

# Adoption of ISO9001 through supply chain in Vietnam : impacts of FDI and product-related environmental regulation

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March 2015

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**Keywords:** ISO 9001, FDI, Product-related Environmental Regulation, Vietnam

**JEL classification:** F18, Q56, D22

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# Adoption of ISO 9001 through Supply Chain in Vietnam: Impacts of FDI and Product-related Environmental Regulation<sup>1</sup>

Hakaru Iguchi, Toshi. H. Arimura, Etsuyo Michida

## *Abstract*

The objective of the present study is to examine the determinants of ISO 9001 certification, focusing on the effect of Product-related Environmental Regulations on Chemicals (PRERCs) and FDI using the answers to several questions in our Vietnam survey conducted from December 2011 to January 2012. Our findings suggest that PRERCs may help with the improvement in quality control of Vietnamese firms. If Vietnamese manufacturing firms with ISO 9001 certification are more likely to adopt ISO 14001, as well as firms in developed countries, our results indicate that the European chemical regulations may assist in the reduction of various environmental impacts in Vietnam. In addition, we found that FDI promotes the adoption of ISO 9001. If FDI firms in Vietnam certify ISO 14001 after the adoption of ISO 9001, as in the case of Malaysia and the developed economies, FDI firms may also be able to improve environmental performance as a result of ISO 14001.

## **1. Introduction**

Vietnamese firms entered the global market by joining the Association of Southeast Asian Nations (ASEAN) in 1995 and the World Trade Organization (WTO) in 2007; they have therefore had to alter their thinking with regard to quality standards and methods of production (McCornac & Hong Bich 2006). Generally, it is likely that firms in developing countries such as Vietnam are located in the upstream of Global Supply Chain (GSC). Therefore, they tend to receive requests about product quality from numerous downstream customers in developed countries (Albuquerque et al. 2007). However, it has been indicated that there are cultural, geographic and linguistic barriers between developing countries and developed countries that create information asymmetries (Potoski & Prakash 2009). A certificate of quality control such as the ISO 9001 standard can reduce these information asymmetries. In other words, when firms in developing countries are granted the ISO 9001 certificate, these information asymmetries, which obstruct the international trade in supply chains, could decrease. Therefore, ISO 9001 certification helps firms fulfill customer requirements and acts as an advertisement in the marketplace. As a result, these certified firms have a competitive advantage.

From the viewpoint of leading firms in developed countries, information asymmetries cause severe problems. Because they have integrated their network for procuring, production and

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distribution globally, it is difficult to observe the actual qualifications of their suppliers. If suppliers adopt poor management systems, this could lead to low-quality supply articles. Then, there will be problems for downstream customer products and services (Albuerque et al. 2007). Therefore, managers in leading global firms are increasingly concerned about the product quality of their suppliers as well.

Recently, it has been indicated that Product Related Environmental Regulation on Chemicals (PRERCs) such as REACH<sup>2</sup> and RoHS<sup>3</sup> have an impact on firm behavior in developing countries in terms of the supply chain (Arimura et al. 2014). Because PRERCs regulate chemical substances and the chemicals contained in products, subjected firms that export to regulated areas have to address these regulations throughout their supply chain. Therefore, it is important to examine what influence these regulations have on firms in developing countries in terms of the supply chain.

The objective of the present study is to examine the determinants of ISO 9001 certification of Vietnamese firms, focusing on the effect of PRERCs. We also examine the role played by FDI in ISO 9001 certification. Developing countries have depended on technology transfers from developed countries as a result of FDI. For these countries, FDI is generally the primary means of technology acquisition. Several studies examine this relationship between FDI and technology adoption in developing countries (Aitken & Harrison, 1999). Moreover, recent studies have thoroughly investigated the effect of FDI on ISO 9001/14001 certification in developing countries (Tambunlertchai et al. 2013; Arimura et al. 2014). We thus examine whether FDI affects ISO 9001 adoption in Vietnamese firms.

Moreover, we also analyze the effect of the export experience of the firms. The existing literature has discussed the relationship between ISO 9001 certification and exports. For example, Corbett (2006) found that exports play a significant role for firms in the decision to adopt ISO 9001. Moreover, Albuquerque et al. (2006) indicated that bilateral trade has a strong effect on the diffusion of ISO 9001 among states. Given that promoting export industries is one of the growth strategies for developing countries (World Bank, 1993), we assume that if firms in developing countries export goods or services to other countries, they also import some management practices from those countries. In other words, because firms with export experience in developing countries face more strict quality assurance challenges, these firms are more likely to seek ISO 9001 certification to increase exports.

This study empirically examines these relationships using the answers to several questions in our survey conducted in Vietnam from December 2011 to January 2012. This survey collects unique data for 63 provinces in Vietnam, and we received 1055 responses, which corresponded to a

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<sup>2</sup> Regulation of the European Parliament and the Council on the Registration, Evaluation, Authorization, and Restriction of Chemicals

<sup>3</sup> Directive of the European Parliament and the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment

response rate of 8.8%.

This paper proceeds as follows. First, we detail ISO 9001 in ASEAN countries, especially in Vietnam (Sect. 2). Second, we review the literature on ISO 9001 certification (Sect. 3). Third, we discuss our survey design, including the construction of our sample and dataset (Sect. 4), as well as the explanatory variables in our analysis (Sect. 5). We conclude with recommendations for the future study of quality management standards (Sects. 6).

## **2. ISO 9001 in Vietnam**

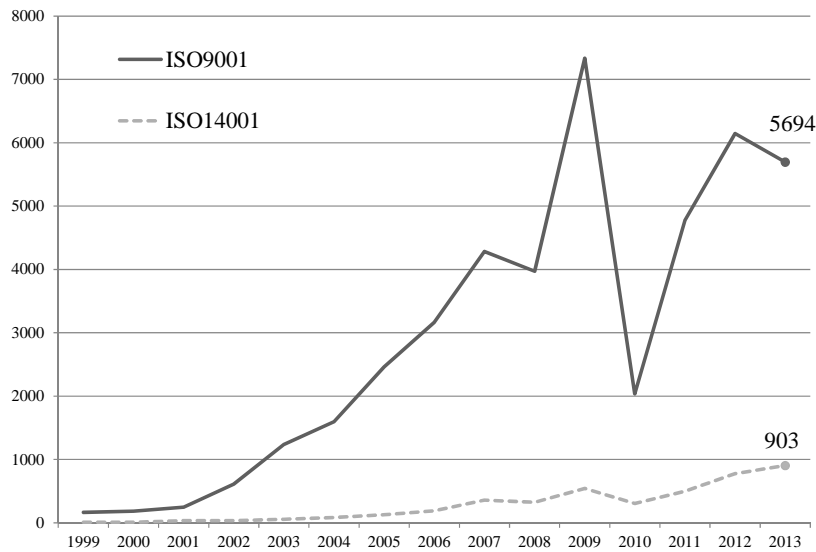
ISO 9001 was published by the International Organization for Standardization (ISO) in 1987. It specifies the requirement for a quality management system to demonstrate that organizations can provide products that consistently meet customer and applicable regulatory requirements (ISO 2002). An accredited third party completes the audit to ensure that the firm system meets the ISO requirements. These audits are renewed every three years.

This standard has been increasingly used worldwide. In 2013, there were 1,129,446 certified organizations in the world (ISO, 2013). The widespread adoption of ISO 9001 resulted from the extension of the certification to a wide variety of industrial sectors, products and services. The strong recommendation for the certification by some leading firms also contributes to the diffusion of this standard (Heras et al. 2001).

In ASEAN countries, the number of certifications of ISO 9001 has increased in the last ten years. In particular, this trend is remarkable in Malaysia and Thailand. Among ASEAN countries, Vietnam ranks 5th in ISO 9001 certification, accounting for approximately 12.7% of all certificates held by these countries in 2013 (ISO 2013). The existing literature has indicated that ISO 9001 certification could reduce the overall cost of ISO 14001 certification, which is the international standard of the environmental management system published by the ISO in 1996 (Grolleau, Mzoughi and Pekovic 2007). Then, firms with ISO 9001 certification can obtain the ISO 14001 certificate more easily than firms without ISO 9001 (Arimura et al. 2014). Among ASEAN countries, ISO 14001 adoption has also tended to increase. However, fewer firms in Vietnam have ISO 14001 certification, as Vietnam ranks 5th in ISO 14001 certification in this region, with 903 certifications (Table 1). Table 2 indicates that the sample characteristics of our sample are similar to those of the ISO survey. In all, 8.5% of the firms have adopted ISO 14001, whereas 24.7% of the firms have adopted ISO 9001. Furthermore, 17.7% have adopted only ISO 9001, while 7.0% of the firms have adopted both ISO 14001 and ISO 9001. These results indicate that firms in Vietnam that adopt ISO 9001 do not necessarily adopt ISO 14001.

**Table 1**

**The number of ISO 9001 and 14001 certifications in Vietnam**



Source: ISO Survey (ISO 2013)

**Table 2 ISO 9001/14001 Adoption in Vietnamese firms**

	Adopt ISO 9001	Not Adopt ISO9001	Total
Adopt ISO 14001	74	16	90
Not Adopt 14001	187	778	965
Total	261	794	1055

### 3. Literature review

The determinants of ISO 9001 adoption have been examined in numerous studies. They investigated the external factors and internal factors. First, neo-institutional theory (DiMaggio and Powell 1991) indicates that coercive, normative, and mimetic forces lead to the diffusion of ISO 9001. For example, the existing literature suggests that Multinational Enterprises (MNEs) function as one of the coercion sources (Javorcik & Spatareanu 2005). Recently, MNEs have become increasingly dependent on the global supply chain, and their suppliers need to meet the quality standards that they seek (Guler et al. 2002). MNEs are likely to recommend that their suppliers adopt ISO 9001 to guarantee product quality. Government agencies are an additional important coercive source. They could facilitate changes in firm behavior by providing incentives or administering punishment. For example, Cole (1985) indicated that the Japanese government agencies played an important role in the diffusion of the quality circle. In addition, as consumers of goods and services, they could apply coercive pressure on their suppliers through the procurement process (Guler et al.

2002). Existing studies also found that the same mechanism would work in the diffusion process among states, indicating that ISO 9001 spread within Europe and then to other countries because European firms pressured their foreign suppliers and trading partners to obtain certification (Casper and Hancke 1999, Corbett 2006).

Second, the literature focusing on internal factors found that firm attributes are associated with ISO 9001 adoption. In particular, the year of firm establishment and the number of employees are typical determinants. Therefore, it is recognized that in Vietnamese firms, these factors facilitate ISO 9001 certification as well.

Additionally, some studies have focused on the benefits of ISO 9001 implementation (Naveh & Marcus 2004; Naveh et al. 2004; Terlaak & King 2006). In these studies, productivity, export performance, quality improvement, and employee motivation are associated with ISO 9001 certification. However, these studies indicate mixed results (Potoski & Prakash 2006). For example, Hudson and Jones (2003) found that product quality is increased by ISO 9001 certification. On the other hand, Terziovski et al. (1996) found that there are no significant positive relationships between ISO 9001 adoption and organizational performance. These results indicated that ISO 9001 adoption is just a first step and that firms have to undertake further efforts to achieve actual quality improvement (Braley 1994, Frehr 1997).

#### **4. Data**

A team from IDE-JETRO, including the authors of this paper, implemented the survey in Vietnam. We conducted several interviews with manufacturing firms in Vietnam before developing the main content of the questionnaire. In addition, the Vietnam Chamber of Commerce and Industry administered the questionnaire and translated it into Vietnamese. In the mail survey, we targeted the sectors, such as the manufacturing and commercial sectors, that are required to manage chemical contents in products. Geographically, the survey covered 63 provinces in Vietnam. We sent the questionnaire to 11,978 firms chosen from a list of firms from the General Department of Taxation, which contained 1,954 foreign-owned firms and 10,024 private domestic firms. In our survey, foreign-owned firms are defined as all firms receiving Foreign Direct Investment (FDI) for our purposes. Thus, in our survey, FDI firms include both 100% foreign-owned firms and joint ventures between local firms and MNEs. Hence, we call these firms FDI firms. We sent the questionnaire to all FDI firms and 70% of the private firms that were randomly selected. We conducted the survey from December 2011 to January 2012. First, we mailed the questionnaire, and then we made follow-up phone calls if necessary. We received responses from 1,055 firms; thus, the response rate was 8.8%.

How does our sample represent the distribution of Vietnamese firms? While 16.3% of questionnaire recipients were FDI firms, the figure was 31.9% in our sample. Thus, the share of FDI



firms is smaller in our sample than in the population. The responding firms are somewhat concentrated in the major two cities. We received 190 responses from firms in Hanoi and 179 from Ho Chi Minh City. Table 3 indicates the distribution of firms by industry in our sample compared with the structure of the industries in Vietnam according to GDP.

**Table 3 The Distribution of the Industrial sector**

	sample (% of firms)	Overall economy (% of GDP)
Food	9.3	17.9
Beverage	0.7	1.6
Tobacco	0.5	0.8
Textile	4.4	4.1
Apparel	25.8	4.1
Leather	3.8	3.4
Wood	12.2	1.7
Paper	0.5	2.0
Printing	0.5	0.7
Petroleum products	0.3	3.7
Chemicals	0.9	4.5
Pharmaceutical	0.6	1.2
Rubber/Plastic	5.0	4.4
Non-metallic mineral	0.9	5.3
Basic Metals	0.9	4.0
Fabricated metal	1.5	5.7
Computer/electronic	1.5	5.6
Electrical	2.1	3.3
Machinery	1.2	1.0
Motor Vehicle	0.4	2.8
Other transport	0.4	3.8
Furniture	2.9	2.8
Other manufacturing	12.5	2.8
Repair	0.3	1.9
Other	11.7	10.9

Source: General Statistics Office of Vietnam, Data downloaded on March 10, 2012, from [http://www.gso.gov.vn/default\\_en.aspx?tabid=470](http://www.gso.gov.vn/default_en.aspx?tabid=470).

Note: Other sectors, including mining, electricity and other services, are not directly comparable between the two data sources and have been excluded.

## 5. Explanatory Variables

Various factors may influence the adoption of ISO 9001. Summary statistics and a correlation matrix of the variables that may influence the adoption of this standard are displayed in Tables 7 and 8, respectively. Because our main interest is the effects of PRERs on chemical substance use in manufactured products, we exclude firms in the food and beverage industry from the sample for our estimations. Thus, the sample size in this study is 270.

### **Requests from Customers**

Because of PRERCs, firms that export their products to the EU market need to manage the chemicals that are used in their products. Thus, these firms must request that their suppliers comply with regulations on chemical substance use, and suppliers in developing countries are not exempt from such requests. Thus, firms that sell their products in the EU market are likely to request that their suppliers in developing countries comply with regulations on the quality of their products. Arimura et al. (2014), using a detailed survey in Malaysia, found that as a result of PRERCs such as REACH and RoHS, the adoption of ISO 9001 is promoted by customer requests. Corbett and Kirsch (2000) conducted a series of interviews with EU and US firms and revealed that pressure from customers is frequently cited as a reason to seek ISO 9001 certification. In our survey, we asked “Why did you think you needed to meet the chemical regulations/private requirement?” The respondents answered that avoiding rejection of products by customers or buyers was the most important reason (Table 4). Given that the ISO 9001 series was published in an attempt to facilitate complying with a set of customer quality requirements (Corbett & Kirsch 2000), we expect that firms that have customers who require them to comply with regulations on chemical substance use will adopt ISO 9001.

To capture the effects of REACH and/or RoHS, we use the following questions. First, we asked “Have you ever needed or been asked to take measures to address chemical substances in your product after 2000?” Second, we asked, “Who required you to take measures to address chemicals in your product?” The variable that captures the effect of PRERCs is 1 if respondents are required by their customers to take measures to address chemicals in their products; otherwise, it is 0.

Until recently, firms have focused on their internal operations; however, they are increasingly recognizing the need to manage risks and opportunities throughout the supply chain. In the case of MNEs, operations are spread across the globe. MNEs may need to manage the quality of their suppliers in developing countries. Therefore, firms that supply their main products to MNEs are expected to adopt ISO 9001. In our analysis, we use a variable to capture whether firms sell their products to global supply chain of MNEs. In our sample, 27.8% of the firms belong to a global value chain. To capture the effects of the GSCs, we use a variable that assumes a value of 1 if the respondents sell their main product to the GSC and a value of 0 otherwise.

**Table 4**

Why did you think you needed to meet the chemical regulations/private requirements?

	Freq.	Percent
To avoid rejection of your products by customs or buyers	139	41.25
To be in full compliances with domestic regulations/require	84	24.93
To increase export	40	11.87
To improve the brand image	20	5.93
To keep the current transaction relationship	18	5.34
To increase domestic sales	18	5.34
To develop new transaction relationship	10	2.97
To attain higher sales price	4	1.19
Others	4	1.19
Total	337	100

### **Firm Characteristics**

In the adoption of ISO 9001, several firm characteristics are important factors. Small firms generally have a small number of employees. However, to manage the PDCA cycle, firms need to have a sufficient number of employees. In other words, large firms may have an advantage in complying with the ISO 9001 standard over small firms. This is why economies of scale play a key role in ISO 9001 certification. In our sample, the average number of employees is approximately 630. We also use a variable that captures the number of years that a firm been established because we assume that some old firms that have developed work routines may adopt the ISO 9001 standard more easily than younger firms. In our sample, the average firm age is 11.5 years.

### **Foreign Direct Investment**

An additional focus of our research is the role played by FDI in ISO 9001 certification. Many developing countries, such as Vietnam, have depended on the technology transfer from developed countries as a consequence of FDI. For developing countries, FDI is generally the primary means of technology acquisition. This relationship between FDI and technology adoption in developing countries has been examined in the international trade/investment literature (Aitken & Harrison, 1999). Moreover, recent studies have thoroughly investigated the effect of FDI on ISO 9001/14001 certification in developing countries. For instance, Tambunlertchai et al. (2013) suggested that FDI is an important factor determining ISO 14001 adoption in Thailand. We therefore examine whether FDI affects ISO 9001 adoption in Vietnam.

In our analysis, we examine the relationship between ISO 9001 certification and FDI in several ways. First, we create a variable that captures whether respondents are an FDI company using the question “What is your company’s business registration form?” Of the respondents, 8.2% are FDI

firms. Second, we create the variable that assumes a value of 1 if the respondent’s current legal form is 100% foreign investor capital and 0 otherwise. In addition, focusing on the country of the investors, we create the variable that assumes a value of 1 if the FDI originated in Japan and a value of 0 otherwise. Table 5 displays the descriptive statistics of the answer to the above question.

**Table 5**

If you are an FDI Company, what country are the investors from?

	Freq.	Percent
Korea	106	32.1
Taiwan	86	26.1
Japan	35	10.6
China	33	10.0
EU	28	8.5
ASEAN	26	7.9
U.S.	11	3.3
Others	3	0.9
India	2	0.6
Total	330	100

### **Export/ Trade**

As mentioned above, it is difficult for the customers abroad to observe supplier product quality in developing countries. However, from a signaling perspective, it is possible that firms with ISO 9001 certification are capable of providing information, which means that they could meet their customers' qualitative expectations. In other words, with this standard, firms' unobservable characteristics can be visible to the public. Therefore, ISO 9001 certification may play a strong role in signaling unobservable characteristics, and it may also increase firm legitimacy and customer trust (Zucker 1986). As a result, this certification helps firms gain entry to the global market. Anderson et al. (1999) found that US firms tend to seek ISO 9001 certification if they had experience exporting to the EU market. In this study, we also assumed that the more experienced export firms are more likely to adopt ISO 9001 to increase their exports. In our sample, 74.1% of the firms export their products.

To construct the variables that capture the effects of the export, we use the following questions. First, we asked, “What proportion of sales did you export last year?” The variable then assumes the value 1 if exports were 100% of sales and a value of 0 otherwise. Second, we created the variable that focuses on the region to which the respondents export, such as the EU and OECD countries.

### **R&D**

Attitudes toward innovation may also affect the decision to pursue ISO 9001 certification. In general, the more innovative firms are, the more likely they are to adopt ISO 9001. Given that ISO

9001 was initially adopted in developed countries, firms in developing countries with R&D capabilities are expected to more likely proactively adopt ISO 9001 than firms without R&D capabilities. Furthermore, we expect firms with R&D capabilities in developing countries to have innovative capabilities for advanced practices that are consistent with ISO 9001. Thus, we investigate whether firms with R&D capabilities in Vietnam are more likely to adopt ISO 9001. To measure R&D capabilities, we use the answer to the question “Do you conduct R&D activities?” The variable that captures respondent R&D activities assumes a value of 1 if respondents answer “Yes” to the above question and a value of 0 otherwise.

## 6. Model & Estimation Results

### 6.1 Model

Our variable of interest is ISO 9001 adoption. Let  $ISO9_i^*$  be the net benefit of adopting ISO 9001.  $ISO9_i^*$  is determined by

$$ISO9_i^* = \delta Z_i + \varepsilon_i \quad (2)$$

where  $Z_i$  is a set of exogenous variables explaining ISO 9001 as mentioned above and  $\varepsilon_i$  is an idiosyncratic error. The variable  $ISO9_i^*$  is not observed. What we actually observe is whether the firm adopts ISO 9001 ( $ISO9_i$ ). We assume that  $ISO9_i$  equals one if  $ISO9_i^* > 0$  and that it equals zero otherwise. That is, the firm adopts ISO 9001 if the net benefit of doing so is greater than or equal to zero.

### 6.2 Estimation Results

The estimation results of the ISO 9001 equations are displayed in Table 6. From equations (1) to (4), we yield estimations for a sample consisting of all manufacturing sectors except the food and beverage industries. The coefficients for the variable that captures the effects of PRERCs are positive and statistically significant. This result is consistent with the findings for Malaysian firms (Arimura et al. 2014) and indicates that Vietnamese firms are more likely to adopt ISO 9001 in response to REACH or RoHS. Thus, there is an impact of REACH or RoHS on ISO 9001 adoption. In other words, if customers require firms to comply with regulations regarding chemical use, the firms are inclined to adopt ISO 9001, as indicated by the positive and significant coefficient for this variable in all models.

We are also interested in the spillover of quality management practices from MNEs to local firms. Specifically, we examine whether firms that sell their products to GSC of MNEs induce ISO 9001 adoption in Vietnamese firms. In all specifications, the coefficient for this variable is negative and significant. This result appears to be somewhat counterintuitive. However, this result can be interpreted as evidence that MNEs have their own procurement standard that includes a quality standard and that they request their suppliers in Vietnam to meet their own standard. If transactions with such MNEs comprise a large portion of business, these suppliers do not necessarily obtain the

ISO 9001 certificate.

The coefficients for the number of employees are also positive and significant in the four specifications. This result indicates that larger firms are more likely to adopt ISO 9001, which is consistent with the findings of Guler et al. (2002). The coefficient for the year of the firm's establishment is also significant in all specifications. This result suggests that older firms consider quality management to be more important than younger firms. R&D activity is also important in explaining the decision to obtain the ISO 9001 certificate. This result suggests that the more innovative firms are, the more likely they are to adopt ISO 9001.

The coefficients for the variables related to export are not significant. For example, the variables that capture export experience are not significant. Moreover, the variable focusing on the region to which the respondents export, such as EU and OECD countries and countries where many firms with ISO 9001 certification exist, is also not significant.

FDI, which involves individuals or firms from another country, promotes the adoption of ISO 9001, as indicated by the positive and significant coefficient for the variable that captures whether firms are FDI firms in equations (1) and (2). However, the coefficient of a dummy variable that we introduce in equations (3) and (4), which captures the FDI respondents' legal form, is not significant. These results indicate that the portion of ownership in FDI firms is not important in explaining the decision to obtain ISO 9001 certification by Vietnamese firms. The variable that focuses on whether investors are from Japan is positive and significant. Thus, these results indicate that FDI from Japan promotes the introduction of quality management systems in developing countries.

Some coefficients for the industrial dummy variables are significant and positive. For example, in the chemical and non-metallic mineral industry, firms are likely to adopt ISO 9001. However, the coefficients for the variables that capture the textile, apparel and wood industries are negative and significant. This result indicates that in these industries, firms are less likely to adopt ISO 9001.

**Table 6**

**Probit Estimation Results**

	(1)	(2)	(3)	(4)
<i>Request from Customers</i>				
Firms have needed to take measures about chemical substances in your product after 2000 (d)	0.644 *** (0.218)	0.639 *** (0.219)	0.616 *** (0.212)	0.610 *** (0.213)
Firm supply their main product for global supply chains	- 0.438 * (0.246)	- 0.472 * (0.241)	- 0.479 * (0.251)	- 0.514 ** (0.248)
<i>Firm Characteristics</i>				
R&D activities (d)	0.980 *** (0.24)	0.977 *** (0.238)	0.878 *** (0.236)	0.873 *** (0.234)
Firm Age	0.063 *** (0.025)	0.062 ** (0.025)	0.055 ** (0.023)	0.054 ** (0.023)
The number of employee (log)	0.223 *** (0.074)	0.216 *** (0.075)	0.229 *** (0.078)	0.223 *** (0.079)
<i>FDI</i>				
Whether firm is FDI or not (d)	1.389 *** (0.478)	1.388 *** (0.483)		
Firm's current legal form is 100% capital			- 0.351 (0.247)	- 0.362 (0.248)
FDI origin is Japan (d)	1.253 ** (0.513)	1.294 *** (0.504)	1.27 ** (0.542)	1.312 ** (0.532)
The category of firm is headquarter (d)	- 0.02 (0.251)	- 0.014 (0.25)	- 0.125 (0.245)	- 0.122 (0.243)
<i>Export</i>				
Expot 100%	- 0.065 (0.23)	- 0.100 (0.233)	- 0.027 (0.234)	- 0.058 (0.237)
The number of years firm start selling their product for foreign markets	- 0.017 (0.027)	0.017 (0.027)	- 0.018 (0.026)	- 0.018 (0.025)
Export to EU market	- 0.149 (0.294)	- 0.306 (0.286)	- 0.038 (0.295)	- 0.191 (0.287)
Export to ISO9001 rich country (d)	- 0.055 (0.244)		- 0.036 (0.237)	
Export to OECD countries (d)		0.167 (0.242)		0.180 (0.235)
<i>Industrial dummy</i>				
CHEMICAL	0.928 ** (0.425)	0.96 ** (0.423)	0.887 ** (0.416)	0.921 ** (0.414)
TEXT	- 1.348 *** (0.423)	- 1.417 *** (0.419)	- 1.279 *** (0.415)	- 1.347 *** (0.415)
APPAREL	- 0.52 * (0.277)	- 0.537 * (0.276)	- 0.481 * (0.274)	- 0.498 * (0.273)
LEATHER	0.155 (0.578)	0.218 (0.58)	0.209 (0.545)	0.270 (0.548)
WOOD	- 0.752 ** (0.366)	0.736 ** (0.368)	- 0.425 (0.381)	- 0.409 (0.381)
NON METAL	1.339 ** (0.631)	1.372 ** (0.631)	1.161 * (0.638)	1.189 * (0.638)
MACHINERY	- 0.02 (0.512)	- 0.077 (0.51)	- 0.091 (0.537)	- 0.157 (0.533)
FURNITURE	0.089 (0.392)	0.106 (0.404)	0.038 (0.404)	0.058 (0.41)
_cons	- 2.86 (0.503)	- 2.859 (0.505)	- 2.532 (0.470)	- 2.534 (0.475)
wald $\chi^2$	98.82	99.97	86.82	86.92
N	270	270	270	270

Note 1: Standard errors are shown in parentheses.

Note2: \*, \*\*, and \*\*\* imply that the coefficient is significantly different from zero at the 10%, 5%, and 1% levels, respectively.

## 7. Conclusion

Drawing upon a unique survey in Vietnam, we investigated the factors promoting the adoption of ISO 9001, the international standard for quality management, in Vietnam. We found that PRERCs, measured by requests for the use of chemical substances, promote ISO 9001 adoption. The main objective of ISO 9001 is to promote quality control in organizations. Thus, our finding suggests that REACH/RoHS may help with the improvement in quality control of Vietnamese firms. This is an interesting byproduct of the chemical regulations in developed countries.

Our findings have important implications for environmental conservation in Vietnam. Numerous studies on developed economies have revealed that ISO 9001 adoption leads to the adoption of ISO 14001, the international standard for environmental management system, in many organizations. For example, Tambunlertchai et al. (2013) revealed that ISO 9001 adoption is an important factor determining ISO 14001 adoption in Thailand. Recently, Arimura et al. (2014) also found similar evidence for Malaysia. They found that Malaysian firms with ISO 9001 certification are more likely to adopt ISO 14001. Thus, it is possible that the chemical regulations in the EU can indirectly promote the diffusion of ISO 14001 in Vietnam through the adoption of ISO 9001. Potoski and Prakash (2005) found that ISO 14001 helps to reduce emissions as measured by the US Toxic Release Inventory. Further, they found that ISO 14001 improves firm compliance with environmental regulations. The positive environmental impact of ISO 14001 goes beyond this example. Arimura (2008) found that ISO 14001 reduces natural resource usage, solid waste generation and waste effluent water among Japanese manufacturing firms. If a similar mechanism works in Vietnamese manufacturing firms, the European chemical regulations may be assisting in the reduction of various environmental impacts in Vietnam. Unfortunately, the diffusion of ISO 14001 in Vietnam was still in the infant stage in 2011, as indicated in Table 1. Thus, we could not investigate this issue. This is an area for future research.

The role of FDIs in quality management and environmental conservation is worth mentioning. Our findings suggest that FDI firms are more likely to adopt ISO 9001. If FDI firms in Vietnam are going to obtain certification for ISO 14001 after the adoption of ISO 9001, as in the case of Malaysia and the developed economies, FDI firms may be able to improve their environmental performance as a result of ISO 14001 certification. This contradicts, to a certain degree, the traditional criticism of multinational firms for the exploitation of natural resources and the environment in developing economies. However, there is a possibility that FDI firms may be able to contribute to environmental conservation through ISO 14001 adoption. This is also an interesting area for future research.



**Table 7 summary statistics (N=270)**

	Mean	Std. Dev.	Min	Max
<b>Dependent Variable</b>				
Whether firms adopt ISO 9001 or not ( <b>d</b> )	0.26	0.44	0	1
<b>Independent Variable</b>				
<b>PRERCs</b>				
Firms have needed to take measures about chemical substances in your product after 2000 ( <b>d</b> )	0.48	0.50	0	1
Firm supply their main product for global supply chains	0.29	0.46	0	1
<b>Firm Characteristics</b>				
R&D activities ( <b>d</b> )	0.17	0.38	0	1
Firm Age	12.14	9.46	2	56
The number of employee ( <b>log</b> )	5.45	1.81	0.69	9.21
<b>FDI</b>				
Whether firm is FDI or not ( <b>d</b> )	0.04	0.20	0	1
Firm's current legal form is 100% capital	0.36	0.48	0	1
FDI origin is Japan ( <b>d</b> )	0.03	0.16	0	1
The category of firm is headquarter ( <b>d</b> )	0.80	0.40	0	1
<b>Export</b>				
Expot 100%	0.29	0.46	0	1
The number of years firm start selling their product for foreign markets	10.11	6.94	2	46
Export to EU market	0.21	0.41	0	1
Export to ISO9001 rich country ( <b>d</b> )	0.45	0.50	0	1
Export to OECD countries ( <b>d</b> )	0.44	0.50	0	1
<b>Industrial dummy</b>				
CHEMICAL	0.07	0.25	0	1
TEXT	0.06	0.23	0	1
APPAREL	0.36	0.48	0	1
LEATHER	0.03	0.17	0	1
WOOD	0.11	0.31	0	1
NON METAL	0.02	0.14	0	1
MACHINERY	0.01	0.09	0	1
FURNITURE	0.02	0.15	0	1

**Table 8 Correlation matrix (N=270)**

	ISO9001	Request	R&D	Age	Employee	Export 100%	Export experience	Export to EU	Export to OECD	Global Supply Chain	FDI 100%	FDI Japan	HeadDum	CHEMICAL
ISO9001	1.00													
Request	0.27	1.00												
R&D	0.36	0.19	1.00											
Age	0.37	0.15	0.16	1.00										
Employee	0.23	0.32	0.10	0.19	1.00									
Export 100%	-0.06	0.10	-0.10	-0.15	0.15	1.00								
Export experience	0.25	0.18	0.07	0.76	0.16	-0.08	1.00							
Export to EU	0.05	0.10	0.02	-0.01	0.03	0.08	0.02	1.00						
Export to OECD	0.06	0.18	0.05	0.01	0.24	0.22	0.05	0.59	1.00					
Global Supply Chain	-0.04	0.17	-0.02	-0.06	0.26	0.07	-0.03	0.06	0.20	1.00				
FDI 100%	-0.10	0.03	-0.18	-0.19	0.40	0.25	-0.10	0.02	0.13	-0.01	1.00			
FDI Japan	0.12	0.03	-0.07	0.00	0.06	0.15	0.05	-0.03	0.00	0.05	0.12	1.00		
HeadDum	0.02	-0.05	0.06	0.06	-0.17	-0.10	-0.02	-0.03	-0.07	0.00	-0.35	-0.03	1.00	
CHEMICAL	0.18	0.01	-0.01	0.03	0.00	-0.04	-0.04	0.08	-0.03	0.06	-0.01	-0.04	0.06	1.00
TEXT	-0.11	-0.04	-0.07	-0.04	0.05	-0.05	-0.01	-0.05	0.01	0.02	0.12	0.06	-0.08	-0.06
APPAREL	-0.16	-0.01	-0.12	-0.06	0.32	0.12	-0.07	-0.06	0.12	0.14	0.19	-0.07	-0.04	-0.20
LEATHER	0.05	-0.04	0.04	0.04	0.17	0.03	0.10	0.02	-0.02	0.13	0.05	-0.03	0.09	-0.05
WOOD	-0.09	0.03	-0.10	0.03	-0.15	0.04	0.09	-0.06	-0.07	-0.01	-0.19	-0.06	0.06	-0.09
NONMET	0.11	-0.02	0.01	-0.01	-0.04	-0.03	-0.02	-0.01	-0.01	-0.03	-0.10	-0.02	0.07	-0.04
MACHINERY	0.05	0.00	0.07	0.00	0.03	-0.06	-0.06	0.06	0.10	0.04	-0.06	-0.01	0.04	-0.02
FURNITURE	0.08	0.06	0.13	0.04	0.05	-0.04	0.05	-0.02	-0.03	0.01	-0.06	-0.02	-0.05	-0.04

	TEXT	APPAREL	LEATHER	WOOD	NON METAL	MACHINERY	FURNITURE
TEXT	1.00						
APPAREL	-0.12	1.00					
LEATHER	-0.04	0.00	1.00				
WOOD	-0.08	-0.26	-0.06	1.00			
NON METAL	-0.03	-0.10	-0.02	-0.05	1.00		
MACHINERY	-0.02	0.02	-0.02	-0.03	0.31	1.00	
FURNITURE	-0.04	-0.11	-0.03	-0.05	-0.02	-0.01	1.00

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