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RESEARCH REPORT

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Voluntary Environmental Programs in Developing Countries: An Examination of the ISO 14001 Environmental Management System Certification in Thailand

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Thailand, like many developing nations, is facing a wide range of environmental challenges, many of which are caused by industrial pollution. The country has found that traditional command and control legislation is not effectively tackling this problem. It is therefore promoting various voluntary environmental programmes as a way for businesses to improve their environmental performance. To provide more information on the effectiveness of this approach, and to see how to maximize its impact, a new EEPSEA study -- has assessed the implementation of one of the most popular voluntary environmental schemes, ISO 14001.

The study is the work of Kanittha Tambunlertchai from the Department of Land Economy, at the University of Cambridge. It finds that firms sign up to ISO 14001 for a number of reasons, the most important being the impetus provided by their management policies, the need to boost corporate image and the desire to be socially responsible. Having ISO 14001 in place can help companies improve their environmental performance. In some circumstances, it may also bring firms cost savings. In light of these findings and the positive light they shine on ISO 14001, the study proposes a number of policies to help firms to adopt the voluntary scheme. These include providing financial incentives and helping firms with training and provision of information and technical advice.

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EEPSEA was established in May 1993 to support research and training in environmental and resource economics. Its objective is to enhance local capacity to undertake the economic analysis of environmental problems and policies. It uses a networking approach, involving courses, meetings, technical support, access to literature and opportunities for comparative research. Member countries are Thailand, Malaysia, Indonesia, the Philippines, Vietnam, Cambodia, Lao PDR, China, and Papua New Guinea.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

In the present climate of environmental awareness, the severity of environmental problems in the developing world as well as the pressing need for environmental protection in these countries are increasingly being recognized. Thailand is one such developing country. Having made vast improvements in several welfare indicators through rapid industrialization from the 1960s through to the mid-1990s, the country has suffered greatly from loss of the once-abundant forestland, degradations of its rivers and coastlines, rising industrial pollution in the forms of wastewater, and solid and hazardous waste, ever-growing incidents of industry-related accidents and illnesses, and increasingly serious conflicts over natural resources between industrial and other uses.

To combat the array of environmental problems stemming from industrialization, several tools have been adopted by the government. The mainstay and most prominent of these tools is the command-and-control approach, implemented through two key legislations regulating all manufacturing facilities in the country.[1] Despite the stringent regulations, monitoring and enforcement have been weak. For developing countries such as Thailand, weak institutions, limited budgets, a focus on economic growth, and rampant corruption often led to failure to follow through with existing environmental laws (Jarusombat 2008). In addition to this, the command-and-control approach has often been criticized for the inefficiencies resulting from its uniform mandates, the rising costs of monitoring and enforcement, and the way it pits regulators against polluters (Siebert 1998; OECD 1999; Börkey and Lévêque 2000; Kolstad 2000). Market-based instruments (MBIs), another tool that has been adopted in the country, has been said to be difficult to implement in the third world where the requirements for effective implementation of economic incentives such as an extensive information base, competitive markets, and a strong legal structure are lacking (Hanley, Shogren et al. 1996).

In light of criticisms of existing environmental policy instruments, a new tool has emerged. Voluntary Environmental Programs (VEPs), broadly defined as non-mandatory commitments on the part of the firm that aim to improve their environmental performance, is a recent addition to the environmental management toolbox. VEPs have been recognized as a potential tool for supplementing existing command-and-control regulations in achieving environmental goals (Prakash and Potoski 2006a). First adopted in industrialized countries, VEPs are increasingly being adopted by those in the developing world and their numbers are on the rise worldwide (OECD 1999; Brink 2002; Blackman, Lyon et al. 2006).

While VEPs tend to be offered by a country's government and enlist participants from within the country, VEPs can take many forms, including being offered by non-government organizations for international participation. The International Organization for Standardization (ISO)'s environmental management system (EMS) certification scheme (ISO 14001) is one such exception. Offered by an international NGO, ISO 14001 enlists international participants through ISO's network of local standards institutes. In Thailand, the Thailand Industrial Standards Institute (TISI) is responsible for overseeing matters related to ISO 14001 certification in the country.

[1] These legislations are the Factory Act of 1992 and the Enhancement and Conservation of Natural Environmental Quality Act of 1992.

Due to their relative novelty and their origin in the field (OECD 1999; Börkey and Lévêque 2000), VEPs are relatively little-understood compared with other policy instruments. The academic literature on the topic is only gradually catching up with the rapid increase in such programs worldwide and, due to its origins in OECD countries, the existing literature has tended to focus almost exclusively on programs and factors relevant to developed countries. Even with this focus, there is still a lack of consensus in the literature on various issues regarding voluntary programs including the motivations for participation in voluntary schemes, and the characteristics of the firms which make them more likely to participate in such programs. Furthermore, other aspects of voluntary programs such as their effects on the environment, and the benefits from participation have, until very recently, received little attention. (See, e.g., Arora and Cason 1995; Khanna and Damon 1999; King and Lenox 2000; Maxwell, Lyon et al. 2000; Henriques and Sadorsky 2006; Barla 2007)

The gaps in the existing literature and the rise of voluntary programs in the developing world lead us to wonder if voluntary programs will work in less developed countries (LDCs) such as Thailand, and, if they do, whether or not they should be formally and informally encouraged. Thus, this research aims to obtain a better understanding of voluntary environmental programs (VEPs) in the developing country context by looking at one international program, the ISO 14001 environmental management system certification, in Thailand. More specifically, the study aims to answer three sets of research questions:

(1) When formal regulations and enforcement are weak, what motivates firms to voluntarily adopt ISO 14001? How do firm characteristics influence their VEP adoption? Is connectedness to the global economy an important factor?
(2) For firms in Thailand, how does ISO 14001 affect environmental performance? Do firms with ISO 14001 perform better environmentally?
(3) What are the firm's opinions regarding ISO 14001 adoption and government encouragement of it? What has the government done that has helped firms achieve certification? What can the government improve on? How do firms react to government promotion?

In seeking to answer the above research questions, the study will focus on the manufacturing sector and on three sectors in particular – food and beverages (ISIC[2] 15), textiles and garment (ISIC 17, 18), and electronic and electrical appliances (ISIC 30, 31, 32). These industries have been carefully chosen to represent the three main types of industries found in Thailand.

The report begins with the conceptual framework section, which reviews and develops the theoretical literature on voluntary approaches to suit the context of the developing world. Following this are sections providing background information on the Thai economy, its manufacturing sector, the three industries of interest, and environmental matters in Thailand. Next is a section which empirically examines firm characteristics and ISO 14001 participation. This section also looks at the environmental effectiveness of voluntary program participation.

[2] ISIC stands for International Standard Industrial Classification, which is published by the UN. At present, ISIC Revision 4 has been announced, but the ISIC codes quoted here are from Revision 3, the version that is still being used to classify industrial activities in Thailand.

Section 5.0 that follows describes the findings from the primary survey, and Section 6.0 sounds off the report with the conclusion.

2.0 CONCEPTUAL FRAMEWORK

2.1 Voluntary Programs in Developing vs. Developed Countries

Although voluntary programs in developed and developing countries share many similarities, there are still differences both in the nature of the programs themselves, as well as in the context within which the program operates. While the objective of voluntary initiatives in industrialized countries is typically to promote beyond compliance with existing environmental regulations, for developing countries, the objective is more to combat rampant non-compliance with existing environmental regulations (Blackman, Lahiri et al. 2007).

The contexts within which the firms operate are also different. Firms in developing countries operate in smaller economies where the influence of the international community is of great importance. Firms in developed countries, on the other hand, are less influenced by international factors, but are more affected by domestic influences (see, e.g., Karamanos 2001; Khanna 2001). Furthermore, developing country firms operate in a context where environmental regulations are usually less stringent, legal structures are relatively weaker, property rights are not as well-defined, and the government has limited budgets for regulatory enforcement. Regulatory power in most developing countries is also known for being strongly influenced by public-sector interest, and for a lack of political will, manpower and budgets for enforcement (World Bank. 2000; Blackman and Sisto 2006).

Since several factors are different for voluntary programs operating in the context of developing countries, voluntary approaches in such countries should be separately considered from those in more industrialized countries. However, the literature on this is quite thin, with the majority of existing papers focused on programs in Latin America rather than the developing economies of Asia (see, e.g., Rivera 2004; Blackman and Sisto 2006; Blackman 2008). Thus, a conceptual framework that deals specifically with voluntary programs in the developing world is necessary.

2.2 Motivation for Participation

Participation in voluntary programs is often seen as an anomaly in conventional economic theory. Since environmental mitigation imposes costs on firms while the benefits are positive externalities, analysis suggests that firms will only abate up to the point required by existing regulations. For developing countries with low regulatory requirements and limited monitoring and enforcement, economic theory suggests that pollution emissions will be unconstrained. Yet, in reality, several firms in the developing world have opted to take part in voluntary environmental initiatives. Furthermore, several plants have been found to have the environmental performance level of their counterparts in developed Western nations with stricter environmental standards (Hettige, Huq et al. 1996; Pargal and Wheeler 1996).

2.2.1 Profit Maximization Behavior in Non-competitive Markets

Traditional environmental economic analysis of firms' responses to environmental policy that conclude that firms have no incentives to reduce pollution emissions when environmental laws are absent, or to go beyond compliance with existing regulations, typically assume that profit-maximizing firms take prices and regulations as given (Cropper and Oates 1992; Storey, Boyd et al. 1999; Khanna 2001). In reality, however, firms may still be able to reap positive benefits from participating in voluntary programs under certain circumstances.

Under monopolistic competition, a market structure commonly found, firms produce differentiated products which are imperfect, but close substitutes for the products of their peers. Product variation allows different prices to be charged for the products, allowing the market to tap into the different consumption preferences of the consumers. In a world such as today where more and more people are concerned about the environmental consequences of their consumption behavior, products with desirable environmental attributes are in demand. Since preference for a clean environment is often associated with affluent consumers, firms which differentiate their products by environmental quality can recover some of the costs of investing in pollution control and/or green product design by collecting price premiums from customers.[3]

Product differentiation by environmental quality can also allow firms to capture market share when consumers care about the environmental attributes of products. Considering a two-stage duopoly model where products are homogeneous except in the environmental impact of their production, Arora and Gangopadhyay (1995) found that complying to a higher environmental standard in markets with a high degree of product homogeneity and low industrial concentration, but with provision of the firm's environmental information, firms that distinguish their products in terms of environmental quality can gain market share. Thus, despite the costs of reducing the product's environmental impact, firms can be compensated by sustained profits in the long run.

2.2.2 Non-profit Objectives of the Firm

In the traditional neoclassical economic framework, firms are treated as cohesive units or quasi-individuals, whose main objectives are to maximize profits (Heyer, Rao et al. 2002). In reality, however, firms are comprised of individuals who play different roles within the firms. Firm management also comprise of individuals with their own beliefs, values, and preferences, all of which can come into play when making management decisions. Thus, firms may not always have the sole objective of maximizing profits (Griffiths and Wall 2001). Participation in voluntary programs, then, must also be considered from the perspective of the various objectives of the firm.

Management decisions may be made with the objective of maximizing the utility of the firm's managers. While profit maximization takes only the costs and benefits firms face into account, utility maximization incorporates the idea that the values and beliefs of the firm's management influences firm behavior. However, the two objectives need not be in conflict with

[3] For an example of the estimation of such price premium see Teisl *et al.* 2002.

one another. Indeed, an environmentally-conscious manager may endorse voluntary programs because they believe that it is the right thing to do, and that doing so can prove beneficial for the firm in many respects. Thus, while the objective function is the manager's utility, that utility can be a function of both the firm's profits and environmental performance (Ervin, Wu et al. 2008).

Firms may also be maximizing revenues or growth, rather than profits. For publicly-owned companies, owners are not managers, and the goals of the management and of owners may differ. Baumol (1959) suggests that since management compensation is correlated to sales revenue rather than profits, firms which are run by managers have a tendency to maximize sales revenues. Williamson (1964) also points out that managers prefer to maximize sales revenues because doing so is the easiest means of providing additional funds for managers to work with. Thus, managers who want to increase satisfaction by spending more on such things as staff and projects will want to maximize sales revenues. As pointed out in the profit-maximization behavior section, product differentiation can lead firms to charge higher prices for its product, thus obtaining more revenues for each unit of product sold.

Firm owners and managers may also want to maximize growth. Managers like to see an increase in demand for the firm's products and services to raise power or status. Shareholders, on the other hand, like growth in the firm's capital value in order to increase personal wealth (Marris 1964). For firms in developing countries where owners are typically managers, firms may prefer growth in the demand for its products and services rather than to see an increase in the firm's capital value since for such companies the main source of wealth for owners comes from the sale of its products. Voluntary program adoption can supply firm owners and managers with this growth in product demand. This is especially true when consumers are environmentally conscious and when firms are exporting to overseas markets. ISO 14001 certification may be stipulated by the importing country or the buyer so having ISO 14001 certification also means access to these markets and buyers.

2.2.3 Stakeholder Pressures

The decision to adopt a voluntary program can be influenced by various stakeholders within the firm. The behavioral and group behavior perspective of the firm sees the firm as an organization comprising many individual groups, all of which have their own objectives and goals (Griffiths and Wall 2001; Heyer, Rao et al. 2002). These groups compete to gain prominence within the firm and this may have some influence on the decision to participate in a voluntary program. In addition to this, institutional theory posits that stakeholders impose both coercive and normative pressures on firms which can also affect their adoption decision (Delmas and Toffel 2004). Club theory also emphasizes the role stakeholders play in determining the value of signing up for green clubs such as ISO 14001 certification (Potoski and Prakash 2005; Prakash and Potoski 2006a). In addition to this, from the strategic network perspective also states that the networks of relationships between firms and stakeholders in which firms are embedded can profoundly influence the conduct and performance of firms (Gulati, Nohria et al. 2000). For firms in developing countries, five stakeholders are of vital importance – its customers, its owners, its management, its investors, and its regulators.

As purchasers of the products and services provided by the firm, customers directly affect the firm's revenues and, thus, the firm's decision making. This gives rise to the idea that consumers can help improve the environment by exercising their purchasing power, or 'green consumerism' (Cairncross 1995). Thus, firms may sign up for voluntary programs such as ISO 14001 in order to cater to consumer demand for products manufactured via environmentally-friendly production processes.

While customers may determine firm revenues, decisions within the firms are made by firm owners and managers. For firms in the developing world, most of which are not publicly traded, owners and managers play an important role in determining firm policies, including the decision to undertake voluntary programs such as putting into place environmental management systems (EMSs). The educational background, values, and beliefs of the firm's owners and managers can affect the decisions they make (Nakamura, Takahashi et al. 2001; Rivera and De Leon 2005; Ervin, Wu et al. 2008). Nationality may also matter. Managers and owners from developed countries are expected to be more aware of the higher expectations for corporate environmental protection imposed by OECD consumers, the media, and international environmental organizations (Neumayer 2001; Rivera and De Leon 2005). Management and owners from industrialized countries are also more likely to have access to low-cost clean production technologies through their exposure to more stringent environmental standards in their OECD facilities. Furthermore, developing country plants owned by foreigners or plants which are subsidiaries of multinational companies are more visible to stakeholders both domestically and internationally, thus receiving more pressure to be environmentally friendly (Pargal and Wheeler 1996; Wheeler 1999; Christmann and Taylor 2001; Delmas 2002; Rivera 2004; Rivera and De Leon 2005).

In developing countries, where environmental regulations suffer from non-stringency as well as monitoring and enforcement problems, informal regulation from local communities and environmental groups play an important role in determining a firm's environmental protection (Hettige, Huq et al. 1996; Pargal and Wheeler 1996). While the lax enforcement of environmental regulations implies that a firm faces no price from the regulators for emitting pollution, the demand for a clean environment from local communities and environmental groups impose non-zero prices for pollution on the firm. Furthermore, pollution emissions from firms that affect local communities often result in hostile relationships between all parties. In a similar way to using participation in voluntary programs to weaken the effectiveness of environmental and consumer groups lobbying for more stringent regulations, adoption of voluntary environmental initiatives can help thwart the direct pressures firms face from local communities and environmental groups. Thus, faced with such pressures, firms are more likely to opt into voluntary initiatives.

For some firms, investors may play a role in determining the decision to adopt voluntary agreements. This is especially true for publicly-traded firms where shareholders and investors exert indirect pressure on firms via the financial market. Poor environmental performance may signal to investors that firms are inefficient or are more exposed to liabilities, penalties and high compliance costs. As a result, publicly traded firms are more likely to want to participate in voluntary programs to prevent negative stock returns (Alberini and Segerson 2002; Khanna and Anton 2002; Uchida and Ferraro 2005).

Regulators can influence a firm's decision to participate in voluntary programs in a number of ways. They determine background regulatory threats, which provide the policy context within which firms operate. For negotiated agreements and public voluntary agreements, regulators play a key role in determining the requirements of voluntary initiatives. Regulators can also come up with a number of measures to promote the adoption of voluntary programs by firms. The role of the regulator will be looked at in more detail in the section on the role of the government.

2.2.4 Regulatory Influence Theory

Regulatory influence theory suggests that firms do not always take regulations as given as conventional environmental economics literature assumes. From the perspective of this theory, adoption of voluntary initiatives are seen as attempts to influence or manipulate the regulatory system (Welch, Mori et al. 2002). In a world where political lobbying efforts do exist, and regulatory monitoring and enforcement are hampered both by a lack of personnel and financial resources, firms have ample opportunities to influence regulations in their favor. By engaging in voluntary initiatives, firms may be able to thwart regulatory scrutiny, and garner goodwill from regulators. Firms may also be able to influence the regulatory process itself. Future environmental regulations may be pre-empted via regulatory capture or they may be promoted by firms in order to drive down future competition (Maxwell, Lyon et al. 2000; Lyon and Maxwell 2002; Lyon and Maxwell 2004).

2.2.5 Club Theory

Participation in voluntary initiatives such as ISO 14001 can also be seen as membership in green clubs (see, e.g., Potoski and Prakash 2005; Cashore 2007; Gugerty 2007). By becoming members, firms derive mutual benefit in terms of the reputation associated with the 'brand image' of the club, which depends on the requirements of club membership. Thus, club members share the same characteristics in terms of program requirements. Furthermore, the benefits members receive is a club good, being excludable from non-members, but non-rival to a certain extent. (Potoski and Prakash 2005; Prakash and Potoski 2006a; Kotchen and van't Veld 2009).

By becoming members of a green club, firms derive the mutual benefit in terms of the reputation associated with the 'brand image' of the club, which depends on the requirements of club membership. Three types of benefits are generated from participation in green clubs: private benefits, club goods, and public goods, the first two of which are important in the firm's decision to participate in green clubs. Participation in voluntary programs generates private benefits for firms mainly in terms of improved production efficiency and a reduction in costs. Membership in green clubs adds further benefits in terms of reputational values, which decreases transaction costs between the firms and its stakeholders[4]. Finally, society benefits from the private provision of public goods in terms of a cleaner environment (Potoski and Prakash 2005; Prakash and Potoski 2006a; Kotchen and van't Veld 2009).

[4] In terms of information gathering costs for the firm's stakeholders, and information provision costs for the firms themselves.

2.3 Firm Characteristics

Firm characteristics also play an important role in determining participation. They can affect the costs and benefits associated with the adoption of voluntary initiatives. Characteristics also determine which stakeholders and factors are influential to the firm, affecting the firm's objectives and priorities. For firms in similar industries facing similar external pressures, differences in plant- and firm-specific characteristics can also result in differences in participation decisions (Delmas and Toffel 2004). Furthermore, firm characteristics that can influence participation decisions are different for firms in the developing world and those in more industrialized countries. For firms in the developing world, characteristics such as export orientation, foreign direct investment, location, size, and product type can influence a firm's decision to adopt voluntary initiatives such as ISO 14001.

2.3.1 Export Orientation

For firms in developing countries with open economies, connectedness to the global economy is an important factor determining a decision to participate in a voluntary program. This is especially true for the decision to adopt international standards such as ISO 14001. One firm characteristic that determines the influence of the international community on the firm is the firm's export orientation. By producing for export, the firm's stakeholders are expanded from local players to international ones. Not only is the firm subjected to the demands of overseas consumers, but the firm is also affected by the rules and regulations of the importing market. For firms based in developing countries, but exporting to industrialized countries, the more environmentally progressive values of the industrialized country consumers have to be taken into consideration. Participation in voluntary environmental programs is one way such firms can signal to their overseas consumers that the firm has not been negligent towards the environment. Anecdotal reports also suggest that more and more customers in developed countries are requiring their suppliers to adopt internationally-recognized environmental standards such as ISO 14001 (Neumayer and Perkins 2004). Thus, firms which export may have greater sensitivity to the trend of green-consumerism (Dasgupta, Hettige et al. 2000). Furthermore, Henriques and Sadorsky (2006) suggest that the more export-oriented the facility is, the higher the benefits that may accrue to it from taking visible actions to protect the environment.

The firm's export orientation also has implications for the regulatory context to which the firm is subjected. Different countries have different environmental standards, some of which are imposed on firms wishing to export there.[5] Thus, while firms producing for the domestic market operate within the context of domestic regulations only, export-oriented firms producing for overseas markets are also subjected to the different environmental regulations and requirements of their importing markets. When those markets are industrialized countries with more stringent environmental requirements, exporting firms may adopt internationally recognized voluntary programs such as ISO 14001 in order to demonstrate their higher environmental standards to the importing country.

[5] Examples are the European Union's Waste Electrical and Electronic Equipment Directive (WEEE) and the Directive on the Restrictions of Hazardous Substances (RoHS) which impose environmental requirements on international manufacturers of electrical and electronic equipment wishing to supply EU markets.

2.3.2 Foreign Direct Investment

Another firm characteristic that determines the influence of the international community in the decision making process of the firm is the amount of foreign direct investment (FDI) within the firm. Entailing both ownership and control, FDI brings in the international stakeholder as owners and, oftentimes, managers of the firm. Thus, the amount of FDI within the firm will highlight which stakeholder is important. A firm without FDI will be dominated by domestic stakeholders, while firms with FDI will bring into play international stakeholders. The country of origin of the FDI is also important in determining whether or not firms will participate in voluntary environmental programs. As stated above, firms with owners and managers from industrialized countries are more likely to participate in voluntary initiatives because of many reasons including more awareness of the higher expectations for corporate environmental protection, and more knowledge regarding technologies available (see, e.g., Wheeler 1999; Neumayer 2001; Rivera and De Leon 2005). Furthermore, firms which are subsidiaries of multinational companies, being more visible and subjected to both domestic and international stakeholders, may be more likely to seek to alleviate these pressures by participating in voluntary programs (see, e.g., Pargal and Wheeler 1996; Christmann and Taylor 2001).

Another aspect of FDI regarding the environment is whether multinational companies are more likely to adopt voluntary environmental controls compared to local firms in the same industry. As argued above, multinational companies, with their larger size, superior technology, and better management, could be more concerned for the environment than indigenous firms. However, there is a counter argument that some multinational firms move from more industrialized countries to developing ones because they are attracted by the less stringent environmental controls there. As a result, such firms do not take into serious consideration the host country's environmental regulation. As adoption of voluntary controls could add to their costs, these firms would be less likely to participate. Another accusation against FDI companies is that they tend to concentrate in 'modern industries' such as electronics, electrical appliances, and transport equipment that are intensive hazardous waste polluters. These two conflicting views of multinational companies have not been resolved.[6] Thus, further exploration of this issue is needed.

2.3.3 Location

Location of the plant can determine the regulatory and policy context of the plant, both of which can affect a firm's decision to participate in a VEP. Club theory predicts that in a context where there is regulatory flexibility, self-disclosed non-compliance from voluntary program participation may allow a temporary regulatory reprieve, thus inducing firms to participate in voluntary programs (Prakash and Potoski 2006a). Background regulatory threat is also important in determining program participation. In the model developed by Segerson and Miceli (1998), a firm will choose to participate in a voluntary agreement if there is non-zero legislative threat.

[6] Closely related to this is the literature on the effects of international trade on the environment. While neo-classical economic theory predicts that trade is beneficial for the environment, others have countered that trade leads to the dumping down of environmental regulations in countries competing to attract foreign firms by reducing the environmental requirements of manufacturing facilities. Further reading on this topic include the following papers: Johnstone (1995), Copeland and Taylor (1994, 2004), Panayotou (2000), and Muradian (2001).

Club theory also predicts that more stringent background regulations will result in a higher likelihood of participation in voluntary schemes since higher background threats reduce the relative cost of participating in voluntary schemes.[7]

Even though several studies have highlighted the role played by background legislative threats, for developing countries with small background regulatory threats, voluntary programs may not be completely inappropriate. The lack of environmental regulatory infrastructure can motivate regulators to rely on voluntary environmental agreements[8] (Blackman and Sisto 2005). Under certain conditions, adoption of voluntary programs in the context of weak regulatory capacity may be welfare-improving by generating private investment in pollution control and more public-sector investment in regulatory capacity (Blackman, Lyon et al. 2006).

The community pressure for good environmental performance faced by each plant may also depend on where the facility is located (Hettige, Huq et al. 1996; Pargal and Wheeler 1996; Gamper-Rabindran 2006; Prakash and Potoski 2006a). In Thailand, there has been a heavy concentration of industrial activities around the Bangkok Metropolitan Region, thus leading to environmental problems including air and water pollution and industrial waste disposal. To encourage the setting up of industrial enterprises in different regions of the country, the Industrial Estate Authority of Thailand (IEAT) was established in 1972. In recent years, the IEAT has increasingly paid attention to the pollution problem generated by factories located within industrial estate zones. The establishment of industrial estates fosters the localization of manufacturing factories and enables factories to share common facilities such as water effluent treatment plant and solid and hazardous waste disposal facilities, thus helping to minimize environmental impacts for industrial activities. Furthermore, the IEAT is more stringent about monitoring the environmental performance of factories located in industrial estates. Thus, it can be expected that factories located in industrial estates are more likely to adopt voluntary programs.

2.3.4 Size

Firm size is one firm characteristic that has been cited as an important determinant of voluntary scheme participation. Compared with smaller firms, bigger firms are more visible in the public eye and are thus more likely to be exposed to liabilities (the so-called deep-pockets argument) as well as other follies associated with a negative corporate reputation (see, e.g., Hettige, Huq et al. 1996; Pargal and Wheeler 1996; King and Lenox 2000). For such firms, the costs of having a negative environmental image are high. As a result, large firms are likely to participate in voluntary programs in order to signal that they have superior environmental performance (Darnall 2001). Visible firms may also partake in voluntary approaches to improve their public image and reduce compliance or penalty costs (Khanna and Damon 1999; Khanna 2001).

[7] When deciding whether or not to adopt voluntary programs, firms compare the costs of adoption with the cost of complying with existing regulations. When background regulations are stringent, cost of compliance is not that different from the cost of voluntary program participation. However, participation in voluntary programs bestows additional benefits beyond complying with existing regulations. Thus, club theory predicts that firms situated in areas with more stringent regulations are more likely to become members of green clubs.

[8] Although this reliance on voluntary agreements while regulatory capacity is weak may, ultimately, undermine the agreement.

Bigger firms are also more likely to face relatively lower marginal costs of environmental protection due to economies of scale, plentiful staff, and abundant capital. Environmental protection requires both financial and human capital. In setting up the environmental management systems (EMSs) required for ISO 14001 certification, manpower is needed to create and maintain a fully-functioning EMS. Meeting ISO 14001 standards also requires financial resources to hire consultants, train staff, and to set up a working environmental management system. For larger firms, the costs of voluntary program participation may be absorbed by their greater financial capabilities and access to human resources, making such firms more likely to participate in voluntary initiatives than smaller ones (see, e.g., Arora and Cason 1995; Prakash and Potoski 2006a).

2.3.5 Product Type

The products produced by the firm also have the potential to affect program participation since the firm's production process is linked to the kinds of pollution it generates. Firms in dirty industries tend to want to participate in voluntary programs to boost their positive image with respect to the environment. As King and Lenox (2000) point out, for firms in the chemicals industry, programs such as Responsible Care were 'essential to its public acceptability and, ultimately, its viability' (p.699). Different industries also produce different pollution emissions. Textiles factories and food product manufacturers, for example, are big emitters of water pollution, while the main environmental impact of electronics and electrical appliance factories is hazardous waste.

Furthermore, whether or not the product produced is an intermediate product or a final product also determines the type of buyers who are influential to the firm. For firms selling final products, supplying the consumer market directly makes the firm more visible to the public and thus subject to more scrutiny. Therefore, for such firms, firm image, or the image of the brand associated with the firm's product, is important. Thus, being directly affected by the pressures exerted upon by green consumers, firms producing final goods are more likely to invest in measures that will improve their public image, measures such as signing up for voluntary environmental initiatives.

While firms producing intermediate goods are not usually directly subjected to public scrutiny and consumer pressure, they may be subjected to the demands of those at the higher end of the supply chain. Since these buyers are not individual consumers but are companies, consideration of the distinction between final and intermediate goods allows the differences between the role of the consumers and the role of the firm, as buyers, regarding environmental protection to be manifested.

2.4 Environmental Performance

Understanding the environmental impact of voluntary initiatives is of great importance in evaluating the viability of voluntary programs as a tool for environmental management. The framework of equilibrium emissions adopted in Pargal and Wheeler (1996), Hettige et al. (1996), and Dasgupta et al. (2000) will also be adopted here. The framework will be extended using insights from club theory and will be adapted to suit the developing world context.

The equilibrium emissions framework uses the manufacturing plant as a unit of analysis and considers the behavior of the plant when formal regulations are weak or absent. Dasgupta et al. (2000) used this framework to look at factors determining the plant's emissions per unit output. Under this modified framework, both the regulators and the local communities come into play in determining the plant's equilibrium pollution emissions. Pressures from the regulators and local communities are exerted via two schedules: the expected marginal penalty (EMP) schedule, and the marginal abatement cost schedule (MAC). Equilibrium emissions emitted by the firm per unit output is indicated by E* in Figure 1, while E_{reg} indicates the emissions standard specified by formal regulations. In Figure 1, the plant is not complying with existing environmental regulations.

Several factors determine the slope and position of both the EMP and MAC schedules. Under the framework used by Dasgupta et al. (2000), the slope and position of the MAC schedule is determined by factors including pollution emissions per unit output, plant and firm characteristics such as size, multi-divisional status, industrial sector, and the degree and quality of environmental management system (EMS). The EMP schedule, on the other hand, is dependent on factors such as the pollution emissions intensity of plants, ownership, formal regulatory activity, local community action, and trade links of the plant.

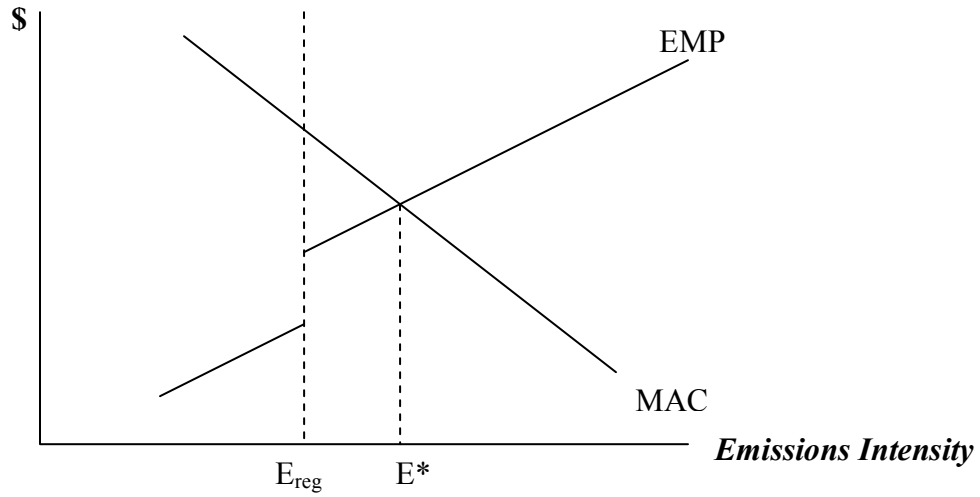

Figure 1. Equilibrium Emissions Framework, Emissions per Unit Output

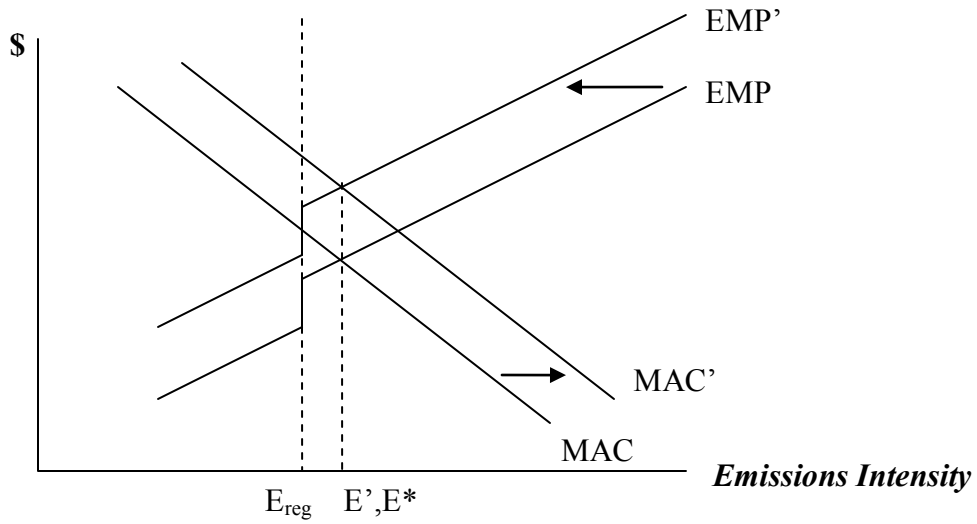

Figure 2. EMP and MAC Shift in Opposite Directions, Results Unclear

If we consider participation in voluntary programs such as ISO 14001 as membership in green clubs, we can see that this has implications for both the MAC and EMP schedules. Membership entails both start-up and ongoing costs,[9] shifting the MAC schedule out to the right. However, these costs might be offset by cost savings from improved efficiency and reduced pollution emissions as a result of the ISO 14001 process. Thus, the effect of participation on the MAC schedule is unclear.

Club membership also affects the EMP schedule. Signing up for ISO 14001 may increase EMP by adding another group of stakeholders to the firm – auditors of the system. ISO 14001 also requires firms to be in compliance with existing environmental regulations and establishes paper trails to monitor this. If firms are discovered to be out of compliance and this discovery is disclosed, firms stand to face increased regulatory scrutiny. On the other hand, being a green club member may deflect attention away from regulators and other stakeholders if the club reputation is good, thereby decreasing EMP. Thus, the resulting shift in the EMP schedule from membership in green clubs is unpredictable.

2.5 Role of Government

Successful implementation of voluntary environmental programs requires the government to play many important roles. One role for the government is to determine the background regulatory and policy context within which firms operate. This role of the government has received much attention from the voluntary agreement literature. Several papers on this topic posit that firms are more likely to participate in voluntary programs when there are strong underlying regulatory and legislative threats. For example, in the model developed by Segerson and Miceli (1998), a firm will choose to accept the government's offer of participating in a voluntary agreement when the probability of the government enacting tougher legislation if the

[9] Environmental management systems (EMSs) certified to the ISO 14001 standard must be reassessed every three years. If the EMS has not been well maintained, certification may be revoked.

firm fails to participate is non-zero. This view is also supported by several other papers (see, e.g., Henriques and Sadorsky 1996; Videras and Alberini 2000; Welch, Mazur et al. 2000).

Despite this, voluntary programs have been shown to be a better policy choice when legislative threats are low under some circumstances. In a model developed by Glachant (2007), voluntary programs are preferred to a legislative pollution quota when lobbying by businesses is particularly strong. Glachant (2007) also concludes that in situations where legislative threats are credible and sufficiently strong, it is better to use legislation as a tool for environmental management rather than voluntary approaches. This view coincides with Blackman et al. (2006), which uses a dynamic game theory model to show that promoting voluntary agreements may be social-welfare-enhancing when the probability of federal enforcement is low, and voluntary agreements allow for a significant penalty for non-compliance in the future.[10]

The role of the government in determining the existing background regulatory context for voluntary programs is especially important for schemes such as the ISO 14001 environmental management system certification. Sponsored by an international non-government organization such as the International Organization for Standardization (ISO), the ISO 14001 program is overseen by local government agencies. For Thailand, this agency is the Thailand Industrial Standards Institute (TISI), which is a part of the Ministry of Industry. TISI takes the international standard, adopts it for use in Thailand, and oversees different certification bodies, which have the authority to grant ISO 14001 certification to firms. Furthermore, the minimum requirement for having ISO 14001 certification is compliance with existing regulations. As a result, the government's role in determining the background regulatory context within which the firm operates is also important for the ISO 14001 program.

As a policymaker, the government also has a role to play in determining whether or not to promote the use of voluntary programs as a means for environmental management. While the government does not set the requirements for programs such as the ISO 14001 certification, the government can choose whether or not to promote the use of voluntary programs as an environmental policy tool. It is also within the jurisdiction of the government to decide whether such programs should be the sole environmental policy adopted, or should be implemented as one policy instrument in a mixture of other policy tools. This latter option is the recommendation of many policy-oriented studies (Bizer and Jülich 1999; OECD 2003; Prakash and Potoski 2006a).

Finally, implementing environmental policies is a two-way process, and, as such, the opinions of those on the receiving end of the policies are also worthy of consideration. How firms perceive the role of the government and government promotional policies regarding voluntary environmental programs may also affect participation and participation outcomes. Measures designed by the government intending to promote voluntary program adoption may backfire if the measures have not been designed to meet the needs of the firms. Thus, the role of

[10] Blackman et al. (2006) examines voluntary approach by way of negotiated agreements between environmental regulators and industries. The paper develops a dynamic model in which voluntary agreements adopted provides a grace period when no penalties are exacted on non-complying firms. However, outside of this period, more stringent penalties will be applied if firms still fail to comply with environmental regulations.

the government and government promotional measures regarding voluntary programs should also be viewed from the firm's perspectives.

3.0 BACKGROUND INFORMATION

3.1 Thai Manufacturing Sector

From its modest beginning in the early 1960s, the Thai manufacturing sector has grown rapidly and overtaken the agricultural sector as the nation's predominant foreign exchange earner. As of April 2009, the country has 146,752 factories listed with the Department of Industrial Works (DIW), an underestimation of the true number of factories actually in operation in the country since small operations are not required to be registered with the DIW, and many small enterprises located in town and rural areas are not included in the registered factory listing. Of the listed factories, the majority are small enterprises which employ no more than 50 people. Another sizeable share is the medium-scale enterprises which employ no more than 200 people. Large-scale enterprises are small in number, but significantly affect both the country's economy and its environment (see Table 1).

Table 1. Number of Manufacturing Enterprises by Factory Size, 2009

	Small	Medium	Large	Total
Number of Factories	132,794	10,335	3,623	146,752
Percentage	90.5	7.0	2.5	100.0

Source: Author's calculations using data from DIW webpage (www.diw.go.th)

Apart from the domination of small and medium enterprises (SMEs), industrial activities in Thailand are also highly concentrated in a few regions. These regions are Bangkok and its six surrounding provinces which comprise the Bangkok Metropolitan Region (BMR), the Central region, and the Eastern region of the country. Industrial activities are also clustered around industrial estates located throughout the country. At present, Thailand has 36 industrial estates in 14 provinces countrywide.

Foreign direct investment (FDI) and export orientation are other important features of the Thai manufacturing sector. Thailand has welcomed FDI since the country first began industrialization in the 1960s and even though the amount fluctuated and the patterns have changed, FDI still remains an important part of the manufacturing sector in Thailand. Export orientation has also been an important industrial policy since the 1970s. Today, Thai firms not only produce for the domestic market, in many industries they are also important producers for the world market.

The manufacturing sector in Thailand today produces an array of manufactured products which can be roughly classified into five categories. Of this five, three categories are the most important to the Thai economy. Engineering industries are important in terms of production and exports. Labor-intensive industries are major employers in the country. Finally, the importance of resource-based industries lies in the emergence of new products, the increasing value of

production quantity, and, since this type of industry relies primarily on domestic raw inputs, the ability to earn high net incomes in terms of foreign exchange. In addition to this, various industries within these three groups such as the manufacture of electronics and electrical appliances, textiles and clothing, and food and beverages are industries that comprise the lion's share of the country's manufactured products. Thus, these three industries are the focus of this study.

3.2 Food and Beverages

The manufacture of food products and beverages is classified by code 15 of the UN's International Standard Industrial Classification (ISIC) revision 3[11]. This category includes the production, processing and preservation of meat, fish, fruit, vegetables, oils and fats; and the manufacture of dairy products, grain, mill products, starches and starch products, prepared animal feeds, and beverages. Factories in Thailand fall into all of these categories. However, factories producing grain, mill products, starches, and animal feeds are the most numerous due to the high number of rice mills in the country. Second in number are factories manufacturing other food products and establishments that produce, process, and preserve meat, fish, fruit, vegetables, oils and fats.

3.2.1 Importance

The manufacture of food products and beverages has been an important industrial activity in Thailand since the country first began industrializing and is closely linked to the country's traditional base of agriculture, aquaculture, and farming. As of 2007, the industry was worth BAHT 255,539 million,[12] 15.14% of the country's total manufacturing value and roughly 6% of the country's GDP (NESDB 2009).

Food products and beverages are produced both for the domestic market and for export markets. In 2008, the export of rice brought the country an estimated BAHT 203,218.72 million or 3.47% of the country's total export earnings. Canned and processed seafood also brought in BAHT 128,923.85 million in export revenue, or 2.2% of the total. Both products were in the top 20 in terms of export earnings (MOC 2009). Thailand is also a major supplier to the world market of various food products including shrimp, canned and processed tuna, processed chicken, rice, and canned and processed pineapple. Main export markets for Thai food products and beverages are Japan, the United States, Malaysia, the United Kingdom, and China.

3.2.2 Industrial Structure

The food and beverage industry in Thailand is made up of 63,454 factories, most of which are small establishments employing no more than 50 people. It is important to note that rice mills account for the majority of this number. Including rice mills, the majority of these registered establishments are located in the Northeastern and Northern regions of the country.

[11] Although the UN has released revision 4 of its ISIC code in 2008, Thailand has yet to adopt this revision. Present industrial classification is done according to ISIC revision 3.
[12] 1988 prices

While the food and beverage industry is resource-intensive, the sector and its related businesses employ a significant share of labor in manufacturing. The food and beverages industry alone employs 665,428 people, or 15.65% of all those employed in the manufacturing sector. Although the overwhelming majority of facilities are small in size, the majority of those employed in this industry work in large factories with more than 200 employees.

Most food and beverage firms are solely owned by Thai entrepreneurs, but there are also foreign firms in the industry. Firms with foreign investments are mostly large and are more export-oriented. They appear more in vegetable and fruit canning, the processing and preservation of fish and fish products, and grain mill products.

3.2.3 Environmental Impact

The main environmental impacts from the food and beverage industry are wastewater, smell, and solid non-hazardous waste. Wastewater is a particular problem for the industry. Activities such as the processing of food, the slaughter and preparation of meat, the manufacture of vegetable and animal oils, the manufacture of alcoholic beverages, and cold storage activities associated with the manufacture of frozen food products are major generators of wastewater. Since organic matter is commonly involved in the manufacturing process, the wastewater emitted is usually full of organic content and has high biological oxygen demand (BOD) values. Large amounts of organic waste can also generate unseemly smells. Bits of paper, tin, and plastics from product packaging also result in solid non-hazardous waste, which must be properly disposed of. In addition to this, the manufacturing process usually involves extensive use of water, heat, electricity, and other fuels.

3.3 Textiles and Clothing

The term 'textiles and clothing' is used here to refer to two manufacturing categories; ISIC 17 – the manufacture of textiles, and ISIC 18 – the manufacture of clothing and the dressing and dyeing of fur. These include the spinning, weaving and finishing of textiles; the manufacture of other textiles; the manufacture of knitted and crocheted fabrics and articles; the manufacture of clothing excluding fur; and the dressing and dyeing of fur, and the manufacture of articles of fur. Thailand has factories that fall into all these categories, with the majority producing clothing and textiles.

3.3.1 Importance

The textiles and clothing industry is a major employer in Thailand. The two industries currently employ about 20% of jobs in the manufacturing sector. Of this number, about 70% are working in the clothing sector, which is the most labor-intensive segment of this industry group. The two industries also contribute to the country's manufacturing GDP. In 2007, the combined value added from the textiles and garment industries was BAHT 156,848 million.[13] This figure is roughly 1.81% of the country's total GDP and 9.3% of the total value added from the manufacturing industry (NESDB 2009).

[13] 1988 prices

The industries together bring in significant amounts of foreign exchange. Although exports of textile products are small compared to exports of clothing, textile products feed into the manufacture of clothing, which is then exported. Exports of clothing brought in an estimated BAHT 101,842.47 million in foreign exchange in 2008. This figure is roughly 1.74% of all export earnings for the country (MOC 2009). Important export markets are the US, EU countries, members of the Association of Southeast Asian Nations (ASEAN), Japan, and China.

3.3.2 Industrial Structure

According to the DIW, there are 7,987 factories in the textiles and clothing industries in Thailand. These factories are mostly small in size, with 4,963 factories employing fifty people or less. The overwhelming majority of these factories are located in the Bangkok Metropolitan Area. Factories are also dispersed throughout the country in various regions. Indeed, local hand-woven fabrics with unique designs and textures are well-known products from particular regions especially in the North and the Northeast. However, in terms of the industrial manufacture of textiles and clothing, no one region stands out as much as the BMA when the number of industrial manufacturing facilities is taken into account.

Being labor-intensive, the textiles and clothing industries together employ approximately 812,689 people, almost 20% of all labor employed by the manufacturing industry in Thailand. While small facilities dominate, more than half of the labor force in manufacturing is employed in large establishments. Another 26% of the labor force is employed in medium-sized enterprises, and 16% are employed in small-scale factories.

The proportion of foreign investment in the textiles and clothing industries is small. Out of about 8,000 registered facilities, only about 500 firms have foreign investment. Of this number, there are 15 wholly foreign-owned companies with the rest being joint ventures between Thai and foreign entrepreneurs. These foreign firms engage in a number of activities including textiles, fibers, spinning, and clothing. As with the case in the food and beverage industry, foreign firms are usually large in size.

Thailand's textiles and clothing industries have been increasingly export-oriented over the years. The main export products are clothes, which comprise more than half of the export value. Other exported products include cotton and synthetic fibers, and textile fabrics. Thailand's textiles and clothing exports are directed to many countries, with the United States and the European Union being important destinations. In Asia, Japan, China, and the ASEAN countries have become important importers of Thai textile fibers, fabrics, and garments in recent years.

3.3.3 Environmental Impact

The manufacture of textiles and clothing is associated with water pollution. Wastewater is generated from both the bleaching and dyeing process and the subsequent clean up process, where water is used to clean machines and the factories. Wastewater produced usually has high BOD, COD, and pH values. The water may also be of a high temperature and may be contaminated with heavy metals such as copper, lead, chromium, and zinc from the dyes used. Other chemicals and solids from the manufacturing process may also be present. In addition to

this, the manufacture of yarns and fibers for making fabrics generates chemicals which are released and unpleasant odors. The weaving process mostly generate noise and air pollution, while the manufacture of finished clothing results in the generation of solid non-hazardous materials, such as bits of cloth and threads from the manufacturing process and bits of paper and plastics from packaging. (TEENET 2010).

3.4 Electronics and Electrical Appliances

The manufacture of electronics and electrical appliances fall into three categories according to the International Standard Industrial Classification (ISIC) revision 3. The term encompasses the manufacture of office, accounting, and computing machinery (ISIC 30), the manufacture of electrical machinery and apparatus (ISIC 31), and the manufacture of radios, televisions, and communication equipment and apparatus (ISIC 32). All three ISIC categories exist in Thailand, but the country mainly manufactures mid-stream products such as printed circuit boards (PCBs) and integrated circuits (ICs), as well as downstream products such as finished electronic goods and electrical appliances.

3.4.1 Importance

The manufacture of electronics and electrical appliances has overtaken traditional agriculture-related industries as the main export product of Thailand and contribute much to the country's GDP. The industries have grown and changed over the years and they currently produce many different types of products. These industries have also changed from mostly assembling imported components into finished products, to producing some of the components that go into finished products domestically. In addition to this, production of electronics and electrical appliances has expanded from producing mainly for the domestic market, to producing for the export market. Since the Asian Financial Crisis in 1997, the value of the two industries has steadily increased from 14.26% of all manufacturing GDP in 1997 to 21.14% of all manufacturing GDP in 2007.[14]

As of 2007, the total value added from the manufacture of electronics and electrical appliances was BAHT 356,776 million[15] or 8.58% of the country's total GDP. The electronics industry is also a big foreign exchange earner with computing machinery and parts being the country's top foreign exchange earner, bringing in 10.34% of the total foreign exchange earned in 2007. Other products in these industries also rank in the top-20 list for highest foreign exchange revenues. The export of integrated circuits ranks fifth in terms of foreign exchange earned, while electrical appliances and parts, air conditioners and components, and radio, television and components rank fourteenth, fifteenth, and sixteenth respectively (MOC 2009; NESDB 2009). However, according to the results of the recent industrial census conducted by the National Statistical Office (NSO) and the surveys of the Office of Industrial Economics (OIE), various electronics and electrical products have to rely heavily on imported parts, components, and other materials. The average import content of the electronics and electrical appliances industries is about 50%. Computer parts and components, including disc drives,

[14] Calculations were done using NESDB data of GDP from the manufacturing sector at 1988 constant prices.
[15] 1988 prices

integrated circuits, and television sets, are some of the products with the highest percentage of imported contents.

3.4.2 Industrial Structure

The number of manufacturing facilities in these industries is far smaller than those in the food and beverage, and textiles and clothing industries. DIW figures from April 2009 show that the industry has a total of 2,966 listed factories. Of this number, the majority employ 50 people or fewer, 607 factories are of medium size and 442 factories employ more than 200 people. As with the textile and clothing industries, industrial establishments in the electronics and electrical appliances industries are highly concentrated in the BMA. The Central and Eastern regions also have a fair share of facilities. In addition to this, there is also a cluster of electronics and electrical appliances facilities in the North of Thailand in Lampoon Province.

Being less labor-intensive than the textiles and clothing industries, the manufacture of electronics and electrical appliances employs approximately 452,189 people compared with textiles and clothing's 806,745 employees. Of this number, over 80% are employed in large factories of more than 200 employees, 12.81% are employed in medium-sized factories, and 6.87% are employed in small factories.

3.4.3 Environmental Impact

Environmental impacts from the electronics and electrical appliances industry group are particularly serious since the industries involve the use of several hazardous substances. Pollution and adverse environmental and health effects can occur in all stages of the products' life cycles. Toxic substances used in the production process can leak out if improper transported, stored, or handled, and exposure to high dosages of these substances can result in lifetime damage to human health and even death. The improper treatment of residues from the production process can also leak into the environment, resulting in the contamination of soil, freshwater, and groundwater sources. Leakage into the environment is particularly problematic, especially when toxic substances contaminate freshwater sources that serve the local population.

Electronics and electrical appliances are also problematic because of the presence of hazardous waste such as lead, mercury, and cadmium. Several countries have recognized the severity of e-waste and have issued directives and rules regarding the proper disposal of such waste as well as a ban on hazardous contents in the manufacture of electronics and electrical devices. These directives and rules directly affect Thai manufacturers who supply such products to the world market. These directives include the EU's Restriction on Hazardous Substances Directive (RoHS), and the Waste Electrical and Electronics Equipment Directive (WEEE). Similar waste disposal and recycling laws are also present in China, Japan, and South Korea.

Table 2. Number of Factories by Industry and Factory Size, 2009

	Small (1-50)	Medium (51-200)	Large (200+)	Total Factories
Food and Beverages	61,840	1,109	512	63,454
Textiles and Clothing	4,963	2,194	830	7,987
Electronics and Electrical Appliances	1,917	607	442	2,966

Source: Data from DIW webpage (www.diw.go.th)

Table 3. Number of Factories by Industry and Geographical Location, 2009

	BMA	Central	East	North	Northeast	South	Total
Food and Beverages	3,418	3,902	2,725	11,074	37,589	4,746	63,454
Textiles and Clothing	6,203	346	257	495	626	60	7,987
Electronics and Electrical Appliances	1,927	327	385	125	159	43	2,966

Source: Data from DIW webpage (www.diw.go.th)

3.5 Environmental Management in Thailand

3.5.1 Legislation and Institutions for Environmental Governance

Two key laws serve as the main tools for the management of environmental problems associated with manufacturing facilities in Thailand. The first is the Enhancement and Conservation of National Environmental Quality Act of 1992, which sets out the underlying structure for environmental governance in Thailand. The second is the Factory Act of 1992 which, among other things, specifically targets manufacturing firms and specifies measures to safeguard the environment that firms must have in place.

Under the National Environmental Quality Act, the organization in charge of overseeing environmental matters and making important environmental decisions is the National Environment Board (NEB) which comprises the prime minister, ministers from relevant ministries, and several high-ranking civil servants. Working closely with the NEB is the Ministry of Natural Resources and the Environment (MNRE). Under MNRE are organizations such as the Pollution Control Department (PCD), which is responsible for setting ambient environmental standards and for monitoring compliance with these standards.

While the PCD may set ambient environmental quality standards, the specific standards applied to industrial facilities are set by the Ministry of Industry (MOI). The MOI is also responsible for implementing the Factory Act, primarily through the Department of Industrial Works (DIW), which is responsible for overseeing and monitoring all aspects of industrial manufacturing facilities, including environmental matters. Apart from this, industrial standards such as ISO 14001 are overseen by the Thailand Industrial Standards Institute (TISI), an organization within the MOI. Activities within industrial estates, on the other hand, are overseen

by the Industrial Estate Authority of Thailand (IEAT), a state enterprise under the supervision of the MOI.

In addition to government agencies, non-government agencies such as NGOs, public organizations, and citizen groups have begun to play more of a role in promoting environmental management practices. For industrial environmental management, key players include the Thailand Environment Institute (TEI), a non-profit agency that first introduced ISO 14001 to Thailand. Other agencies such as the Management System Certification Institute (MASCI), and the Thailand Productivity Institute also play key roles in providing consultancy services and expert advice on management tools. The Federation of Thai Industries (FTI), a large private sector organization of industrial leaders in Thailand, also has an institute dedicated to environmental matters. In addition to this, there are also various industry-specific institutes that can help firms within particular industries. The three industries of interest also have associated institutes. These are the National Food Institute, the Electrical and Electronic Institute, and the Thailand Textile Institute. Furthermore, a number of non-profit organizations independent from the government also exist to provide academic advice and research services on environmental matters in Thailand. These include the Thailand Development Research Institute (TDRI) and the Good Governance for Social Development and the Environment Foundation (GSEI).

3.5.2 Voluntary Environmental Programs

While the regulatory approach is Thailand's dominant environmental management strategy, attempts have been made to use other tools. This is particularly true for economic instruments such as emission charges, user fees, and taxes. In addition to this, voluntary approaches to environmental protection are becoming more and more popular in the country. Although these new instruments are being increasingly explored, their roles are to supplement, rather than supplant, the existing regulatory framework.

Various voluntary environmental schemes have been initiated that aim to entice firms to voluntarily undertake measures to reduce their environmental impact. One of the most widely adopted programs is the ISO 14001 environmental management system certification, the subject of this study. As of 25 March 2010 over 1,000 establishments have environmental management systems that have been ISO 14001 certified. Those certified are wide-ranging and engage in both manufacturing and non-manufacturing activities. Of those in the manufacturing sector, ISO 14001 can be found in a number of different industries. However, only three industries that best represent the range of industrial activities in Thailand are the subject of this study.

The government has also attempted to promote further adoption of ISO 14001 by both industrial and non-industrial organizations. Programs to promote the adoption of environmental management systems (EMS) include the Department of Industrial Works (DIW)'s 'EMS for SMEs' program, which helps participating small- and medium-sized enterprises (SMEs) set up high-quality environmental management systems. Other standards being promoted in Thailand include the ISO 26000 standard for social responsibility (SR) which is being drafted by the International Organization for Standardization (ISO). ISO 26000 is expected to encompass seven key areas including the environment. In addition to these programs, various other certification schemes and voluntary programs exist for manufacturers in Thailand. These programs include

the clean technology program, corporate social responsibility programs, the adoption of clean development mechanism projects, green procurement projects, and the Thai Green Label scheme.

4.0 PARTICIPATION AND ENVIRONMENTAL PERFORMANCE

The main purpose of this section is to make use of existing secondary data and primary survey data to shed light on two topics of importance to this study – participation in ISO 14001, and the associated outcomes of participation in voluntary environmental programs such as ISO 14001.

4.1 Participation

This part of the study employs empirical analysis to shed light on why firms in developing countries are willing to take on non-trivial added costs to become ISO 14001-certified even though there is little formal regulatory pressure prescribing such standards. The focus of this part of the study will be on the role played by firm-specific characteristics.

4.1.1 Hypotheses and Econometric Model

In this study, it is assumed that the decision of firm *i* to participate in voluntary environmental programs such as ISO 14001 depends on the firm's discounted net benefits from participation, D_{it}^{*}, such that:

$$D_{it}^{*} = \boldsymbol{X_{it}}\boldsymbol{\beta_1} + \varepsilon_{it}$$

Where $\boldsymbol{X_{it}}$ is a vector of exogenous variables for the i^{th} firm, and $\boldsymbol{\beta_1}$ is a vector of parameters. However, D_{it}^{*} is generally a latent variable that is unobserved. Instead, what is usually observed is the decision to participate, D_{it}, which depends on D_{it}^{*} in the following manner:

$$D_{it} = 1 \text{ if } D_{it}^{*} \geq 0 \text{ and } D_{it} = 0 \text{ otherwise}$$

Assuming that ε_{it} is normally and independently distributed, the relationship of D_{it}, $\boldsymbol{X_{it}}$ and $\boldsymbol{\beta_1}$can be represented by the probit model:

$$D_{it} = F(\boldsymbol{X_{it}}\boldsymbol{\beta_1}) + \mu_{it}$$

Where *F* is the cumulative distribution of the standard normal variate ε_{it} (Maddala 1994).

From the conceptual framework developed earlier, several factors are hypothesized to be included in $\boldsymbol{X_{it}}$. Of particular importance is the role of firm characteristics. For developing country firms, these characteristics include the firm's export orientation, the influence of foreign owners who directly invest in the firm, firm size, and firm location.

For developing countries such as Thailand, the influence of the international community that filters in through trade is an important determinant in the decision to adopt international standards such as the ISO 14001. Exporting firms face a much broader field of stakeholders who are not just customers, but also governments of importing countries. For Thai industries whose

major export markets are industrialized countries such as Japan, the United States, and European Union countries, the export-orientation of the firm may be an important characteristic that makes firms more conducive to the adoption of ISO 14001.

Ownership shares belonging to foreign nationals are another factor that can influence the adoption of ISO 14001. FDI implies both ownership and control, and, for Thailand, many of these foreigners are from industrialized countries who may also bring in managers and staff from their own country. Firms with such people may be more conducive to signing up to ISO 14001 since they have more awareness of the higher expectations of corporate environmental protection, as well as more knowledge of the technology employed in industrialized countries for environmental protection. Such factors make these firms more likely to adopt ISO 14001. However, it is inconclusive that firms with higher FDI may be more likely to have ISO 14001 certification. Indeed, the pollution haven hypothesis stipulates that the opposite may be the case since foreign investors may move their operations to countries with lower environmental standards in order to bypass the costs of environmental protection and, thus, be more cost-competitive. As a result, the role played by FDI in determining the likelihood of ISO 14001 adoption is unclear.

The type of product firms produce may also influence their decision to adopt ISO 14001. It is hypothesized that customers play an important role in determining the firm's decision to adopt ISO 14001. However, since ISO 14001 is a certification for environmental management systems (EMSs), companies, rather than consumers, may have a better understanding of the complexity and implications of EMSs and ISO 14001. Thus, firms producing intermediate products may be more likely to adopt ISO 14001 than firms selling directly to consumers.

A firm's location may also influence ISO 14001 adoption since location determines the policy and regulatory context within which the firm must operate. Several economic models have been developed to show that background regulatory threats increase the likelihood of participation in voluntary programs. Thus, firms located in areas with stringent regulations – those with high background regulatory threats – are more likely to adopt ISO 14001.

Firm size is also another characteristic of the firm that can make it more likely to adopt ISO 14001. Firms which are larger in size are more visible to the public and, thus, face more pressure to demonstrate environmental-friendliness. In addition to this, larger firms also face lower marginal costs of voluntary program adoption since they have economies of scale and more personnel and capital to spare.

Finally, firms that have ISO 9000 may be more likely to adopt ISO 14001. Although ISO 9000 is a total quality management standard, the process of establishing a Plan-Do-Check-Act (PDCA) system of management and the methods for evaluating such a system were borrowed by the drafters of the ISO 14001 standard, which came later. Thus, for those with ISO 9000, the learning curve for establishing ISO 14001 is significantly smaller, making firms with ISO 9000 in place more likely to have ISO 14001 certification.

The names of the variables to be included in the econometric analysis, their definitions, and expected signs are given in Table 4.

Table 4. Variables and Predicted Signs

Variables	Description	Predicted Sign
iso14001	Dummy variable that takes on 1 if the firm has ISO 14001 certification, and 0 otherwise	(dependent variable)
xtosales	Percentage of export sales to total sales	+
fdipct	Percentage of foreign direct investment (FDI) in the firm	+/-
size1	Number of workers employed by the firm (unit = 1,000 workers)	+
nikom	Dummy variable that takes on 1 if the firm is located in an industrial estate, or an industrial park, and 0 otherwise	+
final	Dummy variable that takes on 1 if the firm produces final products that are sold to consumers and 0 otherwise	-
iso9000	Dummy variable that takes on 1 if the firm has ISO 9000 certification and 0 otherwise	+

4.1.2 Data

For this part of the analysis, the main dataset to be used is the Office of Industrial Economics (OIE)'s Annual Industrial Survey. The survey has been on-going since 2001 and includes approximately 4,000 manufacturing firms annually. Firms are chosen from all manufacturing industries and the number of firms included from each industry is proportional to the industry's contribution to the country's manufacturing GDP. The OIE has also attempted to track the same firms through the years, yielding a panel dataset of roughly 4,000 firms per year. However, the dataset does have gaps where firms fail to reply in some of the years or where firms fall out of the survey completely. The latest data available is for 2007. Thus, we have an unbalanced panel data of manufacturing firms for years 2001 to 2007. Information from the OIE dataset alone is not adequate for our analysis. Thus, additional information was obtained from other sources and added on. Information on certifications was obtained from the Thailand Industrial Standards Institute (TISI).[16] Information on whether or not the firm is located within industrial estates was obtained from the Industrial Estate Authority of Thailand (IEAT). Firms

[16] TISI is the government agency in charge of overseeing all aspects of industrial standards such as ISO 14001. Charged with this responsibility, the agency keeps track of all firms that are ISO 14001 certified within the country and provides a constantly updated list of certified firms on its website.

which have ISO 9000 and ISO 14001 certifications were coded as having the certifications for all the years in the OIE dataset. This is also the same for firms located within industrial estates.

Information on whether the firm produced final goods or intermediate products was generated from the firm's four-digit International Standard Industrial Classification (ISIC) code (revision 3).17 Firms were deemed to produce either final or intermediate goods based on the descriptions of their ISIC four-digit classifications. However, this method was only effective for firms in the textiles and clothing, and electronics and electrical appliances industries. For firms in the food and beverage industry, ISIC four-digit classifications did not allow for clear classifications on whether or not the firm produced final products. Thus, the variable for product type could not be constructed for the food and beverage industry.

Consistency Checks

Since the OIE dataset is a primary survey, there is a chance there might be errors in responses that could confound results should the data be analyzed without first cleaning these errors out. Thus, the following criteria were applied in order to weed out problematic observations.

(a) Duplicates. Data from the same firm that occurs more than once was removed, leaving one observation per firm.
(b) Zero or negative value added. The firm's value added is calculated by subtracting reported material costs[18] from production value. Observations with zero or negative value added were removed since it is unlikely that firms will produce goods with values lower than the costs of raw materials and fuel used.

After applying the above checks, 9,337 observations from the three industries of interest remained. This number comprised of 3,721 observations from the food and beverage industry, 3,736 observations from the textiles and clothing industry, and 1,880 firms in the electronics and electrical appliances industry. The number of observations before consistency checks and the percentage of data retained after the checks are presented in Table 5.

[17] Although ISIC revision 4 has already been released, the OIE data still used ISIC revision 3 in its classification of firms. Thus, ISIC revision 3 is used here.
[18] Material costs here are the costs of the raw materials and fuel used in the production process.

Table 5. Number of Observations Before and After Consistency Checks were Applied

	Raw Data	Removing Negative Value Added	Removing Duplicates	Percentage of data retained
Food and Beverages	4,391	3,775	3,721	84.74
Textiles and Clothing	4,298	3,766	3,736	86.92
Electronics and Electrical Appliances	2,264	1,901	1,880	83.04
Total	**10,953**	**9,442**	**9,337**	**85.25**

Summary Statistics

After consistency checks had been applied to the raw data, summary statistics for the main variables to be included in the probit regressions were obtained for each industry. Statistics for the food and beverage industry are laid out in Table 6, those for the textiles and clothing industry are in **Table 7**, and those for the electronics and electrical appliances industry are in Table 8.

Table 6. Summary Statistics for the Food and Beverage Industry

Variable	Mean	S.D.	Min	Max
iso14001	0.034	0.180	0	1
xtosales	25.082	37.136	0	100
fdipct	8.757	22.444	0	100
oecd	0.133	0.340	0	1
size1	0.453	1.214	0.001	35.776
nikom	0.042	0.201	0	1
iso9000	0.195	0.396	0	1
Number of observations = 3,721				

Table 7. Summary Statistics for the Textiles and Clothing Industry

Variable	Mean	S.D.	Min	Max
iso14001	0.023	0.150	0	1
xtosales	30.506	40.753	0	100
fdipct	7.630	20.560	0	100
oecd	0.080	0.271	0	1
size1	0.346	0.778	0.001	25.558
nikom	0.020	0.140	0	1
final	0.496	0.500	0	1
iso9000	0.163	0.370	0	1
Number of observations = 3,736				

Table 8. Summary Statistics for the Electronics and Electrical Appliances Industry

Variable	Mean	S.D.	Min	Max
iso14001	0.153	0.361	0	1
xtosales	34.109	40.600	0	100
fdipct	40.122	42.017	0	100
oecd	0.440	0.497	0	1
size1	0.698	1.898	0.004	37.673
nikom	0.154	0.361	0	1
final	0.384	0.486	0	1
iso9000	0.344	0.475	0	1
Number of observations = 1,880				

4.1.3 Model Estimation and Results

In order to determine which factors in the $\boldsymbol{X_{it}}$ vector are important determinants of ISO 14001 adoption in Thailand, random effects panel probit models were estimated for each of the three industries of interest. Application of fixed effects models was ruled out since the variable for ISO 14001 certification was coded as 1 for all years for firms with ISO 14001 certification.[19]

Before the regressions were run, pair-wise correlations between the regressors were calculated in order to detect the presence of multicollinearity between regressors. In addition to this, it has been pointed out that the variable *iso9000* has potential to be endogenous with the other independent variables. The low incidence of firms located within industrial estates in the food and beverage, and the textiles and clothing industries could also confound results due to the limited variation within the variable *nikom* for each of these industries. Thus, four regressions were run for each of the three industries of interest. In the first regression, both the variables *iso9000* and *nikom* were included. The second regression included *iso9000*, but no *nikom*. The third regression dropped *iso9000* but retained *nikom*, and the fourth regression dropped both *iso9000* and *nikom*.

For each industry, the four regression specifications were compared using goodness-of-fit measures for panel probit models such as pseudo R-square and AIC values. Based on these criteria, the regression specification that had the best fit was the full model which included both the *iso9000* and *nikom* variables. It is important to note here that both the pseudo R-square and AIC measures indicated much worse fit when *iso9000* was removed from the specification. Thus, *iso9000* was deemed to be an important part of the regression specification and therefore it was retained. The same happened when *nikom* was removed, although the effect was not as drastic as the removal of *iso9000*. Results from the full model regressions are reported here.

[19] Models that assumed $F(\boldsymbol{X_{it}\beta_1})$ was a cumulative distribution of the logistic variate ε_{it} were also explored. However, probit models had better goodness-of-fit measures, and thus their results are reported here.

Table 9. Regression Results

Variables	Food and Beverages[20]		Textiles and Clothing		Electronics and Electrical Appliances	
	Model 1	Marginal Effects	Model 1	Marginal Effects	Model 1	Marginal Effects
xtosales	-0.001	0	0.001	8.90E-25	0.028***	1.26E-43
fdipct	-0.002	0	0.010	1.25E-23	0.009	4.19E-44
size1	0.335***	0	0.653***	7.90E-22	1.828***	8.30E-42
nikom	-28.868	-5.86E-40	0.257	1.98E-29	5.168***	5.64E-51
final	-	-	-0.602	-3.52E-29	0.837	5.72E-79
iso9000	7.123***	5.22E-18	6.186***	1.71E-10	8.878***	5.92E-43
Constant	-14.680***	-	-12.495***		-26.159***	-
Log Likelihood	-134.149		-89.192265		-144.189	
Pseudo R2	0.086		0.276		0.226	
AIC	282.298		194.385		304.379	
Observations	3603		3597		1608	
Cross sections	1148		1012		463	

Note: *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level

Export Orientation

Export orientation, as measured by the percentage of the firm's export sales to total sales (*xtosales*), is an important determinant of ISO 14001 certification for firms in the electronics and electrical appliances industry. For such firms, *xtosales* is positive and statistically significant at the 1% level. This indicates that firms for which exports are an important source of revenue are more likely to adopt ISO 14001 certification than firms for which exports are not as important. However, the marginal effect of the change in *xtosales* on the conditional probability that *iso14001* = 1 is quite low (1.26E-43), indicating that, while it is important, this factor alone will not be enough to determine firm participation in ISO 14001 certification.

As theory posits, export orientation exposes firms to a greater range of stakeholders as well as a range of rules and regulatory contexts (Christmann and Taylor 2001; Potoski and Prakash 2004). Such firms may also have greater sensitivity to the increasing trend of green consumerism, and they may benefit from taking visible action to protect the environment (Dasgupta, Hettige et al. 2000; Henriques and Sadorsky 2006).

These reasons are especially valid for firms in the electronics and electrical appliances industry in Thailand. As the nation's top foreign exchange earner, the industry is clearly very export oriented. In addition to this, electronic products typically contain hazardous chemicals and heavy metals that are used within the production process and end up in the finished products.

[20] The variable *final* could not be constructed for firms in the food and beverage industry since it was difficult to determine whether the firm was producing for the consumer market, or simply as a supplier to other firms. Furthermore, many of the firms in this industry produce both finished and intermediate products. Thus, *final* was not included in the regression for the food and beverages industry.

With the issue of electronic waste disposal becoming more and more problematic, several countries around the world have begun to regulate the production of electronics and electrical appliances more closely. Thus, in order to export to these markets, or in order to maintain their market shares in such markets, firms must demonstrate to the importing countries that they have environmentally-friendly production processes. As an internationally recognized environmental management standard, ISO 14001 can be used as such. Thus, firms sought ISO 14001 in order to demonstrate their environmental friendliness, and to differentiate themselves from non-ISO 14001 firms, which were deemed to be less environmentally-friendly. In addition to this, firms are also vigorously adapting themselves in order to comply with several recent regulations concerning hazardous content and the waste disposal of electronic products.[21]

For firms in the food and beverage and textiles and clothing industries which produce both for the domestic and foreign markets, the influences that come from exposure to more stakeholders and being subjected to more rules and regulations can be said to affect a lesser proportion of firms compared with the proportion of firms in the electronics and electrical appliances industry. In addition to this, for food and beverage producers and textile and clothing manufacturers who export, the regulations they are subjected to, and what stakeholders care about, may not be the environmental-friendliness of their production process. Rather, the safety of the product is of the utmost importance for food and beverage exporters, while for textiles and clothing manufacturers, international consumers seem to be more concerned with the payment of living wages to laborers. ISO 14001 certification, however, does not cover these aspects. Thus, given limited resources, exporting firms in the food and beverage industry would be more likely to opt for complying with internationally-recognized food safety standards such as the Hazard Analysis and Critical Control Points (HACCP) rather than ISO 14001. For the textiles and clothing industry, there is no standard that certifies that firms are paying living wages. However, the low incidence of ISO 14001-certified firms in this industry gives an indication that the environmental-friendliness of the production process may not be important for this industry, even though many firms in this industry do export a significant proportion of their production.

Foreign Direct Investment and Product Type

While the hypothesis is that firms will be either positively or negatively influenced by the presence of foreign direct investment (FDI), which entails both ownership and decision-making power within a firm, the regression results indicate no statistical significance of the *fdipct* variable for any of the three industries. This finding suggests that FDI may not have as big an impact on a firm's decision to adopt ISO 14001 as many have come to believe.

The same findings hold for product type. Although it was hypothesized that firms producing intermediate products were more likely to adopt ISO 14001 certification due to it being a process-based standard that is more easily understood by other firms, there is no empirical evidence here to reject the null hypothesis that the coefficient for product type is zero. Thus, the data does not allow us to conclude that product type is an important factor determining firm participation in ISO 14001.

[21] This new wave of regulations began with the 2003 European Union's directives on the Restriction on Hazardous Substances (RoHS), and the Waste Electrical and Electronics Equipment Directive (WEEE). Several other countries have since adopted similar regulations including China, Japan, and South Korea.

Size

Unlike *xtosales* which is statistically significant for only the electronics and electrical appliances industry, *size* is positive and statistically significant at the 1% level for all three industries of interest. This finding corroborates with the hypothesis that firms which employ a larger number of people are more likely to adopt ISO 14001 certification. In addition to this, the significance of *size* throughout all three industries indicates that size is an important determinant of ISO 14001 certification regardless of industry type. This finding is also in keeping with the existing literature on voluntary environmental programs (see, e.g., King and Lenox 2000; Khanna 2001).

Several reasons have been proposed as to why larger firms are more likely to participate in ISO 14001 certification. Larger firms tend to have economies of scale in adopting ISO 14001 due to abundant people and capital. Big firms are also more visible to the public, and thus more easily targeted by environmentalists and regulators. Thus, not only do larger firms have economies of scale in adopting ISO 14001 certification, their visibility also lead them to care more about their image in the eyes of the public. Having ISO 14001 certification helps to demonstrate to other stakeholders that the firm cares about the environment and so firms with ISO 14001 certification often display their attainment of the standard next to signs announcing the names of their factories.

In addition to public image, having ISO 14001 certification can help firms benefit in other ways. For developing countries where environmental protection agencies are often riddled with insufficient budgets and limited manpower, firms can be less targeted by authorities due to their ISO 14001 status. Indeed, one official from the Department of Industrial Works (DIW), the government agency responsible for regulating manufacturing facilities in Thailand, said in an interview with the researcher that if he was given a choice to inspect a firm with ISO 14001 or a firm without the certification, he would choose the latter since he knows that ISO 14001 firms have been inspected by third parties as a part of their certification process. While the official did add that if complaints were made against the firm, they would be inspected by the authorities regardless of their ISO 14001 status, it was clearly implied that ISO 14001 firms would be favorably viewed as having better environmental performance by government officials.

Location

The proxy for location is *nikom*, a dummy variable which takes the value of 1 if the firm is located in an industrial estate or an industrial park, and is 0 otherwise. *Nikom* measures the regulatory context within which the firm operates. A firm located within an industrial estate or industrial park is typically subjected to more stringent environmental regulations than a firm located outside such clusters of industrial activity. It has been shown, mostly through economic models, that a more stringent background regulatory context can lead to a higher rate of adoption of voluntary environmental programs such as ISO 14001 (see, e.g., Segerson and Miceli 1998). Thus, the expected result is for *nikom* to be positive and statistically significant through all three industries.

While *nikom* is positive and statistically significant at the 1% level for the electronics and electrical appliances industry, it is not statistically significant for the other two industries. This

could be due to the fact that manufacturing facilities for both the food and beverage, and textiles and clothing industries are spread throughout the country and not many are located within industrial estates. Thus, the regressions for these two industries find statistically non-significant coefficients and marginal effects. In contrast to the food and beverage and textiles and clothing industries, a higher proportion of manufacturing facilities in the electronics and electrical appliances industry are located within industrial estates. This could be the underlying reason why *nikom* is only statistically significant for this industry.

ISO 9000 Certification

Having ISO 9000 certification (*iso9000*) is positive and statistically significant at the 1% level throughout all three industries, indicating that having ISO 9000 is one factor that increases the likelihood that the firm will have ISO 14001 certification. This result could stem from the lower knowledge barrier firms with ISO 9000 face when applying for ISO 14001 certification. Modeled after the ISO 9000 certification process, ISO 14001 closely follows the same Plan-Do-Check-Act philosophy as ISO 9000. While their objectives are different, the process and procedures for setting up total quality management systems under ISO 9000 and the ones for establishing environmental management systems under ISO 14001 are similar. Thus, compared with firms who are new to both ISO 9000 and ISO 14001, those with ISO 9000 already in place will face much lower knowledge barriers in participating in ISO 14001. In addition to this, the similarities between ISO 9000 and ISO 14001 allow firms to save on recertification costs since the same set of auditors can audit both ISO 9000 and ISO 14001 at the same time.

4.2 Environmental Effectiveness of Voluntary Environmental Programs

As discussed in the conceptual framework section, it is difficult to determine the environmental outcome of participation in green clubs such as ISO 14001 from theory. Under the expected marginal penalty (EMP) and marginal abatement cost (MAC) framework, participation in green clubs such as ISO 14001 can shift either schedule up or down depending on which factors dominate. Thus, it was concluded that the environmental effectiveness of voluntary program participation was something that had to be determined empirically.

Due to their sensitive nature, reliable firm-level environmental data are difficult to obtain, especially in developing countries such as Thailand where monitoring and enforcement are lax and corruption is still a problem. Thus, in order to shed light on the question of the environmental effectiveness of ISO 14001 certification, a review of the existing empirical literature on voluntary environmental programs, with a focus on ISO 14001, is necessary. Self-reported data obtained from the primary survey conducted for this research will also be used. (Details on how the primary survey was administered can be found in Section 5.0.)

4.2.1 Empirical Evidence on ISO 14001 Participation and Environmental Outcomes

Many empirical studies looking at ISO 14001 certification have found evidence supporting the view that adoption of ISO 14001 is associated with better environmental

performance. Studying the adoption of environmental management practices in Mexican food, chemicals, non-minerals, and metals manufacturing facilities, Dasgupta, Hettige et al. (2000) found that environmental management has a strong effect on self-reported regulatory compliance. Using survey data, Arimura, Hibiki et al. (2008) found that ISO 14001 certification helped reduce firm environmental impacts in three areas – natural resource use, solid waste generation, and wastewater effluent. The study also found that ISO 14001 was more effective than publishing environmental reports in the first two areas. Russo (2002) and Prakash and Potoski (2005; 2006a) also found evidence that ISO 14001 helped US firms reduce environmental impacts. In addition to this, Welch, Mori et al. (2002) found that ISO 14001 adoption is associated with more environmental action, although the study could not conclude that there was clear causal linkage between ISO 14001 adoption and greening activities of firms.

Even though several studies have found positive outcomes, other studies have not found that voluntary program participation helped improve firm environmental performance. In a meta-analysis of voluntary environmental programs in the US, Darnall and Sides (2008) found that, as a whole, participants of voluntary programs do not have improved environmental performance when compared with non-participants. The study also looked at ISO 14001 participation and came to the conclusion that, collectively, ISO 14001 adopters showed inconclusive performance improvements. Looking at emissions from the pulp and paper industry in Canada, Barla (2007) found that having ISO 14001 certification did not lead to reduced total suspended solid emissions and that, while ISO 14001 adopters did reduce their discharge of BOD by 9% after certification, unlike non-adopters, they did not exhibit significant negative trends in emissions over the sample period. Barla (2007) also found that the impact of ISO 14001 was very variable across adopting plants. In a study using data from the UK, Dahlström, Howes et al. (2003) found that while having an environmental management system (EMS) in place improves certain procedural aspects of environmental management, it was not associated with increased regulatory compliance. Similarly, in a study of US firms, Andrews, Amaral et al. (2003) suggested that having ISO 14001 in place did not improve a firm's environmental performance.

4.2.2 Environmental Performance of ISO 14001 Firms in Thailand

The mixed results found in existing empirical literature combined with the fact that the majority of the studies were done for industrialized countries make it difficult to conclude what ISO 14001 adoption implies for the environmental performance of firms in developing countries. However, there is some evidence that, among ISO 14001 adopters, those in the developing world are more enthusiastic about the benefits of ISO 14001 and have reported environmental improvements related to ISO 14001 adoption (Raines, Rong et al. 2002). ISO 14001 firms surveyed by the Thailand Environment Institute (TEI) during the early years of ISO 14001 also concurred with this result (TEI 1999). In addition to this, the primary survey responses given by firms surveyed for this research also point in the same direction.

In order to determine whether having ISO 14001 in place is associated with better environmental performance, data obtained from the primary survey was used to conduct a difference-in-means test. The primary survey conducted for this research asked firms a number of questions designed to proxy firm environmental performance. These include asking the firm for the environmental management practices they have adopted, how frequently the firm publishes environmental reports, how frequently they send their personnel for environmental

training, and the number of environmental personnel they have (questions 10, 11.1, 11.2, 12 on the survey questionnaire – see Appendix I). Replies to these questions were then tallied and their means were calculated for two groups – those with ISO 14001 and those without ISO 14001. The means of the two groups were then compared and tested to see whether their differences were statistically significant. For all measures, the null hypothesis was that there was no difference in means, while the alternative hypothesis was that firms with ISO 14001 had better environmental performance than non-ISO 14001 firms.

Denoting the mean difference between two groups as *d,* such that

$$d = \bar{X}_{iso14001} - \bar{X}_{non-iso14001}$$

The null and alternative hypotheses (H_0 and H_a respectively) are:

$$H_0: d = 0$$

$$H_a: d > 0$$

The t-test was then carried out to determine whether it was possible to reject the null hypothesis based on the data available from the primary survey. As shown in Table 10, firms with ISO 14001, as a group, had higher average environmental performance than non-ISO 14001 firms. This finding indicates that, for the firms sampled in Thailand, having ISO 14001 in place is associated with better environmental performance on average. However, it is important to note that this result does not allow us to determine the causality between ISO 14001 adoption and environmental performance.

Table 10. Results from the Difference-in-means Test

Environmental Performance Measure	$\bar{X}_{iso14001}$	$\bar{X}_{non-iso14001}$	Mean Difference
Environmental Management Practices	26.13	18.96	7.17***
Frequency of Environmental Reports	1.81	1.20	0.61***
Frequency of Environmental Training	2.00	1.13	0.87***
Number of Environmental Personnel	1.75	1.03	0.72***

Note: *** indicates statistical significance at the 1% level

Although causality cannot be determined, the finding of a positive correlation between ISO 14001 adoption and environmental performance from the difference-in-means tests do concur with responses from surveyed firms. When asked whether they experienced environmental improvements after having ISO 14001 in place, the majority of surveyed firms replied that they did see environmental improvements. Firms from all three industries have reported increased recycling and reuse activities. They also reported that they experienced reductions in pollutants emitted, especially water pollution, air pollution, and other waste. Several firms also reported that having the ISO 14001 system in place had helped them comply

with existing regulations. Reductions in resource use such as fuel, water, and electricity have been reported by some of the firms. In addition to this, some firms also report that they were able to improve waste management and save on waste management costs with ISO 14001 in place. Detailed reports of ISO 14001's associated environmental improvements by industry are given in Section 5.0.

5.0 PRIMARY SURVEY RESPONSES

5.1 Primary Survey Process

In order to carry out the primary survey process, a questionnaire was developed, pilot tested, and eventually mailed out to approximately 4,400 firms in the three industries of interest (see questionnaire in Appendix I). This number includes all firms listed as having ISO 14001 according to the Thailand Industrial Standards Institute (TISI) database, and about ten times as many non-ISO 14001 firms. The list of non-ISO 14001 firms mailed was compiled by stratified random sampling using the list of all registered factories from the Department of Industrial Works (DIW). Firms were stratified by industrial classification, size, and location. In each stratum, the number of non-ISO 14001 firms that was mailed was proportionate to the number of firms with ISO 14001 certification.

After initially mailing out the questionnaires, firms which failed to reply by the specified deadline were contacted again by phone. Firms which still failed to reply were contacted a third time. The researcher and several assistants also visited targeted survey firms in person and asked the relevant personnel there to reply to the questionnaire directly. In addition to this, all questionnaires were mailed with introduction letters from the Thailand Environment Institute, along with a letter requesting help in filling out the questionnaire written by the researcher's supervisor. A letter from the Thailand Textiles Institute was also obtained in order to increase response rates from firms in the textiles and clothing industry when it was discovered that the response rates from this industry were lower than those of other industries.

After receiving the questionnaires, consistency checks were made. Questions left blank were filled by making telephone calls to the firms. In addition to this, responses were carefully checked to ensure internal consistency.

The above methods yielded 495 complete responses from the three industries of interest, a response rate of 11.46%. This response rate is consistent with normal figures for mail surveys in Thailand. Of this number, 187 firms or 37.8% replied that they have ISO 14001 certification. A breakdown of responses by industry and the number of firms that have ISO 14001 are shown in Table 11.

Table 11. Responses to Primary Survey Questionnaire

	Responses	ISO 14001
Food and Beverages	160	47
Textiles and Clothing	139	23
Electronics and Electrical Appliances	196	117
Total	**495**	**187**

5.2 Survey Responses and Characteristics of the Sample Firms

The primary survey yielded 495 complete responses – 160 from the food and beverage industry, 139 from the textiles and clothing industry group, and 196 from the electronics and electrical appliances industry. Responding firms are of different sizes and locations. They also produce a wide variety of products. Most of the firms are located outside pollution-control areas. Out of the 495 firms, 123 firms or less than one-fourth are located in industrial estates. Of the firms which replied, 196 or 39.6% received some degrees of foreign direct investment (FDI). Of this number, more than half replied that they are wholly foreign-owned. In addition to this, 348 firms reported varying percentages of exports. Detailed characteristics of the sample firms are presented industry by industry.

5.3 Food and Beverages

5.3.1 Characteristics of Responding Firms

Firms in the food and beverage industry that replied to the questionnaire produce an array of products ranging from the manufacture of mineral drinks and fruit juices to canned fruits and vegetables. This range also includes the manufacture of preserved fruits and vegetables, frozen seafood and other meat products, snacks, rice, noodles, vegetable oil, food additives, tea, and soft drinks.

Of the firms that replied, 96 firms were large firms employing more than 200 people, 47 were medium-sized firms employing between 51 and 200 people, and the rest were small firms with 50 employees or less. In addition to this, 14 firms, or 8.8% of the respondents in this industry, are very large companies employing more than 1,000 employees. The total number of people employed across all three firm sizes is 79,222.

In terms of foreign direct investment (FDI), most of the firms that replied are wholly Thai-owned with just 33 firms having varying degrees of FDI. However, in terms of export orientation, most firms reported they export their products, with just 36 firms reporting that they do not produce for export. The average exporting percentage was 65% of sales in 2008.

5.3.2 Environmental Matters, Standards and Policies

When asked about environmental impacts, about one-third of the respondents reported that their production activities do not have any impact. Of those that did report environmental impacts, wastewater was the most serious concern, followed by particulates and odor. However, due to differences in production process, the main environmental impacts of firms vary according to the products produced. For example, firms whose production involves processing and preserving fish and fish products are more concerned with water pollution and odor, while firms manufacturing fried snacks are more concerned with escaped heat and smoke from the burning of fuel in their production process.

When asked to rate themselves on various aspects of environmental management, with '1' being the most comprehensive in terms of having clear policies, implementation strategies, assessments and continuous improvement and '5' being the least comprehensive, the majority of firms gave themselves '1' for waste treatment. The prevention of waste and pollution by modifying the production process came second, followed by measures to prevent leaks and spills, recycling, and the use of environmentally-friendly raw materials.

In terms of other measures of environmental performance, about half of the firms reported that they publish environmental reports, mostly once a year, but some firms do this two or more times a year. Many firms also reported that they send their staff for environmental training. In addition to this, the majority of firms reported that they have at least one person in charge of environmental matters, although for small firms this person may not be designated as an environmental manager. Some firms choose to outsource environmental management to other firms and employ only a few staff to maintain environmental management systems within their facilities.

Of the 160 firms that replied to the questionnaire, 47 stated that they already have ISO 14001 certification and 21 were in the process of obtaining the certification. ISO 9000 certification is more popular for these firms, with 100 firms replying that they have received this certification. Clean Production (CP) and Corporate Social Responsibility (CSR) are also important corporate policies, with 52 firms having each of these policies in place.

5.3.3 Motivations for Environmental Improvement

For the firms that replied to the questionnaire, the factors that have the most influence on the firm's decision to improve their environmental performance are management policies, existing environmental regulations, corporate image, social responsibility, complaints from neighboring communities, customers' preferences, and orders from head office. It is interesting to note here that out of all the categories listed government support was cited as being important by the least number of firms.

5.3.4 Environmental Improvement Obstacles

Results from this part of the questionnaire indicated that firms are generally more concerned about incurring higher operation costs when becoming more environmentally friendly. Other obstacles cited by the firms were the complicated procedures involved, a lack of knowledge and personnel, a lack of support from the government, a lack of necessary technology, and a lack of cooperation from employees.

5.3.5 Role of Formal and Non-formal Sectors in Promoting Environmental Improvement

Since this part of the questionnaire was different for firms with ISO 14001 and for firms without the certification, the results will be divided accordingly.

For Firms with ISO 14001

Of the 160 firms which replied to the questionnaire from the food and beverage industry, 47 firms had ISO 14001 certification. Most firms replied that they obtained the certification through their own initiative, although some received help from their parent companies and were encouraged by non-government agencies and trading partners.

When asked whether or not they thought the government had a role to play in encouraging ISO 14001 adoption, of the 64 firms that replied to this question, 30 firms replied that the government does have a role to play and that they believe the government has been fairly successful, 23 firms replied that the government does have a role, but that the state has not been successful in promoting ISO 14001. Three firms believed that the government has done an excellent job, while the rest of the firms who replied to this question said that the government does not play any role in promoting ISO 14001.

To the question regarding what measures firms want to see from the government, 42 firms wanted the government to provide them with financial aid such as tax reductions or tax exemptions, low-interest loans, etc. Another 24 firms reported that they would like to see the government set up mechanisms or systems which can provide them with advice on acting according to ISO 14001 standards, while another 25 firms suggested that the government should create a database of environmental laws, and publicize or distribute information to interested firms. Many firms would also like the government to help them to train their employees in ISO 14001 procedures.

This section also included an open-ended question asking for more comments on the role of the government. Some of the replies to this question included suggestions that the government makes ISO 14001 mandatory, that the state should provide free training to environmental managers and other environmental personnel, and comments that the government should provide funds for environmental improvements.

For Firms without ISO 14001

Those firms without ISO 14001 were asked whether or not they had received help from any sector in improving their environmental performance. Most had received help from government agencies such as the Department of Industrial Works (DIW), the Ministry of Energy, regional DIW offices, regional environmental offices, state technology universities, and research institutes. Firms also reported that they had been helped by private sector agencies such as the Management System Certification Institute (MASCI), the Energy for the Environment Foundation, the Thailand Environment Institute, and the Federation of Thai Industries. It is important to note that only a few companies replied that they had received help from their trading partners and the Industrial Estate Authority of Thailand (IEAT).

When asked whether they will apply for ISO 14001 certification, most firms replied that they would if they received financial benefits and/or free or partially-subsidized training. Less important incentives included consultations on ISO 14001 or the collection of relevant environmental laws in one place. Firms also gave other suggestions such as reducing the cost of certifying to the standard by at least 70%, and reducing the costs of improving tools, machinery, etc. as required by the law.

Asked what measures they hope to see, most firms hope to receive more assistance from both government organizations and from private firms in educating personnel about environmental problems and ISO 14001. Firms would also like to see more financial incentives, such as tax exemptions or reductions, as well as cost-cutting assistance when it comes to acting in accord with environmental laws, ISO 14001, requesting for environmental certificates, etc. Finally, firms would also like to see both government and private sector organizations put experts or consultants on environmental matters into each firm so that they can seek advice.

5.3.6 Benefits of having ISO 14001

Firms with ISO 14001 were questioned about the benefits of having ISO 14001. Firms from this industry reported benefits in all the categories listed – reduced water pollution, reduced air pollution, reduced ground pollution, and other environmental benefits. Specific examples are given for each benefit cited. Having ISO 14001 has helped firms to achieve compliance with wastewater laws, improve the quality of their wastewater, and set up monitoring and waste treatment systems. One firm even stated that local farmers have benefitted by using treated wastewater for agriculture. For air pollution, firms cited that having ISO 14001 in place had resulted in the employment of technology to reduce air pollution, such as scrubbers and multi-cyclone systems. Firms also reported that they received no complaints from local people regarding air pollution since putting ISO 14001 in place. In terms of ground pollution and waste treatment, firms reported that having ISO 14001 in place had helped them to separate their waste more effectively, allowing them to recycle and reuse some of the waste. Other benefits included adding value to things once regarded as waste, and savings in energy, water, electricity, and gas.

In addition to reduced pollution, firms were rewarded with a better corporate image, fewer complaints from neighboring communities, and reduced environment-related risks and liabilities. Firms also reported improvements in the working environment, increased

competitiveness, the ability to charge higher prices for their products, and a reduction in complaints from environmental groups. A few firms reported that having ISO 14001 has helped them to enter new markets and helped to create trust amongst customers that their products are clean, hygienic, and safe.

When asked whether or not having ISO 14001 had helped firms to reduce their costs, of the 48 firms that replied, 23 reported that after the system had been put into place, they were able to cut down electricity bills by an average of 2.65%. Twenty-three firms reported that the ISO 14001 system had helped them to reduce energy, 29 firms reported a reduction in water usage, and 24 firms are able to cut down waste management costs.

5.3.7 Reasons for not Adopting ISO 14001

Most firms said that the main reason they had not applied for ISO 14001 was because the firm's production has very little effect on the environment. A number of firms also reported that they lacked the knowledge and personnel to establish an environmental management system, that they did not see the need for an ISO 14001 system, that they already have an environmental management system which was not certified, that the costs for setting up a system are too high, and the information on ISO 14001 certification is difficult to find.

5.4 Textiles and Clothing

5.4.1 Characteristics of Responding Firms

For the textiles and clothing industry group, replies were received from 139 firms. These firms included those from upstream, midstream, and downstream industries. The industrial activities of these firms included the manufacture of fibers, yarns, ropes, and sacks, spinning and weaving, bleaching and dyeing, and the making of ready-to-wear clothes such as clothes, socks, and undergarments.

The responding firms were of various sizes with 90 firms employing more than 200 people, 38 firms employing between 50 and 200 people, and the remainder of the firms employing 50 people or less.

In terms of international influences, of the firms that replied, 29 reported a foreign presence with seven of these firms being wholly owned by foreign investors. Out of the firms that responded, 80 reported that they export. These firms had an average exporting percentage of 77% of their total sales in 2008.

5.4.2 Environmental Matters, Standards and Policies

Of the 139 firms that replied, 98 reported hazardous waste as their main environmental impact. Wastewater followed as the second environmental impact of the most concern, with 89 firms reporting problems with this. Particulates were reported as a problem by 69 firms. Odor was a problem for 66 firms. Other air pollutants are less of a problem for this industry group.

Asked to rank themselves on various aspects of environmental management, most firms in this industry replied that they have wastewater management measures in place (84 firms), while nearly 80% of the firms have recycling systems and measures to prevent spills and leaks of harmful substances. About one-third of the firms reported that they choose raw materials that have lower environmental impact and that they have modified their production processes to minimize the pollution emitted.

Out of the firms that replied, 96 issued environmental reports, while 98 firms send their staff for environmental training. In 91 firms at least one person is in charge of environmental issues. Out of these firms 54 have personnel designated as an environmental officer, while the other 37 firms have staff who take on environmental tasks in addition to other duties.

Of the firms whose responses we have, 23 have ISO 14001 certification and another 12 are in the process of applying for ISO 14001. Again, the ISO 9000 certification and corporate social responsibility (CSR) policies are popular, with 43 firms reporting ISO 9000 certification and 18 reporting the existence of CSR policies. Clean production measures have been adopted by 23 firms and 10 firms have green purchasing policies.

5.4.3 Motivations for Environmental Improvement

According to the responses, influences on a firm's decision to engage in environmental improvements include the firm's image, management policies, social responsibilities, reducing costs, and customers' preferences. Replies indicate that firms tend to give less importance to government support, influence from headquarters, and the importing country's requirements.

5.4.4 Environmental Improvement Obstacles

As with firms in the food and beverage industry, firms from the textiles and clothing industry group also cite higher operating costs as the main obstacle deterring them from adopting environmental improvement measures. Other obstacles cited include lack of support from the government and the complexities of the application procedure.

5.4.5 Role of Formal and Non-formal Sectors in Promoting Environmental Improvement

For Firms with ISO 14001

Of the firms that replied to this question, 13 firms replied that government efforts to promote ISO 14001 have been successful to a certain extent. Seven firms reported that they thought the government rather unsuccessful, and seven others reported that the government has failed to promote ISO 14001. Only one firm reported that the government has been exceptionally successful.

When firms were asked what promotional measures they would prefer, the majority said that they would like the government to provide financial support, such as tax incentives or low-interest loans. Some firms responded that they would like the government to compile and

publicize information on environmental laws to interested firms. A few firms also reported that they would like the government to support training programs on the process of ISO 14001 as well as setting up advisory systems for firms regarding the certification. Other suggestions included not extending permits to operate to firms which do not have ISO 14001, and having clear promotional measures that can be applied to organizations of all types and sizes.

For Firms without ISO 14001

When asked whether firms have received any help to improve their environmental performance from any government or private-sector agencies, firms replied that they had received help from the Department of Industrial Works (DIW), the environmental department branch of the local Bangkok Metropolitan Administration offices, and state-run universities such as Chulalongkorn University, Mahidol University, and Rajamangala University of Technology. Private sector agencies that have helped firms to improve their environmental performance included the Thailand Research Fund, the Thailand Environment Institute, and the Management System Certification Institute (MASCI). In addition to this, a few firms reported that they have received help from their trading partners.

Firms that replied to the questionnaire for this section also commented that the government should support entrepreneurs by providing academic support and consulting firms in order to improve their environmental management systems because firms face high costs and a lack of personnel to oversee environmental matters. Firms also thought that the government should help to reduce the complexities of setting up ISO 14001 systems.

5.4.6 Benefits of having ISO 14001

In terms of benefits from reduced pollution emissions, 22 of the firms with ISO 14001 reported that the standard has helped them to reduce water pollution, allowing them to comply with the existing laws regarding standards for wastewater, to reduce wastewater released by recycling, and to reuse some of the water in the production process. Eleven firms reported that ISO 14001 has helped them to reduce air pollution because having the system in place has led to yearly assessments and inspections of their equipment and monitoring and control of particulates and other toxic gases so that they do not exceed permitted values. Six firms reported that they have reduced ground pollution by not disposing of chemicals in the ground, by having systems that prevent leaks, by ensuring the safe transportation of chemicals to proper disposal sites, and by reducing the amount of industrial waste that needs to be disposed of in landfills. In terms of waste management, 17 firms reported benefits in this area. These firms say ISO 14001 has helped them to properly separate waste, leading them to recycle some of the things they originally discarded as waste.

Other benefits firms received included having a better image or appearing to be more environmentally-friendly (21 firms). Twenty-one firms also reported that by acting according to the standard, they were able to reduce the risk, and therefore potential cost, of damage to the environment. Twelve firms reported that their working environment has improved since the standard was put in place. Fifteen firms claimed to have gained a competitive edge as well as being better able to resolve environmental issues with the surrounding communities, with seven

firms reporting that they were able to tap into new markets, and eight firms being more able to resolve problems with environmental groups.

In terms of cost reduction, five firms reported that they do not see how the ISO 14001 standard has helped to reduce their operation costs. However, eleven other firms reported that ISO 14001 has helped them to cut electricity usage by an average of 10.14%. Eleven firms reported that the ISO standard has helped them to cut water usage by an average of 16.17%, and decrease waste management costs by an average of 34%. Eight other firms reported that the ISO 14001 standard helped their firms to reduce the fuel consumed within the organization by an average of 14.2%. At the same time, there were a few firms which claimed that having ISO 14001 has actually added costs to their firms.

5.4.7 Reasons for not Adopting ISO 14001

For firms in the textiles and clothing industry group, the main reasons for not applying for ISO 14001 certification are a lack of knowledge and personnel for this task, the high costs of certification, and because they believe that their production process affect the environment very minimally. Other prominent factors are the complicated procedures involved in applying, the fact that firms already have other standards in place and because the firms do not see the importance of having ISO 14001 certification.

5.5 Electronics and Electrical Appliances

5.5.1 Characteristics of Responding Firms

A total of 196 firms in the electronics and electrical appliances industry group replied to the mail survey. These firms produce an array of products including intermediate products such as electronic ballasts, print circuit boards, integrated circuits, switches, electric wires, power supplies, hard disc drives, and other electronic and computer parts. Firms producing final products are also included. These firms produce items such as televisions, refrigerators, LCDs, electric fans, microwave ovens, and batteries.

Most firms are large, employing more than 200 people (118 firms), 59 firms are medium in size, employing between 51 and 200 people, while the rest of the firms are small, employing no more than 50 people. These firms employ 157,562 people in total. In terms of international links, 133 firms have varying degrees of FDI and 143 firms export their goods. Therefore this industry has many large firms with foreign investment and these firms are mostly geared to the export market.

5.5.2 Environmental Matters, Standards and Policies

Of the firms that replied, hazardous waste was by far the most common environmental impact cited, being the main concern for 146 firms. Wastewater was another important environmental impact and particulate matter was cited as important by 65 firms. Odor and other toxic substances were also concerns.

Asked to rate themselves on various environmental topics, firms said that they pay the most attention to waste treatment, followed by the prevention of leaks and toxic spills. Reduction of pollution by the modification of the manufacturing process was cited as important by 89 firms, while some of the firms also gave importance to selecting environmentally-friendly raw materials. In addition to this, many firms said that they recycle and have adopted clean technology. Some of the firms also said that they modify their products to reduce their environmental impact throughout the product's lifecycle.

In terms of other indicators of environmental performance, 129 firms reported that they issue environmental reports, and 145 firms reported that they send their personnel for environmental training. The majority of the firms also have at least one person in charge of environmental matters in their facilities (155 firms).

Of the 196 firms, the overwhelming majority reported that they have ISO 14001 and ISO 9000 certification (117 firms and 148 firms respectively). Green purchasing policies have been adopted by 64 firms and while 54 firms have corporate social responsibility measures in place.

5.5.3 Motivations for Environmental Improvement

The most often cited reasons for environmental improvement were management policies, followed by compliance with environmental regulations, customers' demands, good corporate image, reductions in production costs, and the requirements of export markets. Other reasons included competitiveness, corporate social responsibility, and a reduction in complaints from neighboring communities.

5.5.4 Environmental Improvement Obstacles

Firms in this industry group were most concerned about incurring higher operating costs when putting environmental improvement measures in place. Other obstacles included a lack of management support, a lack of knowledge and personnel, a lack of support from the government, and the complexity of the procedure. Lack of cooperation from employees and a lack of necessary technology were the least of the firms' concerns.

5.5.5 Role of Formal and Non-formal Sectors in Promoting Environmental Improvement

For Firms with ISO 14001

When asked to rate the government's role in promoting ISO 14001 certification, the majority of firms said that the government has been quite successful but about 11.7% of the firms believed that the government has been unsuccessful in encouraging ISO 14001, or that the government does not have a role in helping firms to apply for ISO 14001 certification.

When asked what measures firms would like to see from the government to promote ISO 14001, approximately half replied that they hoped the government could provide them with financial support, such as tax exemptions or reductions and low-interest loans. Firms also hope

for training programs in ISO 14001 for their personnel, advisory systems on ISO 14001, as well as the publication of information on ISO 14001. More weight appears to be given to financial support and the compilation and publication of ISO 14001 information.

Firms also provided a variety of suggestions on measures they would like to see from the government to promote ISO 14001, and on what the role of the government should be in environmental management. One firm suggested that the government should promote environmental management systems (EMSs) in small and medium enterprises (SMEs). One firm proposed that the government should target polluting factories such as sugar mills and cement factories. Another firm wanted the government to specify the criteria for firms they recommend to have ISO 14001, while another firm thought that the government should be stricter towards heavily-polluting SMEs by having both short-term and long-term plans to control pollution from these facilities. It was also felt that the government should pay less attention to firms which have held ISO 14001 certification for more than three years. Several of the firms also suggested a participatory approach where all stakeholders are involved in environmental management.

For Firms without ISO 14001

Firms without ISO 14001 were asked which government or private sector agencies had helped them to improve their environmental performance. Most firms reported that they had received help from both the government and private sector agencies. Government agencies cited included the Pollution Control Department (PCD), regional Department of Industrial Works (DIW) offices, the DIW itself, the Thailand Industrial Standards Institute (TISI), and the Electricity Generating Authority of Thailand (in terms of energy usage). Private sector agencies cited were the Thailand Productivity Institute (TPI), the Thailand Environment Institute (TEI), and the Federation of Thai Industries (FTI). In addition to this, 12 firms reported that they received help from their trading partners and one firm received help from the Industrial Estate Authority of Thailand (IEAT).

When asked which measures from the government would induce these non-adopting firms to sign up for ISO 14001, 84 firms said that they would sign up for ISO 14001 if they received financial benefits (tax exemptions, low-interest loans, etc.). Some 68 firms reported that they would seek certification if they received help to train their personnel, or if they received more information and advice on ISO 14001. A total of 63 firms reported that they would apply if there was a database compiling all relevant environmental laws in one place.

An open-ended question asking firms to comment on the role of the government and non-government sectors yielded some replies. One firm said that the government should run more environmental campaigns. One stated that the government should provide support by giving training in the monitoring of pollution. Yet another firm said that the government should provide knowledge to organizations of all sizes.

5.5.6 Benefits of having ISO 14001

Firms were asked to detail the benefits of ISO 14001 in terms of pollution reduction. A total of 95 firms reported that ISO 14001 had helped them to reduce water pollution. The ISO

14001 system had also helped them to understand the environmental status of their operations and easily identify things that needed to be fixed. The ISO 14001 system had also helped firms track the quality of their wastewater and put specific plans into action to reduce water usage. ISO 14001 had also led to firms creating prevention measures for potential environmental impacts. Firms also reported that having ISO 14001 in place helped them to comply with existing regulations on wastewater standards.

Sixty-one firms reported that having ISO 14001 helped them to reduce air pollution. Firms reported that having the ISO 14001 system in place resulted in monitoring their working environment to ensure compliance with existing regulations as well as forcing them to have stricter monitoring procedures. In terms of soil pollution only 28 firms reported that ISO 14001 had helped them with this problem.

In terms of waste management, 108 firms reported ISO 14001 to be beneficial. Firms reported reduced usage of hazardous substances, more organized systems of waste management, and reductions in raw materials and waste from the production process. Firms also reported that having ISO 14001 had helped them look for new ways to reduce environmental impacts, helped increase recycling, ensured that waste generated was properly disposed of, and prevented the mixing of toxic and non-toxic waste.

Firms also reported that having ISO 14001 supports corporate social responsibility, helped firms to gain acceptance and recognition by stakeholders, reduced electricity use, allowed personnel to work in a safer environment, and gave staff knowledge and understanding of toxic substances and their proper disposal procedures.

When asked about other benefits from ISO 14001, most firms in the industry reported that it helped to improve their corporate image and their working environment, and to reduce environment-related risks and liabilities. Forty-five firms in the industry reported that they have been able to enter new markets thanks to ISO 14001 certification, while other firms claimed that ISO 14001 adoption has helped them to resolve problems with surrounding communities and environmental groups. Only nine firms reported that they were able to raise their prices due to having ISO 14001 certification.

In terms of cost reduction, many firms said that ISO 14001 has helped cut electricity costs by an average of 25.2%. About 48 firms said that ISO 14001 helped cut waste management costs and reduced water usage. A reduction in energy and fuel consumption was reported by 32 firms. A few firms reported a reduction in resource usage such as paper, chemicals, etc., as well as an increase in recycling and reuse. However, 19 firms did not believe that ISO 14001 certification had helped them to cut costs in any way.

5.5.7 Reasons for not Adopting ISO 14001

Firms without ISO 14001 were asked why they did not sign up to the standard. Of the firms that replied, 69 said that they believed their production processes only have minimal effects on the environment, 64 firms said the certification costs are too high, and 56 firms said

that they already have environmental management systems in place that are comparable to ISO 14001.

5.6 Summary of Findings

The primary survey process yielded replies from 495 manufacturing firms across three industries, producing a wide array of products. Of the firms in our primary survey sample, roughly 37.8% had obtained ISO 14001 certification. Firms were of different sizes, were located in different regions of the country, and had varying degrees of foreign direct investment (FDI) and export-orientation. Thus, findings based on the survey sample reflect the true situation in the three industries to a significant extent. Some of the main findings are presented below.

5.6.1 Opinions on the Environment

Wastewater, hazardous waste, and particulate matter are the three environmental problems firms are most concerned about throughout the three industries. However, the importance of these environmental problems differ from industry to industry. Food producers are concerned with water pollution, while electronics and electrical appliances manufacturers place more importance on hazardous waste. For textiles and clothing producers, the seriousness of environmental problems depends on the type of product manufactured. Firms engaged in bleaching, dyeing, and printing activities are more concerned with wastewater emissions. Garment manufacturing, on the other hand, is considered less environmentally-damaging. However, some clothes manufacturers are concerned about waste and particulate matter. In the three industries studied, air pollution is substantially less serious compared to ground and water pollution.

In terms of remedial measures, most firms give importance to waste treatment before releasing into the environment. Measures to reduce spills and leaks of environmental contaminants and recycling have also been adopted by many firms. In the food industry, the creation of waste has been prevented by modifying the production process, and measures to prevent leaks and spills, recycling, and the use of environment-friendly raw materials, are environmental practices that have been widely adopted. For textiles and clothing firms, wastewater management and recycling are very popular environmental management measures. Electronics and electrical appliances firms also pay attention to wastewater treatment, but most of them are more concerned with waste treatment and the prevention of leaks and toxic spills.

Most of the surveyed firms produce environmental reports. This is especially true for large firms with some publishing reports biannually, and a few even reporting on a quarterly basis. A number of firms also make sure their employees receive environmental training.

5.6.2 Motivations for Environmental Improvement

While roughly 37.8% of the firms in our sample have ISO 14001 certification, ISO 9000 certification is more popular and most firms with ISO 14001 also have ISO 9000 certification. Other environmental measures adopted by many of the firms include green procurement, clean

technology, and corporate social responsibility. In addition to this, industry-specific standards, such as the food industry's HACCP certification and the electronics and electrical appliances industry's WEEE and RoHS regulations, have also been adopted by many firms.

Of the factors that could motivate firms to improve their environmental performance by adopting the measures outlined above, the most important factor for having ISO 14001 certification cited by responding firms was management policies. For firms with foreign investment, the advice of parent companies was also important to the decision to adopt ISO 14001. Other factors include the demands and requirements of the importing market, and the desire to gain a better corporate image. Government support, on the other hand, seems to be less important for ISO 14001 certification across all three industries.

5.6.3 Obstacles and the Role of the Government

Obstacles to improving environmental performance among the surveyed firms in all three industries included higher costs, the complexity of procedures, lack of knowledge and personnel, and a lack of government support. However, most firms surveyed claimed that they have tried their best to be environmentally-friendly by adopting various appropriate measures.

So far, the Thai government has not been very successful in encouraging industrial enterprises to adopt environmental standards. Most firms replied that they had obtained ISO 14001 certification via their own initiative and without government support. However, various institutes, such as the Management System Certification Institute (MASCI), the Thailand Environment Institute (TEI), and the Thailand Productivity Institute (TPI) were seen as helpful. In all three of the industries surveyed, there were also industry-specific institutes – the National Food Institute, the Thailand Textiles Institute, and the Electrical and Electronics Institute, which have paid attention to environmental issues in recent years. Some of the firms surveyed replied that they had received services from these institutes that helped to improve their environmental performance.

The assessment of the role of the government in promoting ISO 14001 certification was largely unsatisfactory. However, some government agencies were thought of as helpful by a few of the firms surveyed in helping them to adopt environmentally-friendly measures. These agencies included the Department of Industrial Works (DIW) and the Thailand Industrial Standards Institute, both agencies within the Ministry of Industry. State universities were also seen as helpful by many firms.

5.6.4 Benefits of having ISO 14001

Various benefits of ISO 14001 certification were mentioned. For firms in the food and beverage industry, having ISO 14001 has helped them to comply with existing wastewater treatment laws. ISO 14001 adoption was also said to help reduce water and soil pollution, as well as air pollution. Having ISO 14001 certification has also allowed firms to comply with other environmental laws, and helped firms pay more attention to separating and recycling waste from the production process. Moreover, the adoption of ISO 14001 can help to improve the image of a firm.

The cost reductions resulting from ISO 14001 certification were not deemed to be significant, although some firms in the three industries reported that they had been able to cut electricity, energy, water, and waste treatment costs. In the food and beverage industry, firms reported that they were able to cut electricity and energy costs by around 15-20%. In the textiles and clothing industry, savings on electricity and fuel costs were also reported. Other benefits were reduced water usage and waste management costs. In the electronics and electrical appliances industry, in addition to benefits from reduced hazardous waste, more organized systems of waste management, and improving corporate image, firms with ISO 14001 also enjoyed savings on electricity costs and more efficient use of raw materials, as well as an increase in recycling and reuse of materials. However, there were firms across all three industries which reported that ISO 14001 certification had not helped them to cut costs in any way and had, in fact, increased their production costs.

5.6.5 Reasons for not Applying for ISO 14001

The primary survey also included firms without ISO 14001 certification for comparison purposes. These firms were asked why they did not apply for ISO 14001. Various reasons were cited for not applying. Some firms reported that their production has very little environmental impact, some said that they already have other environmental management systems in place so they do not need to apply for ISO 14001. However, more common reasons for failure to apply for ISO 14001 were a lack of knowledge and personnel for establishing a working environmental management system, a lack of understanding of how to apply for the certification, and a fear of high costs.

When asked if they would apply for certification if incentives or financial measures were in place, firms without ISO 14001 mostly replied that they would like to see financial support in some form, such as tax reductions, low-interest loans, etc. Other measures firms would like to see included the provision of information and advice, and help to train personnel. Consultation and advice from government and non-government agencies was also seen as helpful to encouraging ISO 14001 certification, but was not judged as important as the provision of financial incentives.

5.6.6 Conclusion

The primary survey helped to provide further insights into the understanding of ISO 14001 certification in Thailand. While the empirical analysis section identified firm characteristics that are important determinants of ISO 14001 adoption, the primary survey helped to give a better understanding of the motivations behind a firm's decision to voluntarily sign up for ISO 14001. According to the survey, management policies, corporate image, and social responsibility are all important reasons why firms from the three industries sign up for ISO 14001.

The primary survey also provided some evidence that having ISO 14001 in place is associated with better environmental performance. In addition to the difference-in-means test in the last section which found that, on average, ISO 14001 adopters performed better than non-adopters, written responses to the primary survey also revealed that the majority of firms with

ISO 14001 reported that having the system in place has helped them to improve various aspects of their environmental performance, including reducing pollution and waste generated, and reducing resources consumed such as electricity, fuel, and water. In addition to this, responses indicated that ISO 14001 adoption may be financially beneficial to firms in terms of cost savings, although having ISO 14001 may also add costs due to establishing a working environmental management system and maintaining it.

In terms of firms' opinions on the role of the government regarding ISO 14001 adoption, it could be concluded that the government has not yet been very successful in promoting ISO 14001 adoption, and more needs to be done. In this study, various suggestions were made by the surveyed firms regarding the encouragement of ISO 14001 adoption. These included providing financial incentives for firms participating in ISO 14001, helping firms with training and providing knowledge, and singling out small- and medium-sized enterprises and helping them to establish ISO 14001 environmental management systems. Various government and non-government agencies were thought of as helpful in giving advice to industrial firms wanting to improve their environmental performance. In this regard, the government could encourage ISO 14001 adoption in a number of ways.

6.0 CONCLUSION

This research was undertaken in order to answer three sets of research questions aimed at better understanding the voluntary ISO 14001 environmental management system certification program in three industries in Thailand. Which firm characteristics and what motivations are important determinants of ISO 14001 participation? How does ISO 14001 affect firm environmental performance? And, what is the role of the government in promoting ISO 14001?

In terms of better understanding a firm's decision to participate in voluntary programs, this research has shown that a variety of factors underlie this decision and that some of these factors change depending on the type of industry. Apart from firm size and participation in ISO 9000, which were statistically significant across industrial sectors, export orientation and firm location were only significant for the electronics and electrical appliances industry. This implies that, in seeking to promote the adoption of ISO 14001, industry-specific characteristics should be considered.

The primary survey part of the research helped to establish the main factors motivating firm participation in ISO 14001. For firms throughout the three industries, important motivators are internal management, corporate image, and social responsibility. It is interesting to note that consumer preferences are of lesser importance for all three industries. Thus, if ISO 14001 is to be successfully adopted, management must first be convinced of its benefits for the firm.

The study also found a positive association between ISO 14001 participation, and a firm's environmental performance. However, this does not necessarily mean that having ISO 14001 will lead firms to improve their environmental performance. Indeed, while several studies

have concluded that voluntary program participation leads to better environmental performance, several other studies have found evidence against this and concluded that adopting firms do not perform any better than non-adopters. Thus, while the positive association found between adopters and environmental performance indicates that ISO 14001 has potential as an effective tool for environmental management, further studies still need to be conducted in order to fully understand the link between ISO 14001 adoption and its environmental benefits.

Regarding the role of the government, the research has found that firms do see that there is a role for government involvement in ISO 14001, especially in promoting ISO 14001 by way of providing financial incentives, training programs, and ISO 14001-related information. Firms with ISO 14001 also benefitted from the involvement of non-government organizations such as the Thailand Environment Institute (TEI), the Management System Certification Institute (MASCI), and industry-specific institutes. Thus, the cooperation of government and non-government sectors are important if ISO 14001 is to be promoted in Thailand.

In conclusion, given the limited resources and tools for environmental management in Thailand, voluntary environmental programs such as ISO 14001 can potentially be useful, especially in the face of the weak enforcement of existing regulations and a lack of political will to enact and enforce more stringent environmental regulations. This study has identified a number of firm characteristics and various roles for the government and non-government organizations that will be useful when considering policy options to promote voluntary programs such as ISO 14001 in Thailand. However, given the limited understanding of the environmental effectiveness of ISO 14001 certification and the lack of reliable environmental performance data in Thailand, ISO 14001 should be employed cautiously.

REFERENCES

Alberini, A. and K. Segerson (2002). "Assessing Voluntary Programs to Improve Environmental Quality." Environmental and Resource Economics **22**: 157 - 184.

Andrews, R. N. L., D. Amaral, et al. (2003). "Environmental Management Systems: Do They Improve Performance?" Final Report, 30 Jan 2003 Retrieved 26 December, 2009, from http://www.c2e2.org/documents/emsivolumei.pdf.

Arimura, T. H., A. Hibiki, et al. (2008). "Is a Voluntary Approach An Effective Environmental Policy Instrument?" Journal of Environmental Economics and Management **55**(3): 81 - 295.

Arora, S. and T. N. Cason (1995). "An Experiment in Voluntary Environmental Regulation: Participation in EPA's 33/50 Program." Journal of Environmental Economics and Management **28**: 271 - 286.

Arora, S. and S. Gangopadhyay (1995). "Toward a Theoretical Model of Voluntary Overcompliance." Journal of Economic Behavior and Organization **28**(3): 289 - 909.

Barla, P. (2007). "ISO 14001 Certification and Environmental Performance in Quebec's Pulp and Paper Industry." Journal of Environmental Economics and Management **53**(3): 291 - 306.

Baumol, W. J. (1959). Business Behavior, Value and Growth. New York,, Macmillan.

Bizer, K. and R. Jülich (1999). "Voluntary Agreements - Trick or Treat?" European Environment **9**: 59 - 66.

Blackman, A. (2008). "Can Voluntary Environmental Regulation Work in Developing Countries? Lessons from Case Studies." The Policy Studies Journal **36**(1): 119 - 141.

Blackman, A., B. Lahiri, et al. (2007). Voluntary Environmental Regulation in Developing Countries - Mexican's Clean Industry Program. RFF Discussion Paper - 07-36. Washington, DC, Resources for the Future.

Blackman, A., T. P. Lyon, et al. (2006). "Voluntary Environmental Agreements When Regulatory Capacity is Weak." Comparative Economic Studies **48**: 682 - 702.

Blackman, A. and N. Sisto (2005). Muddling Through while Environmental Regulatory Capacity Evolves: What Role for Voluntary Agreements? Resources for the Future Discussion Paper 05-16, Resources for the Future.

Blackman, A. and N. Sisto (2006). "Voluntary Environmental Regulation in Developing Countries : A Mexican Case Study." Natural Resources Journal **46**(4): 1005 - 1042.

Börkey, P. and F. Lévêque (2000). "Voluntary Approaches for Environmental Protection in the European Union - A Survey." European Environment **10**: 35 - 54.

Brink, P. t. (2002). Voluntary Environmental Agreements : Process, Practice and Future Use. Sheffield, Greenleaf.

Cairncross, F. (1995). Green, Inc : guide to business and the environment. London, Earthscan.

Cashore, B. (2007). Conceptualizing Forest Certification as an Environmental Cartel: Implications for the Institutionalization of Globally Effective Clubs. Workshop on Voluntary Environmental Programs. University of Washington - Seattle.

Christmann, P. and G. Taylor (2001). "Globalization and the Environment: Determinants of Firm Self-Regulation in China." Journal of International Business Studies **32**(3): 439 - 458.

Copeland, B. R. and M. S. Taylor (1994). "North-South Trade and the Environment." The Quarterly Journal of Economics **109**(3): 755-787.
Copeland, B. R. and M. S. Taylor (2004). "Trade, Growth, and the Environment." Journal of Economic Literature **XLII**: 7-71.
Cropper, M. L. and W. E. Oates (1992). "Environmental Economics: A Survey." Journal of Economic Literature **30**(2): 675 - 741.
Dahlström, K., C. Howes, et al. (2003). "Environmental Management Systems and Company Performance: Assessing the Case for Extending Risk-based Regulation." European Environment **13**(4): 187-203.
Darnall, N. (2001). To Signal or Not to Signal : Green! Academy of Management Conference. Washington, D.C.
Darnall, N. and S. R. Sides (2008). "Assessing the Performance of Voluntary Environmental Programs: Does Certification Matter?" Policy Studies Journal **36**(1).
Dasgupta, S., H. Hettige, et al. (2000). "What Improves Environmental Compliance? Evidence from Mexican Industry." Journal of Environmental Economics and Management **39**: 39 - 66.
Delmas, M. and M. W. Toffel (2004). "Stakeholders and Environmental Management Practices: An Institutional Framework." Business Strategy and the Environment **13**: 209 - 222.
Delmas, M. A. (2002). "The Diffusion of Environmental Management Standards in Europe and in the United States: An Institutional Perspective." Policy Sciences **35**: 91 - 119.
Ervin, D., J. Wu, et al. (2008). Toward a Fuller Analysis of Business Environmental Management Decisions. Portland State University Working Paper. , Portland State University.**:** 43.
Gamper-Rabindran, S. (2006). "Did the EPA's Voluntary Industrial Toxics Program Reduce Emissions? A GIS Analysis of Distributional Impacts and By-Media Analysis of Substitution." Journal of Environmental Economics and Management **52**: 391 - 410.
Glachant, M. (2007). "Non-binding Voluntary Agreements." Journal of Environmental Economics and Management **54**(1): 32 - 48.
Griffiths, A. and S. Wall (2001). Applied Economics. Harlow, England ; New York, Financial Times Prentice Hall.
Gugerty, M. K. (2007). Self-Regulation and Voluntary Programs Among Nonprofit Organization. Workshop on Voluntary Environmental Programs. University of Washington - Seattle.
Gulati, R., N. Nohria, et al. (2000). "Strategic Networks." Strategic Management Journal **21**: 203-215.
Hanley, N., J. F. Shogren, et al. (1996). Environmental Economics : In Theory and Practice. New York, Oxford University Press.
Henriques, I. and P. Sadorsky (1996). "The Determinants of an Environmentally Responsive Firm: An Empirical Approach." Journal of Environmental Economics and Management **30**(3): 381 - 395.
Henriques, I. and P. Sadorsky (2006). "The Adoption of Environmental Management Practices in a Transition Economy." Comparative Economic Studies **48**: 641 - 661.
Hettige, H., M. Huq, et al. (1996). "Determinants of Pollution Abatement in Developing Countries: Evidence from South and Southeast Asia." World Development **24**(12): 1891 - 1904.

Heyer, J., J. M. Rao, et al. (2002). Group Behaviour and Development. Group and Development - Is the Market Destroying Cooperation? J. Heyer, F. Stewart and R. Throp. Oxford, New York, United Nations University; World Institute for Development Economics**:** 1-22.
Jarusombat, S. (2008). Environmental Policy and Management. Bangkok, Thammasat University (*in Thai*).
Johnstone, N. (1996). International Trade and Environmental Quality. The Economics of Environmental Degradation : Tragedy for the Commons? T. M. Swanson. Cheltenham, Edward Elgar.
Karamanos, P. (2001). "Voluntary Environmental Agreements: Evolution and Definition of a New Environmental Policy Approach." Journal of Environmental Planning and Management **44**(1): 67 - 84.
Khanna, M. (2001). "Non-Mandatory Approaches to Environmental Protection." Journal of Economic Surveys **15**(3): 291 - 324.
Khanna, M. and W. R. Q. Anton (2002). "Corporate Environmental Management: Regulatory and Market-Based Incentives." Land Economics **78**(4): 539 - 558.
Khanna, M. and L. A. Damon (1999). "EPA's Voluntary 33/50 Program: Impact on Toxic Releases and Economic Performance of Firms." Journal of Environmental Economics and Management **37**: 1 - 25.
King, A. A. and M. J. Lenox (2000). "Industry Self-Regulation Without Sanctions: The Chemical Industry's Responsible Care Program." Academy of Management Journal **43**(4): 698 - 716.
Kolstad, C. D. (2000). Environmental economics. New York, Oxford University Press.
Kotchen, M. J. and K. van't Veld (2009). An Economics Perspective on Treating Voluntary Programs as Clubs. Voluntary Programs: A Club Theory Perspective. M. Potoski and A. Prakash. Cambridge, MA, MIT Press.
Lyon, T. and J. Maxwell (2002). Voluntary Approaches to Environmental Regulation : A Survey. Economic Institutions and Environmental Policy (Ashgate Studies in Environmental Policy and Practice). M. Franzini and A. Nicita. Aldershot and Hampshire, Ashgate**:** vii, 240 p.
Lyon, T. P. and J. W. Maxwell (2004). Corporate Environmentalism and Public Policy. Cambridge, UK ; New York, Cambridge University Press.
Maddala, G. S. (1994). Limited-dependent and Qualitative Variables in Econometrics. Cambridge [u.a., Cambridge Univ. Press.
Marris, R. L. (1964). The Economic Theory of Managerial Capitalism. London,, Macmillan.
Maxwell, J. W., T. P. Lyon, et al. (2000). "Self-Regulation and Social Welfare: The Political Economy of Corporate Environmentalism." Journal of Law and Economics **XLIII**: 583 - 617.
MOC. (2009). "Summary of International Trade Statistics." from http://www2.ops3.moc.go.th/.
Muradian, R. and J. Martinez-Alier (2001). "Trade and the Environment: From a 'Southern' Perspective." Ecological Economics **36**: 281 - 297.
Nakamura, M., T. Takahashi, et al. (2001). "Why Japanese Firms Choose to Certify: A Study of Managerial Responses to Environmental Issues." Journal of Environmental Economics and Management **42**: 23 - 52.

NESDB. (2009). "Statistical Tables - National Income of Thailand." from http://www.nesdb.go.th/Default.aspx?tabid=94.
Neumayer, E. (2001). "Pollution Havens: An Analysis of Policy Options for Dealing with an Elusive Phenomenon." Journal of Environment and Development **10**(2): 147 - 177.
Neumayer, E. and R. Perkins (2004). "What Explains the Uneven Take-up of ISO 14001 at the Global Level? A Panel-data Analysis." Environment and Planning **36**: 823 - 839.
OECD (1999). Voluntary Approaches for Environmental Policy: An Assessment. Paris, OECD.
OECD (2003). Voluntary Approaches for Environmental Policy : Effectiveness, Efficiency and Usage in Policy Mixes. Paris, OECD.
Panayotou, T. (2000). Globalization and Environment. CID Working Paper No.53, Environment and Development Paper No.1, Center for International Development at Harvard University.
Pargal, S. and D. Wheeler (1996). "Informal Regulation of Industrial Pollution in Developing Countries: Evidence from Indonesia." Journal of Political Economy **104**(6): 1314 - 1327.
Potoski, M. and A. Prakash (2004). "Regulatory Convergence in Nongovernmental Regimes? Cross-National Adoption of ISO 14001 Certifications." The Journal of Politics **66**(3): 885 - 905.
Potoski, M. and A. Prakash (2005). "Covenants with Weak Swords: ISO 14001 and Facilities' Environmental Performance." Journal of Policy Analysis and Management **24**(4): 745-769.
Potoski, M. and A. Prakash (2005). "Green Clubs and Voluntary Governance: ISO 14001 and Firms' Regulatory Compliance." American Journal of Political Science **49**(2): 235 - 248.
Prakash, A. and M. Potoski (2006a). The Voluntary Environmentalists: Green Clubs, ISO 14001, and Voluntary Regulations. Cambridge, UK ; New York, Cambridge University Press.
Raines, S. S., T. Rong, et al. (2002). "Costs, Benefits, and Motivations for ISO 14001 Adoption in China and Around the World." Chinese Public Administration Review **1**(3/4): 239 - 252.
Rivera, J. (2004). "Institutional Pressures and Voluntary Environmental Behavior in Developing Countries: Evidence from the Costa Rican Hotel Industry." Society and Natural Resources **17**: 779 - 797.
Rivera, J. and P. De Leon (2005). "Chief Executive Officers and Voluntary Environmental Performance: Costa Rica's Certification for Sustainable Tourism." Policy Sciences **38**: 107 - 127.
Russo, M. V. (2002). "Institutional Change and Theories of Organizational Strategy : ISO14001 and Toxic Emissions in the Electronics Industry." Academy of Management Proceedings.
Segerson, K. and T. J. Miceli (1998). "Voluntary Environmental Agreements: Good or Bad News for Environmental Protection?" Journal of Environmental Economics and Management **36**: 109 - 130.
Siebert, H. (1998). Economics of the Environment : Theory and Policy. Berlin ; New York, Springer.

Storey, M., G. Boyd, et al. (1999). Voluntary Agreements with Industry. Voluntary Approaches in Environmental Policy. C. Carraro and F. Leveque. Dordrecht, Kluwer Academic Publishing.

TEENET. (2010). "Pollution Problems from the Textiles Industry." Retrieved 4 April, 2010, from http://teenet.tei.or.th/Knowledge/weave2.html.

TEI (1999). How Can It Benefit Business? - A Survey of ISO 14001 Certified Companies in Thailand. S. Terasart, P. Palapleevalya and S. Veerasawadrak. Bangkok, Thailand, Thailand Environment Institute (TEI).

Teisl, M. F., B. Roe, et al. (2002). "Can Eco-Labels Tune a Market? Evidence from Dolphin-Safe Labeling." Journal of Environmental Economics and Management **43**(3): 339 - 359.

Uchida, T. and P. J. Ferraro (2005). Can Encouraging Voluntary Development of Environmental Management Systems Augment Existing Regulations? Water Policy Working Paper No.2005-015, Georgia Water Planning and Policy Center.

Videras, J. and A. Alberini (2000). "The Appeal of Voluntary Environmental Programs: Which Firms Participate and Why?" Contemporay Economic Policy **18**(4): 449 - 461.

Welch, E. W., A. Mazur, et al. (2000). "Voluntary Behavior by Electric Utilities: Levels of Adoption and Contribution of the Climate Challenge Program to the Reduction of Carbon Dioxide." Journal of Policy Analysis and Management **19**(3): 407-425.

Welch, E. W., Y. Mori, et al. (2002). "Voluntary Adoption of ISO 14001 in Japan: Mechanisms, Stages and Effects." Business Strategy and the Environment **11**: 43 - 62.

Wheeler, D. (1999). Greening Industry : New Roles for Communities, Markets, and Governments. New York, Oxford/ World Bank.

Williamson, O. E. (1964). The Economics of Discretionary Managerial Behavior: Managerial Objectives in a Theory of the Firm. Englewood Cliffs, NJ, Prentice-Hall.

World Bank. (2000). Greening Industry : New Roles for Communities, Markets, and Governments. New York, N.Y., Oxford University Press.