

## Adoption of international standard certification in ASEAN: The roles of R&D, exports and competition

**Van Dung Nguyen**

*School of International Business – Marketing, College of Business,  
University of Economics Ho Chi Minh City (UEH)  
Vietnam*

[dungnv@ueh.edu.vn](mailto:dungnv@ueh.edu.vn)

ORCID0000-0002-3800-909X

**Abstract.** This paper examines whether R&D, exports, and competition affect the adoption of international standard certification in ASEAN. Although prior studies recognized the importance of R&D, exports, and competition in determining a firm's decision to adopt international standards, they often focused on a single determinant of this activity. Hence, this study tries to incorporate three important internal and external factors in a comprehensive study. The current study investigates these questions by analyzing the data from a valid sample of appropriately 4,000 firms in the manufacturing industries in eight countries in ASEAN in 2015-2016. The study utilizes a multilevel mixed-effects logit model for estimation to take into account the hierarchical nature of our data set. The results show that firms with R&D activities tend to adopt more international standard certificates. We also find that exports are highly important, while competition from the informal sector does not show association with firms' innovativeness. These findings remain valid after endogenous and robustness testing using the propensity score matching method.

**Keywords:** exports, informal competition, internationally-recognized quality certification, manufacturing industries, R&D

**JEL Classification:** L15, L60, O32

**Received:**  
September, 2021  
**1st Revision:**  
May, 2022  
**Accepted:**  
September, 2022

DOI:  
10.14254/2071-  
8330.2022/15-3/3

### 1. INTRODUCTION

The process of firms' adoption of international standard certification has received increasing attention in the literature (Fikru, 2014b; Liston-Heyes & Heyes, 2021; Siltori et al., 2021). Information asymmetries about product quality are a worrisome issue in international markets because of the physical and cultural differences between exporters and importers. Therefore, importers tend to rely on proxies to assess product quality. Exporters that can provide assurance about quality using internationally-recognized

quality certificates can gain a competitive advantage (Cao & Prakash, 2011). In addition, faced with globalization and international trade, firms especially those from developing countries tend to adopt management practices to meet international standard requirements (Fikru, 2014b; Grolleau, Mzoughi, & Thomas, 2007). For example, more than a million companies and organizations in 170 economies have adopted ISO 9001 quality management system. Employing ISO 9001 can help customers get high-quality products and services, which ultimately contributes to the development of companies/organizations (ISO, 2021).

Among different determinants of internationally-recognized quality certification adoption, three highly mentioned factors are R&D, exports, and competition (Fikru, 2014b, 2016; Lira et al., 2021; Mangiarotti & Riillo, 2013). Thus, this study aims to examine the possible effects of R&D, exports, and competition on the adoption of internationally-recognized quality certification in ASEAN. This study concentrates on the ASEAN context because ASEAN is a dynamic and fast-growing market with high competition (ADB Institute, 2014; OECD, 2019). Accordingly, the adoption of internationally-recognized quality certificates can help ASEAN firms achieve market advantages and sustainable competitiveness (Intal Jr & Pangestu, 2019).

This work contributes to the literature in two aspects. First, although prior studies recognized the importance of R&D, exports, and competition in determining a firm's decision to adopt international standards (Fikru, 2014b, 2016; Mangiarotti & Riillo, 2013; Pekovic, 2010), they often focused on a single determinant of this activity. This study thus contributes to the literature on international standard certification as probably the first to incorporate three important internal and external factors in a comprehensive study. In this respect, the study can offer a theoretical framework that can explain how these internal and external factors can affect the adoption of internationally-recognized quality certification. Moreover, the current research focuses on the context of developing regions, in particular the ASEAN region. In this way, this research provides an important complement to studies that have focused on the context of developed economies.

Second, this study makes an important contribution in terms of methodology. While previous studies on this research theme did not pay attention to the multilevel issue arising from the data set containing firms in different industries and countries (e.g. Hudson & Orviska, 2013; Mangiarotti & Riillo, 2013; Pekovic, 2010; Wu, Chu, & Liu, 2007), the current study utilizes the multilevel mixed-effects logit model (MMLM) to take into account this econometric problem. To the best of our knowledge, this is one of the few studies to address the multilevel in this research stream (see Fikru (2016) for the use of multilevel modeling). In this way, the research can complement current methods widely used to investigate the adoption of international standard certification.

The next sections are structured as follows. A review of related literature is presented in section 2. Section 3 describes the data source and estimation strategies. Section 4 presents results and discussions. The last section gives the conclusions and implications.

## **2. LITERATURE REVIEW AND HYPOTHESES**

### **2.1. R&D and international standard certification adoption**

R&D plays an important role in enhancing the possibility to adopt international standard certification adoption. According to the resource-based view (RBV), a firm achieves sustained competitive advantage through unique bundles of resources (Barney, 1991), and R&D is a crucial resource in a firm's business strategy (Anzola-Román, Bayona-Sáez, & García-Marco, 2018). In particular, there may exist a complementary relationship between being innovative and adopting ISO 9000 (Blind & Hipp, 2003).

Thus, R&D, as a proxy for being innovative, can contribute to the adoption of international standards as firms carrying out R&D activities tend to have more information, more understanding of the importance of the role of international standard certification. Moreover, firms with more R&D investment are more likely to opt for technological solutions for managing their operations. Hence, they may find it easier to implement international standards (Ha, Thang, & Thanh, 2021; Wu et al., 2007).

The empirical literature on the role of R&D in international standard certification is rather limited. We can only identify one paper by Mangiarotti and Riillo (2013) that investigated this relationship in the context of 1,140 companies in Luxembourg during 2004–2006. There are mixed results. While R&D intensity is positively related to ISO 9000 certification in the manufacturing sectors, R&D intensity has no impact on ISO 9000 certification in the service sectors.

### **H1: R&D is positively associated with international standard certification adoption.**

## **2.2. Exports and international standard adoption**

Exports can affect international standard certification adoption positively for at least two reasons. First, according to the signaling perspective, the quality of a certain firm's products may be unobservable in the market, especially for customers in foreign countries (Liston-Heyes & Heyes, 2021; Pekovic, 2010). Thus, adopting an international standard certification can inform the international markets on the product quality as a form of signaling unobservable characteristics so that firms can meet the quality expectations of international customers (Grolleau et al., 2007; Pekovic, 2010). As a result, following the new institutional perspective can increase the legitimacy of a firm in the international markets, which creates greater customer trust (Guler, Guillén, & Macpherson, 2002; Pekovic, 2010). In addition, as suggested by Montiel and Husted (2009), firms exporting to foreign countries are exposed to new ways of doing business, so there is an increasing tendency to apply management standards.

Second, foreign customers can exert coercive pressure. In particular, under some circumstances, it is a requirement of firms in developing economies to meet international quality standards to export. Otherwise, they may be excluded from international markets (Fikru, 2014b, 2016). Moreover, they can also face the takeback obligation of exported products that do not meet international standards (Fikru, 2016). This makes the difference between exporters and non-exporters because non-exporting firms are not necessarily under pressure to meet the requirements of the international market (Fikru, 2014a, 2016).

As shown in Table 1, the empirical literature on this relationship mainly shows a positive contribution of exporting to international standard certification adoption. The positive role of exporting is found in both developed and developing countries.

Table 1

Empirical studies of the role of exporting on international standard certification adoption

Article	Context	Main findings	
Pekovic (2010)	10,837 French firms during 2003–2006	Positive	Firms with more export intensity are likely to adopt ISO 9000 certification in both the manufacturing and service sectors.
Fikru (2016)	11,862 firms in 27 sub-Saharan African countries in 2006, 2007 and 2009	Positive	Export intensity is conducive to the adoption of international standards.
Fikru (2014a)	644 firms in Ethiopia in 2011–2012	Positive	Firms with a higher proportion of sales in the international market are more likely to obtain international certification.
Fikru (2014b)	10,168 firms in 35 developing countries in 2006	Positive	Firms that export more have more likelihood of adopting international standard certification.

*Source:* own compilation

The above theoretical and empirical literature implies the following hypothesis:

**H2: Exporting is positively associated with international standard certification adoption.**

### 2.3. Competition and international standard adoption

There are various arguments on the role of competition in the adoption of international standard certificates. According to Cao and Prakash (2011), when competition is fierce, the motivation to adopt international standard certification as a signaling mechanism is even greater. These incentives for exporters in developing countries may be higher due to poor reputation and large differences in the quality of exported products (Cao & Prakash, 2011; Halkos, Nomikos, & Skouloudis, 2021; Potoski & Prakash, 2009). Prior studies also show that global competition can accelerate the adoption of ISO 9000 (Mangiarotti & Riillo, 2013; Potoski & Prakash, 2009). In addition, competition from informal sectors may cause obstacles for registered firms. Thus, they can adopt international standard certification to distinguish themselves from informal and unregistered firms (Fikru, 2014a).

Regarding empirical literature, as can be seen from Table 2, there are mixed results regarding the role of competition on international standard certification adoption. This reflects the heterogeneity regarding the impacts of competition on this practice, which may partly stem from the difference in measurements, definitions of competition in various studies.

Table 2

Empirical studies of the role of competition on international standard certification adoption

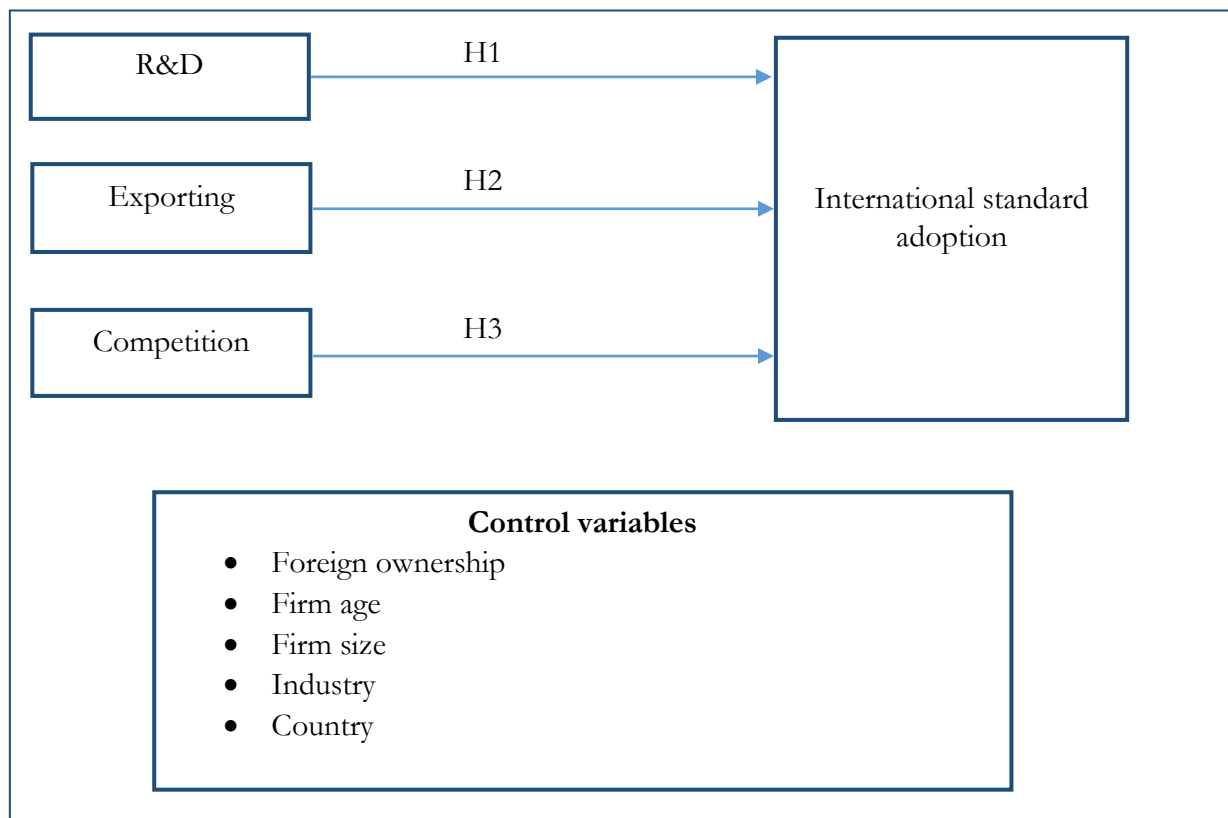
Article	Context	Main findings	
Cao and Prakash (2011)	1039 firms for 134 countries from 1993 to 2002	Positive	Domestic competition has a consistent and positive impact on ISO 9000 adoption.
Hudson and Orviska (2013)	11,668 firms in countries in Asia and Eastern Europe	Mixed	Competitive pressure from domestic competitors prevents firms from adopting international standard certificates. Nevertheless, if the competition is from foreign firms, they have a greater propensity to adopt such certification.
Mangiarotti and Riillo (2013)	1,140 companies in Luxembourg during 2004–2006	No impact	Competition has no impact on the possibility to adopt ISO 9000 certification.
Fikru (2014a)	644 firms in Ethiopia in 2011–2012	Negative	Competition from the informal sector lowers the probability of adopting international standard certificates.

*Source:* own compilation

Considering the theoretical literature, we accordingly propose the following hypothesis:

**H3: Informal competition is positively associated with international standard certification adoption.**

Figure 1 presents the research framework with three hypothesized relationships.



**Figure 1. Research framework**

*Source:* own compilation

### 3. DATA AND RESEARCH METHOD

#### 3.1. Data

The research makes use of the data collected by the World Bank in its large-scale “Enterprise Surveys” (ES). The ES collects information on firm performance and various topics related to firms’ perceptions of the business environment from business owners and top managers of 174,000 firms in 151 economies, which makes the ES one of the most comprehensive databases for researching at the firm level (World Bank, 2021).

For each country, survey rounds are carried out at an irregular time interval with only a very few firms appearing consistently throughout survey rounds (Mertzanis & Said, 2019). Nevertheless, the data set has the advantage of consistent questionnaires following the Global Methodology. Moreover, the ES covers a wide range of developing countries. These advantages enable cross-country analysis (Mertzanis & Said, 2019). This study employs firm-level data for Indonesia, Malaysia, Philippines, and Vietnam in the survey year 2015, and the data for Cambodia, Laos, Myanmar, and Thailand come from the survey year 2016.

In the present analysis, only firms in the manufacturing industries are included in the data set. The ES follows the International Standard Industrial Classification of All Economic Activities Revision 3.1 (United Nations Statistical Division, 2002), and in the current research, there are 23 manufacturing industries with two-digit codes 15-37. This research focuses only on the manufacturing industries because there is a large difference between the manufacturing and the service sectors in terms of the nature of

business operation in general and in international standard certification in particular. The final sample includes nearly 4,000 observations in total from eight ASEAN countries in 2015-2016.

### 3.2. Research method

#### Variables

The proposed hypotheses are tested using the following equation:

$$\text{International standard adoption}_i = \beta_0 + \beta_1 R\&D_i + \beta_2 \text{Exporting}_i + \beta_3 \text{Competition}_i + \beta_4 \text{Control}_i + \varepsilon_i \quad (1)$$

The dependent variable, *International standard adoption*, captures whether a firm has an internationally-recognized quality certification or not. It is constructed as a dummy variable, equal to 1 if a firm has certification, and equal to 0 otherwise. Firms that responded “still in process” and “don’t know” to this question are excluded from the final sample.

Three independent variables in our analysis are *R&D*, *Exports*, and *Informal competition*. *R&D* is a dummy variable, equal to 1 if the firm conducted formal R&D activities, and 0 otherwise (Mangiarotti & Riillo, 2013; Wu et al., 2007). *Exports* is constructed as a dummy variable, equal to 1 if the firms performed exporting activities, and 0 otherwise (Fikru, 2016; Guler et al., 2002; Pekovic, 2010). *Informal competition* denotes the degree of informal competition perceived by the firm (Cao & Prakash, 2011; Fikru, 2014a). The information for this variable is from the question “To what degree are practices of competitors in the informal sector an obstacle to the current operations of this establishment”. 0 = “No obstacle”, 1 = “Minor obstacle”, 2 = “Moderate obstacle”, 3 = “Major obstacle”, 4 = “Very Severe Obstacle”

We control for *Foreign ownership*, *Firm age*, *Firm size*, which previous studies have linked to international standard certification adoption certification activities (Delmas & Toffel, 2004; Fikru, 2016; Hudson & Orviska, 2013; Pekovic, 2010).

*Foreign ownership*: Foreign-owned firms are more likely to seek international standard certificates because they can usually access more resources and knowledge for this activity. They may also face greater internal pressure to adopt international certificates (Fikru, 2014b; Hudson & Orviska, 2013; Pekovic, 2010). *Foreign ownership* is measured as the percentage of this firm is owned by private foreign individuals, companies, or organizations. *Foreign ownership* has values ranging from 0% to 100%. This way of constructing the variable has more advantage over measuring *Foreign ownership* as a dummy variable because we can control for the extent of foreign ownership (Fikru, 2014b).

*Firm age*: Firm age can determine international standard certification because older firms can have more time to build up capabilities for pursuing certification activities (Delmas & Toffel, 2004; Fikru, 2016). *Firm age* is operationalized as the logarithm of the number of years since the firm’s establishment.

*Firm size*: Large firms are more likely to adopt international standard certificates because they have more financial resources to support their certification costs. Moreover, large firms usually have standardized administrative structures, which potentially increases their international certification adoption propensity. In contrast, smaller firms have difficulties in acquiring the necessary expertise to implement the relevant procedures to adopt international standard certifications (Hudson & Orviska, 2013; Pekovic, 2010; Pekovic & Galia, 2009). In this study, *Firm size* represents the logarithm of the firm’s total employees.

#### Estimation approach

To estimate a binary dependent variable, the most popular method is a logit or probit model (Cameron & Trivedi, 2009; Wooldridge, 2010). However, these methods do not take into account the multilevel/hierarchical nature of our data set. Indeed, our data set captures information at the firm level

(Level 1), industry level (Level 2), and country level (Level 3). Hence, we utilize a multilevel mixed-effects logit model (MMLM) as it can address the multilevel/hierarchical problem. The MMLM is compared with the simple logistic model using the likelihood ratio test (StataCorp, 2017). A statistically significant test result indicates that the MMLM is superior to the simple logistic model.

## 4. RESULTS AND DISCUSSION

### 4.1. Descriptive statistics

Table 3 presents the distribution of internationally-recognized quality certificate adoption, R&D, exports, and informal competition status by industry. As can be seen from Table 3, there is a wide variation in the adoption of international standards regarding the different industries, ranging from 50% (coke, refined petroleum products and nuclear fuel and radio, television and communication equipment and apparatus) to 0% (tobacco and office, accounting and computing machinery).

Table 3 also reveals that firms in the chemicals and chemical products industry had the highest rate of R&D activities (26.78%), while no firms in the tobacco, office, accounting and computing machinery and recycling industries conducted R&D. Firms in the radio, television and communication equipment and apparatus industry exported the most (62.26%), while no firms in the tobacco and office and accounting and computing machinery industries exported their products. Moreover, firms in the publishing, printing and reproduction of recorded media industry faced the most intense competition from the informal sector (mean = 1.70), while those in the radio, television and communication equipment and apparatus industry reported the least competition from the informal sector (mean = 0.42).

Table 3

R&D, exports, and informal competition status by industry

Industry	ISIC code	Internationally-recognized quality certification (%)	R&D (%)	Exports (%)	Informal competition (mean)
Food and beverages	15	24.97	14.13	24.37	1.10
Tobacco	16	0	0	0	0.67
Textiles	17	14.75	10.11	27.13	1.36
Garments	18	14.19	8.75	38.74	1.11
Leather	19	24.44	12.09	39.13	1.43
Wood	20	7.89	7.08	36.84	1.31
Paper	21	17.95	10	12.2	0.85
Publishing, printing and reproduction of recorded media	22	14.94	12.22	20.65	1.70
Coke, refined petroleum products and nuclear fuel	23	50	25	33.33	1.08
Chemicals and chemical products	24	35.73	26.78	33.05	1.26
Rubber and plastics	25	32.79	11.29	31.06	0.94
Non-metallic mineral products	26	21.47	15.85	24.5	1.36
Basic metals	27	39.13	13.68	28.42	1.36
Fabricated metal products	28	22.99	15.47	20.49	1.09
Machinery and equipment	29	14.38	10.69	22.64	1.11
Office, accounting and computing machinery	30	0	0	0	1.50
Electrical machinery	31	39.7	22.22	46.1	0.81
Radio, television and communication equipment and	32	50	15.38	62.26	0.42

apparatus					
Medical, precision and optical instruments, watches and clocks	33	40	20	38.46	0.71
Motor vehicles, trailers and semi-trailers	34	32.26	25.81	40.63	0.78
Other transport equipment	35	12.5	25	25	1.13
Furniture	36	14.55	9.09	24.78	1.07
Recycling	37	2.78	0	8.11	0.86

Notes:

ISIC: International standard industrial classification, following International Standard Industrial Classification of All Economic Activities Revision 3.1 (United Nations Statistical Division, 2002)

Source: own calculation

Table 4 reports the descriptive statistics of variables in the analysis. The descriptive analysis reveals that more than 24% of the firms in the sample had internationally-recognized quality certifications while only 14% of the sample firms conducted R&D activities. Besides, more than 30% of the firms reported exporting activities. On average, the competition from the informal sector perceived by the firms in the sample is 1.12 on the 0-4 scale.

Table 4

Descriptive statistics

Variable	Observations	Mean	S.D.	Min	Max
International standard certification	4,372	0.241	0.428	0	1
R&D	4,453	0.140	0.347	0	1
Exports	4,504	0.302	0.459	0	1
Informal competition	4,415	1.124	1.188	0	4
Foreign ownership	4,139	10.433	27.506	0	100
Firm age	4,528	2.750	0.653	0	4.382
Firm size	4,530	3.915	1.477	0	9.903

Source: own calculation

Table 5 presents the correlation matrix. All the correlations are smaller than 0.5 in magnitude. Thus, collinearity is not a significant issue in our analysis (Dormann et al., 2013).

Table 5

Correlation matrix

Variable	1	2	3	4	5	6	7
1. International standard certification	1						
2. R&D	0.2399***	1					
3. Exports	0.3420***	0.1716***	1				
4. Informal competition	-0.0635***	0.0246	-0.0607***	1			
5. Foreign ownership	0.2191***	0.0947***	0.3373***	-0.0888***	1		
6. Firm age	0.1871***	0.0595***	0.0744***	-0.0131	-0.0491***	1	
7. Firm size	0.4994***	0.2597***	0.4469***	-0.0571***	0.3021***	0.1684***	1

Notes:

\*  $p < .10$ ; \*\*  $p < .05$ ; \*\*\*  $p < .01$

Source: own calculation



## 4.2. Empirical results

Table 6 displays the results of the MLM estimation of the possibility to adopt international standard certification. Model 1 presents the results of the baseline regression with only control variables. Models 2, 3, and 4 present the estimation results for the impacts of R&D, exports, and international competition on the propensity to acquire international standard certificates respectively. Finally, Model 5 shows the full model with three explanatory variables of interest. The likelihood-ratio test results as reported in Table 6 suggest that the multilevel mixed effects logit model is more effective than the conventional logistic regression in working with the multilevel characteristic of the data set.

Hypothesis 1 predicts that firms with R&D activities will have more tendency to adopt international standard certification. The *R&D* coefficients are positive and statistically significant at the one percent level in both Models 2 and 5. This result provides indicative support for Hypothesis 1. The result is in line with Mangiarotti and Riillo (2013) that also found that R&D intensity is positively associated with the propensity of ISO 9000 certification in the manufacturing industries. This finding verifies the theoretical arguments on the complementary relationship between R&D and adopting ISO 9000 (Blind & Hipp, 2003). In particular, firms with R&D activities can access better information and have more understanding of the role of adopting international standard certificates so that they can implement international standards more easily (Blind & Hipp, 2003; Mangiarotti & Riillo, 2013; Wu et al., 2007).

Hypothesis 2 states that firms participating in the export market will have more tendency to adopt international standard certification. The *Exports* coefficients are positive and statistically significant at the one percent level in both Models 3 and 5, delivering strong support for Hypothesis 2. The finding is consistent with those of previous studies (e.g. Fikru, 2014a, 2014b, 2016; Pekovic, 2010). The result validates the theoretical arguments on the signaling perspective indicating that firms with international standard certification can better inform the product quality with the international markets (Grolleau et al., 2007; Pekovic, 2010). The result may also highlight that firms in developing countries like ASEAN are under pressure to meet the requirements of the international markets, so they have a higher propensity to adopt international standards (Fikru, 2014a, 2016).

Hypothesis 3 states that informal competition leads to a higher possibility to adopt international standard certification. However, the *Informal competition* coefficients are insignificant in both Models 4 and 5. Thus, this result does not support Hypothesis 3. There are several possible explanations as to why this could be so. First, in line with the explanation of Fikru (2014a), some industries have inherent barriers due to competition from the informal sector. In particular, the informal sector has many difficulties engaging in industries that require large capital, resources such as pharmaceuticals or machinery. As a result, firms in these industries do not face intense competition from informal businesses. Consequently, they do not under much pressure to adopt international standard certification to differentiate from the informal sector. Second, some sectors with easy access for informal businesses such as textiles, leather, food and beverages show high competition from the informal sector (as can be seen from Table 3). However, formal firms might not pay much attention to international standards as the important strategy to differentiate themselves from informal ones, which leads to the insignificant impact of informal competition.

Regarding control variables, we find that the likelihood of adopting international standard certificates increases with firm age, firm size, and is greater in firms with more foreign ownership.

Table 6

## Regression results

	Model 1	Model 2	Model 3	Model 4	Model 5
Fixed effects					
R&D		0.766*** (0.126)			0.743*** (0.131)
Exports			0.771*** (0.106)		0.779*** (0.111)
Informal competition				-0.024 (0.044)	-0.025 (0.045)
Foreign ownership	0.011*** (0.002)	0.012*** (0.002)	0.008*** (0.002)	0.012*** (0.002)	0.008*** (0.002)
Firm age	0.350*** (0.087)	0.379*** (0.089)	0.320*** (0.088)	0.350*** (0.088)	0.344*** (0.092)
Firm size	1.011*** (0.043)	0.952*** (0.044)	0.937*** (0.044)	1.015*** (0.044)	0.885*** (0.045)
Constant	-7.250*** (0.560)	-7.285*** (0.589)	-7.086*** (0.533)	-7.232*** (0.567)	-7.092*** (0.568)
Random effects					
Constant for country effects	1.461 (0.961)	1.654 (1.087)	1.243 (0.848)	1.469 (0.969)	1.423 (0.970)
Constant for industry effects	0.637 (0.184)	0.575 (0.171)	0.716 (0.199)	0.676 (0.195)	0.689 (0.199)
ICC (Country)	0.271	0.300	0.237	0.270	0.263
ICC (Industry)	0.389	0.404	0.373	0.395	0.391
Wald $\chi^2$	707.1	703.73	725.8	690.67	704.43
Prob > $\chi^2$	0.0000	0.0000	0.0000	0.0000	0.0000
	LR test vs. logit model: $\chi^2 = 272.93$	LR test vs. logit model: $\chi^2 = 257$	LR test vs. logit model: $\chi^2 = 271.02$	LR test vs. logit model: $\chi^2 = 267.46$	LR test vs. logit model: $\chi^2 = 249.73$
	Prob >= $\chi^2 =$ 0.0000	Prob >= $\chi^2 =$ 0.0000	Prob >= $\chi^2 =$ 0.0000	Prob >= $\chi^2 =$ 0.0000	Prob >= $\chi^2 =$ 0.0000
Observations	3,989	3,930	3,963	3,889	3,811

Notes:

Standard errors in parentheses. \*  $p < .10$ ; \*\*  $p < .05$ ; \*\*\*  $p < .01$ 

Source: own calculation

### 4.3. Robustness checks

To test the robustness of our findings, we consider the PSM method to account for the possible endogeneity resulting from selection bias. More specifically, it is possible that firms adopting international standard certification choose to perform R&D activities, export, and face informal competition more than those without certification adoption. Therefore, PSM can address this issue by reconstructing counterfactuals using observational data, where a propensity score can be defined as “the probability of study participants receiving a treatment based on observed characteristics” (Li, 2013, p. 5).

PSM is carried out in two steps: (i) estimating propensity scores and (ii) estimating average treatment effect on the treated (ATT) with the “*teffectspsmatch*” procedure in Stata (Li, 2013; StataCorp, 2017). First, propensity scores are estimated, usually by a logit/probit regression. Following Caliendo and Kopeinig (2008, p. 38), “only variables that influence simultaneously the participation decision and the outcome

variable should be included”, so the list of covariates include *Foreign ownership*, *Firm age*, *Firm size*, *Industry dummies*, *Country dummies*. Table 7 presents the estimation of the propensity scores.

Table 7

Estimation of the propensity scores

	Model 6	Model 7	Model 8
	R&D	Exports	Informal competition
Foreign ownership	-0.002	0.021***	-0.006***
	(0.002)	(0.002)	(0.001)
Firm age	0.132	0.217***	-0.114*
	(0.088)	(0.075)	(0.062)
Firm size	0.512***	0.656***	-0.038
	(0.038)	(0.034)	(0.027)
Industry dummies	Included	Included	Included
Country dummies	Included	Included	Included
Constant	-4.724***	-4.779***	1.097***
	(0.747)	(0.572)	(0.423)
LR $\chi^2$	561.59	1234.74	575.3
Prob > $\chi^2$	0.0000	0.0000	0.0000
Number of observations	3,930	3,963	3,889

Notes:

Standard errors in parentheses. \*  $p < .10$ ; \*\*  $p < .05$ ; \*\*\*  $p < .01$

Source: own calculation

Second, we estimate the average treatment effect on the treated (ATT), defined as “the average difference that would be found if everyone in the treated group received treatment compared with if none of these individuals in the treated group received treatment” (Li, 2013, p. 3). Table 8 presents the PSM results. We find the positive impact of R&D and exporting activities on international standard certification adoption, while informal competition does not impact such adoption behavior. These results are similar to those found in the main analysis, which highlights the robustness of our findings.

Table 8

PSM results

	ATT
	International standard certification adoption
R&D	0.153***
	(0.054)
Exports	0.131***
	(0.022)
Informal competition	0.017
	(0.016)

Notes:

Standard errors in parentheses. \*  $p < .10$ ; \*\*  $p < .05$ ; \*\*\*  $p < .01$

Source: own calculation

## 5. CONCLUSIONS AND IMPLICATIONS

By utilizing a survey of appropriately 4,000 firms from eight ASEAN countries in 2015-2016, this paper investigates whether R&D, exports, and competition affect the probability to adopt international standard certification. The empirical evidence shows that both R&D and exports exert a positive impact

on the propensity to adopt internationally-recognized quality certificates. Besides, competition from the informal sector does not affect the possibility to adopt international standards.

Some implications for policymakers emerge from this study. First, the positive influence of R&D on internationally-recognized quality certification suggests that investing in R&D is vital to create a favorable condition for adopting internationally-recognized quality certification. The government should encourage private sector innovative activities via such tools as government support for firms' R&D, tax incentives for R&D activities, and patent protection (Westmore, 2014).

Second, the positive role of exports may suggest that participating in the export market is important to meet international standards. Thus, there should be policies to promote exports such as signing free-trade agreements, providing local producers that would like to start exporting with informational and legal support.

## ACKNOWLEDGEMENT

The author is thankful to University of Economics Ho Chi Minh City (UEH) for financial support to carry out this research.

## REFERENCES

- ADB Institute. (2014). *ASEAN 2030 Toward a Borderless Economic Community*. Retrieved from <https://www.adb.org/sites/default/files/publication/159312/adbi-asean-2030-borderless-economic-community.pdf>
- Anzola-Román, P., Bayona-Sáez, C., & García-Marco, T. (2018). Organizational innovation, internal R&D and externally sourced innovation practices: Effects on technological innovation outcomes. *Journal of Business Research*, *91*, 233-247. <https://doi.org/10.1016/j.jbusres.2018.06.014>
- Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99-120.
- Blind, K., & Hipp, C. (2003). The role of quality standards in innovative service companies: An empirical analysis for Germany. *Technological Forecasting and Social Change*, *70*(7), 653-669.
- Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of economic surveys*, *22*(1), 31-72. <https://doi.org/10.1111/j.1467-6419.2007.00527.x>
- Cameron, A. C., & Trivedi, P. K. (2009). *Microeconometrics Using Stata*. College Station, TX: Stata Press.
- Cao, X., & Prakash, A. (2011). Growing exports by signaling product quality: Trade competition and the cross-national diffusion of ISO 9000 quality standards. *Journal of policy analysis and management*, *30*(1), 111-135.
- Delmas, M., & Toffel, M. W. (2004). Stakeholders and environmental management practices: an institutional framework. *Business strategy and the Environment*, *13*(4), 209-222.
- Dormann, C. F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., . . . Leitão, P. J. (2013). Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. *Ecography*, *36*(1), 27-46. <https://doi.org/10.1111/j.1600-0587.2012.07348.x>
- Fikru, M. G. (2014a). Firm level determinants of international certification: evidence from Ethiopia. *World development*, *64*, 286-297.
- Fikru, M. G. (2014b). International certification in developing countries: The role of internal and external institutional pressure. *Journal of environmental management*, *144*, 286-296.
- Fikru, M. G. (2016). Determinants of International Standards in sub-Saharan Africa: The role of institutional pressure from different stakeholders. *Ecological Economics*, *130*, 296-307.
- Grolleau, G., Mzoughi, N., & Thomas, A. (2007). What drives agrifood firms to register for an Environmental Management System? *European Review of Agricultural Economics*, *34*(2), 233-255.
- Guler, I., Guillén, M. F., & Macpherson, J. M. (2002). Global competition, institutions, and the diffusion of organizational practices: The international spread of ISO 9000 quality certificates. *Administrative science quarterly*, *47*(2), 207-232.

- Ha, L. T., Thang, D. N., & Thanh, T. T. (2021). Effects of R&D, networking and leadership roles on environmental innovation adoption in Vietnam's SMEs. *Economic Research-Ekonomska Istraživanja*, 1-32.
- Halkos, G., Nomikos, S., & Skouloudis, A. (2021). Revisiting ISO 14001 diffusion among national terrains: panel data evidence from OECD countries and the BRIICS. *Environmental Economics and Policy Studies*, 23(4), 781-803.
- Hudson, J., & Orviska, M. (2013). Firms' adoption of international standards: One size fits all?. *Journal of Policy Modeling*, 35(2), 289-306.
- Intal Jr, P., & Pangestu, M. (2019). Integrated and Connected Seamless ASEAN Economic Community.
- ISO. (2021). Why ISO 9001? Retrieved from <https://www.iso.org/iso-9001-quality-management.html>
- Li, M. (2013). Using the propensity score method to estimate causal effects: A review and practical guide. *Organizational Research Methods*, 16(2), 188-226. <https://doi.org/10.1177/1094428112447816>
- Lira, J. M. S., Salgado, E. G., Beijo, L. A., & Da Silva, C. E. S. (2021). Shedding light on the diffusion of ISO 14001 across Africa, Asia and Oceania. *Journal of Cleaner Production*, 289, 125724.
- Liston-Heyes, C., & Heyes, A. (2021). Is there evidence for export-led adoption of ISO 14001? A review of the literature using meta-regression. *Business & Society*, 60(3), 764-805.
- Mangiarotti, G., & Riillo, C. A. F. (2013). A signalling framework for drivers of ISO 9000 certification in services and manufacturing. *International Journal of Productivity and Quality Management*, 11(3), 287-310.
- Mertzanis, C., & Said, M. (2019). Access to skilled labor, institutions and firm performance in developing countries. *International journal of manpower*.
- OECD. (2019). *Economic Outlook for Southeast Asia, China and India 2019 Towards smart urban transportation*. Paris: OECD.
- Pekovic, S. (2010). The determinants of ISO 9000 certification: A comparison of the manufacturing and service sectors. *Journal of Economic Issues*, 44(4), 895-914.
- Pekovic, S., & Galia, F. (2009). From quality to innovation: Evidence from two French Employer Surveys. *Technovation*, 29(12), 829-842.
- Potoski, M., & Prakash, A. (2009). Information asymmetries as trade barriers: ISO 9000 increases international commerce. *Journal of Policy Analysis and Management*, 28(2), 221-238.
- Siltori, P. F. S., Rampasso, I. S., Martins, V. W. B., Anholon, R., Silva, D., Souza Pinto, J., & Leal Filho, W. (2021). Analysis of the motivations for ISO 9001: 2015 adoption in the Brazilian business context. *Quality Management Journal*, 28(2), 76-85.
- StataCorp, L. P. (2017). *Stata multilevel mixed-effects reference manual release 15*. College Station, TX: Stata Press.
- United Nations Statistical Division. (2002). *International standard industrial classification of all economic activities (ISIC) (Revision 3.1)*: United Nations Publications.
- Westmore, B. (2014). Policy incentives for private innovation and maximising the returns. *OECD Journal: Economic Studies*, 2013(1), 121-163.
- Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*: MIT press.
- World Bank. (2021). About Us. Retrieved from <https://www.enterprisesurveys.org/en/about-us>
- Wu, S. Y., Chu, P. Y., & Liu, T. Y. (2007). Determinants of a firm's ISO 14001 certification: An empirical study of Taiwan. *Pacific Economic Review*, 12(4), 467-487.