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DOES SYMBOLISM BENEFIT ENVIRONMENTAL AND BUSINESS PERFORMANCE IN THE ADOPTION OF ISO 14001?

Vera Ferrón-Vílchez
University of Granada
Department of Management
Economics and Business School
Campus Cartuja S/N Granada (Spain) 18071
Phone: (0034) 958.249.596
Fax: (0034) 958.246.222
Email: vferron@ugr.es

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Abstract

Much research has focused on the organisational and reputational benefits of ISO 14001. However, less discussed is the *symbolic* adoption that some firms are implementing without experiencing significant reductions in environmental impacts. This work analyses the relationships between the different ISO 14001 adoption profiles (from *symbolic* profile to *factual* approach) and both environmental performance and profitability. These relationships are examined using a sample of 1,214 manufacturing firms in 7 OECD countries while controlling for selection bias. The results suggest that only ISO 14001 adopters that monitor an extensive set of negative environmental impacts are associated with real improvements in both environmental performance and business performance.

Keywords

Business performance, environmental performance, ISO 14001, multivariate probit, *symbolic* adoption.

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1. INTRODUCTION

Since the international standard ISO 14001 was officially published in 1996, more than 320,000 organisations in 155 countries have certified their environmental management systems[1] (EMSs) to this standard (ISO, 2014). Prior literature has explained extensively the benefits that a firm can achieve from the ISO 14001 adoption, such as organisational (e.g., Ferrón and Darnall, 2016; Nishitani et al., 2012), commercial (e.g., Delmas, 2001; Iatridis and Kesidou, 2016), reputational (e.g., Castka and Prajogo, 2013; Jiang and Bansal, 2003), and stakeholder-related benefits (e.g., Castka and Prajogo, 2013; Heras and Boiral, 2013). Nevertheless, several voices have criticised the *symbolic* adoption of ISO 14001 (Aravind and Christmann, 2011; Boiral, 2007; Yin and Schmeidler, 2009). The *symbolic* adoption of ISO 14001 refers to the use of standards by firms as a way to legitimise environmental practice by looking for the support from the institutional environment but without necessarily implying real environmental commitment (Aravind and Christmann, 2011; Iatridis and Kesidou, 2015). In fact, formerly ISO 14001 adopters were primarily motivated by internal efficiency benefits and functional improvements in their operation processes (Russo, 2009), being more concerned about an effective adoption to comply with regulatory requirements (Jiang and Bansal, 2003). However, nowadays firms might decide to adopt ISO 14001 more influenced by the achievement of institutional legitimacy (Aravind and Christmann, 2011; Boiral, 2007; Borial and Henri, 2012; Castka and Prajogo, 2013; King et al., 2005; Yin and Schmeidler, 2009). When firms prioritise finding external legitimacy instead of internalising efficient behaviour, variations may occur in the implementation of certain

[1] An environmental management system is *"a formal set of articulating goals, making choices, gathering information, measuring progress, and improving performance with respect to resource use, throughput, and emissions"* (Florida and Davison, 2001, p. 64).

organisational practices (Boiral, 2007; Delmas and Montes-Sancho, 2010) in terms of environmental performance. This *symbolic* adoption of ISO 14001 might become a double-edged sword with negative consequences in terms of the standard's reliability, that is, increasing the amount of ISO 14001 adopters but without necessarily implying real reductions in environmental impacts.

Further, prior research has argued that the adoption of ISO 14001 could generate organisational distinctive capabilities which add value to the firm (Castka and Prajogo, 2013; Curkovic and Sroufe, 2011; Darnall and Edwards, 2006; Delmas, 2001; Melnyk et al., 2003). However, less is analysed about how this *symbolic* adoption of ISO 14001 is associated with business performance. A better understanding of this relationship is needed since, in the current context of economic crisis, managers are questioning the priority of adoption of ISO 14001 (Heras et al., 2016), raising to what extent a substantive or a symbolic adoption of ISO 14001 could be positive related to profitability (Iatridis and Kesidous, 2016).

The objective of this work is twofold. On the one hand, from a theoretical point of view, this work attempts to collect the main criticisms that the literature has pointed out about ISO 14001 adoptions, especially those related to its effects on environmental performance (i.e., reductions in negative environmental impacts) and profitability (i.e., positive business performance). On the other hand, this work argues that managers do not consider the adoption of ISO 14001 monolithically (Boiral and Henri, 2012), but this decision is also influenced by stakeholder demands (Castka and Prajogo, 2013; Delmas, 2001). Depending on these influences as well as the potential benefits that managers hope to obtain from ISO 14001 adoption, they opted for different profiles: from a *symbolic* approach to a *factual* approach. From an empirical perspective, this work analyses whether these different adoption profiles are related to significant improvements in both the environmental performance and business performance of the firm. In doing so, this work draws on survey data collected by the Environmental Directorate of the Organisation for Economic Cooperation and Development (OECD) by analysing a sample of 1,214 manufacturing facilities located in 7 countries. The results were controlled for selection bias related to different ISO 14001 adoption profiles by simultaneously estimating the adoption decision using multivariate probit regression.

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2. ISO 14001: ADVANTAGES AND CRITICISMS

The adoption of ISO 14001 can generate a competitive advantage for the firm (e.g., Darnall, 2006; Delmas, 2001; Russo, 2009) through encouraging the development of distinctive skills such as commercial, organisational, and stakeholder-related abilities. Regarding commercial skills, the significant (and continually increasing) global diffusion of ISO 14001 could facilitate international trade for firms (Iatridis and Kesidou, 2016) by harmonising environmental management standards (Bansal and Hunter, 2003; Christmann and Taylor, 2001, 2006; Delmas, 2002). The adoption of ISO 14001 was considered as a way to solve the problems of asymmetric information[2] between commercial partners (Christmann and Taylor, 2006; Montiel et al., 2012) by means of the signalling[3] that is conferred by the standard. Such signalling allows to reduce value chain costs (Christmann and Taylor, 2006; Delmas, 2002; Heras and Boiral, 2013) by indicating externally that the firm complies with several requirements that are difficult to observe if commercial partners are not involved in the firm's internal processes (Montiel et al., 2012). Further, the adoption of ISO 14001 could mean preferential access to foreign markets that trust this well-known international standard (Delmas, 2002; Iatridis and Kesidou, 2016), allowing reductions in information asymmetries that often prejudice parties in an exchange (Heras and Boiral, 2013; King et al., 2005). In fact, even though the adoption costs may become expensive (Darnall, 2006), one of the main reasons firms with advanced environmental practices or which are obligated to report their toxic emissions are considered an affordable investment in such certification (Delmas and Montiel, 2009) is the pressure exerted by markets and customers (Darnall, 2006; Jiang and Bansal, 2003). By adopting ISO 14001, firms are

[2] Asymmetric information occurs when the information about a transaction between a supplier and a buyer is not provided equally (King et al., 2005).

[3] Signalling is understood as those activities that attempt to demonstrate that the firm owns specific features that are otherwise hidden to external parties (Montiel et al., 2012).

able to obtain the benefits of credible signalling, legitimising their environmental behaviour (Aravind and Christmann, 2011; Castka and Prajogo, 2013).

Regarding organisational skills, the adoption of ISO 14001 could represent an intangible and valuable resource that provides a basic framework for the development of an effective EMS (Delmas, 2001). Internal efficiencies emerge because the adoption of ISO 14001 is based on the continual improvement principle (Bansal and Hunter, 2003). It promotes facilities to undertake internal assessments, source and energy consumption reductions, the implementation of life-cycle cost analysis, and other similar practices of advanced environmental management that are directly related to reductions in environmental impacts (Ferrón and Darnall, 2016; Nishitani et al., 2012; Potoski and Prakash, 2005). ISO 14001 could also facilitate the development of complementary resources and skills concerning the achievement of competitive advantage, such as the adoption of quality management systems or the investment in innovation technologies (Darnall, 2006; Darnall and Edwards, 2006). This resource-based complementarity motivates undertaking several improvements in the firm's internal processes, which add value to the firm (Darnall, 2006).

Concerning stakeholder-related skills, the adoption of ISO 14001 is usually motivated by *normative*[4] pressures in the institutional context, as this adoption is a voluntary environmental practice that facilitates legitimising firms' environmental practices in facing certain external stakeholders' demands (Heras and Boiral, 2013). In fact, firms that are continually seeking innovative environmental solutions to face pressures from external stakeholders (Henriques and Sadorsky, 1999) adopt ISO 14001 in order to develop the ability for integrating stakeholders' demands (e.g., customers, suppliers, communities, environmental groups, regulators) into the firm's decision-making process (Delmas, 2001). The ability to involve stakeholders' demands in the design of an EMS, and its subsequent certification by ISO 14001, offers a valuable skill that is difficult to imitate by competitors due to the complexity and causal ambiguity behind this inclusion. In some instances, it is not even feasible to

[4] DiMaggio and Powell (1983) argued that organisations operating in similar institutional environments tend to exhibit isomorphism, that is, a homogenous conduct pattern among them. Specifically, normative isomorphism stems primarily from professionalisation.

understand, fully or partially, how the firm involves the stakeholders' demands in its environmental decision making, specifically in the firm's decision to adopt ISO 14001 (Delmas, 2001).

Nevertheless, in spite of these benefits, several criticisms of ISO14001 have argued that its adoption is not necessarily accompanied by significant improvements in the facility's environmental performance (Aravind and Christmann, 2011; Yin and Schmeidler, 2009), even though this is the main goal of the standard (ISO, 2014). One of the reproaches is, on the one hand, that ISO 14001 adoption could not usually be associated with the development of real abilities that allow firms to achieve significant reductions in negative environmental impacts, because the standard is processes-focused instead of performance-focused (Bansal and Hunter, 2003; Delmas, 2001). In fact, it is feasible that ISO 14001 adopters have significant differences in their levels of environmental performance, even with similar firms' characteristics such as operating in the same industry or having a similar size (Iatridis and Kesidou, 2016; Yin and Schmeidler, 2009). This fact affects the level of development of the facility's skills related to environmental management. Indeed, researchers have found inconclusive and even negative associations between the adoption of ISO 14001 and the facility's environmental performance (e.g., Boiral and Henri, 2012; Darnall and Sides, 2008; Jiang and Bansal, 2003; Lannelongue et al., 2015; Yin and Schmeidler, 2009). For instance, Yin and Schmeidler (2009) noted that strong variations in the development and implementation of ISO 14001 among firms exist, and this fact considerably affects the achievement of improvement in environmental performance, because, in some cases, firms obtain ISO 14001 by doing only the minimum necessary, turning to adoption in a purely bureaucratic act. Consequently, ISO 14001 adoption guarantees neither a similar level of environmental performance nor homogeneous adoption of environmental practices, despite the alleged standardisation rule intended (Boiral and Henri, 2012).

On the other hand, aspiration for legitimacy, as a main advantage of ISO 14001, can also become a double-edged sword with negative consequences. The adoption of the standard with the exclusive purpose of legitimising business practices sometimes generates a superficial or *symbolic* adoption (Aravind and Christmann, 2011; Boiral, 2007; Iatridis and Kesidou, 2016; Jiang and Bansal, 2003; King et al., 2005). This *symbolic* adoption implies the use of this standard as a way to legitimise

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environmental practice within the firm by looking for support from the institutional environment but without necessarily implying greater improvements (Aravind and Christmann, 2011). For instance, Boiral (2007) found a *ritual* integration of ISO 14001 within firms in which a low level of employees' involvement was beside a high intensity of institutional pressures. This *symbolic* adoption might harm the foundations of ISO 14001, such as continual improvement of environmental performance, pollution prevention, and compliance with environmental regulations (ISO, 2015). Thus, the confidence in reducing problems of asymmetric information increases the adoption of ISO 14001 (King et al., 2005), but, on the other side, it could also encourage its *symbolic* adoption, which negatively affects its legitimacy as a signal. For instance, if agents select an ISO 14001 adopter to make a transaction, they can make the mistake of considering that this firm has positive results in terms of environmental performance as well as a real interest in the adoption of environmental management practices, when in fact its environmental behaviour could be questionable. Consequently, ISO 14001 adoption could be intimately related to the decoupling between the achievement of institutional legitimacy and the achievement of real improvements in environmental performance (Aravind and Christmann, 2011; Boiral, 2007; Castka and Prajogo, 2013). This calls into question the efficacy of ISO 14001 as a reliable sign of firms' environmental behaviour (Montiel et al., 2012; Rondinelli and Vastag, 2000).

3. HYPOTHESES DEVELOPMENT

When managers decide to adopt ISO 14001, they evaluate their main motivations for doing so (Iatridis and Kesidou, 2016; González Benito and González Benito, 2005), the isomorphic pressures of the context in which they develop their business activity (Boiral and Henri, 2012; Yin and Schmeidler, 2009), as well as all potential aforementioned benefits that they are able to obtain (Castka and Prajogo, 2013; Heras et al., 2016). Depending on their abilities to face these circumstances and to obtain these perceived benefits, they opt for adopting ISO 14001 by drawing on a more *symbolic* approach (Iatridis and Kesidou, 2016) or, on the contrary, with a more substantial approach (Boiral, 2007; Lannelongue

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et al. 2015; Yin and Schmeidler, 2009). Consequently, this study considers that multiple ISO 14001 profiles exist and that these variations are linked with different results in environmental and business performance. In doing so, this work proposes different adoption profiles of ISO 14001 concerning how firms decide to carry out this adoption process. This study consider whether firms are (or are not) ISO 14001 adopters and also whether firms monitor a wide or a narrow range of negative environmental impacts. Environmental monitoring serves as an essential basis for firms exceeding regulatory requirements, because in order to proactively manage their negative environmental impacts, firms can continually evaluate and improve their environmental performance (Phillips and Caldwell, 2005; Rondinelli and Vastag, 2000). However, different degrees of environmental monitoring exist: from a firm that adopts comprehensive environmental monitoring (i.e., to manage a wide set of negative environmental impacts) to one that addresses fewer (or no) impacts (Darnall and Kim, 2012). When combining ISO 14001 adoption (i.e., to adopt or not to adopt) and high/low monitoring of environmental impacts, four adoption profiles emerge: the *passive* approach, the *symbolic* approach, the *invisible* approach, and the *factual* approach (see Figure 1). The *passive* profile[5] of ISO 14001 is adopted by non-certified firms that monitor a narrower array of environmental impacts (or none). The *symbolic* profile of ISO 14001 is adopted by certified firms that also adopt a less comprehensive monitoring of environmental impacts. Firms with environmental monitoring that is comprehensive in their goal of reducing a broad array of environmental impacts but that are not certified through ISO 14001 are characterised by the *invisible* approach. Finally, the *factual* approach is followed by certified firms that adopt monitoring of environmental impacts comprehensively.

INSERT FIGURE 1 ABOUT HERE

This work considers that these profiles are closely associated with the two main criticisms that were argued above for two main reasons. On the one hand, the notion of comprehensiveness of environmental monitoring is based on the idea that firms manage what they monitor (Rondinelli and

[5] This profile is the reference category for comparison purposes throughout the research.

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Vastag, 2000). This fact is associated with the argument that stated that the better the firm manages its environmental performance, the greater extent to which the firm could develop its ability to reduce its negative environmental impacts (ISO, 2015). On the other hand, ISO 14001 adoption conveys information to a wide range of stakeholders about a firm's latent environmental approach. This notion is linked with the arguments that stated that ISO 14001 adoption could be a feasible way of signalling the firm's environmental behaviour (Aravind and Christmann, 2011; King et al., 2005; Yin and Schmeidler, 2009).

3.1. ISO 14001 and environmental performance

The prior literature has showed controversial results concerning the adoption of ISO 14001 and reductions in firms' environmental impacts (Boiral and Henri, 2012; Lannelongue et al., 2015). Most of researches have demonstrated a positive relationship between the adoption of ISO 14001 and improvements in environmental performance (Potoski and Prakash, 2005; Rondinelli and Vastag, 2000; Russo, 2009). However, the voluntary nature of the ISO 14001 standard as well as the commitment of resources contained therein create the imagery of environmentally responsible firms, but in the background they are not (Darnall, 2006; Rondinelli and Vastag, 2000). In terms of reductions in environmental impacts, some firms decide to adopt ISO 14001 without complying with regulatory requirements daily (e.g., Aravind and Christmann, 2011; Boiral, 2007; Yin and Schmeidler, 2009). This *symbolic* behaviour seeks the signalling of ISO 14001 (Jiang and Bansal, 2003), even though a narrower array of environmental impacts is being managed. Consequently, significant improvements in the firm's environmental performance are not made. The *invisible* profile is the opposite behaviour of the *symbolic* profile, as it focuses on reducing negative environmental impacts comprehensively, but the visibility conferred by ISO 14001 is not the main concern. This profile is usually undertaken when a strong scrutiny exists by environmental regulatory inspections on the firm's environmental activities. In instances such as these, firms are mainly focused on complying with legal environmental requirements, maintaining or even significantly improving their environmental performance, but, on the other hand, they could miss the reputational benefits

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associated with the adoption of ISO 14001 (Darnall, 2006; Darnall and Edwards, 2006; Delmas, 2001; 2002). Finally, the *factual* profile conforms to the strategic approach that is able to develop to a greater extent the most effective response pattern concerning reductions in negative environmental impacts. This profile benefits both the commercial and reputational advantages of ISO 14001 adoption as well as the organisational ones. These firms are interested not only in apparently environmentally responsible but also be *de facto*, because firms that comprise the *factual* profile are subject to greater influences of heterogeneous groups of stakeholders. As a consequence, firms that pursue a *factual* profile have the best conditions for achieving greater improvements in environmental performance.

> ***Hypothesis 1:*** *Compared to the passive profile, firms with a factual profile of ISO 14001 adoption are more likely to be associated with greater reductions in environmental impacts than those with a symbolic profile or an invisible profile.*

3.2. ISO 14001 and business performance

The adoption of ISO 14001 could generate several distinctive capabilities that add value to the firm's resources (Darnall and Edwards, 2006; Delmas, 2001) and facilitate a positive relationship between this adoption and increases in the firm's business performance (e.g., Curkovic and Sroufe, 2011; Delmas, 2001; Ferrón and Darnall, 2016; Melnyk et al., 2003). These economic benefits have been attributed to opportunities to improve internal efficiencies and enhancements in routine processes (e.g., Ferrón and Darnall, 2016; Melnyk et al., 2003; Nishitani et al., 2012; Simpson and Samson, 2010), because the ISO14001 standard is based on the continuous improvement model (i.e., the "plan, do, check, act" approach) towards developing high-quality processes (Bansal and Hunter, 2003). Further, the prior literature has also analysed the effects of the reputational benefits of ISO 14001 on the firm's profitability (Curkovic and Sroufe, 2011; Delmas, 2001; Ferrón and Darnall, 2016). Regarding supply chain stakeholders (e.g., commercial buyers, customers, and suppliers), several commercial partners are interested in establishing preferential purchasing relationships with ISO 14001 adopters (Arimura et al., 2011; Christmann and Taylor, 2006; González Benito and González

Benito, 2005) that might encourage the greater achievement of the firm's positive business performance (Curkovic and Sroufe, 2011). Similarly, several firms are motivated to adopt ISO 14001 with the purpose of obtaining more flexible reactions by external stakeholders such as regulators, communities, or environmental groups (Castka and Prajogo, 2013; Jiang and Bansal, 2003; Potoski and Prakash, 2005). For instance, regulatory goodwill benefits facilitate the expedition of operating permits or, less frequently, public scrutiny for ISO 14001 adopters (Darnall et al., 2010; Ferrón and Darnall, 2016). This more benevolent position for the ISO 14001 adopters places the firm in better conditions to achieve greater business performance (Ferrón and Darnall, 2016). According to the ISO 14001 adoption profiles, the *symbolic* profile seeks the signalling of ISO 14001 and, consequently, its economic-related benefits. However, the insufficient internal efforts in reducing environmental impacts of this profile preclude the whole obtaining of organisational benefits of ISO 14001 (Nishitani et al., 2012). As a consequence, due to their less comprehensive environmental monitoring, firms characterised by the *symbolic* profile could not benefit from the internal improvements associated with ISO 14001, which could lead to an improved business performance in comparison with other ISO14001 adoption profiles. On the contrary, since the *invisible* profile comprises non-certified firms, such firms could not benefit from the reputational advantages of ISO 14001 adoption. Similarly to the *symbolic* profile, the *invisible* behaviour could not gain the whole set of economic benefits associated with ISO 14001, because, in this case, the firms miss the reputational benefits that the standard could offer. This work considers firms that pursue a *factual* profile are the most likely to achieve positive business performance. Because these firms are highly exposed to stakeholders' demands, they have developed both the efficiency-related abilities as well as the reputational skills to a greater extent, and thus they are better able to achieve greater profitability than the rest of the profiles.

> ***Hypothesis 2:*** *Compared to the passive profile, firms with a factual profile of ISO 14001 adoption are more likely to be associated with greater positive business performance than those with a symbolic profile or an invisible profile.*

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4. METHODS

4.1. Data

This work relied on a subset of survey data obtained from the OECD Environment Directorate to empirically test the research hypotheses. This database is particularly appropriate for testing the hypotheses of this work as it is the most comprehensive international collection of information about publicly traded and privately held business' environmental management issues. The OECD survey was sent in 2003 to publicly and privately owned facilities of manufacturing industries in Canada, France, Germany, Hungary, Japan, Norway, and the USA. This survey was focused on manufacturing industries because these sectors produce higher levels of pollution in the air, water and land than service sectors (Stead and Stead, 1992). Prior to data collection, the OECD pre-tested its survey in France, Canada, and Japan before it was translated into each country's official language and then back-translated to validate the accuracy of the original translation (Johnstone et al., 2007). Surveys were answered by people responsible for the facilities' environmental activities, because these individuals typically are experts on the daily operations of their facilities (Simpson and Samson, 2010). The OECD sent two follow-up mailings to prompt additional responses (Johnstone et al., 2007). The survey's overall response rate was 24.7% (4,186 responses), which is consistent with the response rate in previous studies of facilities' environmental practices (e.g., Christmann, 2000; Melnyk et al. 2003)[6]. This work considers stakeholder influences as instrumental variables for predicting the ISO 14001 adoption profiles. As a consequence, it was pertinent to consider only responses that related to firm-level decisions (i.e., not facility-level decision). This distinction was made by drawing on an OECD question that asked: "How many different production facilities does your firm have?" This work included only those cases in which managers answered "one facility", and, as a result, my final sample was 1,214 firms.

Four main biases can arise when using survey techniques. First, common method variance was

[6] Response rates were 20.1% and 10.4%, respectively.

assessed by relying on Harman's single factor test. This test was performed on the OECD data, and the results revealed that no single factor accounted for the majority of variance in the variables. Second, regarding social desirability, OECD researchers addressed this issue by ensuring respondents' anonymity. Additionally, the 6-section, 12-page survey and 42 items questioned a wide range of topics related to facilities' environmental management tools, relationships with stakeholders, and perceptions about environmental policies and measures. Further, survey questions related to ISO 14001 adoption (on page 3) were separated from questions related to environmental performance (on page 5) and those related to business performance (on page 10). Third, non-response bias was addressed by OECD researchers assessing the industry representation and facility size of the sample relative to the distribution of facilities in the broader population (Johnstone et al., 2007), and they found no statistically significant differences with respect to facility size. However, the USA was an exception concerning statistical difference among industry representation, because certain USA industries were either over- or under-represented (Darnall et al., 2010). Similarly, Darnall et al. (2010) weighted the USA portion of the sample using USA census data for the same year in which the survey was administered. Finally, generalisability was less of a concern, because the OECD data were collected in multiple countries.

4.2. Dependent variables

The dependent variables consisted of environmental performance (for testing Hypothesis 1) and business performance (for testing Hypothesis 2). Regarding environmental performance, this study opted for evaluating decreases in several environmental impacts using data from several OECD survey questions, similarly to prior studies (e.g., Arimura et al. 2008; Darnall and Kim, 2012). Specifically, the OEDC survey question asked facility managers: "Has your facility experienced a change in the environmental impacts per unit of output of production processes in the last three years with respect to the following areas of impact?" Five different environmental impacts were assessed: use of natural resources (energy, water, etc.), wastewater effluent, solid waste generation, local or regional air pollutants, and global pollutants (e.g., greenhouse gases). Respondents could report using a five-point

Likert scale: (1) significant decrease, (2) decrease, (3) no change, (4) increase, or (5) significant increase. Then the data were collapsed into a binary variable to account for whether the different ISO 14001 adoption profiles were related to environmental impact reductions per unit of output, that is, significant decrease (1) or decrease (2) were coded 1 and all else 0.

Regarding business performance, the prior literature has assessed this variable by using both self-reported subjective[7] and objective[8] measures (Franco Santos et al., 2007). This work opted for assessing business performance using data from an OECD survey question, similarly to prior studies (Darnall, 2009; Ferrón and Darnall, 2016). This question asked facility managers how they would assess their facility's overall business performance over the past three years. Using a five-point Likert scale, respondents indicated whether revenues had (1) "been so low as to produce large losses," (2) "been insufficient to cover costs," (3) "allowed us to break even," (4) "been sufficient to make a small profit," or (5) "been well in excess of costs". Following the rationale of Ferrón and Darnall (2016), because the focus of analysis was the relationship between the ISO 14001 adoption profile and positive business performance, positive business performance was transformed as a dichotomous scale (i.e., having a positive business performance or not). This variable was created by combining facilities that reported having positive business performance (categories 4 and 5; coded 1) and comparing them to those facilities that broke even or incurred business losses (categories 1, 2, and 3; coded 0). Table 1 shows descriptive statistics of the dependent variables.

INSERT TABLE 1 ABOUT HERE

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[7] Several studies have included managerial perceptions related to the relative position of the organisation compared to its competitors (e.g., González Benito and González Benito, 2005; Martínez-Costa and Martínez-Lorente, 2008) or even managers' perceptions about their facilities' overall business performance (Darnall, 2009).

[8] Return on assets, sales or income, and earnings before interest have been used in the prior literature to measure business performance (e.g., González-Benito and González-Benito, 2005; Martínez-Costa and Martinez-Lorente, 2008).

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4.3. Explanatory variables

The explanatory variables consisted of different ISO 14001 adoption profiles: *passive* approach, *symbolic* approach, *invisible* approach, and *factual* approach. To examine the relationships between these profiles and the dependent variables (i.e., "reductions in environmental impacts" and "positive business performance"), this work considered two variables: ISO14001 adopters and non-adopters and monitoring of a wide/narrow set of environmental impacts. Regarding ISO 14001 adoption, this study drew on a question in the OECD survey that asked whether the facility had acquired ISO 14001. Respondents who reported "yes" were coded 1 and all else 0. Regarding environmental monitoring, this study drew on data from an OECD question that asked managers: "Which of the following environmental performance measures does your firm regularly monitor?" Facility managers were asked about the routine monitoring of (1) the use of natural resources (energy, water, etc.), (2) solid waste generation, (3) wastewater effluent, (4) local or regional air pollution, and (5) global pollutants. Respondents reported "yes" or "no" to each item. By summing these responses, the maximum number of environmental aspects that facilities within the sample could monitor was 5. The mean reported monitoring was 2.78. Thus, facilities that reported monitoring between 3 to 5 environmental aspects were coded as 1, and all other facilities were coded 0.

In order to empirically assess the hypotheses, this study categorised facilities based on ISO 14001 adoption (yes/no) and (high/low) monitoring of negative environmental impacts. By considering these variables together, this work coded: '*passive* profile' as non-adopters with low monitoring of their environmental impacts (0,0), '*symbolic* profile' as ISO 14001 adopters that lowly monitored their environmental impacts (0,1), '*invisible* profile' as non-adopters with high monitoring (1,0), and '*factual* profile' as ISO 14001 adopters that highly monitored their environmental impacts (1,1). After this categorisation, four dummies, that were the explanatory variables, were created: '*passive* profile', in which non-adopters with low monitoring were coded 1 and all else 0 (this dummy was my reference explanatory variable for comparison purposes); '*symbolic* profile', in which ISO 14001 adopters with low monitoring were coded 1 and all else 0; '*invisible* profile', in which non-adopters with high monitoring were coded 1 and all else 0; and '*factual* profile', in which ISO 14001 adopters with high

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monitoring were coded 1 and all else 0. Table 1 shows the sample size for each explanatory variable.

4.4. Control variables

To control for facility heterogeneity, this study included several control variables. Larger facilities often have better access to resources and capabilities (Bianchi and Noci, 1998) that may be exploited towards achieving both improvements in environmental performance as well as a greater business performance. This study thus accounted for facility size by taking the number of employees per facility, similarly to Arimura et al. (2008). This work also included industry sector dummies by differentiating among three categories: high-polluted sectors (i.e., dirty sectors), low-polluted sectors (i.e., clean sectors), and neutral sectors. According to Mani and Wheeler (1997) and Gallagher and Ackerman (2000), who determined a dirty or clean manufacturing sector depending on the obtained environmental performance, clean manufacturing sectors included textiles, leather and footwear (SIC 17-19), machinery and equipment (SIC 29-33), and transport-related equipment (SIC 34-35). Dirty manufacturing sectors included pulp, paper, publishing and printing (SIC 20-22), chemicals, rubber, plastics and fuel (SIC 23-25), other non-metallic mineral products (SIC 26), and basic metal and fabricated products (SIC 27-28). Neutral manufacturing sectors consisted of food, beverage and tobacco (SIC 15-16), furniture (SIC 36), and recycling (SIC 37). In addition, this work also accounted for country of operation dummies. The reference sector dummy was the group of neutral industries, and the excluded country dummy was the USA. Table 2 shows correlations and descriptive statistics for all variables used in this study.

INSERT TABLE 2 ABOUT HERE

4.5. Predicting different profiles in the adoption of ISO 14001

Prior to estimating the above-mentioned relationship, it was first essential to consider whether ISO 14001 adopters did so because of observed or unobserved characteristics that may be correlated with their reductions in environmental impacts or their positive business performance. The foundation of the concern relates to the fact that the ISO 14001 adoption profiles are subject to selection bias. Selection bias refers to the possibility that statistical distortion exists resulting from some members of the population being less likely to be included than others (Heckman, 1979). If this statistical bias exists, it must be considered empirically (Heckman, 1979). To deal with this potential problem, this work simultaneously accounted for the factors that might affect facilities' adoption decisions. The prior literature suggests that those facilities that consider to the greatest extent the stakeholders' demands in their adoption decision-making process are related to a substantive implementation (e.g., Christmann and Taylor, 2006; Delmas and Montes-Sancho, 2010). Thus, stakeholders' influence could encourage the ISO 14001 adoption of a specific facility's profile (Castka and Prajogo, 2013). To capture this influence, this work considered managers' perception about the influence of three types of stakeholders (i.e., non-management employees, commercial buyers, and environmental groups) by asking managers "How important do you consider the influence of these stakeholders on the environmental practices of your facility?" Respondents answered whether these stakeholders were "not important" (1), "moderately important" (2), or "very important" (3). Further, it was essential to examine to what extent facilities included in the sample were scrutinised by regulatory stakeholders. Facilities that fail to comply with regulatory requirements can incur penalties and fines (Henriques and Sadorsky, 1999) that may negatively affect both their profitability and public reputation. Consequently, a link between the ISO 14001 adoption profile and the regulatory stakeholders' influence exists. This study accounted for this influence by relying on data derived from an OECD question that asked managers "How many times has your facility been inspected by public environmental authorities (central, state/province, and municipal governments) in the last three years?"

Further, previous studies have suggested that if facilities know of government programmes that are designed to encourage EMS adoption, they are more likely to adopt them (Arimura et al., 2008, 2011). This relationship is independent of whether facilities actually participate in these assistance programmes. To measure this circumstance, this work relied on data derived from an OECD survey question that asked facility managers "Do the regulatory authorities have programmes and policies in place to encourage your facility to use an EMS?" Respondents answered either "yes" (1) or "no" (0). This work also included several control variables that may be related to facilities' management system adoption. First, due to both operational and reputational synergies resulting from the combined adoption of quality management systems and EMSs in the facility's profitability (Ferrón and Darnall, 2016), this study relied on an OECD survey question which asked managers "Has your facility implemented a QMS?" Respondents who answered "yes" were coded 1, and all other facilities were coded 0. Second, the adoption of ISO 14001 could also be motivated by the scope in which the facility develops its commercial activity (Arimura et al., 2008), especially when it exports and has to represent a homogeneous environmental behaviour at the international level. Consequently, market scope was measured by incorporating OECD survey data that asked respondents whether the facility's market was primarily at a local, national, regional, or global level. Responses were coded 1, 2, 3, and 4, respectively. Third, facility managers were requested to indicate the importance of firm image to their competitive strategy, because it is likely an essential factor that would motivate ISO 14001 adoption (Arimura et al., 2008). More specifically, this study relied on data derived from an OECD survey question that asked facility managers, to "please assess firm image in your facility's ability to compete on the market for its most important product within the past three years". Respondents answered either "not important" (1), "moderately important" (2), or "very important" (3). A dummy variable was created in which respondents who answered "very important" were coded 1 and all else coded 0. Finally, this work included a set of dummies to account for market concentration by relying on data from an OECD question that asked managers to report the number of competitors the facility competed with for its most commercially important product within the past three years. Managers responded by indicating either "less than 5", "5–10", or "greater than 10". The first category ("less than 5") was the omitted reference category. This study also controlled for facility's size (i.e., number of employees), type of sector, and country of operation. The excluded industry dummy was the group that contained the neutral industries, and the excluded country dummy was the USA.

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4.6. Empirics

This work assessed the relationship between different ISO 14001 adoption profiles and reductions in environmental impacts (in Hypothesis 1) as well as the positive business performance (in Hypothesis 2) using multivariate probit estimation to account for selection bias. Multivariate probit estimation belongs to the classification of simultaneous equation models known as selection models, which attempt to control for correlations between the error terms (Greene, 2011) in the diverse equations of a multivariate model. If there are correlations, a standard probit model will offer inconsistent results (Maddala, 1983). Multivariate probit regression consists of a two-stage least square estimation in which the first stage estimates the probability of belonging to the sample, and the second stage simultaneously evaluates the factors that explain environmental performance measures as well as positive business performance. Both estimations assume that the facility's environmental and business performances and the variables that explain the different profiles for adopting ISO 14001 are separate but interrelated, which leads to a correlated error structure (Greene, 2011). This estimation procedure is suitable because it treats the dependent variable (i.e., reductions in environmental impacts and positive business performance) as a dichotomous measure. In estimating the interrelationship of the errors, the indicator "rho" is produced by the multivariate probit model. If "rho" is statistically different from zero (α=.05), this would indicate that the errors are correlated. In such instances, there would be at least a 95% probability that an endogenous relationship exists between the factors associated with ISO 14001 adoption and those associated with environmental and business performance such that simultaneous estimation procedures are needed. Model significance is determined using a Wald Chi-square test.

In executing the multivariate probit models, four equations were estimated simultaneously. *Equation 1* examines the association between the different profiles for adopting ISO 14001 and the binary dependent variables (i.e., "reductions in environmental impacts" in Hypothesis 1 and "positive business performance" in Hypothesis 2). The error term is represented by ε_{i1}.

Equation 1a: (*prob reductions in environmental impacts* = *1*) = *f* ('*symbolic* profile', '*invisible* profile', '*factual* profile', *control variables*, ε_{i1})

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Equation 1b: (*prob positive business performance = 1*) = *f* (*'symbolic* profile*', 'invisible* profile*', 'factual* profile*', control variables,* ε_{i1})

The remaining three equations assess the factors associated with the different profiles for adopting ISO 14001: *Equation 2* considers the factors related to the '*symbolic* profile', *Equation 3* assesses the factors related to the '*invisible* profile', and *Equation 4* considers the factors related to the *'factual* profile*'*. The error terms are represented by ε_{i2}, ε_{i3}, and ε_{i4}, respectively.

Equation 2: (*prob comprising in 'symbolic* profile*' = 1*) = *f* (*stakeholder influences, government encourages QMS adoption, control vars,* ε_{i2})

Equation 3: (*prob comprising in 'invisible* profile*' = 1*) = *f* (*stakeholder influences, government encourages QMS adoption, control vars,* ε_{i3})

Equation 4: (*prob comprising in 'factual* profile*' = 1*) = *f* (*stakeholder influences, government encourages QMS adoption, control vars,* ε_{i4})

By estimating the four equations jointly, the model controls for correlations among them. A likelihood ratio test evaluating the null hypothesis—that the correlations among the four errors terms ($\varepsilon_{i1} - \varepsilon_{i4}$) are jointly equal to zero—was used to offer support for whether a multivariate probit was a suitable specification for the data. When the null hypothesis is rejected, this provides evidence of selection bias among explanatory variables and confirms the need to use selection models as multivariate probit estimation.

5. RESULTS

After executing the multivariate probit estimation, six models were obtained: five models are related to environmental performance measures (i.e., use of natural resources, wastewater effluent, solid waste generation, local or regional air pollutants, and global pollutants) and the sixth model is related to positive business performance. Findings are shown in Tables 3a and 3b. Table 3a contains the results from estimating *Equation 1* in the six presented models and considers the relationship between environmental and business performance measures and the different profiles for adopting ISO 14001. Table 3b shows the results related to estimating *Equations 2*, *3*, and *4*. Overall model statistics in both of these tables are equivalent, because all four equations were estimated simultaneously for each model. The Wald Chi-square statistics in the six models (481.54, 441.14, 436.23, 428.71, 434.54, and 448.01) are statistically significant (p<.01), indicating sufficient model fit.

INSERT TABLE 3a ABOUT HERE

INSERT TABLE 3b ABOUT HERE

The correlations between the estimated errors in each of the four equations are estimated by the *rho* statistics. In each model, six *rho*s are derived from the four equations, representing the correlation between the individual estimation errors. The likelihood ratio test assessing whether each of the *rhos* are jointly equal to zero is rejected (p<.01) in the six models. This fact indicates significant overall correlation between the error terms of the four equations and the need to use the two-stage estimation approach.

In assessing the relationship between the different profiles for adopting ISO 14001 and reductions in environmental impacts, the results indicate that the estimated coefficients for the '*factual* profile' were positive and statistically significant (1.291; p<.01, 1.092; p<.01, 1.067; p<.01, .520; p<.05, 1.108; p<.01) in the five models presented. These findings suggest that ISO 14001 adopters with high environmental monitoring are more likely to reduce their negative environmental impacts than non-adopters that do low environmental monitoring (i.e., '*passive* profile'). In considering the estimated coefficients of the '*invisible* profile', they were also positive and statistically significant in the five models (.781; p<.01, .464, p<.05, .863; p<.01, .692; p<.01, .413; p<.05), indicating that non-adopters with high environmental monitoring are more likely to have reductions in environmental impacts. By contrast, the estimated coefficients for the '*symbolic* profile' (-.213, .409, -.004, .535, .640) were not statistically significant in any of the five models, suggesting that ISO 14001 adopters that do low environmental monitoring have reductions that are not significantly different from those of non-

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adopters with low environmental monitoring (i.e., '*passive* profile').

To assess the relative difference between the sizes of the coefficients of interests, this work performed several post-hoc χ^2 tests. The results indicate that the differences in the size of the estimated coefficients for the '*factual* profile' (1.291, 1.067, .520, and 1.108 in the case of use of natural resources, wastewater effluent, local or regional air pollution, and global pollutants, respectively) were statistically significant and larger (χ^2 =3.98; p<.05, χ^2 =3.13; p<.01, χ^2 =16.10; p<.01, and χ^2 =20.78; p<.01) than the estimated coefficients for the '*symbolic* profile' (which were not significant in any model). Similarly, the differences in the size of the estimated coefficients for the '*factual* profile' (1.291, 1.092, 1.067, .520, and 1.108 for use of natural resources, solid waste generation, wastewater effluent, local or regional air pollution, and global pollutants, respectively) were statistically significant and larger (χ^2 = 7.59; p<.01, χ^2 = 4.68; p<.05, χ^2 = 3.44; p<.10, χ^2 = 4.95; p<.05, and χ^2 = 11.51; p<.01) than the estimated coefficients for the '*invisible* profile' (.781, .464, .863., .692, and .413). Combined, these findings offer support for Hypothesis 1, which states that, compared to a *passive* profile, firms with a *factual* profile of ISO 14001 adoption are more likely to be associated with greater reductions in environmental impacts than those with a *symbolic* profile or an *invisible* profile.

In evaluating the relationship between the different profiles for adopting ISO 14001 and positive business performance, the results indicate that the estimated coefficient for the '*factual* profile' is positive and statistically significant (.544; p<.01). This finding suggests that ISO 14001 adopters with high environmental monitoring are more likely to have positive business performance than non-adopters that do low environmental monitoring. By contrast, the estimated coefficients for both the '*symbolic* profile' (-.058) and the '*invisible* profile' (-.124) were not statistically significant, suggesting that ISO 14001 adopters that do low environmental monitoring (i.e., '*symbolic* profile') as well as non-adopters with high environmental monitoring (i.e., '*invisible* profile') have business performances that are not significantly different from those of non-adopters with low environmental monitoring (i.e., '*passive* profile'). Similarly to the case of reductions in environmental impacts, the results of the post-hoc χ^2 test indicated that the difference in the size of the estimated coefficient for the

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'*factual* profile' (.544) was statistically significant and larger (χ^2 = 7.34; p<.01) than the estimated coefficient for the '*invisible* profile'. Combined, these results support Hypothesis 2, which states that, compared to a *passive* profile, firms with a *factual* profile of ISO 14001 adoption are more likely to be associated with greater positive business performance than those with a *symbolic* profile or an *invisible* profile.

The factors associated with the different ISO 14001 adoption profiles (Table 3b) offer similar findings in the case of both environmental performance measures and positive business performance. In all of the models, the estimated coefficients for the instrumental variables for the '*symbolic* profile' (*Equation 2*) were not statistically significant. However, the estimated coefficients of "environmental groups" were positive and statistically significant (.188; p<.05, .192; p<.05, .190; p<.05, .192; p<.05, .191; p<.05, and .199; p<.01 for use of natural resources, solid waste generation, wastewater effluent, local or regional air pollution, global pollutants, and positive business performance, respectively) for the '*invisible* profile' (*Equation 3*), as were the estimated coefficients for "regulatory stakeholders" (.023; p<.05, .024; p<.05, .023; p<.05, .024; p<.05, .024; p<.05, and .025; p<.01). Finally, regarding *Equation 4*, facilities' knowledge that government programmes exist to encourage EMS adoption is associated with the '*factual* profile' (.482; p<.01, .485; p<.01, .487; p<.01, .462; p<.01, .483; p<.01, and .454; p<.01 for use of natural resources, solid waste generation, wastewater effluent, local or regional air pollution, global pollutants, and positive business performance, respectively). Further, this profile also showed statistically significant coefficients of stakeholders' influences (see Table 3b). These findings support prior research that stated the greater the stakeholders' influence on the facility, the more comprehensive its environmental response (Delmas, 2001; Henriques and Sadorsky, 1999).

6. DISCUSSION AND IMPLICATIONS

6.1. Theoretical implications and future research

By summarising the criticisms showed in the prior literature, the main weakness of ISO 14001 could be concerning its questionable potential for the development of capabilities for reducing the firm's negative environmental impacts, what jeopardises the reliability of the standard due to this *symbolic* signalling. This study addresses this topic by analysing whether the firm's *symbolic* behaviour leads to real improvements in both environmental performance and business performance in comparison with other firms' environmental behaviours. Specifically, regarding ISO 14001 adoption, four different approaches have been considered: the *passive* profile (i.e., non-certified firms that monitor a narrow set, or no set, of negative environmental impacts), the *symbolic* profile (i.e., certified firms that monitor a narrow set, or no set, of negative environmental impacts), the *invisible* profile (i.e., non-certified firms that monitor a wide set of negative environmental impacts), and the *factual* profile (i.e., certified firms that monitor a wide set of negative environmental impacts).

Using an extensive cross-country sample, the results offer two main contributions to prior research. On the one hand, concerning environmental performance, firms characterised by the *factual* profile are the most likely to be positively associated with greater reductions in environmental impacts in comparison with other profiles. In fact, the findings show firms that pursue the *symbolic* profile do not have significant differences in reductions in negative environmental impacts in comparison with the *passive* profile. This result is consistent with the prior literature that criticised a figurative adoption of ISO 14001, because it might be failing in the mission of ensuring the firm's real concern for the environment (Aravind and Christmann, 2011; King et al., 2005; Yin and Schmeidler, 2009). Firms with the *symbolic* profile attempt to gain legitimacy through ISO 14001, but they do not carry out a substantive adoption like the firms that comprise the *factual* profile. Consequently, this *symbolic* adoption of ISO 14001 will not obtain real reductions in negative environmental impacts as are planned by the standard, and this inappropriate behaviour contributes to the degradation of its reliability. On the other hand, previous research on the ISO 14001 standard has pointed out the benefits it offers to firms in terms of both environmental performance (Potoski and Prakash, 2005; Rondinelli and Vastag, 2000; Russo, 2009) and profitability (Curkovic and Sroufe, 2011; Delmas, 2001; Nishitani et al., 2012) but without differentiating adoption profiles (Boiral and Henri, 2012). This work considers that multiple profiles exist, and the empirical results have confirmed that these variations matter (Boiral, 2007; Heras et al., 2016; Yin and Schmeidler, 2009). Specifically, the findings of this work show that firms with a *factual* profile of ISO 14001 adoption are the most likely to be associated with greater positive business performance in comparison with other profiles. This result contributes significantly to the prior literature concerning the positive link between ISO 14001 adoption and profitability (Curkovic and Sroufe, 2011; Delmas, 2001; Ferrón and Darnall, 2016) by offering novel empirical evidence that only firms that adopt ISO 14001 in a substantive manner (i.e., the *factual* profile) are associated with positive business performance. Neither the *symbolic* profile nor the *invisible* profile affords the achievement of all benefits related to ISO 14001. The outcomes of this work conclude that the ISO 14001 standard could lead to profitable results for the firm when its adoption is accompanied by significant reductions in negative environmental impacts.

This work highlights other important implications for future studies concerning the adoption of ISO 14001. First, the prior literature has claimed that *symbolic* adoption is facilitated by the weaknesses of external audits due to their lack of rigor (e.g., Curkovic and Sroufe, 2011; Heras et al., 2013), because these audits do not really evaluate the integration of environmental practices that are recommended by the standard. Future studies could analyse how the level of compliance and the accuracy of external audits affect the firm's profitability. Second, this work proposes different adoption profiles of ISO 14001 (i.e., passive, invisible, factual and symbolic) considering whether this adoption is accompanied by a high or low monitoring of environmental impacts. However, it is important to note that, in practice, there is not a clear cut division among the proposed different adoption profiles. In fact, the ISO 14001 adoption profiles could be represented as a continuum in which a wide spectrum of adopters exists, ranging from hardly concerned to very highly concerned about leading to better environmental performance[9]. Consequently, it is likely that two facilities that pursue a factual profile could have different level of engagement for improving the environmental performance. Further, this work is focused on analyzing the ISO 14001 adoption under the lens of environmental monitoring, but it could be enriching to analyze the ISO 14001 adoption drawing on other variables, such as investment in terms of time, efforts, or even personnel dedication during the adoption process. For instance, it may be expected that newcomers (in the ISO 14001 adoption process) will need a more

[9] The author thanks an anonymous reviewer for suggesting the inclusion of this limitation.

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substantial involvement for obtaining the first approval than older certified facilities that need less effort for maintaining it, even though in both cases improvements in environmental and business performance could be achieved. Consequently, prospective studies could explore a greater number of profiles and what variables are associated with showing differences among them. Third, although this study has considered several negative aspects of ISO 14001 adoption, it is highly recommend an in-depth analysis of other types of criticisms related to the questionable reliability of the standard, such as the trust in certifier companies in corrupt environments (Montiel et al., 2012) or whether managers question the priority of adoption of ISO 14001 carrying out a "*decertification*" in a time of crisis (Heras et al., 2016; Iatridis and Kesidous, 2016). Further, the OECD data are cross-sectional in nature and they were gathered in 2003. Consequently, prospective research would benefit from analyzing the relationship between symbolic adoption and the facility's performance with time-varying longitudinal data as well as with data gathered in more recent years.

6.2. Implications for practitioners and regulators

This study offers important contributions to practice as well as to public regulators. Regarding implications for managers, some firms are reluctant to adopt ISO 14001 in a comprehensive manner due to the excessive bureaucratisation of the standard decreased firm's productivity (Aravind and Christmann, 2011). In fact, Curkovic and Sroufe (2011, p. 75) argued that "*the main criticisms (of ISO 14001) center on a limited focus on continuous improvement, the cost of registration, the ability of a registered company to still produce large amounts of waste and the amount of seemingly unnecessary documentation*". The findings of this work show that these criticisms could be overcome through the substantive adoption of ISO 14001. Further, those ISO 14001 adopters with a *symbolic* profile have an opportunity to move towards a *factual* approach, because the new version of the ISO 14001 standards has recently been launched. This new version places more emphasis on promoting a shift towards improving environmental performance rather than improving the management system (ISO, 2015).

Regarding implications for public regulators, environmental standards must address at least two basic functions: to serve as tools for improving the firm's environmental performance (Aravind and

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Christmann, 2011; ISO, 2015) and to be a signal of environmental responsibility to external stakeholders (Aravind and Christmann, 2011; Delmas 2001, 2002). If the tendency of the *symbolic* adoption of ISO 14001 becomes a generalised behaviour for firms, the survival of the standard will be disputed. Consequently, public regulators play an important role, because they are responsible for developing a scheme (*via* regulatory relief, grants for adopters, etc.) that ensures the reliability of the most well-known environmental standard worldwide as a governance tool for improving firms' environmental performance (Iatridis and Kesidou, 2015).

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Figure 1: Adoption profiles of ISO 14001

		Environmental Monitoring	
		Low monitoring	**High** monitoring
ISO 14001	**Adopters**	*Symbolic* profile	*Factual* profile
	Non-adopters	*Passive* profile	*Invisible* profile

Table 1. ISO 14001 Adoption Profiles and Their Environmental and Business Performance

Profiles	N	Percentage	Environmental Performance[a]	Business Performance[b]
Passive	443	36.45%	1.57 (1.05)	3.47 (.81)
Symbolic	100	8.22%	1.75 (.78)	3.33 (1.01)
Invisible	495	40.77%	2.04 (.78)	3.40 (1.00)
Factual	177	14.59%	2.09 (.68)	3.48 (.99)
Total facilities	1,214	100.00%	1.85 (.91)	3.39 (.99)

[a] Means are shown. Standard deviations are in parentheses. Minimum value = 1 refers to significant decreases in negative environmental impacts; Maximum value = 5 refers to significant increases in negative environmental impacts.

[b] Means are shown. Minimum value = 1 refers to “revenues had been so low as to produce large losses”; Maximum value = 5 refers to “revenues had been well in excess of costs”.

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Table 2. Correlations and descriptive statistics †

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	Use of natural resources	1.00																								
2	Solid waste generation	0.45	1.00																							
3	Wastewater effluent	0.47	0.40	1.00																						
4	Local/Regional air pollution	0.27	0.27	0.32	1.00																					
5	Global Pollutants	0.39	0.26	0.32	0.54	1.00																				
6	Business Performance	-0.01	-0.01	-0.02	0.01	0.01	1.00																			
7	Size	-0.10	-0.14	-0.07	-0.12	-0.16	0.03	1.00																		
8	Non-management employees	-0.13	-0.07	-0.09	-0.08	-0.10	0.09	0.14	1.00																	
9	Environmental groups	-0.05	-0.01	-0.06	-0.04	-0.06	0.05	0.08	0.33	1.00																
10	Commercial buyers	-0.04	-0.05	0.00	-0.01	0.00	0.02	0.10	0.28	0.22	1.00															
11	Regulatory Stakeholders	-0.07	-0.02	-0.10	-0.12	-0.10	0.03	0.23	0.13	0.08	0.04	1.00														
12	Government encouragement of EMS	-0.07	-0.08	-0.07	-0.07	-0.04	0.03	0.08	0.10	0.12	0.05	0.06	1.00													
13	Quality MS	-0.06	-0.07	-0.05	0.00	-0.10	0.07	0.17	0.11	0.03	0.15	0.05	0.05	1.00												
14	Scope	-0.04	-0.05	-0.08	-0.04	-0.08	0.11	0.16	0.10	0.05	0.02	0.09	-0.02	0.17	1.00											
15	Market concentration	-0.02	-0.02	-0.03	-0.05	-0.05	-0.05	-0.03	0.00	-0.01	0.00	0.03	0.00	-0.07	0.01	1.00										
16	Image	0.02	-0.02	0.01	-0.02	-0.02	0.08	0.11	0.17	0.19	0.08	-0.01	0.04	0.01	0.07	0.01	1.00									
17	USA	0.02	0.00	-0.01	-0.08	-0.01	0.04	0.07	0.08	0.15	0.01	0.16	0.10	-0.06	0.03	-0.01	0.02	1.00								
18	Germany	-0.04	0.02	-0.03	-0.09	-0.12	0.07	-0.03	-0.02	-0.12	-0.11	0.14	-0.09	-0.04	0.23	0.18	-0.05	-0.12	1.00							
19	Hungary	-0.07	-0.03	-0.02	-0.05	0.01	0.11	0.11	0.04	0.22	0.16	0.03	-0.01	0.07	0.14	-0.05	0.15	-0.08	-0.23	1.00						
20	Japan	0.07	0.01	0.11	0.08	0.05	-0.24	-0.07	-0.12	-0.19	0.10	-0.14	-0.02	0.01	-0.38	-0.04	-0.12	-0.16	-0.48	-0.30	1.00					
21	Norway	0.00	-0.06	0.01	0.07	0.05	0.04	-0.06	0.02	-0.05	-0.05	-0.08	0.06	0.01	0.04	-0.06	-0.02	-0.06	-0.17	-0.11	-0.22	1.00				
22	France	0.00	0.02	-0.13	0.01	0.01	0.04	0.07	0.01	0.09	-0.13	-0.06	0.03	0.03	0.06	-0.09	0.07	-0.05	-0.16	-0.10	-0.20	-0.07	1.00			
23	Canada	0.04	0.02	0.01	0.04	0.03	0.09	0.00	0.14	0.11	-0.02	0.00	0.04	-0.03	0.04	-0.03	0.07	-0.05	-0.13	-0.08	-0.17	-0.06	-0.06	1.00		
24	Neutral sector	0.02	0.04	0.04	0.01	0.01	0.04	0.06	-0.05	0.03	0.00	-0.02	-0.01	-0.07	-0.11	-0.02	0.03	-0.06	-0.08	0.02	0.02	0.07	0.02	0.01	1.00	
25	Clean sector	0.01	0.00	0.00	0.05	-0.01	-0.10	0.00	0.01	-0.04	0.01	-0.05	0.00	0.13	0.15	-0.03	0.00	0.03	0.04	-0.02	0.06	-0.06	-0.06	-0.07	-0.49	1.00
26	Dirty sector	-0.02	-0.04	-0.04	-0.06	0.01	0.07	-0.05	0.03	0.02	-0.01	0.06	0.00	-0.08	-0.08	0.05	-0.02	0.01	0.02	0.01	-0.08	0.00	0.05	0.08	-0.31	-0.68
	Mean	2.49	2.46	2.58	2.57	2.66	3.39	198.46	1.89	1.67	2.07	3.05	0.17	0.71	2.76	0.21	0.35	0.04	0.27	0.12	0.39	0.07	0.06	0.05	0.18	0.52
	Std. Dev.	0.76	0.75	0.71	0.66	0.64	0.99	294.00	0.65	0.71	0.72	5.25	0.38	0.45	1.04	0.80	0.48	0.20	0.44	0.33	0.49	0.26	0.24	0.21	0.39	0.50
	Min/Max	1/5	1/5	1/5	1/5	1/5	1/5	50/4500	1/3	1/3	1/3	0/55	0/1	0/1	1/4	1/3	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

† Correlations > |.065| and |.049| are significant at the 5% and 1% level of significance respectively

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Table 3a. Predicting Environmental and Business Performance (Multivariate Probit)†

Equation 1—Dependent variables: Reductions on environmental impacts and Positive Business Performance †	Use of natural resources (H1)	Solid waste generation (H1)	Wastewater effluent (H1)	Local/Regional air pollution (H1)	Global Pollutants (H1)	Positive Business Performance (H2)
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Explanatory Variables†						
Symbolic profile	-.213	.409	-.004	.535	.640	-.058
Invisible profile	.781***	.464**	.863***	.692***	.413**	-.124
Factual profile	1.291***	1.092***	1.067***	.520**	1.108***	.544***
Control Variables						
Size	.001	.001*	.001	.001***	.001**	-.001
Germany	.198	-.193	.007	-.509**	-.011	.019
Hungary	.155	-.069	-.133	-.346*	-.298	.196
Japan	-.026	-.029	-.194	-.543**	.018	-.691***
Norway	.026	.325	-.001	-.770***	-.388	-.028
France	-.185	-.164	.324	-.718**	-.251	.021
Canada	-.051	-.183	-.228	-.733**	.033	.308
Clean sectors	-.159	.013	-.118	-.039	.063	-.280**
Dirty sectors	-.070	.201*	-.038	.132	.109	-.049
Constant	-.646**	-.509**	-.956***	-.644**	-1.47***	.512**
Overall Model Statistics						
rho_{12}	.549**	.122	.136	-.126	-.039	.163
rho_{13}	-.099	.012	-.030	-.097	.162*	.178
rho_{14}	-.063	-.046	-.055	.114	-.153	-.234*
rho_{23}	-.133**	-.124**	-.133**	-.117*	-.136**	-.095
rho_{24}	-.108	-.117*	-.106	-.110	-.113	-.181**
rho_{34}	-.856***	-.856***	-.857***	-.859***	-.855***	-.898***
Likelihood ratio test $rho_{12}=rho_{13}=rho_{14}=rho_{23}=rho_{24}=rho_{34}=0$	323.27***	319.47***	320.01***	321.03***	322.13***	364.60***
Wald test χ^2	481.54***	441.14***	436.23***	428.71***	434.54***	448.01***
N	1,214					

† These models were assessed using multivariate probit regression with simultaneous estimation of four equations. *Equation 1* estimates the relationship between the adoption profile of ISO14001 and five measures of reductions in environmental impacts (Hypothesis 1) as well as positive business performance (Hypothesis 2). Our comparison category consists of non-adopters with low environmental monitoring (i.e., '*passive*' profile). The excluded country dummy is the USA; the excluded industry dummy is neutral sectors.

* p<.10; ** p<.05; *** p<.01

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Table 3b. Predicting Different Approaches of Adoption (Multivariate Probit)†

Equation 2, 3 and 4 †	**Use of natural resources (H1)**			**Solid waste generation (H1)**			**Wastewater effluent (H1)**			**Local/Regional air pollution (H1)**			**Global Pollutants (H1)**			**Positive Business Performance (H2)**		
	Coeff (Eq.2)	Coeff (Eq.3)	Coeff (Eq.4)	Coeff (Eq.2)	Coeff (Eq.3)	Coeff (Eq.4)	Coeff (Eq.2)	Coeff (Eq.3)	Coeff (Eq.4)	Coeff (Eq.2)	Coeff (Eq.3)	Coeff (Eq.4)	Coeff (Eq.2)	Coeff (Eq.3)	Coeff (Eq.4)	Coeff (Eq.2)	Coeff (Eq.3)	Coeff (Eq.4)
Instrumental Variables																		
Non-management employees	.060	.012	.229***	.106	-.005	.215**	.113	-.001	.212**	.122	.005	.210**	.111	-.009	.216**	.103	-.031	.288***
Environmental groups	.122	.188**	-.171**	.075	.192**	-.168**	.081	.190**	-.168**	.071	.192**	-.169**	.076	.191**	-.159**	.117	.199***	-.196**
Commercial buyers	.005	-.074	.116**	.071	-.071	.111*	.079	-.073	.112*	.068	-.078	.112*	.071	-.061	.108*	.043	-.089	.140**
Regulatory Stakeholders	-.030	.023**	.007	-.034	.024**	.007	-.038	.023**	.008	-.036	.024**	.007	-.036	.024**	.007	-.036	.025***	.013
Government encouragement of EMS	.044	.057	.482***	.106	.044	.485***	.102	.048	.487***	.128	.058	.462***	.115	.032	.483***	.114	.053	.454***
Control variables																		
Quality MS	.199	-.097	.795***	.118	-.091	.791***	.106	-.088	.803***	.130	-.091	.781***	.128	-.091	.796***	.101	-.130	.714***
National scope	.036	.274*	-.103	.012	.279**	-.081	.043	.278	-.108	.002	.286**	-.075	.014	.259*	-.065	-.024	.249*	-.127
Regional scope	-.072	.016	.380*	-.136	.007	.385*	-.126	.014**	.370*	-.144	.024	.377*	-.126	-.025	.141**	-.201	-.024	.348*
Global scope	.045	.045	.248	-.063	.054	.278	-.057	.055	.249	-.074	.066	.284	-.071	.032	.292*	-.118	.020	.287*
Market concentration (5-10)	-.033	.011	.050	.064	-.006	.049	.067	-.004	.045	.082	.005	.034	.073	-.001	.055	.041	.013	-.038
Market concentration (>10)	-.035	.020	-.035	-.025	.012	-.035	-.054	.017	-.031	-.006	.023	-.040	-.021	.001	-.014	-.035	.023	-.110
Importance of image	-.090	-.020	-.010	-.145	-.001	.005	-.014	-.013	.002	-.137	-.005	.002	-.140	-.013	.003	-.137	-.040	-.067
Size	-.000	-.000***	.001***	.000	-.000***	.001***	.000	-.000***	.001***	.000	-.000***	.001***	.000	-.000***	.001***	.000	-.000***	.001***
Germany	.081	-.420**	.324	.141	-.430**	.339	.196	-.433**	.345	.145	-.422**	.342	.143	-.433**	.329	.090	-.349*	.424*
Hungary	.088	-.432**	.618**	.113	-.446**	.633**	.134	-.448**	.624**	.119	-.435**	.618**	.101	-.456**	.629**	-.116	-.316	.691**
Japan	.401	-1.010***	1.012***	.385	-1.015***	1.021***	.413	-1.018***	1.018**	.396	-1.005***	1.018***	.381	-1.020***	1.014***	.312	-.915***	1.112***
Norway	.368	-.990***	.748**	.401	-.998***	.784***	.435	-.993***	.782**	.418	-.989***	.790**	.405	-1.001***	.781**	.309	-.916***	.764**
France	-3.083	-.754***	.345	-3.214	-.763***	.360	-3.218	-.766***	.371	-3.288	-.749**	.357	-3.329	-.777**	.366	-3.583	-.643**	.387
Canada	-.219	-.824***	-.182	-.135	-.830***	-.190	-.108	-.834***	-.166	-.108	-.829***	-.224	-.131	-.834***	-.182	-.190	-.741**	-.020
Clean sectors	-.174	-.275**	.149	-.178	-.273**	.165	-.177	-.276***	.162	-.185	-.272**	.157	-.184	-.273**	.165	-.204	-.270**	.110
Dirty sectors	-.308	-.243**	.329**	-.306	-.240**	.334*	-.297	-.243**	.326***	-.311	-.241**	.325**	-.298	-.241**	.333**	-.307	-.209**	.227*
Constant	-2.333***	.528*	-3.062***	-2.412***	.551**	-3.075***	-2.481	.550*	-3.055**	-2.454***	.515*	-3.039***	-2.431***	.571**	-3.109***	-2.275***	.551**	-3.033***

† These models were assessed using multivariate probit regression with simultaneous estimation of four equations. *Equation 1* is shown in Table 3a; *Equation 2* (dependent variable = '*symbolic* profile'), *Equation 3* (dependent variable = '*invisible* profile'), and *Equation 4* (dependent variable = '*factual* profile') estimate the factors related to ISO 14001 adoption profiles. The comparison category consists of non-adopters with low environmental monitoring (i.e., '*passive*' profile). The excluded country dummy is the USA; the excluded industry dummy is neutral sectors. Overall model statistics are the same as shown in Table 3a.

* $p<.10$; ** $p<.05$; *** $p<.01$