CONSUMING FOR THE ENVIRONMENT?

Consumer Preferences as a Driver for Voluntary Environmental Action by Firms

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1. Introduction

Voluntary environmental action by firms has become fashionable in recent years. McDonald's has worked to reduce its packaging waste, Federal Express has introduced hybrid-trucks into its delivery fleet, and Dupont has made and kept a voluntary commitment to reduce its greenhouse gas emissions (Lyon, 2006). Other companies have acted similarly. Conventional neoclassical economics – which treats pollution as an externality that profit-maximizing firms do not internalize unless government penalties compel them to do so – does not provide a satisfactory explanation for such actions. As a consequence, a growing literature has emerged to suggest alternate explanations for what might motivate firms to voluntarily undertake the costs of improving their environmental performance. In this paper, I focus my analysis on the proposition that consumer preferences can act as a driver of voluntary environmental action by firms. Specifically, I investigate the effect of consumer preferences on the voluntary implementation of an Environmental Management System (EMS) by a firm. Adoption of such a system signals that a firm has undertaken a comprehensive approach to measuring and mitigating its environmental impact. By ensuring the integration of environmental concerns with a firm's daily business activities, an EMS may improve environmental performance more efficiently and more holistically than separate voluntary commitments in discrete dimensions of a firm's environmental impact.

The literature proposes four main motivations for voluntary environmental action. First, firms may engage in pollution reduction because it helps address their production inefficiencies and increases their productivity (Smart, 1992). Walley and Whitehead (1994) argue, however, that such "win-win" opportunities will be rapidly exhausted and

cannot be a sustainable motivation to drive corporate environmental action. Firms may also undertake voluntary initiatives in order to weaken or to optimize government regulation, but this motivation leads to less than optimal environmental performance (Maxwell and Decker, 2006). Alternatively, firms may engage in voluntary action in response to the environmental preferences of investors (Konar and Cohen, 1997) or of consumers (Arora and Cason, 1996). Considerable research has already been devoted to studying whether investors reward firms that improve their environmental performance (Hamilton, 1995; Hart and Ahuja, 1996; Konar and Cohen, 1997). As the first two motivations for voluntary environmental action are limited in their strength to drive effective action and the third has already been studied extensively, I focus on the less-studied yet more-promising channel of influence of consumer preferences. The potential malleability of consumer preferences may present an opportunity to amplify the effect of this channel once its workings have been understood.

I use the theory of product differentiation to explain how consumer preferences can induce profit-maximizing firms to undertake voluntary environmental action. This theory suggests hypotheses regarding the effect of market and industry characteristics on the likelihood of a firm to implement and certify an EMS. The development of these hypotheses is explained in Section 2. Section 3 describes the empirical framework that is used to test these hypotheses. The results of the empirical analysis are presented in Section 4. Section 5 discusses the implications of this analysis and suggests avenues for further research.

2. Theoretical Model

The theory of product differentiation can be used to explain why firms may choose to undertake the costs of voluntary environmental action in response to consumer preferences. This theory also suggests trade-offs that firms may face when they decide to adopt and certify an Environmental Management System (EMS) as the form of their voluntary action, and consequently "brand" themselves as environmentally-friendly ("green"). My analysis suggests testable hypotheses for the effect of these trade-offs on a firm's propensity to brand itself as green.

Voluntary environmental action of any kind signals to consumers that firms are taking measures to decrease the impact of their products at some point during their lifecycle. Such a decrease (that is beyond what is mandated by law) in the impact of a product during its production or its use amounts to a positive "green" characteristic of the product. Firms can use green characteristics to differentiate their products from other products in the market if some or all consumers prefer more green products to those that have larger negative environmental impacts ("brown" products). Under such conditions, where all products sold in a market are not identical, firms can mitigate price competition and charge prices that are higher than the marginal cost of production in order to earn positive profits. Branding an entire firm (and, by extension, differentiating all of its products) as green via EMS implementation, when compared to a voluntary action such as labeling individual products of a firm as green, has advantages and disadvantages that vary with the characteristics of the industrial sector to which the firm belongs and with the preferences and income of consumers in the market. The discussion suggests that firms have a higher propensity to differentiate their products through branding in markets

where consumers have greener preferences or less diverse preferences and in markets where consumers have higher incomes. Also, firms in industrial sectors that are expected to have a high negative environmental impact are more likely to brand themselves as green than firms in lower environmental impact sectors.

2.1 Greenness as Product Differentiation

Firms can undertake voluntary environmental action to confer differentiating green characteristics upon some or all of their products. In this section I explain how voluntary action as a form of product differentiation through these characteristics can allow firms to make positive profits in markets where consumer preferences for greenness are horizontal as well as in markets where their preferences are vertical.

2.1.1 Greenness as Horizontal Product Differentiation

Consumer preferences are horizontal when all consumers do not have identical preferences – they have different ideal levels of environmental-friendliness of a product if all products in the market have the same price. Dissimilar preferences are possible if the positive environmental characteristics of a product come at the expense of other desirable characteristics. For instance, the space and comfort offered by a large SUV may come at the cost of a more negative environmental impact than that of a smaller car. A consumer who values space and comfort may be more willing to tolerate the high emissions of his vehicle than a consumer who values environmental quality and is willing to forgo some comfort to buy a smaller, more fuel-efficient car.

I use a Hotelling-type model of demand for two products differentiated by a single product characteristic to explain how firms in markets where consumers have horizontal green preferences may voluntarily undertake environmental action to differentiate their products through green characteristics and make positive profits. The single product characteristic I use is a summary characteristic that reflects the level of the environmental effect of a product. A net positive environmental effect or a relatively small negative environmental effect through the life-cycle of a firm's product is considered a "green" (g) characteristic and the opposite effect is considered a "brown" (b) characteristic. These characteristics are then combined in a summary characteristic. This summary characteristic may be expressed as the sum $g + b$ where g is measured in positive units and b is measured in negative units. Since consumers have different ideal combinations of green and brown characteristics, in this model I take them to be located continuously along a horizontal line which measures the summary characteristic. The two ends of this line represent a completely green and completely brown product. Firms that enter this market produce only one product and make a decision about where to locate their product along this line, given that consumers whose ideal value for the summary characteristic differs from that embodied in the firm's product will experience a disutility by purchasing that firm's product. The utility function for each consumer in this model is given by:

$$U = v - c|\,(g_i + b_i) - (g + b)^*| - p_i$$

where p_i is the price of purchasing one unit of product i, v is the intrinsic utility from consumption of the product, $(g_i + b_i)$ gives the summary characteristic of the product, and $(g + b)^*$ is the ideal value of the summary characteristic for the consumer. Here, c is the

rate of reduction in utility to the consumer for each unit of a mismatch between the desired value of the summary characteristic and the actual value of the good[1]. If the product is ideal for the consumer, $|(g_i + b_i) - (g + b)^*| = 0$ and $U = v - p_i$ (Ireland, 1987). A consumer with ideal specification $(g + b)^*$ will purchase product 1 under the following conditions:

(1) $v - c|(g_1 + b_1) - (g + b)^*| - p_1 \geq 0$

(2) $v - c|(g_1 + b_1) - (g + b)^*| - p_1 \geq v - c|(g_2 + b_2) - (g + b)^*| - p_2$

Firms therefore balance two incentives when they undertake environmental action to assign the level of the summary characteristic of their product. The first is the incentive to gain market share by locating as close as possible to the center of the summary characteristic distribution. Through this, firms can maximize the range of summary characteristic values within which consumers experience a greater positive utility from consuming their product than from consuming the other firm's product. The second incentive, which is crucial in obtaining positive profits from differentiation, is that of being able to relax price competition by locating further away from each other and making competition less perfect. A positive value for distance between two products on the line therefore enables firms to charge prices above their marginal costs and to obtain positive profits (Böckem 1994). Eventually, firms settle at an equilibrium that corresponds to neither maximum nor minimum differentiation along the distribution of consumer preferences, where the trade-off between quantity and price is balanced and

[1] This utility function assumes that only the absolute value of the deviation from their ideal product matters to consumers – they are indifferent to the direction of this deviation. This assumption is valid in the case of disutility due to distance in Hotelling's (1929) paper because the direction of the distance is irrelevant. However, it may not hold strictly in the case of green preferences if consumers experience different disutilities from whether the product is "greener" or "browner" than their ideal product. Also, *c* may not be constant across all consumers. Results from the empirical analysis in this paper seem to support the claim that higher income consumers experience lower disutility for deviation from their ideal product specification.

each firm maximizes its positive profit. In this equilibrium, one firm produces a product that is "greener" than that of the other firm.[2]

The above discussion shows how positive profits from differentiation could be a driver for firms to voluntarily undertake environmental action when consumers have horizontal preferences for greenness. Section 2.3, which presents testable hypotheses for the effect of consumer preferences on green branding, discusses how the distribution of consumer preferences along the line of summary characteristics may affect the propensity of firms to undertake green branding.

2.1.2 Greenness as Vertical Product Differentiation

Consumer preferences in the vertical product differentiation framework are identical – consumers unambiguously prefer more environmentally-friendly goods but differ in their willingness to pay for them. Their willingness to pay depends on their income levels, which are heterogeneous. This means that, given two goods that are identical in every respect (including price) except for the degree of their environmental impact, a consumer within this framework will always purchase the good with lower negative environmental impact. The consumer will only purchase a good with higher negative impact if its price is sufficiently lower than that of the more environmentally-friendly good; that is, if the utility lost by consuming the less green product is compensated by the utility of income saved by purchasing it at a lower price. Since marginal utility of income is assumed to be decreasing, utility of saved income does not

[2] The firm that produces the "browner" product is limited in its ability to differentiate through "brownness" if a minimum level of greenness is stipulated by law.

compensate for utility lost from consumption of the less green product at higher incomes, and high-income consumers purchase the greener product.

I apply Arora and Gangopadhyay's (1995) model of voluntary overcompliance with environmental regulation to explain how firms in markets where consumers have vertical green preferences are able to make positive profits through voluntary action. Though their model only examines overcompliance with regulation of the environmental impact of a firm's production process, it can be easily extended to explain why firms may voluntarily mitigate the impact of their products during the entire product life-cycle. Firms can thus differentiate their products through green characteristics to make positive profits.

In Arora and Gangopadhyay's (1995) model, two firms that produce a homogenous product compete in a two-stage game. Production of the good generates pollution emissions at a positive level. Consumers have vertical preferences for greenness and are non-homogenous in income. In the first stage of the game, each firm decides the level of emission-control technology (e_i for i = 1, 2), that it will employ to mitigate its emissions. The cost of this emission-control technology is a fixed cost that increases at an increasing rate with the emissions mitigated by its application. The choice of this emission-control technology is the source of the differentiating green characteristic of a product in this model. For simplicity, the consumer is assumed to not derive any intrinsic utility from the product – he only derives utility from the cleaning activity of the firm.

The utility function, U, of the consumer is represented by:

$$U(y, \theta, e) = y + e - p/\theta(y)$$

where y is a composite commodity called *money*, p is the price of the good, and $1/\theta(y)$ is the marginal utility of money. Since consumers are assumed to be non-homogenous in income, they have different levels of y and consequently different levels of $1/\theta(y)$, which decreases with increase in y. The firms compete in prices in the second stage. Solving the game backwards to obtain a subgame perfect Nash equilibrium, Arora and Gangopadhyay (1995) find that, since firms compete in prices and emission technology is a fixed cost, if emission-control levels are the same then competition drives prices down to marginal cost. For any $e_1 = e_2 > 0$, the firms then make negative profits in the overall game. For $e_1 = e_2 = 0$, both firms make zero profits. The key outcome of this model is that if the firms differentiate their products by voluntarily adopting different positive levels of e ($e_1 > e_2 > 0$, without loss of generality) and cater to different sets of customers, they can charge positive prices and make positive profits.[3] Another important implication of their analysis that is relevant in the development of the testable hypotheses in this paper is that the emission performance of firms improves as income of each group of consumers or of the group with lowest income increases.

This model can be generalized to explain firms' efforts to confer more general green characteristics upon their products by taking e to represent the efforts of a firm to voluntarily mitigate the environmental impact of its products during their entire life-cycle. The assumptions about the costs of improving environmental performance are the same. That is, the cost of improving environmental performance is a fixed cost for a

[3] Note that the minimum value of e_2 is restricted by the emission restrictions from environmental regulation.

particular level of performance, and increases at an increasing rate with performance. A firm that operates in a market where consumers have an unambiguous preference for environmentally-friendly goods thus has the incentive of positive profits to differentiate its product through voluntary environmental action. Furthermore, given identical preferences in two markets that only differ by income, firms in the market where consumers have higher income will have better environmental performance than those in the lower income market.

2.2 Green Branding vs. Green Labeling as forms of Differentiation

Differences between green branding through EMS adoption and an alternate form of voluntary action such as green labeling are highlighted in this section. The trade-offs that arise from these differences are examined in the next section to propose testable hypotheses for the likelihood of firms to brand themselves as green under certain market and industry conditions. Both the forms of voluntary action require firms to study some or all of their environmental impacts, confer positive environmental characteristics upon their products or the entire firm, and undertake costly independent certification of their efforts. However, branding and labeling differ in the scope of the certification and in the level of information that the firm acquires before it applies for and obtains a certification.

"Green branding", as used in this thesis, refers to a firm's communication to consumers that it has voluntarily implemented a *firm-wide*, strategic approach to its environmental policy, plans and actions. This coincides with the adoption and certification of an Environmental Management System (EMS) by a firm. Though the EMSs adopted by different organizations could vary widely, they usually include the

following components: an environmental policy statement, an initial review, environmental objectives and targets, implementation procedures, internal monitoring and auditing, and internal reporting (OECD, 2003). Specifically, a firm that has adopted an EMS may signal to customers and regulators that it has implemented a *firm-wide* system to help it comply with existing environmental regulations and to continually improve its environmental performance. Through green branding, a firm essentially certifies that its production process conforms to certain environmental standards. It thus confers identical differentiating green characteristics upon *all* its products. Unlike green labeling, green branding communicates to consumers that the firm has undertaken a more comprehensive, firm-wide approach to its environmental impacts and has more information about them than it may have if it only labeled some of its products.

When a firm undertakes "green labeling" of *a product*, it communicates to consumers that it has voluntarily studied the environmental effects of the labeled product and has undertaken the costs of labeling of that particular product.[4] Green labels often amount to a certification that a product meets some environmental standard.[5] Consumers

[4] The criteria for labeling are generally determined so that only a small percentage of products in a product category (5 to 30 percent) can obtain the label. Once labeled products occupy a substantial share of the market, criteria are usually revised to be more stringent, create incentives for better environmental performance, and maintain selectivity of the label (OECD, 1997). Since the green label certifies a characteristic in only a certain subsection of all products, it facilitates product differentiation by maintaining differentiated characteristics in the market.

[5] Examples of green labels include Canada's Eco-logo, Germany's Blue Angel, Japan's Eco-Mark, the Nordic Council's Nordic Swan, the US Grean Seal, and the Forest Stewardship Council's label. All of these are classified as *Type I* labels according to the International Organization for Standardization (ISO) Classification. This means that they compare products with others in the same category and are awarded to products that are environmentally preferable throughout their whole life cycle. The criteria are set by an independent body and monitored through a certification or auditing process. The ISO classification defines *Type II* labels as claims of environmental characteristics of products made by their manufacturers, importers or distributors. *Type III* labels, analogous to labels that detail nutritional information on food products, provide specific information about a product's environmental impacts throughout its life cycle. Despite their evident advantage in providing comprehensive information, *Type III* labels have been limited in their application due to high costs and reliance on manufacturer's private information (Konishi, 2007). As a result, green labels can be assumed to generally give the consumer only binary information about whether a product does or does not conform to a certain standard.

who see the labeled product are aware that the scope of the label and of the environmental information available to the firm is limited to that particular product of the firm, and does not necessarily extend to all products and activities of the firm. Since firms label individual products, firms that produce multiple products can choose which of these and how many of these they would like to label and, therefore, differentiate within their market.

2.3 Testable hypotheses

I contrast green branding with green labeling to highlight the trade-offs faced by firms when they decide whether to undertake voluntary environmental action through EMS adoption and certification. This analysis suggests hypotheses for the effect that market and industry characteristics may have on the propensity of firms to adopt EMSs. Since data about relative costs and revenues from branding and labeling are often confidential and difficult to obtain, I restrict my hypotheses and subsequent empirical analysis to a specific set of implications that can be tested with available data.

***Hypothesis 1*: Firms in markets where consumers have a higher preference for greenness are*, ceteris paribus,* more likely to brand themselves as green than firms in countries where citizens have little or no environmental concern.**

As discussed in Section 2.1, firms can make positive profits by differentiating their products via green characteristics irrespective of whether the distribution of consumer preferences is horizontal or vertical. In either framework, we can expect a higher level of consumer preferences for greenness to lead to higher numbers of firms that undertake

green branding through EMS adoption to confer green characteristics upon all of their products.

The vertical preferences framework suggests that firms are able to make higher profits through differentiation and are more likely to undertake voluntary environmental action in markets where consumers place a higher premium on greenness. Their decision about the form of their voluntary action will be based on relative costs of various strategies. Firms that produce a single product may find it more cost-effective to label that product than to implement an EMS, but firms that produce multiple products may find branding a less costly way to differentiate all of their products at once.

Similarly, in the horizontal preferences framework where we may view EMSs and labels[6] as thresholds (a minimum value of the summary characteristic) on the greener portion of the summary characteristic line, greener preferences would lead to more firms locating their products above these thresholds. If consumers in different markets have different end-points of the distribution of their environmental preferences, these would correspond to different segments of the summary characteristic line. Then firms in markets where consumer preferences are greener and overlap largely with the green subsection of the summary characteristic line are more likely to locate their products above the thresholds for branding or labeling. Again, they will decide between the two strategies based on their relative costs.

If branding and labeling have similar relative costs across countries, firms that would have chosen to differentiate through branding based on these relative costs are unambiguously more likely to brand themselves in countries with higher levels of green

[6] This mainly includes *Type I* labels. *Type II* and *Type III* labels do not necessarily reflect compliance with a given set of standards.

preferences than in those whose citizens are not as environmentally conscious. Thus, firms in markets where consumers have a higher preference for greenness are, *ceteris paribus*, more likely to brand themselves as green than firms in countries where citizens have little or no environmental concern.

***Hypothesis 2*: Firms in markets where consumers have more diverse horizontal preferences for greenness are, *ceteris paribus*, less likely to use branding as a form of voluntary environmental action.**

The horizontal preference framework suggests a more nuanced effect of the *spread* of consumer preferences on the likelihood of firms to brand themselves as green. In the case of single-product firms, branding and labeling are equivalent when they are used to assign a level of the summary characteristic to that single product. A firm that produces multiple products, however, may be able to selectively label a subset of these products and leave the rest unlabeled. This enables it to place products at multiple points along the line that describes the summary characteristics of a single market and to differentiate among its own products to secure positive profit from the sale of each of these products.[7] A firm that brands itself assigns an *identical value* of the summary characteristic to each of its products and thus is not able to differentiate among its own products in the same manner as by selective labeling. In such a case, a firm will only prefer to brand itself if the cost of labeling multiple products exceeds the cost of branding by enough to

[7] Additionally, if the firm sells products in multiple markets that are represented by different segments of the line describing the summary characteristic, the firm can place its products at multiple points along each of these segments to make a positive profit in each of these markets.

compensate for any difference in the revenues that accrue from either strategy.[8] If consumer preferences are very spread out along the line describing summary characteristic distribution, the positive profits from a strategy such as selective green labeling that allows a firm to confer different levels of greenness to each of its multiple products are more likely to outweigh the cost savings from green branding. As a result, we can expect that if preferences for greenness are horizontally distributed then firms in markets with high spread of preferences are, *ceteris paribus*, less likely to adopt branding as a form of voluntary environmental action.

***Hypothesis 3*: Firms in markets where consumers have higher income are, *ceteris paribus*, more likely to brand themselves as green than firms in lower income markets.**

A key implication of Arora and Gangopadhyay's (1995) analysis of voluntary overcompliance when consumer preferences are vertical is that the emission performance of firms in the market improves if the distribution of consumer income shifts out. For my analysis of environmental characteristics of products, this implies that firms that operate in markets where consumers have higher incomes are likely to have better environmental performance than those in lower income markets. Since green branding and green labeling are both ways to convey that some or all of a firm's products meet certain requirements for green characteristics, firms in higher income markets are more likely to

[8] This assumes that consumers' utility function only depends on the summary characteristic of the product they consume. It is unaffected by the summary characteristic of other products produced by the firm from which they purchase. However, consumers may care about the summary characteristics of other products produced by the firm whose product they buy. For instance, a person buying a hybrid vehicle may prefer to buy it from an automobile company that only produces hybrid vehicles than from a firm that also produces SUVs. This would limit the ability of a firm that labels its products to place its products at multiple points along the line of summary characteristics.

be able to differentiate their products by meeting these standards. Again, firms may decide between the two strategies based on their costs – labeling may be more cost-effective for single-product firms and branding may be more cost-effective for multiple-product firms. If firms across countries face similar relative costs when they decide between branding and labeling we can expect that, *ceteris paribus*, higher consumer income will lead to a higher likelihood of firms to brand themselves as green when consumer preferences are vertical.

***Hypothesis 4*: Firms that belong to high negative environmental impact sectors are, *ceteris paribus*, more likely to brand themselves as green than firms in sectors that have lower negative environmental impact.**

Hypothesis 2 was based on the difference in the number of products simultaneously differentiated when a firm chooses green branding or green labeling. The two forms of voluntary action, however, also differ significantly in the level of information firms acquire about the life-cycle impact of their products before they apply for and receive a certification. Specifically, green branding through adoption of an EMS requires a firm to acquire more information about its impacts than if it only labeled isolated products. This is because a reliable system for measuring *firm-wide* environmental impacts is a necessary component of an EMS, whereas no such comprehensive system is required while labeling a product. As explained below, when combined with the ability of firms that have intermediate environmental impact to "greenwash"[9] their activities, this

[9] Lyon and Maxwell (2006) define "greenwash" as the "selective disclosure of positive information about a company's environmental or social performance, without full disclosure of negative information on these dimensions."

difference in information available to the firm could lead to greater branding by firms with high negative environmental impact.

Lyon and Maxwell (2006) show that firms have an incentive to selectively withhold information about activities that lead to negative environmental effects. This is based on the outcome that, if the market is unsure of the actual information available to a firm about its own impacts, it does not always interpret unreported information as failures.[10] Thus the market assigns a higher value to an activity that has unreported effects than to one that has a reported negative effect. The threat of penalty if selective disclosure is discovered, however, gives firms the opposing incentive to fully disclose all known information about the impact of their activities. Faced with an expected penalty that is not too high, firms with moderate values of environmental impact may be willing to risk discovery and disclose selectively because they have a lot to gain from disclosing a success and from withholding information about a failure. They may thus be able to sustain a selective-disclosure equilibrium and increase their value in the interim period before their actual impacts become public knowledge.[11] Firms with high negative environmental impact, on the other hand, are not willing to risk discovery of greenwash and are always forced to disclose all known impacts. Since the market already always

[10] Grossman (1981) supports full disclosure of private information based on adverse selection and the assumption that the seller knows the quality of the commodity. Dye (1985), however, demonstrates the possibility of a partial disclosure equilibrium in a scenario where investors are not sure whether the managers are endowed with private information. Given no disclosure of certain information by managers, investors are uncertain of whether this lack of disclosure is due to the non-existence of information or due to its adverse content. Jung and Kwon (1988) extend Dye's model to allow outside investors to revise, in the absence of disclosure, their probabilities that managers have private information. Using the revised conditional probabilities, they establish the uniqueness of a partial disclosure equilibrium.

[11] When information about actual impacts eventually becomes public, the market penalizes firms for negative environmental impact by valuing environmental failures lower than environmental successes in finding the net present value of the firm.

expects their activities to be environmental failures, they have a lot to gain from reporting a success and very little to lose from reporting a failure.

As the information available to a firm increases, the market increasingly interprets withheld information as failures rather than as true uncertainty. Since EMSs and branding correspond with higher information, they decrease the ability of firms with intermediate impact to sustain a selective-disclosure equilibrium. Such firms have a disincentive to adopt EMSs as voluntary action that differentiates their products. The value of high impact firms that are forced to disclose all known information, however, is unaffected by the level of information they are expected to have about their impacts. Firms with high impact therefore do not have the same disincentive as firms with lower impact to adopt an EMS and brand themselves.[12] Since firms with high environmental impact do not bear the negative effect on greenwash ability that corresponds to green branding, we would expect that firms in industrial sectors that have a high environmental impact are, *ceteris paribus*, more likely to differentiate their products by branding themselves as green than firms in industrial sectors with lower environmental impact.

[12] Cost of branding and positive profits from branding are assumed to be the same across high and low impact industries.

3. Empirical Framework

My discussion on the role of greenness as a form of profitable product differentiation suggests that firms operating in industries and markets with certain features are more likely to adopt and certify EMSs to brand themselves as green. I investigate my hypotheses by examining the effect of these features on the numbers of ISO 14001[13] certified EMSs that have been adopted by firms in various industries across European OECD countries. If my hypotheses are correct, I should see greater adoption of ISO 14001 certificates in high impact industries and in countries where consumers have higher income, greater preference for greenness and less diverse preferences.

3.1 Econometric Model

I use a linear regression framework to analyze the various factors that may simultaneously drive green branding. The dependent variable used as a proxy for branding in this analysis is the number of ISO 14001 certificates issued to firms in an industrial sector in a country. The ISO 14001 certification and its choice as a proxy for branding are explained in section 3.2. In order to mitigate unobserved heterogeneity across countries, I restrict my analysis to a set of European OECD countries. These countries have fairly similar political, economic and international positions. A GDP term is included as an explanatory variable to account for differences in the size of their economies. I use a fixed effects model to control for unobserved heterogeneity across industries. Dummy variables for 32 of the 33 industries in the sample are included to hold

[13] The ISO 14001, *Environmental management systems – Requirements with guidance for use* set of standards developed by the International Standardization Organization, is the most commonly implemented standard against which EMSs are certified.

the average effects of each industry constant in the regressions. The identifying assumption that is made in this analysis is that unobservable factors that vary by industry do not vary by country. The fixed effects model, unfortunately, does not permit me to test directly for the effect of the environmental impact of an industry on the numbers of ISO 14001 certificates adopted by firms in that industry. This is because the data for industry impact classify industrial sectors as "high", "medium" or "low" impact and does not give the actual magnitude of impact. As a result, a dummy variable would have to be included for a high impact industry but this is not possible due to a linear dependence between the industry dummies and the dummy for a high impact industry. Instead, the dummy for high impact is interacted with the other explanatory variables to enable indirect examination of its effects.

The general econometric model used to test the hypotheses is as follows:

$$Y_{ic} = \beta_{0ic} + \beta_{1c}*GDP + \beta_{2c}*GDPCAP + \beta_{3c}*GREEN + \beta_{4c}*SPREAD + \beta_{5i}*HIGH*GREEN + \beta_{6ic}*GREEN*GDPCAP + \beta_{7c}*HIGH*GDPCAP + \beta_{8ic}*SPREAD*GDPCAP + \beta_{9c}*GREEN*SPREAD + \beta_{10c}*HIGH*SPREAD + \beta_{11i}*DUMMYIND1 + \beta_{12i}*DUMMYIND2 + \ldots + \beta_{42i}*DUMMYIND32 + \varepsilon_{ic}$$

where the subscript i indicates industrial sector and subscript c indicates country. Table 3.1 overleaf gives a brief description of each explanatory variable and its expected effect based on the theoretical discussion in Section 2. Detailed specification and sources of data are given in Table D.1 in the Data Appendix. Table 3.2, at the end of Section 3, provides summary statistics for each of the explanatory variables.

Table 3.1. Factors and Effect on the Number of ISO 14001 Certificates

	Explanatory Variable	Expected Effect
GDP	GDP in 2000 US$/10[10]	+
GDPCAP	Measure of Income – GDP per capita in 2000 US$	+
GREEN	Primary measure of level of green preferences – Mean of weighted average of survey scores	+
SPREAD	Measure of spread of green preferences – Standard deviation of weighted average of survey scores	–
HIGH	Dummy for a high impact industry	+
TREATIES	Secondary measure of level of green preferences – Sum of dates of ratification of four major international environmental agreements	–
HIGH*GREEN		+/–
GREEN*GDPCAP		+
HIGH*GDPCAP		+/–
SPREAD*GDPCAP		+/–
GREEN*SPREAD		+/–
HIGH*SPREAD		+/–

3.2 Dependent Variable: ISO 14001 as Green Branding

I use the total number of ISO 14001 certifications in an industrial sector of country, in the year 2005, to represent green branding of firms within that sector and country.[14] As explained in section 2.2, green branding coincides with the adoption of an EMS by firms. The ISO 14001, *Environmental management systems – Requirements with*

[14] These data are available from *The ISO Survey*, published on an annual basis by the ISO Central Secretariat (ISO/CS). The ISO/CS compiles this dataset from a variety of sources, including ISO national member institutes, accreditation and certification bodies and certification databases (ISO, 2006).

guidance for use set of standards developed by the International Organization for Standardization (ISO) is the most common set of standards against which EMSs are certified[15] and publicity guidelines for the standard ensure that it can only be interpreted as firm-wide branding. The ISO-issued guidelines in "Publicizing your ISO 9001:2000 or ISO 14001:2004 Certification", 2005 explicitly state that when references to the ISO 14001 certification are made in product-related information, they must not be done so in a way that the certification may be interpreted as being a product certification or product guarantee. Instead, phrases like "the management system governing the management/provision of this product/service is ISO 14001:2004 certified" should be used when the certification is communicated via product-related material. Also, though the ISO 14001 standard only applies to an EMS and not to the organization that implements the system, firms are permitted to advertise themselves as ISO 14001 certified because the system has no independent existence. Certification of a firm as ISO 14001 compliant, therefore, is equivalent to green branding of the firm and cannot be interpreted as green labeling of its products.

The ISO 14001 certification also fulfills the higher information criterion that corresponds to green branding. It ensures more comprehensive involvement and better information collection by the firm in the effort to measure and decrease its environmental impact, than is required by any scheme of product labeling. The standards emphasize the importance of management commitment by requiring the managers of the firm to define its environmental policy, to provide resources to implement and maintain the EMS, and to regularly review all facets of the system to ensure its continuing viability.

[15] "Certification" means that the EMS has been audited against the requirements of the standard by an independent organization that is formally accredited to be competent to carry out the ISO 14001 certification.

Additionally, they require the involvement of employees of the firm because they are essential to the successful implementation of the EMS. Employees in a certified firm must understand its environmental policy and demonstrate competence in applying it. The firm is also required to commit to continual improvement and this commitment is fulfilled in part by management review (Block, 2007).

The ISO 14001 standards' international acceptance and flexibility also facilitates the testing of the hypotheses proposed in this paper. Their widespread acceptance across countries permits cross-country comparisons. The success of the standards is partly because they were developed in response to an increased interest in international standards for environmental management that emerged in the period leading up to the United Nations Conference on Environment and Development (also known as the Earth Summit), 1992. This atmosphere of international cooperation in which the standards evolved contributed to the support they have received from government agencies in various countries. For instance, the US Environmental Protection Agency website notes that, though not all facilities have modeled environmental management systems on ISO standards, "… the approach used by ISO and similar models has proven to be effective" (USEPA, 2005). Such approval has legitimized the standards and led to firms across the world recognizing the ISO 14001 standard. In addition, the applicability of the standards to firms in any industrial sector and of any size enables comparisons across industries. An EMS that meets the requirements of the latest ISO 14001:2004 standards enables the implementing firm to:

- Identify and control the environmental impact of its activities, products or services

- Improve environmental performance continually
- Implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved. (International Organization for Standardization, (a))

Since these requirements are generic and do not specify levels of environmental performance, their implementation is flexible and customizable to the specific characteristics of each firm. Hypotheses 1 through 4, which predict the effects of various market and industry features on green branding, can thus be examined via ISO 14001 certificates that have been adopted by firms in markets and industries with varied characteristics.

One concern about the use of ISO 14001 certificates as an accurate proxy for branding may be that they are issued by "independent accredited bodies" and not by the ISO. In this situation, the moral hazard issue arises where firms that seek certification may be able to give the accredited certifying bodies an incentive to help them attain certification. Hubbard (1998) examines a similar situation in the market for vehicle emission inspections in California, where vehicles must receive smog checks from inspectors who are licensed by the state to complete inspections and perform repairs. He finds that consumers in this market are generally able to provide incentives that lead inspectors to increase their supply of passing inspections. This situation is analogous to the interaction of the firm that seeks an ISO 14001 certificate, the "accredited certifying body" that may certify the firm, and the "accreditation body" that accredits the certifying body. Here the accreditation body may be compared to the state, the inspector to the

certifying body, and the vehicle owner to the firm that seeks ISO 14001 certification. The certifying body in this case has the same incentives to be lenient as the inspector – it may be able to take advantage of higher demand for certification if it is lenient in its assessment, and it may increase the demand for its compliance support services if it is stricter in its assessments. It is reasonable to expect that in the market for certification, where the preferred cost of "repair" or "support" in order to obtain the certificate is zero, firms are similarly able to give certification bodies incentives to be lenient in their requirements. In the case of ISO 14001, accreditation bodies that accredit certifying bodies (like the regulators in Hubbard's (1998) paper) are able to impose restrictions and fines upon certifying bodies if they fail to comply with the requirements for accreditation. The International Accreditation Forum (IAF), an international association that represents the national accreditation bodies set up in a number of countries, develops appropriate processes and practices for accreditation that are applied worldwide by its members. These are published in the *IAF Guidance on the Application of ISO/IEC Guide 62:1996 – General Requirements for Bodies Operating Assessment and Certification/registration of Quality Systems*. This document provides a multi-dimensional, strict framework within which certifying bodies are assessed and its application ensures that the same standards for accreditation are used world-wide. Regular assessment of certifying bodies against this rigorous framework serves to address the moral hazard problem to some extent.

The correspondence of the ISO 14001 standards with the characteristics of branding, in combination with their wide applicability and flexibility, makes them a good proxy for green branding in order to test the hypotheses presented in this paper. The moral hazard problem that may arise because firms are certified by independent

certifying organizations is mitigated by the IAF guidelines and therefore the certificate accurately represents whether a firm's EMS meets the ISO 14001 standards or not.

3.3 Explanatory Variables: Measures of Level and Spread of Green Preferences

The primary measures I use to represent the level and spread of consumer preferences for greenness are derived from responses to the *World Values Survey*, 1999, 2000 or 2001 that reflects consumer preferences for greenness in each country under study. Respondents to the *World Values Survey* in each country were asked to say whether they would strongly agree, agree, disagree or strongly disagree with the following statement: "I would agree to an increase in taxes if the extra money were used to prevent environmental pollution". Since the answers to this question are not directly related to the intrinsic utility of goods purchased and consumed by consumers in each country, the distribution of answers reflects the level of environmental concern of consumers in each country. In order to use the survey answers to establish a single measure that captured the average level of consumer preferences for greenness in each country, a score was assigned to each category and weighted by the percentage of respondents of that category. The weighted average of the survey scores was then used to represent the level of green preferences in a country. The standard deviation of the scores from their weighted average was calculated and used as a measure of the spread of green preferences in a country.[16]

[16] The results from an empirical analysis that uses these measures are robust to proportional increases in the category scores but may not be robust to asymmetric changes in the category scores.

I also use the sum of the dates of ratification of four major International Environmental Agreements by each of the countries in the sample, available from *EarthTrends: The Environmental Information Portal* maintained by the World Resources Institute, as a secondary measure for the level of consumer preferences for greenness. Rapid ratification of environmental treaties is taken to correspond with a higher level of consumer green preferences. Such use of treaties as a reflection of green preferences of consumers in a country is only justified if countries sign and ratify environmental treaties based on constituent preferences. This claim is strongly supported by Recchia's (2002) examination of the drivers of democratic country behavior with respect to international environmental treaty engagement, which concludes that value priorities of citizens are crucial in the active construction and development of international environmental rules and conventions. Recchia's analysis, however, cannot be extended to all countries in the sample without caution. He notes that weak executive-centered ratification power and less perfect democracy may dilute the effect of citizen preferences. Since countries in the sample have varied balances between legislative and executive power for treaty ratification and since some of the countries are recent democracies, the treaty measure may not be completely accurate. I therefore use the treaty measure as a secondary measure to supplement the level of greenness suggested by the survey measure.

3.4 Explanatory Variable: Measure of Industrial Sector Impact

I use the Ethical Investment Research Services Ltd. (EIRIS)[17] Classification of Environmental Impact Sectors to label industry sectors as "High", "Medium" or "Low"

[17] EIRIS is a UK-based research organization that provides information on social, environmental and ethical issues to the socially responsible investment community.

impact[18] (Gordon, 2007). This classification is based on each sector's overall environmental impacts in relation to its size within the United Kingdom. The basic indicator used by EIRIS is a ratio of environmental damage to economic significance of the sector. Environmental impacts considered in this classification include direct impacts relating to climate change, air pollution, water pollution, and waste and water consumption. Impacts arising upstream (from the supply chain) and downstream (during product life-cycles) were also considered, though mainly in qualitative terms. EIRIS profiled each sector in terms of its impacts (high, medium, low) and used an absolute ratio to determine the high, medium or low grade when quantitative data existed for the criteria. For instance, sectors that contributed a higher proportion of the national CO_2 emissions than economic value added in the United Kingdom were assigned at least a medium grade for this effect, whereas sectors that contributed over double the economic significance were graded as high. EIRIS used Gross Value Added[19] as a measure of economic significance, and a wide range of environmental datasets from sources such as the UK's Office of National Statistics, the US Toxic Release Inventory, National Environmental Technology Center (NETCEN, UK), NGOs (non-governmental orgnizations) and corporate reports to determine environmental impact.

Since the EIRIS classification does not provide a measure of the actual magnitude of the environmental impact of an industry, the classification of an industrial sector as "High Impact" can only be incorporated into the regression as a dummy variable. As noted earlier, this prevents direct testing of hypothesis 4 regarding the effect of

[18] The industrial sectors included in the empirical analysis and their categorization by impact is given in Table D.2.
[19] GVA measures the contribution to the economy of each individual producer, industry or sector in the United Kingdom.

environmental impact on green branding by firms. This classification, however, accounts for the environmental impact of industrial sectors in multiple dimensions, and provides a more accurate representation of net environmental impact than a one-dimensional measure such as total carbon-dioxide emissions.

Table 3.2 Summary of Explanatory Variables

Independent Variable	Observations	Mean	Standard Deviation
GDP	660	47.8842	61.0711
GDPCAP	660	30969.3	15724.9
GREEN	660	-0.06665	0.39431
SPREAD	660	1.21615	0.09629
TREATIES	660	7968.65	11.4072
HIGH*GREEN	660	-0.03433	0.28497
GREEN*GDPCAP	660	-602.929	15342.2
HIGH*GDPCAP	660	15953.9	19165.1
SPREAD*GDPCAP	660	37449.7	19223.3
GREEN*SPREAD	660	-0.08864	0.45281
HIGH*SPREAD	660	0.62650	0.61217

4. Results

The empirical analysis suggests that the level and spread of consumer preferences both have the effects on green branding that are predicted by the theoretical model. Income, however, does not seem to have the expected effect. Jointly, these results suggest that consumer preferences may drive EMS adoption. They also point to a more horizontal than vertical distribution of consumer preferences for greenness. The analysis does not show conclusive results for the effect of a high impact of the industry on green branding.

4.1 Main Results

The results of the fixed effects regression described in Section 3 are presented in Table 4.1. I find that the level and spread of consumer preferences have the effect suggested by the theoretical model, and are significant in determining the numbers of ISO 14001 certificates adopted by firms in an industrial sector. Per capita GDP, however, does not have a positive coefficient as was predicted by the theoretical analysis. Since the predicted effect of the spread of preferences was based on the horizontal distribution of green preferences whereas that of income was based on a vertical preference distribution, these results suggest that consumer preferences for greenness may be horizontally distributed. That is, consumers may be making trade-offs between the green and non-green characteristics of goods when they make consumption decisions – they do not always unambiguously prefer the greener product even if the price of products is the same. The significant positive correlation of the level of green preferences with the numbers of ISO 14001 certificates suggests that, despite varied preferences for greenness among consumers, greener preferences are able to induce EMS implementation.

In addition, the interaction term for spread of preferences and income has a positive coefficient and is significant. This could be because the disutility from consuming a product with a higher than ideal level of greenness is lower for high income consumers than for low income consumers – that is, high income consumers are more willing to tolerate "too much greenness". Also, the interaction term for level of green preferences and their spread had a significant negative coefficient. This is what we would expect to see if costs of branding and committing to a single level of greenness increase as consumer preferences become greener. This may be the case if consumers with a higher preference for greenness also experience a higher disutility due to deviation of a product from their ideal level of greenness. Results for the interaction terms with the dummy for a high impact industry were inconclusive.

Table 4.1 also presents the results for the regression that includes the TREATIES measure of greenness as an explanatory variable. The inclusion of the TREATIES variable did not change the significant results from the previous regression. This suggests that including the TREATIES variable provides no additional information. The coefficient for the TREATIES variable does not have the expected sign but it is not statistically significant.

The puzzling results for significant negative correlation of the numbers of ISO 14001 certificates with the per capita GDP of a country may be explained to some extent by the possibility that firms in the relatively wealthy countries in my sample have the option of adopting the EU Eco-Management and Audit Scheme (EMAS) standard instead of the ISO 14001 standard for EMS certification (OECD, 2003). This standard is also overall more stringent than the ISO 14001 standard. Turkey, Poland, Slovakia, Hungary

and the Czech Republic, the five countries with lowest per capita GDP in my sample, were all either non-EU or very recent EU member countries in the year 2005, and have very few EMAS adoptions in that year. Since participation in the EMAS is limited to firms operating in the EU or in the European Economic Area, the EMAS standard was not available to firms in these countries and the numbers of ISO 14001 certificates may capture a higher percentage of branded firms in these lower income countries than in the other countries in the sample.

Table 4.1 Industry Panel Regression
(Dependent Variable: Number of ISO 14001 Certificates)

Independent Variable	(a) Without TREATIES	(b) With TREATIES
GDP	0.58193 **	0.62526 **
	(0.0562)	(0.0698)
GDPCAP	-0.00902 **	-0.0115 **
	(0.0029)	(0.0038)
GREEN	258.989 **	262.073 **
	(76.033)	(77.878)
SPREAD	-256.505 **	-328.447 **
	(82.628)	(107.47)
TREATIES		0.47681
		(0.4555)
HIGH*GREEN	-21.1717	-21.1717
	(13.987)	(13.986)
GREEN*GDPCAP	0.00024	0.00065
	(0.0005)	(0.0006)
HIGH*GDPCAP	0.00019	0.00019
	(0.0003)	(0.0003)
SPREAD*GDPCAP	0.00682 **	0.00893 **
	(0.0024)	(0.0031)
GREEN*SPREAD	-206.651 **	-219.201 **
	(63.132)	(64.256)
HIGH*SPREAD	-13.1857	-13.1857
	(56.226)	(56.222)
Constant	370.665	-3347.00
Number of observations	660	660

Notes: The t-test is a one sided t-test, with the reported sign. The standard errors are given in parentheses. Coefficients significant at the 5% level are marked with * and those at the 1% level are marked with **. Column (a) gives the results from the regression without the TREATIES explanatory variable, and column (b) gives the results from the regression that includes the TREATIES explanatory variable.

The effect of an increase in the value of an explanatory variable by one standard deviation on the predicted number of ISO 14001 certificates was calculated for all explanatory variables excluding the interaction terms and is reported in Table 4.2. This was done to facilitate comparisons between the relative strength of each of the factors that determined the adoption of branding by firms in high and not-high impact industries. The findings suggest that, though the level and spread of green preferences have a significant effect on the numbers of firms that brand themselves as green, the positive effect of a one standard deviation increase in the level of green preferences would outweigh the negative effect of a one standard deviation increase in the spread in both high and low impact industries. Interestingly, such a difference suggests that shifting already green consumer preferences further to the green side and leaving "browner" consumer preferences unchanged may be sufficient to increase firm branding even though this would increase the spread of preferences. Though the significance of this difference has not been tested in this paper, it merits further examination.

Table 4.2 Predicted Effects of Explanatory Variables

Independent Variable	**Mean**	**Std. Deviation**	**Predicted Effect**	
			Not High	High
GDPCAP	30969.3	15724.9	-141.839	-138.851
GREEN	-0.06665	0.39431	102.122	93.77374
SPREAD	1.21615	0.09629	-24.6989	-25.9685

Notes: Column "Not High" gives the effect of the explanatory variable in an industry that is not high impact. Column "High" gives the effect in an industry that is classified as a high impact industry.

4.2 Robustness Checks

The robustness of the results discussed in the previous section was tested by running a second regression with the total certifications at the country-level as a dependent variable (instead of certifications at the industry-level). Here, the dependent variable used was the total number of ISO 14001 certificates adopted by firms in a country in a given year, from 2001 to 2005. The general econometric model for this analysis was as follows:

$$Y_{tc} = \beta_{0tc} + \beta_{1tc}*GDP + \beta_{2tc}*GDPCAP + \beta_{3c}*GREEN + \beta_{4c}*SPREAD + \beta_{5tc}*GREEN*GDPCAP + \beta_{6tc}*SPREAD*GDPCAP + \beta_{c}*GREEN*SPREAD + \varepsilon_{tc}$$

where t represents the year and c represents the country. The results of this regression are reported in Table 4.3 and are generally consistent with the findings from the industry-level analysis. The coefficients for the level and spread of consumer preferences as well as for income have the same sign as coefficients from the previous regression. While the effect of level of preferences on the total number of ISO 14001 certificates in a country is significant, however, the effect of income and of the spread of preferences is not significant.

I also ran two more regressions with the same explanatory variables as in the above model with a restricted sample of countries. This sample contained only those countries that had been members of the EU for all five years under consideration. The first regression used the total number of ISO 14001 certificates in a country in a particular year as the dependent variable and the second used the sum of the total numbers of ISO 14001 *and* EMAS certificates in a country in a particular year. The results from these regressions are given in Table A.1 in the Appendix. While the first

regression had a significant positive coefficient for the level of greenness, neither had other significant results beside the effect of GDP. However, these regressions presented slightly different results for the effect of income than the full country sample regressions. Though not significant, the coefficient for income in both these regressions was positive. This, when compared to the regression for the full country sample, suggests that the EMAS scheme may indeed lead to measurement error when ISO 14001 certificates are used as a proxy for branding. More detailed data on firm-level adoption of an EMS, irrespective of the type of standard used for certification or certification at all, would be crucial in performing a more robust analysis of the hypotheses presented in this paper.

Table 4.3. Full Country Sample Regression

Independent Variable	**Dependent Variable: Total ISO 14001 certificates**
GDP	23.8247 ** (2.5090)
GDPCAP	-0.00776 (0.1393)
GREEN	7811.86 * (3481.3)
SPREAD	-2168.07 (3147.1)
GREEN*GDPCAP	-0.00779 (0.0258)
SPREAD*GDPCAP	0.00659 (0.1125)
GREEN*SPREAD	-5890.20 * (2899.5)
Constant	2932.23
Number of observations	110

Notes: The t-test is a one sided t-test, with the reported sign. The standard errors are given in parentheses. Coefficients significant at the 5% level are marked with * and those at the 1% level are marked with **.

5. Conclusions

This paper contributes to the literature on the drivers of voluntary corporate environmental action by suggesting product differentiation as a viable mechanism for the influence of green consumer preferences on firms' decisions. It provides empirical evidence to support the proposition that higher consumer preferences for greenness lead to increased voluntary adoption of Environmental Management Systems by firms.

The dearth of firm-level data on EMS implementation and its associated costs and revenues, however, limited my empirical analysis to the examination of green branding at the industry level. Additionally, the lack of precise data on firm-level environmental impacts prevented testing of the effect of high environmental impacts on EMS implementation. The availability of such data in the future would considerably alleviate problems such as measurement errors when ISO 14001 certificates are used as a proxy for firm branding, and would enable direct comparisons of the costs and the benefits of Environmental Management Systems and green branding for firms with different characteristics.

Despite its limitations, my analysis is able to provide some insight into consumer preferences as a driver of voluntary environmental action by firms. This may serve to justify the efforts of environmental NGOs to encourage environmentally-friendly consumption, especially in countries where environmental regulation by the government is weak and voluntary action by firms is more important in improving environmental quality. A more detailed examination of the relative effects of the level and spread of preferences may help inform the strategies adopted by these NGOs. If the spread of preferences is found to be sufficient to deter EMS adoption and branding, then NGOs

should focus on shifting the preferences of all consumers towards greener consumption. However, if the spread effect does not have as large a magnitude as the effect of the average level of preferences, shifting consumers that already have green preferences towards even greener consumption may be sufficient to induce great corporate environmental responsibility.

This paper provides only a small part of the answer to the larger question of whether a market economy can provide sustainable solutions to environmental problems without government regulation. A more complete answer to this question requires further research into the actual environmental benefits and limits of voluntary action by firms, as well as an examination of the relative costs of regulation and voluntary action.

Data Appendix

Table D.1 Explanatory Variable Definitions and Source

Variable Definition	Source
ISO 14001 Certificates	The ISO Survey – 2005, 2006
EMAS Certificates	EMAS Statistics Organizations and Sites, 2008
GDP: Gross Domestic Product in 2000 US$/$10^{10}$	United Nations Statistics Division
GDPCAP: Gross Domestic Product per capita in 200 US$	United Nations Statistics Division
GREEN: Mean of weighted average of survey scores	World Values Survey, 1999, 2000 and 2001
SPREAD: Standard deviation of weighted average of survey scores[20]	World Values Survey, 1999, 2000 and 2001
HIGH: Dummy variable for high impact industry	EIRIS, 2007
TREATIES: Sum of dates of ratification of the following four major international agreements that have all been ratified by countries in the sample - Convention on International Trade in Endangered Species - United Nations Framework Convention on Climate Change - United Nations Convention on Biological Diversity - United Nations Convention to Combat Desertification	Earth Trends – The Environmental Information Portal, 2005

Countries in Full Sample: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom

Countries in Restricted Sample: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom

[20] Scores assigned to the categories were: Strongly Agree – 2, Agree – 1, Don't know – 0, Disagree – -1, Strongly Disagree – -2.

Table D.2 Industries in the Sample and their Impact Class (EIRIS, 2007)

Impact Classification	Industries
High	Aerospace Agriculture, Fishing and Forestry Basic metal & fabricated metal products Chemicals, chemical products & fibres Concrete, cement, lime, plaster etc. Construction Food products, beverage and tobacco Machinery and equipment Manufacture of coke & refined petroleum products Manufacture of wood and wood products Mining and quarrying Non-metallic mineral products Other transport equipment Pharmaceuticals Pulp, paper and paper products Transport, storage and communication Water supply
Medium	Electrical and optical equipment Electricity supply Engineering services Financial intermediation, real estate, renting Gas supply Hotels and restaurants Manufacturing not elsewhere classified Printing companies Publishing companies Wholesale & retail trade; repairs of motor vehicles, motorcycles & personal & household goods
Low	Education Health and social work Information technology Other Services Other social services Public administration

Appendix A

Table A.1 Restricted Sample Country Regressions [a]

Independent Variable	(a) Dependent Variable: ISO 14001	(b) Dependent Variable: ISO 14001 + EMAS
GDP	25.1677 **	27.5787 **
	(3.3832)	(3.4752)
GDPCAP	0.10617	0.01993
	(0.3595)	(0.3692)
GREEN	7683.03 *	3107.85
	(4525.9)	(4648.9)
SPREAD	398.7854	-4090.79
	(9474.9)	(9732.66)
GREEN*GDPCAP	-0.05806	-0.04714
	(0.0437)	(0.0449)
SPREAD*GDPCAP	-0.08362	-0.01088
	(0.3023)	(0.3105)
GREEN*SPREAD	-4051.08	-710.2364
	(3877.9)	(3983.4)
Constant	-327.833	5102.60
Number of observations	75	75

Notes: The t-test is a one sided t-test, with the reported sign. The standard errors are given in parentheses. Coefficients significant at the 5% level are marked with * and those at the 1% level are marked with **. Column (a) gives the results for the regression where the dependent variable is the number of ISO 14001 certificates, and column (b) gives the results for the regression where the dependent variable is the sum of the number of ISO 14001 and EMAS certificates.

[a] The sample of countries used for this regression does not include non-EU member countries as well as countries that became members of the EU in 2004.

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