Chapter 9

The Significance of Production Networks in Productivity, Exports and Technological Upgrading: Small and Medium Enterprises in Electric-Electronics, Textile-Garments, Automotives and Wood Products in Malaysia

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CHAPTER 9

The Significance of Production Networks in Productivity, Exports and Technological Upgrading: Small and Medium Enterprises in Electric-Electronics, Textile-Garments, Automotives and Wood Products in Malaysia

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This chapter assesses the impact of production networks on productivity, exports and technological upgrading of SMEs in the Malaysian electric-electronics, textiles-garments, automotive, and wood-products sector. It finds that whereas more integrated firms were showing higher production linkages domestically, less integrated firms showed higher export intensities. Among the technological variables that were significant, less integrated firms showed higher intensities those of the more integrated firms. Although more integrated SMEs appear to face more serious financial problems than the less integrated one, it is largely because of the latter being smaller than the former. The policy solution for Malaysian SMEs here then should be targeted at examining in greater detail the sources of finance accessed by the smaller SMEs. Given the positive results of domestic production networks, the Malaysian government should include the ex ante vetting, monitoring and ex post appraisal of SME conduct and performance using the domestic production network framework to better support them. In doing so it is also important to give greater weight to the specificity of each of the industries, because the nature of influence exerted by production networks tends to be different.

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1. Introduction

For a wide range of reasons governments have promoted the development of small and medium enterprises (SMEs). Whereas industrial district exponents have viewed the role of governments as an important component - within a blend of markets and trust - (Brusco, 1982), neoclassical economists have argued that SMEs not only are the best allocators of resources but their development should be led by markets (Krueger, 1995). The new institutionalists hold markets as the superior institution. However, they argue that because of market failures arising from frequency, asset specificity and uncertainty, they consider that other modes of coordination such as command and trust are important to resolve the gaps left behind by markets (see Coase, 1937; Williamson, 1985; North, 1990). Evolutionary economists consider all institutions as equally important and the significance of size is considered to be influenced by the specificities of the industries involved, including the nature of technical change, sources of access to knowledge and actors involved. The latter is uneven, non-linear and often changes with circumstances and location (see Nelson, 2008).

Using evolutionary economic theory, this paper seeks to examine the impact of production networks on technology, and economic performance of SMEs in the Malaysian manufacturing industries of electric-electronics, textile-garments, automotives and wood products. Value chains play a specific role in particular sets of industries, as internalized multinational production networks, through outsourcing arrangements or through a combination of the three. Existing works on production networks have only documented the significance, new developments or transition in control over value chains (see Gereffi, 2002; Gereffi, Humphrey and Sturgeon, 2005). Hence, the key question the paper seeks to answer is whether the intensity of integration in production networks matters in both the technological intensity and economic performance levels of SMEs in Malaysian manufacturing.

This paper examines the impact of production networks in driving productivity, exports and technological upgrading in SMEs in electric-electronics, textiles-garments, automotives and wood products industries in Malaysia. The rest of the paper is organized as follows. Section 2 discusses government policy targeted at supporting the development of SMEs. Section 3 presents the critical theoretical arguments on SMEs. Section 4 discusses the methodology and data used in the paper. Section 5 examines the descriptive statistics. Section 6 analyzes the impact of production networks controlling for other variables. Section 7 presents the conclusions.

2. Government Policy

SMEs have figured significantly in the industrialization initiatives in Malaysia. The earliest can be traced to colonial Malaya, where, since the 1950s, the British provided small loans through the Rural Industrial Development Authority (RIDA) in order t o stimulate petty handicraft manufacturing (Jomo, 1986; Rasiah, 1995). The purpose of this initiative was to arrest support for the communist insurgency and hence the program did not achieve much success. The Malaysian government opened the Majlis Amanah Rakyat (MARA) as one of the strategies in the late 1960s to uplift the livelihood of *Bumiputeras*,[2] which *inter alia*, supported the development of Malay entrepreneurship. Such forays by the government were carried out through privately incorporated channels. It was only since 1975 through the Industrial Coordination Act (ICA) that the initiatives of the Malaysian government to implement the New Economic Policy (NEP) of 1971 that formal efforts to restructure the economy ethnically using regulatory measures were implemented. Formal SME programs have since mushroomed in several ministries before efforts were taken to integrate them under one body in 1996. These programs have had a bearing on the growth and performance of SMEs in Malaysian industrialization.

[2] *Bumiputera* literally translated means son or prince of the soil. The term was originally used to refer to Malays, but it has subsequently been extended to include the indigenous peoples of Malaysia, Malaysian Thais and the Eurasians and straits Chinese (Baba Chinese) with lineage to pre-colonial Malaya.

The ICA of 1975, inter alia, regulated ownership of industrial firms with paid up capital exceeding MYR250,000, and employment size exceeding 50 employees so that at least 30 percent Bumiputera equity is met. These floor stipulations were raised to MYR500,000 and 75 employees by 1980, and subsequently to MYR1 million and 100 employees before it was raised again to MYR2.5 million by the end of the 1980s (Chee, 1986). The floor stipulation of MYR2.5 million has remained since. Meanwhile foreign firms exporting over 80 percent of output were allowed to keep 100 percent of foreign ownership. As Malaysia has a small domestic market, foreign firms in manufacturing largely exported and hence did not find the ICA regulations stifling (see Rasiah, 1995). However, the expansion of non-*Bumiputera* local firms was considered to have been hampered by such regulations (see Jesudasan, 1987), many of which apparently had to hand out free gifts to find and attract *Bumiputera* partners (see Yoshihara, 1988).

The Government took on direct initiatives during the Dr Mahathir premiership throughout the period of 1981-2003 when government funds and strategies targeted the growth of industrial SMEs. The umbrella concept was introduced to nurture particularly *Bumiputera* SMEs with Proton (backward linkages) and Perwaja Steel (forward linkages) becoming key targets. Firms offering tenders to supply components and parts to Proton and to use wire rods from Perwaja Steel were required to show at least 51 percent *Bumiputera* ownership. Given that these firms supplied largely to the domestic market, they came under the customs regulations of the principal customs area and hence the ICA regulations involving industrial firms selling less than 80 percent of their output in Malaysia.

Following criticism of the first Industrial Master Plan (IMP) of 1986 and the Second Industrial Master Plan (IMP2) of 1996 over the growth of multinationals in key export-oriented industries such as electric-electronics and textile and garments as being truncated with little linkages in the domestic economy, the government introduced the Subcontract Exchange Scheme to stimulate linkages. Electronics multinationals in particular took on the project seriously to not only access incentives, but also to see it as an integral part of their policy to cheapen costs and make manufacturing flexible. Arguably, using detailed studies of production transitions and the evolution of regional and proximate production networks, Rasiah (1988a, 1988b) had argued that the time then was ripe for host-governments to take advantage of these developments to promote the growth of local supplier firms. The key argument is that the multinationals were then seeking to develop suppliers to support their own self -expansion plans. In Penang in particular, suppliers to electronics multinationals expanded several times between 1980 until 1993 (see Rasiah, 1994, 1996). However, only Penang demonstrated a successful expansion of suppliers in the industries of machine tools, plastic molding and packaging, largely benefiting from a surge in proximate demand from electronics multinationals implementing flexible production techniques.

Meanwhile, government promotion of SMEs expanded into other manufacturing industries, including food processing and wood products (Malaysia, 1996). SME products were included in Malaysia’s exhibitions and promotions abroad through MATRADE’s activities. Whereas the depletion of timber, and cane and bamboo has led to a relative contraction of the latter, the promotion of food processing has expanded considerably with palm oil and oleo-chemical products becoming important (Jaya Gopal, 2001; Rasiah, 2006).

The uneven growth of suppliers only in industries complementary to electronics, and only in Penang, led the government to review its SME policies. After much deliberation on the IMP2 the government introduced the Small and Medium Industries Development Corporation (SMIDEC) in 1996. It was felt that the corporatist outlook as well as the integration of all SME activities under one body within the Ministry of International Trade and Industry (MITI) will help rationalize and synergize SME promotions. Because of the problems of funding faced by new start ups and small SMEs, the SME Bank was introduced in 2006 to provide special interest based loans to qualifying SMEs. SMIDEC was subsequently transformed into an SME Corporation in 2009.

The new initiatives were helpful in that they helped provide both advisory as well as more effective support for SMEs as connections and coordination between entrepreneurs were linked much better with the *meso* organizations the government launched to stimulate the growth of SMEs. However, the mid-1990s proved a turning point as the growth of suppliers in Penang plateaued and subsequently began to contract. The lack of human capital and government indecision over leveraging strategies recommended by the IMP2 caused a hollowing out effect in the electronics industry in Malaysia. Denied the capacity to upgrade into higher value added activities, several foreign firms either relocated operations to cheaper cost sites endowed with larger labor reserves such as China and Vietnam or scaled down their operations in Malaysia. The remaining flagship multinationals began to either use largely foreign labor in low-end assembly activities (e.g. Flextronics and Western Digital) or upgraded into designactivities (e.g. Intel and Motorola) or fabrication activities (e.g. OSRAM). Unfortunately the lack of human capital has restricted the latter to a handful of firms (see Rasiah, 2010).

Nevertheless, proactive support from the government has helped support the growth of SMEs in Malaysia. The share of SMEs has risen considerably over the 1996-2008 period. The government's policy to promote SMEs as well as the slowdown in the foreign MNC-led sector were instrumental in the relative expansion of the SME share in overall manufacturing value output, value added and employment (see Table 1). The contribution of SMEs in manufacturing output, value added and employment in Malaysia rose from 22.1, 19.5 and 29.6 percent respectively in 1996 to 29.6, 25.9 and 31.1 percent respectively in 2005 and 30.9, 26.5 and 31.8 percent respectively in 2008. Both output and value added of manufacturing SMEs grew faster on average in 2005-2008 than over the period 1996-2005. Only the number of establishments grew more slowly in the latter period.

Table 1. Contribution of SMEs in Manufacturing, Malaysia, 1996-2005

Indicators	1996	2005	2008
Total Output			
Value (RM billion)	51.5	81.9	100.3
% Share of the manufacturing sector	22.1	29.6	30.9
Average Annual Growth		5.3*	6.3#
Added Value			
Value (RM billion)	10.1	16.6	20.5
% Share of the manufacturing sector	19.5	25.9	26.5
Average Annual Growth		5.7*	6.5#
Number	329,848	394,670	420,917
% Share of the manufacturing sector	29.6	31.1	31.8
Average Annual growth		2.0*	1.8#

Note: * - Average annual growth rate for 1996-2005; # - Average annual growth rate over 2005-2008; Growth rates computed using 2000 prices.Source:http://www.smidec.gov.my/pdf/SME_Performance_Report_2005.pdf; http://www.smecorp.gov.my/sites/default/files/SME%20AR08%20Eng%20Text.pdf

Hence, it can be seen that both government promotion as well as the contribution of SMEs in Malaysian manufacturing have been important since the 1970s, particularly during Mahathir's premiership between 1981 until 2003. In light of this development it will be interesting to examine the dynamics of SMEs growth and expansion in Malaysian manufacturing. Due to the significance of both export-oriented as well as import-substitution manufacturing in the country, and on the basis of the special programs introduced to target growth, the industries of electric-electronics, textiles-garments, and automotives and wood products are chosen for analysis in the paper.

3. Theoretical Guide

Industrial organization economists argue that minimum scale efficiencies vary with industries as the long run average cost curves of firms are determined by the scale involved (Pratten, 1971; Scherer, 1980). Firms are expected to expand production so long as marginal revenue is equal to or greater than marginal cost. Hence, there is a tendency for industrial organization economists to support large size, especially when it involves heavy industries such as automobiles and steel. However, industrial district (see Wilkinson and You, 1994; Marshall, 1890; Piore and Sabel, 1984; Rasiah, 1994;

Sengenberger and Pyke, 1992) exponents argue that SMEs are better allocators and coordinators of resources and production owing to the latter's size flexibility and agility to enter and exit markets.

Unlike the impersonal large firm, SMEs are considered to provide greater room for horizontal relationships that support trust and social capital. Audretsch (2002, 2003) and Acs & Audretsch (1988) produced evidence from the USA to argue that SMEs participate more in R&D activities than large firms. Unlike the dynamic methodology used to capture relationships by industrial district exponents, Audretsch (2002) and Acs & Audresch (1988) used statistical evidence to argue over the allocative and flexibility advantages of small firms. Given the strength of the arguments above, it is worth exploring this debate using empirical evidence from a region endowed with strong basic infrastructure but poor high tech institutions without specifying one size to be superior to the other. The assessment will also allow comparisons with Rasiah & Asokkumar's (2007) findings in Malaysia as a whole where larger firms reported higher human resource and process technology intensities.

Within the SME literature production networks have become increasingly important as intra-industry linkages with considerable decomposition of value chains and significant parts of these segments have been outsourced. Production networks have particularly been important in East Asia with Taiwan, China, Singapore, Malaysia, Thailand, Indonesia, Philippines, Vietnam and Cambodia figuring strongly in global value chains (Gereffi, 2002). However, active domestic intra-industry linkages have largely been important with strong horizontal participation in high value added activities by local firms in Japan, Taiwan, Korea, Singapore, Hong Kong and China among the East Asian nations (see Rasiah, 2003). Fukunari (2002, 2006) had documented the growth and influence of production networks on economic performance in Japan and East Asia. Indeed, in particular industries connecting in global value chains appear to be the initial route to technological catch up (see Mathews, 2006). Hence, the focus of this paper is on production networks intensity, and its influence on economic performance and technological intensities.

4. Methodology

This section introduces the methodology used for examining the impact of production networks on technology and economic performance while controlling for firm-specific variables. Given the usual sequence of examining differences and relationships statistically, the paper will first examine descriptive statistics followed by two tail tests comparing the means of critical technology and economic performance variables differentiated by the degree of integration in production networks. The subsequent analysis will focus on statistical determinants of the key technology and performance variables controlling for size, ownership and age.

As identified in the theoretical guide, productivity and export-intensities are important economic performance variables, while technological intensity is a key explanatory variable. Hence, these three variables are the critical dependent variables that will be examined in the paper. The variables of ownership, size and age will be used as control variables. In addition, technological intensity will be used as the key explanatory variable in the economic performance regressions. The variables on technology have been estimated using embodied logic in the manner initiated by Lall (1992, 2001) but without a focus on investment capabilities.

The key differentiating variable used is the production network intensity (PNI) dummy. PNI is defined by the share of inputs in overall inputs drawn from domestic suppliers and the share of outputs sold to buyer firms for further processing and assembly. Sales to wholesalers (and retailers) and exports, and imports were excluded from the numerator of the PNI variable.

Because of the use of 500 as the dividing employment figure of SMEs in some countries, e.g. the United States and Japan, the selection of SMEs in the sample takes account of this figure rather than the Malaysian cut-off size of 150 employees. Nevertheless, interpretations are made of the impact of production networks by size categories, which will help capture both effects and its consequent implications for policy in Malaysia.

Specification of Variables

The variables used in the paper are specified in this sub-section. The firm-level variables defined refer to labour productivity, export intensity and technological intensity. Size is also an important explanatory variable. The control variables of size, ownership and age are also defined here.

Labor Productivity

Labor productivity is used as one of the key economic performance variables. As the questionnaire used in the survey did not draw out investment or capital data, no attempt is made to estimate total factor productivity. Besides, we believe the controversy of the efficacy of TFP as a technology variable is real. Hence, we do not regard its avoidance to raise questions on the strength of the arguments. It was measured as:

$$\text{Labor productivity} = VA/L$$

Where VA and L refer to value added and workforce respectively. VA is estimated in US dollars.

Export Intensities

Firm level performance is estimated using export-intensity (X/Y), which is measured as follows.

$$\text{Export Intensity} = X_i/Y_i$$

X and Y refer to exports and total gross output respectively of firm *i* in year 2004. Taking into account the fact that India is among the top five exporters of garments in the world, we expect export intensity levels to be encouraging. Both local and foreign owned large firms in the sample recorded higher export levels than SMEs (see Table 2)

Technological Capabilities

Drawing on Rasiah (2009), technological intensity (TI) was measured by incorporating the three proxies of Human Resource (HR), Process and Product

Technology (PPT) and R&D (RD) intensities. The three indexes helped the estimation of firm-level embodied technology.

Human Capital

Human capital (HC) were measured as follows:

HC = Professionals and technical personnel in workforce

Training Expenditure

Training expenditure (TE) is measured as follows:

TE= training expenditure/sales

Process Technology

Process technology (PT) intensity refers to process technology competency of firms, and is expected to have a positive relationship with export intensity. PT is measured as follows:

PT = Cutting edge inventory, process and quality control techniques of firm $_{i}$,

PT is estimated by adding the following cutting edge process techniques: materials requirement planning (MRP), materials resource planning (MRP1), integrated materials resource planning, statistical process control (SPC), quality control circles (QCC), total preventive maintenance, small group activities, ISO9000, ISO 14000, just-in-time (JIT) and quality standard (QS).

Research and Development

Higher levels of R&D (RD) intensity are expected to be correlated with higher levels of economic performance. Hence, we estimate RD as follows:

$$RD = RDEX_i$$

Where RDEX refers to proportion of R&D expenditure to sales.

Technological Intensity

TI, is estimated by using the formula:

$$TI_i = HR_i + TEi + PT_i + RD_i$$

Given no *a priori* arguments on the greater significance of any one of the three technological capabilities, and since their significance is likely to vary with the location of firms in the overall technological trajectories (see Rasiah, 2004), no attempt is made to weight them. The variables on the right hand side of the formula were added through the following formula:

$$\text{Normalization Score} = (X_i - X_{min})/(X_{max} - X_{min})$$

Where X_i , X_{min} and X_{max} refer to the *i*th, minimum and maximum values of proxy X respectively.

Control Variables

Four control variables were used in the econometric regressions, *viz*., production network intensity, size, ownership and age. Throughout the regressions, production network intensity is the key differentiating variable

Production Network Intensity

Intra-industry purchases and intra-industry sales as a share of overall sales and purchases were used as the basis for differentiating firms in two groups, one with high production network intensity (PNI) and the other with low PNI.

PNI= [Domestic intra-industry sales+domestic intra-industry purchases]/[Sales+ Purchases]

Separate regressions were run for high and low PNI using the following classification:

PNI=1 when the PNI score exceeds the median figure; otherwise PNI=0.

Size

Throughout the thesis, size is the key differentiating variable and is represented by the fulltime workforce number of the firm. Because the simple use of actual employees did not produce a significant result, a dummy variable was used to classify size as small and medium enterprises (SME), and large enterprises, and was measured as:

SME = 1- 200 employees= 0;

Large firms = 201 and above employees= 1

Age

Age is simply measured here as follows:

A_i = Number of years since establishment

Age is expected to be positively correlated to export performance and technological capabilities as it is believed that firms over time gather the required knowledge and technological knowhow to perform better than the new start ups.

However, there are also arguments that new firms will find it more convenient to begin their production with the already existing superior technology, or that foreign firms which located recently will bring with them superior technology and will have better access to foreign markets (Rasiah, 2004). In view of the conflicting findings in the past, a neutral hypothesis is assumed at this stage.

Foreign Ownership

There are only five joint venture firms in the sample and all five firms had a minimum equity of 10 percent of overall equity. The 10 percent equity level is acceptable as foreign equity in Indian firms is generally low. Furthermore, it is believed that even small amounts of foreign equity have some influence over the conduct of firms. Foreign ownership is measured as follows:

Own_i = 1 for firms with a minimum foreign equity of 50 percent and above

Own_i = 0, if otherwise

Due to the greater reach of foreign firms in global markets (Hirschman, 1970; Dunning, 1974), foreign ownership is expected to be positively correlated with export-intensities. The World Investment Report 2005 (UNCTAD 2005) had reported that R&D by foreign firms is highly concentrated in home countries. Lall (1992) showed evidence that firms tend to develop only process R&D in the host country. In another study, Rasiah & Gachino (2005) showed a positive relationship between foreign firms and technological intensities in Kenyan manufacturing firms. Thus, we can expect both a positive and negative relationships between foreign ownership and technological intensities.

Data

Data was collected over the period November 2009 until February 2010. Using a sampling frame drawn from the Department of Statistics (DOS), the breakdown of industry was drawn on the basis of manufacturing value added, size and ownership. The sample is dominated by electric-electronics firms, which contributed over 26 percent manufacturing value added in Malaysia in 2008. This was followed by automotives, textiles and garments and finally wood products (see Table 2). A correlation test was done between the variables and the results, and is presented in the Appendix.

Table 2. Breakdown of Firms by Industry, Sample, Malaysia, 2008

Industry	Firms
Automotives	24
Textile and Garments	10
Electric-Electronics	63
Wood Products	6
Total	103

Source: ERIA-Malaysia Survey (2009-10).

Specification of Econometric Models

The final evaluation carried out uses econometric models to examine differences in economic performance and technology variables controlling for industry-based, size-based, ownership-based and age-based influences. The following basic equations were estimated:

$$\text{OLS: VA/L = TI+X/Y+ PNI+ Own+Size+Age} \quad (1)$$

Where VA, L, TI, X, Y, PNI, Own, Size and A refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

$$\text{Tobit: X/Y TI=PID+Own+Size+Age} \quad (2)$$

Where VA, L, TI, X, Y, PNI, Own, Size and Age refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

$$\text{Tobit: TI=X/Y+PNI+Own+Size+Age} \quad (3)$$

A second set of regressions were run using the probit model to predict if production network intensities mattered in economic performance and technological intensities. The following probit models were estimated:

$$\text{Probit: PNI=1, PNI=0; = VA/L + Own+Size+Age} \quad (4)$$

Where VA, L, TI, X, Y, PNI, O, S and A refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

$$\text{Probit: PNI=1, PNI=0; =X/Y+Own+Size+Age} \quad (5)$$

Where VA, L, TI, X, Y, PNI, Own, Size and Age refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

$$\text{Probit: PI=1, PNI=0; TI+Own+Size+Age} \quad (6)$$

5. Descriptive Statistics

The results of the univariate tests of means, medians, standard errors, standard deviation and the number of observations are presented in Tables 2 and 3. Also examined are two-tail ‘Z’ statistics comparing the means between firms in group one with PNI scores of the median and below, and group two with PNI scores of above the median. The variances between the two PNI groups were different and hence the comparison relied on unequal variances statistics. Except for nominal sales growth figures, the responses for the rest of the variables are either complete or almost complete. The final sub-section examines barriers and potential solutions to them by the two PNI groups.

Univariate Analysis

The basic indicators shown in Table 3 were statistically significant using the one-tail test. Although the range between means and medians in some cases were wide, all the means are statistically significant at the 1 percent level of significance. This data is largely targeted at ensuring the validity of statistics used in the paper.

The mean and medians of the control variables of age were 16.9 and 17.0 years respectively, which is almost the same. The foreign equity mean ownership figure estimated using percentages rather than actual totals was 21.8 percent (see Table 3). The median was 0 percent demonstrating domination by local capital among SMEs in Malaysian manufacturing. The mean employment figure was 143 employees with the median being 91 employees. The largest employer had 500 employees while the smallest had 3 employees.

On average the sampled SMEs recorded sales of US$14.7 million in 2008. The median sales figure was US$3.4 million. The maximum and minimum sales figures recorded were US$488. Million and US$10,000 respectively. The mean and median value added recorded in 2008 were US$2.7 million and US$0.6 million respectively in 2008. The maximum and minimum value added recorded were 146,000 and 3,000 respectively. The mean and median share of value added in output 24.1 and 20.6 percent respectively.

Among the small number of firms reporting interest rates on loans, the mean and medians were 4.6 and 5.0 percent respectively in 2008. The highest loan reported was 10 percent and the lowest was 0 percent enjoyed by firms with support from government. By and large, these interest rates are low when compared to global rates.

The mean and median imports in purchases were 36.0 and 33.0 percent respectively in 2008. These figures tend to be much lower than large export-oriented firms (see

Rasiah, 2009). The mean and median export intensities of SMEs were higher at 49.0 and 58.2 percent respectively. To some extent higher export-intensities seem to support backward linkages in Malaysia.

The share of technical and professional staff in the workforce was fairly high in the SMEs as the mean and median figures were 46.7 and 54.0 percent respectively See Table 4). The breakdown of mean percentage share of finance from own equity (including retained earnings) and banks was 27.5 and 25.0 percent respectively in 2008. The remainder was either from suppliers or buyers or other financiers. The commensurate median shares were 15.0 and 12.0 percent respectively. The smaller firms tend to figure less in the formal systems and equity among the SMEs.

Some technology scores were very impressive while others fell short. The mean incidence of use of the standards of ISO9000 (manufacturing practices) and ISO14000 (environmental practices) were 0.8 and 0.3 respectively. The commensurate medians were 1.0 and 0.0 respectively. With the maximum and minimum scores of 1 and 0, the incidence of ISO9000 was high while that of ISO14000 was low. In terms of cutting edge inventory and quality control systems, the mean scores were 1.6 and 2.0 respectively out of a maximum and minimum score of 5 and 4 respectively. The mean training and R&D expenditure in sales was 1.6 and 1.2 percent respectively. The commensurate medians were 0.6 and 0.4 respectively. The latter figures were low. The overall technology intensity (TI) index was low with a mean of 0.26 and a median of 0.24. Several SMEs, especially the micro firms, neither invested on training nor on R&D.

Table 3. Basic Statistics, Malaysia, 2008

	Age	FO	Sales (US$)	Growth (2007-08)	VA (%)	VA ($US)	VA($US)/L	Interest	Employees	Import*	Export#
Mean	16.9	21.78	14,653,858	8.8	24.1	2,709,045	15,735	4.6	143.0	36.0	49.0
Median	17.0	0	3,402,154	7.7	20.6	626,752	8,368	5.0	91.0	33.0	58.2
Std Dev	8.9	41.48	50,905,427	13.9	15.5	7,962,768	22,578	3.4	140.9	31.0	34.8
Std Error	0.9	4.13	5,015,861	1.5	1.5	784,595	2,225	1.1	13.9	3.1	3.4
Minimum	0	0	10000	-35.7	4.7	3,000	142	0	3	0	0
Maximum	41	100.00	488,567,707	72.6	86.0	63,513,802	146,345	10	500	100	100
N	103	101.00	103	88	103	103	103	10	103	101	103

Note: VA – value added; L – workforce; N – number of observations; Share of imports in inputs (%); # Share of exports in output (%). Source: Compiled from ERIA (2009).

Table 4. Finance and Technology Statistics, Malaysia, 2008

	HC	Finance		Standards		Systems		In Sales		TI
	Index	Equity*	Banks	ISO9000	ISO14000	Inventory	Quality	TE	RD	
Mean	46.7	27.5	25.0	0.8	0.3	1.6	2.0	1.6	1.2	0.26
Median	54.0	15.0	12.0	1.0	0.0	2.0	2.0	0.6	0.4	0.24
Std Dev	35.1	33.3	32.1	0.4	0.5	1.2	1.7	3.0	3.1	0.17
Std Error	3.5	3.3	3.2	0.0	0.0	0.1	0.2	0.3	0.3	0.02
Minimum	0	0	0	0	0	0	0	0	0	0
Maximum	100	100	100	1	1	5	5	20	25	0.63
N	103	103	103	103	103	103	103	103	103	101

Note: HC – human capital refers to share of professionals and technical personnel in workforce; Includes retained earnings; OEM – original equipment manufacturing; ODM – original design manufacturing; OBM – original brand manufacturing; TE – training expenditure; RD – R&D expenditure in sales.

Source: Compiled from ERIA (2009).

Comparison by Production Network Intensities

We use the 2-tail Z-tests to examine differences in firm-level characteristics between more integrated and less integrated in domestic production networks. The median of the PNI variable was used to separate the two groups of firms. Some of the characteristics were statistically significant for interpretation.

As shown in Table 5 industry size category and employment numbers were statistically highly significant at the 1% level. Age, industry, ownership, sales, value added, labour productivity and type of funding were statistically insignificant. The more integrated firms with higher PNI scores show lower employment levels than the less integrated firms.

The structure of integration of firms in domestic production networks is shown in Table 6. Except for distance from export processing zones (EPZs), all the results were statistically highly significant (at 1% level). The mean percentage of purchases from local SMEs, local large firms and other domestic suppliers was much higher among the more integrated firms (21.9%, 47.5% and 83.0%) than in the less integrated firms (4.9%, 19.1% and 44.9%). The more integrated firms imported less (17.4%) than the less integrated firms (55.0%).

As is to be expected, the more integrated firms (68.6%) sold more in the domestic market than the less integrated firms (33.1%) (See Table 6). Intra-industry sales were also higher in the more integrated firms (52.6%) than in the less integrated firms (23.9%). The higher amounts of sales in the domestic market meant that the more integrated firms (31.4%) exported less than the less integrated firms (66.9%). Distance from EPZs did not matter at all in the levels of integration in domestic production networks.

Table 5. Integration in Domestic Production Networks and Basic Characteristics Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Age	17.57	16.19	-0.7774	0.4369
Industry	2.43	2.71	1.4958	0.1347
Size	3.94	2.88	-4.5557*	0.0000
Own	0.27	0.17	-1.1130	0.2657
Sales (US$)	13,939,351	15,354,624	0.1415	0.8875
Value Added (US$)	2,894,515	2,527,143	-0.2336	0.8153
Value Added/Employment (US$)	12144.09	19256.76	1.6175	0.1058
Employment	193.37	93.56	-3.8165*	0.0001
Equity and Retained Earning	24.84	30.06	0.7927	0.4279
Banks	24.16	25.88	0.2700	0.7872
Other financiers	4.18	3.12	-0.4194	0.6749
Others	45.65	40.18	-0.6536	0.5134

Note: * refers to statistical significance at the 1% level.

Source: Computed from ERIA Survey (2009-2010).

Table 6. Integration in Domestic Production Networks, and Sales and Purchase Structure, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Local SMEs	4.90	21.92	2.773*	0.006
Local Large Firm	19.09	47.45	5.017*	0.000
Other Domestic Suppliers	44.93	83.01	7.843*	0.000
Imports	54.97	17.38	-7.615*	0.000
Domestic Sales	33.09	68.60	5.991*	0.000
Intra-Industry Sales	23.88	52.63	5.202*	0.000
Exports	66.91	31.40	-5.991*	0.000
Distance from EPZs	3.82	4.94	0.571	0.568

Note: * refers to statistical significance at the 1% level.
Source: Computed from ERIA Survey (2009-2010).

Most technological variables did not show statistically significant differences against levels of integration in domestic production networks (see Table 7). Nevertheless, the overall technological intensity (TI) – which took account of the critical variables of inventory and quality systems, skills intensity, training expenditure in sales and R&D expenditure in sales – was statistically significant at the 5% level. Less integrated firms showed higher TI then more integrated firms, though the difference was small.

Less integrated firms showed higher incidence of participation in cutting edge inventory and quality control systems than the more integrated firms. The incidence of application of ISO9000 series and Materials Requirement Planning (MRPI) in less integrated firms was higher than in more integrated firms (see Table 7). Less integrated firms (22.7% and 24.7%) also showed higher intensity of vocational qualifications in workforce and marketing expenditure in sales than more integrated firms (15.9% and 16.0%).

Table 7. Integration in Domestic Production Networks and Technological Intensities, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Technical and Professional Staff in Workforce	51.27	42.32	-1.302	0.193
Tertiary Qualifications	28.56	28.09	-0.091	0.927
Vocational Qualifications	22.70	15.91	-1.950**	0.051
High School Education	48.57	52.69	0.585	0.559
ISO9000	0.92	0.69	-3.058*	0.002
ISO14000	0.27	0.33	0.575	0.565
JIT	0.51	0.38	-1.275	0.202
QS	0.12	0.17	0.793	0.428
MRP	0.06	0.08	0.362	0.717
MRP1	0.73	0.54	-1.987**	0.047
MRPII	0.25	0.13	-1.542	0.123
Cellular Manufacturing	0.18	0.16	-0.187	0.852
Inventory Control Systems	1.80	1.46	-1.441	0.150
Quality Control Systems	2.27	1.73	-1.647***	0.100
Original Equipment Manufacturing	1.24	1.14	-1.269	0.204
Original Design Manufacturing	1.49	1.55	0.590	0.555
Original Brand Manufacturing	1.90	1.88	-0.283	0.778
Research and Development in Sales	1.58	0.79	-1.268	0.205
Training Expenditure in Sales	1.93	1.24	-1.196	0.232
Marketing Expenditure in Sales	24.72	16.02	-2.383**	0.017
Technological Intensity	0.30	0.26	1.960**	0.038

Note: *, ** and *** refers to statistical significance at the 1%, 5% and 10% level.
Source: Computed from ERIA Survey (2009-2010).

Barriers and Potential Solutions

The firms in the sample were asked to identify the barriers that they consider to have inhibited further improvements in their performance, as well as, what they thought as strategies that could help them overcome them. Likert scale scores ranging from 1 to 8 were given starting with 1 as the highest and 8 as the lowest. The means are presented in Tables 8 and 9.

Differences in the means on information, distribution, logistics and promotion, tax, tariff and non-tariff barriers were statistically significant, while the others were not. Among the significant results other barriers was the most significant at 1% followed by distribution, logistics and promotion barriers at 5% and information barriers at 10% (see Table 8). The less integrated firms with PNI=0 showed higher importance with lower means than the more integrated firms. The big gap in means between less and more integrated firms in the others category suggests that the former are facing more serious barriers than more integrated firms.

Table 8. Integration in Domestic Production Networks and Barriers Faced, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Information Barriers	4.25	4.72	1.646***	0.100
Functional Barriers	4.29	4.70	1.474	0.141
Product and Price Barriers	4.06	3.98	-0.281	0.779
Distribution, Logistics and Promotion Barriers	3.92	4.58	2.367**	0.018
Procedural Barriers	3.90	4.03	0.413	0.679
Business Environment Barriers	4.19	4.23	0.109	0.914
Tax, Tariff and Non-tariff Barriers	4.75	5.35	2.103**	0.036
Other Barriers	4.64	6.23	5.045*	0.000

Looking at the reverse by examining potential solutions that can overcome barriers, counseling and advice, finance and others were statistically significant (see Table 9). The lower means of counseling and advice and others for less integrated firms compared to the more integrated firms show that they are more important among the former than the latter. Interestingly, finance as a solution was rated more highly by the more integrated firms. Because smaller firms are more immersed in domestic intra-industry production networks it may also be a problem of being small.

Table 9. Integration in Domestic Production Networks and Potential Solutions to Barriers, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Training in General Management	4.50	4.22	-0.923	0.356
Counseling and Advice	4.64	5.50	3.020*	0.003
Technology Development	5.36	5.02	-1.089	0.276
Information on Markets	5.09	5.33	0.760	0.447
Business Linkages and Networks	4.58	4.05	-1.304	0.192
Finance	4.75	4.05	-1.970**	0.049
Overall Investment Climate	4.66	4.77	0.344	0.731
Others	5.39	6.35	2.861*	0.004

Overall, the univariate and two-tail 'Z' tests produced some interesting results. However, the differences in means of the two groups of a number of variables of firms drawn by domestic production network intensity were not significant. PNI did not matter in sales, value added and labour productivity as the differences were not statistically significant. It mattered strongly in the intra-industry and the types of purchasers domestically and exports. Whereas more integrated firms were showing higher production linkages domestically, less integrated firms showed higher export intensities. Among the technological variables that were significant, less integrated firms showed higher intensities than more integrated firms. More integrated firms reported higher incidence of barriers and potential solutions than less integrated firms among the statistically significant differences in the means.

6. Statistical Analysis

The previous section examined the basic characteristics and statistical significance of differences in means between groups of firms divided by levels of integration in domestic production networks. This section is devoted to testing statistical relationships to examine the relationship between the dependent and independent variables in the first sub-section, and the significance of PNI on the critical explanatory variables in the second sub-section.

OLS and Tobit Results

The first set of analysis established statistical relationships using OLS and Tobit regressions. The results were significant for interpretation (see Table 10). The F-stats for the OLS regression on VA/L, and the log-likelihood test for the Tobit regressions of X/Y, TI and TE were statistically significant. All results are controlled for industry dummies.

TI was the only independent variable statistically significant in the VA/L regression (see Table 10) demonstrating the importance of technology on productivity. Interestingly the results also show that export-intensity, size, ownership and age did not matter on productivity.

TI and Size were statistically significant in the export-intensity regression. The positive correlation between TI and X/Y shows that technological intensity levels matter in export markets. The statistically highly significant and positive coefficient of size shows that larger size matters among SMEs in export markets. Ownership and age did not seem to matter in export markets.

The key findings in this section are that TI is important in both productivity and export-orientation. Size is important in the export-intensity, TI and TE regressions. The positive correlations involving size shows that bigger size among SMEs matters when it comes to exporting and showing higher intensities of training and overall technology.

Table 10. Multiple Regressions on Economic Performance and Technology, Sampled Firms, Malaysia, 2008

	OLS	Tobit		
	VA/L	X/Y	TI	TE
C	12368.6 (2.016)**	0.019 (0.171)	0.223 (6.263)*	0.241 (0.278)
X/Y	-10404.9 (-1.409)		0.083 (1.642)***	0.026 (0.022)
TI	34941.0 (2.371)**	0.537 (2.116)**		
OWN	5488.9 (0.896)	0.143 (1.384)	-0.067 (-1.595)	0.010 (-0.584)
Size	25.1 (1.161)	0.001 (3.031)*	0.000 (3.418)*	-0.544 (3.021)*
AGE	-313.3 (-1.167)	0.005 (1.080)	-0.003 (-1.900)***	-0.030 (-0.694)
N	101	101	101	101
F-stat	2.491**			
R2	0.1			
LL		-55.47*	41.87*	-223.49*

Note: Figures in parentheses refer to t-statistics in model 1,and Z-statistics in models 2 and 3; *, ** and *** refer to statistical significance at 1%, 5% and 10% respectively.

Source: Computed from ERIA Survey (2009-2010).

Probit Results

The three critical dependent variables, viz., VA/L, X/Y and TI were subjected to more rigorous tests against the independent variables on the basis of the production network intensity (PNI) variable. Probit regressions were run to examine the probability of strongly and weakly integrated firms in domestic production networks. The results passed the log likelihood (LL) test for model fit for interpretation. The results are presented in Table 11.

It can be seen in model 1 that the explanatory variable of labor productivity and the control variable of size were significant statistically. Labor productivity was positively correlated and significant at the 5% level of statistical significance. Size was inversely correlated and statistically highly significant at the 1% level. The results show that more integrated firms in domestic production networks are more productive than less integrated firms. The smaller the firm the more likely that it is strongly integrated in domestic production networks. The latter suggests that smaller firms in Malaysian manufacturing largely operate as suppliers.

Export-intensity and size were inversely correlated and statistically significant in the model 2. The inverse correlation between X/Y and Size, and domestic PNI is to be expected. The higher the exports, the less will the firms sell domestically to other industries. The same logic accounts for the strong inverse correlation between size and PNI as noted above, i.e. smaller firms are likely to outsource and sell to other industries than larger firms.

The explanatory variable of technological intensity showed no statistically significant relationship with PNI in model 3 demonstrating that PNI did not matter in technological intensities. Indeed, separate regressions also showed no statistical relationship between training intensity and R&D intensity, and PNI. This result may also reflect the exposure of SMEs to international competition. For the same reasons explained earlier, size was again statistically inversely correlated with PNI in model 3.

The results in this sub-section show that production network intensities (PNI) matter in labor productivity, export-intensities and size but not on technological intensities. The negative coefficient of size in models 1, 2 and 3 shows that smaller Malaysian SMEs are more integrated into domestic production networks than larger SMEs. The extent of integration in domestic production networks does not appear to matter with technological levels. Overall, the results are interesting as apart from technology, integration in production networks does seem to relate positively with the critical economic performance variables of labor productivity and export intensity.

Table 11. Probit Estimations of Production Network Intensity against Critical Variables, Sampled Firms, Malaysia, 2008

Variable	(1)	(2)	(3)
C	0.165 (0.547)	1.011(3.020)*	0.539 (1.523)
VA/L	0.000 (2.316)**		
X/Y		-2.005(-4.010)*	
TI			-0.465 (-0.533)
Own	0.174 (0.477)	0.439(1.152)	0.178 (0.489)
Size	-0.005 (-3.600)*	-0.002 (-1.683)***	-0.004 (-2.774)*
A	0.014 (0.877)	0.013 (0.779)	0.005 (0.322)
N	101	101	101
PNI=1	52	52	52
PNI=0	49	49	49
LR Stat	19.40*	32.07*	13.61*

Note: *, ** and *** refer to correlations significant at 1%, 5% and 10% respectively.
Source: Computed from ERIA Survey, 2009-2010.

7. Conclusions

This paper sought to assess the impact of production networks on productivity, exports and technological upgrading in SMEs in electric-electronics, textiles-garments, automotives and wood products in Malaysia. In light of the extensive emphasis the Malaysian government has been providing, the evaluation is useful for future policy lessons. SMEs have also responded by demonstrating increasing participation in the manufacturing sector over the period 1996-2008.

The differences in means of the two groups of a number of variables of firms drawn by domestic production network intensities using two-tailed 'Z' tests mattered strongly in the intra-industry and the types of purchasers domestically and exports. Whereas more integrated firms were showing higher production linkages domestically, less integrated firms showed higher export intensities. Among the technological variables that were significant, less integrated firms showed higher intensities than more integrated firms. More integrated firms reported higher incidence of barriers and potential solutions than less integrated firms among the statistically significant differences in the means.

The econometric results show that TI is important in both productivity and export-orientation. Size is important in the export-intensity, TI and TE regressions. The positive correlations between size, and productivity and export intensity, and the lack of it with TI, shows that bigger size among scale matters in driving economic performance but not in technological intensities. The Probit estimations show that production network intensities matter in labor productivity, export-intensities and size but not on technological intensities. The negative coefficient of size in all the models shows that smaller SMEs are more integrated in domestic production networks than larger SMEs in Malaysian manufacturing. The extent of integration in domestic production networks does not matter with technological levels but matters positively with the critical economic performance variables of labour productivity and export intensity.

While SMEs have increasingly become important in the manufacturing sector in Malaysia since 1996 the analysis also offers room for policy to further strengthen their synergies. Barriers other than those typically noted were the most significant obstacles faced by SMEs in Malaysia and they were less serious among firms more integrated in domestic production networks suggesting that networking synergies may have helped lessen their intensities. There is also room for policy as counseling and advice were a significant influence on overcoming barriers. Although more integrated SMEs appear to face more serious financial problems than less integrated firms it is largely because of the latter being smaller than the former. The policy solution for Malaysian SMEs here then should be targeted at examining in greater detail the sources of finance accessed by the smaller SMEs.

Given the positive results of domestic production networks, the Malaysian government should include the *ex ante* vetting, monitoring and *ex post* appraisal of SME conduct and performance using the domestic production network framework to better support them. In doing so it is also important to give greater weight to the specificity of each of the industries as the nature of influence exerted by production networks will be different in each of them.

It will also help governments in Southeast Asia to carefully examine the nexus between suppliers, buyers and economic performance so as to stimulate inter-firm production synergies to capture greater performance by the firms. Connecting in value chains is the starting point. Efforts must then be taken to stimulate their movement atop the value chain. It will also be useful to examine production networks further by extending the linkages to the whole of Southeast Asia. In automotives and electronics, in particular, significant production networking that was originally initiated by Japanese firms has synergized production and trade integrating Southeast Asia more deeply compared the other region in the world (see Rasiah and Amin, 2010).

References

Acs, Z. and Audrestch, D. (1988) "Innovation in Large and Small Firms: An Empirical Analysis." *American Economic Review 78*, no.4: 678–690.

Audretch, D. (2003) "Standing on the Shoulders of Midgets: The US Small Business Innovation Research Program (SBIR)," *Small Business Economics 20*, no.2: 129–135.

Audretsch, D. (2002) "The Dynamic Role of Small Firms: Evidence from U.S.**"** *Small Business Economics 18*, (1-3): 13-40.

Brusco, S. (1982) "The Emilian Model: Productive Decentralization and Social Integration." *Cambridge Journal of Economics 6*, no.2: 167-184.

Chee, P.L. (1986) *Small Industry in Malaysia*, Kuala Lumpur: Berita Publishing.

Coase, R. (1937) "The Nature of the Firm." *Economica 4*, no.16: 386-405.

ERIA-Malaysia (2009-10) "Field Survey Conducted to Gather Data", Kuala Lumpur.

Fukunari, K. (2002) "Subcontracting and the Performance of Small and Medium Firms in Japan." *Small Business Economics 18*, (1-3):163-75.

Fukunari, K. (2006) "International Production and Distribution Networks in East Asia: Eighteen Facts, Mechanics, and Policy Implications." *Asian Economic Policy Review* 1: 326-344.

Gereffi G. (2002) "International Competitiveness in the Global Apparel Commodity Chain." *International Journal of Business and Society 3*, no.1: 27-60.

Gereffi, G., Humphrey, J. and Sturgeon, T. (2005) "The Governance of Global Value Chains." *Review of International Political Economy* 12, no.1: 78-104.

International Institute for Labour Studies, pp 1-24.

Jomo, K.S. (1986) *A Question of Class*, Singapore: Oxford University Press.

Krueger, A. (1995) "East Asian Experience and Endogenous Growth Theory." Smith, H. (ed), The Economic Development of Northeast Asia, Canberra: Australian National University Press.

Lall, S. (1992) "Technological Capabilities and Industrialisation", *World Development 20*, no.2:165-86.

Lall, S. (2001) *Competitiveness, Technology and Skills*, Cheltenham, Edward Elgar.

Marshall A. (1890) *Principles of Economics*, London: Macmillan.

Matthews, J.A. (2006) "Electronics in Taiwan – A Case in Technological Learning." Chandra, V. (ed), *Technology, Adaptation and Exports: How Some Developing Countries Got It Right*", pp 83-126.

McNally.

Nelson, R. (2008) "Economic Development from the Perspective of Evolutionary Theory." *Oxford Development Studies 36*, no.1:9-21.

North, D. (1990) *Institutions, Institutional Change, and Economic Performance,* New York: Cambridge University Press.

Piore, M. and Sabel, C. (1984) *The Second Industrial Divide: Possibilities for Prosperity*, New York: Basic Books.

Pratten, C. (1971) *Economies of Scale in Manufacturing Industry*, Cambridge, Cambridge University Press.

Rasiah, R. (1988a) "The Semiconductor Industry in Penang: Implications for the New International Division of Labour Theories." *Journal of Contemporary Asia 18*, no.1: 24-46.

Rasiah, R. (1988b) "Production in Transition within the Semiconductor Industry and its Impact on Penang." *Kajian Malaysia 6*, no.1.

Rasiah, R. (1994) "Flexible Production Systems and Local Machine Tool Subcontracting: Electronics Component Transnationals in Malaysia." *Cambridge Journal of Economics 18*, no.3: 279-298.

Rasiah, R. (1995) *Foreign Capital and Industrialization in Malaysia*, Basingstoke: Macmillan.

Rasiah, R. (2009) "Growth and Slowdown in the Electronics Industry in Southeast Asia." *Journal of Asia Pacific Economy 14*, no.2: 123-137.

Rasiah, R. and Gachino, G. (2005) "Are Foreign Firms More Productive and Technology Intensive than Local Firms in Kenyan Manufacturing?" *Oxford Development Studies 33*,no.2: 211-227.

Scherer, F. (1980) *Industrial Market Structure and Economic Performance*. Chicago: Rand

Sengenberger, W. and Pyke, F. (1992) "Industrial Districts and Local Economic Regeneration: Research and Policy Issues." in F. Pyke and W. Sengenberger (eds), *Industrial Districts and Local Economic Regeneration*, Geneva,

Wilkinson, F. and You, J.I. (1994) "Competition and Cooperation: Towards Understanding Industrial Districts." *Review of Political Economy 6*:259-278.

Williamson, O. (1985) *The Economic Institutions of Capitalism*, New York: Free Press.

Yoshihara, K. (1988) *The Rise of Ersatz Capitalism in Southeast Asia*, Singapore: Oxford University Press.

Appendix. Correlation Coefficient Matrix, Sampled Firms, Malaysia, 2008

	VA/L	OWN	AGE	Size	X/Y	TI	TE	RD
VA/L	1.000	0.103	-0.095	0.146	-0.016	0.256	0.122	-0.032
OWN	0.103	1.000	0.216	0.471*	0.318	0.033	0.012	-0.075
AGE	-0.095	0.216	1.000	0.365	0.241	-0.034	0.028	-0.007
Size	0.146	0.471*	0.365	1.000	0.511	0.362	0.218	0.045
X/Y	-0.016	0.318	0.241	0.511	1.000	0.289	-0.051	-0.112
TI	0.256	0.033	-0.034	0.362	0.289	1.000	0.477*	0.322
TE	0.122	0.012	0.028	0.218	-0.051	0.477*	1.000	0.835*
RD	-0.032	-0.075	-0.007	0.045	-0.112	0.322	0.835*	1.000

Note: * - high correlation.
Source: Computed from ERIA Malaysia survey (2009-10).

1. Introduction

For a wide range of reasons governments have promoted the development of small and medium enterprises (SMEs). Whereas industrial district exponents have viewed the role of governments as an important component - within a blend of markets and trust - (Brusco, 1982), neoclassical economists have argued that SMEs not only are the best allocators of resources but their development should be led by markets (Krueger, 1995). The new institutionalists hold markets as the superior institution. However, they argue that because of market failures arising from frequency, asset specificity and uncertainty, they consider that other modes of coordination such as command and trust are important to resolve the gaps left behind by markets (see Coase, 1937; Williamson, 1985; North, 1990). Evolutionary economists consider all institutions as equally important and the significance of size is considered to be influenced by the specificities of the industries involved, including the nature of technical change, sources of access to knowledge and actors involved. The latter is uneven, non-linear and often changes with circumstances and location (see Nelson, 2008).

Using evolutionary economic theory, this paper seeks to examine the impact of production networks on technology, and economic performance of SMEs in the Malaysian manufacturing industries of electric-electronics, textile-garments, automotives and wood products. Value chains play a specific role in particular sets of industries, as internalized multinational production networks, through outsourcing arrangements or through a combination of the three. Existing works on production networks have only documented the significance, new developments or transition in control over value chains (see Gereffi, 2002; Gereffi, Humphrey and Sturgeon, 2005). Hence, the key question the paper seeks to answer is whether the intensity of integration in production networks matters in both the technological intensity and economic performance levels of SMEs in Malaysian manufacturing.

This paper examines the impact of production networks in driving productivity, exports and technological upgrading in SMEs in electric-electronics, textiles-garments, automotives and wood products industries in Malaysia. The rest of the paper is organized as follows. Section 2 discusses government policy targeted at supporting the development of SMEs. Section 3 presents the critical theoretical arguments on SMEs. Section 4 discusses the methodology and data used in the paper. Section 5 examines the descriptive statistics. Section 6 analyzes the impact of production networks controlling for other variables. Section 7 presents the conclusions.

2. Government Policy

SMEs have figured significantly in the industrialization initiatives in Malaysia. The earliest can be traced to colonial Malaya, where, since the 1950s, the British provided small loans through the Rural Industrial Development Authority (RIDA) in order t o stimulate petty handicraft manufacturing (Jomo, 1986; Rasiah, 1995). The purpose of this initiative was to arrest support for the communist insurgency and hence the program did not achieve much success. The Malaysian government opened the Majlis Amanah Rakyat (MARA) as one of the strategies in the late 1960s to uplift the livelihood of *Bumiputeras*,[2] which *inter alia*, supported the development of Malay entrepreneurship. Such forays by the government were carried out through privately incorporated channels. It was only since 1975 through the Industrial Coordination Act (ICA) that the initiatives of the Malaysian government to implement the New Economic Policy (NEP) of 1971 that formal efforts to restructure the economy ethnically using regulatory measures were implemented. Formal SME programs have since mushroomed in several ministries before efforts were taken to integrate them under one body in 1996. These programs have had a bearing on the growth and performance of SMEs in Malaysian industrialization.

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[2] *Bumiputera* literally translated means son or prince of the soil. The term was originally used to refer to Malays, but it has subsequently been extended to include the indigenous peoples of Malaysia, Malaysian Thais and the Eurasians and straits Chinese (Baba Chinese) with lineage to pre-colonial Malaya.

The ICA of 1975, inter alia, regulated ownership of industrial firms with paid up capital exceeding MYR250,000, and employment size exceeding 50 employees so that at least 30 percent Bumiputera equity is met. These floor stipulations were raised to MYR500,000 and 75 employees by 1980, and subsequently to MYR1 million and 100 employees before it was raised again to MYR2.5 million by the end of the 1980s (Chee, 1986). The floor stipulation of MYR2.5 million has remained since. Meanwhile foreign firms exporting over 80 percent of output were allowed to keep 100 percent of foreign ownership. As Malaysia has a small domestic market, foreign firms in manufacturing largely exported and hence did not find the ICA regulations stifling (see Rasiah, 1995). However, the expansion of non-*Bumiputera* local firms was considered to have been hampered by such regulations (see Jesudasan, 1987), many of which apparently had to hand out free gifts to find and attract *Bumiputera* partners (see Yoshihara, 1988).

The Government took on direct initiatives during the Dr Mahathir premiership throughout the period of 1981-2003 when government funds and strategies targeted the growth of industrial SMEs. The umbrella concept was introduced to nurture particularly *Bumiputera* SMEs with Proton (backward linkages) and Perwaja Steel (forward linkages) becoming key targets. Firms offering tenders to supply components and parts to Proton and to use wire rods from Perwaja Steel were required to show at least 51 percent *Bumiputera* ownership. Given that these firms supplied largely to the domestic market, they came under the customs regulations of the principal customs area and hence the ICA regulations involving industrial firms selling less than 80 percent of their output in Malaysia.

Following criticism of the first Industrial Master Plan (IMP) of 1986 and the Second Industrial Master Plan (IMP2) of 1996 over the growth of multinationals in key export-oriented industries such as electric-electronics and textile and garments as being truncated with little linkages in the domestic economy, the government introduced the Subcontract Exchange Scheme to stimulate linkages. Electronics multinationals in particular took on the project seriously to not only access incentives, but also to see it as an integral part of their policy to cheapen costs and make manufacturing flexible. Arguably, using detailed studies of production transitions and the evolution of regional and proximate production networks, Rasiah (1988a, 1988b) had argued that the time then was ripe for host-governments to take advantage of these developments to promote the growth of local supplier firms. The key argument is that the multinationals were then seeking to develop suppliers to support their own self -expansion plans. In Penang in particular, suppliers to electronics multinationals expanded several times between 1980 until 1993 (see Rasiah, 1994, 1996). However, only Penang demonstrated a successful expansion of suppliers in the industries of machine tools, plastic molding and packaging, largely benefiting from a surge in proximate demand from electronics multinationals implementing flexible production techniques.

Meanwhile, government promotion of SMEs expanded into other manufacturing industries, including food processing and wood products (Malaysia, 1996). SME products were included in Malaysia's exhibitions and promotions abroad through MATRADE's activities. Whereas the depletion of timber, and cane and bamboo has led to a relative contraction of the latter, the promotion of food processing has expanded considerably with palm oil and oleo-chemical products becoming important (Jaya Gopal, 2001; Rasiah, 2006).

The uneven growth of suppliers only in industries complementary to electronics, and only in Penang, led the government to review its SME policies. After much deliberation on the IMP2 the government introduced the Small and Medium Industries Development Corporation (SMIDEC) in 1996. It was felt that the corporatist outlook as well as the integration of all SME activities under one body within the Ministry of International Trade and Industry (MITI) will help rationalize and synergize SME promotions. Because of the problems of funding faced by new start ups and small SMEs, the SME Bank was introduced in 2006 to provide special interest based loans to qualifying SMEs. SMIDEC was subsequently transformed into an SME Corporation in 2009.

The new initiatives were helpful in that they helped provide both advisory as well as more effective support for SMEs as connections and coordination between entrepreneurs were linked much better with the *meso* organizations the government launched to stimulate the growth of SMEs. However, the mid-1990s proved a turning point as the growth of suppliers in Penang plateaued and subsequently began to contract. The lack of human capital and government indecision over leveraging strategies recommended by the IMP2 caused a hollowing out effect in the electronics industry in Malaysia. Denied the capacity to upgrade into higher value added activities, several foreign firms either relocated operations to cheaper cost sites endowed with larger labor reserves such as China and Vietnam or scaled down their operations in Malaysia. The remaining flagship multinationals began to either use largely foreign labor in low-end assembly activities (e.g. Flextronics and Western Digital) or upgraded into designactivities (e.g. Intel and Motorola) or fabrication activities (e.g. OSRAM). Unfortunately the lack of human capital has restricted the latter to a handful of firms (see Rasiah, 2010).

Nevertheless, proactive support from the government has helped support the growth of SMEs in Malaysia. The share of SMEs has risen considerably over the 1996-2008 period. The government's policy to promote SMEs as well as the slowdown in the foreign MNC-led sector were instrumental in the relative expansion of the SME share in overall manufacturing value output, value added and employment (see Table 1). The contribution of SMEs in manufacturing output, value added and employment in Malaysia rose from 22.1, 19.5 and 29.6 percent respectively in 1996 to 29.6, 25.9 and 31.1 percent respectively in 2005 and 30.9, 26.5 and 31.8 percent respectively in 2008. Both output and value added of manufacturing SMEs grew faster on average in 2005-2008 than over the period 1996-2005. Only the number of establishments grew more slowly in the latter period.

Table 1. Contribution of SMEs in Manufacturing, Malaysia, 1996-2005

Indicators	1996	2005	2008
Total Output			
Value (RM billion)	51.5	81.9	100.3
% Share of the manufacturing sector	22.1	29.6	30.9
Average Annual Growth		5.3*	6.3#
Added Value			
Value (RM billion)	10.1	16.6	20.5
% Share of the manufacturing sector	19.5	25.9	26.5
Average Annual Growth		5.7*	6.5#
Number	329,848	394,670	420,917
% Share of the manufacturing sector	29.6	31.1	31.8
Average Annual growth		2.0*	1.8#

Note: * - Average annual growth rate for 1996-2005; # - Average annual growth rate over 2005-2008; Growth rates computed using 2000 prices.Source:http://www.smidec.gov.my/pdf/SME_Performance_Report_2005.pdf; http://www.smecorp.gov.my/sites/default/files/SME%20AR08%20Eng%20Text.pdf

Hence, it can be seen that both government promotion as well as the contribution of SMEs in Malaysian manufacturing have been important since the 1970s, particularly during Mahathir's premiership between 1981 until 2003. In light of this development it will be interesting to examine the dynamics of SMEs growth and expansion in Malaysian manufacturing. Due to the significance of both export-oriented as well as import-substitution manufacturing in the country, and on the basis of the special programs introduced to target growth, the industries of electric-electronics, textiles-garments, and automotives and wood products are chosen for analysis in the paper.

3. Theoretical Guide

Industrial organization economists argue that minimum scale efficiencies vary with industries as the long run average cost curves of firms are determined by the scale involved (Pratten, 1971; Scherer, 1980). Firms are expected to expand production so long as marginal revenue is equal to or greater than marginal cost. Hence, there is a tendency for industrial organization economists to support large size, especially when it involves heavy industries such as automobiles and steel. However, industrial district (see Wilkinson and You, 1994; Marshall, 1890; Piore and Sabel, 1984; Rasiah, 1994;

Sengenberger and Pyke, 1992) exponents argue that SMEs are better allocators and coordinators of resources and production owing to the latter's size flexibility and agility to enter and exit markets.

Unlike the impersonal large firm, SMEs are considered to provide greater room for horizontal relationships that support trust and social capital. Audretsch (2002, 2003) and Acs & Audretsch (1988) produced evidence from the USA to argue that SMEs participate more in R&D activities than large firms. Unlike the dynamic methodology used to capture relationships by industrial district exponents, Audretsch (2002) and Acs & Audresch (1988) used statistical evidence to argue over the allocative and flexibility advantages of small firms. Given the strength of the arguments above, it is worth exploring this debate using empirical evidence from a region endowed with strong basic infrastructure but poor high tech institutions without specifying one size to be superior to the other. The assessment will also allow comparisons with Rasiah & Asokkumar's (2007) findings in Malaysia as a whole where larger firms reported higher human resource and process technology intensities.

Within the SME literature production networks have become increasingly important as intra-industry linkages with considerable decomposition of value chains and significant parts of these segments have been outsourced. Production networks have particularly been important in East Asia with Taiwan, China, Singapore, Malaysia, Thailand, Indonesia, Philippines, Vietnam and Cambodia figuring strongly in global value chains (Gereffi, 2002). However, active domestic intra-industry linkages have largely been important with strong horizontal participation in high value added activities by local firms in Japan, Taiwan, Korea, Singapore, Hong Kong and China among the East Asian nations (see Rasiah, 2003). Fukunari (2002, 2006) had documented the growth and influence of production networks on economic performance in Japan and East Asia. Indeed, in particular industries connecting in global value chains appear to be the initial route to technological catch up (see Mathews, 2006). Hence, the focus of this paper is on production networks intensity, and its influence on economic performance and technological intensities.

4. Methodology

This section introduces the methodology used for examining the impact of production networks on technology and economic performance while controlling for firm-specific variables. Given the usual sequence of examining differences and relationships statistically, the paper will first examine descriptive statistics followed by two tail tests comparing the means of critical technology and economic performance variables differentiated by the degree of integration in production networks. The subsequent analysis will focus on statistical determinants of the key technology and performance variables controlling for size, ownership and age.

As identified in the theoretical guide, productivity and export-intensities are important economic performance variables, while technological intensity is a key explanatory variable. Hence, these three variables are the critical dependent variables that will be examined in the paper. The variables of ownership, size and age will be used as control variables. In addition, technological intensity will be used as the key explanatory variable in the economic performance regressions. The variables on technology have been estimated using embodied logic in the manner initiated by Lall (1992, 2001) but without a focus on investment capabilities.

The key differentiating variable used is the production network intensity (PNI) dummy. PNI is defined by the share of inputs in overall inputs drawn from domestic suppliers and the share of outputs sold to buyer firms for further processing and assembly. Sales to wholesalers (and retailers) and exports, and imports were excluded from the numerator of the PNI variable.

Because of the use of 500 as the dividing employment figure of SMEs in some countries, e.g. the United States and Japan, the selection of SMEs in the sample takes account of this figure rather than the Malaysian cut-off size of 150 employees. Nevertheless, interpretations are made of the impact of production networks by size categories, which will help capture both effects and its consequent implications for policy in Malaysia.

Specification of Variables

The variables used in the paper are specified in this sub-section. The firm-level variables defined refer to labour productivity, export intensity and technological intensity. Size is also an important explanatory variable. The control variables of size, ownership and age are also defined here.

Labor Productivity

Labor productivity is used as one of the key economic performance variables. As the questionnaire used in the survey did not draw out investment or capital data, no attempt is made to estimate total factor productivity. Besides, we believe the controversy of the efficacy of TFP as a technology variable is real. Hence, we do not regard its avoidance to raise questions on the strength of the arguments. It was measured as:

$$\text{Labor productivity} = VA/L$$

Where VA and L refer to value added and workforce respectively. VA is estimated in US dollars.

Export Intensities

Firm level performance is estimated using export-intensity (X/Y), which is measured as follows.

$$\text{Export Intensity} = X_i/Y_i$$

X and Y refer to exports and total gross output respectively of firm *i* in year 2004. Taking into account the fact that India is among the top five exporters of garments in the world, we expect export intensity levels to be encouraging. Both local and foreign owned large firms in the sample recorded higher export levels than SMEs (see Table 2)

Technological Capabilities

Drawing on Rasiah (2009), technological intensity (TI) was measured by incorporating the three proxies of Human Resource (HR), Process and Product

Technology (PPT) and R&D (RD) intensities. The three indexes helped the estimation of firm-level embodied technology.

Human Capital

Human capital (HC) were measured as follows:

HC = Professionals and technical personnel in workforce

Training Expenditure

Training expenditure (TE) is measured as follows:

TE= training expenditure/sales

Process Technology

Process technology (PT) intensity refers to process technology competency of firms, and is expected to have a positive relationship with export intensity. PT is measured as follows:

PT = Cutting edge inventory, process and quality control techniques of firm $_{i}$,

PT is estimated by adding the following cutting edge process techniques: materials requirement planning (MRP), materials resource planning (MRP1), integrated materials resource planning, statistical process control (SPC), quality control circles (QCC), total preventive maintenance, small group activities, ISO9000, ISO 14000, just-in-time (JIT) and quality standard (QS).

Research and Development

Higher levels of R&D (RD) intensity are expected to be correlated with higher levels of economic performance. Hence, we estimate RD as follows:

$$RD = RDEX_i$$

Where RDEX refers to proportion of R&D expenditure to sales.

Technological Intensity

TI, is estimated by using the formula:

$$TI_i = HR_i + TEi + PT_i + RD_i$$

Given no *a priori* arguments on the greater significance of any one of the three technological capabilities, and since their significance is likely to vary with the location of firms in the overall technological trajectories (see Rasiah, 2004), no attempt is made to weight them. The variables on the right hand side of the formula were added through the following formula:

$$\text{Normalization Score} = (X_i – X_{min})/(X_{max} – X_{min})$$

Where X_i , X_{min} and X_{max} refer to the *i*th, minimum and maximum values of proxy X respectively.

Control Variables

Four control variables were used in the econometric regressions, *viz.*, production network intensity, size, ownership and age. Throughout the regressions, production network intensity is the key differentiating variable

Production Network Intensity

Intra-industry purchases and intra-industry sales as a share of overall sales and purchases were used as the basis for differentiating firms in two groups, one with high production network intensity (PNI) and the other with low PNI.

PNI= [Domestic intra-industry sales+domestic intra-industry purchases]/[Sales+ Purchases]

Separate regressions were run for high and low PNI using the following classification:

PNI=1 when the PNI score exceeds the median figure; otherwise PNI=0.

Size

Throughout the thesis, size is the key differentiating variable and is represented by the fulltime workforce number of the firm. Because the simple use of actual employees did not produce a significant result, a dummy variable was used to classify size as small and medium enterprises (SME), and large enterprises, and was measured as:

SME = 1- 200 employees= 0;

Large firms = 201 and above employees= 1

Age

Age is simply measured here as follows:

A_i = Number of years since establishment

Age is expected to be positively correlated to export performance and technological capabilities as it is believed that firms over time gather the required knowledge and technological knowhow to perform better than the new start ups.

However, there are also arguments that new firms will find it more convenient to begin their production with the already existing superior technology, or that foreign firms which located recently will bring with them superior technology and will have better access to foreign markets (Rasiah, 2004). In view of the conflicting findings in the past, a neutral hypothesis is assumed at this stage.

Foreign Ownership

There are only five joint venture firms in the sample and all five firms had a minimum equity of 10 percent of overall equity. The 10 percent equity level is acceptable as foreign equity in Indian firms is generally low. Furthermore, it is believed that even small amounts of foreign equity have some influence over the conduct of firms. Foreign ownership is measured as follows:

Own_i = 1 for firms with a minimum foreign equity of 50 percent and above

Own_i = 0, if otherwise

Due to the greater reach of foreign firms in global markets (Hirschman, 1970; Dunning, 1974), foreign ownership is expected to be positively correlated with export-intensities. The World Investment Report 2005 (UNCTAD 2005) had reported that R&D by foreign firms is highly concentrated in home countries. Lall (1992) showed evidence that firms tend to develop only process R&D in the host country. In another study, Rasiah & Gachino (2005) showed a positive relationship between foreign firms and technological intensities in Kenyan manufacturing firms. Thus, we can expect both a positive and negative relationships between foreign ownership and technological intensities.

Data

Data was collected over the period November 2009 until February 2010. Using a sampling frame drawn from the Department of Statistics (DOS), the breakdown of industry was drawn on the basis of manufacturing value added, size and ownership. The sample is dominated by electric-electronics firms, which contributed over 26 percent manufacturing value added in Malaysia in 2008. This was followed by automotives, textiles and garments and finally wood products (see Table 2). A correlation test was done between the variables and the results, and is presented in the Appendix.

Table 2. Breakdown of Firms by Industry, Sample, Malaysia, 2008

Industry	Firms
Automotives	24
Textile and Garments	10
Electric-Electronics	63
Wood Products	6
Total	103

Source: ERIA-Malaysia Survey (2009-10).

Specification of Econometric Models

The final evaluation carried out uses econometric models to examine differences in economic performance and technology variables controlling for industry-based, size-based, ownership-based and age-based influences. The following basic equations were estimated:

OLS: VA/L = TI+X/Y+ PNI+ Own+Size+Age (1)

Where VA, L, TI, X, Y, PNI, Own, Size and A refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

Tobit: X/Y TI=PID+Own+Size+Age (2)

Where VA, L, TI, X, Y, PNI, Own, Size and Age refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

Tobit: TI=X/Y+PNI+Own+Size+Age (3)

A second set of regressions were run using the probit model to predict if production network intensities mattered in economic performance and technological intensities. The following probit models were estimated:

Probit: PNI=1, PNI=0; = VA/L + Own+Size+Age (4)

Where VA, L, TI, X, Y, PNI, O, S and A refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

Probit: PNI=1, PNI=0; =X/Y+Own+Size+Age (5)

Where VA, L, TI, X, Y, PNI, Own, Size and Age refer to value added, workforce, technological intensity, production network intensity, ownership, size and age respectively of firm i.

Probit: PI=1, PNI=0; TI+Own+Size+Age (6)

5. Descriptive Statistics

The results of the univariate tests of means, medians, standard errors, standard deviation and the number of observations are presented in Tables 2 and 3. Also examined are two-tail ‘Z’ statistics comparing the means between firms in group one with PNI scores of the median and below, and group two with PNI scores of above the median. The variances between the two PNI groups were different and hence the comparison relied on unequal variances statistics. Except for nominal sales growth figures, the responses for the rest of the variables are either complete or almost complete. The final sub-section examines barriers and potential solutions to them by the two PNI groups.

Univariate Analysis

The basic indicators shown in Table 3 were statistically significant using the one-tail test. Although the range between means and medians in some cases were wide, all the means are statistically significant at the 1 percent level of significance. This data is largely targeted at ensuring the validity of statistics used in the paper.

The mean and medians of the control variables of age were 16.9 and 17.0 years respectively, which is almost the same. The foreign equity mean ownership figure estimated using percentages rather than actual totals was 21.8 percent (see Table 3). The median was 0 percent demonstrating domination by local capital among SMEs in Malaysian manufacturing. The mean employment figure was 143 employees with the median being 91 employees. The largest employer had 500 employees while the smallest had 3 employees.

On average the sampled SMEs recorded sales of US$14.7 million in 2008. The median sales figure was US$3.4 million. The maximum and minimum sales figures recorded were US$488. Million and US$10,000 respectively. The mean and median value added recorded in 2008 were US$2.7 million and US$0.6 million respectively in 2008. The maximum and minimum value added recorded were 146,000 and 3,000 respectively. The mean and median share of value added in output 24.1 and 20.6 percent respectively.

Among the small number of firms reporting interest rates on loans, the mean and medians were 4.6 and 5.0 percent respectively in 2008. The highest loan reported was 10 percent and the lowest was 0 percent enjoyed by firms with support from government. By and large, these interest rates are low when compared to global rates.

The mean and median imports in purchases were 36.0 and 33.0 percent respectively in 2008. These figures tend to be much lower than large export-oriented firms (see

Rasiah, 2009). The mean and median export intensities of SMEs were higher at 49.0 and 58.2 percent respectively. To some extent higher export-intensities seem to support backward linkages in Malaysia.

The share of technical and professional staff in the workforce was fairly high in the SMEs as the mean and median figures were 46.7 and 54.0 percent respectively See Table 4). The breakdown of mean percentage share of finance from own equity (including retained earnings) and banks was 27.5 and 25.0 percent respectively in 2008. The remainder was either from suppliers or buyers or other financiers. The commensurate median shares were 15.0 and 12.0 percent respectively. The smaller firms tend to figure less in the formal systems and equity among the SMEs.

Some technology scores were very impressive while others fell short. The mean incidence of use of the standards of ISO9000 (manufacturing practices) and ISO14000 (environmental practices) were 0.8 and 0.3 respectively. The commensurate medians were 1.0 and 0.0 respectively. With the maximum and minimum scores of 1 and 0, the incidence of ISO9000 was high while that of ISO14000 was low. In terms of cutting edge inventory and quality control systems, the mean scores were 1.6 and 2.0 respectively out of a maximum and minimum score of 5 and 4 respectively. The mean training and R&D expenditure in sales was 1.6 and 1.2 percent respectively. The commensurate medians were 0.6 and 0.4 respectively. The latter figures were low. The overall technology intensity (TI) index was low with a mean of 0.26 and a median of 0.24. Several SMEs, especially the micro firms, neither invested on training nor on R&D.

Table 3. Basic Statistics, Malaysia, 2008

	Age	FO	Sales (US$)	Growth (2007-08)	VA (%)	VA ($US)	VA($US)/L	Interest	Employees	Import*	Export#
Mean	16.9	21.78	14,653,858	8.8	24.1	2,709,045	15,735	4.6	143.0	36.0	49.0
Median	17.0	0	3,402,154	7.7	20.6	626,752	8,368	5.0	91.0	33.0	58.2
Std Dev	8.9	41.48	50,905,427	13.9	15.5	7,962,768	22,578	3.4	140.9	31.0	34.8
Std Error	0.9	4.13	5,015,861	1.5	1.5	784,595	2,225	1.1	13.9	3.1	3.4
Minimum	0	0	10000	-35.7	4.7	3,000	142	0	3	0	0
Maximum	41	100.00	488,567,707	72.6	86.0	63,513,802	146,345	10	500	100	100
N	103	101.00	103	88	103	103	103	10	103	101	103

Note: VA – value added; L – workforce; N – number of observations; Share of imports in inputs (%); # Share of exports in output (%). Source: Compiled from ERIA (2009).

Table 4. Finance and Technology Statistics, Malaysia, 2008

	HC	Finance		Standards		Systems		In Sales		TI
	Index	Equity*	Banks	ISO9000	ISO14000	Inventory	Quality	TE	RD	
Mean	46.7	27.5	25.0	0.8	0.3	1.6	2.0	1.6	1.2	0.26
Median	54.0	15.0	12.0	1.0	0.0	2.0	2.0	0.6	0.4	0.24
Std Dev	35.1	33.3	32.1	0.4	0.5	1.2	1.7	3.0	3.1	0.17
Std Error	3.5	3.3	3.2	0.0	0.0	0.1	0.2	0.3	0.3	0.02
Minimum	0	0	0	0	0	0	0	0	0	0
Maximum	100	100	100	1	1	5	5	20	25	0.63
N	103	103	103	103	103	103	103	103	103	101

Note: HC – human capital refers to share of professionals and technical personnel in workforce; Includes retained earnings; OEM – original equipment manufacturing; ODM – original design manufacturing; OBM – original brand manufacturing; TE – training expenditure; RD – R&D expenditure in sales.

Source: Compiled from ERIA (2009).

Comparison by Production Network Intensities

We use the 2-tail Z-tests to examine differences in firm-level characteristics between more integrated and less integrated in domestic production networks. The median of the PNI variable was used to separate the two groups of firms. Some of the characteristics were statistically significant for interpretation.

As shown in Table 5 industry size category and employment numbers were statistically highly significant at the 1% level. Age, industry, ownership, sales, value added, labour productivity and type of funding were statistically insignificant. The more integrated firms with higher PNI scores show lower employment levels than the less integrated firms.

The structure of integration of firms in domestic production networks is shown in Table 6. Except for distance from export processing zones (EPZs), all the results were statistically highly significant (at 1% level). The mean percentage of purchases from local SMEs, local large firms and other domestic suppliers was much higher among the more integrated firms (21.9%, 47.5% and 83.0%) than in the less integrated firms (4.9%, 19.1% and 44.9%). The more integrated firms imported less (17.4%) than the less integrated firms (55.0%).

As is to be expected, the more integrated firms (68.6%) sold more in the domestic market than the less integrated firms (33.1%) (See Table 6). Intra-industry sales were also higher in the more integrated firms (52.6%) than in the less integrated firms (23.9%). The higher amounts of sales in the domestic market meant that the more integrated firms (31.4%) exported less than the less integrated firms (66.9%). Distance from EPZs did not matter at all in the levels of integration in domestic production networks.

Table 5. Integration in Domestic Production Networks and Basic Characteristics Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Age	17.57	16.19	-0.7774	0.4369
Industry	2.43	2.71	1.4958	0.1347
Size	3.94	2.88	-4.5557*	0.0000
Own	0.27	0.17	-1.1130	0.2657
Sales (US$)	13,939,351	15,354,624	0.1415	0.8875
Value Added (US$)	2,894,515	2,527,143	-0.2336	0.8153
Value Added/Employment (US$)	12144.09	19256.76	1.6175	0.1058
Employment	193.37	93.56	-3.8165*	0.0001
Equity and Retained Earning	24.84	30.06	0.7927	0.4279
Banks	24.16	25.88	0.2700	0.7872
Other financiers	4.18	3.12	-0.4194	0.6749
Others	45.65	40.18	-0.6536	0.5134

Note: * refers to statistical significance at the 1% level.

Source: Computed from ERIA Survey (2009-2010).

Table 6. Integration in Domestic Production Networks, and Sales and Purchase Structure, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Local SMEs	4.90	21.92	2.773*	0.006
Local Large Firm	19.09	47.45	5.017*	0.000
Other Domestic Suppliers	44.93	83.01	7.843*	0.000
Imports	54.97	17.38	-7.615*	0.000
Domestic Sales	33.09	68.60	5.991*	0.000
Intra-Industry Sales	23.88	52.63	5.202*	0.000
Exports	66.91	31.40	-5.991*	0.000
Distance from EPZs	3.82	4.94	0.571	0.568

Note: * refers to statistical significance at the 1% level.
Source: Computed from ERIA Survey (2009-2010).

Most technological variables did not show statistically significant differences against levels of integration in domestic production networks (see Table 7). Nevertheless, the overall technological intensity (TI) – which took account of the critical variables of inventory and quality systems, skills intensity, training expenditure in sales and R&D expenditure in sales – was statistically significant at the 5% level. Less integrated firms showed higher TI then more integrated firms, though the difference was small.

Less integrated firms showed higher incidence of participation in cutting edge inventory and quality control systems than the more integrated firms. The incidence of application of ISO9000 series and Materials Requirement Planning (MRPI) in less integrated firms was higher than in more integrated firms (see Table 7). Less integrated firms (22.7% and 24.7%) also showed higher intensity of vocational qualifications in workforce and marketing expenditure in sales than more integrated firms (15.9% and 16.0%).

Table 7. Integration in Domestic Production Networks and Technological Intensities, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Technical and Professional Staff in Workforce	51.27	42.32	-1.302	0.193
Tertiary Qualifications	28.56	28.09	-0.091	0.927
Vocational Qualifications	22.70	15.91	-1.950**	0.051
High School Education	48.57	52.69	0.585	0.559
ISO9000	0.92	0.69	-3.058*	0.002
ISO14000	0.27	0.33	0.575	0.565
JIT	0.51	0.38	-1.275	0.202
QS	0.12	0.17	0.793	0.428
MRP	0.06	0.08	0.362	0.717
MRP1	0.73	0.54	-1.987**	0.047
MRPII	0.25	0.13	-1.542	0.123
Cellular Manufacturing	0.18	0.16	-0.187	0.852
Inventory Control Systems	1.80	1.46	-1.441	0.150
Quality Control Systems	2.27	1.73	-1.647***	0.100
Original Equipment Manufacturing	1.24	1.14	-1.269	0.204
Original Design Manufacturing	1.49	1.55	0.590	0.555
Original Brand Manufacturing	1.90	1.88	-0.283	0.778
Research and Development in Sales	1.58	0.79	-1.268	0.205
Training Expenditure in Sales	1.93	1.24	-1.196	0.232
Marketing Expenditure in Sales	24.72	16.02	-2.383**	0.017
Technological Intensity	0.30	0.26	1.960**	0.038

Note: *, ** and *** refers to statistical significance at the 1%, 5% and 10% level.
Source: Computed from ERIA Survey (2009-2010).

Barriers and Potential Solutions

The firms in the sample were asked to identify the barriers that they consider to have inhibited further improvements in their performance, as well as, what they thought as strategies that could help them overcome them. Likert scale scores ranging from 1 to 8 were given starting with 1 as the highest and 8 as the lowest. The means are presented in Tables 8 and 9.

Differences in the means on information, distribution, logistics and promotion, tax, tariff and non-tariff barriers were statistically significant, while the others were not. Among the significant results other barriers was the most significant at 1% followed by distribution, logistics and promotion barriers at 5% and information barriers at 10% (see Table 8). The less integrated firms with PNI=0 showed higher importance with lower means than the more integrated firms. The big gap in means between less and more integrated firms in the others category suggests that the former are facing more serious barriers than more integrated firms.

Table 8. Integration in Domestic Production Networks and Barriers Faced, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Information Barriers	4.25	4.72	1.646***	0.100
Functional Barriers	4.29	4.70	1.474	0.141
Product and Price Barriers	4.06	3.98	-0.281	0.779
Distribution, Logistics and Promotion Barriers	3.92	4.58	2.367**	0.018
Procedural Barriers	3.90	4.03	0.413	0.679
Business Environment Barriers	4.19	4.23	0.109	0.914
Tax, Tariff and Non-tariff Barriers	4.75	5.35	2.103**	0.036
Other Barriers	4.64	6.23	5.045*	0.000

Looking at the reverse by examining potential solutions that can overcome barriers, counseling and advice, finance and others were statistically significant (see Table 9). The lower means of counseling and advice and others for less integrated firms compared to the more integrated firms show that they are more important among the former than the latter. Interestingly, finance as a solution was rated more highly by the more integrated firms. Because smaller firms are more immersed in domestic intra-industry production networks it may also be a problem of being small.

Table 9. Integration in Domestic Production Networks and Potential Solutions to Barriers, Malaysian Sample, 2008

	PNI=0	PNI=1	Z-stats	p-value
Training in General Management	4.50	4.22	-0.923	0.356
Counseling and Advice	4.64	5.50	3.020*	0.003
Technology Development	5.36	5.02	-1.089	0.276
Information on Markets	5.09	5.33	0.760	0.447
Business Linkages and Networks	4.58	4.05	-1.304	0.192
Finance	4.75	4.05	-1.970**	0.049
Overall Investment Climate	4.66	4.77	0.344	0.731
Others	5.39	6.35	2.861*	0.004

Overall, the univariate and two-tail 'Z' tests produced some interesting results. However, the differences in means of the two groups of a number of variables of firms drawn by domestic production network intensity were not significant. PNI did not matter in sales, value added and labour productivity as the differences were not statistically significant. It mattered strongly in the intra-industry and the types of purchasers domestically and exports. Whereas more integrated firms were showing higher production linkages domestically, less integrated firms showed higher export intensities. Among the technological variables that were significant, less integrated firms showed higher intensities than more integrated firms. More integrated firms reported higher incidence of barriers and potential solutions than less integrated firms among the statistically significant differences in the means.

6. Statistical Analysis

The previous section examined the basic characteristics and statistical significance of differences in means between groups of firms divided by levels of integration in domestic production networks. This section is devoted to testing statistical relationships to examine the relationship between the dependent and independent variables in the first sub-section, and the significance of PNI on the critical explanatory variables in the second sub-section.

OLS and Tobit Results

The first set of analysis established statistical relationships using OLS and Tobit regressions. The results were significant for interpretation (see Table 10). The F-stats for the OLS regression on VA/L, and the log-likelihood test for the Tobit regressions of X/Y, TI and TE were statistically significant. All results are controlled for industry dummies.

TI was the only independent variable statistically significant in the VA/L regression (see Table 10) demonstrating the importance of technology on productivity. Interestingly the results also show that export-intensity, size, ownership and age did not matter on productivity.

TI and Size were statistically significant in the export-intensity regression. The positive correlation between TI and X/Y shows that technological intensity levels matter in export markets. The statistically highly significant and positive coefficient of size shows that larger size matters among SMEs in export markets. Ownership and age did not seem to matter in export markets.

The key findings in this section are that TI is important in both productivity and export-orientation. Size is important in the export-intensity, TI and TE regressions. The positive correlations involving size shows that bigger size among SMEs matters when it comes to exporting and showing higher intensities of training and overall technology.

Table 10. Multiple Regressions on Economic Performance and Technology, Sampled Firms, Malaysia, 2008

	OLS	Tobit		
	VA/L	X/Y	TI	TE
C	12368.6 (2.016)**	0.019 (0.171)	0.223 (6.263)*	0.241 (0.278)
X/Y	-10404.9 (-1.409)		0.083 (1.642)***	0.026 (0.022)
TI	34941.0 (2.371)**	0.537 (2.116)**		
OWN	5488.9 (0.896)	0.143 (1.384)	-0.067 (-1.595)	0.010 (-0.584)
Size	25.1 (1.161)	0.001 (3.031)*	0.000 (3.418)*	-0.544 (3.021)*
AGE	-313.3 (-1.167)	0.005 (1.080)	-0.003 (-1.900)***	-0.030 (-0.694)
N	101	101	101	101
F-stat	2.491**			
R2	0.1			
LL		-55.47*	41.87*	-223.49*

Note: Figures in parentheses refer to t-statistics in model 1,and Z-statistics in models 2 and 3; *, ** and *** refer to statistical significance at 1%, 5% and 10% respectively.

Source: Computed from ERIA Survey (2009-2010).

Probit Results

The three critical dependent variables, viz., VA/L, X/Y and TI were subjected to more rigorous tests against the independent variables on the basis of the production network intensity (PNI) variable. Probit regressions were run to examine the probability of strongly and weakly integrated firms in domestic production networks. The results passed the log likelihood (LL) test for model fit for interpretation. The results are presented in Table 11.

It can be seen in model 1 that the explanatory variable of labor productivity and the control variable of size were significant statistically. Labor productivity was positively correlated and significant at the 5% level of statistical significance. Size was inversely correlated and statistically highly significant at the 1% level. The results show that more integrated firms in domestic production networks are more productive than less integrated firms. The smaller the firm the more likely that it is strongly integrated in domestic production networks. The latter suggests that smaller firms in Malaysian manufacturing largely operate as suppliers.

Export-intensity and size were inversely correlated and statistically significant in the model 2. The inverse correlation between X/Y and Size, and domestic PNI is to be expected. The higher the exports, the less will the firms sell domestically to other industries. The same logic accounts for the strong inverse correlation between size and PNI as noted above, i.e. smaller firms are likely to outsource and sell to other industries than larger firms.

The explanatory variable of technological intensity showed no statistically significant relationship with PNI in model 3 demonstrating that PNI did not matter in technological intensities. Indeed, separate regressions also showed no statistical relationship between training intensity and R&D intensity, and PNI. This result may also reflect the exposure of SMEs to international competition. For the same reasons explained earlier, size was again statistically inversely correlated with PNI in model 3.

The results in this sub-section show that production network intensities (PNI) matter in labor productivity, export-intensities and size but not on technological intensities. The negative coefficient of size in models 1, 2 and 3 shows that smaller Malaysian SMEs are more integrated into domestic production networks than larger SMEs. The extent of integration in domestic production networks does not appear to matter with technological levels. Overall, the results are interesting as apart from technology, integration in production networks does seem to relate positively with the critical economic performance variables of labor productivity and export intensity.

Table 11. Probit Estimations of Production Network Intensity against Critical Variables, Sampled Firms, Malaysia, 2008

Variable	(1)	(2)	(3)
C	0.165 (0.547)	1.011(3.020)*	0.539 (1.523)
VA/L	0.000 (2.316)**		
X/Y		-2.005(-4.010)*	
TI			-0.465 (-0.533)
Own	0.174 (0.477)	0.439(1.152)	0.178 (0.489)
Size	-0.005 (-3.600)*	-0.002 (-1.683)***	-0.004 (-2.774)*
A	0.014 (0.877)	0.013 (0.779)	0.005 (0.322)
N	101	101	101
PNI=1	52	52	52
PNI=0	49	49	49
LR Stat	19.40*	32.07*	13.61*

Note: *, ** and *** refer to correlations significant at 1%, 5% and 10% respectively.
Source: Computed from ERIA Survey, 2009-2010.

7. Conclusions

This paper sought to assess the impact of production networks on productivity, exports and technological upgrading in SMEs in electric-electronics, textiles-garments, automotives and wood products in Malaysia. In light of the extensive emphasis the Malaysian government has been providing, the evaluation is useful for future policy lessons. SMEs have also responded by demonstrating increasing participation in the manufacturing sector over the period 1996-2008.

The differences in means of the two groups of a number of variables of firms drawn by domestic production network intensities using two-tailed 'Z' tests mattered strongly in the intra-industry and the types of purchasers domestically and exports. Whereas more integrated firms were showing higher production linkages domestically, less integrated firms showed higher export intensities. Among the technological variables that were significant, less integrated firms showed higher intensities than more integrated firms. More integrated firms reported higher incidence of barriers and potential solutions than less integrated firms among the statistically significant differences in the means.

The econometric results show that TI is important in both productivity and export-orientation. Size is important in the export-intensity, TI and TE regressions. The positive correlations between size, and productivity and export intensity, and the lack of it with TI, shows that bigger size among scale matters in driving economic performance but not in technological intensities. The Probit estimations show that production network intensities matter in labor productivity, export-intensities and size but not on technological intensities. The negative coefficient of size in all the models shows that smaller SMEs are more integrated in domestic production networks than larger SMEs in Malaysian manufacturing. The extent of integration in domestic production networks does not matter with technological levels but matters positively with the critical economic performance variables of labour productivity and export intensity.

While SMEs have increasingly become important in the manufacturing sector in Malaysia since 1996 the analysis also offers room for policy to further strengthen their synergies. Barriers other than those typically noted were the most significant obstacles faced by SMEs in Malaysia and they were less serious among firms more integrated in domestic production networks suggesting that networking synergies may have helped lessen their intensities. There is also room for policy as counseling and advice were a significant influence on overcoming barriers. Although more integrated SMEs appear to face more serious financial problems than less integrated firms it is largely because of the latter being smaller than the former. The policy solution for Malaysian SMEs here then should be targeted at examining in greater detail the sources of finance accessed by the smaller SMEs.

Given the positive results of domestic production networks, the Malaysian government should include the *ex ante* vetting, monitoring and *ex post* appraisal of SME conduct and performance using the domestic production network framework to better support them. In doing so it is also important to give greater weight to the specificity of each of the industries as the nature of influence exerted by production networks will be different in each of them.

It will also help governments in Southeast Asia to carefully examine the nexus between suppliers, buyers and economic performance so as to stimulate inter-firm production synergies to capture greater performance by the firms. Connecting in value chains is the starting point. Efforts must then be taken to stimulate their movement atop the value chain. It will also be useful to examine production networks further by extending the linkages to the whole of Southeast Asia. In automotives and electronics, in particular, significant production networking that was originally initiated by Japanese firms has synergized production and trade integrating Southeast Asia more deeply compared the other region in the world (see Rasiah and Amin, 2010).

References

Acs, Z. and Audrestch, D. (1988) "Innovation in Large and Small Firms: An Empirical Analysis." *American Economic Review 78*, no.4: 678–690.

Audretch, D. (2003) "Standing on the Shoulders of Midgets: The US Small Business Innovation Research Program (SBIR)," *Small Business Economics 20*, no.2: 129–135.

Audretsch, D. (2002) "The Dynamic Role of Small Firms: Evidence from U.S.**"** *Small Business Economics 18,* (1-3): 13-40.

Brusco, S. (1982) "The Emilian Model: Productive Decentralization and Social Integration." *Cambridge Journal of Economics 6*, no.2: 167-184.

Chee, P.L. (1986) *Small Industry in Malaysia*, Kuala Lumpur: Berita Publishing.

Coase, R. (1937) "The Nature of the Firm." *Economica 4*, no.16: 386-405.

ERIA-Malaysia (2009-10) "Field Survey Conducted to Gather Data", Kuala Lumpur.

Fukunari, K. (2002) "Subcontracting and the Performance of Small and Medium Firms in Japan." *Small Business Economics 18,* (1-3):163-75.

Fukunari, K. (2006) "International Production and Distribution Networks in East Asia: Eighteen Facts, Mechanics, and Policy Implications." *Asian Economic Policy Review* 1: 326-344.

Gereffi G. (2002) "International Competitiveness in the Global Apparel Commodity Chain." *International Journal of Business and Society 3*, no.1: 27-60.

Gereffi, G., Humphrey, J. and Sturgeon, T. (2005) "The Governance of Global Value Chains." *Review of International Political Economy* 12, no.1: 78-104.

International Institute for Labour Studies, pp 1-24.

Jomo, K.S. (1986) *A Question of Class*, Singapore: Oxford University Press.

Krueger, A. (1995) "East Asian Experience and Endogenous Growth Theory." Smith, H. (ed), The Economic Development of Northeast Asia, Canberra: Australian National University Press.

Lall, S. (1992) "Technological Capabilities and Industrialisation", *World Development 20*, no.2:165-86.

Lall, S. (2001) *Competitiveness, Technology and Skills*, Cheltenham, Edward Elgar.

Marshall A. (1890) *Principles of Economics*, London: Macmillan.

Matthews, J.A. (2006) "Electronics in Taiwan – A Case in Technological Learning." Chandra, V. (ed), *Technology, Adaptation and Exports: How Some Developing Countries Got It Right*", pp 83-126.

McNally.

Nelson, R. (2008) "Economic Development from the Perspective of Evolutionary Theory." *Oxford Development Studies 36*, no.1:9-21.

North, D. (1990) *Institutions, Institutional Change, and Economic Performance,* New York: Cambridge University Press.

Piore, M. and Sabel, C. (1984) *The Second Industrial Divide: Possibilities for Prosperity*, New York: Basic Books.

Pratten, C. (1971) *Economies of Scale in Manufacturing Industry*, Cambridge, Cambridge University Press.

Rasiah, R. (1988a) "The Semiconductor Industry in Penang: Implications for the New International Division of Labour Theories." *Journal of Contemporary Asia 18*, no.1: 24-46.

Rasiah, R. (1988b) "Production in Transition within the Semiconductor Industry and its Impact on Penang." *Kajian Malaysia 6*, no.1.

Rasiah, R. (1994) "Flexible Production Systems and Local Machine Tool Subcontracting: Electronics Component Transnationals in Malaysia." *Cambridge Journal of Economics 18*, no.3: 279-298.

Rasiah, R. (1995) *Foreign Capital and Industrialization in Malaysia*, Basingstoke: Macmillan.

Rasiah, R. (2009) "Growth and Slowdown in the Electronics Industry in Southeast Asia." *Journal of Asia Pacific Economy 14*, no.2: 123-137.

Rasiah, R. and Gachino, G. (2005) "Are Foreign Firms More Productive and Technology Intensive than Local Firms in Kenyan Manufacturing?" *Oxford Development Studies 33*,no.2: 211-227.

Scherer, F. (1980) *Industrial Market Structure and Economic Performance*. Chicago: Rand

Sengenberger, W. and Pyke, F. (1992) "Industrial Districts and Local Economic Regeneration: Research and Policy Issues." in F. Pyke and W. Sengenberger (eds), *Industrial Districts and Local Economic Regeneration*, Geneva,

Wilkinson, F. and You, J.I. (1994) "Competition and Cooperation: Towards Understanding Industrial Districts." *Review of Political Economy 6*:259-278.

Williamson, O. (1985) *The Economic Institutions of Capitalism*, New York: Free Press.

Yoshihara, K. (1988) *The Rise of Ersatz Capitalism in Southeast Asia*, Singapore: Oxford University Press.

Appendix. Correlation Coefficient Matrix, Sampled Firms, Malaysia, 2008

	VA/L	OWN	AGE	Size	X/Y	TI	TE	RD
VA/L	1.000	0.103	-0.095	0.146	-0.016	0.256	0.122	-0.032
OWN	0.103	1.000	0.216	0.471*	0.318	0.033	0.012	-0.075
AGE	-0.095	0.216	1.000	0.365	0.241	-0.034	0.028	-0.007
Size	0.146	0.471*	0.365	1.000	0.511	0.362	0.218	0.045
X/Y	-0.016	0.318	0.241	0.511	1.000	0.289	-0.051	-0.112
TI	0.256	0.033	-0.034	0.362	0.289	1.000	0.477*	0.322
TE	0.122	0.012	0.028	0.218	-0.051	0.477*	1.000	0.835*
RD	-0.032	-0.075	-0.007	0.045	-0.112	0.322	0.835*	1.000

Note: * - high correlation.
Source: Computed from ERIA Malaysia survey (2009-10).