Journal of Entrepreneurship, Business and Economics
ISSN 2345-4695
2022, 10(1), 277–293

EXPORTING AND TECHNOLOGICAL INNOVATION: EVIDENCE FROM SOUTHEAST ASIA

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Received March 2022; accepted June 2022

Abstract
Exporting is imperative for a contemporary business as it enhances firm competitiveness and performance. Previous studies have focused on the link between exporting and innovation. Firms' innovation is enhanced after entering the export market by absorbing the knowledge of these markets. Nevertheless, there is little evidence in developing economies. In the Southeast Asian context, this relationship has not yet been explored. Thus, this study investigates the role of exports in firm-level technological innovation (product and process innovations) in Southeast Asia. Using a sample of 4,416 manufacturing firms in 2015 and 2016 and a multilevel mixed-effects logistic regression to deal with the hierarchies of the data set, the study finds empirical evidence that involvement in exporting activities can spur corporate technological innovation. The practical implication emphasizes the support of Southeast Asian governments to encourage exporting activities.

Research paper

Keywords: Exporting; Process innovation; Product innovation; Southeast Asia

Reference to this paper should be made as follows: Doan, T. N. T., & Chang, C. H. (2022). Exporting and Technological Innovation: Evidence from Southeast Asia. *Journal of Entrepreneurship, Business and Economics*, *10*(1), 277–293.

Introduction

For decades, scholars have been studying the potential benefits of international trade. Although most analyses have been conducted at the national or industry level, some researchers have recently studied the impact of international trade at the firm level (Golovko & Valentini, 2014; Melitz & Trefler, 2012; Salomon & Shaver, 2005b). Among different aspects of international trade, the relationship between exports and innovation has received much attention in the literature (Luo et al., 2016; Nguyen-Van & Chang, 2020b; Olabisi, 2017). Export markets may be an advantageous area for such external knowledge accumulation because they allow companies to access various knowledge bases that cannot be accessed in the domestic market (Golovko & Valentini, 2014; Salomon & Shaver, 2005a; Salomon & Shaver, 2005b). In fact, access to export markets enables companies to obtain international best practices and promote learning (MacGarvie, 2006; Xie & Li, 2018). However, most of the research on this topic is focused on developed countries, mainly the United States and European Union countries. There is little evidence in developing economies. In the Southeast Asian context, this relationship has not yet been explored. Therefore, the research examines the role of exporting in technological innovation, particularly product and process innovations in the Southeast Asian context.

The Southeast Asian region is a large economy with a GDP of over $3 trillion. The Southeast Asian area is the world's fourth-largest exporter. Its member nations' industrial capacities have improved, and their exports have become more diverse (Vinayak et al., 2018). Textiles and clothes are a specialty of Vietnam, whereas electronics are a major export of Singapore and

Malaysia. Thailand has become one of the world's largest exporters of automobiles and automotive components. Natural resources have been the foundation of export businesses in other Southeast Asian countries (Vinayak et al., 2018). Moreover, innovation is also regarded as an important source of growth in the Southeast Asian region (OECD, 2021). Thus, investigating the role of exports in innovation is an interesting topic for research.

This research has some contributions to the economic literature. First, while there have been some studies investigating the role of exporting in product innovation, R&D, and patents, there is little evidence on both product and process innovations, especially process innovation (Tajpour et al., 2020; Islam et al., 2021). To the authors' knowledge, only three studies investigated this relationship (i.e. Abubakar, Hand, Smallbone, and Saridakis (2019); Damijan, Kostevc, and Rojec (2017); Fassio (2017)). Moreover, these studies only focus on developed countries or Africa. Therefore, this study contributes as one of the few studies to investigate the role of exporting in both product and process innovations in the context of the Asian region (i.e. Southeast Asia).

Second, in terms of research methods, the current research takes into account the multilevel nature of the data set when firms are clustered within industries, and industries are clustered within countries. Our review of empirical studies reveals that there have been no studies taking into account this problem. Therefore, using a multilevel mixed-effects logistic regression (MMLR) (Hox et al., 2017), this study contributes as one of the first to address the multilevel nature of the data set.

The paper proceeds as follows. Section 2 reviews the role of exporting on technological innovation and proposes hypotheses. The data source, variable description, and empirical strategy are presented in Section 3. Section 4 discusses the results. Finally, section 5 concludes and suggests practical implications.

Literature review and hypotheses

Innovation is defined as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2005, p. 46). Technological innovation includes product and process innovations (OECD, 2005). Product innovation is "*the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics*" (OECD, 2005, p. 48). Process innovation is "the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (OECD, 2005, p. 49).

The theoretical background to explain the impact of exporting on innovation is usually based on the "*learning by exporting*" view (Damijan, Kostevc, & Rojec, 2017; Luo et al., 2016; Naderibeni et al., 2020). In a broad sense, "learning by exporting" refers to the phenomenon that a company's performance improves after entering the export market by absorbing the knowledge of these markets (Golovko & Valentini, 2014; Melitz & Trefler,

2012). The "learning by exporting" perspective is classified into two smaller effects, "pull effect" and "push effect".

Regarding the "pull effect", as an effective way to approach external knowledge, by interacting with knowledgeable customers in the international markets, exporters can accumulate new production technologies (Ito & Lechevalier, 2010; Mattoussi & Ayadi, 2016). More specifically, in order to ensure the imported goods' quality, foreign importers can deliver information and guidance on quality requirements, production technology, customer preferences, which is very useful for new product development (Luo et al., 2016; Wu et al., 2007).

In addition, through multiple interactions with foreign customers in international markets, exporting firms can gain access to new technologies. Therefore, they can use this knowledge to drive innovation (Cassiman & Golovko, 2011). The impact of "learning by exporting" is vital in developing countries because the majority of companies have outdated technologies. In this case, they can benefit greatly from the spread of technology and knowledge from advanced countries (Olabisi, 2017).

As for the "push effect", exporters have to acquire complex knowledge and update technology due to competitive pressure in the international market, which ultimately stimulates innovation. This makes enterprises more competitive and meet different needs of foreign importers (Almodóvar et al., 2014; Luo et al., 2016).

There has been some empirical research on how exporting activities affect technological innovation in both developed and developing countries. Most of the empirical evidence reveals that exporting is conducive to more technological innovation. In particular, in the context of developed countries,

Bratti and Felice (2012), using data from Italian manufacturing firms, found that there is a positive correlation between a firm's exporting and the likelihood of having product innovation. Damijan, Kostevc, and Rojec (2017), using data from EU economies, found that exporting is vital for the possibility of product and process innovations. Fassio (2017) investigated the role of exporting activities on the innovation of firms in five developed European countries. The results show that exporting activity spurs the probability to introduce firm-level product and process innovations.

In the context of developing countries, Mattoussi and Ayadi (2016), employing data on Tunisian firms, found that exporting is positively associated with R&D investments. In the Chinese context, Luo et al. (2016) found that in the case of state-owned enterprises, the nexus between exporting and innovation follows an inverted U-shaped pattern. Xie and Li (2018) investigated the exporting-innovation relationship among Chinese manufacturers. The results show that exporters have more tendency to innovate. However, Abubakar et al. (2019), using the data for Sub-Saharan countries, found no impact of exporting activities on product and process innovations.

The afore-mentioned theoretical and empirical discussions lead to the following hypothesis:

H1: Exporting is positively related to product innovation.

Regarding the role of exporting in process innovation. By interacting with foreign importers (usually requiring higher-quality standards), exporters may be induced to upgrade their production processes and ultimately intro-

duce process innovation. Moreover, to comply with high requirements in advanced countries, exporting firms also have to improve their production processes by introducing process innovations (Fassio, 2017; Harirchi & Chaminade, 2014). In addition, benefiting from the spillovers from the "technological learning" effect, firms exporting to advanced countries may ultimately come up with more process innovation (Desmet & Parente, 2010; Fassio, 2017). The above arguments lead to the following hypothesis:

H2: Exporting is positively related to process innovation.

Research method

Sample

The research uses data collected by the World Bank's Enterprise Surveys (WBES). The WBES covers 164,000 firms in 144 countries, providing one of the most intensive data on firm-level performance and innovation in developing countries (Nguyen-Van & Chang, 2020a; World Bank, 2021). This study uses the WBES for eight countries in Southeast Asia. More specifically, the WBES in 2015 for Indonesia, Malaysia, the Philippines, Timor Leste, and Vietnam, and the WBES 2016 for Cambodia, Laos, and Thailand. Totally, there are 4,416 observations in manufacturing industries.

Variables

Dependent variable

The dependent variable in this study is *Product innovation* and *Process innovation*. *Product innovation* is a dummy variable, taking the value of

"1" if a firm introduced new or significantly improved products and "0" otherwise. *Process innovation* is constructed as a dummy variable, taking the value of "1" if a firm introduced new or significantly methods of manufacturing products or offering services, logistics, delivery, or distribution methods for inputs, products, or services, supporting activities, and "0" otherwise (Damijan et al., 2017; Fassio, 2017).

Independent variable

The independent variable in this study is *Exports*. *Exports* is a dummy variable, taking the value of "1" if a firm exported and "0" otherwise (Bratti & Felice, 2012; Jiang et al., 2016).

Control variables

Several firm-level control variables are employed in this study. First, *Training* is a dummy variable, taking the value of "1" if a firm provided formal training for its employees and "0" otherwise (Abubakar et al., 2019; Azar & Ciabuschi, 2017). Second, *R&D* is constructed as a dummy variable, taking the value of "1" if a firm performed R&D activities and "0" otherwise (Abubakar et al., 2019; Azar & Ciabuschi, 2017; Stanescu & Virjan, 2020). Third, *Age* is the logarithm of the years in the business of a firm (Azar & Ciabuschi, 2017; Doan & Chang, 2021; Imran et al., 2020). Fourth, *Size* is the logarithm of the total employees of a firm (Abubakar et al., 2019; Doan & Chang, 2021). Fifth, this study controls for the industry that a firm registered as the main business. Each industry is constructed as a dummy variable. There are totally 23 dummies for 23 manufacturing industries. Finally, this research controls for the specific country. Each country is constructed as a dummy variable.

There are totally eight dummies for eight countries (Filipescu et al., 2013; Nguyen-Van & Chang, 2020a).

Estimation approach

It is interesting to find that the data in this study has a hierarchical structure. There are hierarchies with firms clustered within industries. Moreover, industries are clustered within countries. This problem will violate the non-dependence assumption of observations in traditional regressions, which can lead to misleading results (McCoach, 2019; Bouzari et al., 2021). Therefore, to consider the multilevel structure of the data set, this study employs a multilevel mixed-effects logistic regression (MMLR) (Hox et al., 2017; Dana et al., 2022 a, b, c). The MMLR is performed by the "melogit" procedure in Stata.

Results and discussions

Summary statistics

Table 1 shows the summary statistics. In particular, 22% of firms performed product innovation, while the figure for process innovation is 35%. More than 32% of firms exported their goods to international markets. Nearly 32% of firms organized formal training for their staff, and nearly 32% of firms had R&D performance.

Table 1. Summary statistics

Variable	N	Mean	S.D.	Min	Max
Product innovation	4,327	0.222	0.416	0	1
Process innovation	4,416	0.353	0.478	0	1
Exports	4,386	0.323	0.468	0	1
Training	4,350	0.319	0.466	0	1
R&D	4,311	0.157	0.364	0	1
Age (log)	4,367	2.774	0.631	0	5.081
Size (log)	4,300	3.983	1.538	0.693	14.509

Source: WBES for eight countries in Southeast Asia 2015-2016

Table 2 presents the pairwise correlations. All the pairwise correlations are less than 0.5, which suggests that multicollinearity is not an issue in this analysis (Dormann et al., 2013; Rahman et al., 2022 a, b; Ramadani et al., 2022).

Table 2. Pairwise correlations

	Exports	Training	R&D	Age (log)	Size (log)
Exports	1				
Training	0.255***	1			
R&D	0.1736***	0.2603***	1		
Age (log)	0.0747***	0.1284***	0.0576***	1	
Size (log)	0.3962***	0.3521***	0.2615***	0.1903***	1

Note: * p < .10; ** p < .05; *** p < .01

Source: WBES for eight countries in Southeast Asia 2015-2016

Empirical results

Table 3 presents the estimation results using the MMLR. It is important to find the significant likelihood-ratio test statistics, showing that the MMLR is more favorable than the standard logit regression (Rahman et al., 2021). Model 1 presents the results for *Product innovation* and Model 2 presents the results for *Process innovation*.

Regarding the exporting - product innovation relationship, Model 1 shows that the coefficient of Exports is significant and positive at the 1%

level. It means that firms performing exporting activities tend to introduce more product innovation. The result is consistent with previous studies (e.g. Bratti and Felice (2012), Damijan et al. (2017), Xie & Li (2018)). The result lends support to the "learning by exporting" perspective. In particular, by interacting with knowledgeable customers in the international markets, exporters can accumulate new production technologies, which is very useful for new product development (Mattoussi & Ayadi, 2016). In addition, firms can update technology under competitive pressure in the international markets and ultimately have better innovation outcomes (Almodóvar et al., 2014; Luo et al., 2016).

Table 3. Estimation results

	MMLR	
	Model 1	Model 2
	Product innovation	Process innovation
Exports	0.340***	0.188**
	(0.098)	(0.090)
Training	0.278***	0.404***
	(0.101)	(0.091)
R&D	1.670***	2.084***
	(0.108)	(0.118)
Age (log)	0.297***	0.088
	(0.073)	(0.066)
Size (log)	0.036	0.138***
	(0.032)	(0.030)
Industries	Yes	Yes
Countries	Yes	Yes
Constant	-2.878***	-1.972***
	(0.322)	(0.283)
Wald $\chi 2$	363.37	477.48
Prob > $\chi 2$	0.0000	0.0000
LR test versus logit model	$\chi^2 = 211.35$ Prob > $\chi^2 = 0.0000$	$\chi^2 = 185.23$ Prob > $\chi^2 = 0.0000$
N	4,062	4,108

Note: Standard errors in parentheses. * p < .10; ** p < .05; *** p < .01

Source: WBES for eight countries in Southeast Asia 2015-2016

Model 2 presents how exporting can affect process innovation. The coefficient of *Exports* is significant and positive at the 5% level. This reveals that companies conducting exporting are more likely to introduce process innovation. The result is similar to those found in Damijan et al. (2017) and Fassio (2017). However, it is contrary to what was found in Abubakar et al. (2019) (i.e. no impact of exporting activities on process innovation in the case of Sub-Saharan countries).

The finding supports the argument that by interacting with foreign importers (usually requiring higher-quality standards), exporters may be induced to upgrade their production processes and ultimately introduce process innovation (Fassio, 2017). Moreover, benefiting from the spillovers from the technological learning effect, Southeast Asian firms exporting to advanced markets might ultimately come up with more process innovation.

Conclusions and implications

This study used an extensive data set of eight countries in Southeast Asia to investigate the role of exporting in product and process innovations. To take into account the multilevel structure of the data set, this study employs a multilevel mixed-effects logistic regression with a sample of 4,416 manufacturing firms in 2015 and 2016 for the empirical analysis. The results provide rigorous evidence that exports are positively related to firms' technological innovation.

The results suggest important practical implications. First, there should be effective policies (i.e. access to credit and information on the export markets) from Southeast Asian governments to encourage exporting activities. Specifically, the governments should create favorable legal frameworks

to help firms have better access to credit from both banks and non-bank financial institutions so that they can buy modern machines and inputs for exporting. Moreover, Southeast Asian governments should provide firms with more information on the international markets (i.e. forecast of product demand in foreign markets, consumer preferences, and competitors in foreign markets). In this way, firms will have more motivation and conditions for exporting and ultimately increase innovation.

Second, firms should be more active in participating in the export markets. In particular, they should put more effort into finding customers through the internet (e.g. via B2B ecommerce platforms) and participating in overseas exhibitions. In this way, they can have more opportunities to join the export market and gain the "learning by exporting" effect. More specifically, they can learn new technologies and knowledge, which is important for enhancing their innovation performance.

Limitations and further research

This research has some limitations that are suggestions for further research. First, this study focuses on the impact of exporting on only product and process innovations in the Southeast Asian context. Other types of innovations (i.e. marketing and organizational innovations) are not investigated in this study. Therefore, the role of exporting in marketing and organizational innovations should be examined in future studies to have a comprehensive view of innovation performance in the Southeast Asian context. Second, due to data limitations, this study cannot observe the influence of exporting for multiple periods. Thus, future studies, with better access to panel data, can

reinvestigate this research topic to have more insights into the Southeast Asian context.

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