Chapter 8

Trade, Productivity, and Innovation: The Case of Malaysia

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CHAPTER 8

Trade, Productivity, and Innovation: The Case of Malaysia

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This study attempts to explore the relationships between trade, productivity and innovation using firm-level data from three innovation surveys covering the period 1997-2004. It is found that the link between exporting and productivity is a weak one in Malaysia. Productivity is driven mainly by capital intensity and human capital but this may not necessarily translate into export dynamism. Innovation, whether it is product or process innovation, is likely to be the key driver in exporting. Exporters are likely to be larger firms with foreign ownership. There is some evidence that trade liberalization may promote exports but this is less relevant for innovating firms. The main policy implication of these findings is that there should be more emphasis on enhancing innovation capabilities rather than improving productivity per se to ensure export dynamism. The role of small domestic firms and their ability to innovate and venture into exporting needs to be seriously considered.

1. Introduction

Malaysia is a small open economy that has relied heavily on exports as a source of growth. Until the 1960s, the country was a major exporter of primary commodities such as tin and rubber. This changed when the country embarked on an export oriented industrial policy in the late 1960s. As a result, the manufacturing sector and the export of manufactures became increasingly important. Today, the sector's share of GDP is around 30 % and manufactured goods account for more than 80 % of the country's exports. Despite venturing into import-substitution in heavy industries in the 1980s, Malaysia continues to rely heavily on exports of manufactured goods, especially electrical and electronic products. The emphasis in recent years has been on moving up the value chain in manufactured exports. To achieve this, policy makers have emphasized the importance of innovation and productivity. Take, for example, the *Third Industrial Master Plan 2006-2020* (IMP3) which was launched in 2006. The key emphasis of the IMP3 was stated as encouraging the "shift towards higher value-added activities and undertake productivity-driven growth initiatives, as well as adopt and apply higher levels of technology" and human capital development to support these initiatives.[1]

To date, there have been very few empirical studies using firm-level data examining the significance and importance of productivity improvements and innovation in relation to exports. The aim of this paper is to make some contribution in this area by carrying out an empirical analysis of the relationship between trade, innovation and productivity. More specifically, the paper aims to empirically investigate the following issues:

- Trade and productivity trends in the manufacturing sector;
- Sources of productivity in the manufacturing sector, namely, factor accumulation and technological innovation;
- The relationship between exporting, productivity and innovation in the manufacturing sector

[1] Third Industrial Master Plan, Foreword.

The outline of the rest of the paper is as follows. Section 2 provides a brief discussion on the Malaysian economy focusing on the country's manufacturing sector. Section 3 provides a brief literature review on trade, productivity and innovation. Section 4 discusses the methodology and data used in this paper. The empirical results are discussed in Section 5. Section 6 concludes.

2. Malaysia: Trade, Productivity, Productivity and Innovation

The GDP structure of the Malaysian economy has changed significantly over the past 50 years. Today, the services (53%) and manufacturing (28%) sectors dominate the economy (Table 1). The manufacturing sector accounts for at least 67% of the country's exports. About 64 % of manufactured exports come from the electrical and electronic industries. This is the result of the implementation of an export-oriented industrialization policy since the 1960s. A key turning point in the country's industrialization and development process was the Asian financial crisis in 1997/1998. The Malaysian economy was adversely affected by the crisis, albeit to a lesser extent compared to other countries in the region. The period after the financial crisis is characterized by relatively low levels of foreign direct investment as well as lethargic performance of manufactured exports. One of the key concerns / problems is the inability of the country's manufacturing sector to achieve higher levels of productivity and move up the value-chain. This concern is reflected in the country's industrial plans.

Table 1. Structure of the Malaysian Economy, 2008

Sector	GDP Share %	Sector	GDP Share %	Sector	Export Share %
Agriculture	7.3	Consumption	49.7	Machinery & transport	43.2
Mining	8.3	Investment	7.4	Manufactured	8.9
Construction	2.9	Gov. Expenditure	25.6	Misc. Manufactured	8.4
Manufacturing	28.3	Export	89.3	Chemicals	6
Services	53.2	Import	72.1	Mineral Fuels	18.2
				Animal & Vegetable Oils & Fats	8.6
				Others	6.7

Source: Economic Report 2009.

The *Second Industrial Master Plan 1996-2005* (IMP2) was launched during this period with emphasis on strengthening industrial linkages, increasing value-added activities and enhancing productivity.[2] The *Third Industrial Master Plan 2006-2020* (IMP3) had a similar focus, namely with an emphasis on encouraging the "shift towards higher value-added activities and undertake productivity-driven growth initiatives, as well as adopt and apply higher levels of technology" and human capital development to support these initiatives.[3]

Are the concerns related to productivity and innovation as expressed in Malaysia's industrial master plans valid ones? How has the country performed in terms of productivity in recent years?

There have been a number of studies attempting to estimate productivity growth in Malaysia's manufacturing sector over the years. Macro-level computations of Total Factor productivity (TFP) using GDP data indicate that TFP growth rates ranged between 2.0 % to 2.5 % during the period 1970-1980, negative around the first half of the 1980s and 2.0 % to 3.0 % during the period 1988-2000 (with the exception of 1998 in the aftermath of the Asian financial crisis) (see Ab Wahab, 2004). Other studies have also found positive but low TFP growth during the 1980s and 1990s. Mahadevan (2007a), for example, provides evidence that the average annual TFP growth hardly exceeded 1.5 % during many of the sub-periods between 1971 and 2002. During the period 1971-2002, the few manufacturing industries that recorded relatively high TFP growth rates included (Mahadevan 2007a, p.338):

- industrial chemicals (2.47%),
- transport equipment (2.09%),
- electrical machinery (2.01%), and
- other chemicals (1.81%).

Official estimates such as those from the Third Outline Perspective Plan (OPP3) provide a different set of estimates for TFP growth rates. Overall, official estimates of TFP growth rates are much higher than those of Mahadevan (2007a) (Table 2). Furthermore, the estimates obtained for a number of industries have very different signs (-/+) such as wood products, chemicals, rubber and plastic products and transport

[2] The Third Industrial Master Plan, p.3.
[3] Third Industrial Master Plan, Foreword.

equipment. This likely to be due to differences in estimation methodologies and data used.[4]

Table 2. Estimates of TFP Growth Rates in Manufacturing Industries, 1990-1999 (%)

Industry	Mahadevan (2007a)	OPP3
	1990-1999	1990-1999
Food	0.76	6.5
Beverages	1.02	
Textiles	0.21	5.1
Wearing Apparel	0.82	
Wood Products	-0.74	2
Furniture	0.65	8.4
Paper	0.87	2
Printing and Publishing	0.74	
Chemicals	2.81	-6.3
Rubber Products	0.68	-0.7
Plastic Products	1.04	
Fabricated Metals	0.88	4.5
General Machinery	1.36	12
Electrical Machinery	1.83	6.4
Transport Equipment	1.88	-4.1

Note: Mahadevan (2007a) and OPP3.

Even though there are differences in the estimates of productivity growth, it might still be interesting to examine whether productivity growth is observed to be higher in export-oriented industries. Which industries would fall into such categories? These would include industries in which a significant proportion of output is exported (i.e. more than 60% in 2003). Such industries include (Table 3):

- Textiles – spinning, weaving and finishing (67%)
- General purpose machinery (63%)
- Office and computing machinery (73%)
- Electrical lamps and lighting machinery (69%)
- Electronic components (76%)
- Radio, TV and communication (61-68%)
- Watches and clocks (66%)

[4] For example, Mahadevan (2007a) estimated TFP growth rates using the stochastic frontier approach while the official (OPP3) estimates were estimated using the Cobb-Douglas production function.

Table 3. Percentage Output Exported in Manufacturing, 2000-2004

Industry	2000	2001	2002	2003	2004
Manufacturing total	51	51	47	45	33
Meat, fish, fruits, vegetables, oils, fats	27	32	29	26	18
Dairy	9	12	14	11	6
Grain mill, starch, feeds	3	3	3	3	2
Other food	20	20	25	24	21
Beverages	4	6	5	2	4
Tobacco	21	25	29	25	21
Textiles' spinning, weaving, finishing	72	73	70	67	29
Other textiles	22	19	25	21	13
Knitted & crocheted fabrics, etc.	45	33	59	51	39
Apparel except furs	49	64	64	56	42
Leather	63	58	64	39	47
Footwear	15	20	16	19	13
Wood sawmilling & planning	36	33	35	31	28
Other wood	63	57	61	57	60
Paper	19	21	21	14	12
Publishing	2	1	2	1	2
Printing & recorded media	19	19	19	16	5
Refined petroleum	27	46	42	28	50
Basic chemicals	39	37	35	36	30
Other chemicals (incl. man-made fibers)	20	25	26	29	22
Rubber	55	56	54	54	39
Plastics	26	31	44	39	27
Glass	35	34	58	55	25
Other non-metallic mineral products	16	11	12	10	8
Basic iron & steel	17	15	8	15	8
Basic nonferrous metals	45	42	41	32	15
Metals' casting	11	12	14	16	10
Structural metal products, etc.	18	25	26	23	13
Other fabricated metals, etc.	34	30	27	21	23
General purpose machinery	46	28	39	63	24
Special purpose machinery	38	31	40	38	29
Other domestic appliances	53	5	49	54	5
Office & computing machinery	80	93	81	73	62
Electrical motors, generators, etc.	56	61	53	50	19
Electricity distribution machinery	49	41	38	24	18
Insulated wire & cable	54	44	39	36	21
Accumulators, primary cells & batteries	37	31	44	36	24
Electric lamps & lighting machinery	57	79	75	69	78
Other electrical equipment	38	52	27	37	31
Electronic components	82	78	71	76	46
Radio & tv transmitters, telephony	90	93	93	61	39
Radio & tv receivers, recorders	76	79	77	68	33
Medical machinery, etc.	62	53	49	59	49
Optical & photographic machinery	49	78	90	33	8
Watches & clocks	74	53	74	66	36
Motor vehicles	21	2	3	3	1
Motor vehicle bodies, trailers	3	4	0	1	5
Motor vehicle parts	20	14	12	17	14
Ships & boats	6	5	5	6	8
Motorcycles	9	12	8	8	14
Bicycles & wheelchairs	71	85	83	4	7
Aircraft, other transport machinery	3	6	13	11	7
Furniture	48	49	44	45	41
Miscellaneous manufacturing	41	44	43	33	33
Recycling	41	20	19	57	44

Source: Author's computation based on data from Ramstetter and Shahrazat (2009).

Comparing the two sets of information, there are some indications that productivity levels in a number of export-oriented industries such as electrical machinery and general machinery are above average (Table 2 and Table 3).

Given that innovation (especially process innovation) can be related to improvements in productivity, it would also be interesting to see if innovation is related to both productivity and export-orientation. Table 4 provides a summary of the incidence of innovation from three surveys from 1997 to 2004. In these surveys, innovating firms are those indicating that they have carried out process and/or product innovation based on the Oslo Manual's definition.[5] Data from the surveys suggest that the incidence of innovation is high in a number of export-oriented industries such as:

- Office, Accounting and Computing Machinery
- Electrical Machinery and Apparatus, Radio
- Television and Communication Equipment and Apparatus
- Medical, Precision and Optical Instruments, Watches & Clocks

The above discussions suggest that there could be links between productivity, innovation and trade. This issue can be explored in greater detailed using firm-level data.

[5] In the Oslo manual, a product innovation is the market introduction of a new good or service or a significantly improved good or service with respect to its capabilities, such as quality, user friendliness, software and subsystems. Process innovation is the use of new or significantly improved production processes, distribution methods, or support activity for your goods and services.

Table 4. Incidence of Innovation in Malaysian Manufacturing, 1997-2004

Industry	1997-1999			2000-2001			2002-2004			% Innovating Firms		
	Yes	No	Total	Yes	No	Total	Yes	No	Total	1997-1999	2000-2001	2002-2004
Food Products and Beverages	25	162	187	35	80	115	30	35	65	13.4	30.4	46.2
Tobacco Products	1	2	3	2	2	4	NA	NA	NA	33.3	50	NA
Textiles	6	32	38	8	3	11	8	3	11	15.8	72.7	72.7
Wearing Apparel; Dressing and Dyeing of Fur	2	29	31	29	73	102	6	15	21	6.5	28.4	28.6
Tanning and Dressing of Leather; Luggage, Handbags, and Footwear	1	6	7	2	6	8	8	5	13	14.3	25	61.5
Wood; Products of Wood and Cork Except Furniture	6	112	118	7	37	44	22	18	40	5.1	15.9	55
Paper and Paper Products	7	31	38	6	10	16	9	7	16	18.4	37.5	56.3
Publishing, Printing and Reproduction of Recorded Media	4	27	31	30	28	58	11	16	27	12.9	51.7	40.7
Coke, Refined Petroleum Products and Nuclear Fuel	2	3	5	1	0	1	1	3	4	40	100	25
Chemicals and Chemical Products	9	15	24	14	19	33	16	12	28	37.5	42.4	57.1
Rubber and Plastic Products	41	110	151	20	27	47	38	23	61	27.2	42.6	62.3
Other Non-Metallic Mineral Products	8	43	51	14	22	36	6	13	19	15.7	38.9	31.6
Basic Metals	6	19	25	6	16	22	11	8	19	24	27.3	57.9
Fabricated Metal Products, Except Machinery and Equipment	24	72	96	28	65	93	27	21	48	25	30.1	56.3
Machinery and Equipment N.E.C.	9	26	35	4	38	42	7	8	15	25.7	9.5	46.7
Office, Accounting and Computing Machinery				7	7	14	5	3	8		50	62.5
Electrical Machinery and Apparatus N.E.C	38	71	109	12	6	18	8	6	14	34.9	66.7	57.1
Radio, Television and Communication Equipment and Apparatus				9	2	11	25	8	33		81.8	75.8
Medical, Precision and Optical Instruments, Watches & Clocks	2	4	6	3	1	4	4	2	6	33.3	75	66.7
Motor Vehicles, Trailers and Semi Trailers	13	38	51	9	2	11	5	2	7	25.5	81.8	71.4
Other Transport Equipment				3	7	10	3	3	6		30	50
Furniture; Manufacturing N.E.C.	13	25	38	13	34	47	9	12	21	34.2	27.7	42.9
Recycling	0			1	1	2	2	1	3		50	66.7
	217	**827**	**1044**	**263**	**486**	**749**	**261**	**224**	**485**	**20.8**	**35.1**	**53.8**

Source: MASTIC.

3. Brief Review of the Existing Literature

The firm-level empirical literature on the relationships between productivity, innovation and trade is fairly diverse. This is partly due to the different motivation and data sources used in these studies. Much of the initial literature such as Crepon *et al.* (1998) focused on the determinants of innovation. These include firm size, market share and diversification. The subsequent study by Griffith *et al.* (2006) included additional explanatory variables such as national funding for research, and innovation protection. In these studies, the causality between innovation and productivity appears to be from innovation to productivity. However, while Crepon *et al.*'s finding is supportive of this relationship, the later study by Griffith *et al.* (2006) is less supportive.

A second strand of literature comes from international trade where the focus is on exporting. Within this literature, scholars are interested in the determinants of exporting. Both Greenaway and Kneller (2004) and Wagner (2007) do find that exporters are more productive than non-exporters. The evidence here is supportive of the self-selection story whereby the more productive firms are more likely to self-select into export markets. Furthermore, the act or process of exporting per se does not necessarily improve productivity. This implies that the causality between exporting and productivity is likely to run from productivity gains to exporting. One important additional explanatory variable of exporting that is of relevance here is trade liberalization e.g. Greenaway and Kneller (2007) and Baldwin and Gu (2004).

What about the relationship between exporting, productivity and innovation? In the study by Aw *et al.* (2007), it was found that Taiwanese firms that engage in R&D, and/or workers' training, plus export participation, experience larger productivity increases than firms that only export. In another paper by Almeida and Fernandes (2006), there is evidence that both importers and exporters are more likely to adopt a new technology compared to other firms. However, majority foreign-owned firms are less likely to undertake technological innovation compared to domestic firms. These later studies seem to support the earlier findings on the positive impact of innovation on productivity. However, the evidence on the link between exporting and innovation is sparse and thus requires further research.

To summarize the literature, there seems to be good evidence on the determinants of innovation. There is also enough evidence on the positive impact of productivity on exporting. Given the ambiguous link between innovation and productivity, it is not clear whether innovation has an impact on exporting and vice-versa. These issues are explored empirically using Malaysian firm-level data in the rest of the paper.

4. Methodology and Data

4.1. Methodology

The econometric specifications used in this study are constrained by the data used for the study. The data comprises cross sections from three sets of surveys. This implies that it would not be possible to examine some of the dynamic issues relating to entry-exit and productivity adjustments over time that are undertaken in studies using panel data. Given the data limitations, the focus of this study will be confined to examining empirically various relationships between productivity, trade and innovation.

4.1.1. Productivity Differences between Exporters and Non-Exporters

The literature suggests there are differences in productivity levels between exporters and non-exporters. Productivity differentials between exporters and non-exporters can be tested via stochastic dominance of the productivity distribution for exporters over the productivity distribution for non-exporters. Let F and G be the cumulative distribution functions of productivity (z) for exporters and non-exporters. The first-order stochastic dominance of F relative to G implies that:

$$F(z) - G(z) \geq 0 \qquad (1)$$

for all values of z, with strict inequality for some z.

We test this condition using the Kolgomorov-Smirnov test for both definitions of exports. Productivity is measured in terms of value-added per worker or total factor productivity (estimated from residuals of regression on the production function).

Another test that can be used is the Wilcoxon-Mann-Whitney test, which is a non-parametric test that can be used to check if two independent samples are from populations with the same distribution.

4.1.2. Relationship between Exporting and Productivity

Data limitations preclude the testing of the self-selection hypothesis in export participation. Instead, what can be tested is whether productivity levels are related to the propensity to export.

The propensity of firm *i* to export is modelled as:

$$EXPORT_i = x_i \beta_0 + e_i \qquad (2)$$

where *EXPORT* is the observed binary export variable, x_i are the explanatory variables, β_0 the coefficient vector and e_i the error term. The explanatory variables x_i include the degree of local ownership, productivity (measured by value-added per worker or total factor productivity) and firm size (in terms of total number of employees).

4.1.3. Relationship between Innovation and Productivity

The firm-level empirical evidence on the relationship between innovation and productivity is sparse and ambiguous (see earlier discussions). However, productivity is closely related to innovation in modern growth theory. The Solow's residual captures contributions to economic growth arising from technological progress. With endogenous growth, additional variables were included to capture spillovers from investment in physical and human capital or differences in the variety and quality of inputs. A micro econometric version or implementation of such models could take the form of an augmented Cobb-Douglas production function that is used to measure productivity:

$$PROD_i = \alpha_1 CAP_i + \alpha_2 HCAP_i + \alpha_3 INNOV_i + \alpha_4 SIZE_i + e_i \qquad (3)$$

where $PROD_i$ is labour productivity (natural log of value-added per worker), CAP_i the capital intensity proxied by natural log of fixed asset per worker, $HCAP_i$ the human capital variable proxied by percentage of employees with college/university degrees, $INNOV_i$ is the innovation input and $SIZE_i$ the firm size.

4.1.4. Relationship between Exporting and Innovation

If firms with high productivity self-select to export, whether such productivity levels are a result of innovation is an important question – one that has not been conclusively answered. Alternatively, it is plausible that participation in foreign markets could motivate firms to innovate or firms could get innovative ideas from exporting. The use of cross section data precludes the determination of which of the two hypotheses is likely to hold. Despite such limitations, one could test if any statistical relationships exist between the two variables.

In the first case (productivity → exporting), equation (2) could be modified by replacing the productivity independent variable with an innovation (dummy) variable. In the second case (exporting → productivity), it is difficult to motivate a behavioural equation that is rich enough to capture and distinguish the various possible avenues by which exporting can affect productivity.

4.2. Data

The firm-level data for this study is sourced from three national innovation surveys (NSIs) conducted by the Malaysian Science and Technology Information Centre (MASTIC), Ministry of Science, Technology and Innovation. The reference period and sample size for each of the three data sets are summarized in Table 5.

The available data sets for this study are limited and uneven. The full data set containing innovating as well as non-innovating firms is available for NSI3. The two older data sets (NSI1 and NSI2) available for this study cover only innovating firms.

Table 5. Basic Description of Data Set from National Surveys of Innovation

	Data Set 1 (NSI1)	Data Set 2 (NSI2)	Data Set 3 (NSI3)
Reference Period	1997-1999	2000-2001	2002-2004
Survey Type	2 Stage Survey	1 Stage Survey	2 Stage Survey
Stage 1 Sample Size: All Firms	1044 (NA)	749 (NA)	485
Stage 2 Sample Size: Innovating Firms	399	263	439

Note: NA – Not available for this study.
Source: MASTIC.

In terms of sample representativeness, the coverage is uneven. This can be seen by comparing the NSI3 dataset with aggregated data from the Annual Manufacturing Survey. The 485 firms in the data set constitute only 3.4 % of the sample frame maintained by the Department of Statistics at the time of the NSI survey (see Table 6). Most of the firms which responded to the survey are likely to be larger firms because firms in the sample account for 7.62 % of total employment in the Annual Manufacturing Survey in 2004. The sample representativeness by sub-sectors also shows significant variations, the lowest representation being the furniture sub-sector (around 1%) and the highest being medical, precision and optical instruments (around 12 to 17 %). The results in this paper should be interpreted with this in mind.

Table 6. Statistics on Sample Representativeness of the National Survey of Innovation 2002-2004

	(1)	(2)	(3)	(4)	(5) = (1)/(2)	(6) = (3)/(4)
	No. of firms in Sample	No. of firms in sample frame	Total employees in sample	Total Employees in Manufacturing Survey	(%)	(%)
Food products and beverage	65	2,346	6,147	133,402	2.77	4.61
Textiles	11	339	3,207	37,483	3.24	8.56
Wearing Apparel	21	726	3,202	81,152	2.89	3.95
Leather	13	147	915	8,080	8.84	11.32
Wood and cork	40	1,025	14,623	116,329	3.9	12.57
Paper	16	377	3,573	34,821	4.24	10.26
Publishing	27	724	3,870	37,721	3.73	10.26
Coke, refined petroleum	4	47	92	4,353	8.51	2.11
Chemical	28	634	2,849	52,687	4.42	5.41
Rubber, plastic	61	1,509	21,750	174,568	4.04	12.46
Non-metallic minerals	19	728	2,085	56,427	2.61	3.7
Basic metals	19	501	2,909	42,941	3.79	6.77
Fabricated metal	48	1,509	6,063	73,703	3.18	8.23
Machinery, equipment	15	813	609	53,836	1.85	1.13

(Table 6. *Continued*)

	(1)	(2)	(3)	(4)	(5) = (1)/(2)	(6) = (3)/(4)
	No. of firms in Sample	No. of firms in sample frame	Total employees in sample	Total Employees in Manufacturing Survey	(%)	(%)
Office, accounting, computing machinery	8	65	2,482	64,293	12.31	3.86
Electrical machinery	14	425	8,288	68,131	3.29	12.16
Radio, TV, communication equipment	33	439	22,523	285,243	7.52	7.9
Medical, precision, optical instrument	6	50	4,407	24,956	12	17.66
Motor vehicle, trailers	7	253	3,789	51,128	2.77	7.41
Other transport	6	183	1,750	29,679	3.28	5.9
Furniture	21	1,340	1,403	101,361	1.57	1.38
Recycling	3	14	318	544	21.43	58.46
Total	485	14,194	116,854	1,532,838	3.42	7.62

Source: Data (1)-(3) from MASTIC, Data (4) from Ramstetter and Sharazat (2009).

Summary statistics for the three data sets are presented in Table 7. Overall, there are significant variations in firm sizes, whether measured in terms of total employees or turnover, across all the three data sets. The mean values of local ownership (%) in the data sets are also consistently high, ranging from 69 % to 84 %. With the exception for the data set from 2000-2001, the average percentage of revenues derived from exports is relatively high from 39-46 %.

Table 7. Summary Statistics of Data

Observations	1997-1999				2000-2001				2002-2004			
	399				263				485			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Total Employment	207	198	2	979	311	825	1	6500	247	511	1	6000
Total Revenues (RM)	85.3 mil	291 mil	62407	4.36 bil	341 mil	2.2 bil	2400	28.2 bil	68 mil	325 mil	5000	5.7 bil
Local ownership (%)	69	41	0	100	84	34	0	100	75	40	0	100
% Revenue from Exports	46	41	0	100	16	31	0	100	39	40	0	100

Source: Computed by author based on data from MASTIC.

5. Results and Analysis

5.1. Productivity Differences between Exporters and Non-Exporters

The Kolgomorov-Smirnov test for differences in productivity is presented in (Table 8). The first row in the table tests the hypothesis that productivity (measured by value-added per worker) for non-exporters is lower than for exporters. The approximate p-value obtained is 0.002 which is significant. The second row tests the hypothesis that productivity for non-exporters is higher than for exporters. The p-value for this is 0.924 which means this hypothesis is rejected. Results from the combined test, which tests for productivity differences between non-exporters and exporters are reported in the third row. Both the approximate p-value (0.004) and the corrected p-value (0.003) indicate that there are statistically significant differences in productivity between non-exporters and exporters. The results hold for the alternative measure of productivity, namely, TFP. Results from the Wilcoxon-Mann-Whitney test also indicate that there is a statistically significant difference between the two distributions of productivity for exporters and non-exporters (Table 8). Furthermore, exporters have higher ranks (in terms of productivity) than non-exporters.

Table 8. Tests for Productivity Differences between Exporters and Non-Exporters, 2002-2004

Kolgomorov-Smirnov Test			
Labor Productivity	D	P-Value	Corrected P-Value
Non-Exporters	0.1853	0.002	
Exporters	-0.021	0.924	
Combined K-S	0.1853	0.004	0.003
TFP	D	P-Value	Corrected P-Value
Non-Exporters	0.1532	0.046	
Exporters	-0.0539	0.684	
Combined K-S	0.1532	0.093	0.071
Wilcoxon-Mann-Whitney Test			
Exporters	Observations	Rank Sum	Expected
0	138	23818	26979
1	252	52427	49266
Combined	390	76245	76245

Note: H0: Value Added per Employee (non-exporters) = Value Added per Employee (exporters).
Z = -2.970.
Prob > | z | = 0.0030.

Source: Author.

5.2. Relationship between Exporting and Productivity

The probit regressions indicate that the probability of a firm exporting is related to ownership and firm size (proxied by total employees) (Table 9). Firms with foreign ownership are more likely to export. Larger firms are also more likely to export. However, this result holds for the 1997-1999 and 2002-2004 data sets but not for the 2000-2001 data sets. Interestingly, productivity level (measured by value added per employee) does not seem to be related to the probability of exporting.[6] The results are the same if TFP is used as a measure of productivity.

Table 9. Probit Regressions on Relationship between Exporting and Productivity for 1997-1999, 2000-2001 and 2002-2004

	1997-1999	2000-2001	2002-2004	2002-2004	2002-2004
	Innovating Firms	Innovating Firms	Innovating Firms	Innovating & Non-Innovating Firms	Innovating & Non-Innovating Firms
Value Added per Employee		7.54E-09 -1.85E-08	1.90E-10 -4.26E-10	1.41E-08 -2.54E-08	
Percentage Local Ownership	-0.007159*** -0.0024889	-0.0143944*** -0.0030869	-0.0111381*** -0.0038301	-0.0149283*** -0.002776	-0.0131854*** -0.0028222
Firm Size	0.0034949*** -0.0007476	0.0000337 0.0001192	0.0010452*** -0.0004761	0.0020109*** -0.0004391	0.0017921*** (0.0004459)
TFP					5.30E-10 -9.52E-10
Intercept	0.8281483*** -0.2339258	1.146547 -0.287226	1.644838*** -0.3644648	1.365447*** -0.2641005	1.292141*** -0.266401
Observations	322	184	200	350	305
LR Chi2	45.24	27.86	25.69	90.82	66.61
Pseudo R2	0.1385	0.1092	0.146	0.207	0.1792

Note: Dependent variable: value equals one if export > 0, otherwise zero.
Standard errors in parentheses.
*** pí0.01, **pí0.05, *pí0.1.
Source: Author.

Another possible analysis involves the incorporation of variables related to the trade regime. This can be done by using Malaysia's average MFN tariff from WTO's Trade Policy Review for years 2001 and 2005. The results from the regressions are reported in Table 10. In the results obtained, the negative sign for the coefficient suggest that a lower average MFN tariff (perhaps associated with trade liberalization) is related to a higher probability of exporting. However, the variable is statistically significant for

[6] The relationship is not detected even if the exporting and productivity variables are interchanged while maintaining other independent variables the same and applying an OLS regression.

year 2002-2004 for innovating and non-innovating firms. For innovating firms only (2000-2001 and 2002-2004 data sets), the average MFN tariff variable is not statistically significant. These results suggest that tariff levels are not important for exporting by innovating firms. Note that similar results are obtained if TFP is used as a measure of productivity (full regression results are not reported but are available upon request from the author).

Table 10. Probit Regressions on Relationship between Exporting and Trade Liberalization, 2000-2001 and 2002-2004

	2000-2001	2002-2004	2002-2004
	Innovating Firms	Innovating Firms	Innovating & Non-Innovating Firms
Value Added per Employee	-3.16E-07	-3.61E-07	-2.22E-07
	-3.09E-07	-3.72E-07	-3.93E-07
Percentage Local Ownership	-0.0130085***	-0.0048125	-0.0100782***
	-0.0035812	-0.004219	-0.0030282
Firm Size	-0.0001546	0.0020004***	0.0042205***
	-0.0001848	-0.0009792	-0.0008929
Average MFN Tariff (2001, 2005)	-0.0134048	-0.0070779	-0.0361181***
	-0.0101812	-0.0272036	-0.0161877
Intercept	1.433491	1.32776	1.289713
	-0.3649909	-0.4764625	-0.3386313
Observations	127	149	262
LR Chi2	19.13	15.58	78.39
Pseudo R2	0.109	0.1601	0.2631

Note: Dependent variable: value equals one if export > 0, otherwise zero.
Standard errors in parentheses.
*** pí0.01, **pí0.05, *pí0.1.
Source: Author.

5.3. Relationship between Innovation and Productivity

The data limitation for exploring the relation between productivity and innovation is very severe. Only the data set for the 2002-2004 periods contains information on physical and human capital stock. In the OLS regression, both variables are statistically significant (columns 2 and 3 in Table 11). Greater capital intensity and human capital are associated with higher levels of productivity. The signs of the innovation variables suggest that product innovation is associated with higher levels of productivity while the reverse is true for process innovation. However, both variables are not statistically significant.[7] Similar results on the importance of capital intensity and human capital are obtained when TFP is used as a measure of productivity. The same results (column 1) are obtained when productivity is regressed against the two types of innovation using the 2000-2001 data set– note that there is insufficient data (i.e. capital intensity and human capital) to run a well-motivated specification.

Table 11. Productivity and Innovation for 1997-1999, 2000-2001 and 2002-2004

	2000-2001	2002-2004	2002-2004
	Innovating Firms	Innovating Firms	Innovating & Non-Innovating Firms
Capital Intensity		0.0876362***	0.148902***
		-0.0407968	-0.0329454
Human Capital		1.406415***	2.109213***
		-0.6656867	-0.627841
Product Innovation	0.2617075	0.2462003	0.1840611
	-0.4990341	-0.2436427	-0.2276064
Process Innovation	-0.3627744	-0.3020806	-0.3873675
	-0.2901537	-0.31100453	-0.2303578
Intercept	11.67255	9.267929	8.355057
	-0.5601749	-0.7290181	-0.474573
Observations	180	178	315
R2	0.0115	0.069	0.1144
Adjusted R2	0.0003	0.0474	0.1029

Note: Dependent variable: Value Added per Employee.
Standard errors in parentheses.
*** pí0.01, **pí0.05, *pí0.1.
Source: Author.

5.4. Relationship between Exporting and Innovation

Results from the probit regressions with exporting as a dependent variable and with product innovation and process innovation as independent variables are reported in Table 12. The results suggest that process innovation seems to be positively related to exporting propensity (the exception is the 1997-1999 data). Whether innovation per se (whichever type) is related to exporting can be inferred from the use of the full data set from the 2002-2004 period which involves both innovating as well as non-innovating firms. The results there suggest that both types of innovation are positively associated

[7] Given that product and process innovations may take place simultaneously, one alternative specification is to replace the two independent variables with a single innovation variable (for both process and product innovations). The innovation variable specified as such gives a similar result (insignificant).

with the exporting propensity. The other variables such as local ownership and firm size remain statistically significant. Firms with foreign ownership are more likely to export compared to locally owned firms. Similarly, larger firms are more likely to export than smaller firms.

Table 12. Probit Regressions on Relationship between Exporting and Innovation for 1997-1999, 2000-2001 and 2002-2004

	1997-1999	2000-2001	2002-2004	2002-2004
	Innovating Firms	**Innovating Firms**	**Innovating Firms**	**Innovating & Non-Innovating Firms**
Product Innovation	0.6613944*** (0.2239422)	-0.4589041 (0.3369138)	0.3703852 (0.2812146)	0.4778806*** (0.2030802)
Process Innovation	-0.079520202	-0.3433389 (0.1993846)	0.6064402** (0.31195)	0.7571609*** (0.2007789)
Percentage Local Ownership	-0.007124*** (0.0025099)	-0.0137718*** (0.0025879)	-0.011857*** (0.0039508)	-.0164082*** (0.0026275)
Firm Size	0.0036692*** (0.0007638)	0.0001325 (0.0001108)	0.001114*** (0.0004879)	0.0005329*** (0.000207)
Intercept	0.7109743 (0.2433734)	1.428149 (0.4347985)	0.9157908 (0.5189899)	1.206552 (0.2466514)
Observations	321	259	233	427
LR Chi2	53.97	39.38	30.56	144.69
Pseudo R2	0.1655	0.1165	0.155	0.2693

Note: Dependent variable: Value Added per Employee.
Standard errors in parentheses.
*** pí0.01, **pí0.05, *pí0.1.
Source: Author.

6. Conclusions

Policy makers in Malaysia today are concerned about the future of the country’s manufactured exports. There is a widespread recognition that the country’s manufacturing sector will need to move up the value chain by achieving higher productivity and by innovating. Empirical evidence based on firm-level data can inform policymaking in this area by identifying what the key drivers are, as well as the relationship between exporting, productivity and innovation.

Using firm-level data from three waves of innovation surveys covering the period 1997-2004, this study finds that the link between exporting and productivity is a weak one in Malaysia. Productivity is driven by capital intensity and human capital but this may not necessarily translate into export dynamism. Innovation, whether it is product or process innovation, is likely to be the key driver in exporting. There is some evidence that trade liberalization can promote exporting but such policies may be less relevant to innovating firms. Furthermore, exporters are likely to be larger firms with foreign ownership. This is consistent with the present role of FDI and large MNCs in the country's exporting activities. The main policy implication of the findings from this study is that the policy makers should focus more on enhancing innovation capabilities, rather than productivity, to ensure export dynamism. Trade liberalization may have an impact on promoting exporting, especially amongst non-innovating firms. More attention should also be paid to providing a conducive environment for small domestic firms to innovate and venture into exporting.

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