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## IDE DISCUSSION PAPER No. 466

### Impact of Product-related Environmental Regulations in Asia: Descriptive Statistics from a Survey of Firms in Vietnam

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#### Abstract

This paper summarizes the main results of a unique firm survey conducted in Vietnam in 2011 on product-related environmental regulations (PRERs). The results of this survey are compared with the results of a corresponding survey of firms in Penang, Malaysia (Michida, et al. 2014b). The major findings are as follows. First, adaptation to PRERs involves changes in input procurement and results in market diversification, which potentially alters the structure of supply chains. This finding is consistent with the Malaysian survey result. Second, connections to global supply chains are key to compliance, but this requires firms to meet more stringent customer requirements. Third, government policy can play an important role in assisting firms to comply with PRERs.

**Keywords:** global supply chain, FDI, product-related environmental regulation, REACH, RoHS

**JEL classification:** F18, O14

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*Impact of product-related environmental regulations in Asia:*

*Descriptive statistics from a survey of firms in Vietnam*

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**Abstract**

This paper summarizes the main results of a unique firm survey conducted in Vietnam in 2011 on product-related environmental regulations (PRERs). The results of this survey are compared with the results of a corresponding survey of firms in Penang, Malaysia (Michida, et al. 2014b). The major findings are as follows. First, adaptation to PRERs involves changes in input procurement and results in market diversification, which potentially alters the structure of supply chains. This finding is consistent with the Malaysian survey result. Second, connections to global supply chains are key to compliance, but this requires firms to meet more stringent customer requirements. Third, government policy can play an important role in assisting firms to comply with PRERs.

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**Introduction**

Environmental and health-related regulations for products or product-related environmental regulations (PRERs) imposed in developed countries have raised concern among exporting countries. If exported products do not satisfy the regulatory requirements, noncompliant products cannot be placed on regulated markets and firms may face technical barriers to trade (TBT). As PRERs become more demanding and increase in variety, concerns about their use have been most prevalent in developing Asian countries that have been the center of world manufacturing for decades (Michida, et al. 2014a). Many parts and component suppliers of global assemblers are located in these countries and these firms are required to meet PRERs in their manufacturing activities.<sup>1,2</sup>

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<sup>1</sup> See, for instance, Hiratsuka and Uchida (2010).

Although developing Asian countries have improved their manufacturing capabilities, many firms appear to lack capacity to comply with technical regulations. Michida and Nabeshima (2012), through a series of interviews with firms in the electrical and electronic, furniture, and plastic industries of Vietnam in 2011, show that firms that are part of global supply chains (GSCs) are most able to adapt to PRERs. Specifically, firms involving multinational corporations (MNCs) as customers or lead firms often are assisted by the lead firms in adapting to the PRERs imposed in their export markets. In contrast, domestic firms that do not belong to GSCs often face hurdles to continued export to regulated markets. This result implies that PRERs could become a barrier for firms attempting to export to regulated markets lacking the support of MNC lead firms. The Vietnam Research Institute (2011), through case studies of the footwear industry, also confirm that footwear firms working with MNC firms can receive technical advice and, given the relatively larger financial base of these firms, can make production process changes easily. However, there are also a number of small-scale domestic firms that currently target only the domestic market but that are examining the use of exports in the future as a way to increase their market opportunities.

Our research focuses on regulations and requirements related to chemicals contained in products. Two primary European Union (EU) regulations are the major examples of such PRERs examined in this paper. These regulations, enacted by the EU Parliament and Council, are the Restriction of Hazardous Substances (RoHS) Directive and the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) Regulations. The RoHS Directive, which restricts the use of certain hazardous substances in electrical and electronic equipment, was implemented in 2006.<sup>3</sup> The REACH Regulations were implemented in 2007 and regulate chemical substances and chemicals contained in products that cause serious concern for consumer health and the environment. Under REACH, if a product contains chemicals classified as substances of very high concern (SVHC) in excess of 0.1% by weight, firms are required to notify the European Chemicals Agency, the relevant regulatory body, and obtain authorization.

PRERs are not only set by foreign governments. In Vietnam, the Ministry of Industry and Trade issued Circular No. 30/2011/TT-BCT on temporary regulations on allowable concentration limits of certain hazardous substances in electrical products and electronics, which set the same limits for the six hazardous substances defined under the

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<sup>2</sup> For a description of chemical-related PRERs in Asia, see Michida (2014). For Asian countries' actions about PRERs, see Ramungul (2013) for the case of Thailand, Chen et al. (2014) for the case of Malaysia.

<sup>3</sup> Prohibited substances include lead, mercury, cadmium, polybrominated biphenyl (PBB), and polybrominated diphenyl ether (PBDE).

EU RoHS Directive.<sup>4</sup> Thus, this regulation has been referred to as the Vietnamese RoHS.

When chemicals contained in final products are regulated, the materials, parts, and components used in them must be redesigned, monitored, tested, and proven to meet the mandated chemical thresholds. Part and component suppliers are located across borders; therefore supply chains, value chains, and production networks must be managed across firms, industries, and countries. To make adaptation even more complicated, the impact of chemical-related are often affects multiple industries. Firms affected by the EU REACH and RoHS regulations are not only those in the chemical industry, but also the textile, wood products, plastic, rubber, machinery, electric and electronic industries, and many others<sup>5</sup>. Many potentially affected industries are located in developing countries and firms that aim to export to EU markets are affected in particular.

Our research interest lies in examining the impact of PRERs on Asian firms that directly or indirectly export to regulated markets. Differences in capacity and strategies in adapting to PRERs in different industries are also highlighted.

Beyond anecdotal evidence drawn from firms' experiences or case studies, no statistics have been collected on a larger scale on adaption to PRERs. Thus, further examination on the impact of PRERs on firms and their adaptation behavior has not been possible to date. To our knowledge, research has not yet been conducted that allows for extensive examination of how firms adapt to PRERs. Therefore, we decided to conduct a research project on PRERs from 2012 to 2014. We approached the issue from different methodologies, including case studies of firms, interviews with policy makers, and a series of surveys of firms in three Asian countries at different stages of economic development: Vietnam in 2011, Malaysia in 2012, and Japan in 2013. The Malaysia survey results are compiled in Michida, et al. (2014b). Using the survey of firms in these three countries, we have constructed a unique dataset. Using the data obtained in Malaysia, the roles of GSCs in PRER compliance are discussed in Michida et al. (2014a). Arimura et al.(2014) examined the linkage between compliance with PRERs and adoption of ISO standards.

This paper shows the descriptive statistics from our Vietnam survey conducted in

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<sup>4</sup> However, the Circular does not specify which agencies are required to make the assessment of the levels of toxic chemicals in products, and a second circular guiding customs authorities has been issued since there have been difficulties in implementation of the Circular.

<sup>5</sup> The targeted products of RoHS are electrical and electronic (E&E) products. But RoHS affect the sectors other than E&E because the final products may be distributed with textile bags, or the products such as electric outlet are assembled into wooden desks and so on.

2011 and compares the results with those of the Malaysian survey.<sup>6</sup>

Section 1 explains the research questions for our firm survey and Section 2 provides an explanation of our dataset. Section 3 shows general characteristics of firms in Vietnam. Section 4 highlights the structure of supply chains in Vietnam. Section 5 examines the statistical results for each research question addressed in Section 1. Finally, Section 6 concludes the paper.

## 1. Research Questions

This section highlights the research questions used in our survey of firms. As the surveys in Malaysia and Vietnam were conducted using the same research questions, many of the survey questions are common to both surveys. Therefore, the questions described in this paper are the same as in Michida, et al. (2014b) for the Malaysian survey. This paper compares the results of the two surveys conducted in Vietnam and Malaysia. For further details of the Malaysian survey results, please see Michida, et al. (2014b).

Although we have anecdotal evidence on the impact of PRERs on firms, we are not certain how extensive the impact is across firms and industries. In addition, the situation on PRER adaptation in developing countries is not clear. Therefore, our first question is:

*Question 1: Impacts of chemical PRERs on firms: How are firms affected by regulations/requirements for chemicals in products?*

Questions 2 to 4 address firms' adaptation with PRERs and their effect on global supply chain structures.

*Question 2: Material Procurement: How do firms optimize their behavior with regard to purchasing materials?*

Question 2 refers to our hypothesis that changing input materials may require firms to change their suppliers in order to meet regulations. It implies that compliance with regulations could change supply chain structures by prompting firms to switch from non-compliant to compliant suppliers.

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<sup>6</sup> Arimura et al. (2014) analyze diffusion of ISO 9000 and 14001 when firms face chemical regulations. Michida et al. (2014a) focuses on the roles of global supply chains in adapting to PRERs.

*Question 3: Market diversification: Do firms change their destination markets due to stricter regulations implemented in their previous export markets?*

Question 3 addresses whether PRERs hamper trade and require firms to change their markets. Both Question 2 and Question 3 lead us to ask what implications these changes have on the environment in country, regional, and worldwide levels.

*Question 4: Implication on supply chains: What are the implications of switching markets on the environment and health in developing countries?*

Questions 5 and 6 ask about measures taken by firms to adapt to PRERs and their implications for businesses.

*Question 5: Measures taken by firms: What did firms do to adapt to PRERs? What were the motivations for firms to take these measures?*

*Question 6: Business implications: What were the implications for business from adapting to PRERs?*

Lastly, Question 7 relates to implications of government policy. What can policy do to improve the situation?

*Question 7: Policy implications: What can policy do to assist firms adapt to PRERs?*

## **2. Data description: Basic information**

The survey in Vietnam was planned and the main content of the questionnaire developed by a team from IDE-JETRO. Then, the questionnaire was translated into Vietnamese and administered by the Vietnam Chamber of Commerce and Industry. For sampling, the targeted sectors covered manufacturing and commercial sectors that are likely to be required to manage chemicals in products. The geographical scope of the survey covered 63 provinces in Vietnam. The sample was drawn from a list of firms from the General Department of Taxation containing 1,954 foreign-owned firms and 10,024 private domestic firms. For our purposes, foreign-owned firms are defined as all firms receiving foreign direct investment (FDI) and include both 100% foreign-owned

firms and joint ventures between local firms and MNCs (henceforth, we refer to these firms as FDI firms). The survey was sent to all FDI firms and 70% of private firms that were randomly selected. The Vietnam survey was conducted from December 2011 to January 2012. The questionnaire was distributed via mail, with follow-up phone calls made when necessary. Over the month that the survey was conducted, we sent out a total of 11,978 questionnaires and received 1,055 responses, resulting in a response rate of 8.8%.

Comparing the distribution of the firms to which the questionnaire was sent and the distribution of firms from which a response was received, FDI firms account for 16.3% of questionnaire recipients and 31.9% of the responses. Among the responding firms, most were located in Hanoi (190 firms), followed by Ho Chi Minh City (179 firms).

### 3. Basic information on the dataset

This section summarizes general information on our sample. The number of observations in the sample was 1,055. Figure 3.1 shows the years in which firms in our sample were established. As can be seen, the majority of firms in our dataset were established since 2001. Vietnam became a WTO member in 2007 and participation in the WTO brought FDI to Vietnam during this period (Pham, 2011). This increasing trend in investment is observed in our dataset.

**Figure 3.1. Number of firms by year of establishment**

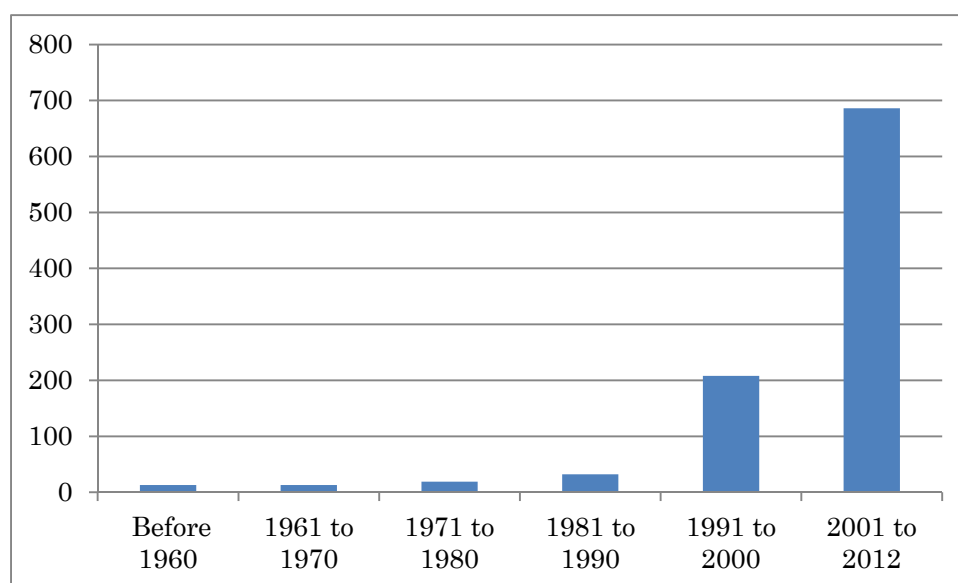
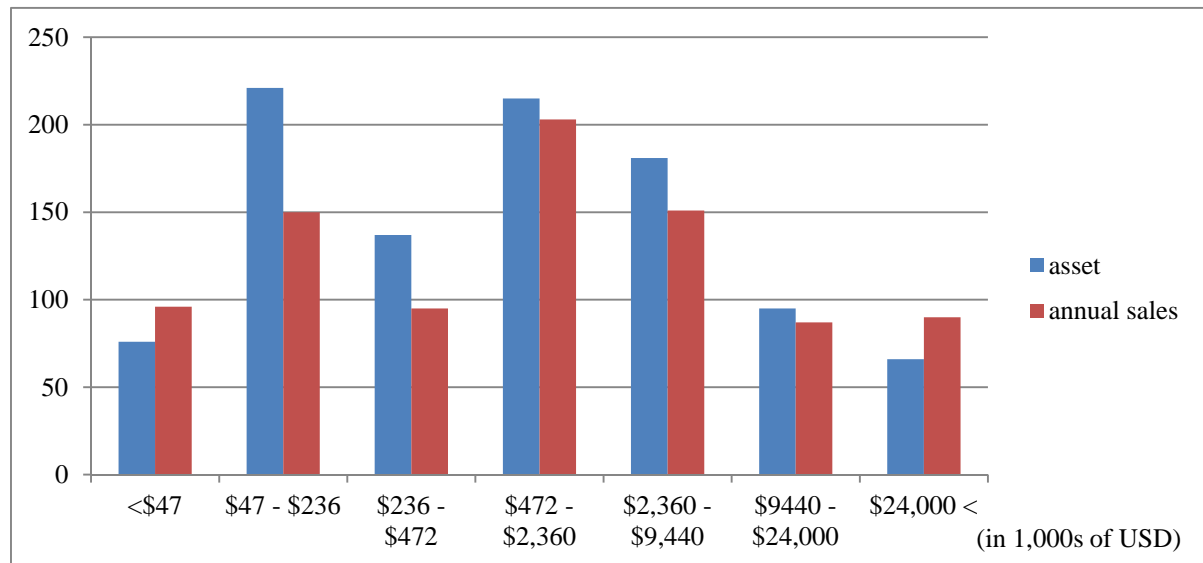




Figure 3.2 shows the asset size and annual sales size. We asked for asset and annual sales as categorical ranges because some firms may be hesitant to give exact figures. Sixty-four firms did not answer the asset size questions and 183 firms did not give answer to the annual sales question.

**Figure 3.2. Number of firms by total assets and annual sales** <sup>7</sup>



**Table 3.1. Distribution of firm employment size**

Cumulative share (%)	Employment (no. of workers)
25%	1~23
50%	~120
75%	~600
95%	~3000
100%	~16,175
Mean	630.4
Std. Dev.	1,407.1
No. Obs.	978

The data covers both manufacturing and trade. Of 935 firms that gave answer to the question about firm's activities, 383 firms are involved in manufacturing only (41%) and 392 firms conduct both manufacturing and commercial activities (42%). The remaining 160 firms (17%) are involved in the commercial sector only. Looking at the data by type of firm, FDI firms tend to have a larger number of employees (Table 3.2).

**Table 3.2. Number of employees by type of firm**

<sup>7</sup> Asset size was reported in Vietnamese dong in the questionnaire. The dollar figures were calculated by using the exchange rate 21,000 VND per 1 USD which was the exchange rate in 2011.

	Domestic Firm		State-owned Firm		FDI Firm		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>Less than 9</b>	96	13.5	0	0	3	0.9	99	9.4
<b>10~199</b>	358	50.4	4	44.4	91	27.2	453	43
<b>200~299</b>	32	4.5	0	0	23	6.9	55	5.2
<b>300~399</b>	30	4.2	1	11.1	14	4.2	45	4.3
<b>400~699</b>	51	7.2	2	22.2	49	14.6	102	9.7
<b>700~999</b>	23	3.2	0	0	30	9	53	5
<b>1,000~1,999</b>	34	4.8	1	11.1	50	14.9	85	8.1
<b>2,000~3,999</b>	21	3	0	0	34	10.1	55	5.2
<b>4,000~9,999</b>	9	1.3	0	0	14	4.2	23	2.2
<b>More than 10,000</b>	4	0.6	0	0	4	1.2	8	0.8
<b>No answer</b>	52	7.3	1	11.1	23	6.9	76	7.2
<b>Total</b>	710	100	9	100	335	100	1054	100

**Figure 3.3. Number of firms involved in manufacturing and commercial activities**

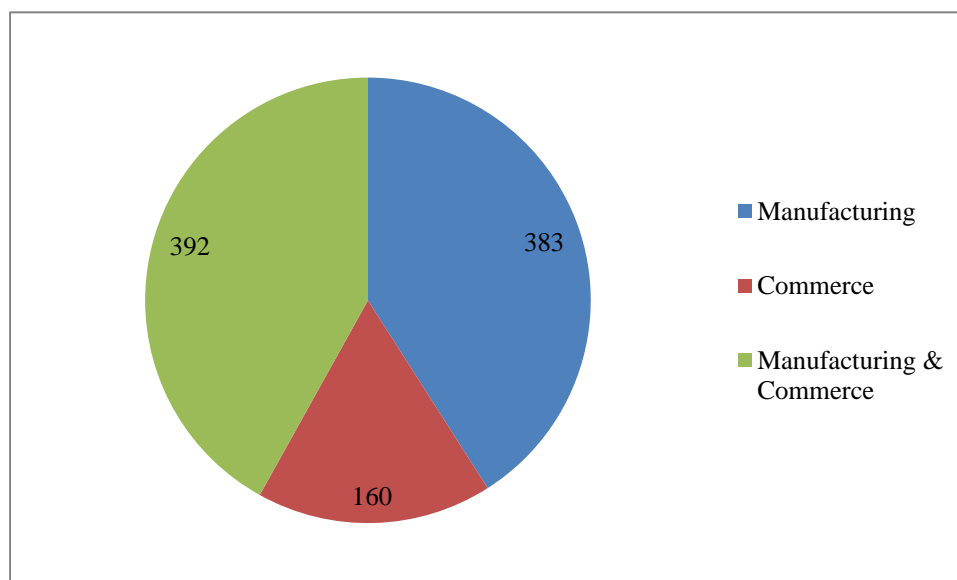
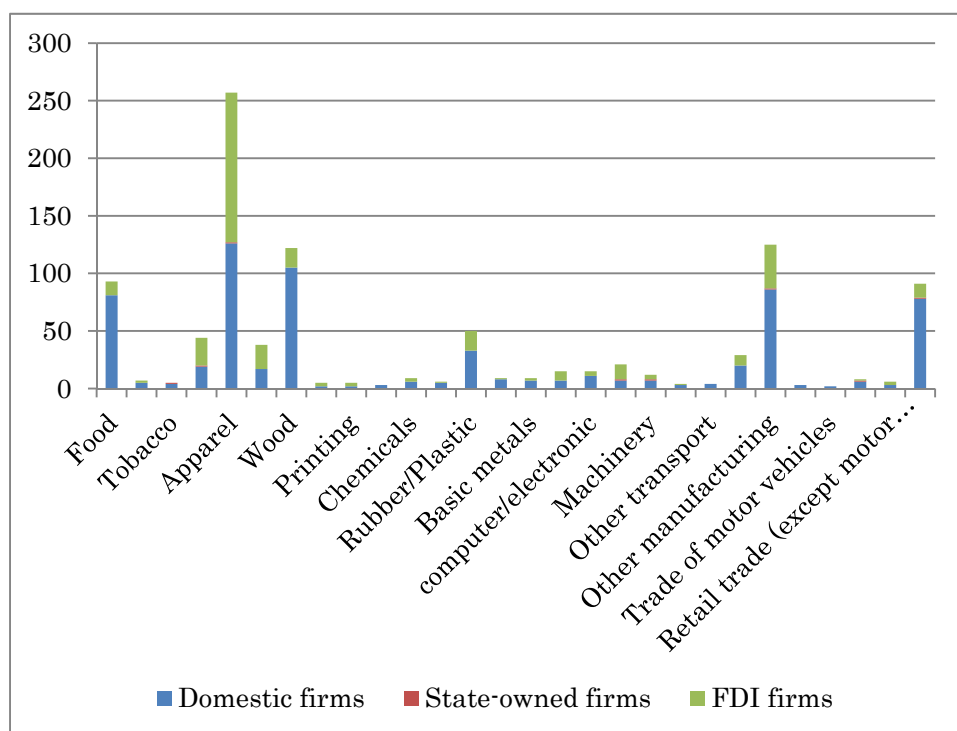


Figure 3.4 shows the industrial distribution of the firms in the sample. Table 3.3 compares the overall structure of industries in Vietnam according to GDP and the distribution of firms by industry in our sample. Reflecting the overall industrial structure in Vietnam, our sample shows labor-intensive industrial sectors such as food, textiles, and apparel as having higher shares. However, our data have a disproportionally larger share of firms in the apparel and wood manufacturing sectors compared with the overall industrial structure in Vietnam as captured by GDP statistics.

**Figure 3.4. Number of firms by industry and firm type**



**Table 3.3. Comparison of industry distribution in sample and overall economy in Vietnam**

	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
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
Fabricated metal	1.5	5.7
Computer/electronic	1.5	5.6
Electrical	2.1	3.3
Machinery	1.2	1
Motor vehicle	0.4	2.8
Other transport	0.4	3.8

<b>Furniture</b>	2.9	2.8
<b>Other manufacturing</b>	12.5	2.8
<b>Repair</b>	0.3	1.9
<b>Other</b>	11.7	10.9
<b>Total</b>	100.0	100.0

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.

Among manufacturing firms, 54.8% are FDI firms. Among firms in the commercial sector and those involved in both manufacturing and commerce, the majority are domestic firms.

**Table 3.4. Number of firm by firm type and activity**

	<b>Manufacturing only</b>		<b>Commerce only</b>		<b>Manufacturing and commerce</b>		<b>All firms</b>	
	No.	%	No.	%	No.	%	No.	%
<b>Domestic firms</b>	171	44.6	155	96.9	314	80.3	640	69
<b>State-owned firms</b>	2	0.5	2	1.3	4	1	8	1
<b>FDI firms</b>	210	54.8	3	1.9	73	18.7	286	31
<b>Total</b>	383	100	160	100	391	100	934	100

#### **4. Structure of supply chains**

##### *Customers and markets*

In the questionnaire, we asked firms, “To whom does your firm sell products? Please let us know your biggest customer.” Four customer categories were presented for selection: domestic firms, firms located abroad, domestic traders, and international traders. We are interested in knowing how supply chain linkages connect firms. A firm that sells products to other firms is considered to be an intermediate goods supplier belonging to a supply chain. Because a firm connecting to a supply chain can communicate with its customers, cooperation in quality management is easier. However, a firm that sells products to traders can be either a final good producer or an intermediate good producer, and the firm is not connected to a supply chain. Table 4.1 shows the main customers of the three types of firms. While domestic firms tend to sell to any of the four types of customers, foreign firms tend to supply products to other firms located abroad. It is also observed that FDI firms tend to have more foreign and international customers than local customers. When comparing sales to firms and to

traders, more FDI firms sell to firms than to traders. For domestic firms, traders play a more significant role in transactions.

**Table 4.1. Type of customers by firm type**

Customer type/ Firm type	Local traders	International traders	Firms abroad	Domestic firms	All customers
<b>Domestic firms</b>	254	167	252	192	865
<b>State-owned firms</b>	5	4	7	5	21
<b>FDI firms</b>	25	66	161	43	295
<b>Total</b>	284	237	420	240	1181

Note: The number of observation is more than 1,055 as some firms checked multiple categories of customers.

Table 4.2 shows the main markets for firms in our sample of Vietnamese firms. Out of 461 respondents, the largest number of firms answered that the EU was their main market, followed by the United States. The EU and US markets are important to both domestic firms and FDI firms.

**Table 4.2. Primary market of firms**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>Domestic</b>	20	2.8	1	11.1	8	2.4	29	2.8
<b>ASEAN</b>	17	2.4	0	0	6	1.8	23	2.2
<b>China</b>	18	2.5	0	0	11	3.3	29	2.8
<b>South Korea</b>	6	0.8	1	11.1	11	3.3	18	1.7
<b>Taiwan</b>	11	1.5	0	0	10	3	21	2
<b>Japan</b>	19	2.7	1	11.1	20	6	40	3.8
<b>EU</b>	108	15.2	3	33.3	51	15.2	162	15.4
<b>US</b>	48	6.8	1	11.1	54	16.1	103	9.8
<b>India</b>	7	1	0	0	1	0.3	8	0.8
<b>Other</b>	19	2.7	0	0	9	2.7	28	2.7
<b>No answer</b>	437	61.5	2	22.2	154	46	593	56.3
<b>Total</b>	710	100	9	100	335	100	1054	100

According to Bui, et al. (2011), Vietnamese domestic electronic and information technology firms are predominantly small- and medium-scale firms, with small amounts of capital, and rather average levels of technology. Firms have various export products, but these are relatively low in quality. Thus, for these firms it is crucial to identify niche markets, specifically those that are not of interest to MNCs. This trend highlights the market segmentation that exists for different types of firms.

However, Bui, et al. (2011) discusses the fact that this situation is improving because of the close cooperation between Vietnamese firms and firms with foreign investment capital. In some cases, Vietnamese firms found partners to export their products, but did not have enough capital and technology. Thus, these firms referred their partners to FDI firms with sufficient resources. At the same time, FDI firms also shifted some of their partners and products to Vietnamese firms based on common benefits and aiming to increase export turnover in the electronics sector.

#### *Procurement of raw materials*

With regard to countries from which raw materials are sourced, 27% of firms procure materials domestically, with China, Korea, Taiwan, EU, and Japan the next most common sources, as shown in Table 4.3. When looking by firm type, 37% of domestic firms procure input materials domestically compared with only 6% of FDI firms. Instead, FDI firms in Vietnam procure materials overseas from countries such as South Korea, Taiwan, China, and Japan. Although the major destination markets for both domestic and FDI firms are the EU and the United States, the source countries for raw materials tend to differ between the two types of firms.

**Table 4.3. Source of procurement by firm type**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>Domestic</b>	265	37.3	2	22.2	20	6	287	27.2
<b>ASEAN</b>	17	2.4	0	0	8	2.4	25	2.4
<b>China</b>	43	6.1	1	11.1	19	5.7	63	6
<b>South Korea</b>	21	3	0	0	42	12.5	63	6
<b>Taiwan</b>	25	3.5	0	0	33	9.9	58	5.5
<b>Japan</b>	16	2.3	0	0	20	6	36	3.4
<b>EU</b>	29	4.1	0	0	15	4.5	44	4.2
<b>US</b>	21	3	1	11.1	15	4.5	37	3.5
<b>India</b>	20	2.8	1	11.1	6	1.8	27	2.6
<b>Other</b>	23	3.2	0	0	32	9.6	55	5.2
<b>No answer</b>	230	32.4	4	44.4	125	37.3	359	34.1
<b>Total</b>	710	100	9	100	335	100	1054	100

As discussed previously, the roles of GSCs in chemical management need to be examined. Therefore, in the questionnaire, firms were asked “Does your firm supply a

primary product to global supply chains (GSCs)?” On the survey, GSCs were defined as a chain of firms sourcing material from and selling products to multiple countries. As shown in Table 4.4, 29% of FDI firms and 16% of domestic firms answer that they are GSC participants.

#### *Global supply chains*

**Table 4.4. Participation in global supply chains**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>GSC participant</b>	112	15.8	1	11.1	97	29.0	210	19.9
<b>GSC non-participant</b>	374	52.7	3	33.3	167	49.9	544	51.6
<b>No answer</b>	224	31.5	5	55.6	71	21.2	300	28.5
<b>Total</b>	710	100.0	9	100.0	335	100.0	1054	100

To see how supply chains are connected across industries, the questionnaire asked firms about the final product of their supply chains. For example, if a firm produces engines, a component in automobiles, and is categorized in the machinery industry, this firm is expected to give an answer of “motor vehicle” as the industry of its lead firm. Table 4.5 shows the industries of lead firms in supply chains in the left column and the industries of firms answering that their lead firms are described in the right column as intermediate good producers. For many sectors, the type of industry of lead firms is the same as those for intermediate producers. This implies that firms operate toward the downstream end of supply chains.

**Table 4.5. Comparison of industry classifications of lead firms and intermediate good producers**

<b>Lead firm sector</b>	<b>Intermediate goods sector</b>
<b>Food</b>	Food, rubber/plastic, wholesale
<b>Beverage</b>	Food, beverage
<b>Tobacco</b>	Tobacco
<b>Textile</b>	Textile, other manufacturing
<b>Apparel</b>	Apparel, computer/electronics, machinery
<b>Leather</b>	Leather, other transportation equipment
<b>Wood</b>	Apparel, wood, furniture, other manufacturing, wholesale
<b>Paper</b>	Wood, paper
<b>Pharmaceutical</b>	Pharmaceutical
<b>Rubber/Plastic</b>	Chemical, rubber/plastic
<b>Non-metallic mineral</b>	Other manufacturing
<b>Basic metals</b>	Wood, basic metal
<b>Fabricated metal</b>	Fabricated metals

<b>Computer/electronic</b>	Computer/electronic
<b>Electrical</b>	Electrical, machinery
<b>Machinery</b>	Apparel
<b>Motor vehicle</b>	Motor vehicle
<b>Furniture</b>	Fabricated metal, motor, furniture
<b>Other Manufacturing</b>	Leather, printing, wood, non-metal, basic metal, machinery, other manufacturing

## 5. Chemical management in Vietnamese firms

*Question 1: Impacts of chemical PRERs on firms: How are firms affected by regulations/requirements for chemicals in products?*

To answer how firms are affected by chemical regulations and requirements, firms were asked, “Have you ever needed or been asked to take measures about chemicals substances in your product since 2000?” in the questionnaire.

As shown in Table 5.1, 43.1% of firms have perceived the need to conduct chemical management. Looking at firms by type, 48.1% of FDI firms responded that chemical management was required, a higher share than for domestic firms. Looking at firms by industry, all firms in the petroleum products sector responded that they needed to conducted chemical management. The next highest industry was the chemicals sector. Contrary to our expectations, only 14% of computer/electronics firms answered that they needed to take measures to manage the use of chemicals in their products.

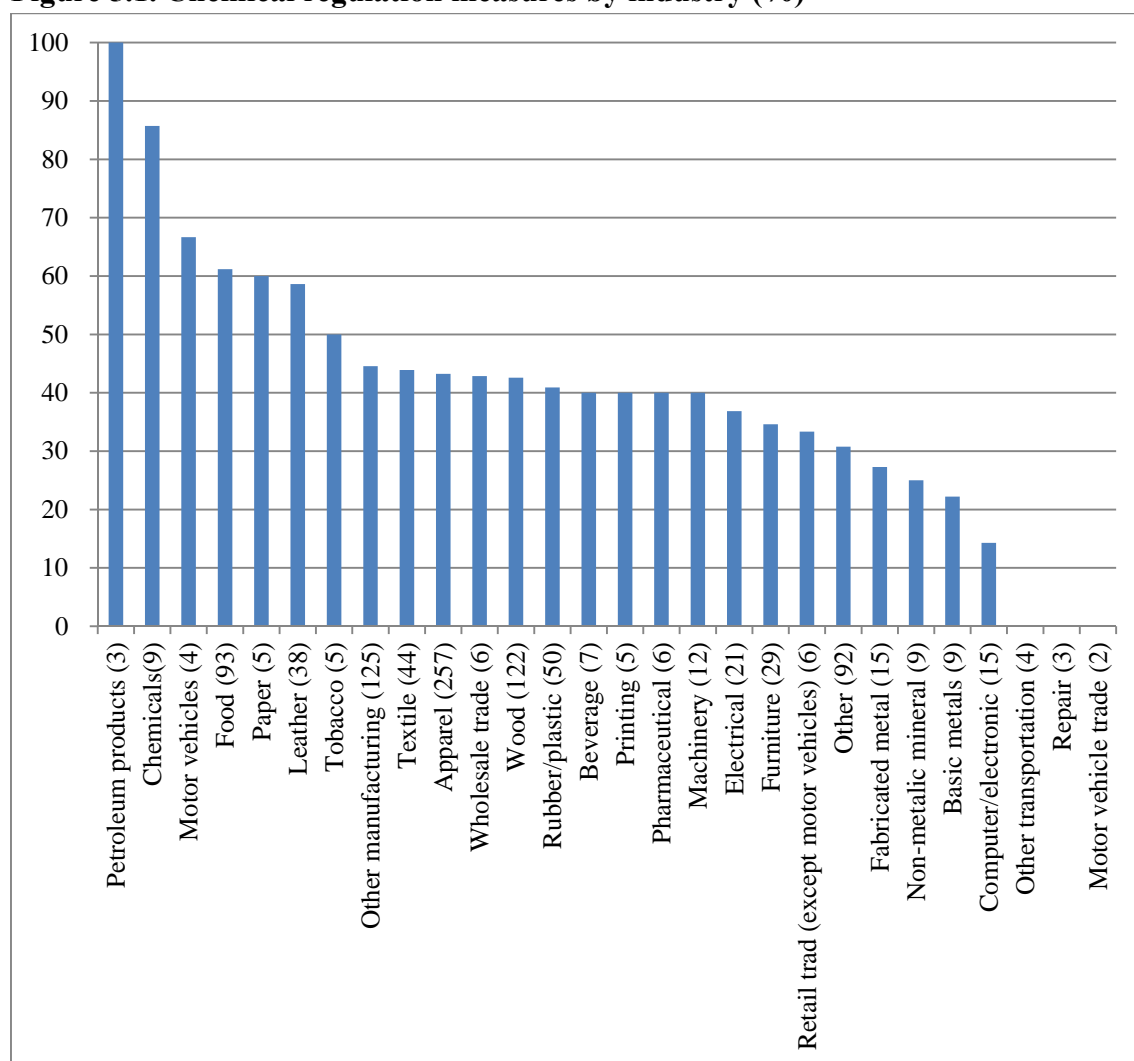
The same question was asked in the survey of Malaysian firms. More than 80% of firms in the computer/electronics sector answered they took chemical management measures (Michida, et al. 2014b). Across the all industries, the percentage of firms in Vietnam taking chemical management measures was much lower than for the corresponding category in Malaysia. Two reasons can help explain these results. First, fewer firms in Vietnam actually face the need to conduct chemicals management. However, as described in Section 4, many Vietnamese firms supply their products to EU markets. Thus, it is unlikely that these firms are not required to conduct any chemical management. Second, as Baldwin (2011) suggests about supply chain structures in Asia, firms in Vietnam are more involved in assembling activities on the downstream end of supply chains and chemical management is not as necessary for these activities as all the prior processed involving chemicals have been completed before reaching firms in Vietnam in the form of parts or components.

**Table 5.1. Chemical regulation measures by firm type**



	No		Yes		Total	
	No.	%	No.	%	No.	%
<b>Domestic Firm</b>	365	59.5	248	40.5	613	100
<b>State-owned Firm</b>	4	44.4	5	55.6	9	100
<b>FDI Firm</b>	153	51.9	142	48.1	295	100
<b>All Firms</b>	522	56.9	395	43.1	917	

**Figure 5.1. Chemical regulation measures by industry (%)**



Note: The figure in parenthesis is the number of samples for each industry.

When a firm fails to meet customer requirements on chemicals, it may result in the rejection of products by customers.<sup>8</sup> Table 5.2 shows the number of rejections

<sup>8</sup> In the questionnaire, firms were asked, "Have your products been rejected by your customers because of chemical substances in products?"

across the three types of firms. Out of 552 firms providing a response, 54 firms (9.8%) reported having products rejected by customers because of chemicals in products. When looking at the figures for domestic and FDI firms, 14.2% of FDI firms experienced rejection compared with 3.7% of domestic firms. Although samples differ between the Malaysian and Vietnamese surveys, the results are comparable with a rejection rate of 9.2% for all firms in Malaysia and FDI firms facing higher rejection rates (See Figure 5.1 for the rejection rates across industries). In fact, the rejection rates for both domestic firms and FDI firms are higher in the survey in Malaysia (Michida, et al. 2014b).

**Table 5.2. Number and percentage of firms experiencing rejections due to chemicals in product**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>No</b>	336	92.8	5	71.4	157	85.8	498	90.2
<b>Yes</b>	26	3.7	2	28.6	26	14.2	54	9.8
<b>Total</b>	362	100	7	100.0	183	100.0	552	100.0

Table 5.3 shows the percentage of firms reporting customer rejection by industry. Firms in the machinery and electrical industries face the highest rejection rates, at 37.5% and 30%, respectively. These industries are followed by the textile (17.4%), leather (12.5%), and rubber/plastic (10.3%) industries in terms of highest percent of product rejections.

**Table 5.3. Number of rejections by industry**

	Yes	No	Total	% Yes
<b>Food</b>	9	53	62	14.5
<b>Beverage</b>	0	2	2	0.0
<b>Tobacco</b>	1	0	1	100.0
<b>Textile</b>	4	19	23	17.4
<b>Apparel</b>	13	131	144	9.0
<b>Leather</b>	3	21	24	12.5
<b>Wood</b>	4	66	70	5.7
<b>Paper</b>	0	3	3	0.0
<b>Printing</b>	0	3	3	0.0
<b>Petroleum products</b>	0	2	2	0.0
<b>Chemicals</b>	0	7	7	0.0
<b>Pharmaceutical</b>	0	2	2	0.0
<b>Rubber/plastic</b>	3	26	29	10.3
<b>Non-metallic mineral</b>	0	5	5	0.0
<b>Basic metals</b>	0	4	4	0.0
<b>Fabricated metal</b>	0	8	8	0.0

Computer/electronic	0	4	4	0.0
Electrical	3	7	10	30.0
Machinery	3	5	8	37.5
Motor vehicle	0	2	2	0.0
Other transport	0	3	3	0.0
Furniture	0	14	14	0.0
Other manufacturing	6	48	54	11.1
Repair	0	1	1	0.0
Trade of motor vehicles	0	1	1	0.0
Wholesale trade	1	4	5	20.0
Retail trade (except motor vehicles)	0	3	3	0.0
Other	1	33	34	2.9
<b>Total</b>	<b>54</b>	<b>498</b>	<b>552</b>	<b>9.8</b>

*Question 2: Material Procurement: How do firms optimize their behavior with regard to purchasing materials?*

As shown in Table 5.4, 24.3% of firms changed input materials to meet regulations or the requirements of customers. For comparison, in the Malaysian survey, 43.9% of firms responded that they had changed input materials.

**Table 5.4. Firms changing input materials to adapt to regulation**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>Yes</b>	87	31.8	1	20.0	30	14.5	118	24.3
<b>No</b>	187	68.2	3	60.0	98	47.3	288	59.3
<b>Total</b>	<b>274</b>	<b>100.0</b>	<b>5</b>	<b>100.0</b>	<b>207</b>	<b>100.0</b>	<b>486</b>	<b>100.0</b>

Changing raw materials is one strategy for meeting regulations because using compliant chemicals is a key way of adapting to regulations. However, finding suitable substitutes is not always easy. Table 5.5 shows that 19.2% of firms responded that they faced difficulty in procuring inputs to meet chemical regulations and requirements.

**Table 5.5. Difficulty procuring substitute inputs**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>Difficult</b>	48	20.1	0	0.0	13	17.1	61	19.2
<b>Not difficult</b>	191	79.9	2	100.0	63	82.9	256	80.8
<b>Total</b>	<b>239</b>	<b>100</b>	<b>2</b>	<b>100</b>	<b>76</b>	<b>100</b>	<b>317</b>	<b>100</b>

For firms that are eager to confirm their suppliers' compliance with chemical

regulations and requirements, specifying or making recommendations about input materials is one way to control chemicals in the products used by suppliers. Customer requests and recommendations that a supplier choose certain input materials are an indicator of the level of control for chemicals in products. We asked firms about the type of requests and specifications from customers in different countries in terms of the selection of input materials. As shown in Table 5.6, depending on customers' country of origin, the degree of specification of raw materials differs. For firms with customers in the EU, 39.2% reported that customers from the EU requested the use of specified materials. For other countries, this was followed by 34.4% of firms with Japanese customers and 32.6% of firms with US customers specified input materials. A similar trend was also observed in the Malaysian survey.

**Table 5.6. Specification of input materials by customer country of origin and firm type**

	<b>Domestic firms</b>		<b>State-owned firms</b>		<b>FDI firms</b>		<b>All firms</b>	
	No.	%	No.	%	No.	%	No.	%
<b>Domestic market</b>								
Specify materials	53	22.0	0	0	13	20.6	66	21.7
Recommend materials	19	7.9	0	0	5	7.9	24	7.9
Did not specify/recommend	169	70.1	0	0	45	71.4	214	70.4
Total	241	100.0	0	100	63	100.0	304	100.0
<b>ASEAN</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	17	19.5	0	0.0	7	17.9	24	18.9
Recommend materials	1	1.1	0	0.0	3	7.7	4	3.1
Did not specify/recommend	69	79.3	1	100.0	29	74.4	99	78.0
Total	87	100.0	1	100.0	39	100.0	127	100.0
<b>China</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	23	21.7	1	50.0	20	33.9	44	26.3
Recommend materials	9	8.5	0	0.0	8	13.6	17	10.2
Did not specify/recommend	74	69.8	1	50.0	31	52.5	106	63.5
Total	106	100.0	2	100.0	59	100.0	167	100.0
<b>Korea</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	23	22.8	0	0.0	15	26.3	38	24.1
Recommend materials	11	10.9	0	0.0	7	12.3	18	11.4
Did not specify/recommend	67	66.3	0	0.0	35	61.4	102	64.6
Total	101	100.0	0	0.0	57	100.0	158	100.0
<b>Taiwan</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	12	14.3	1	100.0	13	28.3	26	19.8
Recommend materials	3	3.6	0	0.0	7	15.2	10	7.6
Did not specify/recommend	69	82.1	0	0.0	26	56.5	95	72.5

Total	84	100.0	1	100.0	46	100.0	131	100.0
<b>Japan</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	32	30.5	1	50.0	20	42.6	53	34.4
Recommend materials	7	6.7	1	50.0	4	8.5	12	7.8
Did not specify/recommend	66	62.9	0	0.0	23	48.9	89	57.8
Total	105	100.0	2	100.0	47	100.0	154	100.0
<b>EU</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	53	37.3	0	0.0	29	43.9	82	39.2
Recommend materials	15	10.6	1	100.0	9	13.6	25	12.0
Did not specify/recommend	74	52.1	0	0.0	28	42.4	102	48.8
Total	142	100.0	1	100.0	66	100.0	209	100.0
<b>US</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	36	30.3	0	0.0	21	37.5	57	32.6
Recommend materials	15	12.6	0	0.0	8	14.3	23	13.1
Did not specify/recommend	68	57.1	0	0.0	27	48.2	95	54.3
Total	119	100.0	0	0.0	56	100.0	175	100.0
<b>India</b>	No.	%	No.	%	No.	%	No.	%
Specify materials	7	9.7	2	100.0	1	4.5	10	10.4
Recommend materials	2	2.8	0	0.0	3	13.6	5	5.2
Did not specify/recommend	63	87.5	0	0.0	18	81.8	81	84.4
Total	72	100.0	2	100.0	22	100.0	96	100.0

*Question 3: Market diversification: Do firms change their destination markets due to stricter regulations implemented in their previous export markets?*

One concern raised in regard to PRERs has been that such regulations could act as TBT for exporters. This concern in regards to firms in Asia has not been examined statistically to date. Therefore, in the questionnaire, we asked whether or not firms had changed their markets because of chemical regulations for products. To examine this research question, firms were asked, “Have you changed export markets because of chemical regulations or requirements?” As shown in Table 5.7, 4.0% of firms answered that they had changed their target market. In terms of firm type, 5.2% of domestic firms changed markets because of PRERs, compared with 2.1% of FDI firms. In the Malaysian survey, the share of all firms that changed their destination markets is also around 4%.

**Table 5.7. Firms changing export market because of PRERs**

Domestic firms	State-owned firms	FDI firms	All firms
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	No.	%	No.	%	No.	%	No.	%
<b>No</b>	362	94.8	6	100.0	235	97.9	603	96.0
<b>Yes</b>	20	5.2	0	0.0	5	2.1	25	4.0
<b>Total</b>	382	100.0	6	100.0	240	100.0	628	100.0

*Question 4: Implication on supply chains: What are the implications of switching markets on the environment and health in developing countries?*

Although changing target markets was not a prevalent strategy for adapting to PRERs, changing input materials was done by a significant number of firms. Moreover, as shown in Table 5.8, 51.4% of firms responded that they changed the types of chemicals used in products depending on the destination market. The same tendency is also observed in Malaysia. The implication is that products with compliant chemicals are sent to regulated markets, whereas noncompliant products are sent to less regulated markets. This trend could result in the creation of pollution havens in countries where proper regulation has not yet been implemented.

**Table 5.8. Firms changing chemicals in products for different markets by firm type**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>No</b>	81	47.4	0	0.0	39	54.2	120	48.6
<b>Yes</b>	90	52.6	4	100.0	33	45.8	127	51.4
<b>Total</b>	171	100.0	4	100.0	72	100.0	247	100.0

*Question 5: Measures taken by firms: What did firms do to adapt to PRERs? What were the motivations for firms to take these measures?*

The most common measures taken by firms to comply with PRERs are sending products for testing, followed by changing production processes (Table 5.9).

**Table 5.9: Measures taken to adapt to regulations**

	Domestic firms		State-owned firms		FDI firms		Total	
	No.	%	No.	%	No.	%	No.	%
<b>Change production processes</b>	41	25.8	0	0	8	11	49	21
<b>Invest in new production, equipment, facility, or physical plant</b>	22	13.8	0	0	9	12.3	31	13.3
<b>Invest in in-house testing/lab facility</b>	16	10.1	0	0	16	21.9	32	13.7
<b>Send products for testing</b>	43	27	1	100	21	28.8	65	27.9
<b>Change inputs</b>	20	12.6	0	0	8	11	28	12
<b>Change product design</b>	2	1.3	0	0	0	0	2	0.9

<b>Obtain certification/labels/logos</b>	2	1.3	0	0	1	1.4	3	1.3
<b>Use external private consulting service</b>	1	0.6	0	0	1	1.4	2	0.9
<b>Use external technical assistance</b>	3	1.9	0	0	1	1.4	4	1.7
<b>Increase the number of technical workers</b>	3	1.9	0	0	0	0	3	1.3
<b>Increase R&amp;D investment</b>	6	3.8	0	0	8	11	14	6
<b>Total</b>	159	100	1	100	73	100	233	100

Table 5.10 shows the key motivating factors for firms to adapt to chemical PRERs. Most firms answered that they adapted to avoid the rejection of products by their customers. The next most common response was seeking full compliance with domestic regulations and requirements. Adaptation to regulations is not seen by firms as a source of competitiveness or improved brand image. Instead, compliance is seen as a mandatory action for firms to keep the business of their customers.

**Table 5.10. Firms' reasons for compliance with regulation**

	<b>Domestic firms</b>		<b>State-owned firms</b>		<b>FDI firms</b>		<b>All firms</b>	
	No.	%	No.	%	No.	%	No.	%
<b>Avoid customer rejection</b>	100	43.5	1	20	38	37.3	139	41.2
<b>Maintain current business relationships</b>	13	5.7	0	0	5	4.9	18	5.3
<b>Develop new business relationship</b>	8	3.5	1	20	1	1	10	3
<b>Improve brand image</b>	10	4.3	0	0	10	9.8	20	5.9
<b>Attain higher sales price</b>	3	1.3	0	0	1	1	4	1.2
<b>Increase export</b>	29	12.6	1	20	10	9.8	40	11.9
<b>Increase domestic sales</b>	15	6.5	1	20	2	2	18	5.3
<b>Comply fully with domestic regulation/requirements</b>	48	20.9	1	20	35	34.3	84	24.9
<b>Other</b>	4	1.7	0	0	0	0	4	1.2
<b>Total</b>	230	100	5	100	102	100	337	100

*Question 6: Business implications: What were the implications for business from adapting to PRERs?*

Does adaptation to chemical regulations and requirements improve firms' competitiveness? We asked firms meeting regulations and requirements whether their exports have increased, decreased or unchanged. Overall, 65.7% of firms responded that compliance did not change their exports. This shows that compliance with regulations offers only the opportunity to export to regulated markets by meeting the minimum requirements. Also, some firms experienced a decrease in exports after regulatory compliance. As compliance with regulations can involve an increase in costs, it may reduce the price competitiveness of firms in some situations.

**Table 5.11. Change in exports after regulatory compliance**

	No.	%
<b>Do not export</b>	61	13.4
<b>Exports increased</b>	42	9.2
<b>Exports decreased</b>	53	11.6
<b>No impact</b>	299	65.7
<b>Total</b>	455	100.0

Table 5.12 shows how adaptation to PRERs changes firms' production costs. Out of 422 firms responding, 60% indicated that costs increased, compared with 34% that did not experience a change in production costs. In terms of the impact of compliance on prices, 53.7% of firms reported higher prices for customers after compliance, compared with 44.3% firms that did not change their prices (Table 5.13). Table 5.14 shows the cross tabulations for cost and price changes. Of firms whose production costs increased due to compliance, about 80% of firms were successful in increasing sale prices. For comparison, the share of firms able to pass on cost increases through higher prices is lower in Malaysia.

**Table 5.12. Change in production costs from regulatory compliance**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>Increase</b>	182	63.0	3	60.0	68	53.1	253	60.0
<b>Decrease</b>	20	6.9	0	0.0	5	3.9	25	5.9
<b>Unchanged</b>	87	30.1	2	40.0	55	43.0	144	34.1
<b>Total</b>	289	100.0	5	100.0	128	100.0	422	100.0

**Table 5.13. Change in price after regulatory compliance**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>Increase</b>	166	58.7	4	80.0	53	41.7	223	53.7
<b>Decrease</b>	8	2.8	0	0.0	0	0.0	8	1.9
<b>Unchanged</b>	109	38.5	1	20.0	74	58.3	184	44.3
<b>Total</b>	283	100.0	5	100.0	127	100.0	415	100.0

**Table 5.14. Cost and price changes after regulatory compliance**

Price change→	Increase		Decrease		Unchanged		Total	
	No.	%	No.	%	No.	%	No.	%
<b>↓Cost change</b>								
<b>Increase</b>	194	79.2	2	0.8	49	20.0	245	100.0
<b>Decrease</b>	14	60.9	6	26.1	3	13.0	23	100.0
<b>Unchanged</b>	12	8.5	0	0.0	130	91.5	142	100.0



<b>Total</b>	220	53.7	8	2.0	182	44.4	410	100.0
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*Question 7: Policy implications: What can policy do to assist firms adapt to PRERs?*

Lastly, we address policy implications concerning compliance with PRERs. What can government policy do to improve the situation? Table 5.15 shows important factors for helping firms adapt to PRERs. Among the responses, 63.9% of firms answered that human resources within firms help them adapt to regulations and requirements. The next most common response was assistance from government agencies. In Vietnam, government assistance and industrial association assistance are seen as being important by firms, more so than in Malaysia. In the Malaysian survey, assistance from customers and suppliers was found as being more important and the role of supply chains was viewed as being more important. However, the current survey in Vietnam shows that firms do not view assistance from customer and supplier as being particularly important.

**Table 5.15. Importance of types of assistance in meeting regulations**

	Not important		Important		Very important		Total
	No.	%	No.	%	No.	%	No.
<b>Government agencies</b>	2	9.1	11	50.0	9	40.9	22
<b>Universities/public research institutions</b>	1	33.3	2	66.7	0	0.0	3
<b>Industrial associations</b>	0	0.0	16	69.6	7	30.4	23
<b>Human resource in company</b>	1	2.8	12	33.3	23	63.9	36
<b>External consultants</b>	6	60.0	2	20.0	2	20.0	10
<b>Customer assistance</b>	22	53.7	13	31.7	6	14.6	41
<b>Supplier assistance</b>	71	53.0	43	32.1	20	14.9	134
<b>Assistance from foreign governments</b>	4	2.9	95	69.9	37	27.2	136
<b>Other</b>	0	0.0	30	88.2	4	11.8	34
<b>Managers' experience in foreign-owned companies</b>	6	22.2	13	48.1	8	29.6	27
<b>Hiring new staffs</b>	3	30.0	7	70.0	0	0.0	10

Note: The question allow multiple answers. The total number of responses does not coincide with the number of firms.

As can be seen, firms' compliance with PRERs has been achieved in a variety of ways, including testing products, changing production processes, changing inputs, and responding to customer specifications for inputs materials. These measures are taken mainly to meet customers' demands. When firms decide to export to regulated markets, individual firms must collect regulatory information and decide how best to meet the regulatory requirements. To understand how firms are prepared to do so, we asked firms whether or not they know why or for what regulations customers request

that certain chemical requirements be met. Table 5.16 shows firms' knowledge of chemical regulations. Overall, 58% of firms know the regulations with which they need to comply, but the remaining firms comply without specific knowledge of the regulations. The firms that do not know the regulations are taking measures as required by their customers. This could lead firms to relying solely on their customers for information and make it difficult for firms to take proactive measures. Moreover, if the firm stops doing business with its current customers, the firm could lose its standing in market due to a lack of regulatory knowledge inside the firm.

Government agencies have roles in disseminating the regulatory information to firms. Industrial associations can also assist firms in this regard.

**Table 5.16. Firm with knowledge of regulations**

	Domestic firms		State-owned firms		FDI firms		All firms	
	No.	%	No.	%	No.	%	No.	%
<b>No</b>	155	47.3	1	20.0	46	30.7	202	41.8
<b>Yes</b>	173	52.7	4	80.0	104	69.3	281	58.2
<b>Total</b>	328	100.0	5	100.0	150	100.0	483	100.0

We also asked firms about what kind of assistances that firms would like to receive when they are adapting to chemical regulations abroad as well as their views on chemical regulations abroad in a free form manner to catch the voices of firms. There were 319 comments in total on these questions and they are rather consistent with the descriptive analysis above..

We categorized these responses into five; (1) more information and training is needed, (2) subsidy or financial support is needed, (3) a lack of laboratory and high testing cost is a significant hurdle, (4) calling for stricter domestic regulations to avoid unsafe chemicals/products to be imported, (5) more awareness raising efforts on chemical safety is needed. Among 319 comments received, the majority of firms expressed the urgent need for (1) and they expect government, chamber of commerce as well as industrial associations to provide them some training courses or guidelines. Specifically, firms would like to have information on RoHS, REACH as well as similar regulations in each market. Also some firms would like to obtain information on pending regulation so that they have enough time to comply.

The second largest responses (17 responses) were concerned with the issue (5). Some of the responses are: "We understand that it is absolutely necessary to control chemicals. On the other hand, if control on chemicals is too strict, it may discourage business activities. Enhancing understanding and responsibility is necessary. To do so,

we need guidelines for using chemicals”. Or we need secured inputs that meet all requirements and standards to produce our products.” “Our firm is ready to bear the cost to comply with whatever requirements or regulations.”

There were 16 comments related to laboratories or testing (3) which makes this as the third largest category. Some firms mentioned that it would be better to have a national laboratory that can meet the requirements and satisfy their customers with lower costs. Other firms complained that testing takes long time.

There are some firms commenting that chemicals are not related to their businesses. Among the answers, “they are small business so there is no required chemical control so far” or “the parent company controls all the chemicals so that they don’t know about chemicals.” There are 12 comments that request stricter domestic regulations (4) as some firms are concerned that less safe or lower quality products are imported in to Vietnamese market. Finally 10 comments are related to requests for subsidy for testing or other financial support from the government.

## **6. Conclusion**

This paper summarizes the descriptive statistics of a survey of firms in Vietnam conducted in 2011. The results show that PRERs, as well as customer requirements with regard to chemicals, have affected various industries in Vietnam. Firms in both Malaysia and Vietnam have similarly faced the need to take measures to comply with regulations and requirements about chemicals in products and have experienced product rejections because of non-compliant chemicals. The results also confirmed that FDI firms have experienced more rejections and are facing tougher compliance requirements compared with domestic firms. This clearly shows that it is more difficult to enter GSCs that target highly regulated markets if firms have not yet entered such markets.

More firms in Vietnam were able to increase product prices after cost increases due to compliance with chemical regulations and requirements compared with firms in Malaysia. However, compliance with PRERs can be considered as a minimum standard for competing in regulated markets and an increase in sales price following compliance seems to become more difficult.

While firms in Malaysia consider cooperation with customers and suppliers along supply chains as important factors in adapting to chemical PRERs, Vietnamese firms consider assistance from government and industrial organization as being particularly important.

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