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**Role of Supply Chains in Adopting
Product Related Environmental
Regulations: Case Studies of Vietnam**

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Abstract

This paper shows some findings how product related environmental regulations, especially those that relate to management of chemical substances affect firms in Asia. Interviews were conducted for some firms in Vietnam that are part of global supply chains of electrical and electronic, furniture, and plastic industries. The global supply chains with MNC lead firms have helped local firms in developing countries to adopt technical PRERs overseas. On the other hand, indigenous firms that do not belong to global value chains might face hurdles to keep exporting to the regulated markets. PRERs could become a barrier for firms that attempt to the regulated markets without supports by MNC lead firms.

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Introduction

An increasing number of product related environmental regulations (PRERs) are introduced in different parts of the world in the recent decades. Product-related regulations have existed in the past for many products (for instance, safety requirements). Sanitary and phytosanitary standards (SPS) are well-known example, often raised in trade disputes.¹ The coverage is expanding into environmental issues and some countries worry that this kind of regulations can affect their export performance.

Some examples of PRERs are the European Union's (EU) Restriction on Hazardous Substance Directive (RoHS),² which restrict hazardous substances in electrical and electronic equipments, and EU Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH),³ which refers to registration, evaluation, authorization and restriction of chemical substances, and others (see Appendix Table 1 for examples of other PRERs). The PRERs aim at protecting consumers' health and safety as well as the environment through regulating manufactured products. The regulations set certain criteria such as allowable thresholds of hazardous substances in products or fuel/electricity efficiency of electrical and electronic products or automobiles. Because a PRER of a country requires all targeted products that are sold on its market to meet the regulation, firms within the border as well as those outside the border exporting to the market are equally affected.

This characteristic of PRERs is a stark contrast to the conventional environmental regulations that aim at preventing pollution arising from production process. These

¹ See for instance Otsuki, Wilson and Sewadeh (2001) find that some African countries were not able to meet tougher aflatoxin standard in the EU and as a result, their exports to EU decreased significantly or in some cases, ceased altogether.

² This entered into force on July 1, 2006.

³ This entered into force on June 1, 2007.

kinds of emission regulations target firms operating within a country (or a jurisdiction in which the said regulations applies). With regard to the PRERs, firms irrespective of the location of production are forced to comply with the regulations of export destination countries. Therefore, although firms are not bounded by such regulations in the countries of production, exporting firms must comply with the PRERs of importing countries in order to keep exporting to such markets.

The second characteristic of PRERs is that lead firms of manufactured products such as automobile and TV set makers are forced to conduct the life-cycle management of products throughout supply chains because of these regulations. Such life-cycle management covers from product design, procurement of raw materials, production, transportation, consumption to waste. Compliance of the final products requires parts and accessories to be in compliance as well, which requires the suppliers along the supply chain to meet the regulations.

In Asia, the impact of the PRERs seems to be significant. Liberalization in trade and investment in the region and fall in transportation costs has enabled manufacturing firms to procure parts and components from different countries based on comparative advantage and such activities have led to a formation of extensive supply chain networks in the region. This was the driving force behind the de fact regional integration in Asia. In general, the longer the supply chains become, the more complex the management of the supply chains. Therefore, PRERs which require significantly more monitoring and screening along the supply chain could adversely affect the existing and potential production networks, that have been the hallmark of industrial development in Asia.

This paper examines how PRERs have impacted firms and production activities in Asia. We focus on the chemical related PRERs, specifically, EU RoHS and REACH

directives and examine the decisions made by Vietnamese supplier firms and their lead firms facing these regulations. In 2011, we conducted interviews with selected Vietnam manufacturing firms in order to gauge the impact of PRERs of EU through supply chains. We find that supply chains that are tightly controlled seem to have no problems meeting PRERs while small and medium enterprises (SMEs) exporting on their own or struggling to enter supply chains are significantly affected.

Section 1 shows the research questions and section 2 to show some interviews in Vietnam to supplement the discussion.

2. Impact of PRERs in Asia

2.1 PRERs as a driver of environmental initiative for firms

Industries face increasing environmental pressure and the corporate strategy more and more reflects the environmental initiatives. There are some motives behind for firms to take environmental initiatives. First and foremost, the regulations have been an important driver for firms to adopt greener production as the regulations are mandatory for firms to meet for keeping their operation. The PRERs, which are implemented actively in EU region, are one branch of such regulations.

EU has approached environmental issues from lifecycle perspectives and with precautionary approach. We elaborate this by using RoHS and REACH directive as an example. RoHS directive took effect on July 2006 and this directive restricts the use of six hazardous substances, e.g. lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ether PBDDE in various types of electrical and electronic (EE) products. If one of the parts exceeds the specified limit, the whole product fails to meet the regulation. RoHS directive is closely linked with the Waste Electrical and Electronic Equipment (WEEE) which sets collection and

recycling targets for EE products and is part of a legislative initiative to combat problems associated with increase in e-waste and related environmental contamination. The intention of two legislations together is to consider the life cycle management of chemicals in EE products. In order to prevent pollution such as soil contamination by mercury, lead and other hazardous materials leaking out from disposed e-waste, EU decided to restrict the use of such chemicals at source in EE products when they are produced.

REACH directive entered force in June 2007. REACH regulates more than 140,000 chemical substances and the number of regulated substances is increasing in each revision. By 2018 when the directive is fully enforced, firms manufacturing as well as importing more than one ton per year of chemical substances will need to register the chemicals to European Chemicals Agency (ECHA). Moreover, since REACH targets a wide range of chemical substances in products, the regulation could affect all firms across industries manufacturing products and importing products to EU. Compliance with REACH directives often require firms producing products for EU to trace chemical information throughout supply chains. Along the chains, every supplier collects relevant chemical information from their buyers of materials and passes it on to their customers. This is the one of the challenging regulations for firms to meet, especially for firms outside EU as the regulation is very technical and many firms need outside consultations to understand what they are required to do. This is especially true for SMEs that do not have enough capacity to deal with such chemical regulations.

In addition to the de jure requirements, Some lead firms set some private standard that limits some chemicals more than some regulations require to appeal to the consumers who have higher environmental concern. This is to respond to pressures from consumers, industrial customers, and suppliers. UNIDO, CBI and Norad(2010) examine

the current situations regarding private standards including those for chemicals in textile/garment, furniture and footwear industries. Some SMEs are given “Green Procurement Manuals” by their lead firms, and the manuals interpret various regulations such as RoHS or REACH as well as additional private standards set by the lead firm. Therefore some firms might not have full understanding of why they need to take some measures with regards to chemicals that they use. Rather they comply with the manuals whatever the background of the requests are.

2.2 Supply-chain Management for PRERs

For modern manufactured goods, production typically relies on the supply chain.⁴ Since technology and customer requirements are changing more rapidly, cycles for new product development are becoming shorter. This is especially true for EE products, for which the periods for new product introductions can be mere weeks and months (Shina. 2008). To keep pace with swift changes of product design, lead firms struggle to master all the individual steps involved in manufacturing their products through supply chains. Competition takes place not between individual companies but rather between networks of companies. Understanding how supply chains are organized and coordinating the activities within their chains is a challenge for firms when competing with other supply networks (Preuss. 2005).

With the advent of increase in PRERs in important markets (especially in EU), being able to adopting PRERs has become one of the requirements set by their customers in various supply chains. Shina (2008) describe the global supply chain management for OEMs (original equipment manufacturers) in EE industries. OEMs are forcing their

⁴ See for instance Yusuf, Altaf, and Nabeshima (2004) and Kuroiwa and Toh (2008) for discussions on the global supply chains, especially in the East Asian context.

suppliers to conform to their design specification and can also specify use of certain “green” materials and finishes. OEMs also ask their suppliers for verification of their production quality such as testing results by certified testing entities. When faced with increasing complexity of supply chain management and to simplify the operation of the lead firm, the lead firm often requires suppliers to inspect parts prior to shipping to the lead firm in order to shift some of the burden to the suppliers. In exchange for this, the lead firms concentrates on information gathering on any (potential) changes in important regulations globally and disseminate and train suppliers if necessary of any changes. In our case studies, we confirm these observations.

On the other hand, as lowering cost is another objective for firms in addition to meeting various requirements of lead firms, some suppliers may be tempted to use materials different from the specified in loosely controlled supply chains. This can be a risk for the supply networks as it causes quality problems of the whole chain. To avoid such risks, some large multinational lead firms have already started to select only those suppliers that are able to clear the supplier auditing which requires suppliers to be able to meet the various PRERs.

2.3 Local SMEs Initiatives to adopt PRERs

However, for a majority of local SMEs in developed as well as in developing countries, collecting information and adapting to the regulation would require additional capabilities, imposes cost burden, and creates a new hurdle for exporting firms.⁵ Tedious supply chain management required to meet PRERs could become trade barriers, and its impact on developing countries, especially for domestic industrial development

⁵ For smaller countries with limited size of domestic market, reliance on export markets is one way to accelerate the industrial development and expansion.

would be large. If firms do not have capacity to comply with PRERs by collecting information and searching for suitable technologies, global market access would be lost. This can be true even for suppliers to MNCs. Therefore, ability to adapt to PRERs is an additional key to continue exporting and industrial development. The nurturing of this capability especially in developing countries could be closely linked to a country's regulatory approach.

In this study, we examine Vietnam as a target for the case study. We chose Vietnam since Vietnam is at the initial stage of industrialization and expanding its exports, and more importantly, has been taking active measures towards PRERs among the Southeast Asian countries. The experience of Vietnam would provide useful guides to other countries at similar level of development.

3. Vietnam case studies

3.1 Current actions towards chemical management in Vietnam

The Vietnamese government has decided to create the RoHS/REACH Information Center within the Chemical Agency supported by the assistance from UNIDO.⁶ The RoHS/REACH Information Center is not officially launched yet, but its operation has already began. Currently, the main focus of this center is to provide necessary information by translating EU documents into Vietnamese, by disseminating this information through web and training courses, by soliciting questions regarding chemical management through web interface, and by providing telephone support. The center has an advisory group consisting of eight specialists to guide the operation of the

⁶ So far, the government has not received any assistance from EU. However, it is planning to contact European Chemical Agency (ECA) in future for technical cooperation.

center. The center has conducted seminars in Hanoi and Ho Chi Minh City with 60 and 80 firms participating respectively. The center plans to expand the locations of seminars to include other cities such as Danang. Currently the focus of such seminars are chemical firms and large users of chemicals. In their opinions, plastic firms are starting to show interest in RoHS and REACH.

The Ministry of Industry and Trade has issued circular #30, which is a Vietnamese version of RoHS.⁷ The requirements are rather similar to EU RoHS. In addition, the circular also specifies the approval of testing facilities within Vietnam to facilitate the adoption of chemical management such as RoHS. The preparation for this circular took only two months. By introducing RoHS regulations in Vietnam, the government hopes to improve environment by weeding out products with excessive amounts of chemical substances and also to aid the exporting firms to ensure that inputs procured within Vietnam comply with EU RoHS. By adopting this kind of regulation, the government hopes that the competitiveness of Vietnamese industry will be strengthened. The government is also considering issuing similar kind of regulations to REACH, but not as one piece of regulations but as a collection of regulations. Currently the government is conducting internal studies on classification and registration requirements of chemical substances, which is a necessary building block of REACH. The Vietnamese government is also planning to adopt GHS labeling (version 3) by the end of this year.

From Vietnam's point of view, testing and certification of products for RoHS and REACH compliances pose difficulties. Most private firms require SGS certification. While SGS facility is located in Vietnam (Ho Chi Minh City), the government would also like to have domestic (private and public) testing and certification facilities to be

⁷ This took force on September 14, 2011.

accepted by firms. To do this, it may be desirable to have mutual recognition agreements with EU regarding these testing facilities. In addition, having East Asia regional standards may be helpful to ensure the competitiveness of manufactured products within East Asia since productions of many products span multiple countries.

3.2 Indigenous Vietnamese Firms⁸

Firm A

This firm used to be a training school to train workers for garment industry. In 2009, it went through equitization and became a joint-stock company, with 55% of shares owned by the government. The firm employs 450 people with an asset of one billion dong and the amount of sales in 2010 was US\$1.27 million. The firm saw expansion of its sales in the last three years. Main product lines of this firm are down jacket, pants, and work clothes. It produces about 30,000 pieces of clothing a month. All the products is exported, of which close to 70% to EU, 30% to Japan, and a small amount to the United States. The firm mainly conducts “cut and sew” services, with all the inputs used is imported from abroad. More than 90% of the input materials come from China. The rest of the materials are procured domestically, but from MNCs located in Vietnam.

Currently this firm does not deal with major brands but instead works with lesser known firms and trading companies. To be a supplier for major global brand would require this firm to obtain some well-known international certification such as ISO9000, ISO14000, SA8000,⁹ and Worldwide Responsible Accredited Production (WRAP).¹⁰

⁸ Interviews with these firms were conducted on July 28th and 29th, 2011.

⁹ This certification is given by the Social Accountability International (<http://www.sa-intl.org/>), aimed at labor practices.

¹⁰ This certification focuses on facilities for garment and footwear manufacturers. For more information on WRAP, please visit their website: <http://www.wrapcompliance.org>

So far, this firm has not obtained any of these, so it cannot participate in a global supply chain of well-known brands.

So far, this firm has not been asked by customers to take any measures related to chemical substances. This may be reasonable for this firm, which essentially offer only processing services (cutting and sewing) with all the inputs controlled by the customers.

In the past, the products from this firm were rejected at the port of an importing country because of the quota.

The firm feels the need to be a part of a supply chain of well-established brands for future expansion of business. However, to do so would require this firm to obtain various international certificates to meet the requirements typically imposed by major brands. The firm has not obtained any of these so far, because of the high cost to obtain them. In addition, customers from different countries put emphasis on different aspect of manufacturing quality. The US and EU firms focus more on labor issues (such as WRAP and SA8000). Japanese firms put more emphasis on the safety of garments. For instance, all pieces of garment have to go through needle detectors for exports to Japan. The fine for each case of violation is \$10,000, which is quite expensive for this firm. The firm sometimes receives assistance from customers, often towards capital investments.

Firm B

This firm was established in 1969 and became a joint stock company in 2000. In terms of the shareholding structure, 65% is owned by the government, and the rest held by employee and the management. The firm employed 2,800 workers. This firm is an independent metal ware firm with two main lines of products: motorcycle metal parts

for a major MNC and metal household products for a major furniture retailer MNC. The motorcycle parts are mainly for domestic use, so the firm does not produce any parts that are used for export markets. In contrast, the products for the furniture MNC is mainly for exports. Thus, this firm can be classified as an indirect exporter. From hereafter we will call the sales of this firm to the furniture MNC as “export”, even though it is only indirect. It has ISO9000 but does not have ISO14001¹¹.

In 2010, the total production of this firm was 1000 billion Dong, of which 350 billion Dong was from “export”. In 2011, the sales of this firm increased by 10% to reach 1100 billion, of which export accounted for 380 billion.

This firm started to take actions towards better chemical management in 1997. The motivation for doing so was to initiate relationship with the major furniture MNC. While the firm was not aware of any specific legal chemical regulations, the firm based its chemical management practices according to the private standards of the major furniture MNC. Upon inspecting some of the private standards of the major furniture MNC, it was apparent that some standards are aimed specifically to REACH regulation. Also, it was interesting to note that not only the chemical standards by this firm applied to the metal ware itself, but also to the packaging materials.

To comply with this private standard, the firm needed to switch suppliers from the one in Singapore to the one in the United States. The main motivation to do so is to keep the transactional relationship to this major furniture MNC. The firm also made some process change, even though the design of the final products did not change. The firm is now required to submit certifications issued by a foreign lab. This particular lab is also specified by the furniture MNC. It also hired private consulting firms from

¹¹ Arimura, et al(2008) and Arimura, et al(2011) examine how the firms decision to obtain ISO14001 are affected and show the roles of supply chains.

outside to initiate and maintain good chemical management practices. In addition, it has relied on assistance from VCCI. The overall effort took one year counting from the time when the effort to gather necessary information started. However, once the decision to implement better chemical management practices is made, it took about three months to implement.

Besides the major furniture MNC, this firm also has multiple customers with varying degree of requirement regarding chemical standards. However, once the chemical management practices are implemented, the firm is producing goods based on the strictest standard. This is to reduce the risk of inadvertently submitting products that do not meet chemical regulations and also it makes managing different variety of goods easier.

Firm C

This firm was established in 2007 as a private joint stock company (with no equity share held by government or foreigners). This firm employs 900 employees with registered capital a little shy of 100 billion dong. The turnover in year 2010 was 800 billion dong. In the last three years, this firm has seen its revenue growing consistently and so does exports. The firm has obtained ISO 9000 and currently in the process of obtaining ISO 14001. The main products of this firm are plastic bags. This firm produces both biodegradable and non-biodegradable ones. Of their productions 90% are destined for exports, mainly to Europe but also to other countries such as Japan, Australia, and countries in Middle East and Africa.

Similar to Firm B, this firm also supplies to major MNCs, mainly in the form of shopping bags and garbage bags. Most of their inputs come from Malaysia and Taiwan in East Asia and countries in Middle East. It used to buy inputs from Thailand

in the past, but not any longer. Their inputs are specified by the customers and customers also strictly control its production process. Any adjustments to chemical managements are due to the requirements by customers.

To accommodate chemical management and other environmental-related regulations in importing countries, this firm has changed inputs (but did not change countries from which they source), obtained certificates, and used external consultants. These kind of actions cost about 20% of sales. The most significant increase in cost came from use of certified inputs compared to uncertified ones. The certified inputs cost twice as much as the uncertified ones. However, the firm was willing to switch to higher inputs, because this would lead to sales to MNCs who would buy their products even though prices may be higher, and the volumes are relatively large.

Firm D

This firm was established in 2005 as a 100% exporting firms of tea leaves. Its shares are all privately owned without any government shareholding. The total asset of this firm is about US\$200,000 and the revenue in 2010 was US\$3.7 million. The firm is steadily increasing its revenue. The firm's main products are bulk teas (more than 5kg) of black, green, and white tea. This firm is a supplier to a major food and beverage MNC. More than three quarters of their products are sold to this MNCs and the rest to various packaging firms¹² in the United States.

The largest export destination is Indonesia because this is where the major regional operation of the above MNC is located. The MNC once they receive tea leaves from this firm, the products are sent to global market.

This firm has just become the supplier to this MNC in 2011. The motivation to

¹² Those firms that they put loose tea leaves into tea bags.

become a supplier to this MNC is to secure steady markets for tea. Vietnam tea leaves have been exported in large quantities to EU and the US. However, problems pesticide residue and microbes led to sharp decline in tea exports to EU (close to 90% reduction) and the US (70% reductions). In fact, a shipment by this firm was also rejected at a port in EU and it had to be shipped back to Vietnam. Of course, the firm had to bear the cost of the return shipment. Also with mold problems, exports to Russia have come down, too. In this kind of situation, being part of a supplier network of a major MNC is seen as a way to survive. However, to become a supplier to an MNC, this firm had to send 12 samples to Germany for quality testing. The cost for each sample was about 350 euro. Also MNCs tend to also have other requirements linked to social responsibility such as those relating to protections of rainforests. This firm also needed to comply with these requirements.

One of the advantage of being a supplier to a global MNC in food and beverage market is that the ability of the supplier to sell different grades of quality. MNCs have global reach in their marketing and naturally they differentiate the quality of their products depending on the local conditions. This enables the supplier to procure high-grade tea leaves and low-grade tea leaves, but enabling the firm to still sell these different grades. This reduces the risk on the part of the supplier who cannot always procure the exact amount of exact quality from year to year. The second advantage mentioned is the lack of concern on payment. While payment issues can be a substantial problem in some exporting markets (such as Pakistan and China), when dealing with MNCs, such problems do not exist. So rather than dealing directly with importers from these countries, it is better from the business stand point of view to deal with MNCs.

To some extent, this firm does not have any control over the quality of tea leaves production in Vietnam since they buy from the traders. However, the lack of attention

by farmers is constraining the activities of the downstream firms. The firm would like to see more government involvement in raising the awareness of various regulations in exporting markets to farmers and provide necessary trainings to ensure that tea leaves produced in Vietnam can pass phytosanitary standards of the importing countries.

3.3 Multinational firms and their suppliers¹³

Firm E

This firm (a subsidiary of a major electronics MNC) produces PC monitors, cathode ray TV, and LCD TV located in an industrial estate in Hung Yen Province. About 10% of the products were exported to the Philippines and other Southeast Asian countries and the rest are for the domestic market. The firm is expected to expand its export operation from this facility to include Australia and New Zealand. For their operation in Vietnam, more than 90% of inputs are imported from China and Korea, mainly from their affiliates. Only 10% of the inputs come from Vietnam. These inputs are plastic materials, boxes, and labels.

This firm adopted RoHS compliant business practices in 2005 and applied that to global operation. Therefore, even their exports to the Philippines are RoHS compliant. For this establishment in Vietnam, adopting RoHS took about three months. It received assistance from the headquarter located in the home country. This establishment was responsible for providing information and assistance regarding RoHS to its local suppliers. This establishment kept most of the suppliers. It has 24 suppliers located in Vietnam. It took 6 months for all the suppliers to be fully RoHS compliant. This establishment audit suppliers every one year. It adopted 4ME (men, material, method, machine, and environment). If any of these items were changed in the supplier's

¹³ Interviews with these firms were conducted on November 16th and 17th, 2011.

factory, the establishment conducts additional testing to make sure that they are compliant to RoHS (and internal rules).

This establishment has its own in-house testing facility to check for chemical composition of the parts and the finished products. However, it also sends out products to a testing center located in Ho Chi Minh City. In the past, they sent these products to Singapore or Taiwan for testing. This kind of testing equipment is expensive, so only about 20% of their suppliers have them.

This establishment has not adopted any measures towards REACH. One of the reason is that none of the finished products or parts from this establishment are destined to the EU market.

On the Circular 30 (the Vietnamese RoHS), the establishment said it is slightly different from EU RoHS in that it requires information dissemination of products.

In terms of the local engineering quality, the firm expressed that there are enough raw supplies of graduates in engineering but they would require 2-6 years of training before they can stand on their own. In addition, a high turnover of workers is a constant issue.

Firm F

This firm is a supplier to major MNCs located in Vietnam and abroad and its establishment is located in an industrial estate in Hung Yen Province. It span off from a major electronics MNC (parent company of Firm E) in 2001 to concentrate on EMS business. Its main products are PCB (mainly used for monitors and TVs) and assembly of cathode ray TV and LCD TV. Most of their buyers export their products from Vietnam.

It has adopted RoHS compliant products from 2009, in line with the requests from the

major electronics MNC (the one used to be the mother firm). Since this firm is an EMS, its inputs are highly controlled by the buyers. Inputs are mainly imported from China, Korea, and Japan. This firm also differentiates products for different markets. This firm is audited by the buyer. This firm audits Vietnamese suppliers who produce mainly plastic parts, boxes, and labels.

Similar to the buyers, this firm also adopts 4M policy. Because of this policy, changing inputs takes about 3 to 4 months, since this firm also needs to receive permission and approval from the buyers on any changes in manufacturing practices.

Currently this firm has an R&D center in the home country (same home country as Firm E). The firm is using that R&D facility as a training ground to train Vietnamese researchers so that within few years, the firm plans to set up an R&D center in Vietnam. In addition to the current product line up, the firm is planning to expand into digital camera module as a next business area.

In terms of REACH, this firm has not taken any measures.

Firm G

This establishment is a part of a major electronics MNC, established in 2007 in an industrial estate in Bac Ninh Province in Vietnam. The products assembled in this establishment are destined to export markets globally (this establishment has a license only to export and cannot sell to domestic market directly). Most of the shipments are routed through Singapore where the firm has a regional distribution center. This establishment also produces OEM product for another major MNCs. Only about 20-30% of inputs are procured locally, but from subsidiaries of other MNCs. The amount of inputs they purchase from indigenous Vietnamese firms is quite low.

This establishment (and the parent firm) has adopted RoHS compliant products in its

global operation. The firm has established a “green procurement standard” in 1997 and it requires the suppliers to follow this standard globally. This green procurement standard is aimed for its first tier suppliers, but these first tier suppliers are responsible for their own suppliers. Also, since this green procurement standard is applied globally, its standard follows the strictest standards and regulations of the major importing countries.

The firm has revised this green procurement standard several times in the past, reflecting changes in regulations in importing countries. The headquarter gathers information on revisions in regulations such as REACH and make necessary revisions to its standard. Once the standard is revised, regional establishments are responsible for dissemination of the information and if necessary, training of local suppliers.

This firm audits its suppliers in three different cycles – every 6 months, 1 year, or 2 years -- depending on the characteristics of suppliers. Those suppliers using a lot of chemical substances subject to controlled usage are audited more frequently than others. When this firm adapted to RoHS and also took actions towards REACH, it did not change suppliers because of these chemical regulations. Instead, the firm opted to train existing suppliers so that they can fully comply with RoHS, REACH, and other environment-related regulations. Firm G requires each supplier to test their inputs and finished parts prior to shipping. Even so, the firm also tests shipments in-house by purchasing testing equipment (made by the same home country as Firm G). While this firm does not require suppliers to submit any testing certificates, it requires suppliers to keep history of input usages so that when the need arises, Firm G can request detailed information on material and chemical usages.

Firm H

This establishment is a foreign subsidiary supplying plastic parts to Firm G in Vietnam and other MNCs located elsewhere. This firm is also located in a same industrial estate as Firm G. They also produce rubber products, molds for plastic parts. The parent firm was already supplying similar parts to Firm G in China. When Firm G decided to invest in Vietnam, this firm also followed and invested in the same industrial estate. This establishment employs about 1,400 people, of which 10 are in management. Chemical management is typically done by the quality control department.

Since it is a supplier to Firm G, it follows its green procurement standard. This establishment has been RoHS compliant since its establishment in 2007. In the past, this firm would send their products to SGS¹⁴ testing facility in China. While SGS is also located in Vietnam, because of the contract that the parent firm has with SGS, it is cheaper for this firm to send products to China for testing. In 2008, it had trouble with inputs sent to Firm G. It contained Bromine¹⁵ where it should not be. Since this incidence, Firm G required this establishment to purchase the same testing equipment (X-ray fluorescence spectrometer) as Firm G to test their parts prior to sending them to Firm G in 2009. While the running cost of this equipment is low, the initial capital outlay is about US\$50,000. Even with purchase of the testing equipment, the price that this firm can obtain from Firm G did not change.

This establishment procures inputs for the parts to Firm G locally, but from a foreign subsidiary. The source of this input (plastic resin) was specified by Firm G.

This establishment has eight main customers, each with different green procurement

¹⁴ SGS is a major inspection, verification, testing and certification firm established in 1878 in Switzerland.

¹⁵ This is one of the chemical element subject to RoHS (polybrominated biphenyl(PBB) and polybrominated diphenyl ether (PBDE)) regulation.

standard. It follows the strictest one to simplify their operation and to avoid accidents as it happened in 2008. Because of this, even though they export some parts directly to China, they are also RoHS compliant. This establishment requires its suppliers to follow the same kind of green procurement standard as Firm G. This establishment requires SGS certification as the evidence of RoHS compliance from its suppliers.

This establishment relies on two different sources for regulations related to chemical management. One source is Firm G. Whenever Firm G makes revisions to its green procurement standard, Firm G notifies and disseminates the information. If necessary, Firm G also provides technical assistance. The other source is a chemical advisor hired by the parent firm. This person is a professor in China. The advisor provides necessary technical assistance on chemical matters.

Overall, this establishment did not face much difficulty in adopting RoHS. This is partly because this is a foreign subsidiary of an established firm globally and the assistance given by major customer, and also the control exerted by the major customer. The only difficulty was the initial purchasing costs of the testing equipment, which the establishment needed to cover.

Firm I

This establishment is a wholly-owned foreign subsidiary of a Taiwanese firm. This establishment is also a supplier to Firm G, which is located within the same industrial estate. This establishment also has other customers (MNCs). Similar to Firm H, this establishment also produces plastic parts to be used in the products of Firm G. There are 1,300 employees at this location, of which 100 works in quality control department. There are two chemists to take care of chemical management and other chemical related issues.

This establishment was established in 2005 in Vietnam to be a supplier to Firm G and other MNCs producing similar goods. From the beginning of the operation in Vietnam, this establishment has been RoHS compliant. Since this firm is a supplier to Firm G, it follows the green procurement standard of Firm G. Similar to Firm H, inputs are specified by Firm G. For inputs, this establishment requires suppliers to submit certification, often from SGS but sometimes from Centre Testing International (CTI) located in Shenzhen, China. This establishment also sends its products to SGS for certification prior to shipping to Firm G. This certification process is a required step by Firm G. Only the test report of this establishment is sent to Firm G, although it is required to keep all records of input usages. While the establishment sends its products to SGS for testing frequently, the cost of testing is low.

Besides Firm G, this firm also has other customers, each with different green procurement standard. This establishment differentiates its products depending on the requirements of the customers. At this point, this establishment has not taken any measures towards REACH.

Firm J

This establishment is a foreign subsidiary of an MNC. This establishment also supplies plastic parts to Firm G, located in the same industrial estate. The parent firm has been a supplier to Firm G in China and Malaysia. When Firm G decided to invest in Vietnam, this firm also followed Firm G and established its operation in Vietnam in 2006.

Since its establishment in Vietnam, the establishment has taken specific measures towards RoHS and REACH. It requires suppliers to submit material safety data sheets (MSDS). While this establishment is not required to supply MSDS and SGS

certification to Firm G, this establishment is required to keep MSDS submitted from its suppliers in the case such information is needed.

Similar to other plastic firms such as Firm H and Firm I, inputs are all specified by Firm G. More than 80% of inputs are imported and the rest procured from Vietnam. However, the input sourced in Vietnam comes from other MNCs. This establishment also purchased the same testing equipment as Firm G and Firm H to test inputs and their products prior to sending them to Firm G. The cost of testing itself is not large, but the establishment needed to train personnel to operate the machine. For REACH, some testing needs to be done outside, and this establishment utilizes SGS.

This establishment has multiple customers including Firm G. As a policy, this establishment follows the strictest standards required by multiple customers to simplify their operation. For customers who do not specify inputs, this establishment utilizes trading firms to procure necessary inputs. Even so, this establishment audits the factory to ensure that the factory is compliant to its standard and requires warranty letter guaranteeing the compliance. The procurement standard by this establishment follows that of the strictest standards of customers.

Similar to other suppliers such as Firm H and Firm I, this establishment also relies on Firm G to keep up with information regarding chemical and environment-related regulations of importing countries.

Firm K

This establishment is a foreign subsidiary firm, established in 2005 with 250 employees. This establishment is also located in the industrial estate in Bac Ninh Province. The main products of this firm is processing of resins to be supplied to other firms such as Firm H and Firm I (suppliers to Firm G) and other similar plastic products firms. The

processing involves coloring and adding of functionality to basic resins. All of their products are exported indirectly, i.e. used as inputs for parts to be assembled in Vietnam and exported. Part of investment for this firm comes from the resin maker relocated in the same home country as Firm G. While its customers are plastic products firms such as Firm H, its final users are finished product maker such as Firm G. Because of this, the parent firm and Firm G discuss and determine the specification of plastic parts and therefore, resin. Based on that decision, the parent firm contracts this establishment to process resin to meet the specification and supplier this processed resins to plastic firms such as Firm H. All the inputs used by this establishment are imported from abroad. This establishment has been RoHS compliant since its start of operation in Vietnam with two persons in quality assurance group responsible for chemical management of this establishment. This establishment has Technischer Überwachungsverein (TUV)¹⁶ certification. For its suppliers, it requires either Inductively Coupled Argon Plasma Optical Emission Spectrometer (ICP) data or warranty letter guaranteeing that their products do not contain any chemical elements exceeding the regulated amounts. It is also asked by Firm G to be REACH-ready.

In terms of complying with RoHS and REACH, this establishment expressed three areas of concerns. The first issue is about testing of its products. This establishment owns its own testing equipment, the same equipment as Firm G and Firm H. The machine is expensive, it requires special permit from the government (Agency for Radiation and Nuclear Safety since the machine uses X-rays), and training of personnel to use the machine. For this establishment where more than 90% of the cost of its products is raw material, increase in costs without reflecting them in price is quite difficult.

Secondly, procuring necessary inputs are becoming harder once this establishment

¹⁶ This is a certification organization located in Germany.

started to require certification documents. Relative to the overall volume of business by input suppliers (such as pigment makers), the orders from this establishment is a fairly small lot. Some input suppliers do not want to bother with cumbersome testing and submission of ICP reports for this kind of small lot orders. In this kind of case, the establishment requests warranty letters, then conduct ICP testing by itself. This increases costs, but it cannot reflect this on prices of its own products. Thirdly, this establishment is required to keep all the documentations on chemical substances of its supplies and products. Maintenance of this document is also cumbersome and costly. Because this establishment deals with chemical elements, it is audited by three different firms: the final product maker (Firm G); suppliers to the final product maker (such as Firm H); and resin maker.

Similar to other suppliers to Firm G, this establishment also relies on Firm G (and other final good producers) to keep up with information regarding chemical regulations and other environment-related regulations of importing countries.

4 Summary of Findings

Interviews with foreign subsidiaries reveal that all of them have already taken necessary steps towards RoHS. The driver for adapting to RoHS is the lead firms of the supply chains. The lead firms provide three different services. They constantly monitor the policy formulation process and the resultant regulations in the destination market. They then synthesize the changes in existing regulations and the addition of new ones into their own standards, which to be followed by the suppliers. Finally they disseminate these revised standards to suppliers and if necessary provide trainings so that suppliers can fully adapt to changes. Because of this role played by the lead firms, suppliers tend to be somewhat passive regarding changes in regulations in importing

countries. For the suppliers, the most important issue is changes in standards and requirements imposed by the lead firms. After all, the lead firms are the ones that make the purchasing decisions. What is a bit perplexing is the total reliance on the lead firm as the information sources, even though these suppliers are subsidiaries and they could have relied on their own parent firms for the dissemination of the information and training. But in reality, it seems that the lead firm located in a country seems to bear the responsibility of information dissemination and trainings to its suppliers located in the same host country.

Prior to conducting interviews with these firms, we anticipated that at least some firms would have changed suppliers when they adapted to RoHS. However, the interview revealed that no firms have changed suppliers because of RoHS (or REACH). Instead, they opted for maintaining their supply chain structure and the lead firm ensured that all parts of the supply chain can fully cope with RoHS (and REACH). Part of this stems from the nature of the supply chain we interviewed in Vietnam. The particular supply chain with Firm G as the lead firm and suppliers (Firm H to Firm K) is a replication of production arrangement elsewhere (such as in China). And to some extent, Firm G asked its suppliers to follow it to Vietnam. So, it seems that for the well-established production network, changes of suppliers stemming from the introduction of the chemical management are infrequent events. Of course, the part of the reason is that these suppliers are MNCs by themselves, and have sufficient capabilities to cope with this kind of requirements. At least, all of the firms interviewed did know exactly what RoHS mean and why they need to take specific measures to manage chemical substances.

In terms of supply chain management, the lead firm seems to have a firm grip on suppliers. The lead firm controls the sources of inputs that suppliers should use. It

also requires them to invest in testing equipment, to test inputs and their products to ensure the quality, even though increase in cost associated with these tests cannot be reflected in the prices charged by suppliers. While many firms can absorb the increase in costs from efficiency increase elsewhere, processing firms (such as Firm K) find it difficult to accommodate these increase in cost of operation without being able to charge higher prices since the share of material costs is more than 90% and there is little room to squeeze efficiency gains.

In terms of managing their chemical usages within the products, most firms with the exceptions of Firm I follows the strictest standards set by the buyers (or the markets for the lead firms) and produces RoHS compliant products. Part of the reason is the global nature in their operations. Even though they are located in Vietnam, almost all of their products are exported directly or indirectly to third markets. To avoid any kind of errors of mixing up products and the requirements by destination markets, these firms opted to produce high quality products only. Therefore, even though some of their products are exported to other developing countries in Southeast Asia, these products are also RoHS compliant.

Relative to universal adaptation to RoHS, some of these firms have not taken any measures towards REACH. Only three firms (Firm G, Firm J, and Firm K) have taken any specific measures so far. While RoHS was introduced earlier than REACH and it directly aims at electronics products, REACH is still new and do not seem to exert any impact on electronics firms yet. As REACH becomes more stricter (i.e. 100 ton level), more and more firms would need to take specific actions to adapt to this.

So far, the impacts of RoHS seem to be quite small to electronics supply chain lead by major MNCs. The lead firms and suppliers belonging to the supply chains seem to have adapted to RoHS quite well, with little increase in costs. However, it seems to be

that it is becoming more difficult to join a supply chain as a new supplier. The supply chain in Vietnam seems to be a replication of existing supply chain elsewhere. Firms involved in this supply chain procure very little from Vietnam. Of the few things they buy, most of them are low-value added commodities such as boxes and labels. The success of industrialization through FDI hinges on the formation of backward and forward linkages. So far, this crucial element is completely missing in Vietnam. With the introduction of product-specific environmental regulations, forming such linkages now seem to be a much tougher task than before.

Compared to MNCs and their suppliers (that also tend to be MNCs themselves), indigenous Vietnamese firms have little understanding of why they need to comply with chemical management. This is not to say that they do not take any actions towards these regulations. They do, but the reason for doing so is because these are the requirements by their main customers (often MNCs). In a way, this is similar to the case for the MNCs and their suppliers that the main source of information is their customers. While the sample size is small, it is interesting to see different strategies taken by indigenous Vietnamese firms. Firm A for instance made deliberate decisions to work with lesser known brands that do not require firm's getting internationally recognized certificates and business management. The main advantage that this firm leverages is the lower labor costs relative to firms in other countries. This firm also concentrates on providing processing services only. This kind of strategy could work while the wage in Vietnam is low, but when the wage in Vietnam rises, then this firm is likely to face difficulties in maintaining its operation. Other firms opted to deal with major brands and took necessary steps such as obtaining ISO9000/9001 and ISO14001, and other industry or private standards (including those proposed by NGOs). Some firm such as Firm B actually switched suppliers so that they can comply with the

requirements by buyers. Taking these steps to become part of global production networks resulted in increase in their costs. However, these firms are satisfied with it because these MNCs are much better buyers compared to others. First, MNCs can accommodate higher prices for the supplies as long as quality is high (quality here includes not only the physical quality of the products itself but also the sustainability of its production process and environmental concerns). Second, by supplying to MNCs, these firms can enlarge their markets substantially. Thirdly, compared to dealing with other buyers especially from developing countries, these firms do not face any payment problems, which can be life-threatening for SMEs. Those firms attached to global MNCs report that procuring inputs from other indigenous suppliers within Vietnam is difficult. Thus, many of them rely on imported inputs for their products.

From these case studies, two important messages emerge. The first is that firms are faced with multiple “standards” and “regulations”. Some are de jure like RoHS and REACH. Some are private standards such as “supplier code of conducts” specified by MNCs, which typically include necessary de jure standards and regulations. Finally there are other voluntary “standards” and certificates such as SA8000 and WRAP. Firms need to comply with many of these if not all to continue their business, especially in a global market through production network. Clearly this is making joining global production networks more difficult and bifurcation of types of firms: one group of firms are those capable enough to be part of a global production network and see expansion of their businesses; and the other focuses on domestic market or markets in other developing countries. As a development strategy, it is desirable if more firms can join global production network since in the long run, this is more resilient form of industrialization given the current trend in liberalization of trade.

The second point is that these firms that are connected with a global production

networks adopt internally acceptable business practices. As mentioned earlier, doing business with MNCs seems to be more profitable from the point of view of domestic firms. But there is a trade-off. To do businesses with MNCs would require these firms to adopt internationally acceptable business practices. This means that these firms would need to obtain necessary certifications (such as ISO), review their production and management practices so that they conform to standards that are aimed more at social dimensions, and to comply with various other standards and regulations. Often firms dealing with MNCs do not know what the origins of these regulations and standards are. The only knowledge that they have is that they need to follow these requirements because often they are embedded inside the “supplier code of conducts”. Nonetheless, there seems to be positive spillovers coming from FDI and being a part of production networks in relations to cleaner environment and better labor conditions. However, governments in developing countries need to pay closer attention to the information gap that these firms have. So far, these firms interviewed seem to be able to adjust to the requirements by MNCs. But clearly these firms lack the true understanding of the origins of the requirements. They are meeting these requirements because they have to. This is making these firms passive and reactive. These firms would not be able to pro-actively adjust to the changes in these regulations and standards. While at the early stage of industrialization, this is to be expected. But as the income and wages rise, firms in these countries need to make sure that they can maintain their competitiveness. Faster access to information and the ability to react changes quicker than others can confer these firms with some advantage. Lead firms typically monitor any activities in these major markets regarding the regulations and standards. While it will be unreasonable to expect these firms in developing countries to follow changes in regulations in other countries, governments can provide some

assistance.

One way is to disseminate information quicker to domestic firms of changes in regulations in major countries. Some countries are already doing this kind of assistance, especially regarding RoHS and REACH. Thailand has RoHS and REACH center and so is Vietnam, which is going to be operational starting in April 2012.

The second way is to slowly revise domestic regulations and standards so that conforming to these would make it easier for firms to adapt to the regulations in importing countries. For firms in developing countries, following changes in domestic regulations would be much easier. To some extent, this kind of move is necessary on the part of exporter, because these firms that are connected to MNCs need to follow much stricter regulations and standards and they often find it difficult to find suitable local suppliers unless they are also connected with MNCs to begin with. This makes it difficult to take full advantage of FDI as a means to foster broader industrialization. In order to do so would require the governments to slowly introduce these regulations. The added benefit of moving towards this direction is that it often helps to achieve both industrialization motive and environment and other social objectives.

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Appendix Table 1: Examples of Product Related Environmental Regulations

Country	Year Enacted	Regulation	Description
EU	2000	ELV (End-of-Life Vehicle)	Vehicle recycling rate: 95% by 2015
	2005	WEEE(Waste Electrical and Electronic Equipment)	WEEE recycling rate: 70~80%
	2006	RoHS(Restriction of the use of certain Hazardous Substances)	Prohibition of 6 toxic substances (lead, mercury, cadmium, hexvalent chrome, PBB and PBDDE in EEproducts)
	2007	REACH(Registration, Evaluation, Authorisation and Restriction of Chemicals)	Registration, toxicity evaluation and approval of chemical substances and chemical substances inside other products
	2009	Regulations on Automobile Exhaust Gas	Control of exhaust gas by automobile groups
	2009	Rules on Exhaust for Greenhouse Gases from Automobiles	Obligation on CO2 exhaust from new automobiles
	2009	ErP(Energy related Products)	Prohibition of market entry of energy using products without Eco-Design: consideration all processes of resource acquisition, production, packaging/transport, usage and disposal
USA	1978	CAFÉ (Energy Policy and Conservation Act of 1975 & Motor Vehicle Information and Cost Saving Act)	Compliance with average fuel efficiency standard of vehicles sold in the US.
China	2007	China RoHS (Electronic and Information Product Pollution Prevention Act)	Display and compliance with 6 toxic substances inside electronic and information products
	2011	China WEEE	Obligation of eco design, product information , collection and

			handling of WEEE
	2011	China ELV	Prohibition of use of 6 substances Recycling rate: 85% , collection rate: 95% from 2017
Japan	2006	Home Appliance Recycling Act	Obligation to recycle 50~60% on manufacturers and importers
	2006	J-Moss (The Law for Promotion of Effective Utilization of Resources)	Displaying 6 substances

Source: Author created from Brochure “Business Service Center for Global Environmental Regulation” created by Korea Ministry of Knowledge Economy.