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Firm Export Behavior and Productivity: Evidence from ASEAN Countries

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1. Introduction

Export growth is one of the most important factors that help to explain the recovery of ASEAN countries from the Asian currency and financial crises in the 1997. Gill and Kharas (2007) states that a change in trade pattern of East Asian trade from low-skill and labor intensive products to high-skill and high technology products has been caused rapidly, and these high technology products, such as electrical machinery, bring about scale economy and vertical specialization. At the same time, export partners have been changed in the past decade. The major export destinations of ASEAN countries had been Japan and US by the late 1990s, while export market shares of China and ASEAN countries have been increasing gradually. This change is attributed to the formation of vertical production network in this region including China.

Since trade growth has brought about not only output growth but also technology development, a steady trade growth is an important factor of steady economic growth. A great deal of studies has demonstrated that international trade plays an important role in technology transfer between developed countries and developing countries. It has been shown that import is one of the most important channels of technology transfer by adapting and applying embodied technologies in capital goods and intermediate goods.[1] Likewise, export can also become a factor of technology progress of exporting firms. Facing international competition, exporting firms are forced to make more efforts to enhance productivity and gain new technologies. Exporting furthermore has a potential to take advantage of a scale economy by increasing production of exporting firms and industry.

In addition, recent empirical studies suggest that technology spillovers via personal exchange between exporters and clients may rise on exporting firms. For example, exporting firms would be able to receive information on products and production method from their foreign client when an exporting firm and the client have close contacts. Especially in recent years, the widespread use of IT technology has enabled even individuals and small companies not only to obtain information of new

[1] For example, Coe, Helpman and Hoffmaister (1997) examine international R&D spillovers from developed countries to developing countries through trade by using macro level data.

products of foreign competitors but also to do business with foreign buyers directly and more easily. Furthermore, recognizing the importance of export promotion by government and industry groups, international exhibitions and trade seminars have been held actively around the world. It seems reasonable to suppose that chances of technology transfers between exporters and buyers have been increasing.

Although there are many studies that examine technology spillover from buyer to export firm in case study approaches, the empirical assessment at firm level data is still inconclusive. Although most of these empirical analyses find that more productive firms intend to enter export market, namely, self-selection effect, it is not clear whether productivity gain following participation in export market, namely, learning by exporting effect, arises or not. One of the early contributions of empirical study on self-selection and learning-by-exporting is Clerides et al. (1996). They estimate a system of equations consisting by an export market participation and marginal cost by using plant level data of Colombia, Mexico and Morocco. They find that self-selection by export participating firms is significant, but firm's unit cost is not affected by export participation, that is, learning-by-exporting effect is not significant.[2] On the other hand, there is a growing literatures that present that exporting firms enhance their productivity after participating into export market in the cases of many countries. The major method of these studies is regression analysis by using instrumental variables or estimation of a system equations, a propensity score matching method, and semi-parametric regression. For example, Crespi et al. (2008) and Girma et al. (2004) use firm level data of UK and apply a regression analysis and a propensity score matching method respectively, and both studies show the effects of learning by exporting. Fernandes et al. (2005) examine the effects of export on productivity by firm data of Colombia, and find that younger firms gain more learning by exporting effects than older firms. Also, Albornoz and Ercolani (2007) use firm level panel data of Argentina and apply Granger causality test, propensity score matching method and GMM. They show the learning effect from exporting is not an automatic process but capacity to absorb knowledge and experience in global market are important factors of receiving the effect. Regarding Asian countries, Aw et al. (2000) use Korean and Taiwanese firm level data and find both self-selection of exporters and learning by exporting effect in the case of Taiwan. Regarding the case of Korean firms, however, they find that self-selection is much weaker and no significant results on learning by exporting. On the other hand, Hahn (2004) and Hahn and Park (2009) find both self-selection and learning by exporting effects in the case of Korean firms during the 1990s by propensity score matching method.

[2] Likewise, Delgado et al. (2002) examined Spanish manufacturing firms during 1991-1996 by applying one and two-sided Kolmogrov-Smirnov test. They also demonstrate a self-selection of exporting firms, but learning by exporting effects is rather weak and limited to younger exporters.

As for the developing countries, Bigsten, et al. (2004) examine the relationship between export participation and productivity in African countries by estimating a system of equations, and find that the learning by exporting effect is significant. Biesebroeck (2005) also shows that exporters increase their productivity after entry into export market, and find that these increases in productivity are explained by scale economy at firm level. In the same way, Blalock and Gertler (2004) apply the estimation of production function and semi-parametric method on Indonesian firm level data during 1990-1996 and find that that firms increase their productivity following the initiation of exporting, and they conclude that it is caused by learning from exporting judging from the timing.

Although recent studies suggest that firms in developing country tend to receive learning by exporting effects, there are few studies on ASEAN countries after Asian financial crisis. Since the development of production networks promotes regional trade in this region especially after the late 1990s, investigation on characteristics of exporting firms is an important subject for stable regional trade and economic growth in this region. This paper provides an empirical assessment on self-selection and learning effects of exporting firms in Indonesia, the Philippines, and Thailand in 2003 and 2004. We address to examine the relationship between productivity and export participation in view of the effects of additional another factors such as the type of ownership and the level of agglomeration measured by the size of the city by using firm level data.

This paper is structured as follows: the next section discusses theoretical and empirical issues of the relationship between export participation and productivity. Section 3 describes data and sample characteristics. In section 4, we analyze the results of estimation. Finally, section 5 summarizes the main findings of this paper.

2. A model of export participation with learning by exporting effects

Our main concern is to estimate the effects of technological spillover through exporting experience on productivity by using firm level data. However, it is requisite that this self-selection of productive firms should be controlled when we estimate the effects of exporting on productivity by using firm level data. In the same way of the study of Clerides, et al. (1996) and Biesebroeck (2005), we apply the model of the exporting decision with a productivity function jointly as a system of equations. Based on the idea that a firm enters export market if expected profit from exporting is positive, we construct a system of export participation equation and productivity function in order to estimate the effect of learning by exporting.

Following the model modified by Clerides et al. (1996),[3] we assume a representative firm

[3] Clerides et al (1996) modified the model of sunk-cost hysteresis by Boldwin (1989), Dixit (1989) and Krugman (1989)

under monopolistic competition and a downward sloping demand curve in the both of foreign and domestic market. Given the gross profit of a firm consisting of gross profits in both domestic and foreign market, it can be expressed by a function of marginal cost and state variable.

$$\pi_i\ (c_i, z_i) = \pi_i^d\ (c_i, z_i^d) + \pi_i^f\ (c_i, z^f) \tag{1}$$

where, c_i is a marginal cost of firm i, and z_i^d and z_i^f are state variables which denotes domestic and foreign demand conditions respectively. When a firm starts to export, a fixed cost of exporting is needed to entry the export-market since the gross profit is not adjusted for the sunk costs to start export. Therefore, the export-market participation condition is described as the following;

$$Exprot = \begin{cases} 1 & if \quad \pi_i^f(c_i, z_i^f)\ - F \geq 0 \\ 0 & otherwise \end{cases} \tag{2}$$

where, denotes a fixed cost of being an exporter. The profit from export-market is expressed as a form of a marginal cost, state variables and fixed cost for exporting. Following the framework of the model, we estimate a reduced form specification based on equation (2) with a productivity function as the following;

$$Exprot = \begin{cases} 1 & if \quad \alpha_{EY} Exyear_i + \alpha_A lnA_i + \alpha_{OP} FP_i + \alpha_{size} Size_i + \sum_m \alpha_m D^m + \sum_c \alpha_c Dc + u_{1i} \geq 0 \\ 0 & otherwise \end{cases} \tag{3}$$

$$lnA_i = \beta_{ER} Exratio_i + \beta_{FY} ln\,(Age)_i + \beta_{Sise} Size_i + \beta_{RD} lnRD_i + \sum_m \alpha_m D^m + \sum_c \alpha_c Dc + u_{2i} \tag{4}$$

Suppose the marginal cost and state variables depend on exogenous factors such as firm's characteristics and technological change such as learning by exporting, and the fixed cost for exporting is common to industry *m* in country *c*. We construct the equation of self-selection for exporting as a function of productivity level of firm as technological level, experiences of exporting and operation in foreign countries, firm size, and in addition country and industry dummies as sunk cost of exporting. As a productivity function, we assume that firm's productivity level, $ln\ A_i$ depends on direct export ratio, years of operation represented by firm's age, firm size, research and development expenditure and country and industry dummies as proxies of external technology shocks. We estimate this system of equations by using the full information maximum likelihood method, assuming that (u_1 u_2) is jointly normal.

3. Data

The data used for this study is from the World Bank Enterprise Surveys that were collected from registered firms with greater than 10 workers[4] in each country. From this data base, we use 713 samples of Indonesia in 2003, 716 samples of the Philippines in 2003 and 1,385 samples of Thailand in 2004, and then these are cross-section data. We estimate the multilateral total factor productivity (TFP) index as the productivity level by using calculated value added, capital and labor cost as described in appendix. Also, we construct a binary variable of export-market participation by share of direct export values in firm's sales. As for the explanatory variables, firm age is calculated from the starting year of firm's operation and the year of the survey conducted, and the years of exporting is estimated by the first year of exporting in the same way as firm age. All variables expressed in local currency are converted to real term by GDP deflator and to US dollars by using exchange rate from IMF's International Financial Statistics.

4. Estimation results

As the beginning, we examine the difference of TFP of exporting firms and non-exporting firms directly.[5] The results of test of the difference of mean of logarithmic TFP of exporting and non-exporting firms in the case classified by country, sector and size of city shows that TFP of exporting firms are higher than those of non-exporting firms and the differences are significant in all cases. These results are suggestive of self-selection of exporting firms or the effect of exporting to increase productivity or both. We examine the results from estimation equation in each productivity effects in the following two sections.

4.1 Self-selection effect

Self selection effects of exporting firms are examined by estimation equation (3), which describes that the decision whether to export or not depends on variables which explain a marginal cost, state variables and fixed cost for export. If the estimated coefficient of Log of TFP which indicates the level of productivity of firm is positive, it is considered that high productivity is a factor of entrance into export market. This denotes that self-selection for exporting by more productive firms has an effect.

Table 1 shows the results of estimation by country and firm size. There is a positive and significant effect of TFP on the decision of export in all countries and all size of firms. In case of large firms of the Philippines and Thailand, the coefficients are relatively larger than those of small

[4] The Enterprise Survey of the World Bank is available from the web site, https://www.enterprisesurveys.org/.

[5] Results of the tests are available upon request to the author.

firms. These results suggest that productivity level is significant for decision of exporting and the impact is relatively higher on large sized firms. Besides, the coefficient of years of export is also positive and significant in almost all case, and the estimates are relatively larger in small and medium sized firms. This result implies that both productivity level and exporting experiences are factors to reduce the cost of export and to promote to enter into exporting market, and the impact of productivity level is more significant for larger firms on the other hand, the longer experience of exporting is more important for small firms on the whole of manufacturing sectors.

Table 1 : Results of estimation by country and firm size

	Indonesia				Philippines				Thailand			
	Small & medium size		Large size		Small & medium size		Large size		Small & medium size		Large size	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
lnTFP												
Export ratio	-0.8234	(0.5536)	0.00001	(0.0000)	-0.1001	(0.2069)	-0.0257	(0.1268)	0.1590	(0.0707)**	0.0869	(0.0250)***
ln(Firm age)	1.1038	(0.8620)	0.00001	(0.0001)	-0.3558	(0.3943)	0.3093	(0.0830)***	-0.0589	(0.1338)	0.2684	(0.0737)***
ln(R&D)					0.9562	(0.2132)***	0.0816	(0.0220)***	0.2866	(0.1091)***	0.1052	(0.0286)***
Export												
TFP	0.5793	(0.0835)***	0.50643	(0.0289)***	0.4778	(0.1077)***	0.6781	(0.0397)***	0.3858	(0.1056)***	0.7017	(0.0388)***
Operation in foreign	-0.3616	(1.3674)	0.00000	(0.0001)	1.2115	(0.2347)***	0.2691	(0.0945)***	-	-	-0.1959	(0.0375)***
ln(Export year)	0.9811	(0.2547)***	0.00000	(0.0000)	0.9760	(0.1925)***	0.6697	(0.1822)***	1.3959	(0.1258)***	0.2755	(0.0477)***
LR Chi2 (Prob>Chi2)	15.27 (0.000)		108.52 (0.000)		20.23 (0.001)		18.98 (0.001)		11.03 (0.000)		122.32(0.000)	
No. of observations	187		248		355		201		574		796	
Log Likelihood	-56.56		-390.75		-86.96		-271.75		-370.37		-1013.74	

Notes: Estimated parameters of industry dummies are abbreviated.

Table 2 shows the estimation results by manufacturing sectors. For only the case of textile and electronics, we can conduct estimation on data divided by firm size because of relative large number of samples. Regarding the effect of productivity on decision of exporting, estimated coefficients are positive and significant in all sectors. The estimated coefficients of textile, electronics and automobile and parts sectors are relatively high, in particular, relative large coefficients are found in small and medium sized firms. These sectors are major exporting sectors, so it is conceivable that entering into exporting market requires higher productivity level, especially for small and medium firms because firms in these sectors face more severe competition with both domestic exporting firms and foreign firms. Also, the years of experience of export significantly has a positive effect on decision of exporting. While the effect is large in the case of automobile and its parts, metals and machinery and wood and furniture sectors, the effect is positive but relative small in the case of textile and electronics sectors. It is likely that this difference of the effect by years of exporting experience is caused by scale economy.

The results of Table 3 are estimates by type of owners of sample firms. As for Indonesia, we cannot obtain enough sample of firms owned by foreign company, therefore the results are limited to case of the Philippines and Thailand. While the higher productivity level and smaller size of firms are

Table 2 : Results of estimation by manufacturing sector

	Textile						Wood and furniture		Non-metalic and plastic materials	
	All firms		Small& medium firms		Large firms					
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
lnTFP										
Export ratio	-0.00165	(0.0966)	-0.14505	(0.1251)	0.23500	(0.0439) ***	-0.17137	(0.0961) *	0.172851	(0.0830) **
ln(Firm age)	0.01380	(0.0755)	-0.13647	(0.1411)	0.12070	(0.0225) ***	-0.07470	(0.2081)	0.291750	(0.1813)
sizecode	1.36247	(0.2876) ***					1.49647	(0.3563) ***	1.254622	(0.2050) ***
ln(R&D)	0.04920	(0.1028)	0.31784	(0.2322) ***	0.17069	(0.1210)	0.27673	(0.1232) **	0.283005	(0.1042) ***
Export										
TFP	0.63467	(0.0379) ***	1.11197	(0.2353) ***	0.52514	(0.0315) ***	0.41246	(0.1459) ***	0.598530	(0.1377) ***
Operation Foreign	0.10871	(0.2802)	1.09439	(0.3076) ***	-0.20695	(0.0407) ***				
ln(Export year)	0.24391	(0.1202) **	0.89885	(0.3972) **	-0.01389	(0.0027) ***	1.18828	(0.2091) ***	1.031933	(0.1928) ***
Sizecode	-0.61633	(0.1857) ***					-0.58871	(0.3654) *	-0.252193	(0.2937)
LR Chi2 (Prob>Chi2)	81.25 (0.000)		12.64 (0.000)		56.17 (0.000)		20.94(0.001)		11.89 (0.001)	
No. of observations	356		144		212		154		235	
Log Likelihood	-330.52		-38.18		-307.00		-146.63		-204.69	

	Metals and machinery		Electronics						Automobile and components	
			All firms		Small& medium firms		Large firms			
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
lnTFP										
Export ratio	0.44626	(0.0962) ***	0.144727	(0.1044)	-0.006291	(0.1265)	0.264565	(0.0835) ***	-0.449058	(0.1128) ***
ln(Firm age)	-0.02953	(0.2264)	0.456088	(0.2067) **	-0.230525	(0.1795)	0.425457	(0.1236) ***	-0.008115	(0.2422)
Sizecode	1.78759	(0.2172) ***	2.020707	(0.2826) ***	0.153647	(0.2842)			1.268456	(0.2279) ***
ln(R&D)	0.27515	(0.0725) ***	0.065232	(0.0478)			0.068060	(0.0448)	0.220581	(0.0916) ***
Export										
TFP	0.43547	(0.1803) **	0.666043	(0.0849) ***	1.343086	(0.5012) ***	0.432706	(0.0694) ***	0.860660	(0.1770) ***
Operation Foreign			0.030622	(0.3345)	0.428032	(1.2117)	-0.005261	(0.0599)	-1.743475	(0.7510) **
ln(Export year)	1.23425	(0.2116) ***	0.595800	(0.1859) ***	0.614376	(0.2611) **	-0.043554	(0.1405)	1.588136	(0.3178) ***
Sizecode	0.14054	(0.4489)	-1.257483	(0.2451) ***					-0.904071	(0.1925) ***
LR Chi2 (Prob>Chi2)	4.18 (0.041)		34.89 (0.000)		11.67 (0.001)		37.03 (0.000)		23.90 (0.000)	
No. of observations	174		274		77		197		157	
Log Likelihood	-161.47		-346.91		-30.97		-317.52		-153.08	

Notes: Estimated parameters of country dummies are abbreviated.

effective in the case of foreign owned firms in the Philippines, the same effects are found in the case of domestic owned firms in Thailand. These results suggest that the difference of effect of productivity level and other factors on decision of export by type of ownership is not clear and there is no common tendency to these two countries.

Table 4 shows the results of estimation by size of population of the city in which a firm is located. Cities are classified in four groups as following, the capital city, large city which has more than 250,000 population, middle sized city which has no fewer than 50,000 nor more than 250,000 population, and small city which has less than 50,000 population. Almost all cases except for large sized firms in capital city, higher productivity level has a positive and significant effect on decision of export. Although a clear difference of factors on decision of export between city sizes is not found, it is found that operation and holdings in foreign countries has an effect on the decision of export in large and middle sized city but does not in capital city. This result suggests that operation and holdings in foreign countries can be an important channel of obtaining information related to

Table 3 : Results of estimation by country and type of owner

	Indonesia		Philippines				Thailand			
	Domestic owner		Foreign owner		Domestic owner		Foreign owner		Domestic owner	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
lnTFP										
Export ratio	-0.0957	(0.1096)	-0.4675	(0.1256) ***	0.0546	(0.1407)	0.1604	(0.0704) **	0.0490	(0.0473)
ln(Firm age)			0.3681	(0.1513) **	0.5945	(0.2340) ***	0.7334	(0.1350) ***	0.2579	(0.0872) ***
Sizecode	0.9860	(0.3322) ***	1.4429	(0.3326) ***	1.9401	(0.2666) ***	2.0432	(0.1805) ***	1.5206	(0.1027) ***
ln(R&D)			0.0809	(0.0364) **	0.1109	(0.1539)	0.1336	(0.0337) ***	0.1875	(0.0398) ***
Export										
TFP	0.5072	(0.0346) ***	0.6904	(0.0470) ***	0.2108	(0.1291) *	-0.5466	(0.0814) ***	0.4925	(0.0696) ***
Operation Foreign			0.5882	(0.2487) **			0.1478	(0.5157)		
ln(Export year)	0.0846	(0.0945)	0.7433	(0.2029) ***	1.1664	(0.1280) ***	1.1462	(0.1636) ***	0.9583	(0.0914) ***
Sizecode	-0.4211	(0.1563) ***	-1.7605	(0.4367) ***	0.3007	(0.3272)	1.3434	(0.2918) ***	-0.6299	(0.1467) ***
LR Chi2(Prob>Chi2)	88.81 (0.000)		26.51 (0.001)		0.71 (0.398)		20.40 (0.000)		31.00 (0.000)	
No. of observations	348		132		424		358		1011	
Log Likelihood	-316.13		-199.72		-157.75		-505.53		-907.73	

Notes: Estimated parameters of industry dummies are abbreviated.

exporting market for firms in large and medium sized city, however, it dose not apply to firms in capital city.

4.2 Learning by exporting effect

The effect of learning by exporting is the main concern of this paper. TFP regression by equation (4) examines whether and how much the direct export ratio as well firm age, firm size and R&D expenditure have an effect on firm's productivity level. When the positive and significant coefficient of the direct export ratio is found, it denotes that the larger ratio of exporting raises firm's productivity level, and the effects of productivity increased by exporting including learning by exporting effect are existing.

Looking on the estimates by country, the productivity effect of exporting is not seen in Indonesia and the Philippines, but a positive and significant coefficient is found in Thailand. It is conceivable that economy of scale is effective on firm's productivity. In addition, the coefficient of R&D expenditure results in positive effect on firm's productivity in both the case of the Philippines and Thailand where R&D data exists. Furthermore, the results of the estimation classified by size of firms are shown in Table 1. Even in this case, the productivity effect by exporting is found in all sizes of firms in Thailand. Compared with large firms, the estimated coefficients of TFP in the case of small and medium sized firms are higher. This result suggests that small and medium sized firms receive more these productivity effects by exporting than large sized firms through various channels such as acquisition of new technology and knowledge through learning by exporting, improvement in productivity as the results of severer competition and scale economy caused by scale expansion by exporting. In addition, Table 3 shows the results of estimation by country and by type of owner. The

Table 4 : Results of estimation by size of city and firm size

	Capital city						Large city					
	All firms		Small& medium firms		Large firms		All firms		Small& medium firms		Large firms	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
lnTFP												
directex	0.0239	(0.0877)	0.0251	(0.1085)	0.2379	(0.1419) *	0.0461	(0.0631)	0.0095	(0.1047)	0.0611	(0.0799)
ln(firm age)	0.4728	(0.1605) ***	-0.1046	(0.2103)	1.4902	(0.2495) ***	0.4708	(0.1309) ***	0.0035	(0.1782)	0.5192	(0.1918) ***
sizecode	1.5798	(0.1681) ***					1.5063	(0.1406) ***				
ln(R&D)	0.1866	(0.0655) ***	0.4529	(0.1771) ***	0.1425	(0.0807) *	0.2245	(0.0450) ***	0.5939	(0.1460) ***	0.1590	(0.0516) ***
Export												
tfp	0.4021	(0.1354) ***	0.3735	(0.2254) *	-0.6070	(0.1926) ***	0.3978	(0.0660) ***	0.4220	(0.1020) ***	0.4540	(0.0817) ***
operation forreign	-0.1739	(0.9663)			1.7429	(3.5953)	0.8931	(0.4573) **	0.0986	(0.6418)	0.9283	(0.5356) *
lnexpyear	1.1569	(0.1842) ***	1.6890	(0.2433) ***	1.4650	(0.2461) ***	0.9519	(0.0917) ***	1.0390	(0.1234) ***	0.8195	(0.1587) ***
sizecode	-0.8010	(0.2620) ***					-0.3625	(0.1585) **				
LR Chi2(Prob>Chi2)	8.854 (0.003)		3.49 (0.062)		2.50 (0.114)		23.95 (0.004)		12.38 (0.000)		19.43 (0.000)	
No. of observations	332		200		132		792		454		338	
Log Likelihood	-281.67		-110.45		-153.22		-683.05		-235.35		-429.39	

	Middle sized city						Small city					
	All firms		Small& medium firms		Large firms		All firms		Small& medium firms		Large firms	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
lnTFP												
directex	0.1738	(0.0670) ***	0.2423	(0.1283) *	0.1124	(0.0673) *	0.0860	(0.0883)	−	−	0.1713	(0.0338) ***
ln(firm age)	0.2033	(0.1042) **	-0.1861	(0.2305)	0.1986	(0.0528) ***	0.4623	(0.1598) ***	−	−	0.6681	(0.1311) ***
sizecode	1.5997	(0.1416) ***					1.9527	(0.2494) ***	−	−		
ln(R&D)	0.1121	(0.0359) ***	0.0538	(0.3173)	0.0613	(0.0394)	0.1146	(0.0614) *	−	−	0.1375	(0.0580) **
Export												
tfp	0.4248	(0.0725) ***	0.2638	(0.1645)	0.69869	(0.0324) ***	0.3324	(0.1597) **	−	−	0.5502	(0.1118) ***
operation forreign	0.5026	(0.2966) *	2.2092	(0.9483) **	-0.15898	(0.0394) ***	−	−	−	−		
lnexpyear	0.9510	(0.1115) ***	1.7504	(0.2430) ***	0.37392	(0.1060) ***	1.0926	(0.1770) ***	−	−	0.9410	(0.2143) ***
sizecode	-0.4663	(0.1670) ***					-0.3383	(0.4027)	−	−		
LR Chi2 (Prob>Chi2)	18.52 (0.000)		1.83 (0.177)		76.12 (0.000)		33.95 (0.000)		−		26.06 (0.000)	
No. of observations	804		305		499		241		−		137	
Log Likelihood	-915.88		-169.55		-690.75		-216.71		−		-159.85	

Note: Estimated parameters of industry and country dummy are abbreviated.

estimated coefficient of TFP is positive and significant only in the case of firms in Thailand and owned by foreign company. These results could provide a policy implication that promoting export is an important factor for improvement in productivity of small and medium sized firms when the productivity effect by exporting is found in the whole country.

Estimation results by manufacturing sectors are represented in Table 2. The productivity effects are found in non-metallic and plastic material sector, and metals and machinery sector. It may be presumed that the productivity effects by exporting in these capital-intensive sectors are caused by scale economy by exporting. On the other hand, in the case of textile and electrical machinery sectors, the productivity effects by exporting are found only in the case of large firms. This result contrasts with the results of self-selection as mentioned above. Self selection for exporting are found in textile and electrical machinery sectors, which are main export sectors, while the productivity effect by exporting appears only in large firms. Large firms which have larger physical and human capital, have enough technological bases which can promote to absorb and apply new technology on

production and management. As Aw et al. (2007) demonstrated that R&D investment and training on workers promote exporting firms to raise their productivity, our result suggests that the technology base which promotes to accept and apply new technology is a prerequisite for acquiring the productivity effect by exporting.

Finally, we see from the estimation results represented in Table 4 whether size of population of city has an effect on the productivity by exporting. This estimation tries to examine whether the agglomeration effect has an influence on firm's productivity gain through exporting. Greenaway and Kneller (2008) find out that spillover effect associated with agglomeration promotes firms to enter the exporting market. Although population size of city is not a direct measure of agglomeration, on supposition that industrial agglomeration is often formed in the larger city in ASEAN countries and firms located in larger populated city have more channel to receive knowledge spillovers from other firms and research institute, we examine whether the productivity effect by exporting has more impact on firms under the environment which the externality of industrial agglomeration tends to arise. As the result of estimation, contrary to the expectation, the estimated coefficients of direct export ratio show that the productivity effect by exporting does not depend on scale of population of city in which firm is located. Positive and significant estimates are found in the case of large sized firms located in both capital and small sized city, and all sized firms in the medium sized city. As for estimated coefficients of R&D expenditure, all estimates are positive and significant for all sub-samples, while these coefficients are larger in the case of capital and large city than in the case of medium or small sized city. These results suggest that external technological spillovers are more important for firms in the medium sized city, on the other hand R&D effort by firm is more effective for firms in the capital and large sized city. Although the relation between the productivity effect by exporting and agglomeration effect requires further exploration, it may be presumed that there is an appropriate scale of city for knowledge acquisition by exporting.

5 Concluding remarks

So far we have examined an interrelation between exporting and productivity with emphasis on self-selection of exporting firms and productivity effect by exporting at firm level data from three ASEAN countries. As for the self selection of exporting, similar to many previous researches, we found a positive and significant effect of productivity on decision of exporting in most cases. On the other hand, exporting effect on firm's productivity level is more complicated. Estimation by country, we found a positive and significant effect on productivity from exporting in all size of firms from Thailand, in capital-intensive sectors such as metal and machinery, in large sized firms of electronics and textile sector. We can deduce a policy implication from these results that promotion of exporting

is useful for improvement in productivity of small and medium firms when the productivity effect by exporting is found in the country. Moreover, our estimation results show that there is a possibility that much of the effect of exporting on productivity comes from scale economy.[6] Also, we can derive from our results that a technology base which promotes to accept new technology is a significant and prerequisite for receiving the learning effect by exporting. Further examination by using firm level data extended with time dimension which is expected to be available in the future, would be focusing on source of productivity effect through exporting which has not been unexplored yet and will be indispensable to derive more detailed implications for this region.

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[6] Biesebroeck (2005) demonstrated source of productivity effect by exporting comes from scale economy by estimating production function of exporting firms.

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Appendix; Estimation of Multilateral TFP index

We estimate the firms' TFP by using the method of the multilateral TFP index developed by Caves et al (1982). First, in order to calculate this index, we construct a hypothetical representative firm's input and output values by country whose cost share of labor and capital is the arithmetic means of cost share for all firms in the country, and whose value added, labor input and capital input are the geometric means of these input and output values of all firms in the country. Then, we calculate relative value of sample firm's input and output values and cost share as the differences between sample firm and the hypothetical representative firm. Finally, we construct the multilateral TFP index of sample firms by subtracting each input multiplied by each cost share from value added by using each values of the differences between sample firm and the hypothetical representative firm, as the following;

$$lnTFP_{it} = (lnY_{it} - \overline{lnY_t}) - \frac{1}{2}(s_{kit} + \overline{s_{kt}})(lnK_{it} - \overline{lnK_t}) - \frac{1}{2}(s_{Lit} + \overline{s_{Lt}})(lnL_{it} - \overline{lnL_t})$$

Where, $\ln Y_{it}$ denotes firm i's logarithmic value added at time t, $\ln Y_t$ is a geometric means of value added of all firms in the country. S_{kit} and S_{Lit} denotes cost share of capital input and labor input respectively, and S_{kt} and S_{Lt} is arithmetic means of each cost share of all firms in the country. $\ln K_{it}$ and lnLt are logarithmic capital stock and labor input of firm i at time t.

As for the value added, we use the total value of operating profit, total wages and salaries, interest charges and financial fees. Operating profit is calculated by deducting direct raw material cost from total sales. We use the total asset multiplied by firm's average capital utilizing ratio as capital stock. Regarding capital service price, interest rate and depreciation rate of firm are supposed to use, however, we cannot use appropriate data for depreciation rate of firm, so we use only average lending rate of each country. We also calculate labor cost as total of wages, salaries and allowances as labor cost, and capital cost by multiplying capital service price and capital stock and adding rent for machinery, land and buildings. We estimate cost and labor share by using these capital and labor cost.