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### **Global Productions Sharing and Local Entrepreneurship in Developing Countries: Evidence from Penang Export Hub, Malaysia**

***Prema-chandra Athukorala***

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Arndt-Corden Department of Economics  
Crawford School of Public Policy  
ANU College of Asia and the Pacific

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# **Global Productions Sharing and Local Entrepreneurship in Developing Countries: Evidence from Penang Export Hub, Malaysia**

Prema-chandra Athukorala

Arndt-Corden Department of Economics

Crawford School of Public Policy

College of Asia and the Pacific

The Australian National University

[Prema-chandra.athukorala@anu.edu.au](mailto:Prema-chandra.athukorala@anu.edu.au)

**Abstract:** This paper examines opportunities and policy options for developing countries to promote engagement of local firms in global production networks. The paper begins with a stage-setting overview of the ongoing process of global production sharing and the emerging opportunities for local firm's engagement. It then undertakes an illustrative case study of the export hub in the state of Penang in Malaysia. Forging operational links between multinational enterprises (MNEs), which set up assembly plants in Penang, and local firms was an integral part of the export-led development strategy of the state. This policy emphasis was instrumental in fostering a domestic supplier network around the operations of the MNE subsidiaries. A number of local firms, which emerged *de novo* through production sharing have become global players in their own right, with production bases in a number of other countries.

**Key words:** globalisation, trade policy, multinational enterprises, global production networks.

**JEL Codes:** F21, F23, O24, O53

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# **Global Productions Sharing and Local Entrepreneurship in Developing Countries: Evidence from Penang Export Hub, Malaysia**

## **1. Introduction**

Cross-border dispersion of production processes within vertically integrated global industries, with each country specialising in a particular stage of the production sequence, has been an increasingly important structural feature of economic globalisation in the recent decades. This phenomenon, which we call ‘global production sharing’ in this paper<sup>1</sup>, opens up opportunities for countries to participate in a finer international division of labour within a given products, instead of producing the product from beginning to end within its national boundaries. Consequently, parts and components, and final assembly traded within global production networks have been growing at a much faster rate in world trade compared to goods wholly produced within countries (‘horizontal trade’) (Yeats 2000, Helpman 2011, Athukorala 2014a, Antras 2016).

The expansion of global production sharing has coincided with a growing emphasis on export-oriented industrialisation in developing countries. In this context, linking the industrialisation process in developing countries with global production networks has gained prominence as a new dimension to the development policy debate. Opportunities for local firms to engage in global production sharing, and the role of public policy in helping these firms to forge links with ‘lead firms’ (MNE subsidiaries) within production networks are among the issues that figure prominently in this debate (Taglioni and Winkler 2016, Kowalski et al. 2015, UNCTAD 2010).

This paper seeks to contribute to the pledging literature dealing with these issues through an illustrative case study of the export production hub in the State of Penang, Malaysia. With a history of over four decade as a major hub in global production networks, Penang 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

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<sup>1</sup> The alternative terms used in the recent international trade literature include global production sharing, international production fragmentation, intra-process trade, vertical specialization, slicing the value chain, and offshoring.

from global production sharing. There is a sizeable literature on policy reforms in Penang and its role as a main regional hub within global electronics and electrical goods production networks (Eg. Todd, H 1986, Narayanan 1999, Ernst 2004, UNIDO 2009 and UNCTAD 2010, Rasiah 1994 and 2002, Kharas et al. 2010, Athukorala 2014b). The novelty of this paper lies in its specific focus on the interplay of MNE's production sharing strategies and government policy in facilitating the emergence of new local firms within production networks.

The study is based on data pieced together from various secondary sources and field research. The secondary sources include documents from Penang Development Corporation (PDC), the Penang state government organization involved in investment promotion and facilitating public-private partnership; Invest Penang, the investment promotion arm of PDC; and 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 2005 Census of Manufacturing Industries conducted by the Malaysian Department of Statistics. As part of the field research during November/December 2010 and September 2016, face-to-face interviews were conducted. Interviews conducted with senior managers of 11 affiliates of multinational enterprises, and representatives of chambers of commerce and industry. In all interviews, a flexible interview guide, thither than a fully structured questionnaire, was used, and respondents were encouraged to relate their experience in their own words and in their own sequence.

The paper first provides a stage-setting analytical narrative of the ongoing process of global production sharing and policy options for facilitating local firms' engagement in the process (Section 2). Section 3 provides an overview of initial economic conditions in Penang, institutional setting in which export-oriented development strategy was implemented, and policy reforms, with emphasis on initiatives for fostering MNE-local firm links. The evolution and structural changes of the export hub is discussed in Section 4, focusing on the structure and dynamics of the relationship between branch plants of MNEs and local firms. Section 5 examines the role of public-private partnerships in forging links between MNEs and local firms. Key findings and policy lessons are presented in the final section.

## **2. Global Production Sharing and Local Entrepreneurship**

Global production sharing is not a new phenomenon. There is ample anecdotal evidence of evolving trade in parts and components within branch networks of MNEs dating back to the early 20th century (Wilkins 1970). What is unprecedented about the contemporary process of global production sharing is its wider and ever increasing product coverage, and its rapid spread from mature industrial countries to developing countries.

Shifting of labour intensive assembly process to developing countries in some traditional labour intensive consumer goods (garments, in particular) and electronics industry began in the late 1960s (Grunwald and Flamm 1985, Helleiner 1973). Since then production networks have evolved and spread into many industries such as footwear, electronics, automobiles, televisions and radio receivers, sewing machines, office equipment, machine tools, automobile, cameras and watches, medical devices and light-emitting diodes (LED). Global production sharing has been the prime mover of a dramatic shift in manufacturing exports from developed to developing countries (Krugman 2008).

The rapid global spread of production sharing has been driven by three mutually reinforcing developments (Baldwin 2016, Helpman 2011, Jones 2000). First, advancements in production technology have enabled the industry to slice up the value chain into finer, 'portable' components. As an outcome of advances in modular production technology, some fragments of the production process in certain industries have become 'standard fragments' which can be effectively used in a number of products. Second, technological innovations in communication and transportation have shrunk the distance that once separated the world's nations, and improved speed, efficiency and economy of coordinating geographically dispersed production processes. This has facilitated, and reduced the cost of, establishing 'service links' needed to combine various fragments of the production process across countries in a timely and cost efficient manner (Jones and Kierzkowski 2004). Third, liberalization policy reforms across the world over the past four decades have considerably removed barriers to trade and foreign direct investment (FDI). There is an important two-way link between improvement in communication technology and the expansion of fragmentation-based specialisation within global industries. The latter results in lowering cost of production and rapid market penetration of the final products through enhanced price competitiveness. Scale economies resulting in

market expansion in turn encourage new technological efforts, enabling further product fragmentation. This two-way link has set the stage for trade in parts and components and final assembly traded within global production networks ('network trade') to increase more rapidly compared to conventional commodity-based trade (Jones 2000).

Yeats (2001) undertook the first quantification of network trade, focusing specifically on component in machinery and transport equipment trade of Organisation for Economic Co-operation and Development (OECD) countries. According to his analysis components accounted for 30% of total world trade in machinery and transport equipment (Section 7 of the Standard International Trade Classification (SITC 7))<sup>2</sup> of these countries in 1996, compared to that of around 15% in the mid-1980s. Following Yeats's approach, but with broader commodity coverage, Athukorala (2014a) estimated the share of parts and components in total world manufacturing trade in 2012 at 32.1%, up from 23.6% in 1992. According to his estimates total network trade (parts and components and final assembly) accounted for over a half of total manufacturing trade in 2012. These estimates also points to a palpable shift in the composition of world network trade from mature industrial countries to developing countries: the share of developing countries in world network trade increased from about 16% in the early 1990s to 52.5% in 2012.

In terms of the organizational structure, production networks take two major forms: buyer-drive production networks and producer-driven production networks. Buyer-driven networks are generally common in diffused-technology based consumer goods industries such as clothing, footwear, travel goods toys and variety of handicrafts. In these networks the 'lead firms' in the value chain are international buyers (large retailers such as Walmart, Mark & Spencer, H&M) or brand manufactures such as Victoria's Secret, Gap, Zarah, Niki). Global production sharing in these networks takes place predominantly through arm's length relationships, with global sourcing companies (value chain intermediaries, such Hong Kong-based Li & Fung Limited) playing a key role in linking producers and the lead firms. Therefore, there is room for local firms to directly engage in exporting through links established with foreign buyers (Gereffi 1999, Schmitz and Knorringa 2000).

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<sup>2</sup> The products belonging to SITC 7 roughly account for more than 40 percent of total manufacturing.

Producer-drive production networks are common in vertically integrated global industries such as electronics, electrical goods, automobiles, and scientific and medical devices. In these production network, the ‘lead firm’ is a multinational manufacturing enterprise (such Intel, Motorola, Apple and Samsung) and production sharing takes place predominantly through the lead firms’ global branch network and/or its close operational links with established contract manufacturers (Grunwald & Flamm 1985, Brown & Lindon 2005, Sturgeon and Kawakami 2011). In these high-tech industries production technology is specific to the lead firm and is closely protected in order to prevent imitations. Also the production of final goods in these industries requires highly customized and specialized parts and components whose quality cannot be verified or assured by a third party; it is not possible to write a contract between the final producer and input supplier that would adequately specify product quality. The bulk of global production sharing, in these industries, therefore, takes place through intra-firm linkages rather than in an arm’s-length manner. However, as production units (affiliated companies) becomes well established in a given country, arm’s length subcontracting arrangements with local firms can develop.

Successfully linking of local firms to global production networks of both types requires policy reforms to create a business environment conducive for export-oriented production.<sup>3</sup> However, there is a strong case for combining economy-wide reforms with public policies specifically designed to help forging operational links between lead firms in the networks and local firms, particularly in the case of production sharing within producer driven networks. In a conducive business environment, international buyers of traditional labour intensive consumer goods such as clothing and footwear who come in search of low-cost production sites could identify local entrepreneurial capabilities and help setting up new firms, without direct government support. However, given the pivotal role of MNEs as lead firms within the networks, government’s role in attracting MNEs to set up production bases and linking potential local entrepreneurs with newly setup MNEs affiliates hold the key to reaping gains from global production sharing.

Employees trained in MNE affiliates could become the seedbed for the emergence of local firms. The potential instruments availed for the government to facilitate this process and broaden the opportunist for other potential entrepreneurs include creating industrial states,

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<sup>3</sup> For surveys of the literature on strategies and policy options for promoting foreign direct investment, see Wells & Wint 2000 and Moran (2015).



vender development programs, vocational training and financial support. Setting up of industrial state side by side with export processing zones that are specifically designed for attracting foreign investors, or in areas where the MNEs are located, can help promoting subcontracting arrangements between MNE affiliates and local firms. (Nadavi 2015). Vender development programs<sup>4</sup> designed in collaboration with MNEs, combined with vocational and management training programs can facilitate transferring technology and managerial capabilities from MNEs to local firms (UNCTAD 2010, Earnst 2000).

Providing financial support on easy credit terms is the most widely talked about and tried policy instruments for helping local firms. However, it is unlikely that this instrument would yield the expected results unless it is used as an integral part of an overall promotion/capability development program (Earnst 2000). The financial constraints faced by local firms could also be more effectively addressed through an effective vender development strategy, under which the anchor firms within the production network automatically take care of the financial needs of the vendor.

Targeted government policy to promote local entrepreneurship have often failed in many countries (Little and Mazumdar 1987). But this risk is presumably not very high when it comes to helping local firms to participate in global production sharing (and other export oriented activities). This is because continuous monitoring of the performance is built into the relationship between local firms and lead firms operating within production networks. Weak links within the procurement network is reflected immediately in the production process requiring corrective action by the lead firm.

### **3. Policy Reforms**

Penang is a state in Malaysia located on the northwest coast of Malaysian Peninsula. It is divided into two parts: Penang Island, an island of 293 square kilometers located in the Strait of Malacca, and Seberang Perai (formerly Province Wellesley), a narrow hinterland of 753 square kilometers on the peninsula bordered by Kedah in the east and north and by Perak in the south. Penang is the second smallest among the 13 Malaysia states by (in) area, but the eighth most populous with a population of 1.52 million.

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<sup>4</sup> Programs designed to promote subcontracting arrangements between lead firms and local firms

During the colonial era, Penang enjoyed ‘free port’ status and its economy evolved around entrêpot trade and related backing and trade-related activities. When Malaysia gained independence in 1957, Penang’s economy was much healthier compared to the other Malaysian states and comparable to Singapore and Hong Kong. However, during the next one-and-a-half decades growth dynamism rapidly dissipated as Port Swettenham (renamed Port Klang) became the main port of the newly independent nation, and the free port status ended in 1967 with the inclusion of Penang into the principal customs area of Malaysia. By the end of 1960s, Penang’s per capital income was 12% lower than the national average and the rate of unemployment was running 25% (Singh 2011).

### 3.1 *Reform process*

The emergence of Penang as an export hub within global production networks dates back to the early 1970s when the state government embarked a sweeping market-oriented reforms that embraced MNEs as ‘partners of development’ (Lim 2005). 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. Based on an analysing Penang’s development potential in light of the experiences of Japan, Taiwan, Hong Kong and South Korea, the Nathan Report recommended ‘plugging in’ the economy into the global economy based on human resources as the only viable strategy for Penang for avoiding economic stagnation and solving the chronic unemployment problem.

The state government of Penang embraced the Nathan Report as the blueprint for policy reforms (Lim 2005, p. 9). The electronics industry – broadly defined to include both electronics and electrical goods – was earmarked as the priority sector, and establishment of free trade zones (FTZs) selected as the vehicle for attracting electronics multinational enterprises (MNEs) to set up production facilities in the state. The choice of electronics as the priority industry was based on two considerations: first, its labour-intensive nature and second, as an environmentally friendly industry it was compatible with Penang’s role as a main tourist destination in the country.

The reforms began with forming a new statutory body, Penang Development Corporation (PDC), as the principal development agency. The legal status as a statutory body provided PDC with flexibility in fulfilling national objectives in the areas where government departments faced institutional and procedural constraints. PDC opened its first FTZ in 1972

in Bayan Baru (Bayan Lepas FTZ). It aimed to attract industries that required movement of materials and products by air-transport such as semiconductor, medical devices and other precision and machining industries. A second FTZ was 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. Five industrial estates were set up near the FTAs for local firms engaged in supportive and ancillary industries related to FTZ firms. Subsequently, the original Bayan Lepas FTZ was extended in three further phases.

From its inception, the PDC undertook investment 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 Lim Chong Eu. Through these missions, the PDC successfully delivered the message that Penang people's skills and adaptability could effectively complement the needs of parts and component assembly in high-tech industries (Todd 1987). When investors arrived in Penang, the PDC provided an efficient and speedy one-stop service of investment approval and facilitation. In addition, the PDC specifically focused on addressing the needs of investors arrived in Penang. Delegation led by the PDC Chairman often called upon CEOs of companies that had invested in Penang to maintain close relationships and obtain inputs needed for reshaping the investment promotion camping (Singh 2011).

### *3.2 Fostering MNE-local firm links*

Fostering links between branch plants of multinational enterprises in Penang and local investors has been a key focus of Penang's export-led development strategy. Based on his close ties to the local business community, the Chief Minister encouraged MNE affiliates to forge subcontracting relationships with local firms. In particular PDC provided MNE affiliates with institutional support to initiate vendor development programmes in order to strengthening backward linkages with local suppliers (Lim 2005, Singh 2011).

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 position compared to foreign investors. In 1986, the incentive package offered to foreign firms, including licensed manufacturing warehouse status, was 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 million for foreign machine tool firms seeking approval to set up operations in Malaysia in order to support smaller local machine tool firms (Rasiah 1994).

In 1970, PDC established an Industrial Training Institute with West German assistance to offer occupational training in areas such as auto mechanics and welding. It 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 employees in local firms.

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 2009). PSDC, which inaugurated its first training programme in July 1989, has since played a pivotal role in meeting manpower requirements of electronics firms. 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. Subsequently, it harnessed its unique relationship with the MNEs to promote local firms through knowledge transfer programs.

PSDC launched a Young Entrepreneur Programmes in 1998 to cultivate an entrepreneurial culture among high school leavers. In the following year it launched a Global Supplier Development Programme (GSDP), a vendor development programme designed to assist local companies to become global suppliers by developing their capabilities through training and forging linkages with MNEs (Ruffin 2006). Under this program courses are offered to potential entrepreneurs in three areas: core competencies, intermediate systems, and advanced systems. After an agreed period of coaching and mentoring MNEs decide whether to accept the particular firm as part of its supply chain.

In 2010, PSDC set up a Shared Services Centre (SSC) that houses the nation's largest electromagnetic compatibility (EMC) laboratory, to serve as a platform for development of local product design capabilities. Motorola Corporation provided technical expertise for setting up the Centre. Having access to state-of-the-art test equipment at SSC not only made the process of local design fabrication more economical and flexible, but also reduced the product-to-market time involved in sending designs abroad for testing. Until then, Malaysian firms relied mostly on Singapore and United States laboratories for EMS testing. The SSC adopts a two-tier pricing system for using the facility in favour of local firms (Poh & Tan 2012).

#### **4. Evolution of the Penang export hub**

The first MNE to set up an assembly plant in the Bayan Lepas FTZ was National Semiconductor (NS) from the United States. Between 1972 and 1975, seven other MNEs set up assembly plants there: National Semiconductors, Advanced Micro Devices, Intel, Clarion, Littronix (later became Osram), Hewlett Packard (later became Agilent Technologies), Robert Bosch, and Hitachi. These eight MNEs, which propelled the industrial transition in Penang, are known locally as the *Eight Samurai*.

By the mid-1980s, an export cluster with a sizable number of branch plants of major electronics firms and a network of supporting industries, was well established in Penang. The international media dubbed Penang Asia's 'Silicon Island', as it had become the world's largest exporter and the third largest assembler semiconductor assembler after the United States and Japan (Todd 1986). 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 then there were no firms involved in consumer electronics assembly plant, except Motorola, which was producing two-way radios, mobile car phones and cordless telephones. 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. In the area of computer peripherals assembly, most significant was the arrival of disk drive firms starting in 1988. Between 1988 and 1991, most major players in this industry, including Seagate, Maxtor, Hitachi Metals, Control Data, Applied Magnetic and Conner Peripherals, set up assembly plants in Penang (McKendrick, Doner and Haggard 2000). Several US-based companies came between 1989 and 1990 to provide contract manufacturing services in printed circuit board assembly (PCBA) and flex circuit board assembly (Rasiah 2002).

From about the late 1990s, 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 because of the competitive pressure from China. At the same time, firm in disk drive industry 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, this structural shift did not resulted in a ‘hollowing out’ of the Penang export hub for two important developments (Narayanan 1999, Narayanan & Cheah 1993, Leong 2010).

First, electronics firms involved in component designing, assembling and testing have 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 global headquarter functions to Penang. Their activities in Penang now encompass corporate and financial planning, R&D, product designing and tooling, sales and marketing, in addition to the standard manufacturing activities. Most MNEs that have shifted final assembly of consumer electronics and electrical goods out of Malaysia perform the related trading and service activities from Penang. Some of them now use their Penang affiliates as an integral part of their global training and skill enhancement programs. Second, the production base has begun to diversify from electronics into a number of other electronics-related dynamic product lines in recent years. These include medical services and equipment, light emitting diodes, photovoltaic design and development, and aircraft parts (Raja 2007, Poh 2010, Leong 2010, PDC 2012, Yoon 2012).

Over the past four decades, Penang has grown to become a major export production hub with more than 250 branch plants employing over 250 thousand workers.<sup>5</sup> In the 1970s, when the first wave of MNEs came to Penang, there was a general perception that MNE affiliates would soon prove to be ‘fly-by-night’ operators. However, the data on firms in

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<sup>5</sup> Information provided by Invest Penang (the investment promotion arm of the Penang Development Corporation) in September 2016.

operation clearly indicates that these firms have become deep rooted in Penang (Table 1). As we will see below, a large number of local firms have emerged to serve the MNEs.

Table 1: Profile of the 25 Top MNE Affiliates Operating in Penang, circa 2010

Company <sup>1</sup>	Home country	Year of entry	Employment	Activities in Penang
Intel Technologies	USA	1974	10,304 <sup>7</sup>	Motherboards/microprocessors
Flextronics Technology	Singapore	1995	7,000	PCBA and supply chain solution
Motorola Technologies	USA	1985	4,811	Wireless communication equipment
B Braun	Germany	1975	4,700	Medical and surgical equipment
WD Media <sup>2</sup>	USA	1986	4,569	Thin film magnetic disks
Dell	USA	1993	4,500	Computer assembly and customer service
Jabil Circuit	USA	1992	4,207	Electronic manufacturing services
Cannon Electronics	Japan	1988	3,805	Magnetic heads and cameras
Sony	Japan	1987	3,750	Consumer electronics
Renesas Semiconductor <sup>3</sup>	Japan	1976	3,700	Integrated circuits, transistors and transistor diodes
Plexux Manufacturing	USA	1987	3,389	Computer peripherals
Agilent Technologies <sup>4</sup>	USA	1974	3,358	Microwave devices, accessories and transceivers
Fairchild <sup>5</sup>	USA	1972	2,980	Semiconductor and engineering services
Kobe Precision	Japan	1992	2,740	Ground aluminium substrate
Seagate Penang	USA	1987	2,733	Hard disk drives
Osrum	Germany	1975	2,731	Car lighting & light emitting diodes
Ase Electronics	Taiwan	1987	2,530	Integrated circuit packaging, and turnkey services
Sanyo Automedia	Japan	1988	2,080	Car radios and CD-changers
Robert Bosch	Germany	1975	2,000	Car parts and automotive semiconductors
Philips Lumiled	Netherlands	1983	1,600	LED lighting and solid state lighting solutions
Sanmina Science Systems	USA	1992	1,203	Printed circuit boards and system integration
Linear Semiconductor	USA	2003	1,167	Integrated circuits
Avago Technologies <sup>6</sup>	USA	1975	961	Optoelectronic components, and wafer fabrication
Altera	USA	1994	950	Integration technology and software development
Advanced Micro Devices	USA	1974	896	Integrated circuits

Notes:

(1) Ranked by employee headcount. (2) Formerly Comag. (3) Formerly Hitachi Malaysia. Renesas was established in 2003 through a merger of Hitachi and Mitsubishi Electric group. (4) Formerly Hewlett-Packard. (5) Formerly National Semiconductor. (6) The semiconductor division of Agilent, which became an independent company in 2005. (7) Total employment in Penang and Kulim (in the State of Kedah) plants.

Source: Compiled from SERI (2008), supplemented by information from Invest Penang, company websites and interviews.



## **5. Emergence of Ancillary Industries and local firms**

A well-developed local vendor base for the supply of ancillary inputs such as jigs, fixtures and tooling services is vital for the expansion of assembly activities in the electronics and electrical industry. Most of these ancillary products are bulky products with low value relative to weight, which are not suitable for air transport. Transport by shipping is not a viable option because timely supply is needed for smooth functioning of assembly lines. Following the entry of Eight Samurai a network of ancillary industries began to emerge to supply these inputs locally.

At the beginning these supporting industries in Penang were undertaken predominantly by firms from Japan, Singapore and Taiwan. Subsequently, local firms began to emerge (Rasiah 1994, Jaconsen 2009). Some emerged out of existing small-scale operations, but most were newly created, mostly by former MNE employees.

The local tooling vendors in the early 1980s operated in 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 for the smooth functioning of the electronic assembly firms. In response, Intel took the lead to initiate an innovative vendor development programme in 1984 to improve supply capabilities of local vendors (Lim 1991). Under the program, Intel identified potential vendors (mostly from its former employees) and provided them with initial training using its internal training facilities, the Penang Skill Development Centre and the National Institute of Occupational Safety and Health for contractor safety certification training. It then gradually allocated tasks or contracts while continually refining the vendor's capabilities. When the vendors gained maturity, Intel helped them to become global suppliers and develop a diversified customer base, without totally relying on Intel for expansion. The mature vendors were also called upon to supply solutions for Intel's technical problems, thus enabling them to become 'total solution supplier'. A number of other MNE affiliates soon followed Intel example and launched their own vendor development programs.

The MNE-local firm partnership strengthened over time, resulting in the growth of a large pool of local tooling and equipment manufacturing firms. Ancillary industries that evolved around the major electronics and auto firms expanded rapidly enhancing network cohesion. Plastics, machine tools, chemicals, and packaging and printing material were added

to the product mix in the early 1990s as the production base diversified to computer peripherals and consumer electronics. 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. Some Penang firms became suppliers to other high-tech firms, operating both locally and overseas, in addition to supplying their MNE partners (Lai 2005). Starting as small backyard workshops, a number of local vendors and some of these firms achieved the status of full-pledged services with substantial R&D and design capabilities. Some of these firms have become global players with production bases in a number of other countries. Summary profiles of five of these ‘Penang MNEs’ are given in Box 1.<sup>6</sup>

**Box 1**  
**Five Penang MNEs:**  
**From backyard workshops to Global Reach**

**Eng Teknologi Holdings**

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 behind his clinic with an initial investment of MYR 500 (US\$ 217) to produce jigs and fixtures for some semiconductor companies. Over the next two decades it ventured into producing precision tooling for the semiconductor industry and actuators and peripheral for the hard disk drive industry. Starting with the first offshore manufacturing plant set up in 1996 in Dongguan, China, now it has a global production network covering Malaysia, China, Philippines, Thailand and Singapore, which employs over 5,000 workers. The group’s customers include Copeland, Danfoss, Eato, Emerson Climate Technologies, Fujitsu, Hitachi, IBM, JVC, Samsung, Seagate, TDK and Western Digital.

**LKT Industrial**

In the early 1970s, Loh Kim Teow Foundry (LKTF), a family-run small firm, diversified into manufacturing of precision tools and components, and fabrication of machinery parts for the semiconductor industry. In 1978, LKTF was incorporated under the name of LKT Precision Engineering (LKTPPE). During the next three decades it diversified production to encompass designing and

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<sup>6</sup> It is important to note that these five firms are not representative of local firms operating within the Penang export hub. These case studies are presented here simply to illustrate possible modes of ‘MNE – local firm’ relationship within global production networks.

manufacturing of automation equipment for the semiconductor industry, custom tooling fabrication, machine structure fabrication, plastic injection moulding, disc drive manufacturing, and computer numerical control machine and assembly solutions to customers across a variety of industries. LKTPE has expanded its operations across the Malaysian mainland, Singapore and Thailand. Over 5,000 workers are employed in its many production plants. In 2010, Singapore Aerospace Manufacturing (SAM) became the majority shareholder of LKTPE and renamed it SAM Engineering & Equipment.

### **Siangtronics Technologies**

Siangtronics Technologies was founded in 1993 by three former employees of Hewlett Packard to provide simple electronic wiring services for Centronics and electrical goods producing factories in the Bayan Lepas industrial zone. By the late 1990s, the company had ventured into testing, when it obtained patent for a tester for the optical mouse which became a standard tester used in that industry. Subsequently it has produced testers for camera modules, mobile phone cameras and LED systems. It has world-wide reputation for research, design and development of test and burn-in systems and application-specific embedded systems for semiconductor, optoelectronic and automation industries. Siangtronics Technologies changed its name to Elsoft Research in 2003.

### **AKN Technologies**

Established in 1984 by a former Intel employer, AKN Technologies has evolved to become an international player in the semiconductor industry. The core competencies are in design and developing application systems for semiconductor chips. It specialises in high stamping, electroplating, thermal and anti-reflective coating and undertake contract manufacturing and designing integrated-circuit solutions and application systems for consumer electronics and computer peripherals, and polymer coating solutions for the synthetic glove industry. The company operates branch plants in 8 countries including the USA and employs over 2000 workers.

### **BCM Electronics**

BCM started operation in 1993 with a workforce of 50 to supply components for Motorola. Motorola helped the company through the transfer of experience workers in response to the state government request to partner with local companies. It first supplied components of 12 Motorola products including Portable, Dual-Tone Multi-Frequency and Mobile Mic. In 1994, BCM introduced its first surface-mount technology and started front-end manufacturing of these products. From 1995 it began shipping its products to Motorola factories worldwide. In 1998 it embarked on design and development for Motorola

culminating in co-development with Motorola of two microphone accessories. Since then BCM has remained one of Motorola's three largest global suppliers.

Data compiled from unpublished returns to the *Industrial Census of 2006* (reference year 2005)<sup>7</sup> conducted by the Malaysian Department of Statistics to illustrate the relative position of MNE affiliates and local firms in the Penang economy are summarised in Table 2. At the time of MNE entry in the early 1970s, there were no local manufacturing firms in Penang other than some family-run operations evolved around the activities of the Penang port (Jacobson 2009). The local firms listed in the table emerged *de novo* over the next four decades side by side with the evolution of the MNE-centered export hub. By 2005 there were 1956 local forms of which 144 had graduated to 'large-firm' status. As discussed, at the formative stage of the export hub, local firms were basically involved in subcontracting for the MNE affiliates located in Penang. Over time these firms seems to have begun to export a significant share of the output. In 2005 exports accounted for over 40% of total gross output of large local firms.

In 2005 local firms accounted for a third of manufacturing output and over a half of total employment in the manufacturing sector in Penang. The average annual wage (total remuneration) of a workers in local firms (US\$5292) was about 30% lower compared to the foreign firms (US\$7770). A similar difference is observable relating to capital intensity of production measured by capital per worker (US\$ 20527 compared to US\$ 25978). The difference in the average level of labour productivity between the two groups is even larger, US\$14267 compared to US\$27907. Interestingly these differences between local and foreign firms is clearly visible among both large firms and SMEs. In sum, local firms are predominantly engaged in relatively more labour intensive ancillary tasks within production networks, and thus their growth dynamism depends on production sharing strategies of lead firms.

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<sup>7</sup> The next five-year Censuses were conducted in 2011 (base year 2010) and 2016. But the DS has stopped releasing firm-level data for confidentiality reasons after we obtained these. However, we believe that data for 2005 are suitable for our purpose: the available information on the overall performance of the economy does not suggest significant structural changes in the ownership structure of manufacturing during the ensuing years.

Table 2: Manufacturing Sector in Penang: Ownership, Firm Size and Key Performance Indicators, 2005

	No. of firms	Output (Value added) (%)	Employment (%)	Exports (%)	Export/output ratio (%)	Capital per worker (US\$)	Remuneration per worker (US\$)	Labour productivity <sup>3</sup> (US\$)
Local firms	1956	34.8	51.1	20.0	42.1	20527	5292	14267
Large	144	24.4	31.1	17.1	49.9	21566	5582	16422
SMEs <sup>1</sup>	1812	10.4	20.0	2.8	21.7	18915	4842	10922
Foreign firms <sup>2</sup>	206	65.2	48.9	80.0	78.1	25978	7770	27907
Large	106	63.4	46.6	79.3	79.0	25962	7841	28515
SMEs <sup>1</sup>	97	1.8	2.3	0.8	35.6	26279	6349	15860
Total manufacturing	2162	100	100	100	66.7	23192	6503	20937
Large	250	87.8	77.6	96.4	71.6	24202	6937	23674
SMEs <sup>1</sup>	1909	12.2	22.4	3.6	23.7	19688	5001	11441

Notes:

1. Small- and medium-scale firms: firms with less than 150 workers or sales turnover of less than RM16 million.
2. Includes both joint venture and fully foreign-owned firms.
3. Value added per production worker  
     SMEs Small and medium enterprises.

Source: Compiled from unpublished returns to the Census of Industry 2005, Kuala Lumpur: Department of Statistics.

Further research to probe these structural differences between local firms and MNE affiliate is directly relevant to the contemporary debate on possibilities for industrial upgrading in developing country through global production sharing (Ernst 2004, Khars et al. 2010, Doner 2015, Kaplinsky 2015). There are two key issues here: do these difference, which seem to have persisted over four decades since the arrival of the *Eight Samurai* in Penang, simply reflect limits to industrial undrapping dictated by MNEs' tendency to restraint functions such as functions such as trading, process innovation and product development in house? Would it have been possible for the government to overcome this barrier by appropriately combining its successful strategy to attract MNEs with innovation-promotion institutional and educational reforms to develop local entrepreneurial capabilities, which rarely emerge naturally from the market? Given the paucity of the available official data, addressing these issues requires a major fresh data collection effort involving a survey of representative sample of local firms.

## **6. Conclusion**

The Penang export hub is a unique example of a government marrying its development priorities with emerging opportunities for international specialization opened up by the ongoing process of global production sharing. Of course, it is not possible to make sweeping generalization from a single case study. The experience of Penang does, however, offer important policy insights that may be useful to policy makers in other countries in formulating policies for reaping gains from global production sharing and effectively linking domestic SMEs to global production networks.

The choice of electronics and electrical goods as the priority sector matched well with Penang's source endowment and unfolding opportunities for international specialization. This clear choice made at the outset also helped the Penang Development Corporation to design an investment promotion strategy with an industrial cluster focus. The cluster approach provided a viable setting for promoting linkages between MNEs and local firms within the export hub.

The state government of Penang 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. Development of supplier network of local firms around the branch plants of MNEs

was an integral part of the overall investment proportion strategy. This unique policy emphasis 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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