Voluntary Environmental Programmes in the Developing World

An Examination of the ISO 14001 Environmental Management System Certification in Thailand

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For my family, Somsak, Siriporn, Suchanan,
Sutida, and Supreeda Tambunlertchai,
with love

Declaration:

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text. It is not substantially the same as any that I have submitted for a degree or diploma or any other qualification at any other University. I further state that no part of my dissertation has already been or is being concurrently submitted for any degree, diploma or other qualification.

This dissertation does not exceed the regulation length, including footnotes, references and appendices.

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SUMMARY

This dissertation studies one of the newest tools in environmental policy in the developing world context – that of voluntary environmental programmes (VEPs). Developed and promoted in the past few decades by policy practitioners looking to regulate environmental pollution without saddling enterprises and governments with high regulatory costs, VEPs remain vastly under-studied, especially when compared with market instruments and the long-standing command and control approach. Fundamental questions such as who the likely participants are, why firms would voluntarily take on added costs of environmental improvement, and whether any financial and environmental benefits arise from participation remain largely unanswered. This gap in the literature is particularly severe for the case of developing countries. While VEPs in general and ISO 14001 in particular have rapidly increased across the developing world, the understanding of their implications in the academic literature trail far behind. This dissertation aims to fill some of this gap in the existing literature by using unique firm level data and applying rigorous empirical micro-econometric methods to analyse the adoption of the ISO 14001 international voluntary scheme in Thailand. The study focuses on three core manufacturing industries – food and beverages, textiles and wearing apparel, and electronics and electrical appliances, chosen to represent three main types of manufacturing activities in the country.

The study finds that both macroeconomic and industry-specific factors influence firms' participation in the ISO 14001 scheme. It also finds that the degrees of environmental impact from programme adoption vary by industry, and that although participation in the programme requires non-trivial commitments of the firm's resources, participating firms are not placed at a financial disadvantage when compared with non-adopting firms.

ACRONYMS AND ABBREVIATIONS

BOD	Biochemical Oxygen Demand
CAC	Command and Control approach to environmental regulation
COD	Chemical Oxygen Demand
CSR	Corporate Social Responsibility
CST	Costa Rica's Certification for Sustainable Tourism Programme
DIW	Department of Industrial Works, Ministry of Industry
EMAS	European Commission's Eco-Management and Audit Scheme
EMS	Environmental Management System
EU	European Union
FDI	Foreign Direct Investment
FTI	Federation of Thai Industries
ISO	International Organization for Standardization
MBI	Market-based Instrument
MOC	Ministry of Commerce
MOI	Ministry of Industry
MONRE	Ministry of Natural Resources and the Environment
MOPH	Ministry of Public Health
NEB	National Environment Board
NEPT	USEPA's National Environmental Performance Track Program
NEQA	Enhancement and Conservation of National Environmental Quality Act
NESDB	National Economic and Social Development Board
NSO	National Statistical Office
OECD	Organisation for Economic Co-operation and Development
OIE	Office of Industrial Economics, Ministry of Industry
ONEP	Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and the Environment
PCD	Pollution Control Department, Ministry of Natural Resources and the Environment
PROPER	Programme for Pollution Control Evaluation and Rating
TDRI	Thailand Development Research Institute
TEENET	Thailand Energy and Environment Network
TEI	Thailand Environment Institute
TISI	Thailand Industrial Standards Institute, Ministry of Industry
TPI	Thailand Productivity Institute
TQM	Total Quality Management
TTI	Thailand Textiles Institute
UNCED	United Nations Conference on Environment and Development
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNRISD	United Nations Research Institute for Social Development

USEPA	United States Environmental Protection Agency, also shortened to EPA
VEP	Voluntary Environmental Programme

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CHAPTER 1

INTRODUCTION

1. Introduction and Main Objective of This Dissertation

This dissertation studies voluntary environmental programmes (VEPs), one of the newest tools for environmental management in the context of developing but rapidly industrialising economies[1]. Broadly defined as any non-mandatory commitment on the part of the firm that aims to improve their environmental performance, VEPs have been rapidly increasing in the industrialised world since the 1990s and has recently been gaining popularity across the developing world (UNRISD 2000, Brink 2002, Lyon and Maxwell 2002, Blackman 2008, Blackman et al. 2009, ISO 2010).

Environmental protection in the developing country context presents the policymaker with a unique problem. Instead of the usual question faced by the industrialised world policymaker of how to mitigate environmental degradation, the problem of crucial importance to the developing world government is how to protect the environment in a way that promotes growth and reduces poverty (Eskeland and Jimenez 1992, World Bank 2000a). Furthermore, the regulators must grapple with the problem of how to achieve these goals within a context of weak institutions, public revenue constraints, limited information and manpower, a certain degree of uncertainty, and inefficient markets (Eskeland and Jimenez 1992, Turner et al. 1994, Kruger et al. 2003, Russell and Vaughan 2003, Welford 2004, Graham and Woods 2006, Blackman 2010).

Despite formidable obstacles, growing environmental problems in the newly industrialising economies (NIEs) have fostered increasing recognition that environmentally unsustainable patterns of growth in such countries must be addressed. In the United Nations Economic and Social Commission for Asia and the Pacific's state of the environment report, it was clearly stated that rapid economic

[1]From this point onward, these countries will be referred to collectively as 'newly industrialising economies (NIEs)'. Countries in this category include China, India, Indonesia, Malaysia, Mexico, and Singapore.

growth has exacted '*a very high cost*' on the region's natural environment and that '*declining environmental sustainability represents a critical political, institutional, social and economic threat for many countries in the region*' (UNESCAP 2006: p.18).

This dissertation considers the case of Thailand, a dynamic Southeast Asian nation which has many features of the typical second-tier newly industrialising economy. Having made vast improvements in several welfare indicators through export-led industrialisation from the 1960s through to the mid-1990s, the country has suffered greatly from loss of 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 (World Bank 2000b, 2001, 2002, 2003, ONEP 2008, PCD 2008).

To combat the array of environmental problems stemming from industrialisation, several tools have been adopted by the Thai 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[2]. 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 lead to failure to follow through with existing environmental laws (Rock 2002, Welford 2004, Jarusombat 2008). In addition to this, developing country regulations are often criticised for being poorly designed and inadequately enforced (Bernstein 1993). These conditions add to the already long list of critiques of the command and control approach (CAC), which include 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).

One alternative to the CAC that has been much explored in the academic literature is market-based instruments (MBIs). Based in economic theory, MBIs are credited as flexible and cost effective means of internalising the negative externalities associated with environmental pollution (Kolstad 2000). However, while developing country

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

governments are increasingly considering implementing such tools domestically, MBIs 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 et al. 1996).

The practitioner's solution to the problem of rising regulatory costs is the voluntary environmental programme (OECD 1999, Börkey and Lévêque 2000), a new tool for environmental management first developed in the industrialised world, but which is now rapidly spreading to the developing countries (UNRISD 2000, Brink 2002, Lyon and Maxwell 2002, Blackman 2008, Blackman et al. 2009, ISO 2010). Recognised as a means of achieving environmental goals in a cost effective and cooperative fashion (Khanna 2001, Prakash and Potoski 2006), VEP is a promising new tool for managing environmental problems in both the industrialised and industrialising worlds.

Despite the great promise VEP offers to policymakers as a burgeoning new tool for environmental management, its relatively short history and origin in the field mean that, unlike MBIs which are based in economic theory and CAC which has had a long history of applications, VEPs are relatively little-understood and remain vastly under-studied. Fundamental questions such as who are the likely participants, why firms would voluntarily take on added costs of environmental improvement, and what, if any, financial and environmental benefits arise from participation remain largely unanswered. With the majority of existing studies on VEPs focused on the industrialised world, the gap in the literature is particularly severe for the application of VEPs in developing countries. With the third world facing vastly different institutional and socio-economic contexts, there is limited generalisability of developed country studies to the situation in the developing world.

Of the array of VEPs in existence, the International Organization for Standardization's (ISO) environmental management system certification (ISO 14001) is the most prominent (Prakash and Potoski 2007). With 223,149 certifications in 159 countries worldwide (ISO 2010), the global presence of the scheme and its uptake in an array of sectors in many developing countries have made the understanding of the programme an imperative. Yet data limitations have hampered rigorous analysis of the programme in the developing country context, leading to an incomplete

understanding of this international voluntary scheme in a setting where environmental protection and poverty-reduction goals must go hand-in-hand and where policymakers are constrained by limited institutional capacity, tight budgets, and little information.

This dissertation aims to fill some of this gap in the existing literature by using unique survey data and applying rigorous empirical methods to analyse the adoption of the ISO 14001 international voluntary scheme in Thailand. The study focuses on three core manufacturing industries – food and beverages, textiles and wearing apparel, and electronics and electrical appliances, chosen to represent three main types of manufacturing activities in the country and in many countries of the lower-income newly industrialising world.

2. Research Questions and Contribution to Knowledge

The main objective of studying the ISO 14001 international voluntary scheme in the developing country context of Thailand can be broken down into four sets of research questions, each of which is addressed in separate chapters of this dissertation. These questions are:

(1) When formal regulations and enforcement are weak, what types of firms are likely to participate in ISO 14001? Is connectedness to the global economy an important factor?

(2) What are the channels through which firms stand to gain financial benefits from voluntarily investing in environmental improvement schemes such as ISO 14001? Do firms obtain positive financial benefits from ISO 14001 adoption? Do firms stand to gain other types of benefits from participation in ISO 14001?

(3) How does ISO 14001 affect environmental performance for firms in the developing world? Do firms with ISO 14001 perform better environmentally?

(4) What are the lessons for policymakers that can be drawn from the research findings?

By addressing these research questions, the dissertation aims to contribute to existing economic research on voluntary environmental programmes in the following ways:

(1) Address a topic that has been greatly overlooked in existing VEP literature: VEP application in the developing world

It is an accepted fact that many social and economic conditions in developed and developing countries differ markedly. Firms in less developed countries (LDCs) operate in situations where environmental regulations are less stringent, legal structures are relatively weak, property rights are not as well-defined, and the government has limited budgets for regulatory enforcement. (Eskeland and Jimenez 1992, Turner et al. 1994, World Bank 2000a, Russell and Vaughan 2003, Blackman and Sisto 2006, Graham and Woods 2006). However, the existing literature on VEPs has mostly dealt with programmes implemented in industrialised countries such as EU member states, the US, and Japan, and does not adequately address the implications of the findings under different socio-economic conditions (see, e.g., Bizer and Jülich 1999, Börkey and Lévêque 2000, Karamanos 2001, Khanna 2001, Alberini and Segerson 2002, Lyon and Maxwell 2002, Welch et al. 2002, OECD 2003, Coglianese and Nash 2006, Prakash and Potoski 2006, Morgenstern and Pizer 2007).

Three differences between NIEs and OECD countries are particularly important barriers to the applicability of developed country studies to the NIEs context. First, the objective of VEPs is different. In advanced economies where the majority of firms are already abiding by environmental regulations, the principal role of VEPs is to encourage firms to go beyond compliance with existing regulations. On the other hand, for developing countries where the problem lies in limited enforceability of existing environmental laws, VEPs have been used as a tool for combating rampant non-compliance with such regulations (Blackman and Sisto 2006). This difference suggests that VEPs in the industrialising world may have far more implications for environmental performance in such countries than for OECD economies (Toffel 2005). This points to the need for considering developing world VEPs within its own context, rather than relying on results extrapolated from industrialised countries with vastly different circumstances.

Second, OECD studies have found that the main drivers for VEP participation are domestic regulatory and market pressures (Khanna and Anton 2002, Lyon and Maxwell 2004). However, such pressures are likely to be diluted in the developing country context due to limited regulatory capacity for monitoring and enforcement,

smaller markets for green products, and limited information on the environmental performance of firms (Hanley et al. 1996, Wehrmeyer and Mulugetta 1999, World Bank 2000a, Kruger et al. 2003, Ruiz-Tagle 2003, Graham and Woods 2006, Blackman et al. 2009). Despite this, VEPs are increasingly being adopted in the developing world (UNRISD 2000, Brink 2002, Lyon and Maxwell 2002, Blackman 2008, Blackman et al. 2009, ISO 2010). This suggests that other factors might be underlying firm participation in VEPs in the context of rapidly industrialising economies.

Third, differences in pressures for regulatory compliance between NIEs and OECD countries could be limiting the applicability of industrialised country studies to the context of third world countries. History of poor regulatory compliance in industrialising economies suggests that there are low-hanging fruits to be picked in such countries. Furthermore, as late-comers to the industrial development scene, low-income NIEs have the potential to leverage on the technical environmental expertise already developed in more advanced economies without having to bear research and development costs (Rock and Angel 2005). Since these factors combine to create conditions within which firms could undertake environmental cleanup at relatively lower costs, the application of VEPs in the developing world could potentially lead to a win-win situation where the firm improves both its environmental and financial performances, and the regulator reduces enforcement costs (Daley 2007).

This research proposes to take these different conditions into account by looking at an internationally-designed voluntary scheme in the dynamic developing country context of Thailand. By doing so, the dissertation joins a handful of research on VEP application in the third world such as Dasgupta et al. (2000), Blackman (2007, 2008, 2010), and Blackman et al. (2009, 2010), which mainly study the adoption of VEPs in Latin America; Rivera (2002, 2004), and Rivera and De Leon (2005), which study the Costa Rican Certificate for Sustainable Tourism scheme, Henriques and Sadorsky (2006), which examines determinants of the comprehensiveness of environmental management systems (EMSs) in Hungary, and Raines et al. (2002) and, Qi et al (2011), which study ISO 14001 in China. However, the study goes beyond existing works on VEPs in the developing world by providing a comprehensive treatment of the major aspects of VEP application – determinants for participation, the gains to

firms from VEP adoption, and the effectiveness of VEP as a tool for environmental management. Specific contributions on each of these aspects are also highlighted in the respective chapters.

(2) Collection and use of a unique firm-level primary survey dataset

Scarcity of detailed firm-level data is one main reason for the dearth of VEP studies in the developing world (World Bank 2000a, Blackman et al. 2010). This limitation is especially severe in Thailand (Rock 2002). The country has no public information on firm environmental performance and the agencies that do keep such information closely guarded. To overcome this constraint, the researcher designed her own questionnaire and, over the course of one year, administered it to both ISO 14001 and non-ISO 14001 adopting firms from the three manufacturing sectors across Thailand. The questionnaire asked detailed firm-level information, and included questions on various environmental aspects of the firm, and on firm characteristics. To avoid non-response, detailed financial information was omitted from the questionnaire. Rather, the dissertation makes use of existing survey data from the Ministry of Industry's Office of Industrial Economics annual industrial survey for analysis of the financial implications of ISO 14001 adoption.

(3) Rigorous econometric methods, supplemented by qualitative firm-level data

Data scarcity in the developing world has limited the majority of studies on ISO 14001 adoption in such countries to case studies and qualitative information. While such studies provide insightful in-depth information on specific cases, conclusions drawn from such data have limited generalisability. Econometric analysis, on the other hand, offers more scope for obtaining reliable and generalisable results although it does not accommodate detailed qualitative information. This dissertation combines the strengths of these two approaches. With the availability of the primary survey data and the government survey data, this dissertation is able to employ various econometric methods designed to account for various types of endogeneity problems that normally would limit the accuracy and reliability of the findings. These results are then supplemented by qualitative information from firms, which allow for a more in-depth understanding of the issues under study.

(4) Focus on three manufacturing sectors that are important to Thailand and other developing countries

Preliminary evidence suggests that factors affecting the participation decision and the resulting outcomes of ISO 14001 certification may be dissimilar for firms in different industries (Wu et al. 2007, Delmas and Montiel 2008, Nishitani 2011). While existing studies on VEP participation acknowledge industrial differences and control for them using industry dummies, the studies usually draw a general conclusion and do not go into detail on how the differences among industries have affected their findings (see, e.g., Dasgupta et al. 2000, Barla 2007, Wu et al. 2007, Delmas and Montiel 2009, Heras-Saizarbitoria et al. 2011). In this dissertation, differences among industries are highlighted and three industries are chosen as representatives of three core industrial activities in the developing world. These industries are the food and beverages industry, the textiles and wearing apparel industry, and the electronics and electrical appliances industry which respectively represent the resource-based, the labour intensive, and the engineering industry types.

(5) Accounting for firm's connectedness to the global economy

Cross country studies on environmental spillovers and the global diffusion of EMS practices indicate that international trade linkages may have important roles to play in determining ISO 14001 diffusion and in determining firm's environmental and financial outcomes from VEP participation (Prakash and Potoski 2007, Albornoz et al. 2009, Perkins and Neumayer 2009, 2010, Nishitani 2011). This is especially true for firms in Thailand and other East Asian NIEs where connectedness to global trade via export orientation and foreign direct investment (FDI) are important economic features (World Bank 1993, Esty et al. 2000, Rock 2002, Bosworth 2005, Rock and Angel 2010). However, due to their lesser influence on the industrialised world economy, these factors have been overlooked by the majority of VEP studies due to their focus on first world contexts (see, e.g., Arora and Cason 1995, 1996, Maxwell and Lyon 1999, Lyon and Maxwell 2004, Coglianese and Nash 2006, Khanna et al. 2007, Morgenstern and Pizer 2007). While these factors are introduced in existing developing country studies, the focus have been on stakeholder and regulatory pressures rather than trade linkages (Dasgupta et al. 2000, Rivera 2004, Henriques and Sadorsky 2006, Blackman et al. 2010). This dissertation addresses this gap in the

literature, and pays special attention to the roles played by international trade. The research applies to firm level analysis the insights from cross regional studies that, in addition to general measures of FDI and export orientation, the country of FDI origin and country of export destination might matter in determining ISO 14001 adoption and its subsequent outcomes (Neumayer and Perkins 2004, Prakash and Potoski 2007, Perkins and Neumayer 2010, Qi et al. 2011).

3. Limitation of the Research

While the researcher has put extensive effort into ensuring the data obtained is accurate and reliable, and that the results will be generalisable, the readers should keep in mind a few caveats while going through the analysis and conclusion chapters of this dissertation.

First, lack of publicly available firm-level environmental data leaves the researcher with only the option of using self-reported measures of firm environmental performance. While this practice is in line with many similar studies (see, e.g., Dasgupta et al. 2000, Raines 2002, Raines et al. 2002, Andrews et al. 2003, Arimura et al. 2008, Yin and Schmeidler 2009) and the researcher has chosen to use a more objective rating scale where firms are asked to rate themselves against specific practices, with no benchmarks to compare the data with, the possibility of an upward bias in responses cannot be ruled out. Nevertheless, this research focuses on relative, rather than absolute measures of environmental performance, which should partially control for bias in the results if it is assumed that upward reporting is practiced by both ISO 14001 and non-ISO 14001 firms.

Second, time and resource constraints have led the researcher to limit the scope of analysis to three manufacturing sectors. Although the industries are carefully chosen to represent the three main types of industrial activities in the country, inherent differences among sectors remain and presents a limit to the generalisability of results of this dissertation. In addition to this, the low percentage of ISO 14001 firms in the country leads to the decision to use stratified sampling of non-ISO 14001 firms based on the industry, location and size characteristics of certified firms. Since ISO 14001 firms tend to be larger than average, this characteristic carries over to the survey

sample. Thus, findings from this dissertation are applicable to larger industrial facilities.

Third, while this dissertation addresses the issue of VEP adoption in the developing world context, its generalisability is constrained by the specificity of the country of study. Thus, the findings are applicable to Thailand and, within a limited degree, to other countries which share similar characteristics to the lower income NIEs. This includes countries where FDI is an important part of the manufacturing sector, there is a high degree of integration to global trade, there is a history of rapid industrialisation, but where there are weak institutions for environmental management.

Fourth, low rates of survey responses in Thailand have necessitated that the length of the survey questionnaire be as concise as possible, and include only those questions firms are more likely to provide a reply. This led to the elimination of questions on financial performance due to their sensitive nature, and to the exclusion of questions on capabilities and organisational factors such as measures of organisational culture, staff educational background, composition of the board of directors, and values and attitudes of managerial staff since experience from past surveys shows that these questions have mainly been ignored by responding firms. Lack of primary survey data on financial performance is made up by the use of government industrial survey data. However, this dataset does not include information on capabilities and organisational factors. Thus, the scope of this dissertation is limited to observable firm characteristics and does not extend to measures of internal firm resources and organisational factors, although their effects are taken into account in the relevant econometric analyses.

4. Structure of the Dissertation

This dissertation continues with background information on the ISO 14001 certification and the Thai manufacturing sector in Chapter 2, which gives details such as the requirements and number of ISO 14001 certification. The chapter also discusses the three industries of interest to this dissertation separately, and has a section on environmental governance in Thailand.

Chapter 3 provides information on the data used in the analyses. For the primary survey questionnaire, the chapter describes the process of questionnaire development, survey implementation, and the data itself. Additional sources of data which are used in this dissertation such as the Office of Industrial Economics (OIE) annual industrial survey data are also described in this chapter.

Chapter 4 is motivated by research questions (1) and aims to understand how the characteristics of firms in developing countries affect their cost-benefit calculus and, thus, the decision to participate in the international voluntary programme, ISO 14001. The chapter reviews existing literature to identify factors which can determine ISO 14001 participation in the developing world context. The factors are then used to construct an econometric model and analysed. Univariate probit estimation, bivariate probit estimation, as well as endogenous switching models are estimated to account for potential endogeneity and to check robustness of results.

Chapter 5 addresses research questions (2), and looks at the private benefits firms stand to gain as a result of ISO 14001 implementation. This chapter builds on Chapter 4 by bringing to the fore the previous chapter's assumption of latent positive net benefits to ISO 14001 participation. Since the traditional view is that environmental improvement requires costly and non-productive investment, this chapter addresses this fundamental question and examines, theoretically and empirically, the sources of positive net benefits to VEP participation. The chapter particularly focuses on quantifiable financial gains, but supplements this with qualitative information of programme impact from ISO 14001 adopters.

Chapter 6 seeks to answer research questions (3) using responses from the primary survey questionnaire. The chapter develops a novel theoretical framework by extending Dasgupta et al.'s (2000) equilibrium emissions framework with Prakash and Potoski's (2006) application of club theory. The analysis uses a number of measures of firm-level environmental performance to proxy various aspects of the firm's environmental impact, and employs various econometric techniques to account for selection bias due to the potential for firms to self-select into participation based on gains.

Chapter 7 addresses research question (4). The chapter sums up findings from the three analysis chapters, draws lessons on ISO 14001 adoption from them, and then discusses what these lessons imply for policymakers. The chapter closes with a section providing suggestions for extending this work further in the future.

CHAPTER 2

ISO 14001 CERTIFICATION AND THE THAI MANUFACTURING SECTOR

1. Introduction

The main aim of this dissertation is an in-depth study of voluntary environmental programmes in the context of newly industrialising economies, with the international voluntary programme, the ISO 14001 certification, being the programme under study and the Thai manufacturing sector providing the context. The purpose of this chapter is to provide the relevant background information on both the context of the study – Thailand, and the certification scheme under consideration. The chapter begins with an introduction to the ISO 14001 environmental management system certification scheme, and then goes on to discuss the Thai economy and its manufacturing sector, focusing in detail on the three manufacturing sectors of interest to this dissertation and relating their impacts on the environment. This section is immediately followed by a section on the system of environmental governance in the country, and the chapter closes off with a conclusion section which recaps on the topics discussed in the chapter.

2. ISO 14001 Certification

ISO 14001 is an international certifiable voluntary standard that sets guidelines for structuring and implementing an organisation's environmental management system (EMS). Developed in response to the difficulties caused by differences in the requirements of existing EMS standards at the time[1], the ISO 14001 certification was designed to serve as a benchmark international standard for EMS that would facilitate global trade (Roht-Arriaza 1995, Clapp 1998). First released in 1995 by the International Organization for Standardization (ISO), a non-governmental voluntary standard-setting body with an established presence in 162 countries worldwide (ISO

[1] These standards include the British Environmental Management Standard (BS 7750) and the European Union's Environmental Management and Audit Scheme (EMAS).

2011a), the ISO 14001 has since compounded its status as a global voluntary standard through its recognition by the World Trade Organization (WTO) as a non-technical barrier to trade. Thereby permitting the use of ISO 14001 as a trade condition (Clapp 1998). This makes the ISO 14001 voluntary scheme especially relevant to industrialising economies which are striving to achieve economic development through export orientation but which must also deal with growing environmental problems associated with rapid industrialisation[2].

2.1. The ISO 14001 Process

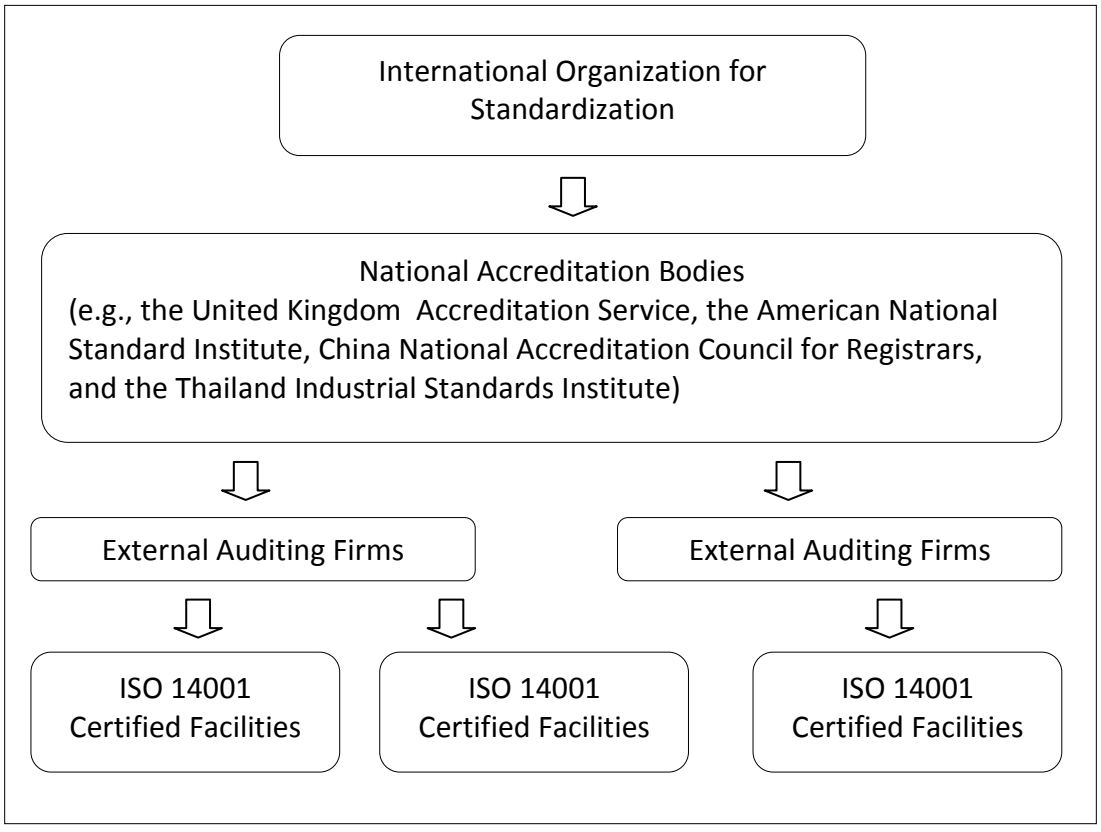
In its contents, the ISO 14001 EMS standard follows the same process-based Plan-Do-Check-Act cycle for continuous improvement as the ISO 9000 total quality management (TQM) standard (Quazi et al. 2001, Casadesús et al. 2008, Molina-Azorín et al. 2009). Firms initially establish and announce their environmental goals, then come up with plans to implement them ('plan'). They then put these plans into action ('do'), and checks are made to ensure implementation goes smoothly ('check'). If errors occur, they are required to take remedial actions ('act'). The whole process is then periodically reviewed by the firm's management. It is envisioned that by adhering to these requirements, adopters would be able to establish themselves in a virtuous cycle of environmental improvement.

To ensure credibility of the standard, the certification process requires licensed third parties to audit the firm's EMS to evaluate whether they meet ISO 14001 requirements. These auditors' findings are then presented to a certification review panel comprised of authorised non-auditors who provide a verdict whether or not the firm should be granted the ISO 14001 certification. Once certified, firms are re-audited at least once every three years to maintain their certification status. The auditors themselves are also subject to scrutiny. The ISO grants authority to national accreditation bodies, which are usually government agencies, to oversee the licensing of third party auditors for its voluntary standards. In addition to initial screenings based on paper evidence of the prospective auditors' competencies, the auditors are also subjected to on-site 'examinations' in which they are evaluated on how they perform audits on clients (Prakash and Potoski 2006). (See Figure 2.1).

[2] The ISO has also been actively trying to further involve developing economies. This is implemented through its action plans for developing countries (ISO 2011b).

As a process-based standard designed to be applicable across numerous countries and organisations, ISO 14001 certification differs from command-and-control and market-based instruments. Unlike CACs, the ISO 14001 standard does not set emissions or technology requirements. The standard also requires neither a cap on pollution price nor a cap on total emissions as would be under MBIs. Instead, firms have the freedom to set their own environmental goals, with the minimum requirement being that firms strive to achieve compliance with existing environmental regulations[3]. This latter condition makes the ISO 14001 certification more in line with the voluntary environmental programmes operating in developing countries, which are aimed at combating rampant non-compliance with existing environmental regulations (Blackman and Sisto 2006). In contrast, the goal of industrialised countries' voluntary schemes is to encourage beyond-compliance with environmental legislations.

Figure 2.1: The ISO 14001 Accreditation Process



Source: Modified from Figure 3.1 in Prakash and Potoski (2006)

[3] In theory, the job of the ISO 14001 auditor is to look at the EMSs that are in place to address regulatory compliance and not the actual compliance status. However, according to Prakash and Potoski (2006), external review audits invariably address compliance issues.

Like other tools for environmental improvement, adhering to ISO 14001 standards require non-trivial commitment of an organisation's resources. In addition to certification costs (auditor fees, application fees, and annual fees), there are additional costs associated with preparation for and establishment of ISO-standard environmental management systems. While specific costs vary from firm to firm, non-certification expenditures can include the procurement of new equipment, infrastructure improvement, equipment/process modification, training, additional staff, and consultant fees (TEI 1999, Prakash and Potoski 2006). Raines et al. (2002) estimates that the average implementation cost for developing country firms seeking ISO 14001 certification is 76,975 US Dollars[4]. For Thai firms, certification costs typically range from 40,000 to 80,000 Thai Baht for the first year and 20,000 to 40,000 Baht annually for subsequent years[5,6]. When combined with non-certification costs, the total estimate for certified firms is in excess of 1 million Baht (33,560 US Dollars) (TEI 1999, Sutthanund 2000). For larger firms, implementation costs can be substantially higher (Prakash and Potoski 2006). One such firm in the electronics sector in Thailand reports spending almost 50 million Baht (1.7 million US Dollars) to become ISO 14001 certified (TEI 1999).

Despite the requirement for third party audits and the non-trivial resource commitment associated with ISO 14001 certification, the standard has not been without criticisms. Sceptics of the certification question the lack of specific quantifiable environmental requirements, the fact that there are no provisions to make public both the firm's own environmental information and the auditors' assessments of the firms (Krut and Gleckman 1998), and there are concerns that high costs of certification may exclude small and medium enterprises from participation (Carraro and Lévêque 1999). The standard-setting process itself has also come under criticism, especially for the dominance of industry interests and the limited participation by environmental groups and developing countries (Roht-Arriaza 1995, Clapp 1998, Krut and Gleckman 1998).

[4] Average costs are lower for Chinese firms, at an estimated 58,111 US Dollars (Raines et al. 2002).

[5] Figures from personal correspondence with an officer at one of the country's official certification body. Fees quoted are for Thai-brand certification bodies. Foreign-brands typically charge higher fees.

[6] In 2011, the exchange rate is approximately 29.9 Thai Baht to 1 US Dollar.

2.2. ISO 14001 Adoption and Importance

Despite the high costs and the criticisms, the ISO 14001 certification has proved to be popular. Indeed, while not the first of its kind in existence, the standard was already overshadowing its counterparts such as the Chemical Manufacturers' Association (CMA) responsible care scheme, and the principles of the Coalition for Environmentally Responsible Economies (CERES) even in its early years (Clapp 1998). Since then, the number of certifications grew from 257 in 19 countries in 1995 to over 200,000 certifications in 159 countries at the close of 2009 (ISO 2002, 2003, 2009, 2010), firmly establishing ISO 14001 as one of the most popular voluntary environmental programmes in the world (See Figures 2.2 and 2.3).

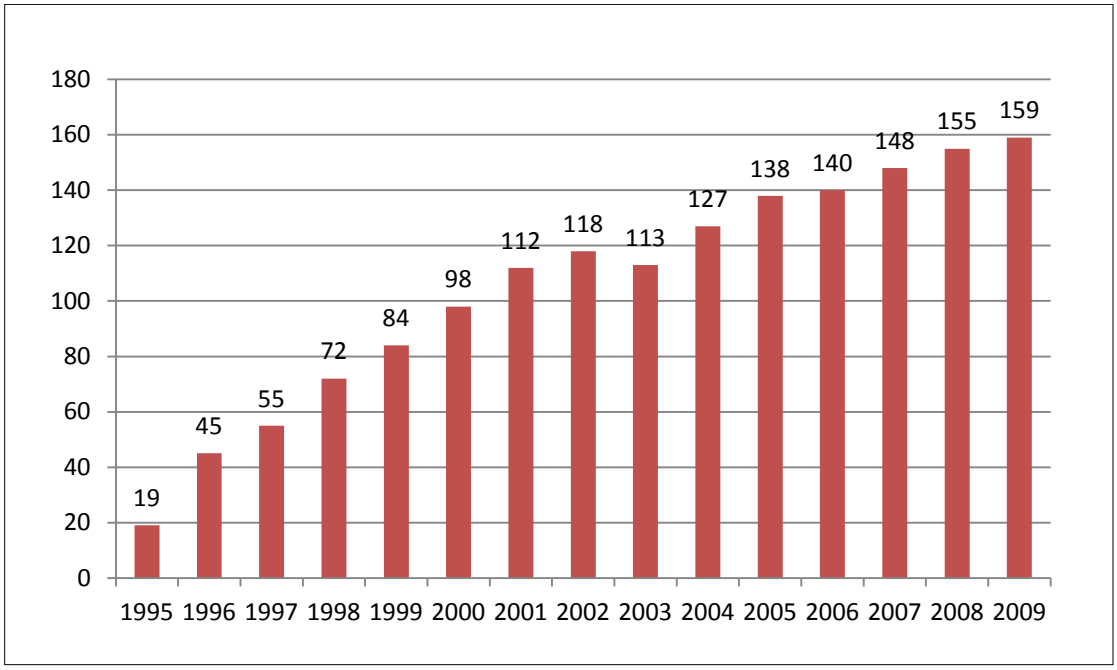
Of the 223,149 certifications in 2009, countries in the Far East account for the largest regional share; at 50.3 percent of all certifications (ISO 2010). Regional growth of ISO 14001 certification was 25 percent, much higher than the worldwide average of 18 percent (ISO 2010). Thailand ranks fifth in this region in terms of certification numbers, and as a developing country, its certification number is second only to China (ISO 2009). The country also ranks in the top ten in terms of highest annual growth of certification (ISO 2010). (See Figure 2.4 for ISO 14001 certifications in Thailand).

While Thailand has one of the highest certification numbers of all Asian developing countries, these numbers vary by industry. The electronics and electrical appliances industry group has 218 certifications, the highest of any industry. The food and beverages industry has 120 certifications, and the textiles and wearing apparel industry has 43 certifications. (TISI 2010).

From the start, Thai officials recognised that ISO 14001 would be important for Thai exporters (TEI 1999) as the WTO permitted the use of the ISO 14001 standard as a trade condition (Clapp 1998). Although Thai authorities did not explicitly encourage exporters and multinational corporations (MNCs) to have ISO 14001 as was the case in various other developing countries (Zarsky and Tay 2000, Raines et al. 2002), these companies still comprise the majority of ISO 14001 adopters in the country (TISI 2010). An early survey of ISO 14001 adoption in the country also reveals that early adopters were mostly exporters (69 percent) and firms with foreign direct investment

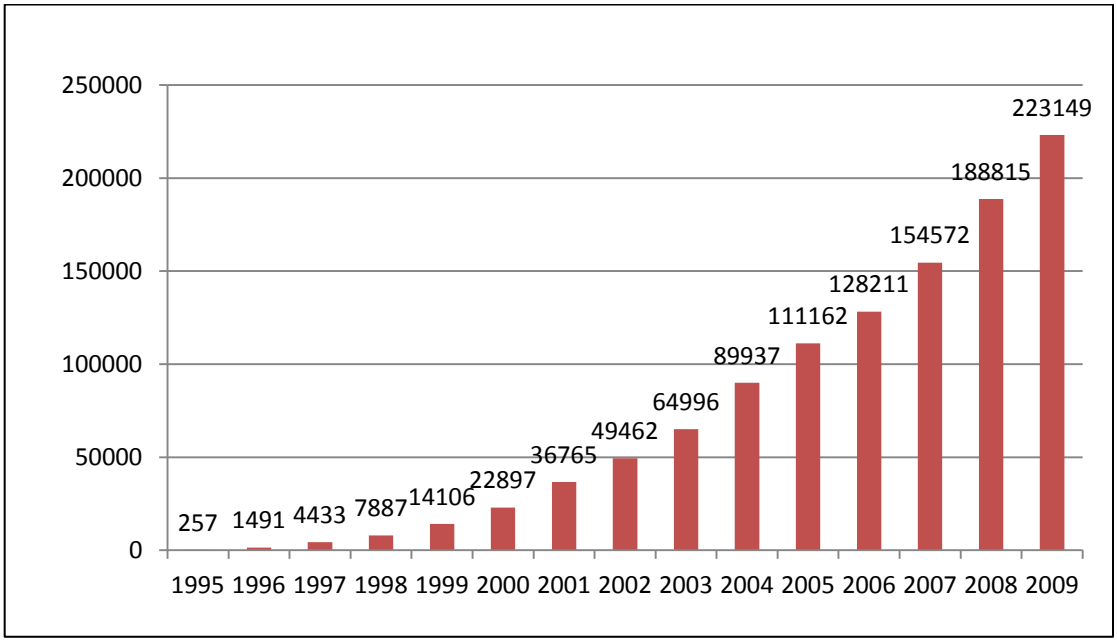
(FDI) (40 percent were MNCs and 29 percent were joint ventures between local firms and foreign companies) (TEI 1999).

Figure 2.2: Number of Countries with ISO 14001 Certification (1995 – 2009)



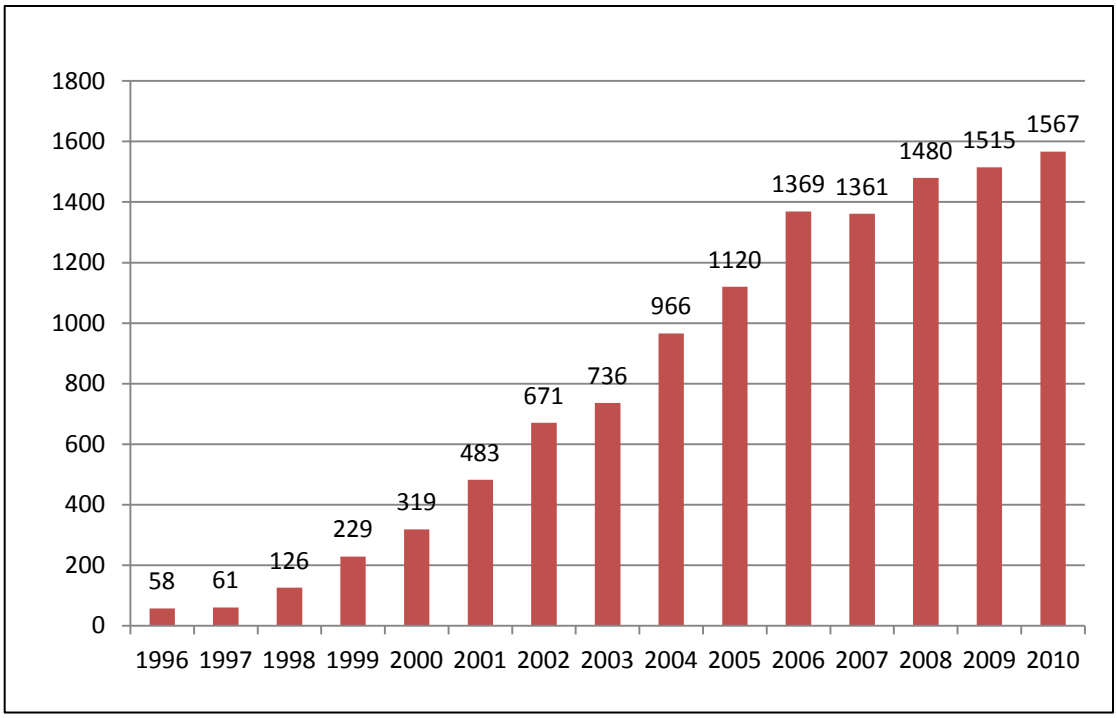
Sources: ISO 12th Cycle Survey (2003), ISO Survey (2006, 2007, 2009, 2010)

Figure 2.3: Global ISO 14001 Certifications (1995 – 2009)



Sources: ISO 12th Cycle Survey (2003), ISO Survey (2006, 2007, 2009, 2010)

Figure 2.4: ISO 14001 Certifications in Thailand (1996-2010)



Sources: ISO 12th Cycle Survey (2003), ISO Survey (2006, 2007, 2009), Thailand Industrial Standards Institute (2010)

3. The Thai Economy

The Thai economy has changed much since the end of the Second World War. Several decades of high and sustained growth have turned a once agricultural and rural economy into one reliant on manufacturing industries and exports. Today, the manufacturing sector accounts for roughly forty percent of the country's GDP and brings in over eighty percent in export revenues. These details of the Thai economy are explored in this section with special attention given to the manufacturing sector and the three industries of interest to this dissertation; food and beverages, textiles and wearing apparel, and electronics and electrical appliances.

3.1. Economic Performance

Before 1950, the Thai economy was primarily an agricultural economy with little or no growth in output per capita and, subsequently, Thailand was one of the poorest countries in the world (Warr 1993). The end of the 1950s, however, ushered in a new era for Thailand. Emphasis was placed on industrial development and various strategies were adopted to promote industrialisation. Economic planning became

formalised with the creation of the National Economic and Social Development Board (NESDB)[7] in 1959, and the publication of the first five-year National Economic and Social Development Plan in 1961. The five-year plans are intended as guidelines for orchestrating economic and social development in the country, and these plans are still in use today.

From the 1960s to the first half of the 1990s, Thailand experienced rapid growth and industrial development. In the 1960s, the economy grew at an average of 7.8 percent per year. Growth remained high throughout the 1970s, 1980s, and the first half of the 1990s, with average growth rates of 6.8, 7.2, and 8.2 percent respectively (see Table 2.1). During this period, the economies of Thailand and other East Asian countries experienced such sustained and rapid growth that their experience was dubbed the 'East Asian Miracle' (World Bank 1993).

Table 2.1: Average Annual Real GDP Growth Rate For Select Years (Percentage)

Year	Annual Average Growth Rate
1960s	7.8
1970s	6.8
1980s	7.2
1990s	8.2
1996	5.8
1997	-1.4
1998	-10.5
1999	4.4
2000	4.8
2005	4.6
2006	5.1
2007	5.0
2008	2.5
2009	-2.3
2010	7.8

Source: National Economic and Social Development Board (NESDB) and the Bank of Thailand (BOT)[8]

After decades of uninterrupted growth, the East Asian Miracle ended when, in 1997, financial problems in Thailand led to the devaluation of the Thai Baht and the

[7] At the time of establishment, the NESDB was known only as the National Economic Development Board (NEDB). The name was changed to NESDB to reflect the importance of social aspects in the country's development plans.

[8] NESDB data: http://www.nesdb.go.th/econSocial/macro/macro.php, cited in Piamphongsant (2007). BOT data: http://www.bot.or.th/Thai/Statistics/EconomicAndFinancial/EconomicIndices/Pages/StatMacroEconomicIndicators.aspx#, accessed May 2011.

closures and bankruptcies of many commercial banks and businesses. The subsequent collapse of the economy sent shockwaves through the entire region, precipitating East Asia and much of the world into a financial crisis. Thailand's GDP growth gives an indication of the severity of the crisis, with the figures registering a negative 1.4 percent in 1997 and an astounding negative 10.5 percent in 1998. GDP growth rebounded in 1999 and has been positive until 2008. The recent financial crisis which began in the Western hemisphere affected the Thai economy and growth was -2.3 percent for 2009. The economy has since rebounded and growth was 7.8 percent in 2010.

3.2. Structural Changes

Decades of rapid industrialisation led to significant structural changes in the Thai economy. In the decades following the end of the Second World War, the country moved from a primarily agricultural economy to one more reliant on manufactured exports. In 1960, agricultural share of GDP was over 40 percent, and its share in exports over 80 percent (Tambunlertchai 2002). In 2009, the share of agriculture in GDP has dropped to 9 percent while manufacturing's share rose to 38.6 percent[9]. Manufactured exports have also contributed much to the country's export earnings in recent years.

In addition to this shift in the dominance of different economic sectors, structural changes have also occurred within sectors. In 1960, foods, beverages, and tobacco accounted for over 60 percent of all manufacturing value added, but these industries have since declined in importance (Tambunlertchai 1993, 2005). Instead, industries like textiles, garments, chemical products, automotives, and electronics and electrical appliances have gained more prominence. A summary of the contributions from various industries is given in Table 2.2.

[9] Author's calculations based on NESDB data for different sectors' share of GDP at 1988 constant prices. Raw data available at http://www.nesdb.go.th/Default.aspx?tabid=94, accessed June 2011 .

Table 2.2: Distribution of Gross Domestic Product in Manufacturing Sector, 1995 to 2009 (selected years) (Percentage)

	1995	2000	2005	2006	2007	2008	2009p
Food Products and Beverages	17.17	15.86	14.97	15.65	15.08	14.82	15.26
Tobacco Products	1.83	1.19	0.93	0.77	0.77	0.73	0.72
Textiles	7.44	6.87	5.39	5.04	4.58	4.26	4.26
Wearing Apparel	7.87	6.47	5.26	5.09	4.72	4.52	4.53
Leather Products and Footwear	3.64	3.81	2.98	2.92	3.03	2.77	2.67
Wood and Wood Products	0.47	0.26	0.23	0.19	0.23	0.21	0.22
Paper and Paper Products	1.48	2.01	1.82	1.83	1.79	1.62	1.70
Printing and Publishing	1.08	0.81	0.76	0.70	0.66	0.64	0.66
Refined Petroleum Products	6.98	9.45	7.39	6.96	6.57	5.58	5.89
Chemicals and Chemical Products	3.51	4.71	4.84	4.64	4.80	4.46	4.97
Rubber and Plastic Products	2.68	3.64	3.64	3.36	3.33	3.23	3.35
Other Non-metallic Mineral Products	5.74	4.32	5.06	4.82	4.40	4.17	4.10
Basic Metals	1.80	1.25	1.14	1.10	0.98	0.87	0.82
Fabricated Metal Products	2.19	2.64	2.66	2.64	2.60	2.44	2.37
Machinery and Equipment	4.08	4.06	5.32	5.39	6.04	6.29	5.82
Office, Accounting and Computing Machinery	3.74	6.54	6.90	8.19	10.07	11.68	12.82
Electrical Machinery and Apparatus	1.23	1.92	2.01	1.99	1.98	1.91	2.01
Radio, Television and Communication Equipment and Apparatus	7.68	9.71	9.28	9.27	8.98	8.37	8.62
Medical, Precision and Optical Instruments, Watches and Clocks	1.27	1.14	1.05	1.08	1.00	1.02	1.03
Motor Vehicles	7.70	5.16	10.46	10.63	10.69	11.99	9.60
Other Transport Equipment	1.49	1.03	1.78	1.59	1.29	1.90	1.76
Funiture; Manufacturing n.e.c.	8.93	7.16	6.15	6.14	6.40	6.54	6.84
Total Value Added	100	100	100	100	100	100	100

Source: NESDB 2011
Note: 1988 constant prices, p = preliminary

Thailand's industrialisation success of the 1950s to the 1990s did not only have profound implications for the nation's economy. The effects of the rapid changes also extended to the country's natural environment. Rapid industrial development coupled with adoption of the 'grow first, clean later' policy of successive governments have led to a rapid decline in the country's environmental quality and an increasingly serious industrial environmental problem (World Bank 2000b, 2001, Rock 2002b, World Bank 2002, 2003). However, as the environmental implications of unchecked industrial growth became clear and the idea of sustainable development began to take hold at the local level, government policy slowly shifted (Esty et al. 2000, Rock

2002b). The structure of environmental governance in Thailand, which came as a response to environmental degradation problems became apparent, is discussed in Section 4.

3.3. Trade Policy and International Linkages

Thailand's industrialisation experience in the past five decades is closely linked to international trade. In the first two of the five-year National Economic and Social Development plans (1961-1971), an import-substituting industrialisation process was advocated. As a result, high tariff barriers were imposed on imports while production of manufactured products for the domestic market was encouraged throughout the 1960s. In the 1970s when industrial growth slowed and Thailand faced a current account deficit after many years of surplus, the government began to shift its focus from import substitution[10]. In place of producing to replace imports, production for exports has been promoted beginning with the third National Economic and Social Development plan (1972-1976). Foreign direct investment (FDI) in export-oriented industries was also actively promoted. Since then, manufactured exports have expanded and gained prominence in the Thai economy.

Over the years, Thailand has attracted various multinational companies as well as other foreign investors to directly invest in the country. The trend of FDI has also changed in accordance with government policies and international economic situations. In the 1960s, FDI was mostly in manufacturing products for domestic consumers. In the 1970s and 1980s, however, FDI was increasingly producing for exports. This is especially true after 1985 when the Plaza Accord resulted in the appreciation of the Japanese yen, resulting in a surge of FDI from Japanese companies in Southeast Asia. Net inflows of FDI slowed in 1993 and 1994, but rebounded after the devaluation of the Thai Baht in 1997. FDI has remained an important part of the Thai industrialisation process and manufactured exports.

The prominence of FDI in the Thai economy and the country's connectedness to the global market has great implications for the nation's environmental management strategies. While rapid industrialisation has brought with it increasingly severe

[10] Import substitution policies in Thailand have also been criticised for their failure to generate significant linkages to other industries as well as their heavy reliance on imported inputs (Tambunlertchai 2002).

environmental problems, the country's integration to the international economy also presents Thailand with opportunities for harnessing growing international environmental market pressures and for benefitting from the 'technique effects'[11] of globalisation (Rock and Angel 2010, Zarsky 2010). However, the process is not automatic. Policies and tools need to be in place for industrial environmental performance to improve (Esty et al. 2000, Rock and Angel 2005, 2010). The ISO 14001 certification is one such tool and the theme of trade and international linkages will be further explored in this dissertation.

3.4. Thai Manufacturing Sector

As discussed in Section 3.2, the Thai manufacturing sector has grown rapidly and overtaken the agricultural sector as the nation's predominant foreign exchange earner. As of 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 since small facilities which fall under Group I of the Factory Act of 1992[12] 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. Big-scale enterprises are small in number, but significantly affect both the country's economy and its environment. (See Table 2.3).

Table 2.3: Number of Manufacturing Enterprises by Factory Size.

	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*, accessed April 2009*)*

Apart from the domination of small and medium enterprises (SMEs), industrial activities in Thailand are also highly concentrated in a few regions. The first industrial areas of the country were located in Bangkok and its five surrounding provinces; Nakorn Pathom, Nontaburi, Pathum Thani, Samut Prakarn, and Samut Sakorn. These

[11] Grossman and Krueger (1991) decomposed the impact of trade liberalization into three effects – scale, composition, and technique, the last of which refers to the impact of technological changes.

[12] Group I factories are certain types of factories which use machines of no more than 20 horsepower, employ no more than 20 people, and do not cause pollution problems.

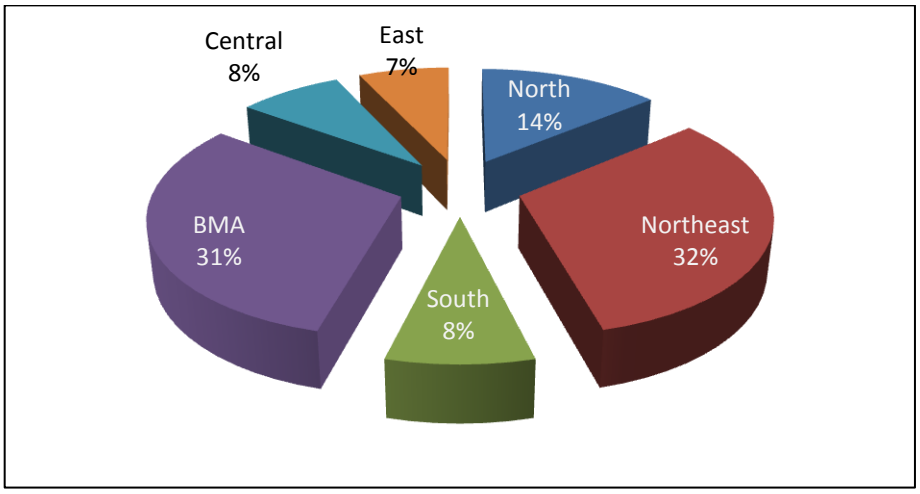
six provinces, collectively known as the Bangkok Metropolitan Area (BMA) or Greater Bangkok, are still home to various large-scale and small-scale manufacturing facilities and industrial estates today despite government efforts to disperse industrial activities to other regions of the country.

In addition to the BMA, the Central and Eastern regions of the country are also heavily industrialised. Since 1982, the government has advocated the development of the Eastern Seaboard as a base for industrial facilities. Located near natural gas sources in the Gulf of Thailand and equipped with infrastructure such as maritime ports, highways, and industrial estates, the Eastern Seaboard became the prime location for large industrial operations such as petrochemical factories. Better transportation systems also led to the location of factories in other provinces in the Central region, away from the congested Greater Bangkok area. Today, industrial facilities are located all over the country, but the BMA, Central, and Eastern regions are still areas with high density of industrial activities.

Attempts to bring industrial development to other parts of the country and the benefit of locating industrial facilities together in one area led the Thai government to establish various industrial estates throughout the country. To facilitate and reduce transportation costs for those facilities located within these areas; industrial estates are usually situated close to transportation hubs such as ports, train stations, airports, and major roads. Industrial estates are also well-equipped with amenities such as electricity, water, phone lines, roads, and central wastewater treatment systems. In addition to this, the government and the Board of Investment (BOI) offer various financial and non-financial incentives for factories locating in industrial estates. The exact incentives offered vary from industry to industry and from region to region, but typically those industries prioritised by the government and those factories located further away from the BMA enjoy more benefits. At present, Thailand has 36 industrial estates located in 14 provinces throughout the country.

In this dissertation, responses are taken from factories located all over the country both within and outside industrial estate areas. As Chapter 3 shows, the sample reflects the country's distribution of manufacturing activities, with larger firms concentrated in the BMA and Eastern regions.

Figure 2.5: Manufacturing Enterprises by Location



Source: Author's calculations using DIW data.
Note: The figures include all manufacturing enterprises including rice mills, saw mills, ice-making and printing firms.

The manufacturing sector in Thailand today produces an array of manufactured products and can be roughly classified into five main categories.

1. *Resource-based industries*. These industries mainly use agricultural products as raw materials and include industries such as foods, wood processing, rubber products, and the production of cement.
2. *Labour-intensive industries*. This type of industry has high labour content in production compared with other types. Examples include the manufacture of textiles, clothes, shoes, leather products, jewellery, and ornaments.
3. *Chemical industries.* Such as the manufacture of petrochemical products in various stages including plastic resins, fertilisers, cosmetics, and other chemical products.
4. *Engineering industries*. Sometimes referred to as high-technology industries. These industries include the manufacture of automobiles and parts, computer parts, other electronic products, and various electrical appliances.
5. *Other industries.* Industries that cannot be categorised as one of the above. Examples include the manufacture of plastic toys and utensils, the manufacture of various ceramic products, and the manufacture of paper and printing.

Of these five categories, the industries that are the most important to the Thai economy are engineering industries, labour-intensive industries, and resource-based

industries. Engineering industries are important in terms of production and exports. Labour-intensive industries, on the other hand, are important in terms of employment, especially in industries such as textiles and wearing apparel. Finally, the importance of resource-based industries lie in the emergence of new products, the increasing value and production quantity, and, since this type of industries rely 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 electronic products and electrical appliances, automobiles, textiles, wearing apparel, and food products, are industries that comprise the lion's share of the country's manufactured products.

Due to their importance to the Thai economy and the scale of their environmental problems, industries which represent the three types of industries important to the Thai economy are the subject of this dissertation. These three industries are (i) food and beverages, (ii) textiles and wearing apparel, and (iii) electronics and electrical appliances. Collectively, the three industries account for 47.5 percent of the country's total manufacturing value added and contribute 18.4 percent to the country's GDP (NESDB 2010). The following sections provide a broad overview of these three different industries within the context of the Thai economy.

3.4.1. Food and beverages

The manufacture of food products and beverages has been an important industrial activity in Thailand since the country first began industrialising. Being a resource-based industry which mainly uses domestic raw materials as inputs, the industry is closely linked to the country's traditional base of agriculture, aquaculture, and farming. While the relative importance has declined as more high-tech industries rose to the fore in terms of manufacturing value added and foreign exchange earned, the extensive backward and forward linkages of the industry to other sectors such as agriculture, transportation, and packaging combine to make the industry a significant employer and income-generator for a large number of workers in the country. In addition to this, the Thai food and beverages industry is still a big supplier of various food products to the world market including shrimp, canned and processed tuna, processed chicken, rice, and canned and processed pineapple. In 2009, the industry's value added was worth 250,979 million Baht, a drop from 2008's figure of 259,538

million Baht[13]. These figures were 15.26 and 14.82 percent of the country's total manufacturing value added and roughly 6 percent of the country's GDP. (NESDB 2010).

Products

The manufacture of food products and beverages is classified by the code 15 according to the UN's International Standard Industrial Classification (ISIC) revision three[14]. This category includes ISIC code 151 – the production, processing and preservation of meat, fish, fruit, vegetables, oils and fats; ISIC code 152 – the manufacture of dairy products; ISIC code 153 – the manufacture of grain, mill products, starches and starch products, and prepared animal feeds; ISIC 154 – the manufacture of other food products; and ISIC 155 – the manufacture of beverages. Factories in Thailand fall into all 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 (ISIC 154) and establishments that produce, process, and preserve meat, fish, fruit, vegetables, oils and fats. In this dissertation, all product categories are represented.

Industrial Structure

The food and beverages industry in Thailand is made up of 63,454 factories, or roughly 43 percent of all registered manufacturing establishments in the country. Most of these facilities are small establishments employing no more than fifty people. Rice mills also account for the majority of this number. Including rice mills, the majority of the establishments are located in the Northeastern and Northern regions of the country. However, larger establishments employing more than 200 people are mostly located in the Bangkok Metropolitan Area (BMA) and the Central region. (See Tables 2.6 and 2.7).

Despite being classified as resource-intensive, the food and beverages industry and its related activities employ a large proportion of workers in the country. The food and

[13] 1988 prices

[14] 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.

beverages industry alone employs 665,428 people, or 15.65 percent of all those employed in the manufacturing sector. An overwhelming majority of these employees work in large facilities with more than 200 workers. (See Table 2.8).

Most of the firms in the food industry 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, processing and preservation of fish and fish products, and grain mill products.

The Thai food and beverages industry is a major supplier of various food products to the world market. These products include rice, canned and frozen seafood products, processed meat products, and canned and processed pineapple products. The industry is an important earner of foreign exchange for the country. In the first eleven months of 2010, the export of rice brought the country an estimated 4,657.72 million US Dollars (147,869.89 million Baht) or 2.61 percent of the country's total export earnings. Canned and processed seafood also brought in 3,733.39 million US Dollars (118,607.34 million Baht) in export revenue, or 2.1 percent of the total. Both products were in the top fifteen in terms of export earnings. (MOC 2010). Important export destinations are Japan, the United States, ASEAN[15] countries, EU countries, and China.

With the industry predominantly using domestic raw materials, net foreign exchange earnings for the industry is high due to the low import content of the exported products. However, the country does import certain food and beverages products from other countries. These include certain seafood, plants and plant products, as well as animals and animal products. Important countries where Thailand imports from are Brazil, the U.S., China, Argentina, India, Indonesia, Taiwan, New Zealand, Malaysia, and Japan.

While there is limited presence of FDI within the food industry, the integration of some firms as supplier to the global market economy provides a means through which international environmental pressures can filter in. This makes such firms conducive to signing up to international voluntary programmes like the ISO 14001 certification. However, since the bulk of firms within this industry are small and medium

[15] The Association of Southeast Asian Nations (ASEAN) includes the ten countries in Southeast Asia.

enterprises which supply the domestic rather than the international market, the influence of export orientation on ISO 14001 could be limited in this industry.

Environmental Impact

The main environmental impacts from the food and beverages industry are wastewater, smell, and solid non-hazardous waste. Wastewater is a particular problem for the industry. Activities such as the processing of foods, the slaughtering 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 industrial water pollution in the country (see Table 2.4). Since organic matter is usually involved in the manufacturing process, the wastewater emitted is usually full of organic contents and have high biochemical oxygen demand (BOD) values. Large amounts of organic waste produced can also generate unseemly smells. Bits of paper, tins, and plastics from packaging the products also result in solid non-hazardous waste which must be properly disposed of. In addition to this, the manufacture process usually involves extensive use of water, heat, electricity, and other fuels. With the main environmental pollutants being wastewater and other organic waste, it is expected that the impact of ISO 14001 adoption for this industry will be in terms of a reduction in wastewater and non-hazardous waste.

Table 2.4: Industries Ranked by Severity of Water Pollution

Rank	Industries
1	Textiles, bleaching and dyeing
2	Food processing
3	Slaughtering, preparation of meat
4	Canned food
5	Vegetable and animal oil, cosmetics, soap
6	Alcoholic beverage
7	Paper pulp
8	Chemicals
9	Cold storage
10	Metal and non-metallic products

Source: Pollution Control Department,
cited in Tambunlertchai and Sutummakid (2006)

3.4.2. Textiles and Wearing Apparel

The textiles and wearing apparel industry group are labour-intensive and, thus, are major employers in the country. The industry group currently employs about 20 percent of the workers in the manufacturing sector. Of this number, about 70 percent work in the wearing apparel sector, which is the most labour-intensive segment of this industry group. The two sectors also contribute a fair share to the country's manufacturing GDP. In 2009, the combined value added from the textiles and wearing apparel industries was 144,594 million Baht[16]. This figure is roughly 3.4 percent of the country's total GDP and 8.8 percent of the total value added from the manufacturing industry. (NESDB 2010). In addition to the contribution to GDP, the industries together bring in significant amounts of foreign exchange into the country. Although exports of textile products are small compared to exports of wearing apparel, textile products are fed into the manufacture of wearing apparel, which are exported.

Products

The term 'textiles and wearing apparel' is used here to refer to two manufacturing categories; ISIC 17 – the manufacture of textiles, and ISIC 18 – the manufacture of wearing apparel, including the dressing and dyeing of fur. These include sub-categories ISIC 171 – the spinning, weaving and finishing of textiles; ISIC 172 – the manufacture of other textiles; ISIC 173 – the manufacture of knitted and crocheted fabrics and articles; ISIC 181 – the manufacture of wearing apparel excluding fur; and ISIC 182 – 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 wearing apparel and textiles (ISICs 181 and 171). This composition is reflected in the data sample used in this dissertation, although products from all categories are represented.

Industrial Structure

According to the DIW, there are 7,987 factories in the textiles and wearing apparel industry group in the country. Facilities from the textiles and garment sectors each account for roughly half of this number. The factories are mostly small in size, with

[16] 1988 prices

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 many regions especially the North and the Northeast. However, in terms of the industrial manufacture of textiles and clothing, no one region stand out as much as the BMA in terms of number of industrial manufacturing facilities[17].

Being labour-intensive, the textiles and wearing apparel industry group employs approximately 812,689 people, almost 20 percent of all labour employed by the manufacturing industry in Thailand. Of this number, the larger share of the labour force is employed in the manufacture of clothing (440,922 workers), while the manufacture of textiles employs a slightly smaller share of the workforce in the industry group (371,767 workers). While small facilities dominate, more than half of the labour force in manufacturing is employed in large establishments. Another 26 percent of the labour force is employed in medium-sized enterprises, and 16 percent are employed in small-scale factories.

The proportion of foreign investment in the textiles and wearing apparel industries is small. Out of about 8,000 registered facilities, only about 500 firms are with varying degrees of 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 textile fibres, spinning, and wearing apparels. As with the case in the food and beverages industry, foreign firms are usually large.

Thailand's textiles and wearing apparel industry has become increasingly export-oriented over the years. Main export products are garments and other apparels, comprising more than half of the export value. Other exported products include cotton and synthetic fibres, and textile fabrics. Thailand's textiles and wearing apparel exports are directed to many countries, with the United States and the European Union being important destinations. In Asia, Japan, China, and ASEAN countries

[17] In addition to these factories, there are numerous small tailor shops located in different areas of the country. These tailor shops are not included in the DIW's list of registered factories. If they were included, the number of apparel facilities could be significantly greater.

have been important importing countries of Thai textile fibres, fabrics, and garments in recent years. Exports of textiles and wearing apparels brought in an estimated 6,939.01 million US Dollars (220,777.33 million Baht) in foreign exchange in the first eleven months of 2010. This figure is roughly 3.9 percent of all export earnings in the country (MOC 2010).

While the textiles and wearing apparel industry group is a net earner of foreign exchange, the group does import certain products in this industry group. These products include yarns, fibres, fabrics, and clothes. Imported products come from China, Japan, and various ASEAN countries.

Like the food and beverages industry, the integration of the textiles and wearing apparel industry to the international market economy means that global environmental pressures can filter in through this channel. However, since roughly half of firms in this industry belong to the textiles sector which has very little exports, the effect of export orientation may not be strong for firms in this industry.

Environmental Impact

While many pollutants are generated by the textile and clothing industries, the most severe environmental problem from these industries is wastewater. Wastewater is generated from both the bleaching and dyeing processes, and the subsequent clean-up process where water is used to clean machines and the factories. In bleaching and dyeing threads and fabrics wastewater produced usually have high BOD, COD, and pH values. The wastewater may also have high temperatures and may be contaminated with heavy metals such as copper, lead, chromium, and zinc from the dyes used. The wastewater may also contain other chemicals and solids from the manufacturing process. With wastewater the primary environmental pollutant for this industry, ISO 14001 certification is expected to result in better management of water pollution, which can lead to reduced discharges of wastewater respectively.

3.4.3. Electronics and Electrical Appliances

The manufactures of electronics and electrical appliances have surpassed the traditional agriculture-related industries as the country's main foreign exchange earner and contributed much to the country's GDP. The industry group has grown and

changed over the years and currently produces many different types of products. Originally, both industries relied heavily on imported inputs with domestic factories mainly assembling these inputs into finished products. While this trend continues to this day for many of the products manufactured, some inputs can now be produced locally, reducing the country's reliance on imported foreign components. 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 added of this industry group has steadily increased, from 14.26 percent of all manufacturing GDP in 1997 to 23.45 percent of all manufacturing GDP in 2009[18]. In 2009, the total value added from the manufacture of electronics and electrical appliances was 385,763 million Baht[19] or 9 percent of the country's total GDP. The industries are also the country's major foreign exchange earners, with many products ranking in the top-fifteen list in terms of export earnings. (NESDB 2010).

Products

The manufacture of electronics and electrical appliances fall into three categories according to the International Standard Industrial Classification (ISIC) revision three. The term encompasses the manufacture of office, account, and computing machinery (ISIC 30), the manufacture of electrical machinery and apparatus (ISIC 31), and the manufacture of radio, television, and communication equipment and apparatus (ISIC 32) (See Table 2.5). 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. Firms producing this product mix are represented in this dissertation.

Industrial Structure

Despite the importance of the electronics and electrical appliances industry to Thailand, the number of manufacturing facilities in these industries is far smaller than

[18] Calculations were done using NESDB data of GDP from the manufacturing sector at 1988 constant prices.
[19] 1988 prices

those in the food and beverages, and textiles and wearing apparel industries. DIW figures show that a total of 2,966 listed factories engage in the manufacture of electronics and electrical appliances in the country. Of this number, the majority (1,917 factories) employs fifty people or fewer, 607 factories are of medium size, and 442 factories employ more than 200 people. As with the textile and clothing industry group, 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 labour-intensive than the textiles and clothing industries, the manufacture of electronics and electrical appliances employs approximately 452,189 people compared with the textiles and clothing's 806,745 employees. Of this number, over 80 percent are employed in large factories of more than 200 employees, 12.81 percent are employed in medium-sized factories, and 6.87 percent are employed in small factories. Over half of these workers are employed in the production of radio, television, and communication equipment and apparatus (ISIC 32).

The industry is a big earner of foreign exchange. The export of computing machinery and parts being the country's top foreign exchange earner, bringing in 17,198.71 million US Dollars (547,468.74 million Baht) in foreign exchange or 9.68 percent of total foreign exchange earned from exports in the first eleven months of 2010. Other products in the industry are also in the top-fifteen list for highest foreign exchange revenues. The export of integrated circuits ranks fourth in terms of foreign exchange earned, while electrical appliances and parts, and radio, television and components rank fourteenth, and fifteenth respectively. (MOC 2010, NESDB 2010). Important markets are EU countries, ASEAN countries, China, the U.S., Japan, and Middle Eastern countries.

While this industry brings in large amounts of foreign exchange, it is also a big importer. According to the results of the recent industrial census conducted by the National Statistical Office (NSO) and the Office of Industrial Economics (OIE) surveys, 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 percent. Computer parts and

components, including disc drives, integrated circuits, and television sets are among the products with high import contents. On the other hand, finished products such as fans, air conditioners, compressors, and transformers are products with high contents of domestic inputs. For products with high import contents, the components come from China, Japan, South Korea, Taiwan, and ASEAN countries.

As a high-technology industry, the manufacture of electronics and electrical appliances is largely dominated by investments from countries with higher technological capital. While some Thai firms exist, these are smaller in number and tend to be smaller operations. Greater presence of MNCs from more technologically advanced countries could make firms in this industry more likely to adopt ISO 14001 since they would have access to more environmentally friendly technology which could help firms more easily comply with ISO 14001 requirements (Zarsky 2010) In addition to this, the industry is also subjected to international market pressures that can filter in through global trade. Thus, it is expected that firms in this industry are more likely to receive higher pressures to become ISO 14001 certified than their peers in the two other industries.

Table 2.5: ISIC 3 digit Industrial Categories

ISIC 3 digit	Activity
300	The manufacture of office, account, and computing machinery.
311	The manufacture of electric motors, generators, and transformers.
312	Manufacture of electricity distribution, and control apparatus.
313	Manufacture of insulated wire and cable.
314	Manufacture of accumulators, primary cells, and primary batteries.
315	Manufacture of electric lamps and lighting equipment
319	Manufacture of other electrical equipment.
321	Manufacture of electronic valves and tubes and other electronic components.
322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy.
323	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods.

Source: ISIC rev.3, UN Statistics Division
(http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2, accessed July 15, 2009*).*

Environmental Impact

Environmental impacts from the electronics and electrical appliances industries 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 could leak out if improperly transported, stored, or handled, and exposure to high dosages of these substances can result in lifetime damages to human health and even death. Improper treatment of residues of these substances from the production process can also result in leakage to the environment, resulting in contamination of soil, freshwater, and groundwater sources. Leakage into the environment is particularly problematic, especially when toxic substances are leaked into freshwater sources that serve the local population.

In addition to the gravity of improper and irresponsible production procedures, electronics and electrical appliances themselves are also problematic as waste due to the contents of hazardous substances such as lead, mercury, and cadmium. However, several countries have recognised the severity of the e-waste problems and have issued directives and rules specifying the proper disposal of such waste as well as the ban on hazardous contents in the manufacture of electronics and electrical devices. These directives and rules directly affect Thai manufacturers who are suppliers of such products to the world market. These directives include the EU's Restriction on Hazardous Substances Directive (RoHS), the Waste Electrical and Electronics Equipment Directive (WEEE), and China's Ministry of Information Industry Order Number 39 on Management Measures for Controlling Pollution caused by Electronic Information Products (China RoHS). Similar waste disposal and recycling laws are also present in Japan and South Korea.

The hazardous nature of the raw materials that go into the manufacture of electronics and electrical appliances makes the industry more at risk for causing environmental harm. Environmental management systems such as the ISO 14001 standard could be adopted to address these harms and, as a result, one environmental impact of certification could be to help firms to better manage industrial waste.

Table 2.6: Number of Factories by Industry and Factory Size.

	Small (1-50)	Medium (51-200)	Large (200+)	Total Factories
Food and Beverages	61,840	1,109	512	63,454
Textiles and Wearing Apparel	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*, accessed April 2009*)*

Table 2.7: Number of Factories by Industry and Geographical Location.

	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 Wearing Apparel	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*, accessed April 2009*)*

Table 2.8: Number of Persons Employed by Industry and Factory Size.

	Small	Medium	Large	Total Employed
Food and Beverages	220,882 (33.19%)	108,357 (16.29%)	336,189 (50.52%)	665,428
Textiles and Wearing Apparel	131,866 (16.23%)	213,126 (26.22%)	467,697 (57.55%)	812,689
Electronics and Electrical Appliances	33,790 (6.87%)	63,061 (12.81%)	395,333 (80.32%)	492,184

Source: Data from DIW webpage *(www.diw.go.th*, accessed April 2009*)*

Table 2.9: Labour Productivity[20] by Industry

	Total Employed	Labour Productivity (Thai Baht)	Labour Productivity (US Dollars)
Food and Beverages	665,428	231,218.10	7,707.27
Textiles and Wearing Apparel	812,689	189,320.88	6,310.70
Electronics and Electrical Appliances	492,184	781,254.57	26,041.82

Note: Labour productivity is in Thai Baht

Source: Author's calculations using data from DIW webpage *(www.diw.go.th*, accessed April 2009*)* and NESDB (*http://www.nesdb.go.th/econSocial/macro/gdp_data/reportagdp.asp?heading_id=25*, accessed July 2010)

[20] Labour productivity is defined here as the industrial output per unit of labour.

4. Environmental Governance in Thailand[21]

Although many decades of rapid economic growth and industrialisation allowed Thailand to make significant progress as measured by various economic and social indicators, pursuing growth without much regard to the environment resulted in both natural resource depletion and environmental degradation. Writing in 1998, Lohani contends that Asia is the dirtiest place in the world (Lohani 1998). World Bank studies (World Bank 2000b, 2001, 2002, 2003) for Thailand concur with this view. It is documented that, despite a global downward trend, Thailand saw a 60 percent increase in organic water pollution in the 1980s through to the 1990s. During the same period, industrial waste in the country also grew at an alarming rate and, as Forsyth (2004) documents, the country saw growing industrial environmental conflicts[22].

Since the beginning, the state has played an important role in addressing industrial environmental degradation by establishing a structure for environmental governance through legislations and the establishment of new institutions. However, environmentalism from NGO groups and public participation are increasingly playing more important roles in shaping the environmental debate in the country in recent decades (Vandergeest 2003, Forsyth 2007, Jarusombat 2008). This section provides background information on the general architecture of Thailand's environmental governance mechanisms, with a focus on the 'brown' agenda of industrial environmental pollution.

4.1. The Constitution, Environmental Law, and Formal Institutions for Environmental Governance

In Thailand, the constitution provides an important foundation upon which environmental governance laws and institutions are built. In the mid-1970s, when the environmental situation had deteriorated to an extent that it became evident that something had to be done in order to prevent further decline, environmental protection

[21] The term 'governance' is used here in its broad definition and encompasses both the government and civil society. This is in keeping with the World Bank's and UNDP's definitions of 'governance' (World Bank 1992, UNDP 1997).

[22] However, it should be noted that while there have been incidents where the 'brown' agenda of environmental pollution have been brought to the fore, Forsyth (2004, 2007) argue that the majority of environmental movements in Thailand continue to be dominated by issues related to conservation of natural resources and local livelihoods.

clauses began to appear in the country's constitution. Drafted under a civilian government, the constitution of 1974 was the first to recognise the importance of environmental preservation. The subsequent promulgation of the 1978 constitution also included an article prescribing the state's role in protecting natural environmental balance and in disposing of substances harmful to human health and hygiene (Article 65). Subsequent constitutions have also recognised the importance of environmental preservation, and the scope for public participation in important environmental decisions has gradually expanded[23].

The constitution of 1974 was followed by the promulgation of the first comprehensive environmental law in the history of Thailand, the Enhancement and Conservation of National Environmental Quality Act (NEQA) of 1975. The Act went through several revisions, which introduced new environmental mechanisms and practices such as the setting of environmental quality standards, the use of environmental impact assessments (EIA), the establishment of an environmental fund, and the adoption of the polluters pay principle (PPP). The NEQA is also complemented by several other laws designed to address and regulate more specific aspects of environmental protection. These laws address issues such as conservation, the preservation of forests and natural resources, health and safety, land use, energy conservation, pollution control, and regulation of hazardous substances. Many of these laws predate the NEQA 1975 and were enacted by the government to address environmental problems on an issue-by-issue basis. These include the Forest Act of 1941, the Public Health Act of 1941 (amended 1992), the Sanitary Act of 1952, the National Energy Act of 1953, the Wildlife Preservation and Protection Act of 1960 (amended 1992), and the Factory Act of 1969 (amended 1992).

The existence of various environment-related laws and the structure of the Thai bureaucracy have led to a complex system of environmental governance. Manufacturing factories must comply with a variety of laws that fall under the jurisdiction of various ministries and agencies. However, in terms of industrial environmental pollution control, there are only a handful of key institutions directly

[23] Political unrest in Thailand, marked by various coup d'états, has led to the adoption of several constitutions. Since Thailand first became a democratic country in 1932 to the present, eighteen constitutions have been adopted. The latest constitution, the 2007 constitution, was drafted after yet another military coup in 2006.

involved in the country's environmental management. The National Environment Board (NEB) is the apex institution responsible for overseeing and deciding important environmental matters in the country. The NEB also oversees the country's environmental fund, mediates between the cabinet and other governmental organisations charged with the task of environmental protection, and has the power to designate heavily polluted or at-risk areas to be Pollution Control Areas (PCAs).

Working closely with the NEB are several offices within the Ministry of Natural Resources and the Environment (MONRE). These include the Pollution Control Department (PCD) which monitors pollution levels throughout the country, helps in setting acceptable pollution standards, and provides expert advice on pollution-related matters. The PCD is also the main agency to which environmental complaints can be reported. Another agency is the Office of Natural Resources and Environmental Policy and Planning (ONEP), which helps drafts national environmental policies and action plans. ONEP also deals with environmental impact assessments of projects that are deemed to have significant environmental impacts. Charged with overseeing environmental issues, MONRE has played an active role in introducing new tools for environmental management to the country. However, this does not include the introduction of voluntary environmental programmes (VEPs), which has mostly been introduced by agencies within or those associated with the Ministry of Industry[24].

An important player in industrial environmental management in the country, the Ministry of Industry (MOI) implements its role in environmental governance through three main agencies, the Department of Industrial Works (DIW), the Thailand Industrial Standards Institute (TISI), and the Industrial Estate Authority of Thailand (IEAT). DIW is responsible for overseeing and monitoring all activities of manufacturing facilities, including environmental matters. TISI, on the other hand, is the agency that adopts and sets industrial standards, including the ISO 14001 standard for environmental management systems. Finally, IEAT is a state-owned enterprise under the supervision of the MOI. IEAT develops industrial estates across the country, or subcontracts this right to private developers. IEAT also monitors all activities within industrial estates, including environmental activities.

[24] However, this was not the case with ISO 14001 certification. The standard was first introduced to the country by an environmental NGO, the Thailand Environment Institute.

4.2. Non-Governmental Institutions for Environmental Management

In addition to government agencies, non-governmental institutions such as NGOs, public organisations, and citizen groups have begun to play more of a role in promoting better environmental management[25] (Vandergeest 2003, Forsyth 2007, Jarusombat 2008). For ISO 14001 certification, the key non-formal players are non-profit organisations, private institutions, and public organisations which have broken off from their previous governmental umbrella. These include the Thailand Environment Institute (TEI), a non-profit agency that first introduced ISO 14001 to the country. TEI works on a project-by-project basis and provides expert knowledge on a range of environmental matters. The Management System Certification Institute (MASCI) and the Thailand Productivity Institute (TPI) provide consultancy services and expert advice on tools such as the ISO 9000 and ISO 14001.

The Federation of Thai Industries (FTI), a large private-sector organisation of industrial leaders in Thailand, also has an institute dedicated to environmental matters. However, the specific details of the services provided by the institute are lacking. In addition to the FTI, industry-specific institutes also exist. These institutes are privately-owned and independently operated. However, some still receive financial assistance from the government. The roles of these institutes are to provide technical assistance to enterprises in specific industries. The assistance often come in the forms of training, consultancy, help in technology upgrading, advice on marketing, and the provision of industry-related information. The three industries of interest in this research also have their own private institutes which espouse environmental protection as one of their concerns. These institutes are the National Food Institute, the Electrical and Electronic Institute, and the Thailand Textile Institute.

In addition to these institutes, a number of non-profit organisations independent from the government, also exist to provide academic advice and research services on environmental matters. The more prominent of these institutes include the Thailand Research and Development Institute (TDRI), which has various publications on environmental economics and environmental governance. Another is the Good

[25] While environmentalism in Thailand mostly centres around conservation and local livelihood issues (Forsyth 2004, 2007), there are business-oriented environmental NGOs which have been working on industrial environmental issues (Rock 2002).

Governance for Social Development and the Environment Institute (GSEI), which carries out multidisciplinary research on environmental matters in Thailand and focuses on building a better understanding of good environmental governance in the public at large.

4.3. Non-regulatory Tools For Environmental Management

While Thailand has fairly comprehensive environmental laws, their implementation has been problematic (Rock 2002a, b, Jarusombat 2008). In studies that compare Thailand with some of some of the other newly industrialising economies of East Asia and Latin America such as Malaysia, Singapore, Indonesia, China, Mexico, Brazil, Argentina, and Chile, Thailand ranks in the bottom three in terms of effective management of industrial environmental pollution (Rock 2002a, b)[26]. In light of this, there has been increasing attention by some in the government to environmental management tools that rely less on state regulatory agencies and more on community and stakeholder pressures (Rock 2002b, Jarusombat 2008). Voluntary environmental programme has been one such tool.

To date, a few voluntary schemes have been initiated to entice firms to undertake measures to reduce their environmental impact. Of these, ISO 14001 certification, the subject of this dissertation, is the most prominent with over one thousand participants at the close of 2010 and with various relevant government agencies further promoting the adoption of ISO 14001 in both industrial and non-industrial organisations. One other standard that is receiving increasing attention in Thailand is the ISO 26000 standard for social responsibility (SR) which is was released in 2010. However, it is difficult to determine how popular the standard is since ISO 26000 is a guidance standard and is non-certifiable.

Apart from international standards such as ISO 14001 and ISO 26000, another extensive effort on the part of the government to involve industry participation in environmental protection is the promotion of cleaner production by way of adopting cleaner technology (CT) methods. This program is actively promoted by various agencies including the Department of Industrial Works, the Pollution Control

[26] For a detailed discussion of the reasons why the Thai government has not made much progress in terms of industrial pollution management, please refer to Rock (2002a,b) and Jarusombat (2008).

Department, and the Thailand Environment Institute. In addition to this, Thailand also has various other awards, certification, and labelling schemes to promote voluntary environmental improvement. These include the Green Leaf rating scheme for hotels[27], the Green Label programme that award labels to products that are more environmentally-friendly than their peers, and the Thailand Quality Award (TQA) that is given to the organisation that is recognised as being the best along various criteria, including the environment. These schemes are accounted for in analysing the impact of ISO 14001 adoption on firm environmental performance in Chapter 6 of this dissertation.

5. Conclusion

This chapter has provided background information on three inter-related topics that are central to the discussions of this dissertation – the ISO 14001 standard, the Thai economy, and the Thai architecture for environmental governance. As a country whose high growth has been predicated on strategies that promote export and welcome foreign direct investment, Thailand is well-poised to channel growing international environmental concerns towards promoting its own industrial environmental performance. The international voluntary programme, the ISO 14001 certification, provides a useful tool for this purpose. Created by an international NGO with built-in third party verification, the standard has been recognised by some in the Thai government as a potentially powerful new tool to combat growing industrial environmental problems, especially when government regulatory efforts have historically been ineffective (Rock 2002b). Despite this optimism, the evidence on ISO 14001 so far has been mixed (see, e.g., Prakash and Potoski 2006, Barla 2007, Arimura et al. 2008, Darnall and Sides 2008). In addition to this, the origin of VEPs in the field, its relative novelty and the focus of existing studies on programmes in industrialised countries have meant that various aspects of ISO 14001 certification in the industrialising country context still remain relatively little-understood. These issues are further explored in the succeeding chapters of this dissertation.

[27] Hotels that apply will be asked to fill in a questionnaire to rate the various practices of the hotel. Hotels which have scored highly – those with very good environmental practices – will be awarded five green leaves. Those with lower scores will be awarded four, three, two, one leaves respectively.

CHAPTER 3

PRIMARY SURVEY DATA AND SECONDARY SOURCES

1. Introduction

One of the main obstacles impeding research into voluntary environmental programmes in the developing world context is lack of data availability. In order to provide answers to the research questions posed, detailed firm-level information is required. This includes sensitive data on individual firm's financial and environmental performances. While there are government agencies which regularly survey firms on their financial performance, a database of firm-level environmental information in Thailand does not exist. To overcome this data problem, the dissertation uses a combination of primary survey data and information from government sources including an industrial government survey.

This chapter provides details of the primary survey questionnaire, the primary data collection process, and a discussion of the government survey and other sources of data used. The chapter begins with a description of the research methodology, and then goes on to describe the development of the survey instrument. The questionnaire is then discussed in detail, followed by a description of the survey process. The chapter then proceeds to describe the other sources of data used to provide supplementary information. A conclusion section closes off the chapter.

2. Research Methodology

The research literature divides research methods into quantitative, qualitative, and mixed process research which combines both quantitative and qualitative methods (Babbie 2007, Bryman and Bell 2007, Creswell and Plano Clark 2007). According to this classification, this research is a mixed process one but with predominantly quantitative features. The research adopts the idea that society can be rationally and objectively studied, an assumption inherent in most economic research. The research

also employs econometric techniques, which allow for greater confidence in the accuracy and the generalisability of research findings. However, the research supplements these quantitative approaches with qualitative features which ask respondents to voice their opinions on various aspects of environmental and financial improvement.

A predominantly quantitative research, especially one which employs econometric methodologies such as this one, calls for intensive data collection. In addition to this, the scope of the research which aims to cover firms in three main manufacturing activities from all over the country indicate that the most appropriate survey methodology is mail-based surveys which require the use of self-administered questionnaires (Denscombe 2010). Compared with structured interviews, such questionnaires are cheaper and quicker to implement and there is no danger of biased responses due to 'interviewer effects' (Bryman and Bell 2007). However, since there is no chance for the respondents to raise questions concerning their understanding of the questionnaire and no immediate pressure to reply that usually accompany structured interviews, self-administered questionnaires need to be carefully designed and implemented so as to reduce misunderstandings, and to induce respondents to complete and return the questionnaires (Yammarino et al. 1991, Dillman 2000). Detailed descriptions of the questionnaire design and the questionnaire itself are provided in Sections 3 and 4. Internet survey was not adopted since it was a medium that Thai manufacturers were not familiar with and was seen as less credible than mail surveys which included proper introduction letters.

3. Development of the Primary Survey Questionnaire: Drafts and Tests

Mail surveys require the use of self-administered questionnaires where respondents read through the document and answer the questions by themselves in the absence of the survey administrator. Thus, the questionnaire design and content are of immense importance in determining responses (Bishop and Smith 2001, Singleton and Straits 2005). In light of this, several steps were undertaken to ensure that the questionnaire included the most relevant contents in as easy-to-follow a design and in as concise a way as was possible to prevent 'respondent fatigue' (Bryman and Bell 2007).

In order to create a concise and carefully designed questionnaire, several drafts of the document were developed and modified through various processes until the final version was finalised and mailed out. The content of the questionnaire benefitted from a careful examination of the existing environmental economics literature, while the structure of the questionnaire benefitted from the literature on mail surveys (Schuman and Presser 1981, Nederhof 1985, Yammarino et al. 1991, Tourangeau and Smith 1996, Krosnick 1999, Tourangeau et al. 2000, Babbie 2007, Tourangeau and Yan 2007, Bryman 2008). To further ensure the relevance of the questions, as well as the appropriateness of the wording and the design of the questionnaire, the initial documents were reviewed by professional environmental economists and tailored to fit the Thai context by experts in environmental mail surveys from Thammasat University, Thailand Environment Institute[1], Thailand Productivity Institute[2], and the Federation of Thai Industries[3]. This process led to the draft final version of the primary survey questionnaire which was then pre-tested.

The pilot tests of the draft final questionnaire involved volunteers from the three manufacturing industries – food and beverages, textiles and wearing apparel, and electronics and electrical appliances. These included managers and business owners. Pilot tests were done face-to-face, and, in each case, the volunteer would be asked to complete the questionnaire and, subsequently, invited to comment on the survey. Responses to survey questionnaires were also carefully studied. The comments and responses were then used to further refine the questionnaire and resulted in the final version of the survey that was subsequently mailed out to firms.

4. Primary Survey Questionnaire

The intensive perusals and tests the questionnaire had undergone resulted in a document of eight pages in length comprising of six parts (see Appendix II). The main

[1] Thailand Environment Institute (TEI) is an independent development research institute that focuses specifically on environmental matters in Thailand. TEI was the organisation responsible for introducing ISO 14001 into the country.

[2] The Thailand Productivity Institute (TPI) is a private organisation that carries out research and provides consultancy services to firms on various management tools, including the ISO 14001 environmental management system certification.

[3] The Federation of Thai Industries (FTI) is a non-profit private organisation for manufacturers in Thailand. It is the largest such organisation in the country and represents all industries. While it is a private organisation, it is overseen by the Ministry of Industry.

objective of the questionnaire is to obtain both quantitative and qualitative information on various aspects of the firms relating to the adoption of measures to improve the firm's environmental performance in general and the adoption of ISO 14001 in particular. The specific objectives of the questionnaire are the following:

(i) Obtain information on firm characteristics.
(ii) Obtain information on the motivation for adoption of measures to improve firm environmental performance.
(iii) Obtain the firm's self-assessed environmental impacts and environmental performance
(iv) Obtain information on the firm's adoption of ISO 14001 and other voluntary initiatives
(v) Obtain information on the effects of ISO 14001 certification
(vi) Obtain the firm's opinion on the role of the government and other relevant agencies with respect to industrial environmental problems
(vii) Obtain the firm's opinion on the role of the government and other relevant parties in ISO 14001 promotion
(viii) Obtain the firm's opinion on ISO 14001 promotion measures they would like to see from the government

The eight specific objectives of the questionnaire correspond to the main research questions posed for this dissertation. The questionnaire was designed to reliably obtain the relevant dependent and independent variables required to test the hypotheses developed for each research question. This section explains the structure of the questionnaire, how each part of the questionnaire links to the research questions posed, and the link between the specific questions of the questionnaire and the existing literature.

4.1 Research Questions 1 & 2: Firm Characteristics and Private Benefits to Voluntary Environmental Programme Participation

Specific Objective (i): Obtain information on firm characteristics: Questions 1 – 6, 15, 16.

Questions 1 to 6 ask for firm characteristics such as the name of the establishment, location, ownership shares, number of employees, main products, and export orientation.

Participation in voluntary programmes is motivated by the firms' considerations of costs and benefits associated with the decision (see, e.g., Alberini and Segerson 2002, Anton et al. 2004). However, the size of the net benefit a firm obtains from participation differs according to the different characteristics of the firm. The location of the firm determines the policy and regulatory context in which the firm is subjected to (Kollman and Prakash 2001, Prakash and Potoski 2006). Furthermore, community pressure for good environmental performance faced by each firm depends directly on where the facility is located (Hettige et al. 1996, Pargal and Wheeler 1996, Gamper-Rabindran 2006, Prakash and Potoski 2006). In Thailand, firms are subjected to varying degrees of regulations depending on their location. Firms situated within industrial estates and pollution control areas are typically subjected to tougher environmental regulations than firms not located in such areas.

Ownership and management may also affect programme participation. Developing country firms owned by foreigners or firms which are subsidiaries of multinational companies are more visible to stakeholders both domestically and internationally. They 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. (Pargal and Wheeler 1996, Wheeler 1999, Christmann and Taylor 2001, Delmas 2002, Bansal and Hunter 2003, Rivera 2004).

Firm size has also been cited as important by several papers for reasons such as economies of scale, and visibility in the public eye (see, e.g., Khanna 2001, Alberini and Segerson 2002). For larger firms, marginal costs of environmental protection are likely to be relatively lower due to economies of scale, plentiful staff, and abundant capital to absorb the costs of environmentally progressive actions such as participation in voluntary programmes (see, e.g., Arora and Cason 1995, Prakash and Potoski 2006). Bigger firms are also more visible in the public eye and are thus more likely to be exposed to liabilities as well as other follies associated with a negative corporate reputation (see, e.g., Hettige et al. 1996, Pargal and Wheeler 1996, King and Lenox 2000). As a result, large firms are likely to participate in voluntary

programmes in order to signal that they have superior environmental performance (Darnall 2001). Visible firms may participate in VEPs to improve their public image and reduce compliance or penalty costs (Khanna and Damon 1999, Khanna 2001). In fact, many surveys of ISO 14001 certified firms report that one of the main benefits to certification is improved corporate image (TEI 1999, Poksinska et al. 2003, Tan 2005, Sambasivan and Ng 2008, de Oliveira et al. 2010).

The products produced by the firm also have the potential to affect programme 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 programmes to boost their positive image with respect to the environment. As King and Lenox (2000) point out, for firms in dirty industries such as the chemical industry, programmes such as Responsible Care was '*essential to its public acceptability and, ultimately, its viability*' (p.699). Different industries also produce different pollution emissions. Textiles factories, for example, are big emitters of water pollution, while electronics and electrical appliances factories are more concerned with hazardous waste.

For many firms in the developing world, non-domestic factors such as foreign trade and foreign direct investment (FDI) are factors that can influence the adoption and outcome of ISO 14001 (Bansal and Hunter 2003, Prakash and Potoski 2007, Perkins and Neumayer 2009, 2010). This is especially true in Asia and Thailand in particular. Initially focused on producing to replace imports, Thailand's industrialisation policy has gradually shifted towards export promotion. This connectedness to the global business world expands the field of stakeholders who care about the firm's environmental reputation and thus there is more pressure on the firm to adopt VEPs (Christmann and Taylor 2001). Thus, firms which export may have greater sensitivity to the trend of green-consumerism (Dasgupta 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.

Question 15 asks firms more specifically regarding the degree of stakeholder pressures firms receive from their various stakeholders. This includes pressures from internal management, customers, regulators, neighbouring communities, etc. Question

16 asks firms what obstacles they face in their attempts to improve the company's environmental performance.

Pressures from stakeholders can influence the firm's likelihood of adopting ISO 14001 certification. Viewing ISO 14001 as a 'brand image' associated with a 'green club,' Prakash and Potoski (2006) posit that stakeholders' perception give value to the brand image of a club since their reaction to the information contained in the brand can either reward or punish firms. For example, government officials' perception of the green club can potentially alter the often conflicting relationships between the regulated firm and the regulator. Furthermore, regulatory influence theory hypothesises that firms can benefit from participation in voluntary programmes since adoption of such programmes sends signals to stakeholders that the firm is committed to improving environmental performance (Boiral and Sala 1998, Welch et al. 2002, King et al. 2005). Thus, ISO 14001 certification can enhance the relations between the firm and its stakeholders (Polonsky 1995, Azzone et al. 1997, Morrison et al. 2000). In situations where lobbying from environmental and consumer groups can induce tougher environmental regulations, participation in voluntary schemes can drive a wedge between the pressures from such groups and the regulatory process (Lutz et al. 2000, Maxwell et al. 2000, Lyon and Maxwell 2002).

Obstacles to participation work in the opposite direction as pressures from stakeholders. While certain pressures from stakeholders can help firms benefit from ISO 14001 adoption, obstacles faced by the firms are associated with increased difficulties and costs of participation. However, since the existing VEP literature focuses more on other aspects of firm characteristics, question 16 was difficult to construct. The reasons stated for firms to check under this question were informed by similar questions on the Thailand Environment Institute (TEI)'s survey of firms adopting ISO 14001 (TEI 1999). Conversations with government officials from the Thailand Industrial Standards Institute (TISI) and businessmen also provided some of the choices included in question 16.

Specific Objective (ii): Obtain information on the financial benefits for adoption of measures to improve firm environmental performance: Questions 7, 8

The questions in this section ask firms to list factors motivating them to undertake environmental improvements, and ask firms to assess themselves on various measures of their financial performance. Question 7 asks whether or not the firm has exported to new markets, while question 8 asks firms to evaluate their financial performance in four areas: growth in profitability, growth in total sales, growth in export sales, and growth in total exports-to-sales ratio. Since some foreign markets prefer that the exporting firms have ISO 14001 certification, adoption of the certification can result in access to new markets and greater export sales (Roht-Arriaza 1997, Poksinska et al. 2003, Tan 2005). Green consumerism can also result in increased sales for ISO 14001 firms (Arora and Gangopadhyay 1995, Cairncross 1995).

While positive net benefit is often assumed as the underlying factor behind firm participation in voluntary programmes, the assumption often goes untested in the existing VEP literature. However, as Rivera (2002) points out, understanding the financial benefits for firms is necessary in determining the sustainability of voluntary programmes. Indeed, being non-mandatory in nature, such programmes should be able to provide short-term and long-term gains in order to promote better environmental performance (Andrews 1998, Highley and Leveque 2001, Kollman and Prakash 2002). Measures of financial gains to participation in VEPs adopted here include the growth of profitability, growth of sales, growth of export sales, and growth of exports-to-sales ratio.

4.2 Research Questions 3: Environmental Impact of ISO 14001 Participation

This part of the primary survey questionnaire was necessitated by the fact that Thailand does not have publicly accessible sources of firm-level environmental information. Although certain firms are required by law to report their pollution releases to the Department of Industrial Works (DIW), this information remains strictly confidential and is not released even for research purposes[4]. Another potential source for environmental data, the Pollution Control Department (PCD), was also explored. However, the information on estimates of industrial pollution published by the PCD is at the province level, not the firm level required for this research. Also,

[4] Attempts have been made to obtain this information from the DIW. However, all requests for access were denied. To date, the researcher knows of no other study that has been able to access this data.

the database contains information from the 1994-1995 survey of industrial facilities and has not been updated. Thus, to obtain firm level data on environmental performance, it was necessary to direct questions to the firm themselves.

Specific Objective (iii): Obtain the firm's self-assessed environmental impacts and environmental performance: Questions 9 – 13

The questions in this section are designed to gauge the main environmental aspects of the firms and to evaluate the firms on their environmental performance. Question 9 asks firms to list the main environmental impacts from their production processes. Question 10 asks them a series of questions on various environmental aspects with the goal of using their replies to construct measures of firm environmental performance. Questions 11 – 13 then go on to ask various environment-related questions which include the implementation of other non-ISO 14001 environmental practices such as environmental report publication and environmental training.

The questions asked here, as well as the categories used, benefit from a review of the literature on environmental management systems, especially the literature that seek to determine factors leading to comprehensive environmental management systems (see, e.g., Dasgupta et al. 2000, Uchida and Ferraro 2005). The questionnaire also benefitted from sample questionnaires on similar topics, especially the Oregon Business Environmental Management Survey (Ervin et al. 2008) and the Canadian Pulp and Paper Industry Survey (Doonan et al. 2005).

Specific Objective (iv): Obtain information on the firm's adoption of ISO 14001 and other voluntary initiatives: Question 14

Question 14 provides a list of voluntary programmes for firms to check whether or not they have joined them, are in the process of joining them, or have not joined in such schemes. Programmes listed are ISO 9000, clean production, clean development mechanism, eco-label programmes, EMSs, and ISO 14001. The purpose of this question is to obtain information for the dependent variable of whether or not the firm has participated in ISO 14001. Other voluntary programmes are included here to control for their effects on environmental outcomes as Arimura et al. (2008) suggests

that focusing on a single treatment in exclusion of others could lead to an overestimation of the environmental outcomes of participation.

Specific Objective (v): Obtain information on the effects of ISO 14001 certification: Questions 21 – 23

Questions 21 – 23 ask firms with ISO 14001 in place for the results of adopting the programme. Question 21 asks firms for the environmental impacts that have been mitigated after having being ISO 14001-certified. Question 22 asks whether or not the motivations that drove firms to seek ISO 14001 are realised in practice. Finally, question 23 asks whether having ISO 14001 in place has helped firms reduce costs. These questions are derived mostly from anecdotes on ISO 14001 successes related by practitioners in the field from the Thailand Environment Institute (TEI) since the literature examining the environmental benefits of ISO 14001 is recent and still inconclusive (Khanna and Damon 1999, Gamper-Rabindran 2006, Morgenstern and Pizer 2007, Vidovic and Khanna 2007, Arimura et al. 2008, Morgenstern et al. 2008). This section also benefitted from TEI's early survey of ISO 14001 adopting firms (TEI 1999), and is in line with existing survey literature on ISO 14001 certification (see, e.g., Petroni 2000, Rondinelli and Vastag 2000, Mohamed 2001, Raines 2002, Tan 2005, Ann et al. 2006, Sambasivan and Ng 2008).

4.3 Research Question 4: Lessons for Policymakers

Despite being a voluntary environmental programme, there is scope for intervention by the government and other environmental agencies in ISO 14001 certification. One distinct role highlighted by the existing literature for the government is that of provider and enforcer of environmental regulations (Segerson and Miceli 1998, Glachant 2007), which form the minimum baseline of compliance stipulated in ISO 14001 requirements. Furthermore, as policymakers, the government plays a very important role in deciding whether or not to initiate voluntary programmes[5]. In the case of ISO 14001 certification, the Thailand Industrial Standards Institute (TISI), which is a part of the Ministry of Industry, takes the standard and adopts it as a national standard. TISI also oversees the qualification of ISO 14001 auditors, as well

[5] This is especially true for public voluntary programmes, a form of VEP especially popular in the United States. Public voluntary programmes are initiated by government agencies and firms are invited to participate in them on a voluntary basis (e.g., the USEPA's 33/50 program).

as the certifying bodies, private companies which have the right to award ISO 14001 certification. Finally, in a broader context of policymaking, the government must also decide whether such programmes should be the sole environmental policy adopted, or 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 2006).

While the government certainly plays a prominent role, other private and non-governmental agencies also have a role to play in the promoting firms to obtain ISO 14001 certification. Companies, for example, can require their suppliers to have ISO 14001 adoption (Roht-Arriaza 1997, Coglianese and Nash 2001). Furthermore, some big companies may even help their suppliers with achieving ISO 14001 certification[6] to ensure a green supply chain. This is especially true for firms which are engaged in long-term contracts with their suppliers. As King et al. (2005) demonstrates, firms which are embedded in long-term vertical relationships with their suppliers are more likely to use ISO 14001 certification as a means for reducing the moral hazards that are associated with long-term contracts between suppliers and customers.

While the roles of the government and other agencies can be determined by statements of such agencies of what programmes and measures they have to promote ISO 14001, this dissertation has, instead, chosen to ask for firm's opinion on the roles these agencies play regarding ISO 14001. The reason for this is the fact that, while the measures and policies of these agencies are the same for all firms, different firms have chosen to respond differently to them (Delmas and Toffel 2004). Thus, an understanding of how different firms perceive the roles of different agencies is crucial to understanding the workings of ISO 14001 adoption and its effects. Knowledge of firms' perceptions will also be useful to policymakers.

[6] This latter point was made by a representative from the electronics and electrical appliances industry in a brainstorming session for a research project on RoHs and WEEE regulations conducted by researchers from the Thailand Environment Institute and Thammasat University (held on 23 May 2008 at the Thailand Industrial Standards Institute). This session was attended by the researchers, representatives from the electronics and electrical appliances industry, and representatives from the Federation of Thai Industries.

Specific Objectives (vi) and (vii): Obtain the firm's opinion on the role of the government and other relevant agencies with respect to industrial environmental problems and ISO 14001 policies: Questions 17, 18, 20, 24, 26, 27

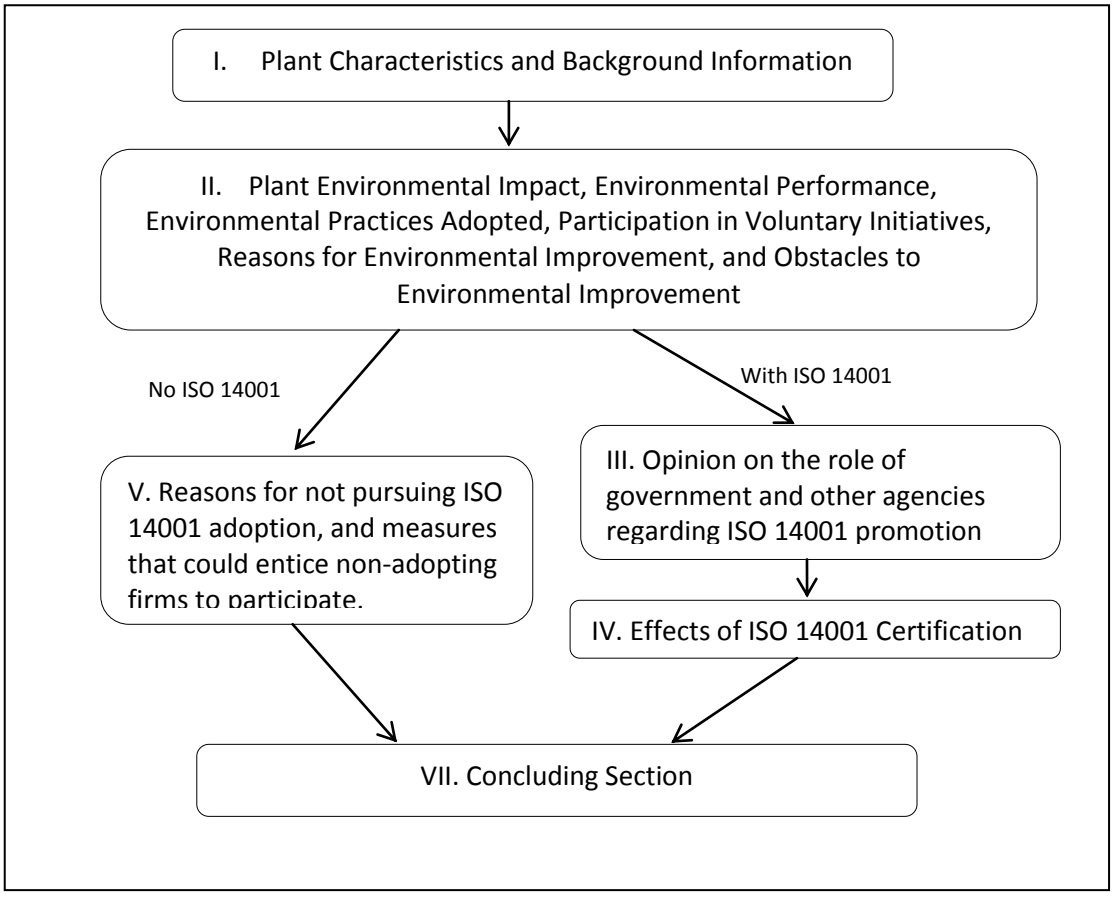
Specific objectives (vi) and (vii) ask similar questions, but are tailored to two groups of firms – ISO 14001 adopters and non-adopters of the certification. The questions are asked in two parts of the questionnaire. Part 3 is for ISO 14001 adopters only and includes questions 17, 18 and 20. Part 5, on the other hand, is for non-adopters only and includes questions 24, 26 and 27. ISO 14001 adopters are asked to specify the agencies/organisations that they received help from on their way to adopting the ISO 14001 certification (question 17), and are asked to give their opinion on government promotional policies of ISO 14001 thus far (question 18). Non-adopting firms are asked for the reasons they are not ISO 14001-certified (question 24), and asked to list the organisations which had given them help in reducing their manufacturing facilities' environmental impact (question 26). Both adopters and non-adopters are also given the space to provide further comments on the role of the government and NGOs regarding environmental management (questions 20 and 27).

Specific Objective (viii): Obtain the firm's opinion on ISO 14001 promotion measures firms would like to see from the government: Questions 19, 25

Questions 19 and 25 are similar in that both ask firms which promotional measures they would like the government and other relevant agencies implement. Question 25 asks non-adopting firms which promotional measures would make them consider ISO 14001 certification, while question 19 asks adopting firms which government and non-governmental measures they would like to see, or to see more of. Although the literature does point out the importance of the role of government (see, e.g., Segerson and Miceli 1998, Bizer and Jülich 1999, OECD 1999, Börkey and Lévêque 2000, OECD 2003), the role of the firm's reaction to government measures have been left largely unstudied. As a result, the choices given in questions 19 and 25, which include provision of training and provision of information on ISO 14001, are derived from a review of promotional measures for many different programmes. The questionnaire also benefitted from the sample questionnaires from the Thailand Environment Institute and the Office of Industrial Economics (TEI 1999, OIE 2007), as well as discussions with practitioners and academics in the field. These questions

are also in keeping with Mbohwa and Fukada (2002)'s suggestions on what promotion strategies the government of Zimbabwe should do to promote ISO 14001 certification in the African nation.

Figure 3.1: Layout of the Questionnaire



4.4 Caveats on the Survey Questionnaire

While every attempt has been made to address the potential channels for errors that are within the control of the researcher such as the wording, structure, and layout of the questionnaire, it would be erroneous to assume that the final document is above the limitations inherent in this medium of data collection. Three main problems are relevant to this dissertation. First, Polivka and Rothgeb (1993) points out that no matter how carefully designed the questionnaire is, the possibility of misunderstanding is never zero. For mail surveys where it is difficult to know who the one filling out the questionnaire is and there are no opportunities for clarification questions, the final replies recorded are affected by the respondents' interpretation of the question. Thus, the researcher has to assume that the changes in the wording of the

questionnaire that followed suggestions in the pilot studies have helped to minimise this type of error, and that, if the questions were misinterpreted, that this was done randomly.

Second, in answering sensitive questions, there is a tendency for responses to be biased towards socially acceptable replies (Bryman and Bell 2007, Bryman 2008). This 'social desirability bias' (SDB) is common in self-reported information and is a threat to validity that is present across many disciplines of social sciences (see, e.g., Zerbe and Paulhus 1987, Fisher 1993, King and Bruner 2000, Tourangeau and Yan 2007). However, studies have shown that the use of postal surveys and self-administered questionnaires with pre-determined replies to select from, such as the one adopted in this dissertation, can limit the occurrence of SDB (Nederhof 1985, Sudman et al. 1996, Tourangeau and Smith 1996, Presser and Stinson 1998, King and Bruner 2000, Kreuter et al. 2008).

Finally, studies have shown that the order of the questions asked and of the response choices presented may have an impact on the replies elicited (McFarland 1981, Schuman and Presser 1981, Israel and Taylor 1990, Krosnick 1999, Bishop and Smith 2001, Singleton and Straits 2005). However, Babbie (2007) and Bryman (2008) warn against drawing general lessons from existing studies since findings on the effects have been mixed and it is difficult to determine what the ordering effects would be for any given questionnaire. The non-uniformity of the effects may depend on the nature of the question (complexity, specificity, etc.) (McFarland 1981, Schuman and Presser 1981, Strack et al. 1988, Schwarz et al. 1991, Sudman et al. 1996), and on the respondents' personal characteristics (McClendon 1986, Benton and Daly 1991, Krosnick 1991, Narayan and Krosnick 1996). As a result, Bryman and Bell (2007) and Bryman (2008) advise researchers to be cautious of attempts to address the ordering problem since the effects of such interventions, for example, by randomising question or choice order, could lead to a substitution of a bias that is within the control of the researcher to one that is outside the researcher's control. However, the readers should keep in mind that the possibility of such a bias still exist for data collected using mail survey questionnaires.

5. Primary Survey Methods

To obtain a target of roughly 400 responses, the final version of the survey was mailed out to approximately 4,400 firms in the three industries of interest. This number includes all firms listed as having ISO 14001 according to the Thailand Industrial Standards Institute 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), the Ministry of Industry agency that is responsible for overseeing manufacturing facilities in the country. 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[7].

Several steps recommended in the survey literature were implemented to ensure accuracy and higher response rates (Yammarino et al. 1991, Dillman 2000, Singleton and Straits 2005, Babbie 2007, Bryman and Bell 2007). To provide background and credibility to the survey, all questionnaires were mailed with introduction letters from the researcher's supervisor on University of Cambridge stationery, and from the Thailand Environment Institute (TEI), an agency manufacturing facilities in Thailand are familiar with. For firms in the textiles and wearing apparel industry, which had lower response rates, a letter from the Thailand Textiles Institute urging firms to respond was also included in the follow-up mailings. To ensure that the responding party was knowledgeable about the topics in the survey, the questionnaires were addressed to CEOs and environmental managers. The questionnaire was also designed for easy return, with the address and postage stamp on the last page of the questionnaire so that firms could easily fold and staple the questionnaire and drop it in the mail. After initially mailing out the questionnaires, firms which failed to reply by the specified deadline were contacted again by phone and questionnaires were re-sent to them if required. Firms which still failed to reply were contacted a third and fourth time requesting response.

[7] Sampling had to be done this way since the proportion of ISO 14001-certified firms in the population is very low (less than 1 percent). This oversampling of ISO 14001 firms is accounted for in the empirical analysis.

These above steps resulted in 494 complete responses, a response rate of 11.3 percent. This response rate is already on the higher end of normal figures for non-government mail surveys in Thailand. Of the 494 responses received, 188 firms or 38.1 percent replied that they have ISO 14001 certification. Responses were also fairly evenly distributed by industry – 157 responses came from firms in the food and beverages industry, 141 responses were from the textiles and wearing apparel industry, and 194 replies came from the electronics and electrical appliances industry. A breakdown of responses by industry and the number of firms that have ISO 14001 are shown in Table 3.1.

When compared with the database of manufacturing facilities provided by the Department of Industrial Works, the characteristics of the primary survey sample leans more towards bigger firms which are located in the Bangkok Metropolitan, Central and Eastern regions of the country. This is partly a result of the stratified random sampling process which is based on the size and location of ISO 14001 certified firms. Since adopting firms tend to be larger than the average firm, and larger firms are mainly concentrated in the BMA, Central, and Eastern regions, the primary survey sample reflects this. In addition to this, in practice, smaller firms are less likely to have the personnel to spare for returning questionnaires. As a result, the findings of this study are applicable to firms of medium- and large-sizes. (See Tables 3.2 to 3.5).

Table 3.1: Responses to Primary Survey Questionnaire

	Responses	Certified with ISO14001	Percentage with ISO14001
Food and Beverages	157	47	29.9
Textiles and Wearing Apparel	141	24	17.0
Electronics and Electrical Appliances	194	117	60.3
Total	494	188	38.1

Table 3.2: Distribution of Firms by Size (DIW Database)

	Small (1-50)	Medium (51-200)	Large (200+)
Food and Beverages	97.46	1.75	0.81
Textiles and Wearing Apparel	62.14	27.47	10.39
Electronics and Electrical Appliances	64.63	20.47	14.90

Source: Author's calculations based on data from DIW webpage *(www.diw.go.th*, accessed April 2009*)*

Table 3.3: Distribution of Firms by Location (DIW Database)

	BMA	Central	East	North	Northeast	South
Food and Beverages	5.39	6.15	4.29	17.45	59.24	7.48
Textiles and Wearing Apparel	77.66	4.33	3.22	6.20	7.84	0.75
Electronics and Electrical Appliances	64.97	11.02	12.98	4.21	5.36	1.45

Source: Author's calculations based on data from DIW webpage *(www.diw.go.th*, accessed April 2009*)*

Table 3.4: Distribution of Firms by Size (Primary Survey Data)

	Small (1-50)	Medium (51-200)	Large (200+)
Food and Beverages	10.83	29.94	59.24
Textiles and Wearing Apparel	7.69	26.57	65.73
Electronics and Electrical Appliances	8.76	29.38	61.86

Table 3.5: Distribution of Firms by Location (Primary Survey Data)

Industry	BMA	Central	East	North	Northeast	South
Food and Beverages	38.22	17.83	10.83	10.19	10.19	11.46
Textiles and Wearing Apparel	67.13	5.59	9.09	3.50	1.40	0.00
Electronics and Electrical Appliances	42.27	15.98	23.71	9.28	4.64	0.00

6. Office of Industrial Economics Data

To avoid non-response, the primary survey questionnaire refrained from asking detailed financial information questions. To make up for this loss of information, this dissertation uses data from the Office of Industrial Economics (OIE)'s Annual Industrial Survey, which include detailed questions on the firm's finances including profits, domestic sales, and international sales.

The OIE survey has been on-going since 2001 and includes approximately 4,000 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, the dataset is an unbalanced panel of manufacturing firms for years 2001 to 2007.

While the OIE dataset has detailed information on firm finances, it does not have information on adoption of industrial standards such as ISO 9000 and ISO 14001. The dataset also does not have information on the firm's location. Thus, additional information was obtained from other sources and added on. Information on certifications was obtained from the Thailand Industrial Standards Institute[8]. Information on whether or not the firm is located within industrial estates was obtained from the Industrial Estate Authority of Thailand (IEAT).

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 analysed without first cleaning these errors out. Thus, the following criteria were applied in order to weed out problematic observations.

(a) Duplicate observations. 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[9] from production value. Observations with zero or negative value added were removed since it is unlikely that firms would produce goods with values lower than the costs of raw materials and fuels 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 3.6.

[8] 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.
[9] Material costs here are the costs of the raw materials and fuel used in the production process.

Table 3.6: 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

Data from the OIE are also checked against the database provided by the DIW. Tables 3.7 and 3.8 show that the OIE sample exhibits similar properties to the primary survey data sample with both datasets including relatively larger firms. Both datasets also contain samples from firms located in the BMA, Central, and Eastern regions of the country, the areas where relatively larger industrial firms are located.

Table 3.7: Distribution of Firms by Size (OIE Data)

Industry	Small	Medium	Large
Food and Beverages	30.93	23.73	44.42
Textiles and Wearing Apparel	27.38	32.63	38.84
Electronics and Electrical Appliances	19.89	29.41	46.38

Table 3.8: Distribution of Firms by Location (OIE Data)

Industry	BMA	Central	East	North	Northeast	South
Food and Beverages	48.75	12.34	7.98	6.48	9.24	8.20
Textiles and Wearing Apparel	82.39	4.26	3.48	2.14	3.24	0.00
Electronics and Electrical Appliances	56.44	10.37	18.78	3.62	2.87	0.00

7. Conclusion

This chapter has provided the necessary background information on the two main sources of data used in the analysis chapters of this dissertation. Data on firm-specific characteristics such as size, location, export orientation, presence of foreign direct investment, voluntary programme adoption, stakeholder pressures, and obstacles to environmental improvement are used to analyse the determinants to ISO 14001 participation in the next chapter, Chapter 4. Some of these variables are also used, in conjunction with detailed environmental information, in Chapter 6 which analyses the environmental effectiveness of ISO 14001 certification. The secondary data sources

figure prominently in Chapter 5, which assesses how firms stand to gain financially from ISO 14001 certification. Findings from the primary survey on the private benefits of VEP adoption are also presented in Chapter 5 to provide a more in-depth picture of the effects of ISO 14001 participation.

CHAPTER 4

FIRM CHARACTERISTICS AND PARTICIPATION DECISION IN THE DEVELOPING WORLD CONTEXT

1. Introduction

This chapter is motivated by the scarcity of studies examining the determinants of ISO 14001 adoption that are specific to the developing world context despite the widespread adoption of the voluntary scheme in developing countries (ISO 2010). Operating in a context where regulations are less stringent, regulatory capacities are weak, budget is tight, information is limited, and manpower is lacking, developing world regulators often face vastly different settings from their counterparts in developed economies, and many aspects of findings from such countries have limited applicability to the industrialising world setting. For example, findings from studies in industrialised countries indicate that the adoption of voluntary environmental programmes (VEPs) is motivated primarily by domestic regulatory and market pressures (Khanna and Anton 2002, Lyon and Maxwell 2004). However, such pressures are likely to be weak or have dampened effects in the developing world context due to limited regulatory capacity to monitor and enforce environmental regulations, casting doubt that regulatory pressures are the driving forces behind the widespread ISO 14001 adoption. Domestic non-regulatory pressures to adopt ISO 14001 are also likely to be dampened in the developing world due to smaller markets for green products (Wehrmeyer and Mulugetta 1999), and limited information about the environmental performance of firms or products among consumers (Hanley et al. 1996).

In contrast, factors such as the export orientation of firms, or whether or not firms receive foreign direct investment (FDI) – two factors which feature strongly in developing economies pursuing export orientated growth strategies – have been neglected in the existing industrialised world literature even though evidence from cross regional studies on environmental spillovers and VEP diffusion have suggested

that they could be important determining factors (Neumayer and Perkins 2004, Prakash and Potoski 2007, Perkins and Neumayer 2010). This chapter addresses this gap in the literature and seeks to examine the extent to which pressures from linkages to international markets that filter in through export orientation and FDI influence the decisions of firms to adopt ISO 14001 certification.

By looking at the determinants of ISO 14001 certification in the three core industries of a dynamic Asian economy, the chapter contributes to the existing literature on VEPs in the following ways. First, this study is one of the few attempts to econometrically examine the determinants of ISO 14001 certification at the firm level in a developing Asian economy. Second, the research focuses on the role played by international trade via FDI and export orientation, factors that are important to developing country firms, but which have not been highlighted in the firm-level literature. Third, the research uses a unique dataset of information on developing country firms collected firsthand by the researcher. Fourth, the research considers three types of industries that represent the range of industrial activities found in many developing countries - the more traditional resource based and labour-intensive industries, and the high-technology engineering industries. Lastly, the research accounts for the possibility that ISO 9000 and ISO 14001 participation may be jointly determined by comparing results from univariate and bivariate probit models and provides further checks on the results by employing endogenous switching models.

This chapter is divided into five sections. Section 2 discusses the factors hypothesised to determine VEP adoption in the developing world context. Section 3 discusses the model specification and methods for analysis. Section 4 discusses the results, and section 5 concludes the paper.

2. Determinants of VEP Participation For Developing Country Firms

Economic theory suggests that in choosing an environmental strategy to adopt, the firm will carefully consider its expected payoffs and choose the most profitable strategy (Segerson and Miceli 1998). Institutional theory, on the other hand, points to institutional pressures as the main driving force behind the firm's choice of environmental practices (Maxwell and Lyon 1999, Delmas 2002, Delmas and Toffel

2004, Lyon and Maxwell 2004). In this chapter, these two strains of theory are brought together and it is stipulated that the institutional pressures a firm receives affect its expected payoffs and ultimately result in the decision whether to adopt or reject an environmental practice.

Perkins (2007) argues that differences in rates of corporate greening across firms in developing countries can be explained by heterogeneity in terms of external institutional pressures, internal resources and capabilities. Furthermore, Delmas and Toffel (2004) stipulates that differences in firms' perception of institutional pressures exerted on it can help explain the resulting differences in environmental practices of firms that should be subjected to the same external institutional pressures. In a similar way, this study posits that the expected payoff of an environmental measure for a firm is influenced by both the external institutional pressures the firm receives and the firm's own perception of these pressures. Firm characteristics play an important role in determining the amount of external pressures a firm is subjected to (Delmas and Toffel 2004). For example, a firm's visibility or multinational status can both affect how much benefits a firm stands to gain from adopting an environmental measure (Hettige et al. 1996, Pargal and Wheeler 1996, King and Lenox 2000). For perceived institutional pressures, this chapter postulates that the firm's decision-maker(s)'s perception of pressures can affect the perceived expected payoffs for an environmental strategy in a similar way to how a person's risk preferences can influence the person's expected payoff in an uncertain and risky situation (Mankiw 2007). Thus, both actual and perceived pressures matter in the firm's decision to adopt environmental measures such as the decision to participate in ISO 14001.

Institutional pressures a firm faces not only vary depending on firm characteristics, but they also depend on the regulatory, political, and socio-economic contexts within which the firm operates (Corbett and Kirsch 2001, Delmas and Toffel 2004, Potoski and Prakash 2004, Perkins 2007, Perkins and Neumayer 2009). This has important implications for studies considering developing country firms since findings from industrialised country studies do not necessarily carry over to the developing country context (Blackman et al. 2007). Thus, while past studies that look at participation in VEPs have provided important insights into the specific factors determining VEP adoption in the developed world (see, e.g., Arora and Cason 1996, Delmas 2000,

Khanna 2001, Nakamura et al. 2001, Welch et al. 2002, Prakash and Potoski 2006), the limited research done for the developing world context suggests that this is one area that needs to be further explored.

Two important distinctions between a developing economy firm and a developed one are dependence on exports to bring in foreign exchange and a reliance on foreign investment for both financial and technological capital. Thus, for firms in the developing world, a connection with the international economy via foreign direct investment and export orientation would likely be more important factors determining the firm's decision to participate in international voluntary standards such as ISO 14001. Cross-national studies of a country's rate of ISO 14001 adoption also point to the importance of trade and investment linkages to programme participation. Higher numbers of ISO 14001 certification in a host country are found to be associated with the presence of FDI and export-orientation, especially when the source of investment and trade partner are countries with high levels of ISO 14001 adoption[1] (Corbett and Kirsch 2001, Neumayer and Perkins 2004, Prakash and Potoski 2006, 2007, Perkins and Neumayer 2010).

In addition to looking at FDI and export orientation, it is also important to assess in the developing country context the idiosyncratic impact of factors affecting VEP participation that have been explored in past studies in the developed world such as firm-specific characteristics (e.g. size, location, product type), firm's experience with other certification schemes (such as the ISO 9000 total quality management certification), local regulatory pressures, as well as stakeholder pressures and obstacles to participate. Thus, the effects of these factors are also discussed alongside the hypothesised effects of international linkages.

Hypothesis 1: Foreign Direct Investment (FDI) plays an important role in determining ISO 14001 certification

Encouragement of FDI has been a part of Thailand's trade policies for the past several decades, and, as a result of this continuity, varying degrees of FDI exist in almost every economic sector in the country including the three industries of interest in this

[1] However, as Perkins and Neumayer (2010) finds, the effects of such ties are stronger in wealthier countries.

research. Unlike other forms of investment, FDI entails both ownership and control, endowing the investor with some degree of decision-making power over the firm's management policies and strategies (Moosa 2002). Thus, FDI directly influences the management decision to adopt ISO 14001.

Theoretically, the role played by FDI in the decision to adopt ISO 14001 is unclear. According to the country-of-origin school of thought, it is argued that the activities and decisions made by MNCs are influenced by their home country institutions, norms, and management practices (Langlois and Schlegelmilch 1990, Porter 1990, Sethi and Elango 1990, Pauly and Reich 1997, Zaheer and Zaheer 1997, Van Tulder and Kolk 2001). Accordingly, this school of thought hypothesises that MNCs originating in countries with many ISO 14001 certifications and with higher environmental standards will be more likely to adopt ISO 14001 in their developing country operations (Prakash and Potoski 2007). This school of thought has found empirical support in many econometric studies that seek to explain regional disparities in the rate of ISO 14001 certification. Neumayer and Perkins (2004), Prakash and Potoski (2007), and Perkins and Neumayer (2010) have found a positive association between presence of FDI from countries with high ISO 14001 adoption and the number of ISO 14001 in the host country. However, Perkins and Neumayer (2010) finds that the effect may be stronger in wealthier economies, and Qi et al. (2011) does not find that FDI is a significant determinant of regional variation in adoption rates across China.

It has also been suggested that MNCs operating in developing countries are likely to be proactive agents of change, actively engaging with the regulators in an attempt to set high environmental standards, which are to their advantage since they have superior technology to local firms and higher standards mean higher costs and a barrier to entry for other firms in the industry (Child and Tsai 2005). In addition to this, the 'brand images' and the visibility of MNCs and their subsidiaries in developing countries make them more likely to participate in voluntary programmes in order to maintain their image and to alleviate pressures to become green (Pargal and Wheeler 1996, Christmann and Taylor 2001, Child and Tsai 2005). This is also in keeping with Porter (1985) which indicates that, for firms with a global standing,

investing in differentiating their global brands will bring more competitive advantages than pursuing a low-cost strategy.

These latter points are collaborated by findings from qualitative studies of multinational corporations in the developing world, which suggest that there are links between environmental strategies and FDI. Dependence on international trade and FDI has been found to influence environmental policy in both Malaysia and Singapore (Bankoff and Elston 1994), and governments have encouraged exporters and MNC suppliers to obtain ISO 14001 certification (Zarsky and Tay 2000). Raines et al. (2002) also report that Chinese regulators strongly encourage foreign firms to adopt ISO 14001 certification. In Thailand, although there is no explicit encouragement of foreign firms to participate, most of the early adopters of ISO 14001 are MNCs (TEI 1999).

Despite theories and some findings in favour of MNCs' adoption of voluntary initiatives, another strand of literature on the pollution haven hypothesis stipulates that MNCs may have located their plants in developing nations because they are attracted by the less stringent environmental control there (Eskeland and Harrison 2003, Cole 2004, Elliott and Shimamoto 2008, Wagner and Timmins 2009). As a result, such firms do not take into serious consideration the host country's environmental regulation and, since adoption of ISO 14001 imposes non-trivial costs, such firms would be less likely to implement the scheme. In addition to this, the dependency school of thought also suggests that MNCs in developing countries employ inferior technologies and practices that are no longer practiced in their home countries (Hymer 1976). Thus, from this perspective, FDI is not conducive to ISO 14001 adoption.

The two conflicting streams of literature on FDI and ISO 14001 adoption does not allow for a formulation of a hypothesis regarding the direction of the relationship between FDI and ISO 14001. This remains to be determined empirically.

Hypothesis 2: Export orientation is one factor that determines ISO 14001 participation

As an international standard that is recognised and permitted by WTO rules (Clapp 1998), ISO 14001 is closely linked to international trade, making factors such as export orientation and FDI important determinants of a firm's ISO 14001 adoption.

This is especially true for firms in developing countries where both factors play important roles in the countries' economies and economic development, and are often strongly encouraged by the government.

For export-oriented firms, there are anecdotal reports of customers requiring that their trade partners be ISO 14001 certified (Epstein 1996, Berry and Rondinelli 1998, Quazi et al. 2001). There have also been reports that more and more customers in developed countries are requiring ISO 14001 certification (Roht-Arriaza 1997, Neumayer and Perkins 2004). In addition to this, cross-regional studies of ISO 14001 adoption have also found a higher incidence of the standard in countries whose trading partners have a high number of ISO 14001 certification (Corbett and Kirsch 2001, Neumayer and Perkins 2004, Prakash and Potoski 2007, Perkins and Neumayer 2010, Qi et al. 2011).

Reputation and the information associated with the ISO 14001 'brand' provide added reasons for standard adoption by export-oriented firms. For developing country firms exporting to overseas market, the physical, social, cultural, and institutional distance between suppliers and customers often aggravate the information asymmetry problem which can lead to distrust and inefficiencies (King et al. 2005). The problem is particularly severe when the goods have credence aspects, such as the environmental impact of the production process. To overcome such information problem and to establish that they have good environmental practices, firms can choose to be associated with a credible certification scheme such as ISO 14001 (Auriol and Schilizzi 2003). With its international recognition and widespread adoption worldwide, ISO 14001 can be the answer for many exporting firms faced with the information asymmetry problem (King et al. 2005, Johnstone and Labonne 2009).

In light of all this, the hypothesis is that developing country firms which are more export-oriented are more likely to adopt the ISO 14001 certification.

Hypothesis 3: Firms which receive more pressures to become green from stakeholders are more likely participants of the ISO 14001 scheme

Institutional theory posits that different stakeholders impose both coercive and normative pressures on the firms which can affect the firm's decision to adopt voluntary approaches (Delmas and Toffel 2004). Under club theory, stakeholders of

the firm are also deemed to be important in determining the value of being associated with green clubs such as ISO 14001 (Potoski and Prakash 2005, Prakash and Potoski 2006). Furthermore, viewed from the strategic network point of view, the networks of relationships between the firm and its stakeholders in which firms are embedded in can profoundly influence the conduct and performance of the firms (Gulati et al. 2000).

Pressures from stakeholders include demand for environmentally-friendly products by buyers either through the trend of green consumerism or of greening-the-supply chain; mandate by firm owners and managers, and demand for a clean environment by local communities and environmental groups (Cairncross 1995, Hettige et al. 1996, Pargal and Wheeler 1996, Nakamura et al. 2001, Rivera and De Leon 2005, Ervin et al. 2008). In addition to this, firms may also receive encouragement from the government to adopt ISO 14001. Thus, negative and positive pressures from various stakeholders can make firms more likely to partake in ISO 14001 certification.

Hypothesis 4: Firms which receive more pressures from regulators are more likely to adopt the ISO 14001 certification

Background regulatory threat is one important determinant of VEP participation in developed country studies (Khanna 2001, Khanna and Anton 2002, Lyon and Maxwell 2004). In a model developed by Segerson and Miceli (1998), a firm will choose to participate in a voluntary agreement if there is non-zero legislative threat. Club theory also predicts that more stringent background regulations will result in higher likelihood of participation in voluntary schemes since it reduces the relative cost of participation in such schemes (Prakash and Potoski 2006). In addition to this, pressure for good environmental performance faced by the firm may also depend on facility location (Hettige et al. 1996, Pargal and Wheeler 1996, Gamper-Rabindran 2006, Prakash and Potoski 2006). Firms located in areas with extensive industrial activities are likely to be subject to more scrutiny environmentally than firms located elsewhere. Thus, such firms may be more likely to adopt ISO 14001 certification.

As explained in Chapter 2, such areas of concentrated industrial activities exist throughout Thailand in the form of industrial estates. These areas of designated industrial zones were created throughout the country in order to promote localisation

of factories and to enable factories to share common facilities such as water effluent treatment and solid and hazardous waste disposal facilities. Such areas are usually subject to more stringent monitoring and enforcement, and are easy targets for citizens and/or environmental groups. Thus, firms located in such areas may be more conducive to adopting ISO 14001 to demonstrate their environmental-friendliness.

Objective regulatory pressures on the firms to be environmentally-friendly may also be due to the nature of environmental pollutants the firms emit. Firms emitting many different types of pollutants and firms which primarily produce hazardous waste are usually prime targets of regulators. Thus, regulatory pressures for these firms can be higher.

Hypothesis 5: Firms which are larger in size are more likely to become ISO 14001 certified

Firm size is one firm characteristic that has been cited as an important determinant of voluntary scheme participation for reasons of visibility, deep pockets, and economies-of-scale. Larger firms are more visible to the public and are more likely to suffer more damage from negative public image due to poor environmental practices. Large firms are also more exposed to liabilities (the deep-pockets argument) (Hettige et al. 1996, Pargal and Wheeler 1996, King and Lenox 2000). As a result of this, large firms may participate in ISO 14001 in order to boost their public image, and to reduce compliance or penalty costs (Khanna and Damon 1999, Khanna 2001).

In addition to this, bigger firms are 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. For ISO 14001 which is costly and requires manpower to create and maintain fully-functioning environmental management systems, larger firms with more money and labour are at an advantage. (Arora and Cason 1995, Prakash and Potoski 2006). Thus, it is hypothesised that larger firms are more likely to adopt ISO 14001.

Hypothesis 6: Producers of intermediate products have a higher likelihood of adopting ISO 14001

The type of product produced by the firm can affect participation decision in voluntary programmes. Firms from dirtier industries may want to participate in

voluntary programmes to ensure public acceptance (King and Lenox 2000). In addition to this, for complex process-based voluntary standards such as ISO 14001, customers who understand the implications of the standard better may be those who are other firms. Consumers may care more about environmental labels placed on the product itself, rather than whether or not the firm that produced the products is ISO 14001 certified. Thus, it is hypothesised that firms who are suppliers of other firms, i.e., firms which produce intermediate products, may be more likely to adopt ISO 14001, as opposed to firms which produce final products for consumers.

Hypothesis 7: Firms with previous experience with the ISO 9000 total quality management certification may find it easier to become ISO 14001 certified

Requirements for establishing environmental management systems according to the ISO 14001 standard borrowed extensively from the ISO 9000 total quality management (TQM) standard which came out earlier (Quazi et al. 2001, Casadesús et al. 2008). The two standards are certifiable standards[2] and are designed to follow the same Plan-Do-Check-Act (PCDA) framework. ISO 14001 was also designed to be integrated smoothly into firms' TQM systems. As a result, compared with firms that do not have TQM systems, firms with ISO 9000 already in place have lower knowledge and establishment barriers to overcome in setting up EMSs according to the ISO 14001 standard. In addition to this, the similarities between ISO 9000 and ISO 14001 allow auditors to audit firms for both standards at the same time, saving costs for the firms. Thus, firms with ISO 9000 already in place are more likely to adopt ISO 14001.

Hypothesis 8: Developing country firms facing more obstacles to certification are less likely to participate in the ISO 14001 programme

For firms in the developing world, there are significant barriers to obtaining the ISO 14001 certification. Reasons that have been cited by firms include the high costs of certification, the complicated procedures, the lack of knowledge and personnel, and the limited access to the appropriate technology (TEI 1999). Thus, firms facing these factors are less likely to have ISO 14001 certification.

[2] Not all ISO standards are certifiable. For example, the recently published standard for corporate social responsibility – the ISO 26000 standard, is a guidance standard rather than a certifiable one.

3. Model Specification

3.1. Participation Decision

The firm's decision regarding whether or not to adopt ISO 14001 depends on the latent variable, D_{1i}^{*}, the expected payoff under a voluntary regulatory regime (Segerson and Miceli 1998), such that:

$$D_{1i}^{*} = X_{1i}\beta_1 + \varepsilon_{1i} \qquad \text{Eq. 4.1}$$

Where X_{1i} is a vector of exogenous variables for the i^{th} firm, including adoption of ISO 9000, and β_1 is a vector of parameters. However, D_{1i}^{*} is generally a latent variable that is unobserved. Instead, what is usually observed is the decision to participate, D_{1i}, which depends on D_{1i}^{*} in the following manner:

$$D_{1i} = \mathbb{1}[D_{1i} \geq 0]$$

Assuming that ε_{1i} is normally and independently distributed, the relationship of D_{1i}, X_{1i} and β_1 can be represented by the probit model:

$$D_{1i} = F(X_{1i}\beta_1) + \mu_{1i} \qquad \text{Eq. 4.2}$$

Where F is the cumulative distribution of the standard normal variable ε_{1i} (Maddala 1994).

The dependent variable is a dummy variable for ISO 14001 certification. The variable takes the value of one if the firm is ISO 14001 certified and is zero otherwise.

3.2. Explanatory Variables

Theoretical consideration suggests that both objective and subjective institutional pressures matter to the firm's expected payoffs. Objective pressures are measured using firm characteristics such as FDI, export orientation, size, and product type. Export orientation and presence of FDI are measured by dummy variables 'Export Orientation' and 'Foreign Direct Investment,' which are one if the firm is export-

oriented and has FDI respectively and zero otherwise[3]. Influence of trading with OECD countries and countries with high ISO 14001 certification per capita are captured by the dummy variables 'Export to OECD Countries' and 'Export to ISO 14001-rich Countries', which take the value of one if the firm exports to OECD and ISO 14001-rich countries respectively and are zero otherwise. Influence of FDI from OECD countries and countries with high ISO 14001 adoption rates are proxied by the dummy variables 'Foreign Direct Investment from OECD Countries' and 'Foreign Direct Investment from ISO 14001-rich Countries', which are one if the firm receives FDI from OECD and high-ISO 14001 countries respectively and are zero otherwise. Firm size is measured as the number of employees employed by the firm[4]. However, since there are many independent variables that are binary, firm size was rescaled to have the unit of one-thousand persons. Product type is also a binary variable which is one if the firm produces final products and is zero otherwise[5]. These measures accordingly proxy pressures from foreign investors, overseas consumers, visibility of the firm, and type of buyer.

One other firm characteristic, whether or not the firm has ISO 9000 certification, is also included to control for the differences in knowledge and experience with management systems of firms. Experience with ISO 9000 is binary, taking the value of one if the firm has ISO 9000 certification and zero otherwise.

Regulatory pressures are measured objectively using several variables. The first proxy is firm location – whether or not the firm is located in an industrial estate where there are more stringent environmental regulations. This is a binary variable which is one if the firm is located in an industrial estate, and is zero otherwise. Other measures

[3]These measures are similar to the measure adopted by Christmann and Taylor (2001), Dasgupta et al. (2000), and Henriques and Sadorsky (2006). The percentage of export sales to total sales have also been used to proxy the importance of export markets (Nakamura et al. 2001). However, in order to allow for comparisons between the effects of FDI and export orientation, I have decided to use similar measures for both.

[4]The number of workers the firm employs is a proxy for firm size that has often been used in the existing literature (e.g., Arora and Cason 1995, Nakamura et al. 2001, Prakash and Potoski 2007). This research also adopts this measure here partly to conform with the existing literature and partly because firms are more likely to provide information on how many people they employ as opposed to other measures of firm size such as the firm's registered capital or the value of its assets.

[5]Product type is used to measure the influence of different types of buyers of products. This research follows Khanna and Damon (1999) in using a binary variable to proxy the product's proximity to final consumers. Other papers have used advertising expenditures to proxy the firm's contact with final consumers. However, since many firms in Thailand are exporting firms and many are subsidiaries of MNCs, spending on local advertisements is not a good proxy for contact with final consumers.

include 'Number of Pollutants', which is a dummy variable equal to 1 if the firm reports emission of three or more types of pollution and is zero otherwise, and 'Hazardous Pollutant', yet another dummy equal to 1 for firms who reported hazardous waste as their primary environmental impact and is zero otherwise.

Subjective measures of institutional pressures are constructed from questions that ask firms to state the importance of various stakeholders and to indicate the severity of various obstacles they face. Replies were constructed into two index variables – 'Stakeholders' and 'Obstacles' using principle components analysis. Pressures from stakeholders is an index created by applying the technique to firm responses to questions on factors affecting their decision to adopt better environmental practices such as EMSs. This includes questions on the role of the management, customers, the government, and nearby communities. A measure of obstacles to environmental improvement was also obtained using the same principle components factor analysis technique. This factor was constructed from questions asking firms to rate severity of several factors hindering their environmental improvement including costs, complicated procedures, lack of knowledge and personnel, lack of management support, lack of government support, technological barriers, and lack of support from the general staff [6].

Description of variables and summary statistics for the variables of interest are provided in Table 4.1.

3.3. Estimation Strategy

Estimation of the probit model specified above is complicated by the potential for joint determination of the dummy variables of ISO 9000 and ISO 14001. Since ISO 14001 was modelled on ISO 9000 and both are international management standards, some of the factors included as independent variables on the right hand side for ISO 14001 could also be driving the firm's ISO 9000 certification (Anderson et al. 1999, Quazi et al. 2001, Guler et al. 2002, Casadesús et al. 2008). There could also be unobserved factors driving ISO 14001 certification which could also drive ISO 9000 certification. Thus, in addition to estimating univariate probit models, this potential

[6] This is similar to the methods adopted in Ervin et al. (2008) and Ruiz-Tagle (2003), although both variables used here were not re-scaled to be between 0 and 1.

endogeneity problem is taken into consideration by employing recursive bivariate probit models where ISO 9000 enter into the ISO 14001 participation regression, and ISO 14001 and ISO 9000 participation are estimated simultaneously. To check the robustness of the bivariate probit results, endogenous switching models are also estimated with the dummy variable for ISO 9000 participation serving as the endogenous switch. Thus, in addition to equations 1 and 2 for ISO 14001, there is also a need to add the following equations for ISO 9000 adoption (denoted by D_{2i}).

$$D_{2i}^{*} = X_{2i}\,\beta_2 + \varepsilon_{2i} \qquad \text{Eq. 4.3}$$

Where X_{2i} is a vector of exogenous variables determining the payoff for ISO 9000 adoption for the i^{th} firm, and β_2 is a vector of parameters. D_{2i}^{*} is a latent variable with the following relationship with D_{2i}.

$$D_{2i} = \mathbb{1}\,[\,D_{2i}^{*} \geq 0] \qquad \text{Eq. 4.4}$$

It is assumed that ε_{1i} (from Eq. 4.1) and ε_{2i} are independently and identically distributed and follow the bivariate normal distribution with a correlation coefficient denoted by ρ (Greene 2003, Miranda and Rabe-Hesketh 2006).

As explained in Chapter 3, the primary survey data was drawn based on the dependent variable, 'ISO 14001 Adoption'. Thus, estimation of the econometric models without first correcting for the biased sample would result in inconsistent estimators (Cameron and Trivedi 2005, Hensher et al. 2005). To overcome this problem, Cameron and Trivedi (2005) suggests three methods – Cosslett (1981)'s maximum likelihood estimator (MLE) with endogenous stratification, Imbens (1992)'s generalised method of moments estimator (GMM) with endogenous stratification, and Manski and Lerman (1977)'s weighted exogenous sampling estimator (WESML). Being semi-parametric in nature, the use of GMM is usually computation intensive and may not allow for estimation of the marginal effects (Greene 2003). While classified as a MLE Cosslett (1981)'s method is also semi-parametric and its results are more difficult to implement than Imbens (1992)'s GMM estimator (Cameron and Trivedi 2005). Thus, this paper uses Manski and Lerman (1977)'s WESML estimator. The use of the

WESML estimator is also suggested by Greene (2003) for discrete choice models of data obtained from choice-based sampling[7].

To account for the non-randomness of the data sampling process, Manski and Lerman (1977) suggested that estimating a weighted log likelihood function instead of the usual log likelihood function would result in consistent and asymptotically normal estimates. The weight, w*(k)*, is the share of the population choosing choice *k* divided by the share of the sample choosing *k*, and enters into the likelihood function in the following manner (Stata Corporation 2007):

$$\mathcal{L} = \sum_{i=1}^{N} \left(w(k_i) \ln \Phi(q_{1i}\mathbf{X}_{1i}\beta_1, q_{2i}\mathbf{X}_{2i}\beta_2, \rho_i^*) \right) \qquad \text{Eq. 4.5}$$

Where $q_{1i} = 1$ if $D_{1i} \neq 0$, and

$q_{1i} = -1$ otherwise

$q_{2i} = 1$ if $D_{2i} \neq 0$, and

$q_{2i} = -1$ otherwise

$\rho_i^* = q_{1i} * q_{2i} * \rho$

In the analysis, this weighted likelihood function is used instead of the usual likelihood function to correct for sampling bias.

To determine the effects of FDI and export orientation, the effects of the source of FDI and the influence of the trading partner on ISO 14001 adoption, as well as the effects of different measures of local regulatory pressures, six variations of the same basic model are specified for estimation. Models 1 and 2 look at the aggregate effects of export orientation and FDI by including dummy variables 'Export Orientation' and 'Foreign Direct Investment'. Models 3 and 4 examine the effects of exporting to and receiving investment from ISO 14001-rich countries, while Models 5 and 6 are used to look at the influence of exporting to and receiving FDI from OECD countries. To look at different measures of local regulatory pressures, odd-numbered models include the 'Number of Pollutants' variable, while even-numbered models include the 'Hazardous Pollutant' variable instead.

[7] It should be noted that the WESML estimator is not as efficient as the GMM estimator proposed by Imbens (1992) and the MLE estimator proposed by Cosslett (1981). However, the advantage to using the WESML estimator is its simplicity. Once the weighting has been accounted for, the data can be treated as a random draw from the population and the same analysis applied to randomly drawn data can be applied to the survey data despite the non-random nature of the sampling.

4. Results[8]

Results from the univariate and bivariate probit models are reported in Tables 4.2 – 4.5[9] and indicate that the model specifications are statistically significant at the 1 percent level, but that the values of rho (ρ) are generally not statistically significant, indicating that the endogeneity problem of the ISO 9000 variable is not a serious threat. The results are also consistent across model specifications and estimation strategies. These results indicate that FDI, size, product type, experience with ISO 9000, obstacles, and the number of pollutants a firm emit are all important determinants of ISO 14001 certification.

All three measures of FDI are positive and statistically significant for all model specifications and estimation strategies, indicating that not only is presence of FDI within a company an important determinant of ISO 14001 certification, the source of FDI is also important to the proliferation of ISO 14001. Firms which receive FDI from OECD countries and from countries with a higher number of ISO 14001 certification are more likely to participate in the VEP. Interaction terms between industry variables and FDI are also positive and significant, suggesting that the effect of FDI is important in individual industry as well as on the whole. These results are consistent with qualitative reports from other developing countries (UNRISD 2000, Perry and Singh 2001), and with findings from cross-country studies on the diffusion of ISO 14001 certification (Neumayer and Perkins 2004, Prakash and Potoski 2007, Perkins and Neumayer 2010). These results also lend support to the country-of-origin school of thought that MNCs tend to adopt the environmental practices of their home countries (Langlois and Schlegelmilch 1990, Porter 1990, Sethi and Elango 1990, Pauly and Reich 1997, Zaheer and Zaheer 1997, Van Tulder and Kolk 2001).

Although export orientation is an important part of the Thai economy, the three measures of export orientation are not statistically significant, and there are no significant interaction effects between the export dummy variable and industry

[8] Prior to estimation, all the usual regression diagnostics were performed. Regressions using data from individual industries instead of including them as interacting terms were also estimated as another check for the robustness of results. Results from these regressions confirm the findings presented in this section.

[9] Results from the endogenous switching models are available in Appendix III.

dummies. This indicates that firms which sell directly to foreign markets are not more likely to adopt ISO 14001 in all the three industries of interest. While this result is contrary to our expectation, it can be explained. One possible explanation is that the presence of indirect exporters – firms which produce for domestic customers, but whose intermediate products are inputs into products which are exported. Such firms would also be subjected to similar pressures as the exporting firm and would likely behave like one, leading to the non-significance of the export orientation variable. Results from the 'Final Good' variable supports this explanation. The negative and statistically significant sign of the 'Final Good' variable suggests that, compared with export orientation, direct pressure from the customers downstream in the supply chain has more impact in motivating ISO14001 participation. This is consistent with the evidence from other papers that it was pressures from firms on their suppliers to have ISO certification that led to adoption of ISO 14001 (Bansal and Bogner 2002, Delmas and Montiel 2009).

In addition to this, non-significance of the export orientation variable in the food and beverages, and electronics and electrical appliances industries could be the result of availability of more industry-specific standards which are more important for entering foreign markets such as compliance with the HACCP[10] standard for food safety, and the RoHS[11] and WEEE[12] Directives for electrical appliances[13]. The findings indicate that for developing country firms which usually have limited resources to allocate to standard adoption, compliance with industry-specific standards is more important than investing in ISO 14001 certification. Although there are no standards equivalent to the food industry's HACCP or the electronics industry's RoHS and WEEE standards for the textiles and wearing apparel industry, international attention on the textiles and wearing apparel manufacturing sector has been more concerned with working conditions and payments of living wages to the industrial workers rather than on the industry's environmental impacts (see, e.g., Emmelhainz and Adams 1999, Rosen

[10] HACCP stands for Hazard Analysis and Critical Control Points.

[11] RoHS is short for Restriction on Hazardous Substances and is derived from the name of EU Directive 2002/95/EC (the Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

[12] WEEE stands for Waste Electrical and Electronic Equipment and is the name of EU Directive 2002/96/EC regulating the disposal of electrical and electronic waste.

[13] Although RoHS and WEEE began in Europe, several other countries have adopted similar policies. These countries include Japan, Korea, and China, three countries which are major trading partners with Thai firms.

2002, Pollin et al. 2004, Bartley 2005). Thus, adoption of ISO 14001 may not be as important for firms in this industry.

For perceived pressures from stakeholders, although the sign of coefficients and marginal effects are positive, the measure of stakeholder pressures is not statistically significant. However, the interaction terms between the textiles industry dummy variable and the stakeholders variable is positive and significant at the 5 and 10 percent levels, while the interactions between the electronics dummy and the stakeholders variable are not. These results suggest that the effect of perceived stakeholder pressures vary from industry to industry, with those from the textiles industry having more effects on ISO 14001 certification.

Perceived obstacles, on the other hand, are found to be negative and statistically significant at the 5 percent level for almost all model specifications. This suggests that, for developing country firms, perception that there are high costs associated with ISO 14001 adoption, that there is limited access to the appropriate technology and knowledge, and that there is no support from the government and internal workers often deter firms from adopting certifications such as ISO 14001. The results also indicate that there are no industry-specific effects for obstacles, indicating that these deterrents to ISO 14001 occur across the board for all three industries.

The regression models in this chapter also tests several measures of local regulatory pressures that could be due to the nature of pollutants the firm emits. The measure of number of pollution emitted is positive and statistically significant at the 1 percent level. Being located in an industrial estate and emission of hazardous substances, on the other hand, are generally not statistically significant. These results indicate that being located in industrial estates may not have as much of an effect on ISO 14001 adoption as was previously believed and that the nature of the pollutants the individual emit is more important. The results also show that it is not the type of pollutants the firm emits that matters to ISO 14001 certification, but the number of different types of pollution emitted.

Firm size is found to be positive and statistically significant at the 1 percent level. This finding corroborates with the hypothesis that larger firms are more likely to adopt ISO 14001 certification. The finding is also in keeping with the existing

empirical literature on voluntary environmental programme participation (see, e.g., King and Lenox 2000, Khanna 2001). Several reasons have been proposed as to why firms with larger sizes are more likely to participate in ISO 14001. Larger firms tend to have economies of scale in adopting ISO 14001 due to abundant manpower and capital. Bigger 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, thus, firms with ISO 14001 certification often proudly 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 senior official from the Department of Industrial Works, the government agency responsible for regulating manufacturing facilities in Thailand, disclosed in an interview that firms with ISO 14001 were less targeted for inspection since such firms were already subjected to third-party auditing[14].

Previous experience with ISO 9000 is also positive and statistically significant even after controlling for the possibility of the variable being endogenous. In addition to this, obstacles faced by the firms are also found to be negative and statistically significant with no significant industry interaction effects. These findings suggest that familiarity with similar process-based systems is conducive to VEP adoption, while factors that hamper environmental improvement such as high costs, limited knowledge, shortage of manpower, lack of internal management and personnel support, unavailability of government support, and restricted access to the appropriate technology all conspire to obstruct the firm from participating in the ISO 14001 voluntary programme.

[14] The official did add, however, that ISO 14001 firms would still be subjected to inspections should complaints be made against them.

5. Conclusion

This chapter set out to fill an important gap in the literature on the adoption of voluntary environmental programmes by exploring the determinants for such firm behaviour in the developing world context. The chapter uses the case of firm participation in the ISO 14001 international voluntary standard in Thailand. Based on insights from past theoretical and empirical literature the research especially focuses on the roles played by FDI and export orientation. Both of these factors are posited as being of extreme importance to developing world economies, but have not received much attention in the existing VEP literature. The research also provides an assessment of certain idiosyncratic factors that have been explored in past studies in the more industrialised world including certain firm-specific characteristics (e.g., size, location, product type, experience with ISO 9000, etc.). Three industries, representing the resource-based industry type, the labour-intensive type, and the engineering industry type, are the subject of this analysis. The research also makes use of a novel primary survey data of firms in Thailand.

Findings from this study confirm that FDI is an important factor determining ISO 14001 participation and that it is important regardless of industry. The study also finds evidence in support of the country-of-origin school of thought since firms which receive FDI originating from OECD countries and countries with higher numbers of ISO 14001 certification are found to be more likely to participate in ISO 14001. Export orientation, on the other hand, is not found to be an important determinant of programme participation. This could be due to the presence of indirect exporters as well as due to the availability of other more industry-specific certifications. Firm size, number of pollutants emitted, product type, and experience with ISO 9000 certification are significant determinants of ISO 14001 adoption, while factors which hinder environmental improvement also serve to obstruct participation in the VEP.

By using econometric analysis and data from a survey administered in a newly industrialising economy this chapter has shed some light on the reasons why firms located in such countries sign up for the ISO 14001 international voluntary programme in the presence of weak domestic regulatory and market pressures. The chapter has demonstrated that there are some determinants and deterrents to ISO 14001 which are, indeed, unique to developing country firms.

Table 4.1: Description of Variables and Summary Statistics

Variables	Description	Mean	S.D.	Min	Max
ISO 14001 Adoption	Dummy variable equals to 1 for firms with ISO 14001 certification and is 0 otherwise.	0.38	0.49	0	1
ISO 9000 Adoption	Dummy variable equals to 1 for firms with ISO 9000 certification and is 0 otherwise.	0.59	0.49	0	1
Firm Size	Number of employees in a firm. The unit is one-thousand persons.	0.70	1.75	0.005	29.416
Foreign Direct Investment	Dummy variable equals to 1 for firms with foreign direct investment (FDI) and is 0 otherwise.	0.37	0.48	0	1
Export Orientation	Dummy variable equals to 1 for firms which export and is 0 otherwise.	0.70	0.46	0	1
Foreign Direct Investment from ISO 14001-rich Countries	Dummy variable equals to 1 for firms which receive FDI from countries with high ISO 14001 adoption and is 0 otherwise.	0.26	0.44	0	1
Export to ISO 14001-rich Countries	Dummy variable equals to 1 for firms which export to countries with high ISO 14001 adoption and is 0 otherwise.	0.40	0.49	0	1
Foreign Direct Investment from OECD Countries	Dummy variable equals to 1 for firms which receive FDI from OECD countries and is 0 otherwise.	0.30	0.46	0	1
Export to OECD Countries	Dummy variable equals to 1 for firms which export to OECD countries and is 0 otherwise.	0.45	0.50	0	1
Location in Industrial Estate	Dummy variable equals to 1 for firms located in an industrial estate or industrial park and is 0 otherwise.	0.24	0.43	0	1
Final Goods	Dummy variable equals to 1 for firms which produce final goods and is 0 otherwise.	0.62	0.49	0	1
Number of Pollutants	Dummy variable equals to 1 for firms which emit three or more types of pollutants and is 0 otherwise.	0.49	0.50	0	1

Variables	Description	Mean	S.D.	Min	Max
Hazardous Pollutant	Dummy variable equals to 1 for firms which rank hazardous waste as their top pollutant and is 0 otherwise.	0.21	0.41	0	1
Stakeholders	Index variable proxying perceived pressures from stakeholders constructed using principle component analysis.	-0.01	1.92	-6.91	2.38
Obstacles	Index variable proxying perception on obstacles to environmental improvement constructed using principle component analysis.	-0.05	1.88	-4.61	2.82
Export*Textiles	Interaction term generated by multiplying export orientation with the dummy variable for firms in the textiles and wearing apparel industry.	0.17	0.38	0	1
Export*Electronics	Interaction term generated by multiplying export orientation with the dummy variable for firms in the electronics and electrical appliances industry.	0.29	0.45	0	1
Foreign Direct Investment* Textiles	Interaction term generated by multiplying FDI with the dummy variable for firms in the textiles and wearing apparel industry.	0.06	0.24	0	1
Foreign Direct Investment*Electronics	Interaction term generated by multiplying FDI with the dummy variable for firms in the electronics and electrical appliances industry.	0.26	0.44	0	1
Stakeholders*Textiles	Interaction term generated by multiplying Stakeholders with the dummy variable for firms in the textiles and wearing apparel industry.	-0.02	0.52	0	1
Stakeholders*Electronics	Interaction term generated by multiplying Stakeholders with the dummy variable for firms in the electronics and electrical appliances industry.	0.03	0.68	0	1
Obstacles*Textiles	Interaction term generated by multiplying Obstacles with the dummy variable for firms in the textiles and wearing apparel industry.	0.06	0.54	0	1
Obstacles*Electronics	Interaction term generated by multiplying Obstacles with the dummy variable for firms in the electronics and electrical appliances industry.	-0.05	0.65	0	1

Table 4.2: Bivariate Probit Regression: ISO 14001 Equation

	(1)	(2)	(3)	(4)	(5)	(6)
Export Orientation	-0.004	-0.085				
	(0.240)	(0.239)				
Foreign Direct Investment	0.524**	0.402*				
	(0.233)	(0.224)				
Export to ISO 14001-rich Countries			-0.029	-0.034		
			(0.138)	(0.134)		
Foreign Direct Investment From ISO 14001-rich Countries			0.394*	0.370*		
			(0.204)	(0.197)		
Export to OECD Countries					0.138	0.084
					(0.133)	(0.127)
Foreign Direct Investment from OECD Countries					0.494**	0.461**
					(0.204)	(0.198)
Firm Size	0.27***	0.280***	0.279***	0.287***	0.294***	0.308***
	(0.090)	(0.091)	(0.090)	(0.092)	(0.083)	(0.084)
Location in Industrial Estate	-0.035	0.013	-0.014	0.003	-0.035	-0.019
	(0.179)	(0.173)	(0.176)	(0.176)	(0.180)	(0.179)
Final Goods	-0.33**	-0.378**	-0.363**	-0.406**	-0.371**	-0.414**
	(0.164)	(0.166)	(0.168)	(0.165)	(0.170)	(0.166)
ISO 9000 Adoption	1.08***	1.173***	1.003**	1.127**	0.895**	0.974**
	(0.415)	(0.437)	(0.447)	(0.464)	(0.421)	(0.462)
Stakeholders	0.016	0.044	-0.008	0.019	-0.002	0.025
	(0.062)	(0.059)	(0.050)	(0.049)	(0.052)	(0.050)
Obstacles	-0.10**	-0.093*	-0.109**	-0.107**	-0.114**	-0.112**
	(0.048)	(0.049)	(0.050)	(0.050)	(0.049)	(0.049)
Number of Pollutants	0.40***		0.317**		0.344***	
	(0.140)		(0.126)		(0.126)	
Hazardous Pollutants		0.266*		0.227		0.217
		(0.153)		(0.153)		(0.152)
Textiles	0.528	0.353	0.384	0.322	0.434	0.322
	(0.326)	(0.323)	(0.305)	(0.314)	(0.290)	(0.296)
Electronics	1.00***	0.874***	0.914***	0.885***	0.991***	0.935***

	(1)	(2)	(3)	(4)	(5)	(6)
	(0.336)	(0.328)	(0.296)	(0.290)	(0.294)	(0.284)
Export*Textiles	-0.309	-0.164	-0.232	-0.193	-0.350	-0.252
	(0.345)	(0.348)	(0.287)	(0.292)	(0.286)	(0.286)
Export*Electronics	0.196	0.239	0.197	0.162	0.112	0.112
	(0.338)	(0.332)	(0.278)	(0.278)	(0.272)	(0.267)
Foreign Direct Investment*Textiles	0.459	0.679*	0.680*	0.792**	0.463	0.600*
	(0.390)	(0.377)	(0.352)	(0.348)	(0.357)	(0.349)
Foreign Direct Investment*Electronics	0.468	0.450	0.679***	0.599**	0.592**	0.508**
	(0.297)	(0.304)	(0.256)	(0.250)	(0.251)	(0.244)
Stakeholders*Textiles	0.459*	0.417*	0.501**	0.466**	0.502**	0.465**
	(0.238)	(0.227)	(0.227)	(0.220)	(0.229)	(0.218)
Stakeholders* Electronics	0.134	0.078	0.148	0.094	0.139	0.083
	(0.163)	(0.163)	(0.152)	(0.153)	(0.154)	(0.153)
Obstacles*Textiles	-0.004	0.011	-0.015	0.004	0.027	0.032
	(0.153)	(0.154)	(0.157)	(0.158)	(0.152)	(0.152)
Obstacles*Electronics	-0.059	-0.031	-0.008	0.019	-0.005	0.018
	(0.142)	(0.142)	(0.144)	(0.143)	(0.142)	(0.141)
Constant	-4.01***	-3.73***	-3.79***	-3.67***	-3.84***	-3.64***
	(0.365)	(0.344)	(0.379)	(0.376)	(0.390)	(0.400)
N	494	494	494	494	494	494
χ^2	277.2***	281.8***	265.5***	257.7***	272.1***	261.4***
Rho	0.21	0.16	0.24	0.18	0.33*	0.29

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level

Table 4.3: Bivariate Probit Regression: ISO 9000 Equation

	(1)	(2)	(3)	(4)	(5)	(6)
Export Orientation	0.624**	0.624**				
	(0.297)	(0.297)				
Foreign Direct Investment	0.067	0.067				
	(0.330)	(0.330)				
Export to ISO 14001-rich Countries			-0.052	-0.053		
			(0.252)	(0.253)		
Foreign Direct Investment from ISO 14001-rich Countries			0.239	0.239		
			(0.408)	(0.408)		
Export to OECD Countries					0.220	0.220
					(0.241)	(0.241)
Foreign Direct Investment From OECD Countries					-0.031	-0.031
					(0.390)	(0.390)
Final Goods	0.013	0.013	0.028	0.028	0.003	0.003
	(0.318)	(0.318)	(0.343)	(0.343)	(0.346)	(0.346)
Firm Size	0.709**	0.709**	0.836**	0.836**	0.760**	0.760**
	(0.317)	(0.317)	(0.331)	(0.331)	(0.316)	(0.316)
Textiles	-0.519	-0.519	-0.995***	-0.995***	-0.919***	-0.918***
	(0.345)	(0.345)	(0.298)	(0.298)	(0.298)	(0.298)
Electronics	0.344	0.344	-0.100	-0.100	-0.048	-0.048
	(0.376)	(0.376)	(0.348)	(0.348)	(0.348)	(0.348)
Export*Textiles	-0.278	-0.279	0.330	0.330	0.165	0.165
	(0.423)	(0.423)	(0.362)	(0.362)	(0.369)	(0.369)
Export*Electronics	-0.106	-0.106	0.506	0.507	0.387	0.387
	(0.414)	(0.415)	(0.335)	(0.335)	(0.330)	(0.330)
Foreign Direct Investment*Textiles	-0.452	-0.452	-0.514	-0.514	-0.360	-0.360
	(0.532)	(0.517)	(0.505)	(0.504)	(0.554)	(0.554)
Foreign Direct Investment*Electronics	-0.077	-0.078	-0.152	-0.154	0.0002	-0.0007
	(0.426)	(0.426)	(0.379)	(0.379)	(0.393)	(0.393)
Constant	-0.86**	-0.86**	-0.428	-0.428	-0.465	-0.465
	(0.376)	(0.376)	(0.367)	(0.367)	(0.368)	(0.368)

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level

Table 4.4: Marginal Effects from ISO 14001 Bivariate Probit Regression

	(1)	(2)	(3)	(4)	(5)	(6)
Export Orientation	-0.001	-0.003				
	(0.003)	(0.004)				
Foreign Direct Investment	0.010	0.009				
	(0.007)	(0.007)				
Export to ISO 14001-rich Countries			-0.0003	-0.0004		
			(0.002)	(0.002)		
Foreign Direct Investment From ISO 14001-rich Countries			0.007	0.008		
			(0.006)	(0.006)		
Export to OECD Countries					0.001	0.001
					(0.002)	(0.002)
Foreign Direct Investment from OECD Countries					0.011	0.013
					(0.008)	(0.008)
Firm Size	0.002*	0.003**	0.002*	0.003**	0.002*	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Location in Industrial Estate	-0.0004	0.0002	-0.0002	0.0001	-0.0004	-0.0003
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Final Goods	-0.006	-0.009	-0.008	-0.010	-0.007	-0.010*
	(0.004)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
ISO 9000 Adoption	0.004***	0.005***	0.004***	0.005***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Stakeholders	0.0002	0.0007	-0.0001	0.0003	0.0000	0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Obstacles	-0.001**	-0.001*	-0.002**	-0.002**	-0.002**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of Pollutants	0.005***		0.005**		0.005**	
	(0.002)		(0.002)		(0.002)	
Hazardous Pollutant		0.005		0.004		0.004
		(0.004)		(0.004)		(0.004)
Textiles	0.015	0.010	0.014	0.011	0.017	0.013
	(0.014)	(0.011)	(0.012)	(0.011)	(0.014)	(0.012)
Electronics	0.041	0.036	0.041	0.042	0.048	0.047

	(1)	(2)	(3)	(4)	(5)	(6)
	(0.031)	(0.028)	(0.028)	(0.028)	(0.032)	(0.030)
Export*Textiles	-0.003	-0.002	-0.003	-0.003	-0.003*	-0.003
	(0.002)	(0.004)	(0.002)	(0.003)	(0.002)	(0.002)
Export*Electronics	0.003	0.005	0.002	0.002	0.001	0.001
	(0.008)	(0.010)	(0.005)	(0.006)	(0.004)	(0.005)
Foreign Direct Investment*Textiles	0.013	0.028	0.028	0.039	0.014	0.024
	(0.018)	(0.030)	(0.028)	(0.034)	(0.018)	(0.025)
Foreign Direct Investment*Electronics	0.011	0.012	0.024	0.021	0.017	0.015
	(0.013)	(0.014)	(0.019)	(0.017)	(0.015)	(0.014)
Stakeholders*Textiles	0.006*	0.006*	0.007**	0.007**	0.007**	0.007**
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Stakeholders* Electronics	0.002	0.001	0.002	0.001	0.002	0.001
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Obstacles*Textiles	-0.0001	0.0002	-0.0002	0.0001	0.0003	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Obstacles*Electronics	-0.0007	-0.0005	-0.0001	0.0003	-0.0001	0.0003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level

Table 4.5: Univariate Probit Regression: ISO 14001 Equation

	(1)	(2)	(3)	(4)	(5)	(6)
Export Orientation	-0.099	-0.156				
	(0.238)	(0.228)				
Foreign Direct Investment	0.530**	0.406*				
	(0.243)	(0.232)				
Export to ISO 14001-rich Countries			-0.035	-0.039		
			(0.146)	(0.141)		
Foreign Direct Investment From ISO 14001-rich Countries			0.380*	0.358*		
			(0.214)	(0.206)		
Export to OECD Countries					0.099	0.050
					(0.143)	(0.137)
Foreign Direct Investment from OECD Countries					0.525**	0.487**
					(0.218)	(0.211)
Firm Size	0.228***	0.248***	0.232***	0.248***	0.235***	0.252***
	(0.081)	(0.079)	(0.081)	(0.080)	(0.080)	(0.078)
Location in Industrial Estate	-0.037	0.013	-0.016	0.003	-0.041	-0.022
	(0.182)	(0.175)	(0.181)	(0.178)	(0.188)	(0.184)
Final Goods	-0.339*	-0.383**	-0.377**	-0.416**	-0.385**	-0.426**
	(0.173)	(0.174)	(0.174)	(0.172)	(0.175)	(0.173)
ISO 9000 Adoption	1.438***	1.442***	1.419***	1.437***	1.482***	1.488***
	(0.235)	(0.234)	(0.238)	(0.235)	(0.247)	(0.241)
Stakeholders	0.019	0.046	-0.005	0.020	0.0002	0.027
	(0.062)	(0.059)	(0.051)	(0.049)	(0.054)	(0.051)
Obstacles	-0.099**	-0.094*	-0.111**	-0.108**	-0.117**	-0.113**
	(0.049)	(0.049)	(0.051)	(0.050)	(0.050)	(0.050)
Number of Pollutants	0.394***		0.312**		0.343***	
	(0.142)		(0.129)		(0.131)	
Hazardous Pollutant		0.267*		0.228		0.221
		(0.154)		(0.155)		(0.156)
Textiles	0.601*	0.410	0.546*	0.446	0.653**	0.516*
	(0.342)	(0.333)	(0.291)	(0.289)	(0.294)	(0.288)
Electronics	0.970***	0.850**	0.959***	0.917***	1.060***	0.992***
	(0.358)	(0.345)	(0.312)	(0.301)	(0.318)	(0.305)

	(1)	(2)	(3)	(4)	(5)	(6)
Export*Textiles	-0.294	-0.153	-0.317	-0.257	-0.448	-0.339
	(0.366)	(0.364)	(0.297)	(0.298)	(0.306)	(0.304)
Export*Electronics	0.214	0.252	0.117	0.101	0.014	0.026
	(0.362)	(0.349)	(0.293)	(0.286)	(0.302)	(0.291)
Foreign Direct Investment*Textiles	0.545	0.739*	0.800**	0.875**	0.600	0.715*
	(0.413)	(0.396)	(0.363)	(0.355)	(0.381)	(0.369)
Foreign Direct Investment* Electronics	0.476	0.454	0.702***	0.615**	0.603**	0.515*
	(0.316)	(0.319)	(0.272)	(0.262)	(0.277)	(0.268)
Stakeholders* Textiles	0.447*	0.406*	0.490**	0.455**	0.496**	0.456**
	(0.240)	(0.228)	(0.228)	(0.221)	(0.235)	(0.223)
Stakeholders* Electronics	0.126	0.072	0.139	0.088	0.131	0.076
	(0.165)	(0.165)	(0.155)	(0.155)	(0.158)	(0.158)
Obstacles*Textiles	0.002	0.015	-0.008	0.009	0.039	0.043
	(0.154)	(0.154)	(0.159)	(0.159)	(0.157)	(0.156)
Obstacles* Electronics	-0.057	-0.030	-0.002	0.023	0.003	0.025
	(0.143)	(0.143)	(0.146)	(0.144)	(0.146)	(0.145)
Constant	-4.13***	-3.81***	-4.02***	-3.83***	-4.18***	-3.94***
	(0.338)	(0.314)	(0.291)	(0.286)	(0.302)	(0.286)
N	494	494	494	494	494	494
χ^2	181.9***	179.8***	184.5***	174.6***	183.6***	169.8***
Pseudo R^2	0.4233	0.4167	0.4202	0.4158	0.4253	0.4196

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level

Table 4.6: Marginal Effects from ISO 14001 Univariate Probit Regression

	(1)	(2)	(3)	(4)	(5)	(6)
Export Orientation	-0.0001	-0.0002				
	(0.0003)	(0.0004)				
Foreign Direct Investment	0.001	0.001				
	(0.001)	(0.001)				
Export to ISO 14001-rich Countries			0.00004	-0.0001		
			(0.0002)	(0.0002)		
Foreign Direct Investment From ISO 14001-rich Countries			0.001	0.001		
			(0.001)	(0.001)		
Export to OECD Countries					0.0001	0.0001
					(0.0002)	(0.0002)
Foreign Direct Investment from OECD Countries					0.001	0.001
					(0.001)	(0.001)
Firm Size	0.0002	0.0003*	0.0003*	0.0004*	0.0002	0.0003*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Location in Industrial Estate	0.00004	0.00002	0.00002	0.000004	0.00004	0.00003
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)
Final Goods	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ISO 9000 Adoption	0.004***	0.005***	0.005***	0.005***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Stakeholders	0.00002	0.0001	0.000006	0.00003	0.0000002	0.00003
	(6.5e-5)	(8.2e-5)	(6.3e-5)	(6.9e-5)	(5.4e-5)	(6.2e-5)
Obstacles	-0.0001	-0.0001	-0.0001	-0.0002	-0.0001	-0.0001
	(6.9e-5)	(8.5e-5)	(8.5e-5)	(9.5e-5)	(7.2e-5)	(8.5e-5)
Number of Pollutants	0.0005		0.0004		0.0004	
	(0.0003)		(0.0003)		(0.0003)	
Hazardous Pollutant		0.0005		0.0004		0.0004
		(0.0005)		(0.0004)		(0.0004)
Textiles	0.002	0.001	0.002	0.001	0.002	0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Electronics	0.006	0.005	0.006	0.006	0.007	0.007
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)
Export*Textiles	-0.0002	-0.0002	-0.0003	-0.0003	-0.0002	-0.0003

	(1)	(2)	(3)	(4)	(5)	(6)
	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Export*Electronics	0.0003	0.0005	0.0002	0.0002	0.00002	0.00003
	(0.0008)	(0.0011)	(0.0005)	(0.0006)	(0.0003)	(0.0004)
Foreign Direct Investment*Textiles	0.002	0.004	0.004	0.006	0.002	0.003
	(0.002)	(0.005)	(0.004)	(0.006)	(0.002)	(0.004)
Foreign Direct Investment*Electronics	0.001	0.001	0.003	0.003	0.002	0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Stakeholders*Textiles	0.0005	0.0005	0.0006	0.0006	0.0005	0.0006
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0004)
Stakeholders* Electronics	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Obstacles*Textiles	0.000002	0.00002	0.000009	0.00001	0.00004	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Obstacles*Electronics	-0.0001	0.00004	0.000002	0.00003	0.000003	0.00003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
N	494	494	494	494	494	494

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level

CHAPTER 5

PRIVATE BENEFITS TO PARTICIPATION: ASSESSING MOTIVES TO PARTICIPATE IN ISO 14001

1. Introduction

The rise of voluntary environmental programme adoption in the developing world context where there are few regulations and often limited regulatory capacity is a conundrum that is the subject of this dissertation. The previous chapter (Chapter 4) examines and identifies, by means of microeconometrics, the factors and characteristics of developing country firms that make them more conducive to investing in ISO 14001 certification. The participation model of Chapter 4 builds on a latent class structure and assumes that firms are observed to participate in ISO 14001 when there are positive expected net benefits from programme adoption. However, the model assumes latent rather than observed benefits. This chapter complements the previous one by bringing these benefits to the fore, and assesses the effects of ISO 14001 certification on various measures of private benefits accruing to the developing country firm.

The question of private benefits to VEP participation has often been sidelined in the environmental economics literature (Khanna 2001, Rivera 2002), preferring, perhaps, to leave such topics to the business and management ones (Rivera 2002). However, as Rivera (2002) also points out, the voluntary nature of such schemes makes such assessments extremely pertinent in gauging the ability of such programmes to sustain itself in the long run. This chapter directly addresses this issue in the context of Thailand by looking at short-term and long-term consequences to ISO 14001 adoption.

To address this question of private firm benefits to VEP participation, the research makes use of a panel dataset constructed from the government's annual industrial survey for detailed econometric analysis of the financial impacts of ISO 14001 adoption. To control for potential bias from self-selection in treatment based on

expected gains, the analysis uses Hausman and Taylor's (1981) hybrid estimators. The econometric analysis is then complemented by information from ISO 14001 adopters from the three industries of interest obtained from the primary survey to provide a more complete picture of the benefits accruing to firms from ISO 14001 adoption.

By tackling the question of private benefits to ISO 14001 certification, the chapter contributes to the VEP literature in the following ways. First, the chapter addresses a topic that has often been neglected in this literature in the developing world context where the majority of firms are not listed in the stock market. Second, the study extends the few pieces of existing works on the subject by looking at the effect of financial performance over different time horizons and by looking separately at the effect of adoption on profitability, total sales, export sales, production costs, and general business conditions. Third, this study combines the strengths of econometric and qualitative analyses by utilising two survey datasets, one a seven-year panel data providing detailed firm financial information and the other a unique primary survey dataset specifically designed for the study of ISO 14001 adoption. Fourth, the research considers three types of industries that represent the range of industrial activities found in many developing countries - the more traditional resource based and labour-intensive industries, and the high-technology engineering industries. Lastly, the econometric analysis section of this research is one of the first of its kind in this literature to directly address the problem of potential biases in results due specifically to unobserved individual heterogeneity, the main threat underlying the estimation of treatment effects of programmes where firms voluntarily apply for treatment.

The chapter begins by giving the readers an idea of the costs involved in adopting voluntary measures, and goes on to draw from the economic and business/management literature to provide theoretical explanations for sources of positive returns to environmental investment. The chapter then reviews the existing empirical evidence on VEP adoption and firm financial performance before empirically assessing the financial sustainability of ISO 14001 adoption in the Thai context using a unique set of financial variables from a government survey of industrial firms, and complements this with information from ISO 14001 adopters from the primary survey. Finally, the conclusion section closes off the chapter.

2. Costs of Voluntary Compliance

Compliance with environmental regulations imposes direct costs on the firms. Since environmental impacts are negative externalities, requiring firms to internalise them necessarily incurs abatement costs in the form of equipment purchases, investments in environmentally-friendly processes, and expenditures in environmental research and development. In the case of ISO 14001 certification, firms have to bear the costs of establishing and implementing the environmental management system (EMS), pay certification fees, and expend on hiring consultants and auditors. To establish an EMS that is up to ISO 14001 standards, firms often have to spend on new equipment, infrastructure improvement, process and/or equipment modification, new technology, training, and additional staff. Furthermore, to obtain the stamp of approval and bear the ISO 14001 insignia there are added consultant fees and assessment costs.

Cost estimates of ISO 14001 certification vary from company to company. Kolk (2000) puts the estimate at around 25,000 to 100,000 US Dollars per facility, while Bansal and Bogner (2002) estimates a wider range of 10,000 to 200,000 US Dollars. However, as Prakash and Potoski (2006) points out, costs can be significantly higher for larger firms. Citing information from an EPA officer, Prakash and Potoski (2006) quotes an estimate of 1 million US Dollars in sunk costs for large firms applying for ISO 14001 certification in the United States. In an international survey of ISO 14001 firms that span 15 countries, Raines (2002) finds that average certification costs do not vary much between firms in newly industrialising economies and firms in industrialised countries. For NIE firms, average certification costs is 76,975 US Dollars[1,2], while for industrialised countries the estimate is 82,102 US Dollars. However, the estimated certification costs for lower income developing countries can be lower. Mbohwa and Fukada (2002) estimates that it costs Zimbabwean firms approximately 30,000 US Dollars to become fully ISO 14001 certified.

For firms in Thailand choosing to certify with local certification bodies, certification costs typically range from 40,000 to 80,000 Thai Baht for the first year, and from 20,000 to 40,000 Baht annually for subsequent years for maintenance of the

[1] The estimate for Chinese firms is slightly lower – at 58,111 US Dollars. For an explanation of this lower figure see Raines et al. (2002).

[2] The developing countries sampled include Malaysia, Mexico Argentina, Colombia, Ecuador, and Indonesia, but not Thailand.

certification[3,4]. In addition to this, firms also have to expend on non-certification costs associated with the establishment of EMSs, which can include the procurement of new equipment, the employment of additional staff, fees for the services of EMS consultants, and costs of staff training. When these costs are combined, the total cost estimate for certified firms in Thailand is in excess of 1 million Baht (33,560 US Dollars) (TEI 1999, Sutthanund 2000). Costs are even higher for larger firms. One such firm in the electronics sector reports spending almost 50 million Baht (1.7 million US Dollars) to become one of the first firms in the country to be ISO 14001 certified (TEI 1999).

In addition to requiring substantial initial financial investments, ISO 14001 certification also takes time. An early survey of certified firms in Thailand reports that while most of the early adopters took less than one year to become fully certified, for some firms the process took more than 2 years to complete (TEI 1999). A survey of Chinese firms conducted by the China Center on EMS and the United Nations Centre for Regional Development (UNCRD) in the same year also reports similar results. In this report, Chinese firms replied that EMS implementation and subsequent certification takes a total of 7 – 12 months (Matouq 2000). The average reported for Chinese firms in the Raines et al. (2002) survey is 10 months, while the average for all the developing country firms surveyed is 14.5 months.

From this brief review, it is evident that ISO 14001 certification is a costly and time-consuming process, especially for firms in developing countries which may not have access to the necessary infrastructure to obtain ISO 14001 certification. Despite this, the annual number of certifiers in the developing world has been steadily increasing since the programme's inception (ISO 2001, 2003, 2006, 2007, 2009, 2010). Theoretical explanations for such firm behaviour are explored in the next section, and the channels through which firms stand to reap positive returns from voluntary environmental investment are identified.

[3] Figures from personal correspondence with an officer at one of the country's official certification bodies. Foreign companies offering certification services typically charge higher fees than local certification bodies.

[4] In 2011, the exchange rate is 29.9 Thai Baht to 1 US Dollar.

3. Theoretical Explanations for Voluntary Adoption

In neoclassical economic theory, adoption of voluntary environmental programmes is, *prima facie*, an anomaly. Expenditures towards environmental improvements are traditionally seen as costly and non-productive investments (Ambec et al. 2010) and it follows from this reasoning that firms should not be willing to do more than the minimum required (Blinder 1988). For developing countries, which typically have low regulatory requirements and limited capacity for monitoring and enforcement, the expectation is that pollution emissions will be unconstrained (Hettige et al. 1996). Yet this has not been the case. On the contrary, there is evidence that developing country firms have been steadily improving their environmental performance (Hettige et al. 1996, Luken and Rompaey 2007), and voluntary environmental initiatives are taking off in the developing world (UNRISD 2000, Brink 2002, Blackman 2008, ISO 2010). This section explores the business, management, and environmental economics literature to identify channels through which firms can reap positive benefits from investing in environmental improvement.

3.1. Profit-Maximisers and Voluntary Participation

Standard microeconomic assumptions of profit maximising firms and perfect competition indicate the firms investing in more environmental improvements than required would be uncompetitive compared with competitors operating at lower costs. However, in a world where products are not homogenous and firm behaviour can influence regulations, there is room for firms to benefit from investing in environmental attributes.

In the nascent VEP literature, there has been a focus on the role of regulations as a channel through which participation in VEPs can be advantageous to firms. Regulatory influence theory suggests that firms do not always take regulations as given as the conventional economic literature assumes. Rather, firms often take action to influence or manipulate the regulatory system (Welch et al. 2002). In a world where political lobbying efforts matter, 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 favour. In such environments, firms which move first to adopt environmentally advanced practices can influence future

regulations in their favour and put their competitors at a cost disadvantage (Salop and Scheffman 1983, Lutz et al. 2000, Maxwell et al. 2000, Lyon and Maxwell 2002, Lyon and Maxwell 2004). Multinational companies operating in developing countries are especially equipped to do so. With superior resources, technology and expertise, MNCs are well-placed to offer assistance to local governments and indirectly influence environmental policy (Child and Tsai 2005).

Imperfect market conditions are often the norm in the developing world where the conditions and institutions which ensure perfect competition and well-functioning markets often have limited capacities or are underdeveloped (Eskeland and Jimenez 1992, Turner et al. 1994). Ironically, when such conditions are prevalent, firms have better chances of gaining economic rents from investing in voluntary environmental improvement. In the Salop and Scheffman (1983) model, moving to influence regulations only accrues benefits to firms in oligopolistic markets. Considering a two-stage duopoly model where products are homogeneous except in the environmental impact from their productions, Arora and Gangopadhyay (1995) also finds that 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 shares. Association with the ISO 14001 brand can help firms reap positive benefits in this regard since the reputation of the certification provides stakeholders with environmental information (Auriol and Schilizzi 2003, King et al. 2005, Johnstone and Labonne 2009). Thus, despite the costs of reducing the product's environmental impact, firms can be compensated by sustained profits in the long run.

One other avenue for positive returns to environmental investments occurs when there is monopolistic competition in the market. While such markets retain many features of the perfectly competitive market such as the presence of many buyers and sellers, and easy entry and exit of firms, the market structure assumes firms produce differentiated products which are close substitutes for the products of their peers. Product variation allows different prices to be charged which then allow the market to tap into the different consumption preferences of the consumers. In the modern world where more and more people are concerned about the environmental consequences of their consumption behaviour, there is growing demand for environmentally friendly

products (Mainieri et al. 1997). Since preference for a clean environment is often associated with the well-to-do, 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 consumers [5] (Cairncross 1995).

When information is imperfect, there are also avenues for firms to obtain positive returns to environmental investments. Environmental attributes of products are credence goods, leading to an information asymmetry problem between the purchasers and producers of the product. To overcome the problem, firms can take environmentally progressive steps to establish a reputation as an environmentally friendly firm and reap the benefits from such a reputation (Cavaliere 2000)[6]. By investing in obtaining the internationally known ISO 14001 certification, firms reap the benefits associated with the reputation of the ISO 14001 'brand' and can differentiate themselves from their competitors.

The firm's environmental reputation also plays an important role in enhancing the firm's competitive advantage in the resource based view of the firm. In this view, investments in environmental improvements can generate persistent above-normal returns so long as the investment is sufficiently unique (Conner 1991). Rivera (2002) applies this view to the context of voluntary environmental programme adoption and further specifies two conditions under which participation in VEPs can generate competitive advantages for the firm. First, consumers must have preferences for environmentally friendly goods. Second, the firm's associated environmental reputation must be credible. Fulfilment of these conditions can allow firms to charge higher prices and/or achieve higher sales.

In a world of imperfect information, the firm's management has an important role to play in exploring uncertain possibilities that could enhance the firm's profitability (Demsetz 1988). Because there are hidden opportunities that remain to be uncovered within firms, Porter and Van der Linde (1995) theorises that in the face of flexible environmental regulations, firms will be spurred to innovate in ways that could

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

[6] In the Cavaliere (2000) model, this is the result of a repeated, but finite game between a monopolist and consumers.

generate positive financial benefits[7]. This point is also propounded in Lankoski (2008) which suggests that adoption of certain corporate responsibility practices can help firms which are operating inefficiently due to imperfect information reduce costs and become more streamlined.

3.2. Non-Profit-Maximising Behaviour and Voluntary Participation

The decision to adopt voluntary environmental programmes can also be driven by utility maximisation behaviour rather than profit maximisation. In the traditional neoclassical economic framework, firms are treated as cohesive units or quasi-individuals, whose main objectives are to maximise profits (Heyer et al. 2002). In reality, however, firms are comprised of individuals who play different roles within the firm. The firm's management is comprised 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 maximising profits (Griffiths and Wall 2001). Indeed, in a study of ISO 14001 adoption in Japan, Nakamura et al. (2001) finds that a model of utility maximisation provides a better explanation of adoption than a model based purely on profit maximisation. This finding is also in keeping with the literature on the theory of management of the firm (Becker 1957, Williamson 1964, Alchian 1965).

While profit maximisation takes only the costs and benefits firms face into account, utility maximisation incorporates the idea that the values and beliefs of the firm's management influences firm behaviour. However, the two objectives need not be in conflict with one another. An environmentally-conscious manager may endorse voluntary programmes 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 et al. 2008).

Firms may also be maximising 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

[7] The Porter Hypothesis has been extensively debated since its inception. For further readings on this topic see, e.g., Palmer et al. (1995), Xepapadeas and de Zeeuw (1999), Lanoie et al. (2007, 2008) and Ambec et al. (2010)

correlated to sales revenue rather than profits, firms which are run by managers have a tendency to maximise sales revenues. Williamson (1964) also points out that managers prefer to maximise sales revenues because doing so is the easiest means of providing additional funds for them to work with. Thus, managers who want to increase satisfaction by spending more on such things as staff and projects will want to maximise sales revenues by engaging in product differentiation.

4. Existing Evidence on the Relationship Between Firm Financial Performance and Environmental Performance Measures

Despite the global popularity of ISO 14001 programmes, detailed assessments of its financial implications are rare. Of the works that do exist, the majority are concentrated in the management and manufacturing literature. On the other hand, such studies are extremely scarce in the voluntary environmental programme literature with existing works primarily focused on finding determinants of firm participation, and on the subsequent assessment of environmental impacts from programme adoption. This section provides a review of the VEP, management and manufacturing literature, and also discusses findings from the related literature assessing the links between firm environmental and financial performance.

Studies evaluating the impact of the adoption of EMS, ISO 14001 certification, and other VEPs have employed either qualitative or statistical analysis tools. While both types of work aim to determine the financial impacts of programme adoption, there is one important difference. Studies which employ statistical methods require quantifiable measures of financial performance drawn from a larger number of firms. This characteristic makes findings from such studies more robust to generalisations, but provides limited understanding of aspects of impacts which are not easily quantifiable. On the other hand, qualitative work based on in-depth examination from case studies is able to provide more insights into the benefits of programme adoption that are difficult to translate to empirical measures, and, because a smaller number of firms are studied in detail, this type of work is able to extract more detailed information regarding firm financial performance. Both types of studies are reviewed here.

In the voluntary environmental programme literature, four core studies examine the impact on financial performance of the adoption of four different voluntary schemes with varying time horizons. The first of these studies, undertaken by Khanna and Damon (1999) looks at the impact of participation in the United States Environmental Protection Agency (EPA)'s 33/50 programme for voluntary reduction of toxic releases. Using excess value to sales (EV/S) and returns on investment (ROI) as long term and short term proxies for firm economic performance respectively, the study finds that participation in the 33/50 programme negatively impacts short term profitability, but has significant positive impacts on long term economic performance.

The second study in the literature assesses the impact of participation in the Costa Rican Certification for Sustainable Tourism (CST) scheme, which is one of the first performance-based voluntary environmental initiatives in the developing world. Using cross-sectional data, Rivera (2002) demonstrates that participation in the programme alone is not enough to generate financial returns in the form of price premiums and higher sales. However, the study does find that participating hotels that demonstrate superior environmental performance show significant association with higher room prices. Thus, the study concludes that free riders do not benefit from participation in the programme. To reap positive benefits, firms must first demonstrate superior environmental performance.

The third study, Yu (2010), looks at the impact on firm financial performance of news of membership in the EPA's National Environmental Performance Track (NEPT) programme. Measuring financial benefits in terms of the firm's stock market price, Yu (2010) finds that participation in the NEPT programme is associated with positive cumulative abnormal returns over the 10 to 15 day event window following the release of membership news.

The fourth study, Nishitani (2011), examines the relationship between implementation of environmental management systems and the firm's value added, with special attention paid to the effect of EMSs which are in accordance with ISO 14001 standards. Using panel data from 1996 – 2007 from Japanese manufacturing firms, the study finds that, taken together, EMS implementation positively affects firm value added through increased demand and improved productivity. However, gains from

implementation vary from industry to industry, suggesting that there are industrial differences in the benefits from EMS adoption.

Outside of the VEP literature, there is a larger literature that examines the impact of environmental improvement on firm financial performance. Various measures of firm environmental and financial performance have been employed (Molina-Azorín et al. 2009a, Molina-Azorín et al. 2009b). ISO 14001 adoption and the existence of environmental management systems have been used by some in the literature (see, e.g., Andrews et al. 2003, Melnyk et al. 2003, Watson et al. 2004, Tan 2005, Link and Naveh 2006, Halkos and Sepetis 2007, Darnall et al. 2008, Sambasivan and Ng 2008, Wahba 2008, Iraldo et al. 2009), while others have used environmental awards (Klassen and McLaughlin 1996), environmental ratings (Russo and Fouts 1997, Sharma and Vredenburg 1998), environmental practices (González-Benito and González-Benito 2005), and various measures constructed from firm pollution emissions (see, e.g., Jaggi and Freedman 1992, Hamilton 1995, Hart and Ahuja 1996, Cohen et al. 1997, King and Lenox 2001, King and Lenox 2002, Al-Tuwaijri et al. 2003, Wagner 2005, Earnhart and Lizal 2007).

Findings from this broader literature have been mixed. In the business literature, Margolis and Walsh (2003) reviews 95 studies published between 1972 and 2000 that look at the association between corporate social performance (CSP) and corporate financial performance (CFP). The study finds that over 53 percent of the studies reviewed find positive association between CSP and CFP, while the other 47 percent find negative or insignificant effect of CSP on CFP. Molina-Azorín et al. (2009a) and Ambec et al. (2010) also come to the same conclusion. Surveying the environmental and financial performance literature, Molina- Azorín et al. (2009a) conclude that, although findings are mixed, the majority of the studies reviewed indicate that there is a positive association between the two. Reviewing papers published on the relationship between environmental regulation and firm productivity, Ambec et al. (2010) finds that older studies tend to find a negative impact of environmental regulation on productivity but that more recent papers have found more positive results. Of these new studies, Lanoie et al. (2008) finds that stricter regulations lead to modest gains in productivity, but reminds the readers that firms also bear direct costs from environmental regulations. Thus, they conclude that while regulatory

compliance may not be as costly as initially assumed due to offsets, environmental improvement is still a costly undertaking.

Papers that find positive relationships between environmental and financial performance employ both qualitative and statistical analysis tools. An early survey of ISO 14001 firms in Thailand finds that firms report cost savings as a result of certification (TEI 1999). These findings are concurred in Raines (2002), which looks at adoption in 15 NIEs and OECD countries, Raines et al. (2002), which examines certification in China, and Tan (2005) and Sambasivan and Ng (2008), which studies the implications of adopting the ISO 14001 standard in Malaysia. Empirically, adoption of ISO 14001 by Egyptian firms is positively associated with better stock-market performance as measured by Tobin's Q (Wahba 2008). Melnyk et al. (2003) also comes to the same conclusion in a study of ISO 14001 certification in U.S. firms. Studying stock market reaction to environmental information in Argentina, Chile, Mexico, and the Philippines, Dasgupta et al. (2001) also finds that stock market value increases with recognition of good environmental performance and decreases with poor environmental performance. Ruiz-Tagle (2003) also finds similar results in a study of Chilean manufacturing firms[8]. Using various measures of financial and environmental performance, Hart and Ahuja (1996), Klassen and McLaughlin (1996), Russo and Fouts (1997), Sharma and Vredenburg (1998), Konar and Cohen (2001), and King and Lenox (2001, 2002) also find that there is a positive link between green environmental strategy and firm financial performance.

Despite many incidences of positive results, many other studies fail to find a positive association between adoption and corporate financial performance. Comparing 46 adopting firms with an equal number of non-adopting firms, Bansal (2002) finds that there are no differences in the financial performance of certified and non-certified firms. Watson et al. (2004) compares various measures of business performance for ten firms that adopt EMS and ten that do not, and also finds no significant differences between the two groups of firms. Studying 77 ISO 14001 adopters in Israel, Link and Naveh (2006) finds that while those with stricter policies and procedures perform better environmentally, there is no evidence of superior financial performance. Heras-Saizarbitoria et al. (2011) also finds that signing up for ISO 14001 does not make

[8] However, she cautions that stock market data do not always react to the news in the expected direction.

Spanish firms financially better off. Gilley et al. (2000) find no effect of greening on stock returns, while Hamilton (1995), Cohen et al. (1997), Stanwick and Stanwick (1998), Wagner (2005), and Earnhart and Lizal (2007) find that environmentally progressive behaviour is associated with negative financial performance.

5. Critiques of the Existing Literature and Steps Taken to Address Them

The mixed empirical results found across the various literatures on the relationship between taking environmentally progressive steps and firm financial performance has been given various explanations by reviewers of the literatures (Konar and Cohen 2001, Margolis and Walsh 2003, Ambec et al. 2010). Attempting to systematically tease out the factors that lie behind the mixed findings, Horváthová (2010) conducts a meta-analysis of the existing empirical environmental and financial performance literature, which offers insights into the flaws of many existing studies. The study finds that important factors affecting outcomes are estimation methods, and time coverage of the study. Studies that rely on portfolio analysis or correlation coefficients, which are the majority of studies in the EMS/ISO 14001 literature, suffer from omitted variable bias and are the ones that tend to find a negative relationship between corporate environmental performance (CEP) and corporate financial performance (CFP). On the other hand, the use of more advanced statistical methods such as multivariate regression analysis and panel data methods do not affect outcomes and so are more reliable.

Time coverage of studies are also found to be important in explaining differences in findings (Horváthová 2010). Here, the study finds that in order to establish a positive link between CEP and CFP, appropriate time coverage is important as it takes time for environmental actions to materialise in financial benefits. This conclusion is also in line with Ambec et al. (2010), which stresses the need to use models with long time horizons in empirical studies of the Porter Hypothesis since investments in environmental improvement incur costs in the short run while benefits may be

realised in the long term. Despite this, few existing studies have examined the impact on economic benefits in the long term[9].

One other factor found to influence results is the institutional context within which the study has been conducted. Given the vastly different contexts between developing and developed countries, this finding implies that findings on the relationship between CEP and CFP from existing developed country studies have limited generalisability to the developing world context. With measures such as ISO 14001 and CSR becoming increasingly popular in the developing world, this finding suggests that there is a great need for studies that looks at the effect of corporate social performance measures in the industrialising economy.

Another critique of the existing environmental and financial performance literature is sample selection. In their review of the literature, Margolis and Walsh (2003) point out that many studies base their findings on a sample that is biased towards those firms in the extremities – those that are environmentally prominent or those that have bad environmental reputations, limiting the ability of such studies to be generalised. In the EMS/ISO 14001 impact assessment literature, Heras-Saizarbitoria et al. (2011) also stresses the fact that most existing studies in this literature fail to take into account the potential endogeneity of EMS/ISO 14001 adoption. This greatly jeopardises the reliability of the results as failure to take into account the endogeneity of treatment can lead to biased and inconsistent estimates of the treatment effects (Cameron and Trivedi 2005).

These critiques greatly inform the empirical analysis undertaken in this research and several steps are taken to ensure the validity of results. Firstly, to ensure that omitted variable bias is not a problem, the study estimates multivariate regressions using the panel data obtained by the Office of Industrial Economics (OIE). This is in keeping with Horváthová (2010) who finds that these methods are more robust than case studies and correlation coefficients. Secondly, since Ambec et al. (2010) and Horváthová (2010) suggests that the effects of environmental improvement measures might be realised in the longer term, this study uses a dataset that spans seven years

[9] These few studies include Khanna and Damon (1999), which uses a panel of 3 years (1991-1993) to assess the impact of the 33/50 programme, Wahba (2008) which also uses a panel of 3 years (2003-2005), and Heras- Saizarbitoria et al. (2011) which uses a panel of 6 years (2000-2005).

from 2001 to 2007 in order to capture the long-term effects of the corporate social performance measure, ISO 14001. Thirdly, the problem of sample selection bias towards firms with either very strong or very weak environmental performance raised in Margolis and Walsh (2003) is eliminated in the sample since the OIE dataset aims to collect industrial data and did not collect environmental data from the firms. In fact, to prepare the data for analysis of ISO 14001 adoption, participation information from the Thailand Industrial Standards Institute (TISI) has to be matched to the OIE dataset. Fourthly, to address the endogeneity problem and to assess the reliability of results, the study employs the Hausman Taylor estimation method which specifically controls for endogenous unobserved heterogeneity that is not accounted for by the model, but is correlated with the regressors. Finally, the study recognises that while econometric analysis better allows the results to be generalised, qualitative information from firms can provide more in-depth information into the specifics of ISO 14001 adoption. Thus, the study also supplements econometric findings with qualitative information from ISO 14001 firms in order to better portray the implications of ISO 14001 adoption in the developing world context.

6. Empirical Tests of Financial Gains From ISO 14001 Adoption

6.1. The Potential Outcomes Framework

In the econometric literature geared towards evaluating outcomes of programme participation, the main object of interest is the comparison of outcomes when the units under study are exposed to multiple levels of the programme or treatment (Imbens and Wooldridge 2009). For programmes such as ISO 14001 where there are two levels of treatment (D_1 = 1 for being a part of the programme, and D_1 = 0 for not taking part in the programme), the quantity of interest to evaluators is:

$$\Delta_i = Y_{1i} - Y_{0i} \qquad \text{Eq. 5.1}$$

In this context, the subscript *i* refers to individual firms, while Y_{1i} is the outcome when firm *i* receives treatment (D_{1i} = 1) and Y_{0i} is the non-treatment outcome (D_{1i} = 0). The subscript *i* is used here to highlight the shift in the evaluation literature from assuming homogeneity of treatment outcome to recognising that there is heterogeneity in the

impact of treatment among individuals (Heckman 2001, Cobb-Clark and Crossley 2003).

The evaluation of Δ_i would be straightforward if firms could be observed to be with and without treatment at the same time. However, since at any given point in time the firm is either in the programme or outside the programme, it is impossible to directly compare programme and non-programme outcomes for the same unit in the same time period. This lack of counterfactual problem pervades treatment effects evaluation, and has been called the 'fundamental problem of causal inference' (Holland 1986).

The lack of a directly comparable non-treatment outcome of a firm receiving treatment implies that an evaluation framework based on potential outcomes is more appropriate than one based directly on realised outcomes. The former was developed in a series of papers by Donald B. Rubin in the 1970's (Rubin 1973a, 1973b, 1974, 1977, 1978) and has a number of advantages over the realised outcomes framework (Imbens and Wooldridge 2009). First, the Rubin model allows for heterogeneity of treatment effects which makes it compatible with the shift in the evaluation literature from assumptions of homogeneity of treatment to impact heterogeneity (Heckman 2001, Cobb-Clark and Crossley 2003). Second, the framework explicitly links the analysis of causal effects to treatments, which clarifies the interpretation of causal effects. Third, the Rubin model allows for separation of modelling potential outcomes and modelling the assignment mechanism, which allows researchers to draw on different sources of information for each process. Fourth, the model allows for the formulation of probabilistic assumptions in terms of variables which are potentially observable, as opposed to unobserved components as in the realised outcomes model. This makes the assessment of the plausibility of these assumptions easier in the potential outcomes model. Fifth, the Rubin Causal Model (RCM)[10,11] allows for clarification of where the uncertainties in the estimators are coming from. Lastly, in the RCM, the causal effects can be defined before specifying the assignment mechanism and without making functional form or distributional assumptions. Causal

[10] The term 'Rubin Causal Model (RCM) is coined by Holland (1986). The model is also known by various other names including the Potential Outcomes Framework (Cobb-Clark and Crossley 2003), and the Roy (1951) – Rubin (1986) model (Caliendo and Hujer 2006).

[11] It should be noted that the RCM assumes that the treatment effect for each person is independent of the treatment effects on other persons. This is known in the literature as the stable unit treatment value assumption (SUTVA), and is the standard assumption in the treatment effects literature (Imbens and Wooldridge 2009).

effects are more difficult to define in terms of realised outcomes, and the constancy of causal effects over the population and the properties of the unobserved components in the model are left unclear.

Thus, because of the above reasons, this study makes use of the Rubin Causal Model and specifies the observed outcome for individual i, Y_i, as a function of the individual's potential outcomes, Y_{1i} and Y_{0i}.

$$Y_i = Y_i(D_{1i}) = Y_{0i}(1 - D_{1i}) - Y_{1i}(D_{1i}) \qquad \text{Eq. 5.2}$$

6.2. Measures of Financial Performance

There is no one agreed-upon measure of financial performance in the existing literature and, as such, a plethora of measures have been used. Horváthová (2010) classifies these measures into three categories – market-based, accounting, and a mixture between the two. The first and third types incorporate measures based on stock market information such as stock prices, price to earnings ratio, and Tobin's Q. However, since many of the manufacturing firms in the developing world are not listed in the stock market, this chapter does not make use of market-based measures of financial performance. Instead, this research makes extensive use of accounting-based measures collected by the Office of Industrial Economics (OIE) in their annual industrial surveys.

To proxy various aspects of firm financial performance, several measures of economic performance are constructed from the OIE data. To gauge the compatibility of ISO 14001 certification with the profit maximisation objective of the firm, the study uses return on investment (ROI) as a measure of firm profitability. Measures of the firm's performance in terms of sales are also used as dependent variables to determine whether ISO 14001 adoption is more in line with utility maximisation behaviour of the firm. Sales are measured by asset turnover (AT), calculated by dividing total sales revenues with total assets. In addition to this, to reflect the fact that firms may be motivated to adopt ISO 14001 to increase export sales, turnover of export sales, calculated by dividing total export sales by total assets, is included. Measures that asked firms to compare the present year's performance to previous years are also included. These latter measures include comparisons on profitability,

sales, export sales, production costs, and general business conditions. A description of the variables and their summary statistics are given in Table 5.2.

6.3. Factors Affecting Firm Financial Performance

The main hypothesis to be tested in this chapter is that the adoption of the voluntary environmental improvement scheme, ISO 14001, positively affects firm financial performance. This makes the ISO 14001 variable the key variable of interest. However, since the purpose of the Office of Industrial Economics survey is industrial and not environmental, the survey does not collect data on ISO 14001 adoption. To address this deficiency, data of ISO 14001 certification from the Thailand Industrial Standards Institute is carefully matched with the OIE data. Data on the date of ISO 14001 adoption was also obtained and incorporated into the dataset, making ISO 14001 adoption a dynamic variable. With only two levels of the treatment available – the firm is either receiving treatment or it is not – the ISO 14001 variable is a dummy variable which takes the value of 1 if the firm has ISO 14001 certification and is 0 otherwise. This construction of the ISO 14001 variable is the same as the one adopted in the previous participation chapter.

In addition to the ISO 14001 participation variable, other major determinants of firm financial performance include firm size, expenditures on advertising, and research and development (R&D), and industry-specific characteristics. Firm size is measured by the number of employees in the firm's employment[12], and is expected to be positively associated with financial performance due to economies of scale (Baum 1996), greater control over external stakeholders and resources (Pfeffer and Salancik 2003), and ability to attract and retain better employees (Williamson 1975). Advertising and R&D expenditures are measured as intensities with the actual expenditures normalised by total sales. Both measures are expected to positively affect firm financial performance. Expenditures in R&D can be seen as investments in technical capital which can lead to product and process innovation which can then lead to enhanced financial performance, while advertising intensity proxies the degree of product differentiation by firms (Capon et al. 1990, McWilliams and Siegel 2000). Industry-specific characteristics such as growth and barriers to entry (Hansen and

[12] In this analysis, the natural log of firm size is used to account for non-normality in the distribution of the size variable.

Wernerfelt 1989, McWilliams and Siegel 2000, Tsoutsoura 2004) are controlled for by including industry dummy variables into the regression. Other control variables include the adoption of the total quality management system standard - ISO 9000, which is matched from TISI data, and the presence of foreign direct investment. Detailed descriptions of the dependent and independent variables included in the regressions are given in Table 5.2.

6.4. Estimation Strategy

In addition to addressing the inherent problem of the lack of counterfactual introduced in Section 6.1, the estimation strategy must also take into account the mechanism for treatment assignment, another ingredient of the Rubin Causal Model (Imbens and Wooldridge 2009). For studies using non-experimental data such as this one, there is always the danger that treatment was non-randomly assigned. Selection bias could occur on observables, in which case including additional regressors as controls, or using matching estimators or similar methods would be appropriate (Caliendo and Hujer 2006, Nichols 2007). However, when selection occurs on unobservables and these unobserved factors have causal impact on outcomes, estimates of treatment effects may be biased and inconsistent if this potential endogeneity is not properly addressed (Cameron and Trivedi 2005, Basu et al. 2007, Nichols 2007). This omitted variable or misspecification problem[13] is one of the key problems of the existing literature examining ISO 14001's effect on firm financial performance (Horváthová 2010), and one of the key factors limiting the generalisability of existing studies. The misspecification problem is addressed here by applying the Hausman and Taylor's (1981) estimator for the random effects model, which, to the author's knowledge, is the first instance of the application of this method in this literature. To ensure robustness, these results are checked against fixed effects regressions which also control for selection on unobservables[14], and individual industry regressions.

For a study based on panel data such as this one, the standard starting point is the general panel data model specification:

[13] This formulation of the problem of self-selection into treatment which leads to correlated effects biases is discussed in Heckman (1979) and Arellano (1993) who regard the problem as one of omitted variable or misspecification.

[14] While both Hausman-Taylor (HT) and fixed effects estimators control for unobserved individual heterogeneity, the HT estimator does so while also allowing the coefficients of time-invariant regressors to be estimated. Thus, results from the HT estimators are reported.

$$y_{it} = X_{it}\beta + \varepsilon_{it} \quad \text{Eq. 5.3}$$

However, since one of the goals of panel data models is to control for individual-specific unobserved effects (Hausman and Taylor 1981), the general specification can be re-specified as an error components model to highlight the presence of such individual-specific terms. In this analysis, period effects are also controlled for using time intercepts, resulting in a two-way error components model:

$$y_{it} = X_{it}\beta + \alpha_i + \delta_t + \nu_{it} \quad \text{Eq. 5.4}$$

Where $\alpha_i + \nu_{it} = \varepsilon_{it}$

α_i is a random variable that captures unobserved individual heterogeneity

δ_t is the time specific intercept that captures period effects

ν_{it} is the remaining disturbance in ε_{it}, and is identically and independently distributed over *i* and *t*

Individual-specific effects, α_i, figure prominently in analyses that deal with firm financial performance such as this one. According to the resource-based view of the firm, the ability to achieve competitive advantage and superior corporate performance primarily depends on the unique sets of resources available to each firm (Penrose 1959, Barney 1991, Grant 1991, Darnall et al. 2008). In addition to this, for long-term competitive advantage to be maintained, the firm's resources must be sufficiently heterogeneous and cannot be imitated without its rivals incurring great costs (Barney 1991, Peteraf 1993). Despite these findings, measures of heterogeneous firm-specific resources are not included in this study because of two main reasons. First, the definition of 'resources' is broad and encompasses intangibles and often unobserved aspects of the firm which could be related to the adoption of certifiable environmental management practices such as organisational culture (Hansen and Wernerfelt 1989), and the characteristics of the firm's board of directors (Carter et al. 2003, Croson and Gneezy 2009). Second, since this dissertation utilises data from a government survey which the researcher has no control over, the analysis is constrained by the omission of questions on the firm's internal organisational aspects. The absence of such data leaves the researcher with the second-best alternative of using econometric techniques to control for endogeneity due specifically to unobserved individual heterogeneity.

Two estimation methods can account for endogenous but unobserved firm-specific differences within the context of panel data estimation – fixed effects (FE) and Hausman and Taylor (1981) (HT) estimators. The usual alternative specification to the FE estimator, the random effects (RE) specification is not employed here since the RE specification assumes independence between the individual specific term, α_i, and the included explanatory variables (Baltagi 2008, Greene 2008), which is contrary to the presence of self-selection bias due to unobserved individual specific heterogeneity (Nichols 2007) [15]. The estimator of choice in this dissertation is the HT estimator since, in addition to controlling for individual heterogeneity, the method also allows for the recovery of coefficients from time-invariant regressors, which cannot be estimated with the FE specification (Hausman and Taylor 1981, Baltagi 2008, Greene 2008) [16]. However, to ensure robustness of results, outcomes for time variant variables from HT estimations are cross-checked with outputs from the FE specification and industry specific regressions.

The general Hausman-Taylor specification extends the two-way error components model (Eq.5.4) in the following way:

$$y_{it} = X_{1it}\beta_1 + X_{2it}\beta_2 + w_{1i}\gamma_1 + w_{2i}\gamma_2 + \alpha_i + \delta_t + \nu_{it} \qquad \text{Eq. 5.5}$$

Where X_{1it}denotes time-variant exogenous regressors

X_{2it}denotes time-variant endogenous regressors

w_{1i}denotes time-invariant exogenous regressors

w_{2i}denotes time-invariant endogenous regressors

In this dissertation, the endogenous regressor, ISO 14001 adoption, is time varying and is included in the $X_{2it}\beta_2$ term.

The model is estimated using Stata version 10.0 using the `xthtaylor` command as suggested by Baltagi (2008). To control for heteroskedasticity, the standard errors are

[15] The presence of endogenous individual heterogeneity is also empirically tested for using the Hausman test. Results strongly reject the RE specification as a viable alternative.

[16] The estimator uses a form of instrumental variable (IV) regression method (Cameron and Trivedi 2005) but differs from the usual IV method in that it uses within variation of the time-varying exogenous regressors as instruments for the endogenous regressors (Hausman and Taylor 1981). Thus, one condition for identification of the model is that the number of exogenous regressors is at least as large as the number of time-invariant endogenous regressors (Baltagi 2008). Another condition is that there is sufficient correlation between the instruments and the endogenous regressors to avoid the weak instruments problem (Cameron and Trivedi 2009).

estimated via bootstrapping. The process is non-parametric and estimates the true parameter by drawing random samples (with replacement) from the observations (Guan 2003). The standard error is estimated from:

$$\widehat{se} = \left\{ \frac{1}{k-1} \sum_{i=1}^{k} \left(\hat{\theta}_i - \bar{\theta} \right)^2 \right\}^{1/2} \qquad \text{Eq.5.6}$$

Where $\hat{\theta}_i$ is the statistic calculated using the i^{th} bootstrap sample

k is the number of replications, and

$\bar{\theta} = \frac{1}{k} \sum_{i=1}^{k} \hat{\theta}_i$

Since bootstrapping is based on the same theory underlying Monte Carlo simulation methods, its accuracy depends on sample size and the number of replications, *k* (Guan 2003). Ideally, the number of replications should approach infinity (Andrews and Buchinsky 2000). However, in practice, using too large a number of replications can be computationally expensive (Andrews and Buchinsky 2000). Efron and Tibshirani (1993) recommends between 50 to 200 replications for standard error estimation[17], while Cameron and Trivedi (2009) acknowledges this but recommends using $k = 400$ in order to be in line with Andrew and Buchinsky's (2000) finding that the bootstrap estimate of the standard error with $k = 384$ is within ten percent of that with $k = \infty$. This analysis follows Cameron and Trivedi's (2009) guideline and estimates standard errors with $k = 400$ replications.

In addition to controlling for heterogeneity and simulation bias, biasedness due to simultaneity and the possibility of delayed effects from ISO 14001 adoption (Ambec et al. 2010, Horváthová 2010) are also accounted for by using lagged independent variables of one, two, three, and four years respectively. For each lag, three regression specifications are estimated for measures of profitability, total sales, and export sales respectively. This adds up to a total of 12 specifications. An additional five regressions are for subjective measures of financial performance where firms are asked to compare the present year's performance in terms of profits, sales, export sales, production costs, and general business conditions to previous years. As a result, a total of 17 regression specifications are estimated.

[17] Stata's default is 50 replications.

6.5. Results[18]

Results from the 17 Hausman-Taylor regressions are reported in Tables 5.3 and 5.4 and indicate that the model specifications are all significant at the 1 percent significance level. In addition to this, as the Hausman-Taylor estimator relies on instrumental variables to construct coefficients, Cameron and Trivedi (2009) recommend reporting results from tests of overidentifying restrictions along with the estimated Hausman-Taylor coefficients. Test results are in the form of the Sargan-Hansen statistic, which extends easily from the homoskedasticity context to one where heteroskedasticiy is present such as this one[19]. These are also reported in Tables 5.3 and 5.4.

Contrary to expectation, the regression results indicate that the variable of interest, ISO 14001 certification, is not a significant determinant of any of the subjective and objective measures of financial performance adopted in this dissertation. After selection bias from unobserved individual heterogeneity, simultaneity, and simulation bias are controlled for, firms with ISO 14001 are indistinguishable from firms without the certification in their ratings of the company's profits, sales, export sales, production costs, and general business conditions. Certified firms also perform no better than non-adopters in terms of objective measures of economic performance such as return on investment, asset turnover, and normalised export sales. Furthermore, results also suggest these conditions persist over a longer time horizon, with the ISO 14001 variable being statistically indistinguishable from zero in specifications with one, two, three, and four year lags respectively. The results also do not indicate that there are differences among industries, with interaction terms between industry and ISO 14001 certification status showing no significant effects in all 17 specifications.

While contrary to expectation, these findings are not unprecedented given that results of progressive environmental performance on firm financial performance have been mixed in the existing literature. Thus, the findings from this study lie in between those

[18] Prior to estimation, all the usual regression diagnostics were performed. Fixed effects models and individual industry regressions were also estimated as another check for the robustness of results. Results from these regressions confirm the findings presented in this section.

[19] The Sargan-Hansen statistic indicates that the instrument is valid when the test fails to reject the null hypothesis.

papers which have found that it pays to have EMS/ISO 14001 certification (Hibiki et al. 2003, Melnyk et al. 2003, Wahba 2008, Nishitani 2011) and studies which have found that firms are penalised for being green (Stanwick and Stanwick 1998, Wagner 2005, Earnhart and Lizal 2007, Halkos and Sepetis 2007). Furthermore, the results that certified firms perform no better than non-certified firms are consistent with findings from other empirical studies of ISO 14001 certification such as Link and Naveh (2006)'s study of Israeli firms, and Heras-Saizarbitoria et al. (2011)'s study of Spanish firms. Similar findings have also been found in other works which study process-based measures of environmental performance such as Gilley et al. (2000) and Watson et al. (2004).

The explanation for the non-significance of ISO 14001 certification on profitability is explained in McWilliams and Siegel (2001). In examining the financial implications of adoption of corporate social responsibility (CSR) practices by two competitor firms which differ only in their social attribute, McWilliams and Siegel conclude that adoption of CSR would neither help nor hurt the firm's profitability at equilibrium. This is because the higher costs faced by adopting firms would be offset by higher revenues while the non-adopting firms would incur lower costs but reap lower revenues.

While McWilliams and Siegel (2001)'s study explains the non-significance of the certification variable on profitability, it does not explain the finding of neutral effect on other measures of firm economic performance. Failure to find any differences between certified and non-certified firms in terms of total sales and export sales could result from downstream firms helping their non-ISO14001 certified suppliers become certified rather than cutting them off because of their certification status. As a result, the supplying firm's sales will be fairly constant before and after adoption. This is especially true for firms which are engaged in long-term vertical relationships with their suppliers and are looking for ways to reduce the moral hazards that might result from the establishment of long-term contracts between suppliers and buyers (King et al. 2005).

One other possible explanation for the non-significance of certification status on the firm's total sales and export sales could be the existence of other more industry-specific certifications which are more important to sales. For the food and beverages

industry, these standards include the GMP[20] and HACCP[21] standards, while for the electronics and electrical appliances industry, there are the RoHS[22] and WEEE[23] Directives for electrical appliances[24]. While no comparable standard exists for the textiles and wearing apparel industry, the sector has most often been targeted for its working conditions and payments of living wages to labourers rather than the industry's environmental impacts (see, e.g., Emmelhainz and Adams 1999, Rosen 2002, Pollin et al. 2004, Bartley 2005). As a result, certification status does not have as much of an effect on firms' total sales and export sales.

While many surveys of ISO 14001 adopters report that firms obtain cost savings from certification, empirical analysis using self-assessments by adopting and non-adopting firms show that there are no indications of differences between certified and non-certified firms in terms of production costs. While this could simply mean that ISO 14001 certification does not contribute to the firm's cost savings, another explanation that is more consistent with the qualitative literature is that the majority of benefits from ISO 14001 adoption are not easily quantifiable and are not included in the firm's consideration of production costs. In an in-depth examination of ISO 14001 certification in the United States which include interviews with key personnel, Rondinelli and Vastag (2000) conclude that the main benefits of programme implementation come from changes in the attitude and behaviour of managers and employees, which are difficult to quantify. In addition to this, the study also finds that certification resulted in reduced waste and waste treatment costs. Studies of ISO 14001 adoption in countries such as Argentina, China, Egypt, Indonesia, Malaysia, Mexico, Thailand, and the U.S. also find that certified firms report benefits in terms of a reduction in waste treatment costs, savings on insurance premiums, reduced fines for environmental violations, and improved corporate image (TEI 1999, Montabon et al. 2000, Mohamed 2001, Raines 2002, Tan 2005, Zeng et al. 2005, Ann et al. 2006,

[20] GMP standards for Good Manufacturing Practices and can serve as the basis for obtaining the HACCP.

[21] HACCP stands for Hazard Analysis and Critical Control Points.

[22] RoHS is short for Restriction on Hazardous Substances and is derived from the name of EU Directive 2002/95/EC (the Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

[23] WEEE stands for Waste Electrical and Electronic Equipment and is the name of EU Directive 2002/96/EC regulating the disposal of electrical and electronic waste.

[24] Although RoHS and WEEE began in Europe, several other countries have adopted similar policies. These countries include Japan, Korea, and China, three countries which are major trading partners with Thai firms.

Sambasivan and Ng 2008), none of which enter into the calculation of production costs .

The finding of no effect of ISO 14001 adoption on general business conditions could be due to the fact that the measure encompasses a broad view of the firm which include factors with such large impacts as economic climate and business prospects that the effect of ISO 14001 certification becomes insignificant in comparison. An analogy of this argument can be found in the pollution haven hypothesis literature. While the hypothesis is that firms might choose to relocate to areas with less stringent environmental policy, some have argued that the costs of environmental compliance to firms is often much less compared to other production costs such as raw materials and labour that environmental regulations would have very little impact on the firm's relocation decision (see, e.g., Antweiler et al. 2001, Cole and Elliott 2003, Eskeland and Harrison 2003, Cole 2004, Copeland and Taylor 2004, Elliott and Shimamoto 2008).

While results on ISO 14001 certification may be non-significant, results for the ISO 9000 variable indicate that there may be long term effects to ISO 9000 certification. ISO 9000 starts off negative in the first year lag regressions, but show positive results in subsequent years. This is indicated by the positive effect on subjective measures of profits, exports, and general business conditions, which asked firms to compare the performance in the survey year with two years previously. Objective measures of financial performance concur with this assessment with coefficients for total sales and profitability positive and significant after 4 years since the start of the dataset. Since ISO 9000 came out before ISO 14001, this finding suggests that there could be a much longer time horizon for firms in Thailand to see positive returns to accounting measures of financial performance from certification.

Table 5.1: Correlation Coefficients

	ISO 14001	FDI	Firm Size	Advertising Intensity	R&D Intensity	ISO 9000
ISO 14001	1					
FDI	0.1336	1				
Firm Size	0.2224	0.3100	1			
Advertising Intensity	-0.0202	0.0258	0.0901	1		
R&D Intensity	0.0011	0.0143	-0.0036	0.0806	1	
ISO 9000	0.2363	0.1347	0.2918	0.0440	-0.0018	1

Table 5.2: Summary Statistics for OIE Data

Variable	Description	Mean	S.D.	Min	Max
	Subjective Measures of Financial Performance				
Profits	Change in profits in the present year compared to previous years. The categories are increase, no change, or decrease.	1.954	0.880	0	3
Sales	Change in sales in the present year compared to previous years. The categories are increase, no change, or decrease.	1.783	0.860	0	3
Export Sales	Change in export sales in the present year compared to previous years. The categories are increase, no change, or decrease.	1.271	1.096	0	3
Production Costs	Change in production costs in the present year compared to previous years. The categories are increase, no change, or decrease.	1.535	0.751	0	3
General Business Conditions	Change in general business conditions in the present year compared to previous years. The categories are increase, no change, or decrease.	1.882	0.802	0	3
	Objective Measures of Financial Performance				
Return on Investment	Measure of profitability, found by dividing net income by total assets.	0.443	0.735	-4.973	13.186
Asset Turnover	Measure of sales, found by dividing total revenue by total assets.	1.784	1.466	0	9.464
Export Sales	Measure of export sales, found by dividing total export revenue by total assets.	0.552	1.066	0	13.926
	Independent Variables				
ISO 14001 Adoption	Dummy variable equals to 1 for firms with ISO 14001 certification and is 0 otherwise.	0.037	0.189	0	1
Firm Size	Natural log of the number of employees in a firm.	4.952	1.601	0	10.54
Advertising Intensity	Advertising intensity, found by dividing advertising expenditures by total sales.	0.014	0.038	2.06E-11	0.764
R&D Intensity	Research and development (R&D) intensity, found by dividing R&D expenditures by total sales.	0.001	0.016	2.06E-11	0.94
ISO 9000 Adoption	Dummy variable equals to 1 for firms with ISO 9000 certification and is 0 otherwise.	0.200	0.40	0	1
Foreign Direct Investment	Dummy variable equals to 1 for firms with foreign direct investment (FDI) and is 0 otherwise.	0.292	0.455	0	1

Table 5.3: Subjective Financial Benefits Regressions With Bootstrapped Standard Errors

	(1) Profits	(2) Sales	(3) Export Sales	(4) Production Costs	(5) General Business Conditions
ISO 14001 Adoption	0.0651	0.553	0.0719	0.463	0.115
	(0.734)	(1.375)	(0.860)	(1.092)	(0.580)
ISO 14001*Textiles	0.362	-0.564	0.0491	-0.601	-0.450
	(1.233)	(1.570)	(4.072)	(1.510)	(1.025)
ISO 14001*Electronics	0.139	-0.673	-0.132	-0.685	-0.324
	(0.799)	(1.387)	(0.892)	(1.111)	(0.622)
Foreign Direct Investment	0.0718**	0.0682*	0.329***	0.0483*	0.0479
	(0.0354)	(0.0385)	(0.0529)	(0.0291)	(0.0342)
Firm Size	-0.0244*	-0.053***	0.199***	-0.0196	-0.0447***
	(0.0145)	(0.0130)	(0.0252)	(0.0130)	(0.0125)
Advertising Intensity	-0.558	-0.549	0.287	-0.409	-0.881**
	(0.547)	(0.482)	(0.478)	(0.373)	(0.381)
R&D Intensity	0.884	-0.0244	1.345	-0.0831	-0.0559
	(1.684)	(1.375)	(1.739)	(1.268)	(1.273)
ISO 9000 Adoption	0.0711*	0.0473	0.0952*	-0.0112	0.0806**
	(0.0422)	(0.0477)	(0.0559)	(0.0382)	(0.0393)
Textiles	0.0136	0.108**	0.131**	0.0923**	0.0894***
	(0.0391)	(0.0431)	(0.0520)	(0.0390)	(0.0340)
Electronics	-0.149***	-0.00198	0.0251	0.0600	-0.0386
	(0.0512)	(0.0522)	(0.0650)	(0.0464)	(0.0437)
Constant	1.969***	1.838***	-0.160	1.468***	1.974***
	(0.0779)	(0.0685)	(0.130)	(0.0695)	(0.0680)
Observations	5,473	5,473	5,449	5,471	5,470
Groups	1,726	1,726	1,724	1,724	1,726
χ^2	45.86***	32.35***	100.18***	68.76***	163.99***
Sargan-Hansen Statistic†	20.42	19.50	84.26	42.04	70.26

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level.

†Sargan-Hansen statistic reports the results of overidentifying restrictions tests.

Table 5.4: Objective Financial Benefits Regressions, 1-4 Year Lags

	(6) Profits (lag 1)	(7) Sales (lag 1)	(8) Export Sales (lag 1)	(9) Profits (lag 2)	(10) Sales (lag 2)	(11) Export Sales (lag 2)
ISO 14001 Adoption	0.347	0.155	-0.288	-0.0943	-0.735	-0.512
	(0.574)	(6.336)	(1.429)	(0.818)	(2.679)	(2.284)
ISO 14001*Textiles	-0.535	-0.818	0.0366	-4.934	-14.00	-4.749
	(1.648)	(9.232)	(3.026)	(3.770)	(15.65)	(12.44)
ISO 14001*Electronics	-0.455	-0.429	0.235	0.0143	1.564	0.891
	(0.579)	(6.344)	(1.443)	(0.868)	(3.068)	(2.802)
Foreign Direct Investment	0.0348	-0.118	0.0683*	0.00884	-0.102	0.169**
	(0.0296)	(0.0804)	(0.0388)	(0.0314)	(0.107)	(0.0753)
Firm Size	-0.031***	0.182**	0.304***	-0.0164	0.0691	0.197***
	(0.0120)	(0.0794)	(0.0375)	(0.0141)	(0.0656)	(0.0441)
Advertising Intensity	0.686	-0.481	-0.872**	0.0130	-0.820	-0.484
	(0.433)	(0.471)	(0.405)	(0.234)	(0.562)	(0.373)
R&D Intensity	-0.896	-2.736	-0.300	0.176	-3.294	-0.0216
	(1.119)	(4.911)	(2.389)	(1.512)	(5.356)	(2.364)
ISO 9000 Adoption	-0.085***	-0.216***	-0.0873*	0.0872*	0.0660	0.0103
	(0.0290)	(0.0775)	(0.0518)	(0.0482)	(0.132)	(0.0977)
Textiles	0.0114	-0.211	0.146**	0.132***	0.0143	0.228*
	(0.0368)	(0.132)	(0.0657)	(0.0498)	(0.165)	(0.131)
Electronics	-0.0802**	-0.220	-0.0891	-0.097**	-0.58***	-0.278*
	(0.0393)	(0.154)	(0.0620)	(0.0443)	(0.174)	(0.163)
Constant	0.570***	1.021**	-0.915***	0.560***	2.037***	-0.260
	(0.0711)	(0.400)	(0.186)	(0.115)	(0.371)	(0.238)
Observations	4,222	4,164	5,484	2,232	2,222	2,231
Groups	1,499	1,487	1,729	1,240	1,239	1,240
Wald chi2	277.54***	105.97***	55.56***	58.16***	70.16***	65.13***
Sargan-Hansen Statistic†	58.51	30.20	40.19	14.02	30.78	44.63

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level.

†Sargan-Hansen statistic reports the results of overidentifying restrictions tests.

	(12) Profits (lag 3)	(13) Sales (lag 3)	(14) Export Sales (lag 3)	(15) Profits (lag 4)	(16) Sales (lag 4)	(17) Export Sales (lag 4)
ISO 14001 Adoption	-0.953	-0.537	-0.185	-10.18	-20.22	-7.136
	(2.126)	(7.298)	(3.385)	(6.834)	(30.77)	(6.417)
ISO 14001*Textiles	1.127	0.869	0.399	10.24	20.21	7.040
	(4.838)	(10.45)	(5.624)	(8.928)	(34.03)	(9.017)
ISO 14001*Electronics	1.569	0.654	0.263	10.08	20.39	7.207
	(2.159)	(7.318)	(3.396)	(6.907)	(30.76)	(8.228)
Foreign Direct Investment	0.0007	-0.162**	0.207***	0.0238	0.0145	0.275***
	(0.0516)	(0.079)	(0.0566)	(0.087)	(0.133)	(0.0834)
Firm Size	-0.059**	-0.092**	0.121***	-0.054**	0.0206	0.142
	(0.0239)	(0.036)	(0.0372)	(0.024)	(0.042)	(0.0891)
Advertising Intensity	0.736	0.0122	0.697	0.218	-1.508	-1.033
	(0.477)	(0.749)	(0.652)	(1.021)	(1.374)	(0.767)
R&D Intensity	-0.848	-5.564	-0.0324	-15.98**	-5.823	1.202
	(2.896)	(6.695)	(4.148)	(6.906)	(18.07)	(9.773)
ISO 9000 Adoption	0.0106	0.104	0.0169	0.333**	0.484***	0.128
	(0.0613)	(0.110)	(0.0582)	(0.142)	(0.165)	(0.0917)
Textiles	-0.0130	-0.293	0.0911	-0.182	-0.610**	-0.117
	(0.0683)	(0.181)	(0.0893)	(0.150)	(0.287)	(0.139)
Electronics	-0.171**	-0.0844	-0.0491	-0.303*	-0.600**	-0.245
	(0.0830)	(0.192)	(0.102)	(0.162)	(0.264)	(0.329)
Constant	0.745***	2.56***	-0.0962	0.85***	2.00***	0.0605
	(0.133)	(0.207)	(0.177)	(0.158)	(0.391)	(0.442)
Observations	2,863	2,793	2,870	2,196	1,978	2,209
Groups	1,209	1,186	1,210	1,144	1,053	1,148
Wald chi2	21.10*	41.34***	64.82***	21.01*	33.53	41.75***
Sargan-Hansen Statistic†	11.07	42.56	46.19	9.64	12.76	22.05

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level.

†Sargan-Hansen statistic reports the results of overidentifying restrictions tests.

7. Primary Survey Evidence on the Benefits of ISO 14001 Adoption

While the Office of Industrial Economics survey asks detailed financial performance questions, the purpose of the survey is to give policymakers an overview of the manufacturing sector in Thailand. As a result, the survey contains no questions pertaining to ISO 14001 certification. On the other hand, while the primary survey could not ask detailed questions on the firm's economic performance, the questionnaire is constructed to obtain information on an array of aspects pertaining to ISO 14001 certification. One section of the questionnaire is devoted entirely to gauging the benefits firms receive from programme adoption and two questions from this section asks firms to report whether or not they received cost savings from having the certification in place (Question 23), and whether they received any other benefits from adoption (Question 22). This section supplements the previous empirical analysis section and reports findings from Questions 22 and 23 of the primary survey questionnaire.

As described in Chapter 3, the primary survey data consists of 494 cross sectional observations from three manufacturing industrial sectors. 157 firms are from the food and beverages sector, 141 are from the textiles and wearing apparel sector, and 194 are from the electronics and electrical appliances sector. Of this number, 188 firms are ISO 14001-certified, comprising 47 firms from the food and beverages industry, 24 from the textiles industry, and 117 from the electronics industry. These firms produce an array of products, and are of small, medium, and large sizes[25]. Responding firms include those who are solely export-oriented, solely domestic market-oriented, or cater to both overseas and domestic markets. In addition to this, there is also a good mixture of firms with and without foreign direct investment in all three industries. The results reported are obtained from the firms in the sample which have ISO 14001 certification.

[25] Firms classified as small are those employing 50 or less employees. Medium firms employ between 50 and 200 employess. Large firms employ 200 or more employees. While smaller firms are included in the sample, the majority of the firms in the primary survey sample are of medium to large sizes.

Table 5.5: Responses to Primary Survey Questionnaire

	Responses	Certified with ISO14001	Percentage with ISO14001
Food and Beverages	157	47	29.9
Textiles and Wearing Apparel	141	24	17.0
Electronics and Electrical Appliances	194	117	60.3
Total	494	188	38.1

Figure 5.1: Questions 22 and 23 of the Primary Survey Questionnaire

Part 4: Effects of ISO 14001 Certification (for those with ISO 14001 only)

22. What have the benefits to having ISO 14001 been for your establishment?

(Please check all that apply.)

☐ Improved corporate image, especially in environmental area.
☐ Improved working conditions for establishment's personnel.
☐ Increased competitiveness.
☐ Able to access new markets.
☐ Able to charge higher prices for products.
☐ Reduced environment-related risks and liabilities.
☐ Able to alleviate the number of complaints against the plant from nearby communities.
☐ Able to reduce the complaints against the plant from environmental groups.
☐ Others, please specify

……
……

23. Do you believe that having an ISO 14001-certified environmental management system in place can reduce production costs?

☐ ISO 14001 does not reduce help costs.
☐ Helped reduce the use of energy from fuels within the establishment by …… % compared with before having ISO 14001.
☐ Helped reduce electricity charges by …… % compared with before having ISO 14001.
☐ Helped reduce water fees by …….. % compared with before having ISO 14001.
☐ Helped reduce waste management fees by …….. % compared with before having ISO 14001.
☐ Helped reduce other expenses, please specify

……
……

In spite of the diversity in firms both within and across industries in the primary data, what these firms report regarding the benefits of ISO 14001 certification is remarkably similar, and are consistent with findings from similar studies of ISO

14001 certified firms. For firms in all three industries, the foremost benefit reported is improved corporate image. This is congruent with results from an early survey of ISO 14001 certified firms in Thailand (TEI 1999) and findings from a survey of adopters in neighbouring Malaysia (Tan 2005, Ann et al. 2006, Sambasivan and Ng 2008) which find that firms report enhanced corporate image as the strongest impact from certification. Studies from countries as diverse as Brazil, China, Egypt, Sweden, and the U.S. also report reputational effects as one of the benefits firms receive from programme participation (Aboulnaga 1998, Boiral and Sala 1998, Mohamed 2001, Poksinska et al. 2003, Zeng et al. 2005, de Oliveira et al. 2010).

In addition to improved corporate image, the second most reported benefit from ISO 14001 certification across all industries is reduced risks and liabilities. This is consistent with Tan (2005)'s and Sambasivan and Ng (2008)'s findings based on sampled Malaysian firms. Tan (2005) finds that 83 percent of firms report savings due to reduced insurance premiums, while in Sambasivan and Ng (2008) firms report reduced environmental liabilities as a result of ISO 14001 certification. For firms in Egypt, Mohamed (2001) cite reduced exposure to environmental redemption or tort liability as a benefit of programme participation. Similar results are also reported by Brazilian firms. De Oliveira et al. (2010) report that ISO 14001 firms are more attractive to investors because they have reduced environmental liabilities which translates to decreased risks of financial troubles.

Increased competitiveness is also reported as one of the main financial benefits to ISO 14001 certification by firms in the sample. However, the ranking differs slightly among industries. Firms in the textiles and wearing apparel, and electronics and electrical appliances industries, competitiveness is ranked third overall. However, for the food and beverages industry, it is fourth in rank, falling slightly behind improved neighbour relations. Nonetheless, the results indicate that increased competitiveness is one important outcome of ISO 14001 certification.

While firms do report that increased competitiveness is a result of certification, this finding is not at odds with the findings from the previous empirical analysis section that find that ISO 14001 firms do not perform better than non-ISO 14001 firms financially. The increased competitiveness reported by programme adopters could come from improved operational and administrative efficiency (Montabon et al. 2000,

Mohamed 2001), and increased staff morale and motivation (Boiral and Sala 1998, Rondinelli and Vastag 2000, Sambasivan and Ng 2008), all of which are difficult to capture numerically.

On the other end of the scale, responses from firms are also similar. Across all three industries, the majority of firms report that they do not receive benefits in terms of price premiums, nor does ISO 14001 certification allow them to improve their relationships with environmental groups. Furthermore, in all three industries, there are a higher number of firms reporting no benefits in terms of gaining market access than those reporting gains. These results are consistent from findings from the previous empirical analysis section which finds that ISO 14001 certification does not help firms increase their export sales, total sales, or profits. Furthermore, these results suggest that ISO 14001 certification may not be as big of a barrier to entry as previously believed, with other requirements taking precedence as entry barriers. This is especially true for firms in the food and beverages industry where food safety standards such as the HACCP are more prominent. In the electronics and electrical appliances industry also the more industry-specific requirements of WEEE and RoHS are dominant; sidelining the effects of ISO 14001 in helping firms gain access to new markets.

Figure 5.2: ISO 14001 Adopters Responses to Question 22: Do Firms Receive Benefits from ISO 14001 Adoption? (All Industries)

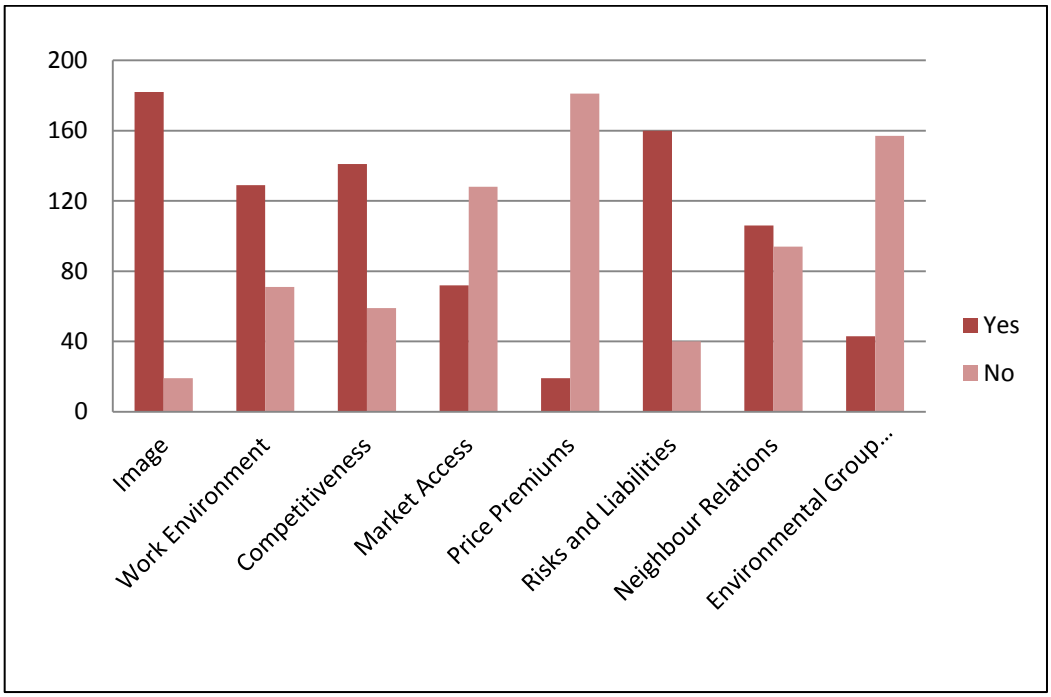


Figure 5.3: ISO 14001 Adopters Responses to Question 22: Do Firms Receive Benefits from ISO 14001 Adoption? (Food and Beverages Industry)

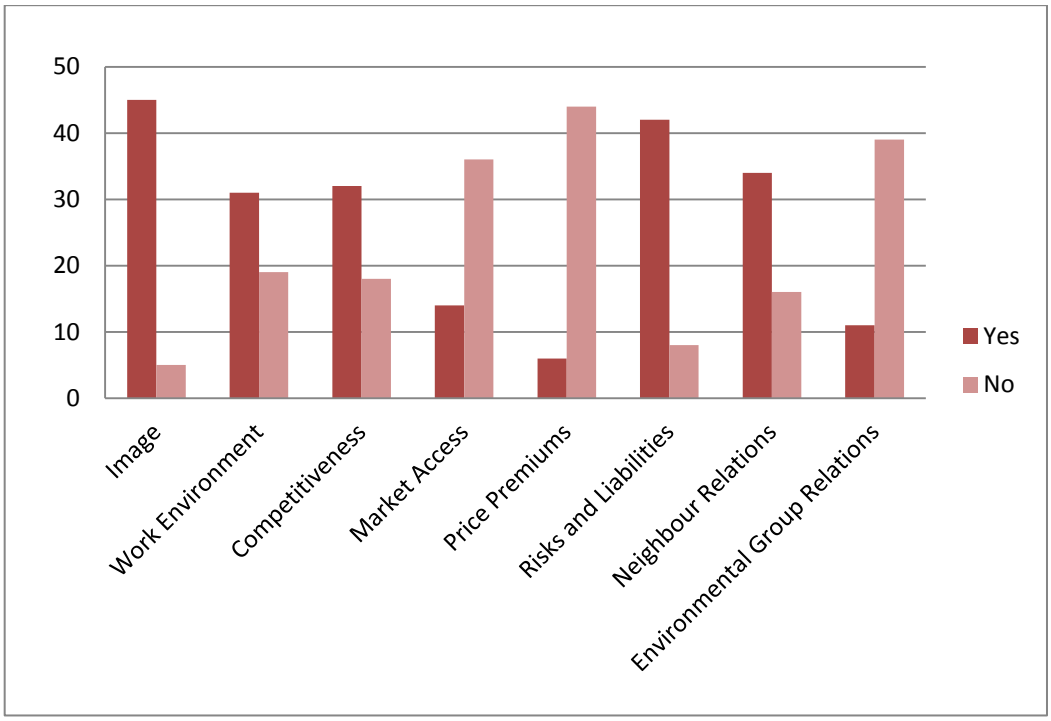


Figure 5.4: ISO 14001 Adopters Responses to Question 22: Do Firms Receive Benefits from ISO 14001 Adoption? (Textiles and Wearing Apparel Industry)

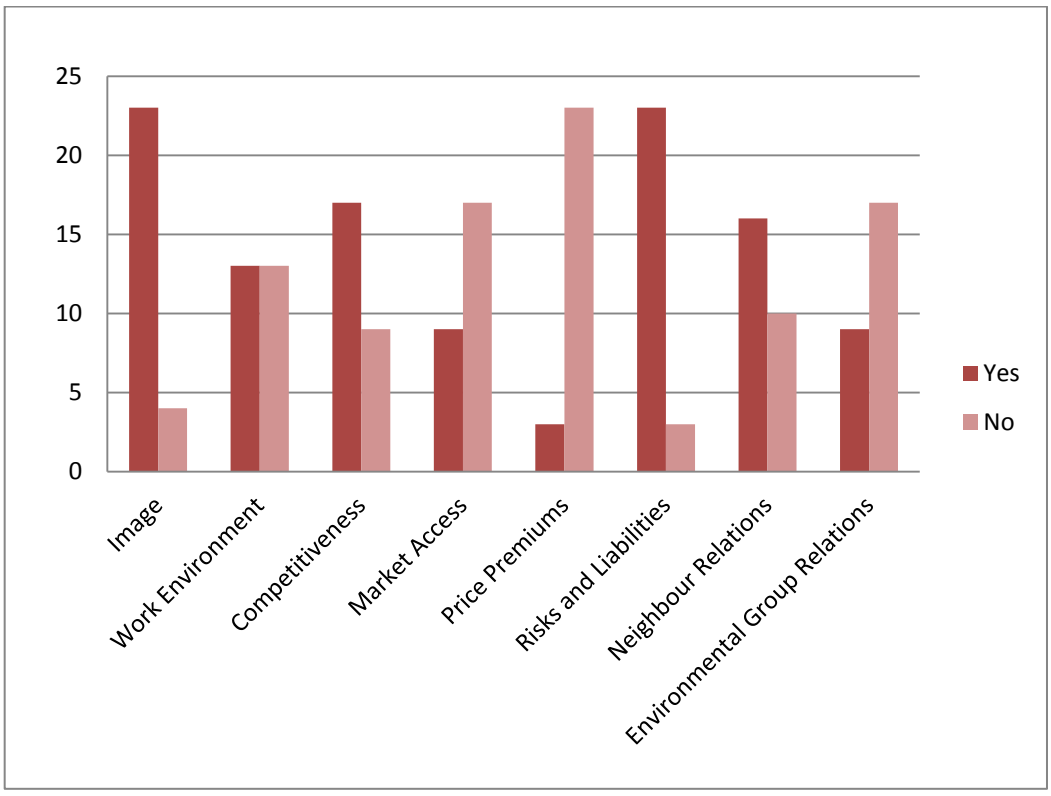
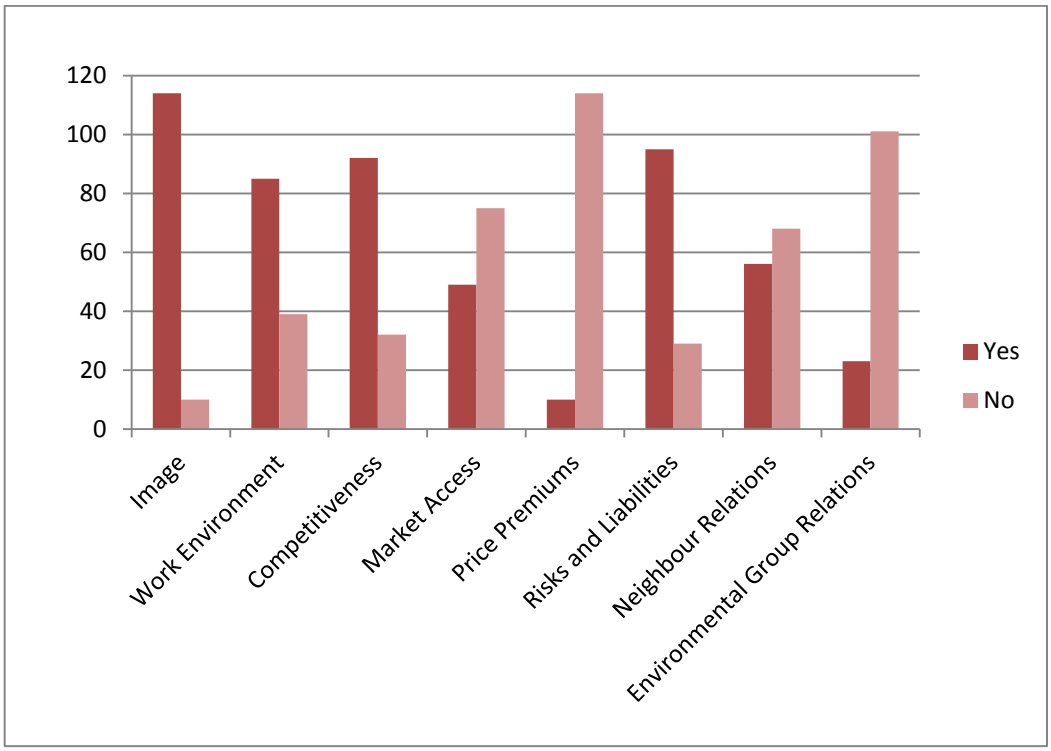


Figure 5.5: ISO 14001 Adopters Responses to Question 22: Do Firms Receive Benefits from ISO 14001 Adoption? (Electronics and Electrical Appliances Industry)



Question 23 asks ISO 14001 adopters whether or not ISO 14001 certification has helped them obtain cost savings in energy, electricity, water, and waste management expenditures. Eighty-five percent of the respondents report that it has. However, cost savings are reported more in the food and beverages, and electronics and electrical appliances industries. In the textiles and wearing apparel industry, although cost savings are reported, the number of those reporting no savings is higher than those reporting savings on all four categories.

In the food and beverages industry, and electronics and electrical appliances industry, the top two categories of cost savings reported are electricity and water. In the food industry, the average reduction in energy expenditures is 14.06 percent, and the average reduction in electricity, water, and waste management bills are 15.13 percent, 14.16 percent, and 20.73 percent accordingly. Additionally, firms in this industry also report that cost savings can be indirect such as in terms of improved production efficiency and better stakeholder relations.

Figure 5.6: ISO 14001 Adopters Responses to Question 23.1: Do Firms Receive Cost Savings from ISO 14001 Adoption? (All Industries)

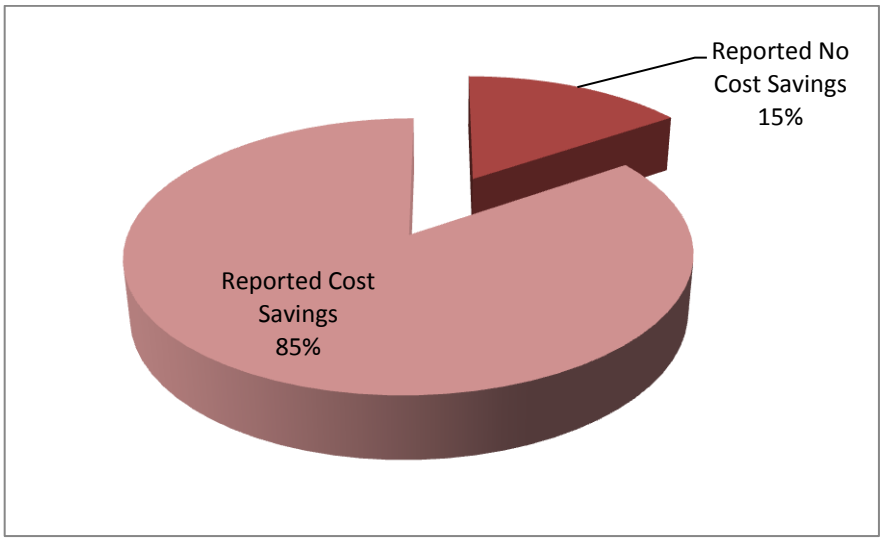
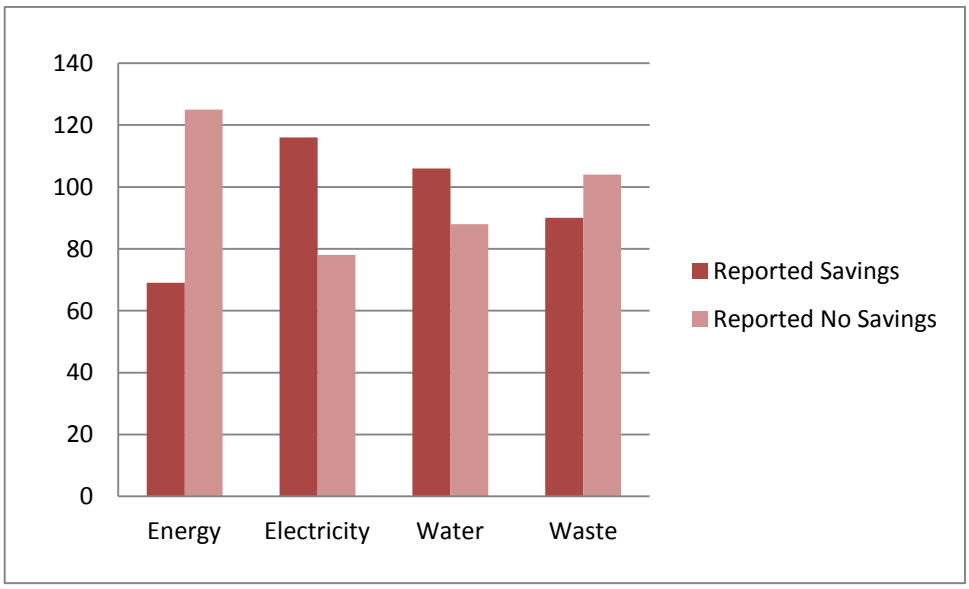


Figure 5.7: ISO 14001 Adopters Responses to Question 23.2 – 23.5: Do Firms Receive Cost Savings from ISO 14001 Adoption? (All Industries)



For the electronics and electrical appliances industry, average savings in energy, electricity, water, and waste management expenditures stand at 17.5 percent, 16.94 percent, 28.17 percent, and 21.03 percent respectively. Firms in this industry also report that they have been able to save on raw material costs due to recycling practices, and that they have saved on having to pay for chemicals and paper. Firms also report savings in terms of not having to pay fines due to the ability to meet wastewater

standards. Finally, firms report that improved sorting of waste has allowed them to gain additional income from selling recyclables.

For the textiles and wearing apparel industry, although a higher number of adopters report receiving no cost savings from it, for those that do, the average cost savings is greatest in waste management at 31.67 percent reduction. Cost savings in energy usage has an average of 20.17 percent, and savings in electricity and water expenditures are 10.14 percent and 16.17 percent on average.

As with Question 22, reported answers to Question 23 are consistent with results from similar studies on ISO 14001 certification. While reported cost savings are much less than the estimated 2 million US Dollars reported to have been saved by Meridian Magnesium company mentioned in Bansal and Bogner (2002), these figures are consistent with the estimated 21.9 percent savings that occurred from a reduction in waste following ISO 14001 adoption by an Alcoa Mt.Holly facility studied in Rondinelli and Vastag (2000). Reported results also concur with findings from the Thailand Environment Institute's 1999 survey of early adopters which report savings from reduced consumption of electricity, energy, and paper, and decreased waste management costs (TEI 1999). These results are also consistent with Mohamed (2001) and Tan (2005). However, there are also studies which have not found ISO 14001 to be helpful to firms in terms of cost savings (Montabon et al. 2000, Bansal and Bogner 2002, Ann et al. 2006, de Oliveira et al. 2010).

While firms in the primary survey sample do report cost savings in terms of decreased consumption of energy, electricity, water, and waste management, these findings are not at odds with the empirical analysis section's results that ISO 14001 adoption has no effect on the firm's production cost. Since ISO 14001 applies to all aspects of the firm and not just the production, the saved costs could be from the non-production aspects of the firm. Of the four types of savings studied, only savings from energy usage, a category in which more firms report receiving no cost savings than those that do, enters into the calculation of production costs according to the OIE definition. Savings in terms of electricity and water expenditures, the two most prominent savings reported, and savings in terms of reduced waste management costs are not included.

Table 5.6: Average Reported Cost Savings

	Energy	Electricity	Water	Waste Management
Food and Beverages	14.06%	15.13%	14.16%	20.73%
Textile and Wearing Apparel	20.17%	10.14%	16.17%	31.67%
Electronics and Electrical Appliances	17.50%	16.94%	28.17%	21.03%
All Industries	17.24%	14.07%	19.50%	24.48%

Figure 5.8: ISO 14001 Adopters Responses to Question 23.2 – 23.5: Do Firms Receive Cost Savings from ISO 14001 Adoption? (Food and Beverages Industry)

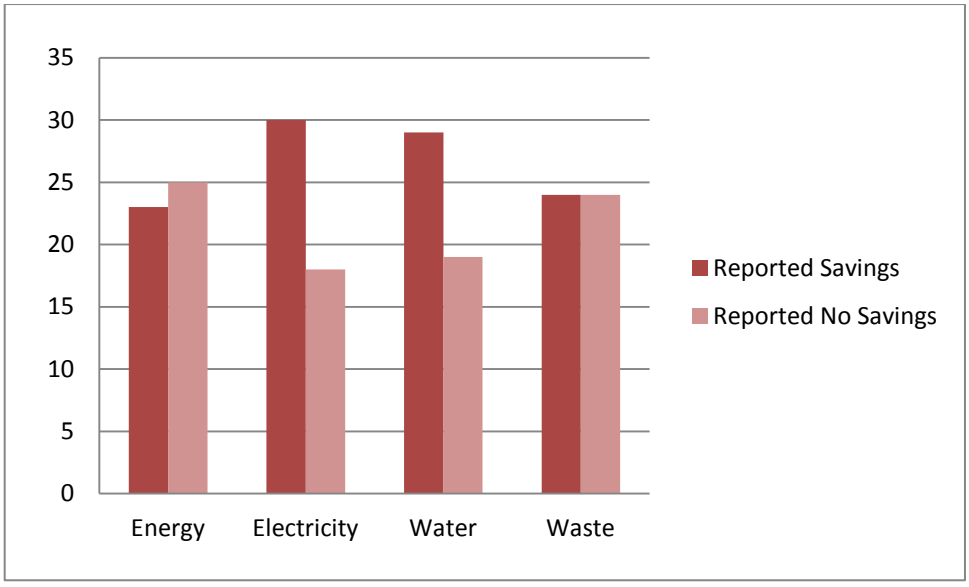


Figure 5.9: ISO 14001 Adopters Responses to Question 23.2 – 23.5: Do Firms Receive Cost Savings from ISO 14001 Adoption? (Textiles and Wearing Apparel Industry)

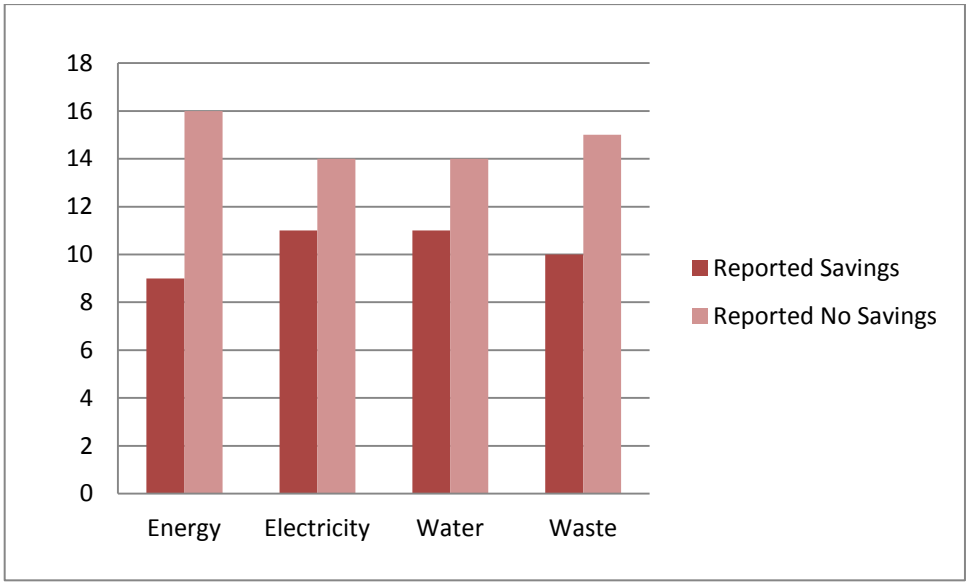
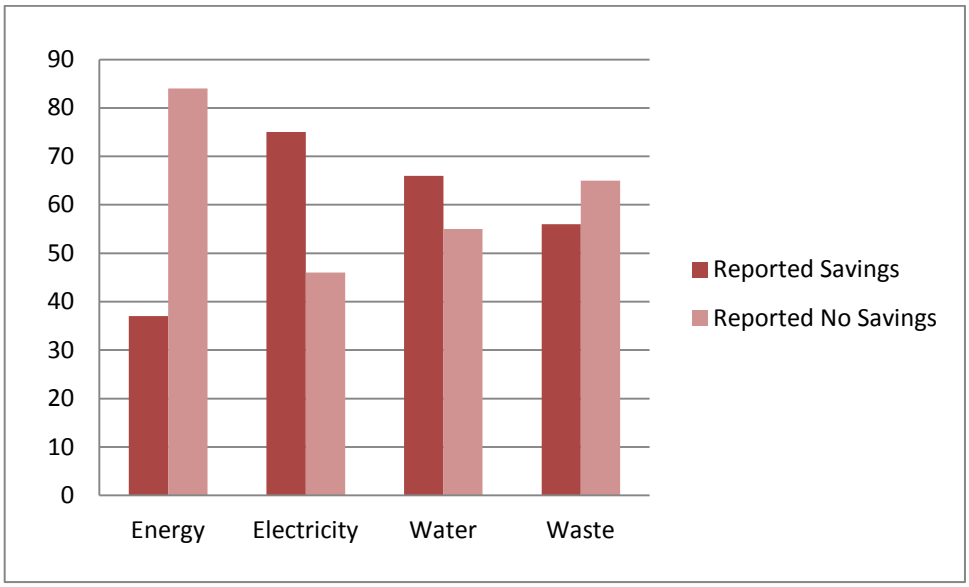


Figure 5.10: ISO 14001 Adopters Responses to Question 23.2 – 23.5: Do Firms Receive Cost Savings from ISO 14001 Adoption? (Electronics and Electrical Appliances Industry)



8. Conclusion

Chapter 5 sets out to find the benefits underpinning the developing country firm's decision to adopt ISO 14001 certification in the Thai context, a topic which has rarely been explored in the existing VEP literature. The seeming paradox of voluntary investments in environmental improvement is first examined from the theoretical literature. This review indicates that when the usual assumptions of perfect competition fail to hold, such as when information is imperfect, products are not homogenous, and the number of players in the marketplace is limited, there are avenues for firms to gain financial benefits from VEP participation. The type of benefits associated with ISO 14001 certification are then econometrically tested for in a way that addresses the main critiques of the current empirical literature, and the results are complemented with qualitative findings from the primary survey.

Findings indicate that while certification imposes direct costs on firms, adopting firms are not placed at a disadvantage to non-adopters in any of the measurable aspects of economic performance regardless of whether the measure is subjective or objective. This finding also persists over time and is applicable across industries. Information from ISO 14001 adopters in Thailand also indicate that programme participation can bring about benefits which are more difficult to quantify such as improved corporate image, increased competitiveness, reduced environmental risks and liabilities, and

improved relations with neighbouring communities. Findings also indicate that ISO 14001 certification is not conducive to obtaining price premiums and improving relations between the firm and environmental groups. In addition to this, there are some firms which do not report receiving benefits from ISO 14001 adoption, especially firms in the textiles and wearing apparel industry.

In conclusion, by using a combination of econometric and qualitative analysis methods and by employing different measures of firm financial performance, this chapter has demonstrated that while ISO 14001 certification does require non-trivial investment costs, adopting firms are not placed at a disadvantage in terms of profitability, total sales, export sales, production costs, and general business conditions. For many firms, programme participation may also bring added benefits in terms of reputation, reduced risks and liabilities, and increased competitiveness.

CHAPTER 6

ENVIRONMENTAL EFFECTS OF ISO 14001 PARTICIPATION

1. Introduction

Voluntary environmental programmes have been used in a variety of countries worldwide as a new tool for environmental management (UNRISD 2000, Brink 2002, Lyon and Maxwell 2002, Blackman 2008, Blackman et al. 2009, ISO 2010). However, given its origin by practitioners, its relatively short history, and the smaller literature on the topic compared with other main environmental management tools, the actual environmental impact of such programmes is still not clearly understood. This lack of understanding of programme impact has profound implications for the adoption of VEPs, especially for developing countries where weak monitoring and enforcement mechanisms often lead to the promotion of VEPs as a means for combating rampant non-compliance with existing regulations (O'Connor 1995, Dasgupta et al. 1997, World Bank 2000a, Blackman et al. 2007). Thus, before VEPs such as ISO 14001 can be recommended as a tool for supplementing existing regulatory systems, there first needs to be a better understanding of programme impact. This chapter aims to contribute to this aspect of VEPs by examining the impacts of ISO 14001 participation.

The international nature of the ISO 14001 certification, its widespread adoption, and the GATT/WTO agreement that effectively sets ISO 14001 as the ceiling for environmental management standard in international trade under WTO rules (Clapp 1998) combine to make the understanding of the environmental implications of ISO 14001 participation an especially important task. This is especially true for countries in the Far East, which make up 50.3 percent of the world's ISO 14001 certifications (ISO 2010) and are active participants in the international economy (Rock and Angel 2010), but which has been the focus of only a small percentage of empirical assessments of the ISO 14001 programme in the English-language literature on VEPs.

Thus, this study also contributes to the understanding of ISO 14001 in the context of a dynamic Asian economy which is not only actively engaged in international trade, but also one which saw one of the highest growth in ISO 14001 certification in the world in recent years (ISO 2010).

By evaluating the environmental effects of ISO 14001 certification, this chapter contributes to the existing literature on the evaluation of VEPs in the following ways. First, the study overcomes the problem of environmental data scarcity plaguing most of the developing world[1] by collecting primary survey data and imputing the firm's environmental performance based on their responses to a number of environment-related questions[2]. The survey also asked ISO 14001 firms to list environmental benefits they have received from having the certified environmental management systems in place. In so doing, the study makes use of a unique set of data which allows the researcher a glimpse at the firm's level of environmental performance. Second, the study covers an array of environmental aspects that span the whole production process from the use of raw materials to end-of-pipe emissions reductions. Third, the study looks at the evaluation problem through the lens of a novel theoretical framework that brings together elements of the equilibrium emissions framework (Hettige et al. 1996, Pargal and Wheeler 1996, Dasgupta et al. 2000) and the idea of ISO 14001 as a green club (Prakash and Potoski 2006). Fourth, the study not only takes into account the potential for firms to self-select into ISO 14001 participation, but also considers the potential for the endogeneity resulting from the adoption of other environmental practices by using the Heckman selection model and multivariate probit estimation method. Finally, the study combines the strength of empirical econometric analysis with the benefits of in-depth information from using qualitative data, thereby allowing for a more complete picture of the effects of ISO 14001 adoption in the developing world context.

The chapter begins by developing a theoretical framework for considering the environmental impact of ISO 14001 adoption in the developing world context. The current literature is then reviewed and existing findings on the environmental effects

[1]A few rare exceptions are Indonesia's PROPER, the Philippines EcoWatch, and China's GreenWatch schemes which publish colour-coded ratings of firm environmental performance.

[2]This is in keeping with other studies in the literature such as Dasgupta et al. 2000 and Arimura et al. 2008 which also use self-reported data in their analysis of environmental impacts of adoption of environmental management systems (EMS) in Mexico and Japan respectively.

of implementing environmental management systems (EMSs) are presented. The chapter then goes on to consider the specific case of ISO 14001 adoption in Thailand, examining it econometrically and qualitatively. The chapter ends with a conclusion section.

2. Theoretical Considerations of the Environmental Impact of ISO 14001 Participation

Designed as a tool for environmental management, ISO 14001 puts into place a series of procedures to ensure the organisation meets its stated environmental goals. However, since ISO 14001 only specifies the steps for an environmental management system, and has no other requirements beyond the minimum required by existing regulations, it is difficult to conclude from participation status alone that ISO 14001 adopters perform better environmentally when compared with non-adopters. Thus, in order to shed light on expected environmental impact of ISO 14001 adoption, this chapter calls upon the existing equilibrium emissions framework adopted in Pargal and Wheeler (1996), Hettige et al. (1996), and Dasgupta et al. (2000), then extends it using insights from club theory, and adapts this new framework to fit the context of industrial firms in the third world.

The equilibrium emissions framework is tailored for use with firms in developing economies since it considers the behaviour of the plant when formal regulations are weak or absent, a situation often found in developing country contexts (O'Connor 1995, Dasgupta et al. 1997, Blackman and Sisto 2005, Blackman et al. 2006, Van Rooij 2010). Under the framework, equilibrium emissions is determined by the demand for environmental services by the plant, and the supply of environmental services, or the expected price schedule exacted by the affected local community (Hettige et al. 1996, Pargal and Wheeler 1996). This framework was later modified by Dasgupta et al. (2000). Instead of considering pollution emissions by plants, Dasgupta et al. (2000) looked 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*, while

E_{reg} indicates the emissions standard specified by formal regulations. In Figure 6.1, the plant is not complying with existing environmental regulations.

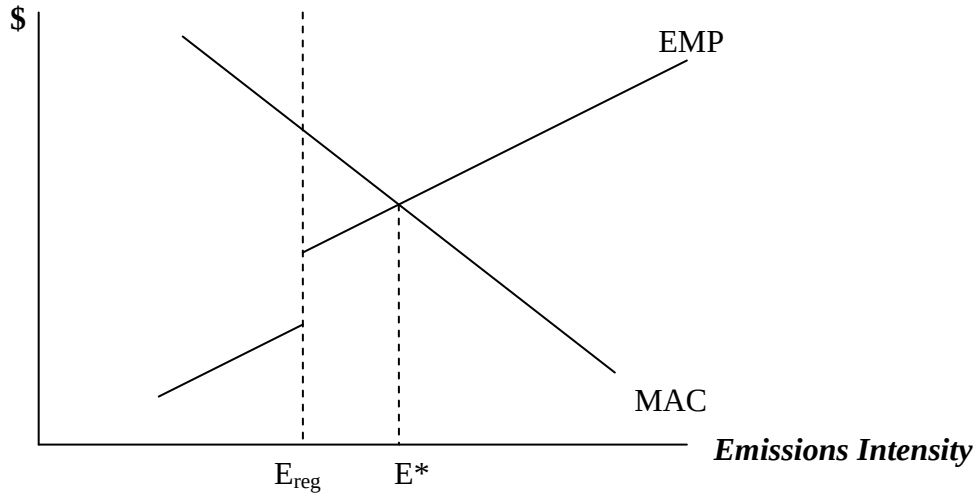


Figure 6.1: Equilibrium Emissions Framework that looks at emissions per unit output

The equilibrium emissions observed for each plant depends on the slope and position of the EMP and MAC schedules, which, in turn, are affected by a variety of factors both internal and external to the firm. 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 the firm's environmental management system. 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. Generated from the intersection of the two curves, equilibrium pollution emissions intensity is thus dependent upon all the factors affecting the slope and position of both the MAC and EMP schedules.

Another factor not considered by Dasgupta et al. (2000), but that also affects the equilibrium emissions intensity is participation in green clubs. For the participating firm, club membership affects both costs and expected penalty. Signing up for green clubs initially increases the marginal abatement cost for each unit of pollution emitted since club membership entails non-zero club costs. For green clubs such as ISO 14001 (Prakash and Potoski 2006), club costs include the initial costs for setting up an environmental management system that meets the requirements for ISO 14001

certification, as well as ongoing costs necessary for maintaining the EMS[3]. Although having an EMS in place may impose higher costs initially, it can result in various cost savings due to improved production efficiency, reduced environmental risks and liabilities, and better environmental management that result in the reduction of pollution emissions[4]. Since firms sign up to green clubs such as ISO 14001 because they expect positive returns to participation, in the long run, adoption will result in a decrease in the MAC schedule. However, the size of the shift will depend on the size of club costs and the cost savings resulting from participation.

Membership of green clubs also affects the EMP schedule. However, the direction of the shift of the EMP curve cannot be determined *a priori*. On the one hand, club membership may increase the EMP faced by the plant per unit emission since participation in green clubs such as ISO 14001 adds another group of stakeholders for the firm: the auditors of the EMS. Furthermore, ISO 14001 certification requires that firms should, at the very least, strive to be in compliance with existing environmental regulations. If firms are discovered to be non-compliant when subjected to mandatory audits and this discovery is disclosed, firms will receive more scrutiny from regulators. Finally, ISO 14001 requires firms to establish paper trails, documenting the firm's various environmental aspects. For firms which may have discovered and documented regulatory non-compliance, these documents can be incriminating if they are leaked out, regardless of whether the firm has remedied the problem or not. On the other hand, club membership can also result in the shifting down of the EMP curve. The reputation of the green club may keep pressures from stakeholders at bay. This is especially true for regulators in developing countries who are often operating with limited resources for monitoring and enforcement. Members of credible green clubs may be less targeted by regulators who prefer to target non-club members who are more likely to be non-complying with environmental legislation. (Prakash and Potoski 2006). Thus, given that there are forces acting on the EMP schedule in both directions, the resulting shift in the EMP will depend on the size of the two opposing forces.

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

[4] The cost savings and financial benefits to ISO 14001 participation are discussed in detail in Chapter 5.

With the MAC only shifting downwards with the adoption of ISO 14001, the emissions equilibrium resulting from ISO 14001 certification will depend on what happens to the EMP schedule after participation in the green club. If the two opposing forces acting on the EMP cancel themselves out so that there is no change in the EMP curve even after participation in the green club, then the decrease in marginal abatement cost will lead to a decline in emissions (Figure 6.2). Emissions further decreases if the overall effect of participation increases expected marginal penalty (Figure 6.3). On the other hand, equilibrium emissions intensity will increase even after participating in the voluntary programme if the overall effect of participation shifts the EMP schedule more to the right relative to the MAC schedule (Figure 6.4). As a result, the effect of programme participation on equilibrium emissions is unclear.

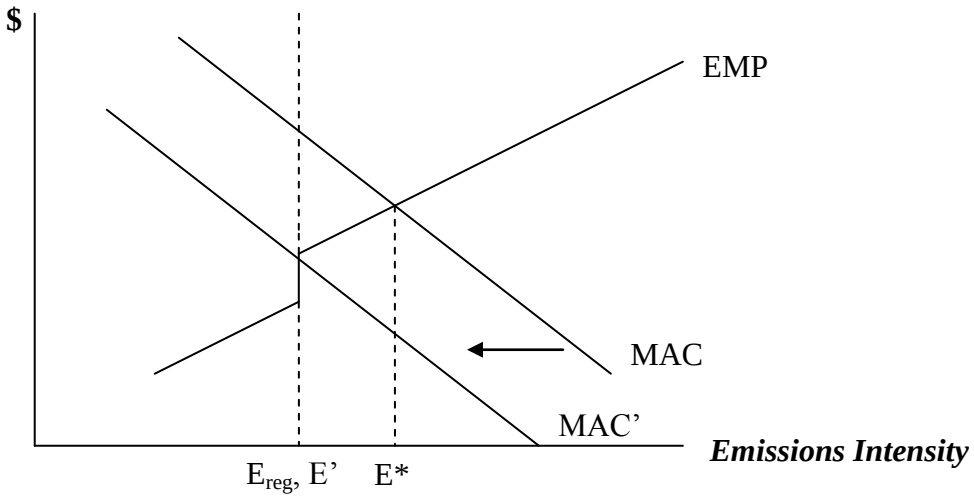


Figure 6.2: Two opposing forces on the EMP cancel. The EMP stays the same while MAC decreases due to positive financial benefits

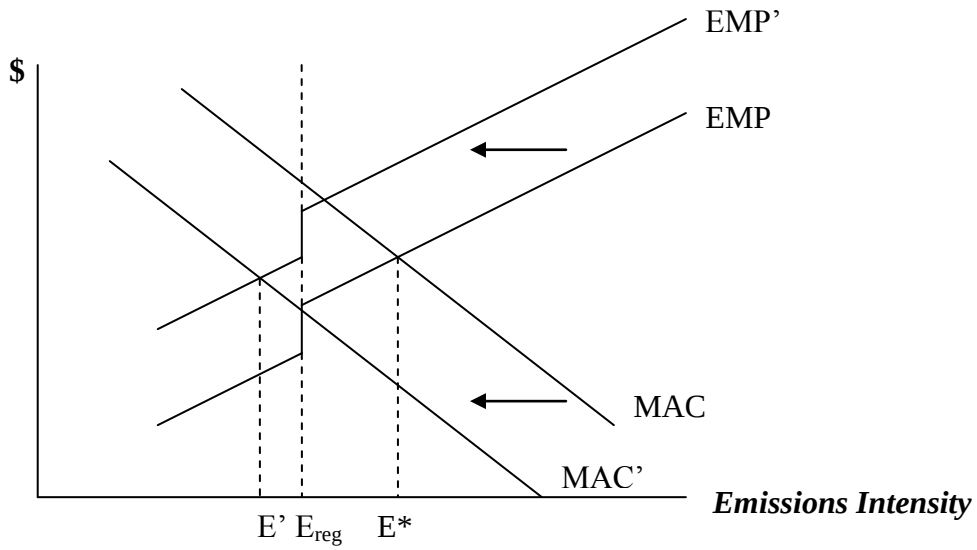


Figure 6.3: EMP increases due to participation, while MAC decreases as a result of positive financial benefits

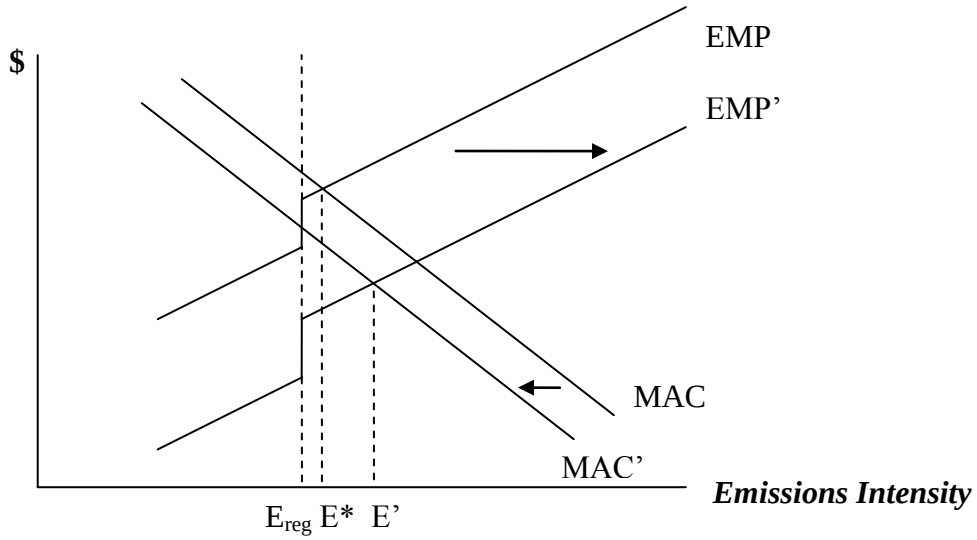


Figure 6.4: Both EMP and MAC decrease after participation but the shift in EMP is relatively larger than the shift in MAC

Figures 6.2 – 6.4 show that the resulting equilibrium pollution emissions per unit output for each manufacturing plant depends on the factors that determine the slope and position of the MAC and EMP curves. These factors include plant- and firm-specific characteristics such as ownership and size, the firm's decision to participate in voluntary programmes, the industrial sector the firm is in, the cost of implementing the voluntary programme, the estimated cost savings from programme participation, and the pressures from different stakeholders. Since the effect of programme participation depend on the different factors affecting the slope and position of the

MAC and EMP schedules, theory cannot predict whether or not participation in voluntary initiatives can improve firm environmental performance. This matter must be further investigated using real data.

3. Current Evidence on ISO 14001 Participation and Environmental Outcomes

The theoretical framework developed earlier on in the chapter points to the importance of using real data to determine the result of ISO 14001 adoption on the firm's environmental footprint. Thus, before employing the primary survey data, a review of the existing literature on ISO 14001 adoption is necessary in order to shed further light on the topic. However, it should be noted that, although the focus of this study is on developing countries, the state of the current literature is such that the overwhelming majority of studies reviewed in this section are undertaken in industrialised countries. Thus, while the general conclusions from this review provide certain insights into the environmental impacts of ISO 14001 certification, the findings are more applicable to the industrialised world context. This review covers two strands of literature – the more qualitative survey of ISO 14001 adopters and econometric-based articles.

To determine the environmental impact of ISO 14001, a number of researchers sampled certified firms and directly asked them whether or not they received environmental benefits from implementing ISO 14001. Studies ranged from those focusing on one country to ones which drew from an international sample of certified firms. For Thailand, a study undertaken in 1999 reveals that 73 percent of the firms surveyed replied that having ISO 14001 in place helped them decrease their environmental impacts (TEI 1999). The majority of the firms also reported reductions in pollution emissions, use of raw materials and natural resources, and work-related accidents (TEI 1999). Similar results are also reported by various studies of environmental management systems in the United States. Rondinelli and Vastag (2000) find that ISO 14001 certification help to significantly reduce waste in one aluminium plant which was already operating at the forefront of its industry in terms of environmental performance prior to certification. Using a much larger sample, Montabon et al. (2000) find that certification helps to increase the firm's efficiency

and effectiveness. Comparing firm performance both before and after EMS adoption, Andrews et al. (2003) find that firms generally report improved environmental performance after having EMSs in place[5]. Similar results are also reported in other countries. In an international survey of ISO 14001 adopters, Raines (2002) finds that the majority of firms report that they have made significant environmental improvements due to ISO 14001 adoption. Waste reductions and improved environmental impact are also reported by certified firms in Brazil (de Oliveira et al. 2010), China (Raines et al. 2002, Zeng et al. 2005), Egypt (Mohamed 2001), and Malaysia (Tan 2005, Ann et al. 2006, Sambasivan and Ng 2008).

Findings from such surveys of ISO 14001 certified firms are useful in providing insights into the effects of ISO 14001 for those who implement them. However, they do not allow for comparisons of certified and non-certified firms. Econometric studies fill this gap by empirically comparing adopters with non-adopters, although the environmental impacts such studies are able to evaluate are limited to quantifiable measures.

Among the econometric studies looking at the adoption of EMSs and ISO 14001 certification, some have found evidence supporting the view that adoption is associated with better environmental performance. In one of the few developing country studies in existence, Dasgupta et al. (2000) looks at the adoption of environmental management practices in Mexican manufacturing facilities and finds that environmental management has a strong effect on self-reported regulatory compliance[6]. Another study by Arimura et al. (2008) finds that ISO 14001 certification helps reduce firm environmental impacts in three areas – natural resource use, solid waste generation, and wastewater effluent. The study also finds that ISO 14001 is more effective than publishing environmental reports in the first two areas. Russo (2002) and Prakash and Potoski (2005, 2006) also find evidence that ISO 14001 helps U.S. firms reduce environmental impacts. In addition to this, Welch et al. (2002) finds that ISO 14001 adoption is associated with more environmental action,

[5] The study also finds that the reported benefits come from the implementation of EMSs. The study finds no significant differences between reported environmental improvement of certified and non-certified firms.

[6] The facilities included in the study come from four sectors – food, metals, chemicals, and non-minerals.

although the study could not conclude that there is a clear causal linkage between ISO 14001 adoption and greening activities of firms.

While several studies have found positive outcomes, other studies have not found that voluntary programme participation help improve firm environmental performance. In a meta-analysis of voluntary environmental programmes in the U.S., Darnall and Sides (2008) finds that, as a whole, participants of voluntary programmes do not have improved environmental performance when compared with non-participants. The study also looks at ISO 14001 participation and comes to the conclusion that, collectively, ISO 14001 adopters show inconclusive performance improvements. Looking at emissions from the pulp and paper industry in Canada, Barla (2007) finds that having ISO 14001 certification do not lead to reduced total suspended solid emissions and that, while ISO 14001 adopters did reduce their discharge of BOD by 9 percent after certification, unlike non-adopters, they did not exhibit significant negative trends in emissions over the sample period. Barla (2007) also finds that the impact of ISO 14001 is very variable across adopting plants. In a study using data from the U.K., Dahlström et al. (2003) finds that while having an EMS in place improves certain procedural aspects of environmental management, it is not associated with increased regulatory compliance.

As it stands, the current qualitative and quantitative literature evaluating ISO 14001 and EMS adoption in the industrialised world have found inconclusive evidence on the potential of environmental improvement associated with programme adoption. However, as Toffel (2005) points out, estimating programme impacts in industrialised countries might significantly underestimate the effectiveness of such schemes in the developing world which have less regulatory pressures for compliance. Comparing the benefits of ISO 14001 adoption in Malaysia and Singapore, Perry and Singh (2001) finds that in Singapore where environmental compliance is already high, certification has not brought about much additional improvements. On the other hand, the study finds that programme participation has more benefits in Malaysia where there are less resources devoted to ensuring regulatory compliance. The novelty of environmental management systems for firms in industrialising economies also mean that such firms stand to gain more benefits at the margin when compared with firms in developed countries which have already reaped the low-hanging fruits of EMS

implementation (Raines et al. 2002, Lankoski 2008). Since environmental information is costly to gather, firms in developing countries facing weak formal regulatory activity would have little incentives to pay these costs (Blackman et al. 2004). Thus, schemes which help firms uncover new environmental information such as information disclosure programmes and ISO 14001-standard EMSs can generate 'environmental audit effects' that can help previously uninformed factory managers improve their performance following participation[7,8].

The potential for developing country firms to benefit more from EMS adoption is reflected in the small but growing literature on programme evaluation in third world countries. Studying EMS adoption in Mexican industries, Dasgupta et al. (2000) finds that participation has a strong effect on regulatory compliance. In two international surveys of ISO 14001 certified firms undertaken by Raines et al. (2002) and Raines (2002), it is found that firms in developing countries are more likely to view ISO 14001 as being 'very helpful' in helping them improve their environmental performance. In both studies, firms are reported as citing reduced resource use and reduction in energy use as benefits to having ISO 14001 certification. Similar findings are also reported in surveys of ISO 14001 adopters in Thailand (TEI 1999), Brazil (de Oliveira et al. 2010), China (Raines et al. 2002, Zeng et al. 2005), Egypt (Mohamed 2001), and Malaysia (Tan 2005, Ann et al. 2006, Sambasivan and Ng 2008). Thus, there is room for optimism in the adoption of ISO 14001 certification in the developing world context. However, empirical analysis of the research problem is still needed in order to better understand the implications of ISO 14001 adoption in the Thai context.

[7] Studying Indonesia's PROPER information disclosure programme, Blackman et al. (2004) find that, contrary to expectations generated from a review of the existing literature, the environmentally beneficial impact of the programme is due mainly to the environmental audit effect, which work in conjunction with external pressures.

[8] Since environmental disclosure programmes are not the subject of this dissertation, a review and discussion of their impacts are omitted. For the literature on such schemes see, e.g., Konar and Cohen (1997), Blackman and Bannister (1998), Garvie (1999), Barthelot et al. (2003), Blackman et al. (2004), Petrakis et al. (2005), and Dasgupta et al. (2007).

4. Measuring Environmental Impact in the Three Manufacturing Sectors in Thailand

For developing countries such as Thailand, reliable environmental data is severely lacking. Unlike many industrialised countries where firms are mandated to release environmental information to the public, firms in the majority of developing countries are not required to do so[9]. In Thailand, while firms classified by law as potentially environmentally harmful are required to submit reports to the Ministry of Industry's Department of Industrial Works (DIW), the reports are strictly confidential and are not released to the public[10]. To overcome this lack of publicly-available firm-level environmental data, the study follows the example of many articles on environmental assessments in the literature and uses self-reported environmental information (see, e.g., Dasgupta et al. 2000, Montabon et al. 2000, Raines 2002, Raines et al. 2002, Andrews et al. 2003, Zeng et al. 2005, Arimura et al. 2008, Yin and Schmeidler 2009).

To ensure that the data obtained is as reliable as possible, advice was sought from experienced environmental researchers from Thammasat University, the Thailand Environment Institute, the Thailand Productivity Institute, and the Federation of Thai Industries on how to design the questionnaire and word the questions so as to entice respondents to present an accurate picture of their firm's environmental status[11]. This resulted in one core question asking both ISO 14001 certified and non-certified firms to rate themselves on seven environmental aspects (Question 10). The question spans a range of environmental themes and includes questions on the manufacturing process as well as end-of-pipe pollution reduction. Additionally, firms with ISO 14001 certification are asked to list the environmental benefits they received from adopting the certifiable environmental management system (Question 21).

[9] A few rare exceptions are Indonesia's PROPER, the Philippines EcoWatch, and China's GreenWatch schemes which are public disclosure programmes that rate firm's environmental performance by using colour codes. (See Wheeler and Afsah 1996, Afsah and Vincent 1997, Blackman et al. 2004, Dasgupta et al. 2007, etc.).

[10] Repeated attempts were made to obtain this information from the DIW for use in this research with assurances that firm names would not be released. However, all requests were rejected. To date, the researcher knows of no other studies on Thailand that is able to access this data.

[11] The primary survey process and the primary survey questionnaire are discussed in detail in Chapter 3 and Appendix II of this dissertation.

For Question 10, rather than asking firms to rate their environmental performance using subjective criteria such as 'excellent', 'poor', etc. (Dasgupta et al. 2000), the questionnaire employs a more objective set of criteria that is graduated on a scale of 1 to 5. For each question, a reply of '5' is warranted for firms that have that environmental aspect as a policy, have implementation plans and implementation, carry out evaluations of their actions, and continually improve their handling of that environmental aspect. A reply of '4' is warranted when firms have the policy in place, have implementation plans and implementation, but have no evaluations for improvements. A reply of '1' means the firms have not addressed that environmental issue. The seven environmental aspects the firms are assessed on are given in Table 6.1 and correspond to Questions 10.1 to 10.7 on the primary survey questionnaire. Specific details of the questions asked are available in Appendix II.

Table 6.1: Core Questions Used To Assess Firm Environmental Performance

No.	Topic
10.1.	Treatment of waste before release into the environment.
10.2.	Measures to reduce spills and leaks of environmental contaminants
10.3.	Recycling activities
10.4.	The use of raw materials that have low environmental impacts in the production process
10.5.	Pollution prevention in the production process by modifying the production process or the product itself.
10.6.	Use of clean technology in reducing energy consumption, or in increasing energy efficiency.
10.7.	Modification of products to reduce environmental impact throughout the product life-cycle (production process, raw material selection, transportation, usage, and disposal)

Those familiar with the ISO 14001 certification will see that the rating criteria used resemble the Plan-Do-Check-Act (PDCA) cycle characteristic of ISO 14001. This is intentional. Asking the questions in this way allows for an assessment of whether or not having the programme in place actually means that firms with ISO 14001 perform better than non-ISO 14001 firms on the criteria set by the programme. The use of these criteria is then complemented by the range of questions on different environmental aspects of the firms. Since ISO 14001 allows firms to set their own environmental policies, the questions asked and the criteria used combine to provide a clearer picture of the breadth of environmental policies adopted by firms. Thus, this

way of measuring environmental performance also allows for a broad measure of environmental impact which encompasses end-of-pipe emissions as well as more upstream production processes.

Despite the care taken to minimise misinterpretation and to ensure objectivity of the rating exercise, it should be noted that, as discussed in Section 4.4 of Chapter 3, the use of self-administered mail-based survey questionnaires is not without its flaws. While the use of self-reported environmental information is common in the existing literature (see, e.g., Dasgupta et al. 2000, Montabon et al. 2000, Raines 2002, Raines et al. 2002, Andrews et al. 2003, Zeng et al. 2005, Arimura et al. 2008, Yin and Schmeidler 2009) and is necessarily employed in this dissertation due to the lack of readily-available firm-level information, the readers should bear in mind that replies to such sensitive questions may be tainted by 'social desirability bias' (SDB), which occurs when respondents over-report socially desirable traits (Zerbe and Paulhus 1987, Granberg and Holmberg 1991, Fisher 1993, Fu et al. 1998, Belli et al. 2001). In the worst case scenario, firms resort to misreporting that they are complying and improving their performance while actually doing the opposite (Boiral 2003, 2005, Yeung and Mok 2005, Egels-Zandén 2007, Lyon and Kim 2008). However, as discussed in Chapter 3, the use of self-administered postal surveys such as the one adopted here limits this tendency for firms to report socially desirable results (see, e.g., Nederhof 1985, Sudman et al. 1996, Tourangeau and Smith 1996, Presser and Stinson 1998, King and Bruner 2000, Kreuter et al. 2008) [12].

5. Econometric Evaluation of Environmental Impacts from ISO 14001 Participation

As discussed in Chapter 5, the object of interest in the programme evaluation literature is the comparison of outcomes when the units under study are exposed to

[12] A related issue is the type of firm VEPs attract. On the one hand is the finding that voluntary programmes tend to attract dirtier firms (King and Lenox 2000, Khanna and Anton 2002, Blackman et al. 2010), while on the other hand, some studies have found that VEPs actually attract cleaner firms which have lower participation costs (Morgenstern and Pizer 2007, Vidovic and Khanna 2007). It is unclear what the implications for each finding are. While programmes that attract dirtier firms have been negatively viewed as being prone to adverse selection (Lenox and Nash 2003), participation of firms with higher emissions have also been positively viewed as indicative that dirty firms are willing to commit to environmental improvement by signing up (Koehler 2007). This dissertation does not distinguish between clean and dirty firms. Rather, it assumes that firms self-select into ISO 14001 certification based on expected gains.

multiple levels of treatment. The parameter of interest, Δ_i, is defined in Equation 5.1 as

$$\Delta_i = Y_{1i} - Y_{0i}$$

where Y_{1i} is the outcome when firm i receives treatment (D_{1i} = 1) and Y_{0i} is the non-treatment outcome (D_{1i} = 0). The observed outcome, Y_i, is given by the Rubin Causal Model (RCM) and is defined in Equation 5.2 as

$$Y_i = Y_i(D_{1i}) = Y_{0i}(1 - D_{1i}) - Y_{1i}(D_{1i})$$

The mechanism for treatment assignment is the second ingredient of the RCM (Imbens and Wooldridge 2009). In a study which uses non-experimental data to estimate programme impact such as this one, the potential for non-random assignment of treatment is always a present threat (Wooldridge 2002, Morgenstern et al. 2008). In addition to this, in evaluating the environmental impact from adoption of one voluntary programme, there is a threat that adoption of other voluntary practices will bias results if it is not properly accounted for (Arimura et al. 2008). This dissertation recognises both of these threats and begins the econometric analysis section by applying multivariate probit estimation, which simultaneously tackles these two potential sources of bias. Endogeneity of treatment is also tackled separately using the Heckman selection model, which allows for the recovery of additional parameters of treatment effect such as the effect of treatment on the treated population (TT) and the effect of treatment on the untreated population (TUT).

For both the multivariate probit regressions and the Heckman selection models, factors hypothesised to determine environmental outcomes of the firm are the same. These explanatory variables are described in detail in Section 5.1. Details of the dependent variables are discussed in the relevant analysis sections. Descriptions and summary statistics of both dependent and independent variables are given in Table 6.3.

5.1. Explanatory Variables

The theoretical framework developed in Section 2 indicates that a variety of factors combine to determine the position of the expected marginal penalty (EMP) and the marginal abatement cost (MAC) curves, whose intersection, in turn, determine the

environmental outcome associated with ISO 14001 adoption. These factors include ownership, formal regulatory activity, local community action, trade links of the manufacturing facility, costs associated with ISO 14001 certification, and intensity of stakeholder pressures. [13,14]

To reflect the measures used in the first-stage participation regression, ownership is measured here using three separate variables. First there is the dummy variable for foreign direct investment (FDI) which is 1 for firms with FDI and is 0 otherwise. Then there is the dummy variable for firms receiving FDI from countries with a high rate of ISO 14001 adoption which takes the value of 1 for such firms and is 0 otherwise. Finally, there is the dummy variable which takes the value of 1 for firms which receive FDI from OECD countries and is 0 otherwise. These three measures are used in separate regression specifications.

Trade links of the manufacturing facility, another determinant of the EMP curve, is also measured via three variables to reflect the measures used in the participation regressions. The first of these measures is the dummy variable for export orientation, which takes on the value of 1 for exporting firms, and is 0 otherwise. The second of these measures is the dummy variable for firms exporting to countries with a high number of ISO 14001 certification. This variable takes the value of 1 when firms export to ISO 14001-rich countries, and is 0 otherwise. The third and last measure is the dummy variable for exporting to OECD countries. This variable is 1 for firms who export to at least one OECD market, and is 0 otherwise.

Formal regulatory activity, local community action, and intensity of stakeholder pressures are measured using two variables. The dummy variable for location in

[13] The explanatory variables used reflect the extended emissions equilibrium framework developed in Section 2 of this chapter. Alternative theoretical frameworks are the resource-based view of the firm (RBV) and dynamic capabilities approach which posit that heterogeneity in the firm's performance is a function of internal firm resources and capabilities (see, e.g., Hart 1995, Rangone 1999, Sharma, 2000, Hoffman 2001, Aragon-Correa and Sharma 2003, Aragon-Correa et al. 2008, Russo 2009, Yin and Schmeidler 2009). Although these measures are not directly included in the econometric analysis, they are indirectly accounted for by the estimation strategies adopted which allow for individual heterogeneity. However, because firm internal organisational variables are not included, the conclusions drawn from this dissertation are more relevant for policymakers looking for a general overview of the impact of ISO 14001 certification rather than firm managers who are more interested in the organisational and strategic aspects of ISO 14001 certification.

[14] Although many of these variables are the same as the ones included in the participation regressions, the exclusion restriction requirement for identifying the Heckit model is fulfilled with the use of variables such as ISO 9000 participation, the production of final products, etc. in the first-stage participation regressions.

industrial estate, which is 1 for firms located in industrial estates or industrial parks and is 0 otherwise, is a proxy for local regulatory pressure since such firms are subjected to more stringent environmental requirements than firms located outside of such designated industrial zones. The variable stakeholder pressures, constructed using principle components analysis, is an index used to measure pressures the firms receive from all its stakeholders including formal regulators and the local community.

Finally, while the costs of ISO 14001 certification is not directly measured, a measure which includes the costs associated with environmental improvement is used instead. This alternate measure also has the advantage of being available for both those who choose to adopt ISO 14001 and those who choose not to participate in the programme. This measure is the proxy for obstacles to environmental improvement, an index variable constructed using the principle components method.

5.2. Estimation of Programme Impact in the Case of Multiple Endogenous Treatments

While the ISO 14001 standard is designed so that firms could achieve continuous environmental improvement and is thus likely to positively affect the firm's environmental performance, the measures of performance adopted here are general measures not specific to ISO 14001 participants. As a result, they also stand a chance of being affected by other environmental practices or voluntary programmes that are adopted by the firms instead of or in conjunction with ISO 14001 certification. In light of this, the current practice in the literature of solely focusing on evaluating the effect of one voluntary environmental programme in isolation from the adoption of other non-programme environmental practices may lead to an overestimation of programme impacts (Arimura et al. 2008).

For the case of Thailand, the low number of VEPs in existence and their small participation numbers indicate that this problem may not be as serious a threat as it is for the Japanese setting studied in Arimura et al. (2008) which sees a much higher presence of VEPs. Nonetheless, the beginning proliferation of VEPs in the country coupled with rapidly rising interest in sustainable environmental practices amongst manufacturing firms suggest that there is a need for caution in programme evaluation within the context of Thailand. This section addresses this potential problem and

adopts a framework for estimating treatment effects regressions in the presence of multiple treatments. The analysis also extends the few pieces of work done in this area by taking into account both the effects of the publication of environmental reports by firms (analysed in Arimura et al. (2008)) and firm's participation in other voluntary environmental programmes (analysed in Sam et al. (2009)[15]).

5.2.1. The Multivariate Probit Model

To eliminate the threat of biased results due to the firm's adoption of other voluntary environmental practices, the estimation method must be able to account for the endogeneity of the multiple treatments in the outcomes regression as well as deal with the potential correlation between the treatments. In addition to this, for this study, the estimation strategy must also allow for the correction from choice-based sampling of the survey data. The multivariate probit model can account for all these complications and is shown to be one of the best methods of estimation in the case of multiple treatments, provided that the outcomes and respective treatment variables are binary (Bhattacharya et al. 2006). The model provides consistent and unbiased estimators of the coefficients and treatment effects under assumption of multivariate normality of the error terms, and it has been shown to perform better than other estimation strategies in the event of model misspecification (Angrist 1991, Bhattacharya et al. 2006). This research adopts the recursive multivariate probit model where treatments enter recursively into the outcomes regression, but do not enter as independent variables in the individual treatment regressions.

The general specification of the multivariate probit model with M equations employed here is of the form:

$$
\begin{aligned}
D_1^* &= X_1\beta_1 + u_1 \\
D_2^* &= X_2\beta_2 + u_2 \\
\vdots \quad &\quad \vdots \quad \quad \vdots \\
D_{M-1}^* &= X_{M-1}\beta_{M-1} + u_{M-1}
\end{aligned}
$$

[15]Unlike Arimura et al. (2008) which studies the effects of having environmental management systems and the publication of environmental reports simultaneously, Sam et al. (2009) is more interested in determining the mechanism through which voluntary pollution reduction programmes reduce pollution and, thus, studies the sequential effects of first participating in the 33/50 programme and then adopting total quality environmental management (TQEM) practices.

$$D_M^* = \alpha_{M1}D_1 + \alpha_{M2}D_2 + \cdots + \alpha_{M,M-1}D_{M-1} + X_M\beta_M + u_M \qquad \text{Eq. 6.1}$$

Where $D_i = \mathbb{1}[D_i^* \geq 0]$

u_i is the error term, and

i = 1, 2, …, M

The model assumes the errors are M-variate normally distributed with the following properties:

$$\begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_M \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \\ \vdots \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_{12} & \cdots & \rho_{1M} \\ \rho_{12} & 1 & \cdots & \rho_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ \rho_{1M} & \rho_{2M} & \cdots & 1 \end{pmatrix}\right]$$

5.2.2. Estimation of the Multivariate Probit Model

Estimation of the multivariate probit model requires the outcomes and treatment variables to all be binary. Participation in ISO 14001 is a dummy variable which is 1 for firms with ISO 14001 certification and is 0 otherwise. The publication of environmental reports asked in Question 11 and the adoption of other VEPs asked in Question 14 of the primary survey questionnaire are both coded as dummy variables equal to 1 if the firms adopt the environmental practice in question and are 0 otherwise. Finally, the outcome variable in this estimation, dummy environmental score, is derived from the firm's overall environmental score which sums up the firm's score on each of the seven individual environmental aspects. Thus, dummy environmental score takes the value of 1 for firms with strong environmental performance and is 0 otherwise[16].

To estimate the multivariate probit model, the estimation of M-variate normal integrals and their derivatives is required. However, this is a formidable task which, at present, can neither be accurately nor efficiently estimated using standard quadrature methods (Greene and Hensher 2010). To overcome such estimation problem, simulation-based methods are employed instead (Cameron and Trivedi 2005). This dissertation uses the Geweke-Hajivassiliou-Keane (GHK) simulated maximum likelihood estimator because of its many desirable properties in the context of M-

[16] Strong environmental performance is defined here as those scoring mostly 4 and 5 for each individual environmental aspect.

variate normal limited dependent variable models (Börsch-Supan et al. 1992, Cappellari and Jenkins 2003). The GHK simulator has unbiased simulated probabilities which are bounded in the interval (0,1), and is more efficient than similar estimators. In addition to this, the estimator is asymptotically consistent and equivalent to the maximum likelihood estimator when the number of simulations is large (Cameron and Trivedi 2005). In practice, this translates roughly to setting the number of simulations (R) as least as great as the square root of the number of observations ($\sqrt{N}$) (Cappellari and Jenkins 2003). To ensure minimum risk of simulation bias, this study uses R of greater than 400 for the square root of the sample size ($\sqrt{N}$) of approximately 22.

As indicated earlier, this section of the dissertation considers the effect of ISO 14001 on firm environmental performance in the presence of two other environmental practices that are potentially endogenous. Thus, a total of four econometric equations are considered. One for environmental performance, one for participation in ISO 14001, one for participation in non-ISO 14001 voluntary environmental programmes, and, finally, one for the publication of environmental reports.

Simulations are time consuming estimation methods, especially when the number of draws, R, is set at a high value such as in this study to ensure accuracy of results. Run time also increases with the number of equations to be simultaneously estimated (Cappellari and Jenkins 2003). To save calculation time, pairwise correlations between the three treatment variables and the dummy environmental score are first calculated to see if the two treatments are indeed endogenously determining ISO 14001 certification and environmental outcome. The results are reported in Table 6.1 and indicate that the adoption of other voluntary environmental programmes such as CSR, ecolabels, and green procurement practices are not significantly correlated with either ISO 14001 adoption or the outcome variable, dummy environmental score. It is therefore safe to drop the adoption of other VEPs from the multivariate probit estimation. This results in a multivariate probit estimation of three equations with dummy environmental score, ISO 14001 participation, and publication of environmental reports as the dependent variables. To determine robustness of results and to echo the participation models in Chapter 4, six specifications of each set of equations are estimated. Results are shown in Tables 6.4-6.6.

Table 6.2. Pairwise Correlations of Environmental Score, ISO 14001 Participation, and the Two Environmental Practices

	ISO 14001 Certification	Adoption of Other VEPs	Environmental Report	Dummy Environmental Score
ISO 14001 Certification	1			
Adoption of Other VEPs	-0.0188	1		
Environmental Report	0.0969**	0.2749***	1	
Dummy Environmental Score	0.3555***	0.0149	0.1557***	1

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

5.2.3. Results From Multivariate Probit Regressions[17]

The GHK estimator results show that the coefficients of ISO 14001 participation in the environmental outcome regressions are positive and highly statistically significant throughout all six specifications, indicating a strong positive relationship between certification status and firm environmental performance. These findings are in line with Toffel (2005)'s suggestion that the impact of VEP adoption could be stronger in developing countries where regulatory pressures are less stringent, and Perry and Singh (2001)'s discovery that the effect of ISO 14001 implementation is stronger in Malaysia which has less resources for environmental regulation than in Singapore where the majority of firms are already in compliance. They also concur with Raines et al. (2002)'s stipulation that developing country firms are likely to report more benefits to certification because of the novelty of EMS implementation and, as a result, have more to gain at the margin (Lankoski 2008). The results are also in keeping with Dasgupta et al. (2000), Welch et al. (2002) and Arimura et al. (2008), and Russo (2002) and Prakash and Potoski (2006), which find that environmental management has a strong effect on regulatory compliance in Mexican firms, that ISO 14001 is associated with strong environmental action and reduces impacts in Japanese firms, and that certification helps U.S. firms reduce their environmental impacts accordingly. The findings also go hand-in-hand with findings from qualitative surveys of ISO 14001 firms, especially TEI (1999), which finds that early adopters of the VEP in Thailand report improved environmental performance as a result of programme participation.

[17] Prior to the estimation of the GHK regressions, the usual regression diagnostics were performed.

Despite the positive relationship between ISO 14001 and environmental performance, the study finds that the coefficients of the adoption of the publication of environmental reports are all non-significant. Furthermore, the values of the correlations between equations are only statistically significant for ISO 14001 adoption and environmental performance. Rho values between ISO 14001 adoption and environmental report publication, and between environmental performance and environmental report publication are not statistically significant. These results concur with earlier speculation that the roles played by non-ISO 14001 voluntary environmental programmes and the publication of environmental reports in determining the firm's environmental performance are still limited in Thailand. Since the country has no other VEP that is as widespread as the ISO 14001 scheme, the limited adoption of these other VEPs could be the reason why even the collective aggregation of non-ISO 14001 programme participation is not statistically significant.

The non-significance of the publication of environmental report, on the other hand, tells a different story. According to Ministry of Industry regulations, firms deemed to be potentially environmentally harmful are required to periodically submit their environmental reports to the Department of Industrial Works and to retain a copy in their premises in case of inspections. However, these environmental reports are never released to the public. The lack of public scrutiny may be the reason why the presence of these reports does not have a significant impact on the firm's environmental performance indicator. This conclusion is in line with Pargal and Wheeler (1996), Hartman et al. (1997), Dasgupta et al. (2001), and Blackman et al. (2004) which find that in the context where formal regulatory enforcement is weak, informal regulators can step in to provide pressure on the firm to perform well, and that this is especially true in the case when these alternative 'regulators' have access to environmental information.

The results of the simulated maximum likelihood estimation above indicate that, for the case of Thailand, focusing on one treatment only in the evaluation of programme impact is not likely to lead to an overestimation of programme impact as was the case in the Arimura et al. (2008)'s Japanese study. Results also suggest that a bivariate probit (BVP) model which estimates the participation and environmental score regressions simultaneously is more appropriate than multivariate probit (MVP)

models which introduce other treatments. Thus, in addition to the trivariate probit models, BVP models which jointly estimate the environmental score and ISO 14001 adoption regressions are also further estimated. Estimated coefficients and marginal effects from the six specifications of the BVP models are shown in Tables 6.4-6.6. BVP results also confirm the significance of ISO 14001 participation in determining firm environmental performance.

In addition to the significance of the ISO 14001 adoption variable, the coefficients of export orientation, number of pollutants emitted, emission of hazardous substances, and obstacles to environmental improvement are also positive and statistically significant in both the BVP and MVP models. As is expected from the theoretical framework, factors that lead to an increase in the expected marginal penalty (EMP) schedule such as trade links and pressures from local regulatory agencies and communities lead to an increase in firm environmental performance. These results are in line with Tietenberg and Wheeler (1998) and Christmann and Taylor (2006), which find that in the present era of globalisation product markets may play significant roles in determining firm environmental performance outcomes. The findings are also consistent with Hettige et al. (1996), Pargal and Wheeler (1996), Hartman et al. (1997), and Dasgupta et al. (2001) which find that informal regulatory pressures from local communities can stimulate firms to go beyond compliance with *de facto* environmental regulations.

The positive and significant coefficients for the obstacles variable which is used as a proxy for costs of environmental improvement are contrary to expectation since they suggest that firms which face greater obstacles to environmental improvement are more likely to have better environmental performance. According to the extended equilibrium emissions framework developed in Section 2, firms facing greater costs either have higher or steeper marginal abatement cost (MAC) curves. Given the same level of EMP, such firms should have higher emissions intensity than their peers. However, the positive sign of the coefficients could be a result of these firms simultaneously facing either steeper or higher EMP schedules, which then shifts the firm's equilibrium emissions intensity to the left, resulting in a better than expected performance level. This could be the case if such firms are easily identified as

potentially dirty firms[18]. Deily and Gray (1991, 1996), Dion et al. (1998), and anecdotes from environmental regulators in Thailand indicate that, given limited resources, regulators direct greater inspection efforts towards plants which are more likely to inflict environmental damage. Thus, it may be in the self interest of such firms to reduce their emissions rather than to consistently fluctuate around the regulated pollution thresholds (Russo and Fouts 1997, Lyon and Maxwell 2002, Koehler 2007). This explanation has empirical support in Gunningham et al. (2003) and Bandyopadhyay and Horowitz (2006), which find that facilities intentionally discharge less pollution than the permitted level in order to create a regulatory buffer.

[18] Findings from Chapter 4 suggests that firms facing greater obstacles to environmental improvement are unlikely to become ISO 14001 certified. Thus, such firms can be easily singled out by regulators due to their non-certification status.

Table 6.3: Variable Description and Summary Statistics

Variable	Description	Mean	S.D.	Min	Max
Dummy Environmental Score	Dummy variable equals to 1 for firms with strong environmental performance based on overall environmental score and is zero otherwise.	0.73	0.45	0	1
Adoption of Other VEPs	Dummy variable equals to 1 for firms which adopt at least one other non-ISO 14001 voluntary scheme and is zero otherwise.	0.46	0.50	0	1
Publication of Environmental Reports	Dummy variable equals to 1 for firms which publishes its environmental report and is zero otherwise.	1.43	1.29	0	4
Overall Environmental Score	Sum of scores on the various environmental aspects in Question 10	23.43	6.71	7	35
Waste Treatment	Question 10.1 of the primary survey questionnaire. A score of 5 indicates the firm has the full PDCA cycle on this environmental aspect, a score of 1 indicates the firm has not addressed this aspect.	4.59	0.98	1	5
Reduction in Spills	Question 10.2 of the primary survey questionnaire. A score of 5 indicates the firm has the full PDCA cycle on this environmental aspect, a score of 1 indicates the firm has not addressed this aspect.	4.45	1.04	1	5
Recycling Practices	Question 10.3 of the primary survey questionnaire. A score of 5 indicates the firm has the full PDCA cycle on this environmental aspect, a score of 1 indicates the firm has not addressed this aspect.	3.97	1.19	1	5
Low Impact Raw Materials	Question 10.4 of the primary survey questionnaire. A score of 5 indicates the firm has the full PDCA cycle on this environmental aspect, a score of 1 indicates the firm has not addressed this aspect.	2.47	1.41	1	5
Pollution Prevention Practices	Question 10.5 of the primary survey questionnaire. A score of 5 indicates the firm has the full PDCA cycle on this environmental aspect, a score of 1 indicates the firm has not addressed this aspect.	3.99	1.19	1	5
Clean Technology	Question 10.6 of the primary survey questionnaire. A score of 5 indicates the firm has the full PDCA cycle on this environmental aspect, a score of 1 indicates the firm has not addressed this aspect.	3.37	1.36	1	5

Variable	Description	Mean	S.D.	Min	Max
Life Cycle Analysis	Question 10.7 of the primary survey questionnaire. A score of 5 indicates the firm has the full PDCA cycle on this environmental aspect, a score of 1 indicates the firm has not addressed this aspect.	3.27	1.36	1	5
ISO 14001 Adoption	Dummy variable equals to 1 for firms with ISO 14001 certification and is 0 otherwise.	0.38	0.49	0	1
Export Orientation	Dummy variable equals to 1 for firms which export and is zero otherwise.	0.71	0.46	0	1
Foreign Direct Investment	Dummy variable equals to 1 for firms with foreign direct investment (FDI) and is 0 otherwise.	0.39	0.492	0	1
Export to ISO 14001-rich Countries	Dummy variable equals to 1 for firms which export to countries with high ISO 14001 adoption and is 0 otherwise.	0.41	0.49	0	1
Foreign Direct Investment from ISO 14001-rich Countries	Dummy variable equals to 1 for firms which receive FDI from countries with high ISO 14001 adoption and is 0 otherwise.	0.27	0.44	0	1
Export to OECD Countries	Dummy variable equals to 1 for firms which export to OECD countries and is 0 otherwise.	0.45	0.50	0	1
Foreign Direct Investment from OECD Countries	Dummy variable equals to 1 for firms which receive FDI from OECD countries and is 0 otherwise.	0.31	0.46	0	1
Firm Size	Natural log of the number of employees in a firm.	0.69	1.73	0.005	29.416
Location in Industrial Estate	Dummy variable equals to 1 for firms located in an industrial estate or industrial park and is 0 otherwise.	0.25	0.43	0	1
Stakeholders	Index variable proxying perceived pressures from stakeholders constructed using principle component analysis.	-6.60E-09	1.89	-6.91	2.38
Obstacles	Index variable proxying perception on obstacles to environmental improvement constructed using principle component analysis.	-5.78E-09	1.88	-4.61	2.82
Number of Pollutants	Dummy variable equals to 1 for firms which emit three or more types of pollutants and is 0 otherwise.	0.49	0.50	0	1
Hazardous Pollutant	Dummy variable equals to 1 for firms which rank hazardous waste as their top pollutant and is 0 otherwise.	0.21	0.41	0	1

Table 6.4: Multivariate Probit Regression Results: Environmental Score Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
ISO 14001 Adoption	2.436***	2.485**	2.228***	2.258***	2.201***	1.925***
	(0.294)	(1.258)	(0.283)	(0.249)	(0.303)	(0.665)
Environmental Report	0.283	0.669	-0.164	0.301	-0.123	-0.612
	(0.319)	(0.567)	(0.298)	(0.323)	(0.330)	(0.942)
Export Orientation	0.669**	0.500**				
	(0.276)	(0.235)				
Foreign Direct Investment	0.095	0.091				
	(0.302)	(0.338)				
Export to ISO 14001-rich Countries			-0.072	-0.238		
			(0.233)	(0.230)		
FDI From ISO 14001-rich Countries			0.259	0.262		
			(0.366)	(0.343)		
Export to OECD Countries					-0.023	-0.201
					(0.236)	(0.242)
FDI From OECD Countries					0.261	0.330
					(0.349)	(0.363)
Firm Size	0.187	0.355	0.365	0.526	0.358	0.517
	(0.266)	(0.276)	(0.317)	(0.343)	(0.321)	(0.342)
Location in Industrial Estate	-0.207	-0.145	-0.123	-0.074	-0.154	-0.005
	(0.323)	(0.348)	(0.290)	(0.344)	(0.309)	(0.452)
Stakeholders	-0.047	-0.042	0.014	0.007	0.010	0.058
	(0.072)	(0.107)	(0.055)	(0.055)	(0.057)	(0.082)
Obstacles	0.157***	0.146***	0.158***	0.157***	0.161***	0.165***
	(0.058)	(0.057)	(0.056)	(0.056)	(0.056)	(0.061)
Number of Pollutants Emitted	0.892***		0.813***		0.805***	
	(0.257)		(0.245)		(0.257)	
Emit Hazardous Waste		0.588		0.587**		0.505**
		(0.424)		(0.239)		(0.232)
Constant	-0.492	-0.388	0.199	0.199	0.165	0.650*
	(0.302)	(0.662)	(0.227)	(0.285)	(0.240)	(0.365)
χ^2	295.61***	366.53***	304.57***	371.76***	275.01***	267.20***
N	494	494	494	494	494	494
Rho 2,1	-0.93***	-0.97***	-0.95***	-0.97***	-0.94***	-0.88**
Rho 3,1	0.30	0.45	-0.28	-0.15	-0.27	-0.16
Rho 3,2	-0.06	-0.23	0.22	0.03	0.19	0.57

Note: Standard errors in parentheses. * = significant at the 10% level, ** = significant at the 5% level, *** = significant at the 1% level

Table 6.5: Bivariate Probit Regression Results: Environmental Score Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
ISO 14001 Adoption	2.248***	1.847***	2.399***	1.973***	2.484***	2.028***
	(0.358)	(0.562)	(0.655)	(0.402)	(0.593)	(0.371)
Export Orientation	0.635**	0.455*				
	(0.269)	(0.248)				
Foreign Direct Investment	0.117	0.123				
	(0.308)	(0.320)				
Export to ISO 14001-rich Countries			-0.069	-0.244		
			(0.252)	(0.237)		
FDI From ISO 14001-rich Countries			0.279	0.318		
			(0.386)	(0.378)		
Export to OECD Countries					-0.003	-0.208
					(0.245)	(0.229)
FDI From OECD Countries					0.275	0.376
					(0.356)	(0.360)
Firm Size	0.227	0.450	0.407	0.654*	0.385	0.632*
	(0.312)	(0.354)	(0.394)	(0.392)	(0.364)	(0.383)
Location in Industrial Estate	-0.156	-0.034	-0.159	-0.052	-0.182	-0.122
	(0.335)	(0.366)	(0.305)	(0.334)	(0.314)	(0.340)
Stakeholders	-0.022	0.005	0.014	0.034	0.011	0.031
	(0.064)	(0.061)	(0.060)	(0.060)	(0.061)	(0.061)
Obstacles	0.155***	0.163***	0.152**	0.163***	0.154***	0.166***
	(0.058)	(0.061)	(0.060)	(0.061)	(0.059)	(0.060)
Number of Pollutants Emitted	0.929***		0.783***		0.785***	
	(0.258)		(0.245)		(0.252)	
Emit Hazardous Waste		0.707***		0.629**		0.599**
		(0.254)		(0.249)		(0.249)
Constant	-0.347	-0.021	0.122	0.334*	0.102	0.335*
	(0.247)	(0.218)	(0.185)	(0.174)	(0.195)	(0.182)
χ^2	243.19***	194.19***	248.59***	174.97***	229.09***	175.05***
N	494	494	494	494	494	494
Rho	-0.87***	-0.64*	-0.94	-0.74***	-0.96	-0.78***

Note: Standard errors in parentheses. * = significant at the 10% level, ** = significant at the 5% level, *** = significant at the 1% level

Table 6.6: Marginal Effects From the Bivariate Probit Regression

	(1)	(2)	(3)	(4)	(5)	(6)
ISO 14001 Adoption	0.48***	0.61***	0.50**	0.57***	0.474	0.52***
	(0.147)	(0.090)	(0.245)	(0.108)	(0.403)	(0.117)
Export Orientation	0.114	0.055				
	(0.151)	(0.114)				
Foreign Direct Investment	0.49***	0.258*				
	(0.169)	(0.146)				
Export to ISO 14001-rich Countries			-0.113	-0.197		
			(0.225)	(0.126)		
FDI From ISO 14001-rich Countries			0.56***	0.39***		
			(0.171)	(0.145)		
Export to OECD Countries					-0.159	-0.186
					(0.258)	(0.139)
FDI From OECD Countries					0.64***	0.47***
					(0.251)	(0.148)
Firm Size	0.259	0.280*	0.47***	0.432**	0.515**	0.451**
	(0.183)	(0.156)	(0.179)	(0.190)	(0.242)	(0.219)
Located in Industrial Estate	0.035	0.072	0.024	0.031	-0.086	-0.037
	(0.204)	(0.156)	(0.275)	(0.033)	(0.294)	(0.193)
Stakeholders	0.070	0.050	0.102	0.066	0.136	0.079*
	(0.050)	(0.041)	(0.113)	(0.043)	(0.135)	(0.047)
Obstacles	-0.001	0.046	-0.032	0.031	-0.069	0.022
	(0.049)	(0.027)	(0.128)	(0.032)	(0.154)	(0.036)
ISO 9000 Adoption‡	0.72***	0.381	0.854**	0.501**	0.93***	0.59***
	(0.204)	(0.263)	(0.371)	(0.229)	(0.189)	(0.218)
Number of Pollutants Emitted	0.76***		0.823*		0.89***	
	(0.187)		(0.439)		(0.304)	
Emit Hazardous Waste		0.354**		0.39***		0.43***
		(0.143)		(0.120)		(0.123)

Note: Standard errors in parentheses. * = significant at the 10% level, ** = significant at the 5% level, *** = significant at the 1% level

‡ = the marginal effects reported are indirect effects only.

5.3. Accounting for Endogeneity of Treatment : The Heckman Two-Step Estimator

Results from the multivariate probit estimations in Section 5.2 indicate that, unlike the Japanese case considered in Arimura et al. (2008), adoption of other environmental practices in addition to ISO 14001 certification does not lead to biased results in the Thai case. Without the need to take into account several simultaneous treatments, avenues for employing other estimation methods that allow for further recovery of other treatment effect parameters such as the average treatment effect on the treated (TT) and the average effect on the untreated group (TUT) can be explored. These parameters and the more common average treatment effect (ATE) parameter are defined in the treatment effects literature and are given by (Blundell and Costa-Diaz 2000, Wooldridge 2002, Cobb-Clark and Crossley 2003):

ATE = average effect of treatment for the general population

$$= E(Y_1 - Y_0 | X) \quad \text{Eq. 6.2}$$

TT = average effect of treatment on the treated population

$$= E(Y_1 - Y_0 | D_1 = 1, X) \quad \text{Eq. 6.3}$$

TUT = average effect of treatment on the untreated population

$$= E(Y_1 - Y_0 | D_1 = 0, X) \quad \text{Eq. 6.4}$$

Where Y_1 is the outcome resulting from participation in the programme/treatment, Y_0 is the outcome resulting from non-participation in the programme/treatment, X is a vector of explanatory variables, and D_1 is the observed participation dummy variable which is 1 for participants and 0 for non-participants.

This dissertation applies the Heckman two-step estimation method to recover these parameters. The method also has other desirable properties discussed in Section 5.3.1.

5.3.1. The Heckman Two-Step Estimator

As discussed earlier in both Chapter 5 and Section 5.2, estimation of programme impact using non-experimental data presents the evaluator with a number of challenges. First, there is the problem of the lack of counterfactual where agents either participated in the programme, or they did not, ruling out the possibility of determining programme impact by directly comparing the participation and non-participation outcomes of the same agent (Blundell and Costa-Diaz 2000). Second, for most programmes evaluated, programme participation is not randomly assigned and, in many cases, there is some dependence between the participation decision and the outcomes (Wooldridge 2002, Morgenstern et al. 2008). Third, development in the treatment effects literature in the last few decades indicates that there is heterogeneity in the impact of treatment among agents (Heckman 2001, Cobb-Clark and Crossley 2003). Thus, evaluation of the effect of any programme should allow for this heterogeneity in programme outcomes.

The Heckman selection method[19], first developed by Heckman (1979), accounts for all three problems. The method is based on the family of Roy models, which stipulates that agents self-select into programmes based on expected gains from participation (Roy 1951, Gronau 1974, Heckman and Honore 1990). This family of models fit well with this dissertation which also assumes that firms choose to become ISO 14001 certified based on expected payoffs from participation.

Since this setup assumes that agents self-select into participation, directly regressing outcome, Y, on D_1, and X will result in endogeneity and selection bias (Heckman 1979, Caliendo and Hujer 2006). To overcome this problem, Heckman (1979) proposed the inclusion of correction terms known as inverse Mills ratios to the outcome regressions to allow for consistent estimation of the parameters of interest (Heckman 1979, Wooldridge 2002). The Heckit correction also allows programme impacts to vary across individuals (Cobb-Clark and Crossley 2003), and controls for selection on unobservables (Blundell and Costa-Diaz 2000, Caliendo and Hujer 2006).

[19]This method is also known as the Heckit correction method.

The Heckman selection method functions in a way similar to the instrumental variable approach. First, a probit of the participation model is undertaken and information from the regression results is used to construct the relevant inverse Mills ratios. Then, in the second stage, the outcome variable is regressed on the explanatory variables, *X*. However, for the Heckman method, the sample is divided into two sectors – those receiving treatment (D_1=1) and those not receiving treatment (D_1=0). Y_1 is regressed on *X* and one of the inverse Mills ratio for D_1=1, and Y_0 is regressed on *X* and the other inverse Mills ratio for D_1=0.

The outcomes for those receiving treatment is:

$$Y_1 = \beta_1 X + U_1 \qquad \text{Eq. 6.5}$$

Whereas for those not receiving treatment, the outcomes regression is:

$$Y_o = \beta_0 X + U_0 \qquad \text{Eq. 6.6}$$

The latent decision rule, D_1^*, is denoted by:

$$D_1^* = Y_1 - Y_0 = X(\beta_1 - \beta_0) + (U_1 - U_0) \equiv Z\gamma + V \qquad \text{Eq. 6.7}$$

And the observed participation, D_1, depends on the decision rule in the following way:

$$D_1 = \mathbb{1}\,[\,D_1^* \geq 0]$$

The model assumes that U_0, U_1, and *V* are jointly normal such that:

$$\begin{pmatrix} U_o \\ U_1 \\ V \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_0^2 & \sigma_{01} & \sigma_{0V} \\ \sigma_{10} & \sigma_1^2 & \sigma_{1V} \\ \sigma_{0V} & \sigma_{1V} & \sigma_V^2 \end{pmatrix}\right]$$

Where σ_i^2 is the variance of *i* and σ_{ji} is cov(*j*, *i*).

For D_1 = 1, the inverse Mills ratio is given by $\dfrac{\phi\left(-Z\gamma / \sigma_V\right)}{\Phi\left(Z\gamma / \sigma_V\right)}$ Eq. 6.8

For $D_1 = 0$, the inverse Mills ratio is given by $\frac{\phi\left(-Z\gamma/\sigma_V\right)}{\Phi\left(-Z\gamma/\sigma_V\right)}$ Eq. 6.9

Once completed, both stages of regressions allow for the calculation of the three treatment parameters – average treatment effect (ATE), average treatment on the treated (TT), and average treatment on the untreated (TUT). These parameters are linked by the inverse Mills ratios.

$$TT = ATE + \left(\frac{\sigma_{1V} - \sigma_{0V}}{\sigma_V}\right)\left(\frac{\phi\left(-Z\gamma/\sigma_V\right)}{\Phi\left(Z\gamma/\sigma_V\right)}\right) \quad \text{Eq. 6.10}$$

$$TUT = ATE - \left(\frac{\sigma_{1V} - \sigma_{0V}}{\sigma_V}\right)\left(\frac{\phi\left(-Z\gamma/\sigma_V\right)}{\Phi\left(-Z\gamma/\sigma_V\right)}\right) \quad \text{Eq. 6.11}$$

Where ϕ denotes probability density function and Φ denotes cumulative density function.

For this section, the main dependent variables are the firm's environmental scores constructed from the firm's responses to Questions 10.1 to 10.7 of the primary survey questionnaire. This includes the overall environmental score, and the scores from the individual environmental aspect questions. Details on the questions asked and the summary statistics of the data are given in both Section 4 and Table 6.3. The six specifications adopted in the participation regressions in Chapter 4 and the multivariate probit regressions in Section 5.2 are also adopted here. Regressions are run first using data from all three industries, and then data from individual industries are treated separately.

5.3.2. Results From the Heckman Two-Step[20]

Results from the Heckman two-step regressions and subsequent calculations of the ATE, TT, and TUT values indicate a uniform general effect of ISO 14001

[20] These results are obtained from data which have been carefully examined with the usual regression diagnostics pertaining to the Heckman Selection model.

participation on the key parameters of interest regardless of measures used to proxy ownership and trade links. For all six sets of ATE, TT, and TUT values calculated for the overall environmental score regression, the average treatment effect on the treated population (TT) is the largest, followed by the average treatment effect (ATE) for the entire sample population. The average treatment effect on the untreated population (TUT) is the smallest of the three measures, as is expected. Differences between TT and ATE values are also statistically significant for all six model specifications[21]. These results concur with earlier multivariate probit estimation results, which find ISO 14001 participation to have a significant and positive impact on firm environmental performance, and also confirm the appropriateness of the two-step method.

In terms of individual environmental aspects, the Heckit results generally indicate differential impacts across industries. After potential endogeneity of treatment is taken into account, it is found that the industry where ISO 14001 participation has had the least impact in improving firm environmental performance is the food and beverages industry. The industry where ISO 14001 has had the most impact is the electronics and electrical appliances industry, while the textiles and wearing apparel industry's impact falls in between the two. Findings also indicate that selection on gains is most prominent in the electronics and electrical appliances industry, followed by the textiles and wearing apparel industry. Firms in the food and beverages industry, however, are not found to be as prone to participate in the programme based on expected gains.

For the food and beverages industry, when compared with non-participants, ISO 14001 adopters perform better only in terms of the use of environmentally friendly raw materials (topic 10.4). In terms of pollution prevention (topic 10.5), the use of clean technology (topic 10.6), and the application of life cycle assessment methods (topic 10.7), there are no differences between firms with ISO 14001 and without ISO 14001. However, non-adopters do better in terms of waste reduction and reduction in spills (topics 10.1 and 10.2 respectively). In fact, if they had chosen to adopt ISO 14001, non-participants would have achieved better environmental outcomes on these two aspects. Thus, there is room for improving firm environmental performance by

[21] Differences between TT and ATE values are reported in the row/column labelled 'd' in Tables 6.7 – 6.9.

encouraging facilities in the food and beverages industry to become ISO 14001 certified.

For the textiles and wearing apparel industry, ISO 14001 firms perform better when compared with non-adopters in terms of waste treatment (topic 10.1), recycling (topic 10.3), and pollution prevention practices (topic 10.5), as well as on the use of environmentally friendly raw materials (topic 10.4), and the adoption of life cycle assessment methods (topic 10.7). In terms of the adoption of clean technology (topic 10.6), and measures to reduce spills and leakages (topic 10.2), however, there is no significant difference between adopting and non-adopting firms.

For the electronics and electrical appliances industry, ISO 14001 firms perform better than non-adopters of ISO 14001 on almost all environmental aspects – waste treatment (topic 10.1), measures to reduce spills and leakages (topic 10.2), recycling practices (topic 10.3), pollution prevention measures (topic 10.5), application of clean technology (topic 10.6), and the use of life cycle assessment methods (topic 10.7). However, had they adopted the certification, non-ISO 14001 firms would have performed better than ISO 14001 participants when it comes to the use of environmentally friendly raw materials (topic 10.4). Thus, if the target is to encourage the use of low-environmental-impact raw materials, firms in the electronics and electrical appliances should be encouraged to undertake ISO 14001 certification.

The results obtained above indicate that, on the whole, ISO 14001 adopters are firms who believed they would benefit from participation and that participants do indeed perform better when compared with non-adopting firms. However, there is a caveat since a look at the individual environmental aspects suggests that ISO 14001 have differential impacts on firms across industries. The programme has had the least pronounced impact in the food and beverages industry where ISO 14001 adopters perform better only on one aspect – the use of low impact raw materials, while non-adopters, had they adopted, would perform better on two aspects – waste treatment and reduction in spills and leakages. Impacts are more pronounced in the electronics and electrical appliances, and textiles and wearing apparel industries where programme outcomes for adopting firms are better than non-adopting firms on almost all environmental aspects. For firms in the textiles and wearing apparel industry, adopters perform better in five aspects with no difference between the two groups in

measures to reduce spills and the adoption of clean technology practices. For those in the electronics and electrical appliances industry, adopters perform better than non-adopters on all aspects with the exception of the use of environmentally friendly raw materials where non-adopting firms would have performed better had they been ISO 14001 certified.

Table 6.7: Overall Environmental Score Regressions' ATE, TT, and TUT Values for Different Model Specifications

	(1)	(2)	(3)	(4)	(5)	(6)
ATE	1.37	1.49	1.69	1.75	2.23	2.30
TT	12.51	12.52	13.21	13.09	13.04	12.73
TUT	0.54	0.61	0.90	0.95	1.27	1.40
d	11.14***	11.02***	11.52***	11.33***	10.81***	10.43***

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

Table 6.8: Overall Environmental Score Regressions' ATE, TT, and TUT Values for Different Industries

	All Industries	Food and Beverages	Textiles and Wearing Apparel	Electronics and Electrical Appliances
ATE	1.37	18.72	-10.46	-2.98
TT	12.51	40.58	20.06	7.66
TUT	0.54	-4.64	-11.53	-5.56
d	11.14***	21.85	30.52***	10.64***

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

Table 6.9: Individual Environmental Impacts' ATE, TT, and TUT Values for Different Industries

No.	Topic	Food and Beverages		Textiles and Wearing Apparel		Electronics and Electrical Appliances		All Industries	
		ATE	*d*	ATE	*d*	ATE	*d*	ATE	*d*
10.1	Waste Treatment	-1.30	-5.03***	-1.20	2.02**	-0.59	2.49***	-0.40	1.00***
10.2	Reduction in Spills	-1.26	-4.00***	-3.45	3.18	-0.89	2.75***	-0.59	1.89***
10.3	Recycling	1.02	0.64	0.86	1.34***	-0.44	2.36***	0.39	1.32***
10.4	Green Raw Materials	3.37	16.38*	0.92	3.78***	1.23	-1.47***	0.29	-0.97***
10.5	Pollution Prevention	2.00	-0.39	-0.46	4.22***	-1.53	1.88***	-0.45	1.12***
10.6	Clean Technology	1.86	-1.51	-2.01	-0.68	-1.12	0.67***	-0.29	0.46***
10.7	Life Cycle Analysis	3.68	4.00	-0.19	2.60***	0.04	2.48***	0.47	1.47***

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

5.4. Findings from Empirical Results

Sections 5.2 and 5.3 address the potential problems that might arise from endogeneity of treatment using multivariate regression analysis and the Heckman selection model. Section 5.2 also considers the possibility that programme effects might be overestimated due to multiple treatments that could potentially affect the firm's reported environmental performance. To check robustness of the results, for each regression run there are six corresponding specifications.

For all estimation methods, ISO 14001 participation is associated with better environmental performance compared with non-ISO 14001 firms. In the MVP models where both endogeneity of treatment and the presence of multiple treatments are assumed to be present, both the coefficients and marginal effects of the ISO 14001 variable are positive and strongly statistically significant throughout all six specifications. Multivariate results are also confirmed in findings from the Heckman selection regressions, and provide evidence for trusting these results since it is found that the presence of other treatments such as the presence of environmental reports and the firm's participation in other non-ISO 14001 voluntary environmental programmes do not lead to an overestimation of the effects of ISO 14001 participation. This latter point is evident in the non-significance of the correlation coefficients (ρ) between the ISO 14001 and the environmental report equations, and between the environmental score and the environmental report equations.

In addition to findings that ISO 14001 participation has an overall positive impact on the firm's environmental performance, econometric results also indicate that there are industry-specific effects to participation in ISO 14001. Industry-wise, after accounting for endogeneity, results point to the food and beverages industry as being the one where the impact of ISO 14001 certification has been least pronounced, with ISO 14001 firms performing better than non-ISO 14001 firms only on one aspect (topic 10.4 – the use of environmentally friendly raw materials). However, results also suggest that non-participating firms in this industry should be encouraged to participate in the ISO 14001 programme since treatment outcomes for non-participants had they participated are higher than for participants, indicating that there will be improvement in environmental performance for non-adopters if they are

encouraged to receive treatment. Results of the textiles and wearing apparel industry indicate that ISO 14001 adoption brings some changes when compared with non-adopters. In areas such as waste treatment (topic 10.1), recycling measures (topic 10.3), the use of environmentally friendly raw materials (topic 10.4), pollution prevention practices (topic 10.5), and the application of life cycle analysis techniques (topic 10.7), ISO 14001 firms perform better than non-ISO 14001 firms in this industry. Results of the electronics and electrical appliances industry indicate the firms which stand to gain from ISO 14001 participation have adopted the certification, but that there can be gains from encouraging non-adopting firms to participate if the target is to improve the firm's performance in terms of the use of environmentally friendly raw materials.

6. Information From ISO 14001 Firms

In addition to asking firms to rate themselves on a range of environmental aspects in Question 10, the primary survey questionnaire also has a section which specifically targets firms with ISO 14001 certification. Question 21 specifically asks firms what environmental benefits they received after having the certified environmental management system in place. The focus of the question is on reductions in pollution emissions. Reductions in energy, raw materials, and natural resources used are covered in the cost savings question (Question 23), which is discussed in detail in Chapter 5. Essentially, replies to Question 23, which is also directed to ISO 14001 firms only, indicate that ISO 14001 adoption has more impact on reducing the use of electricity and water consumption, and that there are industrial differences. Reported cost savings are greatest in the food and beverages, and electronics and electrical appliances industries, while reduction in natural resource consumption is not so high in the textiles and wearing apparel industry.

In terms of reduction in environmental pollution, four main sources are covered – water, air, soil, and waste. Firms are also given the space to detail additional environmental benefits they received from having the certification in place. Reported benefits are similar across industries with minor industrial differences. Across industries, the most reported environmental benefits are reduction in water pollution and waste management benefits. In the food and beverages industry, reduction in water pollution is the foremost reported environmental benefits, followed by replies

that ISO 14001 certification has helped them in managing their wastes. The story is similar in the textiles and wearing apparel industry. The order is switched in the electronics and electrical appliances industry, with more firms reporting benefits in terms of waste management than those reporting benefits from reduced water pollution. There are also reports of benefits in terms of reduced air and soil pollution in all three industries, but the number of firms reporting receiving no benefits from such aspects is generally higher than those reporting benefits. Overall, these findings are in line with Rondinelli and Vastag (2000), Mohamed (2001), Babakri (2003), Tan (2005), Zeng et al. (2005), Sambasivan (2008), and de Oliviera (2010) which find that certified firms in diverse countries report reductions in wastes and harmful environmental emissions, reduced environmental impacts, and decreased consumption of water and energy.

Figure 6.5: Reported Environmental Benefits for All Industries

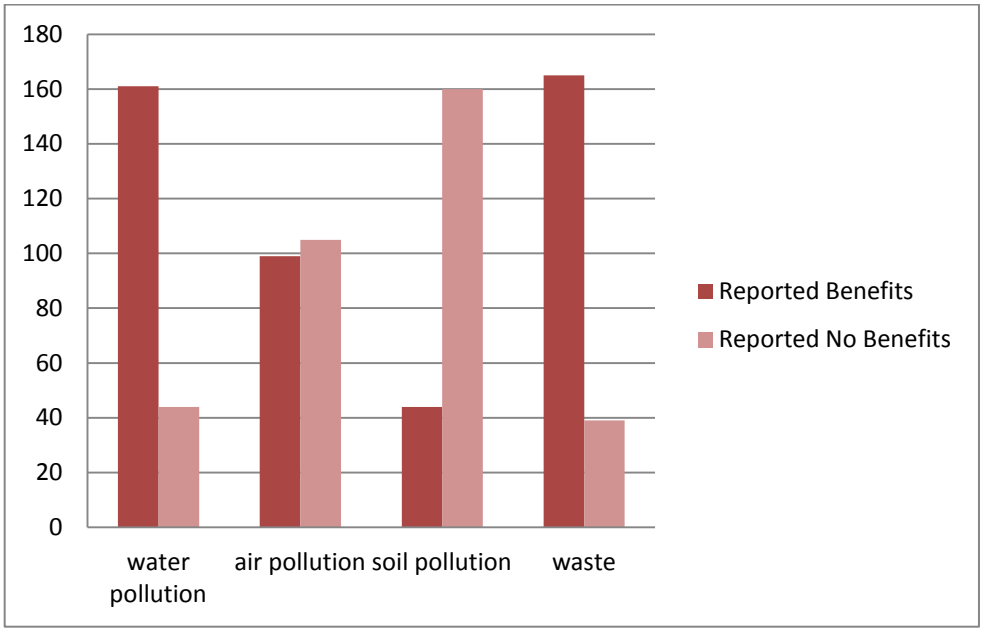


Figure 6.6: Reported Environmental Benefits from the Food and Beverages Industry

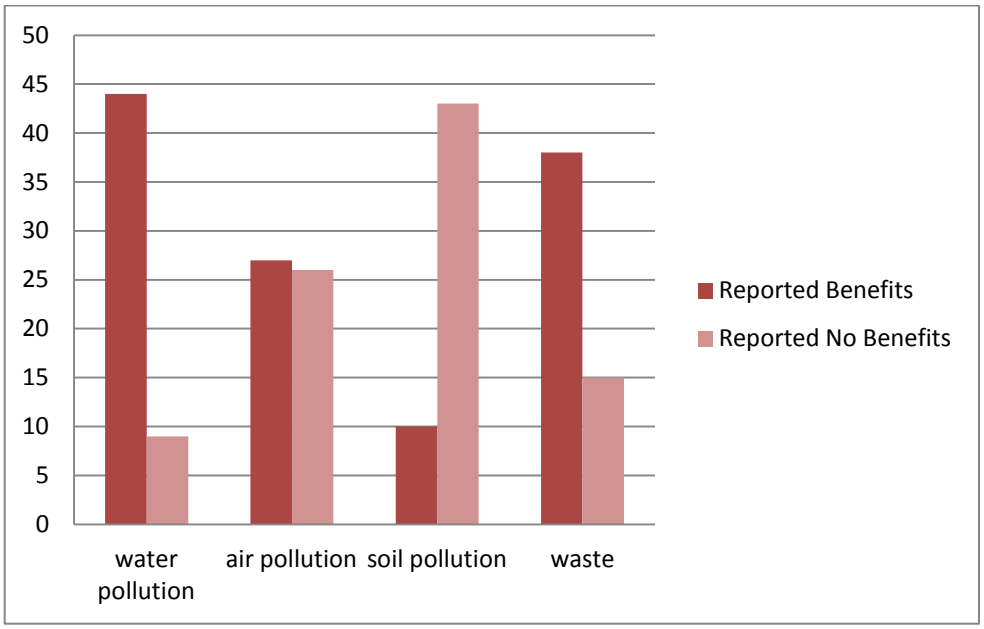


Figure 6.7: Reported Environmental Benefits from the Textiles and Wearing Apparel Industry

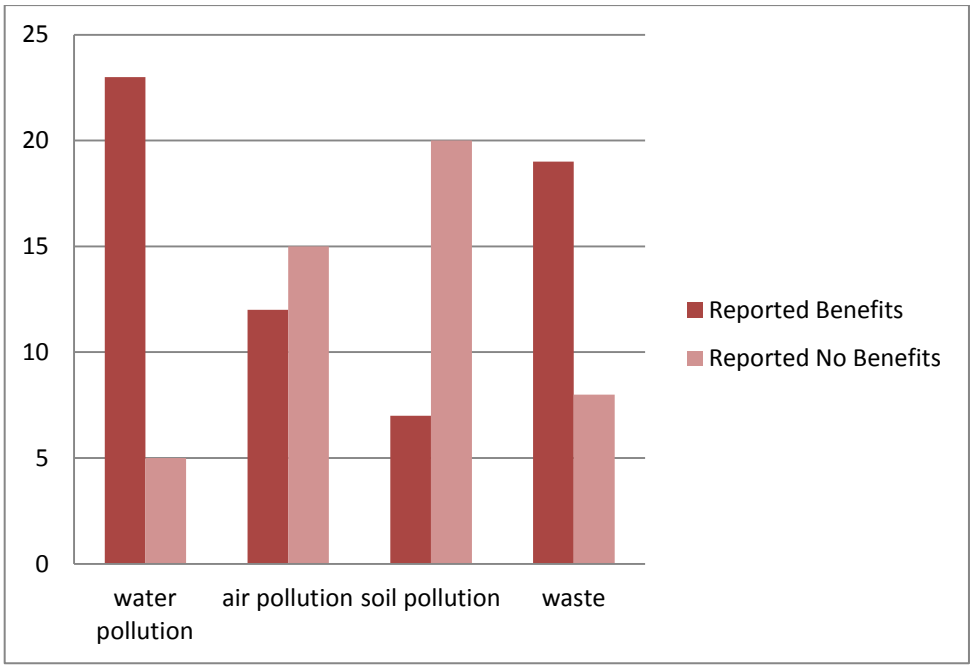
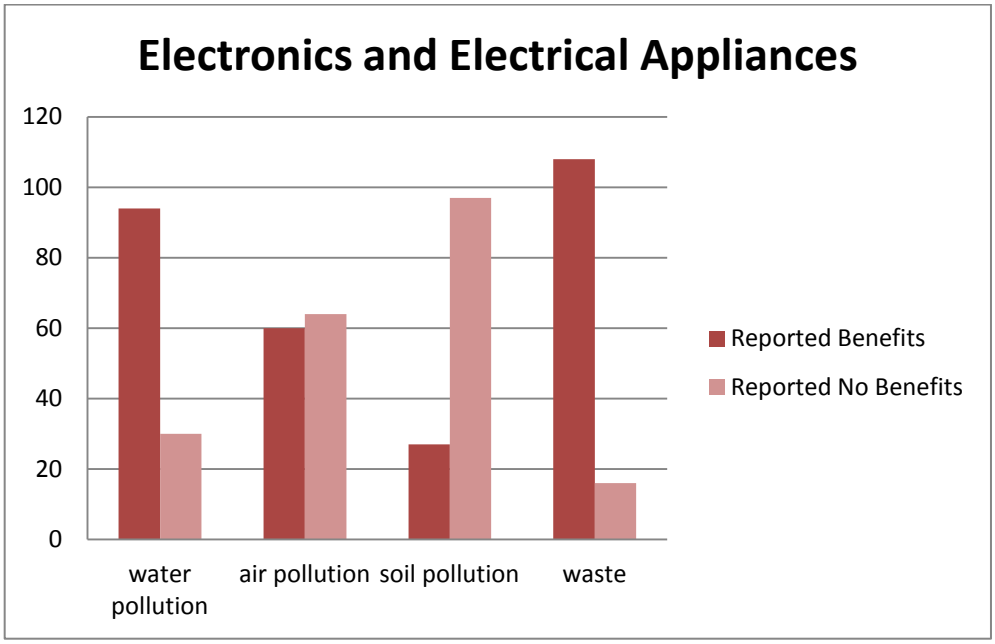


Figure 6.8: Reported Environmental Benefits from the Electronics and Electrical Appliances Industry



In addition to indicating the environmental impact reduced, several firms also provide further information as to how the reductions come about. In terms of water pollution, many firms reply that they implemented systems to monitor water quality and have procedures in place to treat sub-standard wastewater before discharge. Others also report increased recycling of water, with some firms reporting that they re-use treated water for other activities within the plant. Two firms even report that they provide treated water to nearby farmers for use in their agricultural activities.

For firms reporting benefits in terms of reduction in air pollution, these benefits are ascribed to the adoption of technology to reduce air pollution such as the installation of filters, scrubbers, and cyclone and multi-cyclone systems. ISO 14001 has led to improved monitoring of pollutants, which has helped them in being more aware of the problems. The certifiable environmental management system has also helped firms establish clear procedures for handling air pollution, which results in better handling of air pollutants.

Of the few firms that report reduced soil pollution after having ISO 14001 certification, the main cause of reduction reported is less release of chemicals to the soil. This is a result of being able to identify high-risk areas and activities so these can

be better targeted. Firms also report that reductions come from having more appropriate procedures for storing, moving, and using chemicals, which result in less accidental spills and leaks. ISO 14001 certification has also led some firms to come up with emergency procedures for dealing with accidents and leaks of dangerous chemicals.

Across all three industries, the majority of firms which report receiving benefits in terms of better waste management identify the source of this benefit as coming from better sorting of waste. This has allowed some firms to reuse some of the things they used to throw away, and allowed others to sell recyclables to third parties for a small monetary gain. Improved systems to manage waste are also cited as benefits of ISO 14001 certification. Reduced waste generation due to having more efficient production systems is also cited as a benefit of ISO 14001 adoption.

Overall, the reported benefits of ISO 14001 certification reflect the main environmental pollution problems associated with each industry. For the food and beverages, and textiles and wearing apparel industry where the main environmental impacts are mostly emissions of wastewater and non-hazardous waste, having ISO 14001 certification appear to be more beneficial in these aspects. For the electronics and electrical appliances industry, on the other hand, waste, especially hazardous waste, is the main problem. Thus, it is not surprising to see the majority of firms reply that having the certification in place has helped them most in terms of waste management. Further responses from certified firms also indicate that the environmental benefits from ISO 14001 certification stem from the establishment of better monitoring mechanisms to detect environmental digressions and from having appropriate procedures in place to quickly and appropriately deal with the situation.

7. Conclusion

The effectiveness of using ISO 14001 certification as a tool for environmental management is a question of extreme importance, both to policymakers and to researchers alike. As a relatively new tool for environmental management, the use of voluntary environmental programmes such as the ISO 14001 certification has potential to supplement the existing command-and-control regulatory approach, especially in developing countries where such systems are known to be weak and to

foster rampant non-compliance with existing regulations. However, the relative novelty of VEPs compared with other instruments, its origin in the field, and the limited availability of reliable environmental performance data all combine to render the assessment of environmental benefits from ISO 14001 certification in the third world a difficult undertaking, and one which comprises only a fraction of the small, albeit growing, literature on VEPs.

This chapter hopes to contribute to this literature by assessing the environmental outcome associated with ISO 14001 certification in three industries in Thailand. The study overcomes the lack of publicly available environmental data problem by using a unique primary survey dataset collected from roughly 500 manufacturing enterprises in the country. The study also uses carefully constructed measures of environmental performance that span an array of environmental aspects associated with the firm. These measures are unique in the sense that firms are asked to rate themselves on an objective scale of 1 to 5, rather than using subjective scales such as 'excellent,' 'poor,' etc. (Dasgupta et al. 2000). These questions are supplemented by an ISO 14001-only part of the questionnaire, which asks for information on the benefits of ISO 14001 adoption. The questionnaire was also designed in close consultation with environmental survey experts in Thailand and pre-tested to ensure that the structure of the questions was suitable to the Thai context and the wordings were clear-cut.

The chapter begins by developing a theoretical framework to explain environmental outcomes in the developing world context, extending the already-existing emissions equilibrium framework with club theory considerations. The result of this exercise, however, points to using real data to determine environmental impact since theoretical consideration of the context of firms in developing countries indicate that the direction of environmental impact depends on the relative influences of various factors that differ from firm to firm.

Assessments of VEPs in the existing literature also show mixed results. While some articles report that having environmental management systems (EMSs) and ISO 14001 certification in place improved the firm's environmental performance, there are also other papers which conclude that the firms with EMSs and/or ISO 14001 do not perform better than non-adopting firms. However, there has been some evidence that

firms in developing countries tend to report more benefits from having ISO 14001 in place (see, e.g., TEI 1999, Dasgupta et al. 2000, Raines 2002, Raines et al. 2002).

Using unique primary survey data and econometric methodologies, this chapter has found evidence in support of the finding that ISO 14001 certification improves the firm's environmental performance. Several methodologies are employed. In the first instance, the possibility of multiple treatments affecting firm environmental score is taken into consideration and accounted for using the Geweke-Hajivassiliou-Keane (GHK) simulated maximum likelihood estimation of the multivariate probit model. To check robustness of results and to ensure minimal simulation bias, six variations to the basic model are estimated at over 400 draws. The GHK results strongly find a positive impact of ISO 14001 on the firm's environmental performance, with the marginal effects and coefficients for ISO 14001 participation positive and statistically significant throughout all six specifications of the model. The GHK results also indicate that the presence of other treatments such as the adoption of non-ISO 14001 voluntary programmes and the presence of environmental reports are not endogenous and are found to have no statistically significant impact on the firm's environmental indicator.

To derive further parameters of treatment effects, the Heckman two-step technique is then employed. To check robustness of results, six variations of the Heckman model were specified. Results indicate that ISO 14001 firms perform better when compared with treatment outcomes for non-ISO 14001 firms on overall environmental score. However, results differ slightly when it comes to the individual environmental aspects of firms in the three different industries, suggesting that there are industrial differences in the impacts of ISO 14001 certification.

Econometric results are further supplemented by qualitative information provided by ISO 14001 firms in all the three industries of interest. These findings indicate that ISO 14001 certification proves more beneficial in reducing electricity and water consumption, in helping the firms deal with water pollution, and allowing firms to better manage wastes. Benefits are derived from having better monitoring mechanisms and appropriate procedures to deal with environmental problems as a result of having the environmental management system in place.

The various methodologies and specifications employed in this chapter to determine the environmental effects of ISO 14001 adoption allows for the conclusion that ISO 14001 adopters do perform better environmentally than non-ISO 14001 adopters. However, environmental impacts of ISO 14001 certification can differ from industry to industry. The certification has had the least impact on the food and beverages industry, while it has the most impact on the electronics and electrical appliances industry, and, for the textiles and wearing apparel industry, ISO 14001 certification brings about impacts only on certain environmental aspects. Thus, promotion of ISO 14001 certification must be done with discretion.

CHAPTER 7

LESSONS ON VEP ADOPTION: A SUMMARY OF FINDINGS, POLICY RECOMMENDATIONS AND CONCLUSION

1. Introduction

This dissertation is motivated by the need to find newer tools to supplement the traditional command and control approach in addressing environmental pollution problems in the context of newly industrialising economies (NIEs) where economic progress has come at a high cost to the natural environment. The focus of the research is on voluntary environmental programmes (VEPs), one of the fastest growing tools for environmental regulation in the third world. As a new tool for environmental management, VEPs are still relatively little understood especially in the developing country setting where data limitations have seriously hampered rigorous academic research. Yet direct transfers from findings in the industrialised country context to these countries are difficult because of the vastly different institutional and socio-economic environments. (Eskeland and Jimenez 1992, Turner et al. 1994, World Bank 2000, Kruger et al. 2003, Russell and Vaughan 2003, Welford 2004, Graham and Woods 2006). Goals of VEP application are also different. While industrialised country policymakers use VEPs to encourage beyond compliance behaviour, their industrialising world counterparts apply VEPs as a means to battle rampant non-compliance with existing environmental regulations (Blackman and Sisto 2006). This dissertation addresses this gap in the existing literature and considers the application of the world's foremost voluntary environmental scheme, the ISO 14001 environmental management system certification, in the developing country context of Thailand.

In this chapter, findings from the analysis sections of the dissertation are summarised, and implications for policymakers are drawn. Thus, in addition to providing a conclusion for the research, this chapter also addresses research question 4 set out in

the introduction chapter of this dissertation. The chapter begins with a summary of findings section, which recaps on the results of the main analysis chapters. This is immediately followed by a policy implications section, which draws on the findings to provide conclusions and suggestions relevant to the policymaker. A section with recommendations for further research is then presented, followed by a concluding remarks section, which closes off this dissertation.

2. Summary of Findings

Four main sets of research questions guide the analysis sections in this dissertation:

(1) When formal regulations and enforcement are weak, what types of firms are likely to participate in ISO 14001? Is connectedness to the global economy an important factor?

(2) What are the channels through which firms stand to gain financial benefits from voluntarily investing in environmental improvement schemes such as ISO 14001? Do firms obtain positive financial benefits from ISO 14001 adoption? Do firms stand to gain other types of benefits from participation in ISO 14001?

(3) How does ISO 14001 affect environmental performance for firms in the developing world? Do firms with ISO 14001 perform better environmentally?

(4) What are the lessons for policymakers that can be drawn from the research findings?

The research questions are addressed in the context of three manufacturing industries in Thailand – the food and beverages industry, the textiles and wearing apparel industry, and the electronics and electrical appliances industry. The industries are carefully chosen to represent the three main types of manufacturing activities in the country and are illustrative of the industries found in the majority of the developing world. These sectors are, respectively, representatives of resource-based industries, labour-intensive industries, and engineering industries. Together, these manufacturing activities are responsible for generating both hazardous and non-hazardous waste, for

emitting wastewater with high BOD, COD, and pH values, and for releasing water contaminated with heavy metals.

To provide a thorough picture of ISO 14001 adoption in the NIEs context, the dissertation combined the strengths of quantitative microeconometric techniques with the qualitative method's ability to provide more detailed and in-depth information. To answer the research questions posed, a unique primary survey questionnaire was developed and sent out to both ISO 14001 and non-ISO 14001 firms in the three industries across the country. To increase response rates, confidential financial information was omitted from the questionnaire. Instead, panel data from a government industrial survey supplemented the primary data in considering research questions (2).

For research questions (1), addressed in Chapter 4, a review of both firm-level and cross national studies identified several factors hypothesised to affect the firm's net benefits to participation. The chapter emphasised the roles played by two key factors that are thought to be of extreme importance to firms in developing countries, but which have received limited attention in the existing VEP literature – export orientation and foreign direct investment (FDI). Insights from cross regional studies that the country of FDI origin and the country of export destination could affect the firm's decision to adopt ISO 14001 certification (Prakash and Potoski 2007, Perkins and Neumayer 2010, Qi et al. 2011) were brought in and these variables included in addition to overall measures of FDI and export orientation. The hypotheses were that, for developing countries which rely on funding from overseas and on foreign exchange earned through exports, all measures of FDI and export orientation would be positive and significant determinants of ISO 14001 adoption. These hypotheses were then econometrically tested, along with idiosyncratic factors hypothesised to affect VEP participation in industrialised country studies such as firm size, location, stakeholder pressures, obstacles to environmental improvement, and local regulatory pressures.

After accounting for the potential endogeneity of the ISO 9000 variable, the analysis found that FDI, size, product type, experience with ISO 9000, obstacles to environmental improvement, and the number of pollutants a firm emit are important factors affecting ISO 14001 certification. Findings on the key FDI variables also

concur with existing cross national studies that existence of FDI from countries with higher adoption of ISO 14001 are likely to induce host country firms to adopt the standard (Prakash and Potoski 2007, Perkins and Neumayer 2010). Furthermore, this dissertation found a stronger effect of FDI since both overall FDI and FDI from OECD countries were found to be significant determinants of ISO 14001 participation. However, contrary to findings from these same cross regional studies, export orientation was found to have no effect on ISO 14001 certification, possibly due to the availability of other industry-specific standards and the effect of other firms in the supply chain which produced for export oriented firms. Findings also indicated that the importance of certain factors varied from industry to industry. For example, stakeholder pressures was important in the textiles and wearing apparel industry but not in other industries.

Chapter 5 addressed research questions (2) and examined in detail the sources of financial benefits from ISO 14001 certification using both econometrics and qualitative methods. In doing so, the chapter addressed one of the most neglected issues in the VEP literature and extended the few existing work on the subject by looking at the effect on financial performance over different time horizons, by looking separately at the effect of adoption on profitability, total sales, export sales, production costs and general business conditions, and by specifically accounting for endogeneity due to unobserved individual heterogeneity. Focused on the developing world, the study also provided an analysis of the private benefits to VEP adoption in a context where the majority of firms are not listed in the stock market or are multinationals whose stocks are listed elsewhere.

The chapter found that although adoption of the ISO 14001 standard required non-trivial commitments of the firm's resources, certification status did not affect any of the quantified measure of firm financial performance, subjective or objective. This finding is in line with Gilley et al. (2000), Bansal (2002), Link and Naveh (2006), and Heras-Saizarbitoria et al. (2011). Gilley et al. (2000) find no effect of greening activities on the firm's stock market returns, while Bansal (2002), Link and Naveh (2006), and Heras-Saizarbitoria et al. (2011) find that American, Israeli, and Spanish firms with certified EMSs did not perform better than non-certified firms in terms of profitability and sales revenues.

Responses from ISO 14001 adopters obtained from the primary survey provided additional information. Across all three industries, the majority of firms reported benefits in terms of improved corporate image, increased competitiveness, reduced environmental risks and liabilities, and improved relations with neighbouring communities. However, these benefits are difficult to quantify and do not show up in the quantitative measures of financial performance. Adopting firms also reported cost savings from ISO 14001 participation. This finding is not at odds with the empirical results since the costs saved are mostly on items which do not enter into the calculation of production costs such as water consumption, electricity usage, and waste management expenditures.

Environmental outcomes from ISO 14001, research questions (3), were addressed in Chapter 6. The chapter developed a novel theoretical framework that brought insights from club theory to the emissions equilibrium framework, and further contributed to the existing literature on the environmental effectiveness of VEP adoption by collecting new data which measured different aspects of the firm's environmental performance, applying both qualitative and econometric analyses to draw conclusions on the effects of ISO 14001 participation, and accounting for potential endogeneities arising from self-selection into the programme and from the adoption of other environmental practices.

Findings from both the qualitative and econometric analyses indicated that ISO 14001 adopters improved their overall environmental performance as a result of VEP participation. These findings are in line with qualitative surveys of ISO 14001 firms (TEI 1999, Raines 2002, Andrews et al. 2003). They also concur with findings from the Mexican study by Dasgupta et al. (2000), and with results from the only other paper which accounts for the endogeneity of environmental report in conjunction with ISO 14001 adoption (Arimura et al. 2008). However, while the findings from other studies are uniform across industries, this dissertation found that when individual environmental aspects were considered, there were industry differences in the impact of ISO 14001. Results indicated that firms in the electronics and electrical appliances, and the textiles and wearing apparel industries were more prone to self-selection into the programme based on expected gains than firms in the food and beverages industry. Findings also suggested that, although the programme had had the least impact for

firms in the food and beverages industry, non-participating firms in this sector would also improve their environmental performance on two aspects had they participated in the programme. For firms in the electronics and electrical appliances industry, non-adopters stood to improve on one environmental aspect, while non-participating firms in the textiles and wearing apparel industry did not stand to improve from participation.

Econometric findings were complemented by qualitative information from ISO 14001 firms. On the whole, responses from certified firms indicated that the certification proved more beneficial in reducing the consumption of water and energy resources, and in helping firms deal with water pollution. Participating firms also reported that the adoption of the certified EMS standard also helped them in terms of waste management. Free-response answers from these firms provided more details, with many firms reporting that they were able to reap environmental benefits because the certification allowed them to establish better monitoring mechanisms and have appropriate procedures to deal with environmental problems. However, the benefits are not uniform across firms and a smaller number of firms report that they had not received much benefits from ISO 14001 adoption.

3. Lessons on VEP Adoption and Implications for Policymakers

This dissertation has considered the topic of environmental policy instrument in the context of low-income newly industrialising economies (NIEs). The research argues that the third world case should be considered separately from that of the industrialised world because of three main reasons. First, the objective of VEPs application in such countries differ from those in OECD economies since the main environmental problem faced by third world countries is rampant noncompliance with existing regulations (Blackman and Sisto 2006). Second, since domestic regulatory and market pressures in developing countries are diluted (Hanley et al. 1996, Wehrmeyer and Mulugetta 1999, World Bank 2000, Kruger et al. 2003, Ruiz-Tagle 2003, Graham and Woods 2006, Blackman et al. 2009), such factors are unlikely to explain the rising adoption of VEPs across the third world. Third, historical non-compliance with existing regulations combined with their status as late-comers to the industrial development scene suggests that there may be low-hanging fruits to be reaped. This is especially true for many low-income NIEs which have not been so

successful in combating environmental pollution problems, but whose connectedness to the global economy via both export orientation and foreign direct investment of firms make them uniquely placed to leverage on the technical environmental expertise already developed in OECD countries (Rock and Angel 2005, 2010). These latter conditions give rise to opportunities for low-cost pollution abatement, and, when combined with the application of ISO 14001, a fairly stringent but flexible tool for environmental regulation, could potentially lead to a win-win situation where the firm is able to achieve better environmental and financial performances, and the regulator reduces enforcement costs while obtaining superior environmental results (Porter 1998, Daley 2007).

The promise of VEPs as a tool for combating environmental problems in the developing world context has some support in the findings of this dissertation. The research finds evidence that, subject to some caveats, VEPs with third party verification has potential to combat industrial environmental problems in the context where regulatory capacities are weak, and governments have limited budgets for monitoring and enforcement. The study finds that, on the whole, ISO 14001 adopters have stronger environmental performance than those who do not adopt the certification, and that reported benefits include less and better management of industrial wastes, increased recycling activities, and a reduction in water pollution. The study also finds that the channels through which these benefits are realised are by way of having better monitoring mechanisms and the development of appropriate procedures for dealing with both expected and unexpected environmental problems.

However, the study also finds that VEPs are not a panacea for all industrial pollution problems. Closer examination of individual environmental aspects reveals that the effect of ISO 14001 adoption varies from industry to industry. Programme participation has had the least impact in the food and beverages industry, but results also reveal that non-participants from this industry also stand to gain the most from being encouraged to sign up for ISO 14001 certification. Non-adopters in the electronics and electrical appliances industry also stand to gain in terms of the use of environmentally friendly raw materials. However, the study finds no evidence that firms in the textiles and wearing apparel industry would benefit from being encouraged to participate in ISO 14001 in terms of the seven environmental aspects.

These findings imply that VEPs are by no means a one-size-fits-all tool for environmental regulation, and that policymakers should be prudent in the application of VEPs. Before deciding on which environmental policy instrument to adopt, policymakers should first determine the main environmental problems they want to address and consider the nature of the industries that are the main source of those problems. If the target is to improve waste treatment and reduce spills and leakages in resource-intensive industries emitting mostly organic waste, then the application of ISO 14001 should be considered since results indicate that non-adopting firms in such industries can improve their environmental performance on these aspects as a result of programme participation. Also, if the goal is to encourage firms in engineering industries to adopt more environmentally friendly raw materials, then ISO 14001 should be promoted. However, for firms in labour intensive industries which employ relatively less advanced technologies, encouraging non-adopters to partake in third party voluntary schemes will most likely prove to be ineffective in improving firm environmental performance.

In terms of the ability of VEPs to generate a win-win situation where firms can improve their financial performance while at the same time reducing their environmental impacts, this dissertation finds that although VEP adoption requires non-trivial upfront investments, participating firms are not placed at a disadvantage when compared with non-adopting firms in terms of quantifiable financial benefits. Furthermore, participation in ISO 14001 can help firms reduce costs from decreased energy, water, and electricity consumption, save on waste management costs, and allow firms to reap fringe benefits such as improved corporate image, increased competitiveness, reduced environmental risks and liabilities, and improved relations with neighbouring communities.

Although programme participation can result in private gains, since certification to ISO 14001 does require non-trivial initial investments in terms of time and financial resources while private benefits are not immediately obvious, many firms might be prevented to participate in the programme even though they stood to benefit from certification. This conclusion is supported by evidence from the participation part of this dissertation, which finds that firms faced with more obstacles to environmental improvement are less likely to sign up for ISO 14001. This is especially true for

smaller firms, and for firms in more traditional resource-based industries such as the food and beverages sector which require less capital and manpower to operate. In such a case, government agencies or non-governmental organisations should step in to encourage programme adoption.

For policymakers looking to encourage firms to participate in the ISO 14001 certification scheme, findings on the characteristics of firms that make them more likely to adopt the voluntary programme from the participation chapter provide important information on which to base their promotion strategies. In addition to finding that obstacles associated with programme adoption such as high costs, complexities of procedures, lack of knowledge, personnel and support from both internal and external sources, and limited access to the appropriate technology hamper VEP participation, the dissertation also finds that firms in NIEs can be influenced by their multinational investors, and by their customers further down the supply chain. Larger firms emitting a variety of pollutants and with prior experience in applying the process-based standard, ISO 9000, are also more likely to sign up for ISO 14001.

One obvious implication of these findings is that any attempt to encourage firms to become ISO 14001 certified should be aimed at addressing the obstacles deterring programme participation. The strategies adopted will have to address issues regarding the high cost of adoption, the lack of knowledge and understanding of ISO 14001 standard and procedures, the limitation in terms of manpower and access to the relevant technology, and the lack of support for participation on both the firm's part and on the part of government agencies. However, findings from the financial benefits chapter suggest that the interventions need not require intensive financial resources on the part of the government since programme adoption had no measurable negative impact on the firm's financial performance. In fact, participation can prove beneficial in reducing non-operational costs and can bring out remunerations that are more in-kind than in cash.

Encouragement of ISO 14001 participation can come in the form of information provision, which will not only help firms overcome misgivings regarding the VEP due to misconceptions, but will also address the problem of non-participation due to the lack of understanding of the complicated procedures associated with ISO 14001. Information could be provided through pamphlets, a dedicated website, and training

programmes. Since firms are likely to have different levels of understanding, the information and activities provided should be clearly tailored to the different levels. Novice firms beginning their first forays into process-based standards could be provided with an introduction course aimed at giving them enough overview of the programme to make an informed decision whether or not the standard is suitable for them. This could be further supplemented by provision of information on where the firms can find additional knowledge on the scheme, and what they can do if they decide to pursue certification. Intermediate firms which already have the basic knowledge, but are just starting out on their EMSs would benefit from an EMS introduction course, as well as contacts with experts. Policymakers can also facilitate peer-to-peer learning by putting non-certified firms in touch with volunteer certified firms willing to share their experience of ISO 14001 certification. This would be easy to achieve for policymakers at the Thailand Industrial Standards Institute (TISI), the Management System Certification Institute (MASCI), the Thailand Environment Institute (TEI), and the Thailand Productivity Institute (TPI), which already have contacts with certified facilities through their work on industry standards. For advanced firms well on their way to implementing ISO 14001-based EMSs, schemes that put them in contact with experts at TISI, MASCI, TEI and TPI, or even with each other to share their successes and discuss potential solutions for obstacles can help pave the way for a smooth transition from non-certified to certified status.

To further facilitate firms in implementing EMSs, relevant environmental legislations pertaining to different firm types and industries should also be gathered and access provided to firms at little or no cost. A list of companies and NGOs that provide certification services should also be published to reduce search costs for firms looking to seek certification for their EMSs. To further relieve the cost burden of firms, financial institutions could be called upon to provide low interest loans in the first few years of VEP implementation. Alternatively, the government could also grant eligible firms tax exemptions in the years when the firm is preparing to become ISO 14001 certified to help companies overcome the initial cost barrier to VEP participation. Finally, it would be beneficial to set up a taskforce or committee comprising of members from the various government and non-governmental agencies working on ISO 14001 certification to serve as the go-to point for firms interested in partaking in the VEP. This will allow for the pooling of information from the various organisations,

help reduce inefficiencies that result from various agencies doing the same work separately, and would eliminate the need for firms to hunt around for information and services at various different agencies. This taskforce should also work closely with industry-specific institutes such as the the National Food Institute, and the Electrical and Electronics Institute, which have paid increasing attention to environmental issues in recent years.

4. Recommendations for Further Research

The greatest challenge faced when studying developing countries is data limitation, which this study has tried to overcome by collecting primary survey data and supplementing it with data from government sources. Thus, the clearest priority for future researchers and policymakers is to build up and maintain a database of firm-level environmental and non-environmental information such as those provided in Indonesia's Program for Pollution Control Evaluation and Rating (PROPER) in order to facilitate further research on voluntary environmental programmes in the developing world context.

Data limitation aside, time constraint, finite resources, and practical considerations have led the researcher to limit the coverage of this dissertation to three manufacturing industries that represent the main types of industrial activities in Thailand. However, since the study has found that certain determinants of VEP participation and the outcomes of VEP adoption can vary from industry to industry, an interesting extension of the present study would be to expand the scope for analysis to firms in other pollution-generating industrial activities and economic sectors such as mining and metal production, and the manufacture of automobiles.

In addition to expanding the scope of the study industry-wise, further studies could also be conducted in other developing country contexts. The focus of this research has been on VEP adoption within the newly industrialising economy context where foreign direct investment and export orientation are of great importance. However, not all less developed countries (LDCs) are as reliant on FDI and exports as the developing economies of East Asia. Thus, further research could focus on the case of LDCs that do not have much connection to the global economy to see what the

determinants and outcomes of VEP adoption in such cases are, and whether the findings of this study will still hold under this new context.

Difficulties in measurement and the need to limit the questionnaire to a reasonable length have led the study to omit measures of organisational factors such as organisational culture, composition of the board of directors, and characteristics of managers from the survey questionnaire. Further research could include these factors as determinants of VEP adoption and/or financial outcomes of VEP adoption to examine the roles they play in determining adoption and outcomes of voluntary environmental programmes.

While this dissertation has focused specifically on ISO 14001 due to its relatively long history in Thailand and other developing countries compared to other voluntary programmes, the recent surge in corporate environmentalism, especially in the form of corporate social responsibility (CSR) schemes, across the developing world make them a fertile area for future research. Researchers could focus on classification of the multitude of activities undertaken under the CSR banner, study the dynamics of their adoption, evaluate the effectiveness of such schemes to deliver on their promised goals, and study the interaction between newer voluntary schemes such as CSR and older schemes such as ISO 14001 to see if they complement or compete with each other.

Finally, one other avenue for future research is to study why some voluntary schemes have proved to be popular while others have not. For example, in Thailand, the ISO 14001 certification for environmental management systems has proved to be popular, while the ecolabel programme, the Thai Green Label, which was launched a few years before the ISO 14001 certification was promulgated, has received very little following. Thus, dynamics of programme adoption should also be explored to provide further information to policymakers seeking to use VEPs as an environmental policy tool.

5. Concluding Remarks

Overall, this work has provided valuable insights into the workings of third party voluntary environmental programmes in the developing world context where environmental goals must be achieved at little or no cost to economic growth, institutional capacities are limited, and regulatory enforcement is weak. By

identifying the gaps in the existing literature and addressing them through a combination of microeconometric and qualitative analyses, this work has contributed to the academic understanding on various aspects of VEPs. However, this study needs not be limited to the scholarly audience for although it is firmly rooted in the academic literature, its analysis of a burgeoning new tool for environmental management and the suggestions for policymakers should also be of great relevance to environmental practitioners in the developing world.

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APPENDIX I

MAP OF THAILAND

Source: United Nations Map No. 3853 Rev. 2, July 2009.

APPENDIX II

PRIMARY SURVEY QUESTIONNAIRE

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เรื่อง ขอความอนุเคราะห์ในการให้ความร่วมมือสำรวจข้อมูลและให้สัมภาษณ์

วันที่ 26 มีนาคม 2552

เรียน ท่านกรรมการผู้จัดการ

ด้วยทางกลุ่มวิจัยของ Department of Land Economy มหาวิทยาลัยเคมบริดจ์ ประเทศอังกฤษ และโครงการฉลากเขียว สถาบันสิ่งแวดล้อมไทย กำลังทำการศึกษาเรื่อง "Voluntary Environmental Agreements – A Case Study of ISO 14001 Environmental Management System in Thailand" โดยมีวัตถุประสงค์เพื่อ ให้เกิดความเข้าใจต่อกระบวนการการตัดสินใจของผู้ประกอบการภาคอุตสาหกรรม ในเรื่องที่เกี่ยวกับสิ่งแวดล้อม การตัดสินใจ ขอรับการรับรองระบบการจัดการสิ่งแวดล้อม ตามมาตรฐาน ISO 14001 และผลที่ได้ จากการมีระบบการจัดการสิ่งแวดล้อม ดังกล่าว นอกจากนี้ การศึกษายังครอบคลุมถึง มุมมองของผู้ประกอบการต่อบทบาทของภาครัฐ ภาคเอกชน และองค์กรต่างๆที่เกี่ยวข้อง

ผลของการศึกษา จะได้นำเสนอต่อ สถาบันสิ่งแวดล้อมไทย และคณะกรรมการสิ่งแวดล้อมแห่งชาติ เพื่อ เป็นประโยชน์ในการส่งเสริม การคุ้มครองสิ่งแวดล้อมของประเทศ ดังนั้น ความร่วมมือในการตอบแบบสอบถามของท่าน จะมีส่วนต่อการกำหนดนโยบายสิ่งแวดล้อมในประเทศไทยด้วย

ในการนี้ คณะผู้วิจัยใคร่ขอความร่วมมือจากท่าน ในการตอบแบบสอบถามตามความจริงทุกข้อ ข้อมูลของท่านจะถูกเก็บเป็นความลับ และไม่มีการเปิดเผยแหล่งที่มาของข้อมูล เมื่อท่านตอบแบบสอบถามเสร็จแล้ว โปรดส่งชุดแบบสอบถาม กลับมายังคณะทำงานเพื่อการวิจัย ***ภายในวันที่ 15 พฤษภาคม พ.ศ. 2552*** ทางโทรสาร หมายเลข 0-2883-[redacted] หรือ ส่งทางไปรษณีย์ตามที่อยู่ด้านหลังแบบสอบถาม โดยไม่ต้องติดแสตมป์

ทั้งนี้ ถ้าท่านมีข้อสงสัย หรือข้อคิดเห็นอื่นๆ โปรดติดต่อ นางสาว ขนิษฐา แต้มบุญเลิศชัย ผู้ประสานงานคณะทำงาน เพื่อการวิจัยได้ที่ โทร. 02-883-[redacted] หรือ 089-769-[redacted]

คณะผู้วิจัยขอขอบคุณเป็นอย่างสูงในความร่วมมือของท่าน

ขอแสดงความนับถือ

Dr. Andreas Kontoleon
ผู้อำนวยการโครงการนโยบายสิ่งแวดล้อม
มหาวิทยาลัยเคมบริดจ์ ประเทศอังกฤษ

(ฉบับแปล)

UNIVERSITY OF CAMBRIDGE
Department of Land Economy

Dr. Andreas Kontoleon
19 Silver Street, Cambridge CB3 9EP, UK
Tel: +44 1223 339773; Fax:+44 1223 337130
E: mail: ak219@cam.ac.uk

Subject: Co-operation in Completing Opinion Survey on Environmental Matters

Date: Thursday, 26 March 2009

Dear Managing Director,

We, the research team from the University of Cambridge, and our partner, the Thai Green Label Scheme, Thailand Environment Institute, are undertaking a study entitled "Voluntary Environmental Agreements – A Case Study of ISO 14001 Environmental Management System in Thailand". The purpose of this study is to better understand firm's decisions regarding environmental matters, including the decision to have ISO 14001, and firm's opinions on the role of the government, private sector, and NGOs. This research will provide Thailand with important information that will pave the way for future policies of relevant stakeholders, which include various government agencies. Thus, we seek your co-operation and support in carrying out this project by helping to complete our survey questionnaire and providing further insights where possible. This questionnaire mostly asks you to state your opinion by selecting from lists of choices and the parts of the questionnaire not relevant to your facility can be skipped. Thus, this questionnaire will take very little of your time.

Please return the completed questionnaire by 15 May 2009. The completed questionnaire can be faxed to 02-883-[redacted] (attn. Miss Kanittha Tambunlertchai). Alternatively, it can be folded and sent off by mail (postage has been provided) to the address given at the back of the questionnaire.

All responses will be kept strictly confidential and the source of the data will not be revealed.

Should you have any questions or comments regarding this study, please contact Miss Kanittha Tambunlertchai at 0-2883-[redacted], or at 089-769-[redacted].

We thank you for your kind co-operation.

Sincerely,

Andreas Kontoleon

Director of Environmental Policy Programme
University of Cambridge, United Kingdom

โครงการ ฉลากเขียว
Thai Green Label Scheme

ที่ TEI/GL-TISI_2552/059

สำนักงานเลขานุการโครงการฉลากเขียว
สถาบันสิ่งแวดล้อมไทย
16/151 เมืองทองธานี ถ.บอนด์สตรีท
ต.บางพูด อ.ปากเกร็ด จ.นนทบุรี 11120

11 มีนาคม 2552

เรื่อง ขอความอนุเคราะห์ในการให้ความร่วมมือสำรวจข้อมูลและให้สัมภาษณ์

เรียน ท่านกรรมการผู้จัดการ

ด้วยโครงการฉลากเขียว สถาบันสิ่งแวดล้อมไทย และกลุ่มวิจัยของ Department of Land Economy มหาวิทยาลัยเคมบริจจ์ ประเทศอังกฤษ ภายใต้การสนับสนุนงบประมาณจาก EEPSEA Awards Funding กำลังทำการศึกษา เรื่อง 'Voluntary Environmental Agreements: A Case Study of ISO 14001 Environmental Management System in Thailand' โดยการศึกษานี้ มีวัตถุประสงค์เพื่อให้เกิดความเข้าใจในแง่มุมต่างๆ เกี่ยวกับมาตรฐาน ISO 14001 ให้มากขึ้น เช่น เหตุผลในการจัดทำ ISO 14001 ผลที่ได้รับจากการทำ ISO 14001 ทั้งทางด้านการเงินของทางสถานประกอบการเองและทางด้านผลต่อสิ่งแวดล้อม นอกจากนี้การศึกษายังครอบคลุมถึงบทบาทของภาครัฐในมุมมองของผู้ประกอบการ โดยผลการศึกษาดังกล่าว จะเป็นข้อมูลพื้นฐานสำคัญของประเทศเพื่อนำเสนอแนวทางอันเป็นประโยชน์ต่อภาคส่วนที่เกี่ยวข้อง และต่อกลุ่มวิจัยที่เกี่ยวข้องในต่างประเทศ เพื่อขอความร่วมมือและสนับสนุนในการดำเนินโครงการอันเป็นประโยชน์ต่อกลุ่มผู้ประกอบการได้รับการรับรองเครื่องหมายฉลากเขียว ในอนาคต

ในการนี้ โครงการฯ จึงเรียนขอความอนุเคราะห์มายังท่านโปรดให้ความร่วมมือในการตอบแบบสำรวจและให้ข้อคิดเห็นอันเป็นประโยชน์และส่งกลับมายังคณะทำงานเพื่อการวิจัย Voluntary Environmental Agreements โดยติดต่อนางสาวขนิษฐา แต้มบุญเลิศชัย ผู้ประสานงานคณะทำงานเพื่อการวิจัย โครงการ ฯ หวังเป็นอย่างยิ่งในความร่วมมืออันดีจากท่าน และขอขอบพระคุณเป็นอย่างสูงมา ณ โอกาสนี้

ขอแสดงความนับถือ

(นายปฐม ชัยพฤกษทล)
ผู้จัดการโครงการฉลากเขียว
สถาบันสิ่งแวดล้อมไทย

คณะทำงานเพื่องานวิจัย Voluntary Environmental Agreements
โทรศัพท์ 02-883-[redacted] หรือ 089-769-[redacted]
โทรสาร 02-883-[redacted]

สำนักงานเลขานุการโครงการฉลากเขียว
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16/151 เมืองทองธานี ถ.บอนด์สตรีท ต.บางพูด
อ.ปากเกร็ด จ.นนทบุรี 11120
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100 % recycled Paper

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Tel: (662) 503 3333 Ext. 315,316 Fax: (662) 504 4826-8

UNIVERSITY OF CAMBRIDGE

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เลขที่ .....

วัน/เดือน/ปี ...../...../.....

Environmental Management and Opinion Survey Questionnaire
University of Cambridge Research Project

Suggestions for Filling Out the Questionnaire

1. Please answer all questions by marking ✓ in the space that best corresponds to your response, or by writing your answer in the space provided.
2. Completed questionnaires can be returned by fax to 02-883-9889, or by post to the address provided at the back of the questionnaire (postage has also been provided). Please return completed questionnaires by **15 May 2009**.

Note: The information provided in the questionnaire will be treated as confidential information and the source of information will not be disclosed.

Part I: Background Information

1. Name of establishment ……

2. Location ……Postcode……

Telephone ……. Extension ……

Email: ……Webpage ……..

2.1) ☐ Located in an industrial estate/ industrial park

(please name) ……..……

☐ Not located in an industrial estate/ industrial park

2.2) ☐ Located in a pollution control area (please name) ……...…….……..…

☐ Not located in a pollution control area

3. Establishment's share of ownership

3.1) Thai ownership ……. %

3.2) Foreign ownership (1) …….. %, country ……..…

(2) …….. %, country ……..…

(3) …….. %, country ……..…

4. Number of employees in establishment, approximately ……..… people.

5. In 2008, your establishment's two most important products were

(1) ……., which accounted for …… % of total sales.

(2) ……., which accounted for ……. % of total sales.

6. Exports in 2008

☐ No exports (skip to 8.)

☐ Exports, at ……. % of total sales

Exports mainly to (specify country/ countries) ……....

7. If your establishment exports, have you had access to new markets in the past years (2003 – present)?

☐ No new markets.

☐ New markets. Please list important new market(s) ……

8. For the years 2003 – 2007, how has your establishment performed in these categories?

Please mark ✓ in the appropriate box. If your establishment does not export, please mark ✓ in the N/A (Not Applicable) box for no. 3 and 4.

No.	Category	Negative	No Change	Positive	N/A
1	Growth in profitability				
2	Growth in total sales				
3	Growth in export sales				
4	Growth in exports to total sales ratio				

Part 2: Opinion on the Environment

9. Please indicate the main environmental impacts that your establishment have and indicate the ones which your establishment gives importance in preventing and remedying.

(Please check all that apply and indicate the three most important impacts by writing 1 (most important), 2, or 3 next to the choice).

No.	Topic	Impact?		Rank
		Yes	No	
1.	Wastewater			
2.	Hazardous waste			
3.	Particulates			
4.	Odor			
5.	Ozone-depleting substances (e.g., CFC)			
6.	Sulfur gas			
7.	Greenhouse gases			
8.	Other toxic substances (both liquid and solid)			
9.	Other impacts, please specify …… ……			

10. Please rate, on a scale of 1 to 5, the extent to which your establishment addresses the following topics. Please check only one box for each statement.

No.	Topic	1	2	3	4	5	N/A
1.	Treatment of waste before release into the environment.						
2.	Measures to reduce spills and leaks of environmental contaminants						
3.	Recycling						
4.	The use of raw materials that have low environmental impacts in the production process						
5.	Pollution prevention in the production process by modifying the production process or the product itself.						
6.	Use of clean technology in reducing energy consumption, or in increasing energy efficiency.						
7.	Modification of products to reduce environmental impact throughout the product life-cycle (production process, raw material selection, transportation, usage, and disposal)						

Note: 1 = Gives importance by having clear policies, implementation, assessment, and continuous improvement.
2 = Gives importance by having clear policies and implementation, but lacks assessment for improvement.
3 = Gives importance by having policies and plans for implementation
4 = In the process of deliberating the appropriateness of implementation.
5 = No plans or implementation on the topic.
N/A = Not applicable

11. Please indicate how often your establishment undertakes these measures

No.	Topic	More than twice in a year	Twice a year	Once a year	Less than once a year	None
1.	Publish environmental reports					
2.	Provide opportunities for relevant personnel to go for trainings on various environmental management tools such as environmental management accounting (EMA), environmental management systems (EMS), etc.					

12. Does your establishment have designated environmental managers? If yes, how many?

☐ Yes ..... people.

☐ No, but we have ..... people who are responsible for environmental matters.

☐ No.

13. How many times have your establishment been inspected in the past year (2008)?

☐ Inspected …… times ☐ No inspections.

14. Please check if your establishment has (or is in the process of obtaining) any of the following. If any is in place, please indicate the year it was first acquired. (Please check all that apply).

	Does not have	In Process	Has	If has, please indicate year acquired.
ISO 9000 certification				
ISO 14001 certification				
Corporate Social Responsibility (CSR) Policy				
Clean Production Policy / Clean Technology				
Green Purchasing Policy				
Clean Development Mechanism				
Thai Green Label, indicate product ……..…… ……..……				
Other environmental awards and/or certifications, please indicate ……..…….. ……..……..…… ……..……				

15. Which of the following factors are important in your decision for environmental protection, including having an environmental management system?

Please indicate importance by marking ✓ in the appropriate box.

Please also rank the order of importance by placing 1 (most important), 2, and 3 in the 'Rank' box.

No.	Topic	Not Important	Important	Very Important	Rank
1.	Corporate/ parent company policy				
2.	Policy of organization's management				
3.	Customer demand for environmentally friendly products and services				
4.	Requirement of importing market(s)				
5.	Comply with existing environmental regulations				
6.	Government support				
7.	Responsibility to society				
8.	Better corporate image				
9.	Increase competitiveness				
10.	Desire to improve production and work process to reduce production costs				
11.	Alleviate complaints from local communities				
12.	Others (please specify) …… …… …… ……				

16. What factors have hindered the establishment's attempts to improve environmental performance, including any attempt to apply for environmental management system certification?

Please indicate importance by marking ✓ in the appropriate box.

Please also rank the order of importance by placing 1 (most important), 2, and 3 in the 'rank' box.

No.	Topic	Not Important	Important	Very Important	Rank
1.	High costs				
2.	Complexities of the procedures				
3.	Lack of knowledge and personnel				
4.	Lack of support from upper management				
5.	Lack of government support				
6.	No access to appropriate technology				
7.	Lack of support from staff / personnel				
8.	Others (please specify) …… …… …… ……				

❖ If your establishment **has ISO 14001** certification, please answer **Part 3** and **Part 4**.

❖ If your establishment **does not have ISO 14001** certification, please skip to **Part 5**.

Part 3: Role of Government and Other Agencies (for those with ISO 14001 only)

17. What roles have the various agencies played in your establishment's ISO 14001 certification process? (Please check all that apply).

☐ Our establishment did not have outside help in setting up an environmental management system and in applying for ISO 14001.

☐ We received help from our parent company

☐ We received help from our trading partner who wants their associates to have ISO 14001.

☐ We received help from non-governmental organizations such as the Thailand Environment Institute (TEI), the Management System Certification Institute (Thailand) (MASCI), Thailand Productivity Institute (TPI), etc.

Please specify: 1) ……..…

2) ……..…

☐ We received help from government agencies such as the Department of Industrial Works, Thailand Industrial Standards Institute, Ministry of Industry, etc.

Please specify: 1) ……..…

2) ……..…

18. In your opinion, has the government played a role in promoting ISO 14001? If it has, how successful has the government been in promoting ISO 14001?

☐ Yes, the government has been highly successful in promoting ISO 14001.

☐ Yes, the government has received some success in promoting ISO 14001.

☐ Yes, but the government has not been successful in promoting ISO 14001.

☐ The government has not played a role in promoting ISO 14001.

19. Which of the following measures do you think the government should support or arrange to have in order to promote ISO 14001 certification in manufacturing facilities? (Please check all that apply).

☐ Financial incentives such as tax exemptions (or subsidies), low-interest loans, etc.

☐ Training of personnel on the ISO 14001 process.

☐ Provision of information and advice on the ISO 14001 process

☐ Availability of a review of relevant environmental laws

☐ Others, please specify ……...……...……..

……

20. If you have other opinions on the role of the government and other relevant agencies in promoting the establishment of environmental management systems in manufacturing facilities, please note them here.

…...…….

…...…….

…...…….

…...…….

…...…….

…...…….

Part 4: Effects of ISO 14001 Certification (for those with ISO 14001 only)

21. Which environmental impacts were mitigated after your establishment has the ISO 14001 certification in place?

☐ Reduced water pollution. Please explain……..

☐ Reduced air pollution. Please explain……..…….

☐ Reduced ground pollution. Please explain…….

☐ Reduced waste management. Please explain…… ……

☐ Others, please specify ……..

……..

22. What have the benefits to having ISO 14001 been for your establishment? (Please check all that apply.)

☐ Improved corporate image, especially in environmental area

☐ Improved working conditions for establishment's personnel

☐ Increased competitiveness

☐ Able to access new markets

☐ Able to charge higher prices for products

☐ Reduced environment-related risks and liabilities

☐ Able to alleviate the number of complaints against the plant from nearby communities

☐ Able to reduce the complaints against the plant from environmental groups

☐ Others, please specify ……...……..

…….

23. Do you believe that having an ISO 14001-certified environmental management system in place can reduce production costs?

☐ ISO 14001 does not reduce help costs.

☐ Helped reduce the use of energy from fuels within the establishment by …… % compared with before having ISO 14001.

☐ Helped reduce electricity charges by …… % compared with before having ISO 14001.

☐ Helped reduce water fees by …….. % compared with before having ISO 14001.

☐ Helped reduce waste management fees by …….. % compared with before having ISO 14001.

☐ Helped reduce other expenses, please specify …..……...……..

…….

…….

❖ <u>If your establishment **has the ISO 14001** certification, please skip to **Part 6**.</u>

Part 5: Role of Government, NGOs and the Private Sector (for those without ISO 14001 only)

24. Which factors motivate your establishment's decision not to adopt ISO 14001 certification?
Please check all that apply, and rank the most important factors by placing 1 (most important), 2, and 3 under the 'rank' column.

No.	Topic	Not Important	Important	Very Important	Rank
1.	Lack of knowledge and personnel				
2.	Does not see the importance of having ISO 14001				
3.	Facility already has an environmental management system in place, but it still does not meet the requirements of ISO 14001				
4.	Facility has environmental management system which is comparable to ISO 14001 (e.g. EMAS)				
5.	High costs				
6.	Complicated procedure				
7.	Difficulty in obtaining information on ISO 14001				
8.	Facility's environmental impact is minimal				
9.	Others (please specify) ……..… ……				

25. Would your establishment apply for ISO 14001 certification if the following measures were offered? (Please check all that apply).

☐ Financial support (tax exemptions, low-interest loans, etc.)

☐ Training of personnel in the ISO 14001 process, either free-of-charge or with subsidy

☐ Provide information and advice on how to create an environmental management system that meets ISO 14001 standards

☐ Easily accessible review of relevant environmental regulations

☐ Others, please specify ……..……..

……

26. Has your establishment received help on environmental improvements from any of the following sectors? (Please check all that apply).

☐ The government through the following agencies:

1) ……..

2) ……

3) ……

☐ Private agencies such as Thailand Environment Institute (TEI), the Federation of Thai Industries (FTI), the various industrial institutes, etc. Please specify:

1) ……..

2) ……

3) ……

☐ Trading partners

☐ Industrial Estates Authority of Thailand

☐ Others, please specify: ……..…

27. Please note down any additional comments you might have regarding the role of the government and non-governmental organizations in promoting improvements in environmental performance within manufacturing facilities.

……
……
……
……

Part 7: Concluding Section

28. The surveyors might wish to contact you for further interviews regarding the role of the government and other agencies. Would you be willing to be interviewed by us?

☐ Yes, please contact (name). …….

Tel: …….. Email: ……..

☐ Not available for interviews, but willing to provide addition information at the following contacts:

Tel: …….. Email: ……..

29. Please note down any additional comments you might have here.

……
……
……
……

Thank you very much for completing the survey!

APPENDIX III

ENDOGENOUS SWITCHING REGRESSION RESULTS

Table III.1: ISO 14001 Regression

	(1)	(2)	(3)	(4)	(5)	(6)
ISO 9000 Adoption	0.956**	1.047**	0.864**	0.985**	0.768*	0.845*
	(0.400)	(0.418)	(0.418)	(0.434)	(0.399)	(0.444)
Export Orientation	-0.005	-0.082				
	(0.232)	(0.231)				
Foreign Direct Investment	0.511**	0.390*				
	(0.228)	(0.219)				
Export to ISO 14001-rich Countries			-0.024	-0.03		
			(0.134)	(0.130)		
Foreign Direct Investment from OECD Countries			0.382*	0.357*		
			(0.199)	(0.192)		
Export to OECD Countries					0.151	0.098
					(0.131)	(0.124)
Foreign Direct Investment from OECD Countries					0.476**	0.444**
					(0.199)	(0.194)
Firm Size	0.262***	0.275***	0.275***	0.283***	0.289***	0.303***
	(0.086)	(0.090)	(0.085)	(0.087)	(0.079)	(0.083)
Location in Industrial Estate	-0.040	0.016	-0.015	0.007	-0.036	-0.015
	(0.178)	(0.170)	(0.174)	(0.172)	(0.179)	(0.176)
Final Goods	-0.331**	-0.376**	-0.366**	-0.406**	-0.381**	-0.420***
	(0.162)	(0.164)	(0.165)	(0.161)	(0.167)	(0.163)
Stakeholders	0.018	0.044	-0.005	0.019	0.0004	0.026
	(0.061)	(0.057)	(0.049)	(0.047)	(0.051)	(0.048)
Obstacles	-0.096**	-0.092*	-0.107**	-0.105**	-0.112**	-0.109**
	(0.047)	(0.047)	(0.049)	(0.049)	(0.048)	(0.048)
Number of Pollutants	0.379***		0.298**		0.328***	
	(0.138)		(0.124)		(0.124)	
Hazardous Pollutant		0.244		0.205		0.196
		(0.150)		(0.150)		(0.149)
Textiles	0.373	0.202	0.226	0.166	0.283	0.175
	(0.308)	(0.304)	(0.283)	(0.292)	(0.269)	(0.275)
Electronics	0.796**	0.685**	0.710**	0.691**	0.783***	0.741***
	(0.325)	(0.316)	(0.285)	(0.278)	(0.284)	(0.271)
Export*Textiles	-0.288	-0.147	-0.210	-0.173	-0.338	-0.243
	(0.327)	(0.329)	(0.270)	(0.275)	(0.271)	(0.270)

	(1)	(2)	(3)	(4)	(5)	(6)
Export*Electronics	0.207	0.246	0.210	0.174	0.124	0.120
	(0.323)	(0.318)	(0.264)	(0.263)	(0.260)	(0.254)
Foreign Direct Investment*Textiles	0.405	0.627*	0.613*	0.729**	0.404	0.543
	(0.373)	(0.359)	(0.336)	(0.332)	(0.340)	(0.333)
Foreign Direct Investment*Electronics	0.427	0.403	0.627**	0.548**	0.548**	0.460**
	(0.282)	(0.289)	(0.244)	(0.238)	(0.240)	(0.233)
Stakeholders*Textiles	0.432*	0.390*	0.472**	0.438**	0.475**	0.437**
	(0.227)	(0.214)	(0.214)	(0.207)	(0.218)	(0.206)
Stakeholders*Electronics	0.117	0.060	0.131	0.076	0.123	0.065
	(0.160)	(0.161)	(0.149)	(0.150)	(0.151)	(0.151)
Obstacles*Textiles	0.001	0.0182	-0.007	0.013	0.0334	0.041
	(0.145)	(0.146)	(0.149)	(0.151)	(0.145)	(0.145)
Obstacles*Electronics	-0.062	-0.032	-0.007	0.021	-0.006	0.020
	(0.139)	(0.139)	(0.143)	(0.142)	(0.140)	(0.140)
Constant	-3.953***	-3.685***	-3.728***	-3.621***	-3.775***	-3.596***
	(0.353)	(0.330)	(0.360)	(0.359)	(0.374)	(0.387)

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level.

Table III.2: ISO 9000 Regression (Switching Regression)

	(1)	(2)	(3)	(4)	(5)	(6)
Export Orientation	0.624**	0.625**				
	(0.2973)	(0.297)				
Foreign Direct Investment	0.0665	0.0664				
	(0.3301)	(0.330)				
Export to ISO14001-rich Countries			-0.0508	-0.0509		
			(0.2534)	(0.2535)		
Foreign Direct Investment to ISO14001-rich Countries			0.2371	0.2371		
			(0.4104)	(0.4105)		
Export to OECD Countries					0.2204	0.2205
					(0.2417)	(0.2418)
Foreign Direct Investment to OECD Countries					-0.0315	-0.0317
					(0.3917)	(0.3918)
Final Goods	0.0218	0.0217	0.0368	0.0367	0.0105	0.0105
	(0.323)	(0.323)	(0.349)	(0.349)	(0.352)	(0.352)
Firm Size	0.7068**	0.707**	0.8341**	0.8341**	0.7584**	0.7582**
	(0.3183)	(0.318)	(0.3329)	(0.3330)	(0.3177)	(0.3178)
Textiles	-0.524	-0.524	-0.100***	-0.100***	-0.924***	-0.924***
	(0.3474)	(0.347)	(0.3012)	(0.3011)	(0.3006)	(0.3006)
Electronics	0.3305	0.3304	-0.1136	-0.1138	-0.0624	-0.0625
	(0.3804)	(0.380)	(0.3531)	(0.3532)	(0.353)	(0.353)
Export *Textiles	-0.2741	-0.2742	0.333	0.333	0.1686	0.1685
	(0.4255)	(0.425)	(0.3649)	(0.3648)	(0.3723)	(0.3723)
Export*Electronics	-0.1088	-0.1086	0.5026	0.503	0.3838	0.384
	(0.4240)	(0.424)	(0.3462)	(0.3464)	(0.3425)	(0.3426)
Foreign Direct Investment*Textiles	-0.4777	-0.4774	-0.5387	-0.5385	-0.3843	-0.3844
	(0.5429)	(0.543)	(0.5179)	(0.5176)	(0.5665)	(0.5664)
Foreign Direct Investment*Electronics	-0.1297	-0.1305	-0.1994	-0.2005	-0.0525	-0.0532
	(0.4342)	(0.434)	(0.386)3	(0.3865)	(0.4002)	(0.4005)
Constant	-0.8639**	-0.864**	-0.4368	-0.4367	-0.4731	-0.4730
	(0.3800)	(0.380)	(0.3715)	(0.3715)	(0.3727)	(0.3727)
N	496	496	496	496	496	496
Rho	0.2114	0.1627	0.2520	0.1960	0.3356	0.2986

Note: Standard errors in parentheses. *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level.