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Voluntary environmental standards A new strategy to promote greener business

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Abstract

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Abstract
Environmental Management Systems (EMS) are thought to help organizations recognize the cost saving potentials of eco-innovation. Nevertheless, their direct impact on firms? business performance is still debated. The aim of this research is to test the impact of the adoption of standards such as ISO 14001 ? supposedly one of the most efficient tool among EMS ? on (early and late) adopters? business performance. The distinction between early and late adopters is an important contribution of this research. The empirical analysis is based on firm-level data acquired from a large French survey (COI 2006) matched with administrative data. Our dataset comprises 11,168 manufacturing and services firms. Working with this data allows us, first, to identify firms characteristics that facilitate the adoption of ISO 14001-type standards and second, to examine the impact of their adoption on business performance (measured by Total Value Added, hereafter TVA). We used the Propensity Score Matching (PSM) technique to examine these two issues. Our estimation results show that medium-size, high-tech manufacturing firms operating at the EU level and using quality standards (such as ISO 9001) are more likely to be early adopters. By contrast, late adopters are more likely to be large, low/medium tech manufacturing firms that rely on quality standards. Last but not least, we find that the adoption of ISO 14001-type standards significantly increases the TVA of both type of adopters. These findings are robust to a change in the econometric methodology (namely, using a Fully Interacted Linear Model instead of PSM). Hence, our results support the so-called "Porter hypothesis", which claims that firms may enjoy ?win-win? opportunities (becoming greener and more competitive) by following environmental standards and regulations.

Keywords: Environmental Management systems, Eco-innovation, ISO 14001, Propensity Score Matching, Porter hypothesis.
JEL Classifications: L2 - Firm Objectives, Organization, and Behaviour, Q5 -Environmental Economics, O3 - Technological Change

Jelcodes:L21,Q55

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Environmental Management Systems (EMS) are thought to help organizations recognize the cost saving potentials of eco-innovation. Nevertheless, their direct impact on firms' business performance is still debated. The aim of this research is to test the impact of the adoption of standards such as ISO 14001 – supposedly one of the most efficient tools among EMS – on (early and late) adopters' business performance. The empirical analysis is based on firm-level data acquired from a large French survey (COI 2006) matched with administrative data. Our dataset comprises 11,168 manufacturing and services firms. Working with this data allows us, first, to identify firms' characteristics that facilitate the adoption of ISO 14001-type standards and second, to examine the impact of their adoption on business performance (measured by Total Value Added, hereafter TVA). We used the Propensity Score Matching (PSM) technique to examine these two issues. Our estimation results show that medium-size, high-tech manufacturing firms operating at the EU level and using quality standards (such as ISO 9001) are more likely to be early adopters. By contrast, late adopters are more likely to be large, low/medium tech manufacturing firms that rely on quality standards. Last but not least, we find that the adoption of ISO 14001-type standards significantly increases the TVA of both type of adopters. These findings are robust to a change in the econometric methodology (namely, using a Fully Interacted Linear Model instead of PSM). Hence, our results support the so-called "Porter hypothesis", which claims that firms may enjoy "win-win" opportunities (becoming greener and more competitive) by following environmental standards and regulations.

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1. Introduction

Environmental issues have been ignored for many years due to the accelerating globalization process and intensified competition between countries. Nevertheless, many ideas and objectives to solve environmental problems, while becoming more competitive in the global arena, have been put forward. For instance, the EU's Lisbon strategy acknowledged environmentally innovation (a.k.a. Eco-innovation) as one of the most significant opportunity to become more competitive and more sustainable. This recent relevance and increasing importance of the environment, innovation and competitiveness deserves thorough analyses to be able to understand and contrast the variation between units with regard to such innovation activities, and the rest. Therefore, searching and developing empirical evidence in every scale is crucially important. The aim of this research is to test the impact of the adoption of standards such as ISO 14001 – supposedly one of the most efficient tools among Environmental Management Standards (EMS) – on (early and late) adopters' business performance. Even though, economic gain is not one of the goals of the environmental standards itself. The performance of the firm is measured by its total value added with factor costs (hereafter TVA). More precisely, in our approach the TVA is calculated as the difference between total sales price and total production cost of a product by taking into account the subsidies and taxes. Adopters of the environmental standards considered as organisational-eco-innovator. Organisational eco-innovation refers to the incremental or radical change of a firm's processes and responsibilities, which reduces environmental impact and supports organisational learning (OECD, 2009). Undoubtedly, Porter and van der Linde are the key researchers who have contributed to the discussion related to environmental regulations, innovativeness and firm performance. Their work has changed the established ideas about the relation environmental regulatory framework and innovativeness. The so-called Porter hypothesis claims that "strict environmental standards can encourage innovations that increase competitiveness by decreasing firms' environmental liabilities while having an increase in the performance" (Porter and van der Linde, 1991). This is called as the "win-win" situation for the firms. Hence, proposed research attempts to 1) conduct an analysis in order to find out the firms' intrinsic factors that may have an impact on environmental standards adoption and 2) conduct an analysis that compares the impact of environmental standards on the early and late adopting firms' business performance. The distinction among the adopters is rather rare in the literature hence, it sought to be one of the crucial contributions of the current research. Furthermore, Porter's win-win hypothesis has been intensely criticized by many

scholars (see Palmer, Oates and Portney, 1993) yet there is no clear cut conclusion. Therefore, this research is a direct attempt to test the validity of so-called hypothesis. Proposed research links important recent fields of environmental policy (namely the promotion of EMS) with environmental innovations and with firm performance. The data constraint for the empirical analyses is acknowledged as rather a common problem for eco-innovation studies. To tackle this problem the empirical analysis is based on firm-level data acquired from a large French survey (COI 2006, Organisational Changes and Computerization) matched with administrative data (EAE, The Annual Enterprise Survey). The dataset comprises 11,168 manufacturing and services firms that allow us, first, to identify firms' characteristics that facilitate the adoption of ISO 14001-type standards and second, to examine the impact of standards adoption on adopters TVA. Working with such a retrospective and comprehensive dataset gave us an opportunity to compare two years, 2003 and 2006. Hence, we could investigate all significant changes concerning the companies that had the ISO 14001-type standards and certification in 2003 (early adopters) and in 2006 (late adopters). This paper is organized as follows. Section 2, reviews the related literature environmental management system. We discuss our estimation strategy, the model, the data and the variables that are used in the econometric analysis in section 3. The section 4 represents the estimation results. Finally, in section 5, we draw some conclusions and offer direction for further research.

2. Environmental management systems

An environmental Management System is a management structure that provides firms with a framework to minimise their environmental impact, ensure compliance with environmental laws and regulation, and reduce wasteful uses of natural resources. EMS could be integrated in a firm's daily operation via different environmental standards (e.g. ISO 14001, EMAS Environmental Management and Audit Scheme, Responsible Care, etc.). In recent years, voluntary proactive approaches to environmental protection are considered useful supplements to traditional mandatory command and control regulations, and economic incentives (e.g., Khanna and Damon, 1999; Alberini and Segerson, 2002). According to Ziegler and Nogareda (2009) one of the central Voluntary Environment Programmes (VEPs) are unilateral agreements by firms regarding EMS and the most important program in this respect is the ISO 14001. The ISO 14001 standards include voluntary standards for EMS that must be adopted (Potoski and Prakash, 2005). The main components and the standards include 1) environmental policy, including commitment to prevent pollution, 2) performance

goals: objectives and targets, taking into account; legal and other requirements, environmental aspects of activities, products and services, views of interested parties, business, technical, and economic requirements, 3) environmental programs: action plan to meet objectives, 4) roles and responsibilities, 5) training and awareness, 6) communication—internal and external, 7) documentation of the system, including procedures or operational controls, 8) monitoring, measurement and record keeping, 9) procedures for corrective and preventive action, 10) Environmental Management System audits and 11) management reviews (adopted from Marshall, 1998). Moreover, standards exist to help organisations (a) minimise how their operations negatively affect the environment (i.e. cause adverse changes to air, water, or land); (b) comply with applicable laws, regulations, and other environmentally oriented requirements, and (c) continually improve in the above. ISO 14001 standard is considered as one of the most efficient tools in order to support the market-based instruments (i.e. tradable permits, emission taxes, subsidies etc.) because it does not impose environmental performance requirements but helping organisations to form their own EMS. This feature of the standard ensures that organisations are responsible for setting their own environmental targets and environmental measures. In addition, it makes standards applicable to wide variety of organisations, in size and in occupation, such as companies, branch offices, plants, construction sites, refineries, mines, administration centres, schools, banks, restaurants etc. However, different aspects should be considered when deciding the proper unit for certification. For example, large companies may choose to certify certain sites while SME's may choose to be certified at the company level. Adoption of ISO 14001 environmental standards may lead them to get some advantages such as process improvement, environmental cost reduction, better relationships with regulators, insurers, investors and financial markets, product improvement, marketing advantages, better control of liabilities, reduced regulatory burden, protection of company image and name, demonstration of responsible management, improvement in the working conditions and environment and thus employee satisfaction (ISO). Adoption of the standards induces important changes in the work organisation, characterised by job rotation, self-responsible teams, multi-tasking, a greater involvement of employees in decision-making and may indirectly influence employee outcomes (Pekovic and Delmas, 2010). Therefore, environmental standards might also be associated with an improvement of working conditions, which in turn may increase employee satisfaction and productivity. For instance, adopting the standards may also decrease the accidents rates (Delmas, 2001). Once the certification process starts the certification body addresses many subjects related to organisation's compliance management. However, this is not their only and

the most important task. Compliance part of the auditing team does not focus on full compliance to the standards. More precisely, auditors' responsibility remains with the organisation being audited. ISO 14001 includes self-imposed standards but failing to comply with these standards does not impose any penalty for those failed adopters except facing the risk of losing the certification after a certain amount of time. The auditing teams from the certification body return on regular basis (usually every 6 or 12 months) to evaluate the compliance of organisation's EMS with ISO 14001 and to verify corrections of deficiencies identified by previous assessments. Some critics consider VEP as "green washing" because they fail to lead participants to clean their operations due to absent significant obligations or enforcements (e.g., Potoski and Prakash, 2005). Nevertheless, some studies, such as Fischer et al. (2003) and Rennings and Rammer (2009) do not find a clear ranking of the instruments. According to Fischer et al. (2003) no instrument is generally preferable and the welfare gain of environmental policy instruments depends on different sets of circumstances, i.e., on the number of polluting firms, the costs of an innovation and the costs of imitating an innovation. Rennings and Rammer (2009) state that none of the policy instruments is generally preferable when the endogeneity of technological progress is taken into account, as it is done in evolutionary economics as well as in the new institutional and growth theory. While, according to Pekovic and Delmas (2010), Frondel et al. (2007) and Labonne and Johnstone (2007) EMS has positive effect on firms' performance such as improving internal efficiency, reducing costs or enhancing the firms' reputation and providing access to green markets. Hence, adopting of EMS may allow firms to decrease their environmental liabilities while having an increase in their performance, which is called as "win-win" opportunity for firms. The literature asserts that the debate on appropriate policy instruments is still open and choice of adequate policy may change depending on the situation. This is the reason why the objective of this research is to test a particular case of the so-called Porter hypothesis. The Porter hypothesis asserts that *"Pollution is a manifestation of economic waste and involves* unnecessary or incomplete utilisation of resources... Reducing pollution is often coincident with improving produc*tivity with which resources are used". Therefore, strict environmental* standards can encourage innovations that increase competitiveness. Thus, the right environmental policies can greatly reduce the costs of environmental policies and can even make compan*ies more profitable by creating "win-win" opportunities through environmental* regulation, where simultaneously pollution is reduced when having an increase in productivity (Porter and van der Linde, 1991, 1995a, 1995b). According to Porter and van der Linde, firms are not rational and therefore, they are not able to evaluate all the available opportunities

especially, when the environment is the concern. However, environmental regulations, norms and standards may give firms some incentives to look for and realise those opportunities. Additionally, Darnall et al. (2001) mentions that basically the documentation requirements of the standard itself may increase firms' understanding of how they affect the natural environment. The adoption of such standards may require considerable amount of documentation depending on the size, the complexity and the organisational structure of the establishment since the standards require all the process of the establishment to be defined and listed in details. Henceforth, documentation requirements of ISO 14001 may cause firms to systematically analyse some of their environmental impacts for the first time and lead them to consider their impacts related to various inputs and their production process. If realised, this can be considered as a significant contribution to increase the awareness towards environmental impact of the firm and possibly help them to lower the hazardous effect that is created during the different phase of their operations. However, for some organisations growing global environmental consciousness, hence growing pressure to clear their operations, might perceived as a burden that threatens their existence. For instance, average cost of ISO 14001 standards implementation ranges from 30,000$ to 100,000$ depending the size and the activity of the organisation. Moreover, the estimated time required for the implementation is about 18 months to 2 years which makes it an obligation for some firms to hire additional employees to be able to manage the ISO certification process. Firms may have various reasons to adopt the certification; they may be forced to by their suppliers, customers and/or parent company, they may adopt to attract new customers by giving green signal, to enter new markets. Whatever the reason for the adoption, those firms may be forced to pass certification costs onto customers by various means resulting in customers to turn elsewhere. Hence, the certification could reveal some unexpected affects onto the organisation.

3. Econometric analysis

3.1 The Data

The research is based on two data sources. The first one is the French "Organisational Changes and, Information and Communication Technologies use 2006" (COI 2006) survey. The COI survey provides a matched employer / employee dataset on organisational change and ICT use, compiled through the joint efforts of the INSEE (National Institute for Statistics and Economic Studies), DARES (Ministry of Labour) and CEE (Centre for Labour Studies). This comprehensive survey contains various questions related to changes addressed to companies and to their employees. The latest survey was conducted in 2006 on a

representative sample of (7700 firms) the population of French firms from all industries except agriculture, forestry and fishing. Each of these firms filled in a questionnaire concerning the use of ICT and organisational practises in 2003, in 2006 and during the period in between. The COI 2006 survey is a retrospective survey in which firms answer in 2006 a questionnaire that includes questions pertaining to 2003 and to the period in between. Furthermore, the survey design allows for an easy matching with administrative databases. In order to obtain information about value added, material expenditures, number of employees and some other accounting variables we merged the COI survey with another French administrative data; the Annual Enterprise Survey (EAE). As a result of this merge, we work with a panel of 11,168 observations (5584 firms observed in 2003 and in 2006) with more than 11 employees.

Table 1. here

Table 1 (see tables and figures) reports summary statistics on some key variables, before and after merging, such as size, turnover, having ISO 14001 and 9001 certificates, being part of a group, business markets, technological classification and industries. The test for differences in means indicate that merging those two datasets does not lead any significant difference, except ISO 19001, Low-tech manufacturing and other services. This suggests that merging datasets did not lead to severe selection biases. The dataset also includes firms' 4-digit Nace codes which allow us to identify the field of activity of each firm. The Nace codes have been aggregated according to the OECD's technological level classification. The OECD identifies industries largely on the basis of their level of research and development intensity (research and development expenditure in relation to value added). According to this approach firms are considered in 1) High-technology industries if their R&D-turnover ratio is above 5%, 2) Medium-high technology industries if the ratio is between 5% and 3%, 3) Medium-low technology industries if the ratio is between 3% and 0.09%, 4) Low technology industries if the ratio is between 0.09% and 0%. Table 2. below represents total number of adopting firms within each technological levels as well as the number of non-adopters and total number of firms in our respective dataset.

Table 2. Number of firms according to the OECD's technology classification

	Adopter	**Non-adopter**	**Total**
High-technology manufacturing	66 (%23)	222 (%77)	288
High-medium-technology manufacturing	246 (%23)	822 (%76)	1068
Low-medium-technology manufacturing	179 (%15)	999 (%75)	1178
Low-technology-manufacturing	202 (%12)	1522 (%88)	1724
Knowledge intensive services	92 (%5.5)	1585 (%94.5)	1677
Other services	388 (%7.5)	4841 (%92.5)	5229
Total	1173	9995	11168

3.2. Estimation strategy

3.2.1. Methodology

The aim of this research is twofold. First, we are interested in finding out firms' intrinsic characteristics that may have an impact on the adoption of environmental standards. Secondly, the causal effect of adoption of environmental standards on the firms performance (the average effect of treatment on the treated – ATT). There are several other performance measures such as labour, material, energy productivity. However, specific issues and problems call for an appropriate measure of performance. In our approach, we use a performance indicator to measure efficiency in the use of **resources**, (total price of sales minus the total production cost) as the Porter hypothesis postulates. Therefore, we deem it relevant to use Total Value Added (TVA) as the relevant measure of performance proxy. In order to estimate the impact of adoption on adopters' TVA , we need to compare the average TVA of these firms to the average TVA that these same firms would have achieved had they not adopted the standards. However, since a firm either adopts the standards or does not, the average TVA that firm would have achieved had they not adopt the standards remains an unobserved counter-factual. The evaluation problem consists in providing unbiased estimates of this average counter-factual through the use of appropriate methods and usually untestable assumptions (Goodman and Sianesi, 2005). Hence, we used the Propensity Score Matching (PSM) method proposed by Rosenbaum and Rubin (1983) and further developed by Heckman et al. (1997, 1998). The matching method is a non-parametric alternative to Instrumental Variable (IV) and Heckman type models for estimating a causal effect net of endogeneity bias.

3.2.2. Propensity score matching

In our research relying on ordinary least square method may produce biased results when consider the fact that there would be some firms adopting the standards, which are not

comparable to the firms in the non-adopting sample. In this sense, performing OLS might hide the fact that we are actually comparing incomparable firm by using the linear estimation (Goodman and Sianesi, 2005). The propensity matching method then offers a unique advantage by excluding the firms from the sample that are not comparable to any other firm in the non-adopting sample, letting only firms from both group that have same features and hence, comparable. We have also performed an alternative approach to the PSM method, which is known as Fully Interacted Linear Regression Model (a.k.a. FILM). One of the significant advantages of this method over PSM method is that it allows the impact of adoption to vary for each observable factor. Moreover, The FILM allows us to test the presence heterogeneous effects (Goodman and Sianesi, 2005). Hence, both of these methods have been carried out in this research in order to provide a base for comparison and check for the consistency of PSM method results.

3.3. Variables

3.3.1. The treatment group

In this research, we have used another, a rather rare, approach concerning the adopters. We separated the adopters into two categories as early and late adopters. To be more precise, firms that already adopted voluntary environmental standards and obtained the certificates in 2003 considered as "early adopter" and similarly, firms that did not have the certification in 2003 but obtained the certification between 2003 and 2006 are considered as "late adopter". We may assume that a certain amount of time is required before the standards can have significant effect on firms' performance. According to Hart and Ahuja (1996) there is a positive relationship between emissions reductions and financial performance. However, there is a two-year lag until financial performance benefits are reaped (ibid), which we intend to test by introducing such separation among the adopters. The database does not distinguish between the standards (i.e. ISO 14001, organic labelling, AB, fair trade, etc.) since they were put together under the same category in the survey. Nevertheless, the literature acknowledges that the ISO 14001 environmental standards as the most widely used EMS in the world. Widespread use of the standards makes adoption an unofficial obligation for organisations in order to continue to do business with their existing business partners in national and international markets.

3.3.2. The control variables

The first control variable that included in the analysis is the adoption of ISO 9001 standards. Those standards are one of the most widely used management tools in the world today. Previous studies have shown that use of ISO 9001 certification makes implementation of environmental standards easier (King and Lenox, 2001; Delmas, 2002; Grolleau et al. 2007a, b). By integrating ISO 14001 like standards into the existing ISO 9001 management system, organisations' environmental responsibility may become a component of their product quality. "Size" measured by the number of employees and "Size_sq" measured by the square of size also included as control variables. Most empirical studies found that the probability of implementing environmental standards increases with firm size (e.g. Delmas and Montiel, 2009; Grolleau et al. 2007a, b). Moreover, being part of a "Group" could play an important role in the adoption process of EMS (Abrahamson and Rosenkopf, 1997, Darnall and Sides, 2008) since being a part of a group may give access to a larger amount of financial resources to invest in new practices (Pekovic, 2010; Zyglidopoulos, 2002).

Another control variable is "Delivery", which represent the importance of customer relations. Having an established delivery service within a firm which "contractually undertakes to deliver or supply goods or services in a fixed deadline" naturally requires a close relation with customers. Such a relation with customers may help firms to obtain feedback and precisely identify customers' needs. Corporate reputation can also be affected by information about an organisation's environmental performance (Arora and Gangopadhyay, 1995; Konar and Cohen, 1997; Marshall and Mayer, 1991). Hence, firms that have close link with their customers may also have strong incentives to demonstrate goodwill to them by adopting and implementing successful environmental management systems (Nishitani, 2009).

We have also included categorical variables such as; "Local or regional", "National", "European" and "International" markets in order to measure respective importance of business markets. Increasing awareness through the environmental problems in the international and European markets has increased the demand for environmentally friendly products, which put the environmental concern on the top of the list. Moreover, local firms are expected to be smaller in size and therefore, available financial resources for the adoption of standards would be also limited, while the reverse could be assumed for the firms that are active in national, international and European markets. Table 3 shows the classification of the technological levels, the industries, while table 4 represents the summary statistics of the variables.

Table 3. OECD'S technology classification

Technology classification	**Nace Rev 1.1 codes**
High-technology	**24.4** Manufacture of pharmaceuticals, medicinal chemicals and botanical products; **30** Manufacture of office machinery and computers; **32** Manufacture of radio, television and communication equipment and apparatus; **33** Manufacture of medical, precision and optical instruments, watches and clocks; **35.3** Manufacture of aircraft and spacecraft
High-medium-technology	**24** Manufacture of chemicals and chemical product, **excluding 24.4** Manufacture of pharmaceuticals, medicinal chemicals and botanical products; **29** Manufacture of machinery and equipment n.e.c.; **31** Manufacture of electrical machinery and apparatus n.e.c.; **34** Manufacture of motor vehicles, trailers and semi-trailers; **35** Manufacture of other transport equipment, **excluding 35.1** Building and repairing of ships and boats **and excluding 35.3** Manufacture of aircraft and spacecraft.
Low-medium-technology	**23** Manufacture of coke, refined petroleum products and nuclear fuel; **25 to 28** Manufacture of rubber and plastic products; basic metals and fabricated metal products; other non-metallic mineral products; **35.1** Building and repairing of ships and boats.
Low-technology	**15 to 22** Manufacture of food products, beverages and tobacco; textiles and textile products; leather and leather products; wood and wood products; pulp, paper and paper products, publishing and printing; **36 to 37** Manufacturing n.e.c.
Knowledge-intensive services (KIS)	**61** Water transport; **62** Air transport; **64** Post and telecommunications; **65 to 67** Financial intermediation; **70 to 74** Real estate, renting and business activities**;** **80** Education; **85** Health and social work; **92** Recreational, cultural and sporting activities

Table 4. Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
ISO9001	0.51	0.5	0	1
Size	640.4	3611.2	11	116.989

Group	0.34	0.47	0	1
Local	0.87	0.34	0	1
National	0.71	0.45	0	1
European	0.47	0.5	0	1
International	0.36	0.48	0	1
High tech	0.025	0.15	0	1
High-medium tech	0.095	0.29	0	1
Low-medium tech	0.10	0.31	0	1
Low-tech	0.15	0.36	0	1
Knowledge intensive	0.15	0.36	0	1

4. Econometric results

4.1. Probit estimation results

The first step of the analysis is to estimate the propensity score i.e. the probability of adopting environmental standards on a voluntary basis conditional on observable control variables that may affect this probability as well as the response variable. The results are reported in Table 5. The results of the probit model indicate that ISO 9001 certificate is an important facilitating factor for voluntary environmental standards adoption both, for early and late adopters. Many industries and countries often adopt ISO standards as requirements for doing business, making them virtually mandatory (Marshall, 1998). Moreover, size of the firm seems to be another crucial factor facilitating the adoption of standards for both adopters indicating that innovativeness is proportional to the size of the firm. In addition, size square variable implies that the relation among adoption of the environmental standards and size can be represented by an inverted U shape. Hence, the result asserts that targeting bigger firms in order to promote voluntary environmental standards could be an important starting point. However, too big firms may suffer from implementation expenses and the time required for implementing the standards, which could hamper investments in voluntary environmental standards. Furthermore, contrary to what we expect, being part of a group decreases the probability of adopting environmental standards for the early adopters, while it has no impact on the late adopters' adoption decision. The result claims that independent companies are more prone to adopt the environmental standards, while the "group companies" are most likely to bound to the decision of the headquarter. By contrast, having an established delivery service in the organisation has a significant positive impact on standards adoption for the early adopters. Finally, firms that are active in local and national markets tend to be more evasive in adopting environmental standards than the firms that are active in European. It could be expected that the local and national firms could indeed perceive the cost of

environmental standards adoption as a burden. Hence, they would have difficulties to allocate resources for the adoption. Moreover, the argument is becomes more significant when we consider that the adoption is solely voluntarily and not-free. Conversely, the international markets could perceive the environmental standards adoption as a compulsory action as a result of the isomorphic pressures within industry. Finally, we may claim that firms, which are active in "high-technology and high-medium manufacturing" sectors are more prone to the adoption when compared to firms in other technological levels.

Table 5. Probit estimation results

Variables	**Adopter (2003)**	**Adopter (2006)**
	Coefficient	Coefficient
ISO9001	1.07***	0.75***
	(0.0577)	(0.085)
Size	0.0001***	0.00007***
	(0.00001)	(0.00002)
Size_sq	-8.02e-10***	-9.78e-10
	(1.46e-10)	(5.33e-10)
Group	-0.23***	-0.136
	(0.056)	(0.078)
Delivery	0.16***	0.12
	(0.058)	(0.82)
Local	-0.146**	-0.078
	(0.062)	(0.084)
National	-0.144**	-0.19**
	(0.066)	(0.09)
European	0.147**	0.09
	(0.071)	(0.1)
International	0.083	0.073
	(0.066)	(0.09)
High_tech_man	0.325***	0.004
& High_medium	(0.074)	(0.1053)
Low_medium	0.06	0.125**
& Low_tech_man	(0.063)	(0.084)
Knowledge_serv	-0.35***	-0.244*
	(0.079)	(0.12)
N	5455	4867
Psuedo R_sq	0.21	0.1
LR chi2(12)	978.81	192.82

-* significant at 10%, ** significant at 5%, *** significant at 1%

-Standards errors are in parentheses below each coefficient

4.2. PSM estimates of the ATT

The second step of our analysis is to estimate the average treatment effects on the treated (i.e. the impact of environmental standards adoption on total value added). We calculated the ATT given the propensity scores calculated as predictions of the Probit models estimated. The dependent variable for the ATT is log of total value added indicated by LNVACF (total price of sales minus total production costs) and Table 6. reports the ATT results.

Table 6. ATT estimations

	Adopter (2003)	**Adopter (2006)**
LNVACF	ATT	ATT
FILM	0.28***	0.26***
	(0.0733)	(0.0736)
PSM	0.49***	0.51***
	(0.07)	(0.1)

-* significant at 10%, ** significant at 5%, *** significant at 1%
-Standards errors are in parentheses below each coefficient

To be able to compare the results we have also added the ATT results of the FILM method in Table 6. The ATT results of the FILM estimation indicate that adoption of environmental standards has enabled, for both early and late adopters, an increase in the total value added. The ATT's coefficient is significant and has positive sign while the impact of the adoption on firms' total value added is almost the same for both of the years.

Moreover, the PSM estimation result is in line with the previous results with a slight difference in the coefficients. Nevertheless, the sign and the magnitude of both results are the same. Hence, we can conclude that the efficiency of both approaches is ensured.

The estimations point out the fact that adopting voluntary environmental standards may indeed increase the TVA regardless the adoption year. These results are also in line with the predictions of the so-called Porter hypothesis hence could be considered as a preliminary proof for "win-win" situation. One crucial point which the results take our attentions is that there is no significant difference between early and late adopters of the voluntary environmental standards in terms of the competitive gain they can reap. Both adopters ultimately increase their TVA, which may actually emphasize the efficiency of the voluntary environmental standards. Therefore, the results assert that the voluntary environmental standards may be efficient enough to decrease firms' environmental liabilities while enabling them to reap competitive advantage. Even though, increasing firms' business performance and competitiveness is not the primary aim of ISO 14001 kind standards; lesser environmental

liability, reduced input costs, environmentally friendly image, increased employee, consumer, investor, shareholder and insurer trust would enable firms to increase their TVA. This result may also indicate that the "win-win" opportunity indeed exists even without relying on the strict environmental regulations. Additionally, communicating and explaining positive economic and social gains that could be reaped from the adoption of environmental standards would help to launch a domino effect. The communication channels should be used efficiently to explain the impact of voluntary environmental standards on economic performance of the firm and moreover, their impact on the environment. By doing so, number of adopters would increase ultimately, while leading less environmentally hazardous and more profitable organisations.

4.3. Performance indicators: Balancing Test

In the PSM framework, the quality of the matching depends on the extent to which the propensity score is a truly balancing function. Hence, the next step is to perform a test that checks whether the propensity score effectively balances characteristics between the treatment and comparison group. The objective of the test is to confirm that treatment is independent of unit characteristics after conditioning on observed characteristics: $D \perp X \mid p(X)$, where X is the set of characteristics that are believed to satisfy the conditional independence assumption. In other words, after conditioning on p(X), there should be no other variable that could be added to the conditioning set of the propensity score models that would improve the estimation, and after the application of matching, there should be no statistically significant differences between covariate means of the treatment and comparison units (Heinrich et al. 2010). We should note here that "after-matching" test only compares differences in time-invariant covariates (that are unaffected by treatment) for the resulting matched sample. We must check that any differences in the covariate means between the treated and the control group in the matched sample have been eliminated, which should increase the likelihood of unbiased treatment effects. If the differences are no longer statistically significant than we can say that matching helps reduce the bias associated with observable characteristics. Table 7. shows the balancing tests that are performed for the two groups, adopters versus non-adopter. In addition to reporting the mean values of the groups and the t-statistics, we also report the standardised difference, that is, the size of the difference in means of a conditioning variable (between the treatment and comparison units), scaled by (or as a percentage of) the square root of the average of their sample variances (Heinrich et al. 2010).

Table 7. Summary statistics

Variables	**Before matching**			**After matching**			
Adopter_vs_No	Treated	Control	t-test	Treated	Control	t-test	%reduction in bias
ISO9001	0.9	0.42	27.8***	0.9	0.89	0.68	%97.9
Group	1.16	1.39	-12.41***	1.16	1.17	-0.49	%96
Delivery	0.84	0.65	11.05***	0.84	0.84	0.01	%99.9
Size	1590.1	464.1	8.5***	1590.1	1254.1	1.14	%70
Size_sq	4.9e+07	6.7e+06	3.45***	4.9e+07	3.1e+07	0.7	%58.2
Local	0.78	0.88	-7.74***	0.78	0.76	0.7	% 85.8
National	0.82	0.69	7.66***	0.82	0.81	0.52	% 92.5
European	0.67	0.43	13.66***	0.67	0.67	0.12	% 99
International	0.56	0.32	13.98***	0.56	0.57	-0.34	% 96.7
High-tech man. & High-medium man.	0.29	0.096	16.38***	0.29	0.32	-1.03	%88.5
Low-medium man. & Low-tech man.	0.32	0.26	3.41***	0.32	0.31	0.55	%78.2
Knowledge services	0.08	0.18	-7.07***	0.08	0.086	-0.21	%97

* significant at 10%, ** significant at 5%, *** significant at 1%

Before-matching results show that there is clearly an imbalance between the treated and the control groups. All t-statistics are highly significant which indicates that the null hypothesis of joint equality of means in the matched sample is rejected. By contrast, in the after-matching results, we clearly see that the differences are no longer statistically significant, therefore our matching significantly reduced bias.

5. Conclusion

In recent years, voluntary proactive approaches, such as ISO 14001 standards, to environmental protection are considered useful supplements to traditional mandatory command and control regulations, and economic incentives (e.g., Khanna and Damon, 1999; Alberini and Segerson, 2002). Voluntary standards exist to help organisations (a) minimise how their operations negatively affect the environment (i.e. cause adverse changes to air, water, or land); (b) comply with applicable laws, regulations, and other environmentally oriented requirements, and (c) continually improve in the above. Moreover, the so-called Porter hypothesis postulates that "strict environmental standards can encourage discovery, introduction and adoption of innovations that increase competitiveness by decreasing firms' environmental liabilities while having an increase in the performance (Porter and van der

Linde, 1991)". However, this assumption has been heavily criticised by many scholars, which has leaded us to directly test its validity using PSM method on a comprehensive data set. Our research aimed at, firstly, finding out firms' internal characteristics that may have an impact on the adoption of voluntary environmental standards. Secondly, the causal effect of adoption of environmental standards on the firms performance. Moreover, we made a slight distinction among firms that adopt standards on a voluntary basis. We separated the adopters as early and late adopters which is rather rare in the literature.

Estimation results indicate that firms' internal characteristics indeed play a significant role in environmental standards the adoption process. Having ISO 9001 standards and delivery service established within the organisation seem to facilitate the adoption of environmental standards. The results also assert that firms that are bigger in size tend to adopt the standards easily. Moreover, the adoption of such standards is more relevant in the European markets, which may actually point out the importance given to the environment within Europe. The results also show a significant positive relation in the "high-technology and high-medium manufacturing" level indicating that the firms within this technology level are more prone to adopt the standards than the rest. Finally, the results postulate that voluntary environmental standards (ISO 14001, EMAS, fair trade etc.) might be an efficient choice for firms to become more competitive and greener. Having such environmental standards would not only help firms to clean their operations but it would enable firms to market themselves as environmentally friendly. They could use such a signal for capturing additional market share or to enter new markets or even to reduce input costs by replacing them with less environmentally hazardous ones. Regulatory pressures and increasing customer awareness and sensitivity towards nature, products and production processes make it necessary for firms to adopt such standards. Our estimation results seem to support the predictions of the so-called Porter Hypothesis. Even though, environmental regulations are still the most important factor leading firms to lower their hazardous impact on environment, the results show that voluntary environmental standards may be a good complement for market-based instruments (such as; tradable permits, emission taxes, subsidies etc.) and, command and control mechanisms to increase the economic performance while becoming greener. Hence, the policy setting institutions would use this opportunity to communicate and explain positive economic and social gains that could be reaped from the adoption of environmental standards. By doing so, a domino effect could be launched and the number of adopters could be multiplied while leading less environmentally hazardous and more profitable organisations which enable them to enjoy the "win-win" opportunity.

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Tables and figures

Table 1. Summary of key variables before and after merging

	COI		COI and EAE		
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value**
Size	691,85	3739,84	653,70	3735,85	0,29
Turnover	168558,50	1132874,00	152650,10	1034387,00	0,21
Group 2006	1,34	0,48	1,35	0,48	0,38
Group 2003	1,36	0,48	1,36	0,48	0,37
Local or Regional 2006	1,13	0,34	1,13	0,34	0,48
National 2006	1,30	0,46	1,30	0,46	0,24
European 2006	1,54	0,50	1,53	0,50	0,25
International 2006	1,64	0,48	1,64	0,48	0,41
Local or Regional 2003	1,14	0,34	1,14	0,34	0,46
National 2003	1,31	0,46	1,30	0,46	0,20
European 2003	1,55	0,50	1,55	0,50	0,26
International 2003	1,65	0,48	1,65	0,48	0,39
ISO 9001 2006	1,49	0,50	1,47	0,50	0,10
ISO 14001 2006	1,80	0,40	1,79	0,41	0,20
ISO 9001 2003	1,53	0,50	1,52	0,50	0,08*
ISO 14001 2003	1,85	0,36	1,84	0,37	0,19
High-tech manufacturing	0,03	0,18	0,04	0,19	0,27
High-medium tech	0,09	0,29	0,10	0,29	0,16

manufacturing					
Low-medium techn	0,10	0,30	0,10	0,31	0,14
Low-tech manufacturing	0,14	0,35	0,15	0,36	0,08*
Knowledge intensive services	0,18	0,39	0,18	0,38	0,32
Other services	0,46	0,50	0,44	0,50	0,02*
Textile, clothing, accessories	0,02	0,14	0,02	0,15	0,32
Wood	0,01	0,09	0,01	0,09	0,37
Paper and printing	0,03	0,17	0,03	0,17	0,26
Coal, petroleum and nuclear products	0,00	0,05	0,00	0,05	0,43
Chemical products	0,03	0,17	0,03	0,17	0,28
Rubber and plastic	0,02	0,15	0,02	0,15	0,31
Non-metallic mineral products	0,02	0,13	0,02	0,13	0,32
Metal and metal products	0,06	0,23	0,06	0,24	0,23
Machinery and equipment	0,03	0,18	0,03	0,18	0,30
Electrical and electronic equipment	0,04	0,19	0,04	0,20	0,28
Transportation equipment	0,02	0,14	0,02	0,15	0,30
Other manufactured products; recycling	0,02	0,13	0,02	0,13	0,34
Electricity, gas and water	0,00	0,07	0,01	0,07	0,40
Construction	0,07	0,26	0,07	0,26	0,21
Car dealing and repair	0,03	0,16	0,03	0,17	0,27
Wholesale trade	0,08	0,27	0,08	0,27	0,15
Retail trade	0,09	0,29	0,10	0,30	0,13
Hotels and restaurants (horeca)	0,03	0,18	0,04	0,18	0,29
Transportation & communication services	0,09	0,29	0,10	0,29	0,16
Housing and real estate	0,02	0,14	0,02	0,14	0,34
Rental	0,02	0,13	0,02	0,13	0,37
ICT services, R&D	0,04	0,21	0,03	0,18	0,00*
Services to firms	0,12	0,32	0,12	0,33	0,09*
Culture, entertainment, sports	0,01	0,10	0,01	0,10	0,45
Financial and insurance services	0,04	0,20	0,04	0,20	0,20