Chapter 10

Exporting, Productivity, Innovation and Organization: Evidence from Malaysian Manufacturing

Cassey Lee
University of Wollongong, Sydney, Australia

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CHAPTER 10

Exporting, Productivity, Innovation and Organization: Evidence from Malaysian Manufacturing

CASSEY LEE

School of Economics,Faculty of Commerce,University of Wollongong, Australia

The main purpose of this paper is to untangle the complex relationships between exporting, productivity, innovation and organization. Findings from this paper provide evidence for strong productivity premium for continuing exporters (compared to non-exporters). The corresponding productivity premium is likely to be very weak (even negative) for new exporters. There is also evidence on causality from exporting to innovation which supports the learning-by-exporting hypothesis. Part of this effect may take place in the form of productivity improvements via process innovation. In terms of organization, continuous exporters are also likely to enjoy significant exporting premium in terms of scale of production. Exporting may also be associated with a decentralization of decision-making, especially for continuing exporters.

Keywords: Exporting, Productivity, Innovation, Organization
JEL Classification: L60, O3

1. Introduction

Economic globalization in the form of export-oriented industrialization (EOI) driven by foreign direct investment (FDI) has been the main industrialization strategy in the Southeast Asian region since the early 1970s. The sustainability of this strategy has been intensely debated especially in the aftermath of the 1997/98 Asian Financial Crisis (AFC). Today, there is widespread concern amongst policy makers in the region about whether their economies can graduate from a middle income to a high income country i.e. the so-called "middle-income trap". In Malaysia, this policy concern is manifested in the country's recent industrial policies such as the *Third Industrial Master Plan* (2008-2020) which put emphasis on upgrading the country's manufacturing base towards activities characterized by higher value-adding, productivity and innovation.

The key challenge in overcoming the "middle income trap" problem is finding ways to upgrade the industrial and technological capabilities of firms such that they are globally competitive – measured in terms of their ability to operate at the frontiers of global productivity and technology. The process of industrial and technological upgrading can take place either internally within a firm such as through undertaking research activities or externally via its interactions with suppliers, customers and universities (Griliches, 1979). In this regard, foreign sources of knowledge and technology are particularly important especially for developing countries. Knowledge and technological can diffuse from developed to developing countries through trade and foreign direct investment (FDI) (Keller, 2004). It is therefore important to understand how trade is related to both productivity and innovation. In addition, a deeper understanding of the relationship between trade, productivity and innovation requires an analysis of the nature and role of organization (Helpman, 2006 and Antras & Rossi-Hansberg, 2009). This is reflected by the recent convergence of four areas of studies in the study of trade, innovation, productivity and organization i.e. international trade, industrial organization, innovation studies and economics of organization.

The main purpose of this paper is to empirically examine the relationships between exporting, productivity, innovation and organization. More specifically, it investigates:

- the relationship between exporting decisions and productivity
- the causality between exporting decisions and innovation
- the relationship between productivity and innovation
- the relationship between trade and organization

The outline of the rest of the paper is as follows. Section 2 will briefly review the literature. This will be followed by a discussion of the research methodology which covers the framework utilized, econometric specifications and data source in Section 3. Section 4 provides a discussion of the results. Policy implications are discussed in Section 5. Finally, Section 6 concludes.

2. Brief Literature Review

This study draws from a number of related literatures. The first strand of literature focused on the relationship between trade (exporting), productivity and innovation. The second strand of literature deals with trade and organizations.

Exporting, Productivity and Innovation

The seminal work by Melitz (2003) provides a theoretical framework that relates trade to industry-level and firm-level changes in productivity. In his model, trade brings about intra-industry and inter-firm reallocation of resources which raises the average productivity level of the industry. This is brought about by the engagement (or self-selection) of firms with higher productivity in exporting as well as the exit of less productive (non-exporting) domestic firms. The empirical evidence on the role of self-selection at the firm-level in exporting is documented in Greenaway & Kneller (2007) and Wagner (2007). The role of innovation activities such as R&D (via their impact on productivity) on exporting has been highlighted by recent works such as Aw *et al.* (2007) and Damijan *et al.* (2010). Using a three year panel data from the Taiwanese electronics industry, Aw *et al.* (2007) find evidence of self-

selection. In addition, exporting firms benefit from R&D investment and worker training in terms of higher future productivity. These activities are related to firms' in-house capabilities to assimilate new information. Using innovation survey data from Slovenia, Damijan *et al.* (2010) provides evidence that product and process innovation does not increase the probability of a firm becoming a first time exporter. Furthermore, past exporting does not have impact on product innovation but there is some indirect evidence of past exporting on process innovation - thus providing some evidence of learning-by-exporting.

Trade and Organization

Yeaple (2003) extends the theory of FDI using a three-country model to show that, aside from undertaking horizontal or vertical integration strategies, firms may undertake complex integration strategies in which firms may simultaneous adopt both types of integration strategies. Such strategies can arise due to complementarities between vertical FDI (benefit from factor price differentials) and horizontal FDI (minimize transport cost). Helpman *et al.* (2004) provides an analysis of firm's choice between exporting or horizontal FDI (defined by the authors as "investment in a foreign production facility that is designed to serve customers in the foreign market". They demonstrate that heterogenous firms (in terms of productivity) sort-out across the different forms of ownerships such that globalized firms (exporting and/or FDI) is more productive than non-globalized firm (serving domestic markets) and that globalized firms that engage in FDI are more productive than globalized firms that are engaged in exporting only. Tomuira (2007) investigates the relationship between productivity and the different modes of globalization such as FDI, exporting and foreign outsourcing. In the case of outsourcing, Tomuira (2007) uses unique cross section survey data from Japanese manufacturing sector that contains data on outsourcing to find some evidence of FDI firms being more productive than both foreign outsources and exporters.

3. Methodology

3.1. Exporting and Productivity

The relationship between exporting and productivity can be analyzed by examining the average differences in productivity between firms that always export, entering into exporting and exiting exporting. This is undertaken by regressing productivity (proxied by labour productivity) of firm *i* in industry *j* against dummies representing different types of establishments with regards to changes in exporting status. The specification is as follows:

$$LProd_{ij} = \alpha_1 AE_{ij} + \alpha_2 NE_{ij} + \alpha_3 EE_{ij} + I_j + \varepsilon_{ij} \quad (1)$$

where *AE* is a dummy for firms that export in t and t+1, *NE* firms that do not export in t but export in t+1, *EE* firms that export in t but do not export in t+1, *LProd* labour productivity and I_j are industry dummies. The reference category for these exporting/non-exporting status variables is non-exporters (in both t and t+1). Two versions of the performance variable, namely productivity (*LProd*) are used - level and changes. By and large, we expect the exporting premium in terms of productivity to be larger for firms that export (*AE* and *NE*) compared to those that exit from exporting (*EE*). If the productivity premium from exporting is larger for continuing exporters (*AE*) than new exporters (*NE*), then there might be a learning-by-exporting effect.

3.2. Exporting and Innovation

Following Damijian (2010) and Hahn & Park (2011), the bi-directional causality between exporting and innovation can be investigated by using propensity score matching. The propensity score specification for the probability to undertake innovation is given by:

$$\text{Prob}(Innov_{t-1}) = f(X_{t-1}) \quad (2)$$

where X_{t-1} is the vector of lagged explanatory variables. Three measures of innovation are used, namely - product innovation, process innovation and organizational innovation.

The lagged explanatory variables include natural log of the number computers (COMP), firm size measured by natural log of number of employees (SIZE), labour productivity (LPROD), foreign ownership dummy when the firm's head-quarter if located abroad (FOREIGN), research and development dummy variable (RND), average wage of employee (WAGE), managerial experience by dummy for more than 10 years' experience (MGREXP), percent of employees with degrees (EMPDEGREE), trade liberalization by average MFN tariff (TARIFF), dummy for government assistance in research (GOVRES), dummy for government financial assistance (GOVFIN) and industry dummies.

The propensity scores from the probit estimations of the probability to innovate (equation 2) are used to match innovators and non-innovators and test the effects of lagged innovation on current exporting status. Matching was undertaken using the STATA command psmatch2 which relies on nearest neighbour matching.

A similar exercise is undertaken for exporting:

$$\text{Prob}(Exp_{t-1}) = f(X_{t-1}) \tag{3}$$

3.3. Productivity and Innovation

Productivity has been traditionally theorized in terms of a growth accounting production function framework. Within this framework, technological factors augment growth and is measured as a residual. In addition, human capital can also be included as an augmenting factor. Process innovation is generally understood to reduce fixed or variable costs (Swann, 2009). Thus, process innovation could reduce the use of factor inputs resulting in higher productivity. Product innovation can be conceived as involving the introduction of new product. Its effect on productivity is more ambiguous depending on whether the new products increases or reduces the total output of the firm.

Following Griffith *et al.* (2006), the relationship between productivity and innovation for firm *i* in industry *j* can estimated using an augmented production function in the form of:

$$Y_{ij} = f(K_{ij}, H_{ij}, \mathbf{T}_{ij}) \quad (4)$$

where *Y* is labour productivity (LPROD), *K* is capital intensity proxied by the number of computer per employee (COMPEMP), *H* human capital proxied by percentage of employees with degrees (EMPDEGREE), **T** is the vector of innovation comprising product innovation (INNOVPROD), process innovation (INNOVPROC) and organizational (INNOVORG).

3.4. Exporting and Organization

There have been a number of theoretical and industry/macro-level empirical studies linking trade and organization. Organizations have several characteristics such as horizontal boundaries (scale of production), vertical boundaries (make or buy/outsourcing decisions), and span of control.

Similar to the approach used by Bustos (2011), differences in organization characteristics of firm *i* in industry *j* are estimated using the following specification:

$$Y_{ij} = \alpha AE_{ij} + \alpha_2 NE_{ij} + \alpha_3 EE_{ij} + I_j + \varepsilon_{ij} \quad (5)$$

where *AE* are firms that export in 2002 and 2006, *NE* firms that do not export in 2002 but export in 2006, *EE* firms that export in 2002 but do not export in 2006, *Y* firm chacteristic(s) and I_j are industry dummies. The reference category for these exporting/non-exporting status variables is non-exporters (in both 2002 and 2006).

In the empirical exercise, scale of production is provided by natural log of revenue (REV) and natural log of employment size measured in full-time equivalent (EMP). The vertical boundaries variables are proxied by four dummies for outsourcing (OUTSOURCE), local outsourcing (LOUTSOURCE), insourcing (INSOURCE), local insourcing (LINSOURCE). The span of control is proxied by two dummies created for responses indicating “agree” or “strongly agree” to the

questions on whether “senior managers and middle managers frequently supervise our workers on tasks” (SUPERVISEMGR) and ”our workers are directly involved in work-task decisions, and are not frequently supervised by middle or senior management” (SUPERVISEWKR).

3.5. Data

The firm-level data that are used in this study come from two sets of surveys for the *Study on Knowledge Content in Economic Sectors in Malaysia* (MyKE Study). The two waves of surveys were conducted by the Department of Statistics for the Economic Planning Unit at the Prime Minister’s Department (EPU) in 2002 and 2006. The dataset is not available publicly and were obtained from EPU by the author. The original dataset contains firms from the manufacturing sector as well as services sector. Only firms from the manufacturing sector are used for this study.

There are 1,228 firms and 1,148 firms in the 2002 and 2006 datasets, respectively. A balanced panel is constructed for 753 firms. **Table 1** provide a summary statistics for some of the key variables. There is significant diversity in the sample, judging from the mean and standard deviation for firm size and total revenues. Majority of the firms in the sample have headquarters in Malaysia. A high proportion of firms in the sample are exporters, about 77.8% in 2002 and 61.5% in 2006. Innovation is defined as per OSLO

Manual’s definition. Non-innovators make up about half of the firms in the sample. Industry dummies at the 2-digit level are included in all regressions.

Table 1: Basic Descriptive Statistics

Year 2002				
Variable	**Mean**	**Standard Deviation**	**Min**	**Max**
Size (no. Employees)	232	442	3	6086
Revenues (RM, million)	124	1040	0,14	24500
Year 2006				
Variable	**Mean**	**Standard Deviation**	**Min**	**Max**
Size (no. Employees)	265	562	11	8471
Revenues (RM, million)	183	1180	0,15	21300

	Year 2002		**Year 2006**	
	Number	**%**	**Number**	**%**
HQ in Malaysia	630	83,7	607	80,6
HQ Outside Malaysia	123	16,3	146	19,4

	Year 2002		**Year 2006**	
	Number	**%**	**Number**	**%**
Exporting	630	83,7	607	80,6
Non-Exporting	123	16,3	146	19,4

	Year 2002		**Year 2006**	
	Number	**%**	**Number**	**%**
Product Innovation	23	3	50	6,6
Process Innovation	176	23,4	154	20,5
Prod & Proc Innovation	134	17,8	147	19,5
Non-innovators	420	55,8	402	53,4

Source: Economic Planning Unit, Malaysia.

4. Result

4.1. Exporting and Productivity

The results from this study provide some evidence of a higher productivity premium of continuing exporters (**Table 2**). Only this result is statistically significant (at the 1 percent level). Surprisingly, the value of the coefficients indicate that the exporting premium of exiting exporters are higher than new exporters - even though

only the exiting exporter variables are significant for the regression involving the productivity level in 2006. This might be due to the relatively smaller productivity gains achieved by new exporters. This is confirmed by separate regressions for the two different class sizes, namely small and medium sized firms (< 51 employees) and large sized firms (> 50 employees) [Note: Both definitions are based on official definitions adopted by the Malaysian Government]. In fact, SME-sized entry exporters may have lower productivity compared to their counterpart non-exporter (**Table 3**).

Table 2: Exporting and Productivity

Variables	LPROD Year 2002	LPROD Year 2006	LPROD Change
Always Export	0.442***	0.628***	1.427
	(0.125)	(0.117)	(1.338)
Entry Export	0,121	0.0955	0.687
	(0.252)	(0.247)	(2.730)
Exit Export	0.214	0.249*	-0.114
	(0.150)	(0.138)	(1.602)
Industry Dummies	Yes	Yes	Yes
Observations	633	749	630
R-squared	0.148	0.173	0.009

Note: Standard errors in parenthesis
*, ** and ** indicate statistical significance at 10, 5, and 1 percent, respectively
Source: Author

Table 3: Exporting and Productivity - SMEs and Large Firms

Variables	SME Firms LPROD Year 2002	Large Firms LPROD Year 2002
Always Export	0.482**	0.316*
	(0.224)	(0.164)
Entry Export	-0.269	0.0671
	(0.555)	(0.296)
Exit Export	0.155	0.132
	(0.238)	(0.194)
Industry Dummies	Yes	Yes
Observations	134	499
R-squared	0.150	0.168

Note: Standard errors in parenthesis
*, ** and ** indicate statistical significance at 10, 5, and 1 percent, respectively
Source: Author

4.2. Exporting and Innovation

The results from this study indicate that the causal direction between exporting and innovation is from exporting to innovation, and not vice versa (**Table 4**). This applies for both product and process innovations and not vice versa. Thus, with regards to these two types of innovations, the learning-by-exporting effects seem to apply. These results are similar to those from Damijan *et al.* (2010). Since both the results from this study and Damijan's (based on Slovenian data) differ from the selection hypothesis – it may indicate that the experience of developing countries may differ from more developed countries (such as Taiwan or South Korea). This would be consistent with the general observation that technology diffuse from developed to developing countries (Keller, 2004). For such countries, this occurs partly through exporting. Finally, there is no causal relationship between exporting and organizational innovation.

Table 4: Average Treatment Effects of Lagged Innovation (Exporting) on Current Exporting Status (Innovation)

Causality	Average Treatment Effects	Standard Error	Treatment Observations	Control Observations
Lagged product innovation on current exporting status	-0,056	0,066	125	460
Lagged exporting status on product innovation	0.150**	0.080	452	133
Lagged process innovation on current exporting status	-0.012	0.058	253	332
Lagged exporting status on process innovation	0.272***	0.090	452	133
Lagged organization innovation on current exporting status	-0.116	0.064	277	308
Lagged exporting status on organization innovation	0.051	0.100	452	133

Note: Standard errors in parenthesis
*, ** and ** indicate statistical significance at 10, 5, and 1 percent, respectively
Source: Author

4.3. Productivity and Innovation

Productivity is driven by capital intensity and human capital (proxied by percentage of employees with degrees) (**Table 5**). This is consistent with both the theoretical framework underlying growth theory as well as the empirical results from firm-level studies. Productivity is also driven by process innovation - which indirectly confirms Damijan *et al.*'s (2010) suggestion that exporting leads to productivity improvements via process innovation rather than product innovation. However, it should be noted that product innovation is not well measured in a production function approach to productivity measurement because the total output does not sufficiently capture product variety that arise from product innovation. Thus, the role of product innovation may be underestimated in such exercises.

Table 5: Productivity and Innovation

Variables	LPROD	LPROD	LPROD
COMPEMP	0.406***	0.357***	0.351***
	(0.0329)	(0.0352)	(0.0356)
EMPDEGREE		0.0142***	0.0141***
		(0.0036)	(0.0036)
INNOVPROD			-0.0415
			(0.0740)
INNOCPROC			0.140**
			(0.0699)
INNOVORG			0.0173
			(0.0648)
Industry Dummies	Yes	Yes	Yes
Observations	633	749	630
R-squared	0.148	0.173	0.009

Note: Standard errors in parenthesis
*, ** and ** indicate statistical significance at 10, 5, and 1 percent, respectively
Source: Author

4.4. Exporting and Organization

The evidence on organizational differences between exporters and non-exporters is complex. In terms of horizontal boundaries or scale or production, continuing exporters do have larger revenues or employment size compared to non-exporters (**Table 6**). The scale exporting premium of continuing exporters is larger than those enjoyed by new exporters and exiting exporters (the latter two are not statistically significant). New exporters performed worse than exiting exporters in terms of both revenue and employment size - similar to earlier findings on productivity.

Table 6: Exporting and Horizontal Boundaries

Variables	Revenue Year 2006	Employment Year 2006	Revenue Change	Employment Change
Always Export	2.154 e+08*	241.0***	5.671 e+07	46.30*
	(1.191 e+08)	(55.15)	(1.276 e+08)	(26.22)
Entry Export	-1.575 e+07	57.9	-1.060 e+07	12.18
	(2.481 e+08)	(114.9)	(2.660 e+08)	(54.63)
Exit Export	4.660 e+07	71.83	3.033 e+07	11.15
	(1.405 e+08)	(65.08)	(1.506 e+08)	(30.94)
Industry Dummies	Yes	Yes	Yes	Yes
Observations	753	753	753	753
R-squared	0.027	0.077	0.017	0.026

Note: Standard errors in parenthesis
*, ** and ** indicate statistical significance at 10, 5, and 1 percent, respectively
Source: Author

In terms of vertical boundaries (measured by outsourcing and insourcing), there are no statistically significant differences between continuing exporters, entry exporters and exit exporters (**Table 7**). There is strong evidence on exporting on decentralization (**Table 8**). This confirms the theoretical predictions that the accumulation of knowledge may lead to hierachies in which may routine-type decisions are delegated to production workers (see Caliendo & Ross-Hansberg, 2011).

Table 7: Exporting and Vertical Boundaries

Variables	Outsourcing	Outsourcing Local	Insourcing	Insourcing Local
Always Export	0.210	0.191	0.197	0.117
	(0.139)	(0.142)	(0.160)	(0.163)
Entry Export	0.0923	0.136	0.431	0.362
	(0.289)	(0.291)	(0.302)	(0.310)
Exit Export	-0.134	-0.106	0.173	0.187
	(0.170)	(0.172)	(0.186)	(0.189)
Industry Dummies	Yes	Yes	Yes	Yes
Observations	753	753	753	753

Note: Standard errors in parenthesis
*, ** and ** indicate statistical significance at 10, 5, and 1 percent, respectively
Source: Author

Table 8: Exporting and Decentralization

Variables	SUPERVISEMGR	SUPERVISEWORKER
Always Export	-0.513***	0.182
	(0.156)	(0.152)
Entry Export	-0.511*	-0.0201
	(0.295)	(0.327)
Exit Export	-0.301*	0.346**
	(0.182)	(0.173)
Industry Dummies	Yes	Yes
Observations	753	753

Note: Standard errors in parenthesis
*, ** and ** indicate statistical significance at 10, 5, and 1 percent, respectively
Source: Author

5. Policy Implication

A number of policy implications can be drawn from the findings of this study. The continued emphasis on exporting as a development strategy for the manufacturing sector is the right approach given the productivity premium associated with exporting. However, given the productivity differentials between continuing, new and exiting exporters (compared to non-exporters), the government should consider focusing on new exporters, especially SME firms.

With regards to innovation and exporting, the results on the direction of causality between the two (exporting → innovation) suggest that there is perhaps a need to policies to encourage more product innovation rather than policies to promote exporting per se. The findings on productivity and innovation imply that human capital development should be a key area of focus.

Whilst organizational innovation is likely to be mostly an endogenous and adaptive phenomenon, it is possible that human capital development plays an important role as suggested by the current theoretical literature on knowledge accumulation and hierarchies. The empirical evidence linking decentralization to exporting may

constitute an early indirect evidence of this – thus reinforcing the importance of policies on human capital development.

6. Conclusions

Many developing countries continue to focus on export-driven industrialization as an engine of growth and development. There is a greater need to understand how exporting is related to productivity and innovation at the micro-level. Using firm-level data from Malaysian manufacturing, this study has found some evidence of strong productivity premium for continuing exporters (compared to non exporters). Such premium are much weaker (even negative) for new exporters, especially for smaller firms. There is evidence on the causality from exporting to innovation which supports the learning-by-exporting hypothesis. The impact of exporting on productivity may take place through process innovation. There are also important organizational changes associated with exporting, namely scale effects (horizontal boundaries) and the decentralization of decision-making, especially for continuing exporters. In terms of policy implications, findings from this study suggest that export entry is a difficult process especially for smaller firms. As the productivity gains from exporting are likely to come from learning-by-exporting, there is perhaps a need for government providing incentives and support for human capital investment to increase firm-level productivity (rather than provide incentives for exporting per se).

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