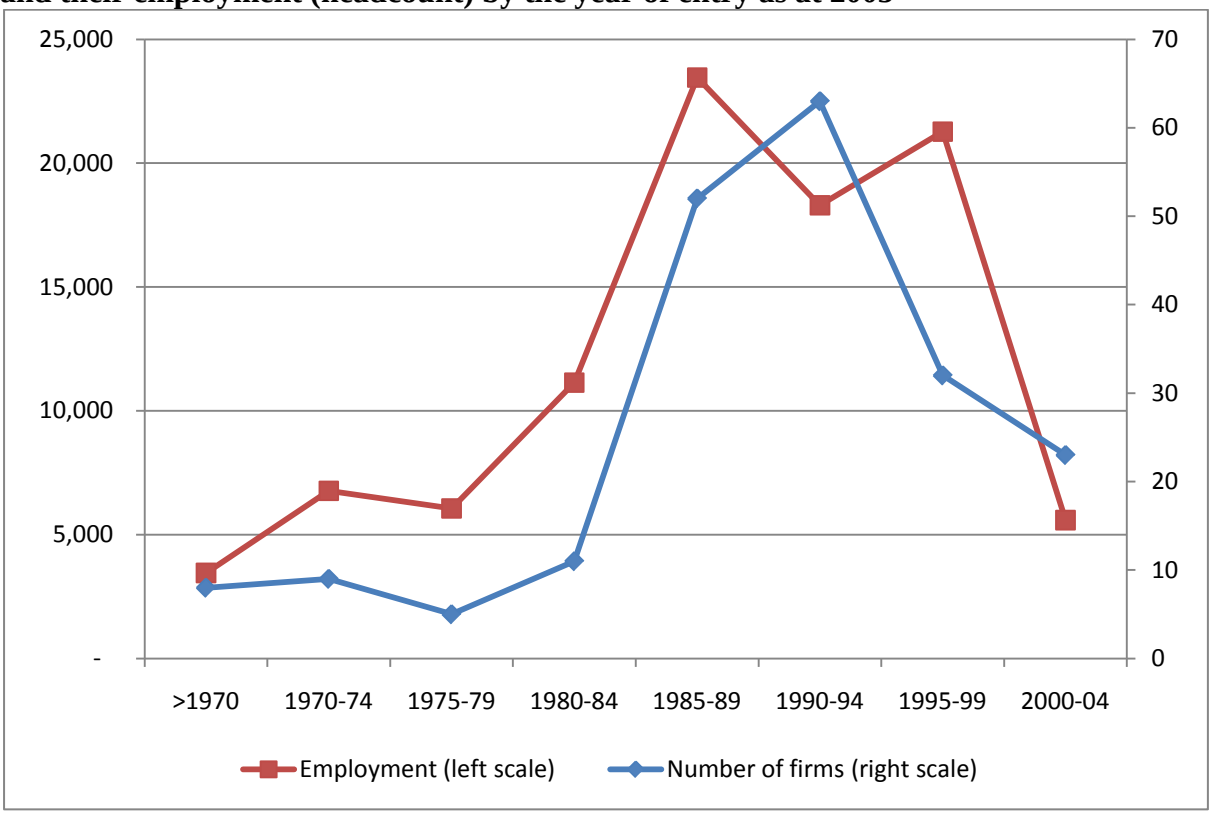
Table 12 Manufacturing employment, capital per worker, labour productivity and average wage/salary: Penang in the national context, 2005

	Employment (number)	Employment (%)	Labour productivity (US$)	Capital per worker (US$)	Average wage/salary
Penang	215,517	100.0	22,100	23,192	6,504
Foreign firms	96,037	44.6	30,447	27,523	7,950
Local firms	119,480	55.4	15,391	19,711	5,341
Johor	357,733	100.0	12,043	19,844	4,469
Foreign firms	150,356	42.0	13,904	24,847	4,817
Local firms	207,377	58.0	10,693	16.216	4,217
Malacca	80,994	100.0	23,274	27,277	4,665
Foreign firms	35,307	43.6	15,787	13,027	4,656
Local firms	45,687	56.4	29,059	38,289	4,673
Selangor	410,160	100.0	19,828	30,192	6,264
Foreign firms	136,598	33.3	25,242	29,245	6,688
Local firms	273,562	66.7	17,125	30,664	6,053
Other	610,759	100.0	22,509	38,560	4,380
Foreign firms	126,297	20.7	23,737	40,619	5,309
Local firms	484,462	79.3	22,189	38,023	4,138
Malaysia	1,675,163	100.0	19,602	29,991	5,148
Foreign firms	544,595	32.5	22,068	29,313	5,942
Local firms	1,130,568	67.5	18,414	30,318	4,765

Note: Values in Malaysian Ringgit converted at US$/MYR = 3.8. Source: compiled from unpublished returns to the Manufacturing Census 2005, Department of Statistics, Malaysia.

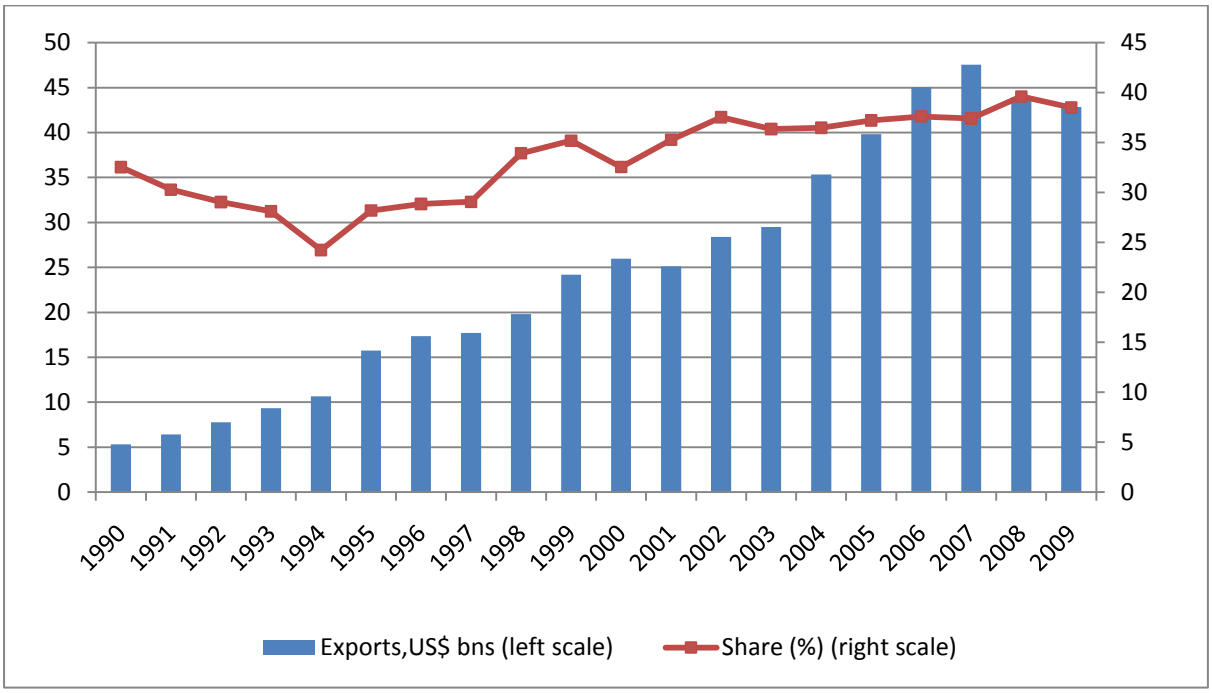
FIGURE 1: MAP OF MALAYSIA AND PENANG

Figure 2: Penang: distribution of the number branch plants of MNEs in operation and their employment (headcount) by the year of entry as at 2005



Source: Based on data compiled from unpublished returns to Manufacturing Census 2005, Department of Statistics, Malaysia.

Figure 3: Manufactured Exports from Penang: Vale (US$ million) (left scale) and share in Malaysian exports[1]

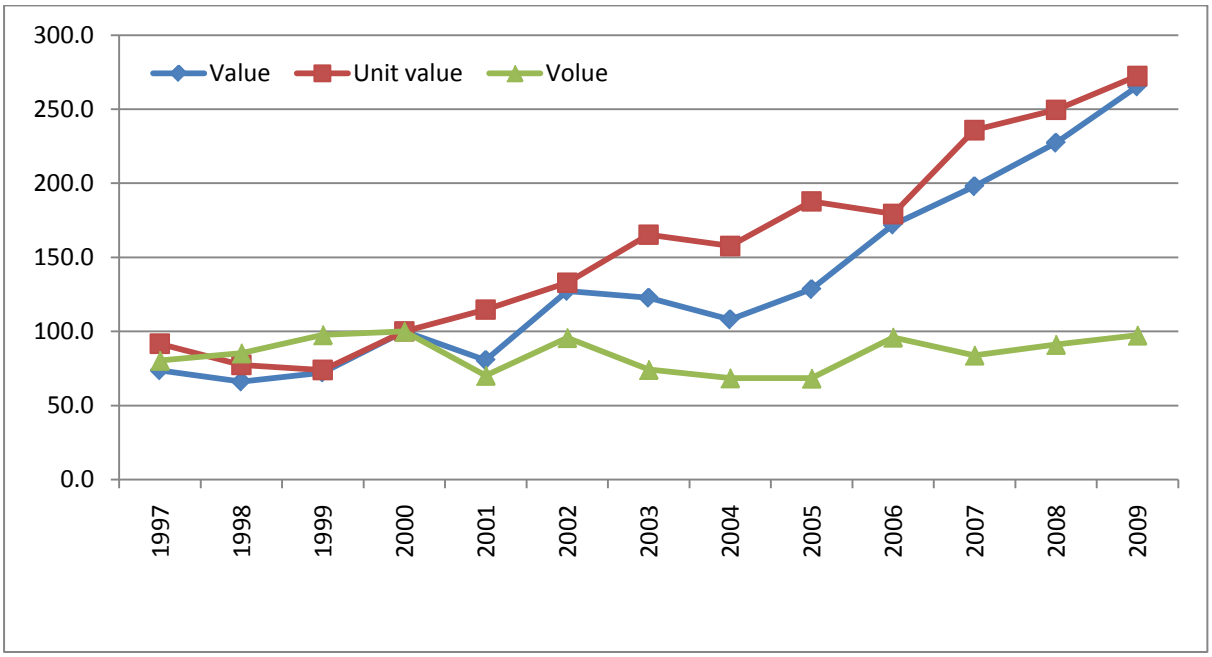


Note: 1. Annual average growth rates (%):

	1990-09	1990-99	2000-09	2000-07
Malaysia	11.4	18.0	6.1	8.4
Penang	12.2	18.9	7.5	9.0

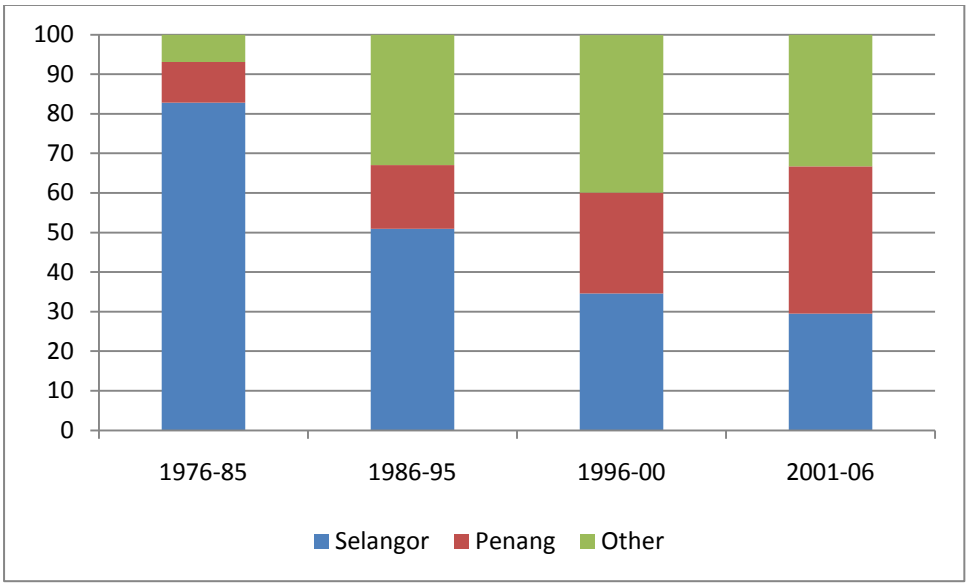
Source: Based on data compiled from unpublished returns to Manufacturing Census 2005, Department of Statistics, Malaysia

Figure 4: Value, Volume and Price (unit value) indices of electronics exports from Malaysia



Source and methodology: Compiled for UN Comtrade database. Cover 20 products at the HS 6 digit level which for which volume data are available for all years during the period 1997-2009. These products accounts for about 70% of the commodity category of electronics under the Standard International Trade Classification (SITC 77)

Figure 5: Malaysian Patent registration: Selangor, Penang and other states, 1976-2006



Source: NEAC 2009, Part 1, p. 183

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