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THE ISO 14001 MANAGEMENT STANDARD: EXPLORING THE DRIVERS OF CERTIFICATION

Abstract: In this paper, we explore the drivers of certification with the ISO 14001 environmental management standard. Scholars and practitioners debate whether ISO 14001 certification signals superior underlying environmental performance or signifies merely the adoption of specific environmental management practices. Our paper helps to resolve this debate by developing a theory of why and when organizations will choose to certify with ISO 14001. We propose that certification with a management standard will be more likely when it is difficult to communicate credibly environmental practices to supply chain partners. We develop hypotheses concerning the type of information that will be communicated through certification. We empirically investigate our hypotheses using a rich longitudinal database. We find evidence that organizations certify with ISO 14001 to reduce information asymmetries with supply chain partners. In particular, we find that geographically and culturally remote suppliers are more likely to seek certification. We do not find evidence that certification serves as a signal of superior environmental performance. Rather, our findings suggest that suppliers use certification to communicate about environmental improvement efforts. In our conclusion, we discuss the implications of our findings for public policy makers and firm managers. (190 words)

Keywords: institutions, management standards, industry self-regulation, ISO 14001

The use of certified management standards to regulate business activity is of growing interest to academics, business managers, and policy makers. These standards stipulate neither product specifications nor process attributes. Instead, they require and certify the existence of a set of internal organizational practices and routines. For business managers, these standards may increase efficiency or solve inter-firm coordination problems. For policy makers, these standards may provide an alternative to costly government regulation. Prominent examples of certified management standards include the OHSAS 18000 standard (for occupational health and safety), the International Organization of Standardization's ISO 9000 and ISO 14001 management standards (for quality and environmental management), and the Eco-Management and Audit Scheme (EMAS).

In this paper, we explore certification with the ISO 14001 environmental management standard. Sponsored by the International Organization for Standardization (ISO) and designed by an international technical committee (TC 207) comprising more than 500 members, ISO 14001 specifies a set of environmental management guidelines and practices. It creates a system for third-party auditors to certify compliance with the standard. From the outset, the role of this standard has been a source of considerable debate. For example, in testimony before the U.S. Congress, members of the standard setting committee expressed differing expectations. Some suggested that certification would help "to distinguish companies that are doing the bare minimum from those that are committed to environmental excellence" (Morella, 1996). Others noted that "ISO 14001 compliance may become a standard of due care in assessing whether a company was [acting] in good faith" (Mazza, 1996). Still others suggested that the program might provide direct operational advantages (Collins, 1996).

Our paper helps to resolve this debate by developing a theory of why and when organizations will choose to certify with ISO 14001. We propose that certification with a management standard will be more likely when it is difficult to communicate credibly environmental practices to supply chain partners. We develop hypotheses concerning the type of information that will be communicated through certification. We hypothesize that certification will either help buyers choose high performing suppliers or help them monitor performance improvement among existing suppliers. We empirically investigate our hypotheses using a rich longitudinal database. Finally, we discuss the implications of our findings for public policy makers and firm managers.

THEORY & HYPOTHESES

Certified management standards like ISO 14001 include two fundamental elements. First, they codify a set of standard practices and behaviors. Second, they provide a certification system that allows organizations to demonstrate their compliance with these practices and behaviors. Most of the pioneering work on ISO 14001 and similar standards has emphasized the importance of the former element and made use of certification only as a mechanism for measuring the adoption of the specified practices (Corbett & Kirsch, 2001; Delmas, 2002; Guler, Guillen, & Macpherson, 2002). This research has tended to model adoption as a process of institutional pressure or information based contagion.

A handful of recent studies have proposed that *certification* represents a distinct and important element of these standards and fundamentally changes the way the standards are used (Anderson, Daly, & Johnson, 1999; Jiang & Bansal, 2003). These studies suggest that more consideration should be given to how certification could help resolve problems of credible communication. This evidence suggests that managers in organizations may choose to certify with standards such as ISO 14001 when they recognize that asymmetric information could cause inefficient exchange with skeptical supply chain partners (Anderson et al, 1999; Jiang & Bansal, 2003).

Asymmetric information causes two main problems among exchange partners. First, it makes it harder to assess the quality of potential partners (the 'selection problem'). Second, it makes it more difficult to evaluate improvement efforts among existing partners (the 'monitoring problem'). Akerlof (1970) used the pre-owned car market to illustrate how asymmetric information could result in a selection problem. He postulated a market in which sellers have some information about the quality of used autos (maintenance, history, improvements, etc.) that buyers do not. He pointed out that if buyers recognize the possibility that sellers could make false claims of superior quality, buyers would be unwilling to pay a higher price for cars with allegedly higher quality. In response, sellers would withdraw their high quality vehicles, leaving only lemons in the market. As a result, even if both suppliers and buyers would prefer to deal in high quality used cars, this selection problem will cause a market in which only low quality cars are bought and sold.

The second type of asymmetric information problem, the monitoring problem, occurs when asymmetric information makes it difficult to know if agreements have been met. Asymmetric information between suppliers and buyers may make it difficult to observe fully the actions of the supplier (Silverman, Nickerson & Freeman, 1997; Williamson, 1985). For example, a customer that pays a mechanic to do repair work on a vehicle may be unable to determine if the work has been done properly. As with the selection problem, this monitoring problem can cause an inefficient market for goods and services, and thereby harm both suppliers and buyers.

We theorize that certified management standards such as ISO 14001 reduce asymmetric information problems by allowing suppliers to credibly communicate information to buyers. To begin testing our theory, we first seek to uncover whether certification with ISO 14001 occurs more frequently when organizations are likely to have less information about supply chain partners. We then develop hypotheses to distinguish the use of certification to solve the selection or the monitoring problem. We focus our theory on intermediary supply relationships.

Certification and Information Asymmetries

Numerous factors influence the transfer of credible information and thus its distribution among parties. A common finding across many literatures is that the physical distance between two parties is a critical factor (Allen, Lee et al., 1980; Hamilton, Godfrey & Linge, 1979; Katz & Tushman, 1979). Distance reduces information transfer through its direct effect on transfer costs and by its association with other restricting factors (Mariotti & Piscitello, 1995). For example, distance may reduce the number of shared information links and so prevent receiving parties from checking the veracity of information through redundant sources (Lane & Bachman, 1996). Distance may also reduce the frequency of interaction and so reduce the propensity of parties to develop a reputation as a credible source (King, 1999). Empirically, numerous studies in various social settings have documented that information transfer decreases rapidly with increasing physical distance between two parties (Adams, 2002; Allen, Lee, & Tushman, 1980; Hamilton, Godfrey & Linge, 1979).

Given the propensity for physical distance to reduce information transfer and increase asymmetric information, we should expect suppliers to use certification to communication credibly with buyers when buyers are more physically distant.

> *H1a: The more distant an organization is from its buyers, the greater the propensity for the organization to certify with the ISO 14001 management standard.*

Aside from physical distance, social, cultural, and institutional distance can reduce information transfer and increase information asymmetries (Caves, 1982). One explanation is that a shared culture or belief system facilitates the processing of transferred information (Hofstede, 1980). Numerous studies have shown that cultural and physical distance increases the difficulty and cost of selecting and monitoring foreign suppliers (Buckley & Casson, 1979; Hamilton et al., 1979; Kogut & Singh, 1988). Such "liability of foreignness" is one of the central tenants of international business theory (Zaheer, McEvily & Perrone, 1998). Following this tradition, we argue that information asymmetries should be especially high in international supply relationships. As a result, organizations that are more likely to supply foreign buyers will be more likely to certify with a management standard.

> *H1b: The more an organization sells to foreign buyers, the greater the propensity for the organization to certify with the ISO 14001 management standard.*

Certification and Selection

In the above section, we hypothesize that certified management standards like ISO 14001 help resolve asymmetric information problems. We did not explore whether they resolve selection or monitoring problems. In this section, we develop hypotheses consistent with the use of certified management standards to reduce the selection problem, i.e., we consider the potential that buyers use certification to determine which organizations to use as suppliers. Recall that a selection problem occurs when buyers cannot observe underlying product or firm quality. Akerlof's market for lemons exemplifies how this situation can result in inefficient markets. To overcome this inefficiency, sellers (suppliers) may employ signals that allow buyers to differentiate high from low quality suppliers.

Because a certified management standard does not stipulate any outcome requirements (instead, it specifies a set of management practices), it can only provide a signal of superior organizational performance by causing organizations to act in ways that reveal what they know about themselves. It must entice high performing organizations to certify, while dissuading low performing ones from doing so. In his seminal contribution, Spence (1973) used the job market to provide an explanation for how such signaling might function. The idea is that high productivity workers (e.g., more motivated or intelligent people) choose to get a college degree not because they seek to learn something, but because they seek to differentiate themselves from those that choose not to get a degree. Because the cost of getting a degree (studying, writing papers, etc.) is less for high productivity workers than it is for low productivity ones, and assuming that employers are willing to pay a premium to the high productivity workers (once they can identify them), only high productivity workers will obtain a degree. In contrast, a low productivity worker will refrain from seeking a degree since the premium that could be obtained from having a diploma will be less than the cost of acquiring it.

To serve as a signal of superior performance, certification with a management standard like ISO 14001 must follow a similar logic. Specifically, the cost of certifying must be lower for high performing suppliers and buyers must be willing to pay a premium to high performing suppliers. With respect to the first requirement, there are many reasons for buyers to pay a premium to suppliers with higher environmental performance. Environmental problems at the supplier can cause supply disruptions. For example, "in 2001, a refinery fire in Illinois caused shortages lasting for weeks and forced the EPA to temporarily rescind reformulated gasoline requirements in the Chicago area (Slawsky, 2004)." Environmental problems at the supplying organization can damage the reputation of its supply chain partners. For example, it was concern about the practices of suppliers that damaged the reputation of Nike, Starkist, and Unilever (among many others) and caused these organizations to create management practices that their suppliers must follow. Finally, under U.S. CERCLA statutes, supply chain partners can be held responsible for improperly disposed toxic waste (Snir, 2001).

With respect to the second requirement, there are several reasons to believe that environmentally responsible organizations can certify at lower cost. Technical committees (like TC 207 for ISO 14001) seek to make it easier for high performing organizations to certify by designing the management standard so that it includes practices that have been found to improve organizational performance (Collins, 1996). The logic of such a design is that high performing organizations should have implemented some of the required practices and thus need to adopt fewer additional practices to obtain certification (Collins, 1996). Empirical research provides further evidence that certification cost are inversely related to performance (Naveh, Marcus, Allen, et al, 1999). For the ISO 9000 quality management standard (which is the older brother of ISO 14001 and served as a model for its design), Marquardt (1992) observes that certification costs depend on where you start. "If you've just won a Baldridge Award, registration of a plant or business may take you a few days. But if your quality system needs to be improved or created from the ground up the process can take as long as a year and cost $100,000 or more" (Marquardt, 1992: 51). In the case of ISO 14001, a survey found that a majority of respondents felt that leading organizations could certify with ISO 14001 more cheaply than environmental laggards (Ferrer et al, 2003).

The literature on business and environment adds a specific reason to believe that the cost of certification to ISO 14001 should be lower for high performing organizations. Scholars suggest that organizations are responding to environmental pressures in stages (OTA, 1986). They first ignore environmental problems, then perceive them to be a regulatory issue, and only later understand them as a source of strategic advantage (Hoffman, 1997; OTA, 1986). As an organization moves through these stages, its environmental (and potentially economic) performance improves because its response shifts from one emphasizing technical buffers to one emphasizing proactive environmental management (Russo & Fouts, 1997). These theories would suggest that organizations in the later stages of evolution (and thus with higher performance) will be more able to certify with environmental management standards. Bansal and Hunter (2003) indeed find that organizations with better environmental reputation (and presumably performance) were quicker to certify with ISO 14001 than those with lower performance, possibly due to relatively lower certification costs.

The above discussion suggests that some of the conditions are present that would allow certification with ISO 14001 to act as a signal of underlying organizational performance. Whether or not organizations use it in this way is an empirical question. Evidence to support or disconfirm such a signaling theory can best be found by evaluating whether high performing organizations tend to certify. No signaling equilibrium can exist in which low quality suppliers (or all suppliers) certify. If low performance suppliers certified, ISO 14001 would no longer convey superiority, and no supplier would certify because doing so would entail a cost with no benefit (recall that buyers are only willing to pay a premium to certified suppliers if the signal provides credible evidence of superior performance). Thus, if certified management standards act as a market signal, and if we observe any certification at all, we should expect higher performing organizations to have a greater tendency to certify.

H2: The higher the environmental performance of an organization, the greater the propensity for the organization to certify with the ISO 14001 management standard.

Certification and Monitoring

In the above discussion, we assumed that suppliers use certification with ISO 14001 to signal about underlying performance attributes, and that buyers use certification to identify better performing suppliers. The functioning of ISO 14001 as such a signal assumes that the attributes about which certification communicates are stable. It also assumes that buyers can easily switch suppliers and thus have a continuous need to identify high performing suppliers. In this section, we discuss how suppliers may use certification to provide buyers with credible information about performance improvements (rather than performance levels) in existing supply relationships.

Stakeholder-agency theory suggests that institutions for monitoring organizational behavior are needed when stakeholder interests are not aligned with the interests of agents (organizations), and when information asymmetries between stakeholders and agents prohibit direct observation of agents' activities (Hill & Jones, 1992). In the arena of environmental performance, incentives between suppliers and buyers may be misaligned, because some of the cost of poor supplier performance is borne by the buyer. As discussed in the previous section, environmental problems at the supplier can impose costs on buyers through supply disruptions and spill-over reputation damage (Reinhardt, 1997).

As a result of these conditions, buyers have an incentive to encourage suppliers to improve or maintain their environmental performance. Unfortunately, asymmetric information problems may prevent the buyer from providing effective incentives to suppliers. Because environmental improvement efforts usually involve internal processes and management procedures, buyers may be unable to observe actions at supplying organizations. Certification with ISO 14001 may partially resolve this monitoring problem by providing a mechanism for gaining credible evidence of a supplier's due diligence or performance improvements.

The need for monitoring a supplier increases the more the relationship between buyers and suppliers is ongoing. When buyers can easily switch to new suppliers, the selection problem (i.e., the problem of selecting high quality suppliers) is paramount and market pressures provide incentives to suppliers to improve and signal performance. When buyers cannot easily switch to new suppliers, however, buyers seek to motivate and monitor improvement efforts among ongoing suppliers.

Joskow (1988) demonstrated that partner specific specialized assets cause switching costs that determine the degree to which buyers and suppliers have an ongoing vertical relationship (Joskow, 1988; Williamson, 1985). Idiosyncratic firm and facility level differences may determine the extent of these costs. In many cases, however, industry level differences influence the degree organizations tend to have partner specific assets and thus the tendency for these organizations to have an ongoing relationship with supply chain partners (Maddigan, 1981). These industry specific effects have been shown to be both wide-ranging and tractable to measurement (Balakrishnan & Wernerfelt, 1986; Maddigan, 1981). When organizations in an industry tend to have ongoing relationships with their suppliers, and if buyers use ISO 14001 to solve monitoring problems among long term supply partners, we should expect:

> *H3: The more an organization is engaged in ongoing vertical relationships with its buyers, the greater the propensity for the organization to certify with the ISO 14001 management standard.*

Suggesting that a certified management standard can help solve a monitoring problem implies that certification will be associated with some desired organizational activity. In the case of ISO 14001, it seems likely that stakeholders are seeking to monitor the existence of environmental management systems (EMS) and that these systems improve environmental performance. Note that implementation and certification of an EMS are distinct concepts and may occur at different points in time. An EMS represents a set of procedures and guidelines that systemize and control an organization's environmental management process. ISO 14001 stipulates a particular form of an EMS. To be certified with ISO 14001, an organization must have a stated environmental policy, must determine and monitor the environmental impacts of its activities, must set environmental objectives and measurable targets, must monitor actions and take corrective actions where appropriate, and must continuously review this process. An organization could have all of these elements and choose not to certify, it could have all of these elements and choose to communicate their existence by certifying, or it might choose to adopt the elements it lacks in order to certify.

We theorize that certification with ISO 14001 provides a means of credibly communicating about the existence of a performance improving EMS. We are agnostic about whether certified organizations are informing supply chain partners about the existence of a previously adopted EMS, or whether they are adopting additional EMS activities in order to certify. To the extent that certification follows the former logic we should expect that the existence of an EMS is associated with performance improvement and that certification with ISO 14001 will simply reveal this. To the extent that certification follows the latter logic, we should expect to see that ISO 14001 certification itself is associated with performance improvement.

H4a: Adoption of an environmental management system will improve an organization's environmental performance.

H4b: Certification with the ISO 14001 management standard will improve an organization's environmental performance.

DATA & METHOD

We test our hypotheses by examining a sample of 8358 facilities (49413 observations) drawn from the population of U.S. manufacturing facilities from the year 1995 to 2001. Facility data were derived primarily from the U.S. EPA's Toxic Release Inventory (TRI) and Dun & Bradstreet's (D&B) directory of facilities. We also gathered industry-level data from the Bureau of Economic Analysis (BEA) and the Census Bureau of Foreign Trade. We gathered demographic information from the Internal Revenue Service (IRS) and the Census Department. Our sample is limited by the reporting requirements of the TRI. Facilities must report to the TRI if their manufacturing processes generate scrap above certain levels and if they have more than nine employees.

The most recent TRI data extends only to 2001, but data on ISO 14001 certification is available through 2002. Because certification with ISO 14001 did not begin in earnest until 1996, we limit our sample to the years from 1996 to 2002 for the dependent variables (1995 to 2001 for the independent variables) in evaluating the propensity of facilities to certify. In analyzing the effect of management practices and ISO certification on improvement, we extend the panel back to 1994 to allow at least a two-year pretest window.

Measures

Dependent variable. The primary dependent variable for our analysis is certification to the ISO 14001 environmental management standard. We gathered certification data from the QSU database of ISO 14001 certified facilities (QSU, 2002a). Certification occurs at the facility level. We coded *ISO 14001 Certification* as simply whether a facility is ISO 14001 certified during a particular annual period. *ISO 14001 Certification* takes a value of "1" for all certified facilities in a given year and "0" otherwise.

Independent variables. To test Hypothesis 1a, we measured the geographic distance from a facility to the nearest major buyer (*Distance to Buyers*). To calculate this distance, we first used TRI data to gather longitude and latitude information for each facility. We then used the BEA input-output tables to determine the major (largest percentage) buying industry for each selling industry. For each supplying facility (identified by its 4 digit SIC code), we then calculated the great circle distance (in miles) to the nearest member of this buying industry. We take the natural log of this measure to reduce its skew.[1] To test Hypothesis 1b, we created *Foreign Buyers*. This variable measures the degree to which facilities in an industry sell to buyers outside of the United States. It captures the percentage of all goods produced by members of an industry that are shipped to buyers outside of the U.S. We used Input-Output data from the BEA to create this variable.

To test Hypothesis 2, we calculated a facility's environmental performance using the King & Lenox (2000) method of estimated relative pollution among facilities in an industry. The method estimates the relationship between facility size and facility toxic waste generation in each 4-digit Standard Industry Classification (SIC) code and year.[2] We measured the

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[1] To ensure the robustness of this measure, we also calculated an alternative variable that measured the number of such buyers within a 50 mile radius of the facility. Analysis of using the natural log of this count variable confirmed the sign and significance of our results.

[2] For any four-digit SIC Code level, if there was an insufficient number of facilities to estimate the production function, we aggregated to the three-digit code. We were able to estimate production functions at the four-digit level for 99% of the facilities.

standardized residual, or deviation, between observed and predicted waste generation given the facility's size and industry sector.

$$ln(W_{it}) = \alpha_{jt} + \beta 1_{jt} \ln(s_{it}) + \beta 2_{jt} \ln(s_{it})^2 + \varepsilon_{jt} \quad (1)$$

$$\textit{Environmental Performance}_{it} = -\varepsilon_{jt} / \sigma_{jt} \quad (2)$$

where W_{it} is the toxicity weighted sum[3] of all Toxic Release Inventory waste generated by facility *i* in year *t*, s_{it} is facility size, and α_{jt} ,β_{1jt}, and β_{2jt} are the estimated coefficients for sector *j* in year *t*. Size is measured using the number of employees working at facility *i* in year *t*. We reversed the sign of the residual to reflect the fact that more waste than predicted for a facility represents lower environmental performance.

To test Hypothesis 3, we measured *Ongoing Vertical Relationship* as the likelihood that a facility is in a long-term relationship with its buyers. To create this variable, we adopted a method similar to that developed by Maddigan (1981) and Balakrishnan & Wernerfelt (1986). First, we used data from the BEA to identify pairs of supplying and buying industries. For each supplying industry in each pair, we then used the entire 1997 D&B database (500,000 facilities) to calculate the percentage of suppliers that was owned by a corporation that also owned a facility in the buying industry.[4] We then used shipment data from the BEA input-output tables to

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[3] To account for toxicity differences in facility waste generation, we weight the 246 toxic chemicals that have been consistently reported in the TRI by their toxicity using the threshold "reportable quantity" (RQ) for an accidental spill as required in the CERCLA statute (See King & Lenox, 2000). We then sum all of the toxicity-weighted was created by a facility to calculate the total waste generation for the facility.

[4] This ownership structure was updated for other years by tracking changes in ownership reported in the TRI.

weight this percentage.[5] We take the natural log of this weighted percentage value to reduce the skew of our final variable. Thus, the final value estimates the log percentage of any dollar produced by each industry (SIC code) that is shipped to a vertically integrated buyer. Previous research suggests that this industry level variable approximates well an industry's propensity to employ long-term contracts or have ongoing vertical relationships with buyers (Balakrishnan & Wernerfelt, 1986; Maddigan, 1981).

To test Hypothesis 4a, we measured the existence of an operating environmental management system by analyzing the reports of pollution reduction activity in the TRI (*EMS*). As part of their annual TRI submission, facilities report changes they have made to the production processes that could reduce waste or control pollution. The types of changes can be broken into two main categories: 1) technical modifications and 2) changes in the environmental management process. Facilities also report the sources of these technical changes. We coded *EMS* as a binary variable indicating whether or not these sources provided evidence of systematized environmental management practices. Sources of change that indicated evidence of an operating EMS are: (1) internal pollution prevention opportunity audits, (2) materials balance audits, (3) participative team management, (4) employee recommendations under a formal company program.

Control variables. Experience with related management standards has previously been shown to influence the tendency for an organization to certify with the ISO 14001 environmental management standard (King & Lenox, 2001). Previous experience may increase a facility's absorptive capacity with respect to management standards. This would allow adoption at lower

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5 Some supplying-buying industry pairs have greater interaction (according to dollar values shipped) then other pairs, and these differences must be captured to account more accurately for the supply chain relationships.

costs and thereby increase adoption propensities. To account for this tendency, we measured whether a facility participates in the Responsible Care Program. The Responsible Care Program is sponsored by the American Chemistry Council and, like ISO 14001, requires the establishment of environmental management practices. We captured program participation using a binary variable (*RC Member*) that indicates if that facility was owned by a firm that participated that year in the Responsible Care Program. We also created a binary variable (*ISO 9000 Certified)* that is coded such that a "1" indicates any year in which the facility is certified with the ISO 9000 quality management standard. ISO 14001 was modeled after ISO 9000, and the structural resemblance of the two standards may facilitate certification with ISO 14001 subsequent to certification with ISO 9000. We gathered ISO 9000 certification data from the ISO 9000 Registered Company Directory of North America (QSU, 2002b).

Supply chain pressures could influence the tendency of facilities to adopt environmental management practices and to certify. These supply pressures could emanate from both waste and product streams. More specifically, 'buyers' of waste may request their suppliers to adopt environmental practices and certify with ISO 14001 with the expectation that this would make the supplying facility's waste more predictable and less toxic, thereby facilitating waste treatment. To capture the pressures from waste stream partners, we created two binary variables. *Offsite Waste Transfer* indicates whether or not the facility transfers waste to an offsite waste processor that either recycles or treats the waste. *POTW Waste Transfer* measures the potential for regulatory pressure from Publicly Owned Treatment Works (POTW). To create the measure, we determined if the facility sent any waste material to a POTW in each year. A value of "1" indicates evidence of a physical connection to the POTW. To capture the pressures emanating from product supply streams, we created *Auto Supplier*, which is a binary variable that indicates whether or not the facility sells products to automobile assemblers. Ford, GM, and Toyota have all announced that they will give preference to ISO 14001 certified facilities.

Regulatory and stakeholder pressures could also influence the propensity to certify with ISO 14001. To account for these, we created several other control variables. *Industry Waste Generated* measures the degree to which an industry generates toxic waste (and thus is likely to be the target of regulation and stakeholder pressure). It is measured as the mean of the natural log of the toxicity weighted waste generation for all facilities within each 4-digit SIC code. *Regulatory Pressure* measures the stringency of state-level environmental regulation. It is constructed using a measure devised by Meyer (1995) based on the logged aggregate emissions per state over the sum of the Gross State Product in four polluting sectors (chemicals, pulp & paper, textiles, and petroleum products). Research has also shown that local stakeholder pressure is related to the affluence of the surrounding community (Walsh, Rex, & Smith, 1993). To measures the *Affluence* of citizens in the area surrounding a facility, we calculated the annual average local income using IRS data on the 5-digit zip code area. Scholars have argued that the Responsible Care initiative could reduce stakeholder pressure on an industry by reducing the likelihood of regulatory action. To control for this potential effect we also measured the annual percentage of the facilities in the industry (*RC Industry*) that participate in the Responsible Care initiative.

Finally, a number of firm and facility attributes could influence a facility's decision to certify. A facility's size could influence the availability of resources and thus its propensity to adopt an environmental management system or certify with ISO 14001. We measure *Facility Size* as the normalized (by industry and year) log of the number of employees at that facility. Foreign ownership could also influence the propensity for certification. Foreign parents may use certification as a means to monitor their overseas facilities. Foreign parents may also require certification of their international facilities in an attempt to standardized practices across facilities. We created a binary variable that measures whether a U.S. facility is owned by a foreign parent (*Foreign Owned*). Foreign ownership was determined using D&B's Who-Owns-Whom dataset. In some cases, the database did not list a nationality. For these, we individually verified the nationality of the ultimate parent. We coded the variable *Foreign Owned* to be "1" if the ultimate parent firm is non-U.S. owned, "0" if it is U.S. owned. Common corporate ownership of buyers and suppliers could influence the propensity for certification since vertical integration can reduce market incentives and thereby increase the need for monitoring. Alternatively, common ownership may facilitate information transfer between supplier and buyer, thereby reducing the need for certification. We created a binary variable, *Vertically-Integrated Buyer*, to capture these potential effects. The variable takes on a value of "1" if at least one potential buyer of the facility's output (as determined by the BEA input-output tables) has the same corporate parent as the facility. Finally, *Firm Size* measures the annual count of the number of facilities owned by the target facility's parent. The count is logged to reduce the skew of the distribution.

Table 1 summarizes our measures and provides the pair wise correlation between variables.

Insert Table 1 about here

Method

Our analysis requires evaluation of a facility's propensity to certify with the ISO 14001 standard. It also requires that we evaluate the effect of environmental management practices.

For the first analysis, we use a discrete time random effect logistic model. For each facility, we predict certification with ISO 14001. As soon as a facility is certified, we no longer consider it in our sample, as it is no longer at risk to certify. The model is specified as:

$$P_{it+1} = F(Z) = F(a_i + \mathbf{bX}_{it}) = e^{(Z_{it})}/(1 + e^{(Z_{it})})$$

where P is the probability that facility i will certify with ISO 14001 in the next year (t+1). The vector $\mathbf{X}_{it}$ represents the characteristics of the i^{th} facility in year t. The facility random effects are measured as a_i. We use a random, rather than a fixed effect specification because the fixed effect model would disregard all observations that do not certify with ISO 14001 within our panel. Furthermore, a fixed effect specification would prohibit the interpretation of any variables with values that do not vary across groups (or time). To investigate the robustness of our model specification, we also employed a maximum likelihood proportional hazard model (with an exponential base-line hazard) and a Cox's non-parametric partial-likelihood estimation procedure. The Cox estimation is inefficient, but does not require specification of a particular functional form of the base line hazard. These robustness checks generate results that confirm the reported ones in coefficient sign and significance.

Our model includes a potential selection problem. It is possible that some unobserved disturbance causes both the decision to adopt an EMS and to certify with ISO 14001. For example, organizations with a particular culture or leadership might tend to adopt both. Even if EMS is included in a second stage regression, this disturbance term will tend to bias coefficient estimation. Unfortunately, solving this problem in a logistical regression analysis of panel data is on the frontier of statistical knowledge. For all but a few cases of simple attrition, correcting for selection in panels longer than two periods remains impractical (Honore & Kyriazidou, 2000; Kyriazidou, 2001).

To address the selection problem, we therefore chose to shrink the panel to a cross section to eliminate the panel analysis problem and to allow use of estimation techniques with normally distributed disturbance terms. We use the approach developed by van de Ven and van Praag (1981) which specifies a selection model (adoption of an EMS) and a probit model (certification with ISO 14001).

$$\text{Prob(ISO=1)} = \text{prob}(\mathbf{B}\mathbf{x}_i + \upsilon_{1i} > 0) \quad (4)$$

$$\text{Prob(EMS=1)}=\text{prob}(\mathbf{Z}\mathbf{x}_i + \upsilon_{2i} >0) \quad (5)$$

where **B** & **Z** are separate coefficient vectors and $\mathbf{x}_i$ is our set of explanatory variables. The two disturbance terms υ_{1i} and υ_{2i} are assumed to be bivariate normally distributed but correlated ρ. Using methods developed by Heckman (1979) and van de Ven and van Praag (1981), both the coefficients and this correlation can be calculated either through a two stage procedure or through a single maximum likelihood estimation. We employ the second approach.

Finally, we use a differences-in-differences approach to analyze the effect of environmental management systems on environmental performance. This approach vastly reduces the propensity for unobserved organizational attributes to bias estimates and cause spurious findings. Specifically, we estimate:

$$y_i\,(t+1) = \mathbf{B}[y_i(t),\mathbf{x}_i(t)] + \delta_i + \varepsilon_i \quad (6)$$

where *i* index the facilities, y_i is the facilit*y*'s environmental performance, **B** is a vector of estimated coefficients, $\mathbf{x}_i$ is a vector of measured facility level attributes, δ_i is dummy variable capturing unmeasured facility fixed attributes, and ε_i is the error term. Because of the lagged independent variable, this formulation is prone to autocorrelation. We use a method developed by Anderson and Hsiao (1982) to correct for this potential problem.

Our sample is a large one and this can cause an inflated tendency to reject the Null hypothesis. Previous research using large samples has tended to correct for this by reporting significance only for $p < 0.01$ and $p < 0.001$.

ANALYSIS & RESULTS

Analysis of Certification

Table 2 presents the first part of our analysis of the causes of certification with the ISO 14001 environmental management standard. Model 1 presents estimates for a baseline specification that includes only our control variables. The estimates suggest that the propensity to certify with ISO 14001 is greater in the presence of related practices (*ISO 9000 Certified*), supply chain pressures (*POTW Waste Transfer, Auto Supplie*r), and larger facility and firm size. Interestingly, *RC Industry* is associated with a lower propensity to certify, suggesting that a high degree of participation in Responsible Care among firms in an industry may reduce the need for ISO 14001 certification. Furthermore, facilities that have foreign parents (*Foreign Owned)* are more likely to certify with ISO 14001. We also find that vertical integration between a facility and its buyers (*Vertically-Integrated Buyer*) increases the propensity to certify. Finally, facilities with existing environmental management systems (*EMS*) are more likely to certify, presumably to take credit for previously pursued activities. (Note that we include *EMS* as a control variable in Table 2. *EMS* will become an independent variable as we test Hypothesis 4a).

In Model 2, we add our measures capturing the likelihood of information asymmetries and the need for signaling and monitoring. The addition of these independent variables in Model 2 provides a significant increase in the explanatory power over the base case (as indicated by a significant incremental χ^2 test). Coefficients estimated in Model 2 support Hypotheses 1a, 1b, and 3. Consistent with H1a, we find that the propensity for a facility to certify with ISO 14001 increases with greater distance between the facility and its buyers. Consistent with H1b, we find that a facility's propensity for certification increases with the tendency of the industry to export to foreign buyers[6]. Taken together, these results suggest that certification with ISO 14001 is more likely if information asymmetries in the supply chain are high, thereby supporting our proposition that facilities use certification to reduce asymmetric information with buyers.

Insert Table 2 about here

Turning now to whether facilities use ISO 14001 to help resolve problems of asymmetric information in selection or monitoring, we find support only for the monitoring hypothesis. We find no significant evidence that superior environmental performance (i.e., relative facility waste generation) positively influences certification propensities. Thus, we have no evidence that ISO 14001 is operating as a signaling mechanism. We do find consistent evidence that ISO 14001 certification may act as a monitoring device. With respect to Hypothesis 3, we find that the coefficient for *Ongoing Vertical Relationship* is positive and strongly significant, suggesting that the greater the likelihood that a facility is in an ongoing vertical relationship with its buyers, the higher the propensity for ISO 14001 certification.

Interestingly, our analysis provides hints that asymmetric information between corporate parents and local facilities may also be an important driver of certification. Throughout our analysis, we find evidence that foreign owned facilities are more likely to certify with ISO

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6 To ensure that this effect was not caused by exports to particularly environmentally sensitive regions, we investigated the effect of exports to different regions. We could find no evidence that exports to Europe, Australia, Asia, or Central America had a different effect on certification than exports to North America (Canada and Mexico).

14001. Information asymmetries between foreign parents and domestic facilities may have caused facility managers to seek certification in order to signal to corporate parents about their management abilities. We also find that *Vertically-Integrated Buyer* – one of our control variables - consistently and significantly increase certification propensities. This suggests that suppliers that are vertically integrated (i.e., commonly owned) with their buyers are more likely to certify with ISO 14001. This finding lends further support to Hypothesis 3. It suggests that the move towards integrated governance structures (like long term contracts as hypothesized in H3 or hierarchy as captured by this control variable) is associated with greater monitoring needs (due to higher switching costs and lack of market incentives), thereby triggering certification.

To explore the potential for confounding unobserved industry effects, we include two-digit SIC code fixed-effects in Model 3. Our results are consistent with Model 2. With the exception of *Foreign Buyer*, the coefficients for the variables of concern remain significant at a minimum of $p<0.01$. The inclusion of industry fixed-effects does reduce the significance of *Foreign Buyer* but does not change the coefficient estimate. Since *Foreign Buyer* is an industry level variable (calculated on the 4-digit SIC code level), co-linearity with industry fixed-effects may cause its significance to drop if the variable varies little across two-digit SIC codes. Note that an incremental χ^2 test suggests that the inclusion of industry fixed-effects does not improve model fit, suggesting that we have no evidence of other unobserved industry effects – at least as captured at the two digit SIC code.

Separating Adoption and Certification

Similar industry and organizational attributes might determine the propensity both to adopt environmental management practices (systems) and to certify with ISO 14001. If we fail to capture in our right hand side variables some factors that explain both adoption and certification, our analysis of the causes of certification could be biased. To account for these missing factors and correct this problem, we perform a two-stage estimation. In the first stage, we estimate the facility and industry attributes that are associated with a higher propensity to have an environmental management system (EMS) in place.[7] In the second stage, we estimate which facilities are likely to certify with ISO 14001. This method also has the appealing property that it allows us to analyze the factors that cause adoption of EMS practices and compare these factors with those that cause certification.

As explained in the methods section above, this two-stage estimate requires us to collapse our data into a cross-section so that we can use a probit specification. To check that such conversion from a panel to a cross-section does not change our results, we first estimate a model similarly to Model 3 (in Table 2) using our collapsed panel. We report the results of this Model (Model 4) in Table 3. Note that because some facilities enter the panel after 1996, collapsing the panel reduces our data set to 7899 facilities. The estimates from our probit model in Model 4 are similar in direction and significance to those in Model 3 in Table 2. We continue to find a significant positive effect for *Distance to Buyer*, *Foreign Buyer*, *Ongoing Vertical Relationship*, *Vertically-Integrate Buyer,* and *EMS*. Our estimate for *Environmental Performance* remains negative and is now significant at the $p < 0.01$ level.

Insert Table 3 about here

We present the results of our two-stage analysis in Model 5 in Table 3. The first column

[7] We use the idea of stages for expository convenience. In the actual analysis the two stages are calculated simultaneously using a maximum likelihood estimator.

reports the likelihood that a facility will have an EMS. The estimates from this "selection model" are then used to correct for potential unobserved attributes that might bias our estimates in the second stage probit model. Due to the particular structure of this technique, the second stage estimates reported in Model 5 for ISO 14001 certification are based only on data from those facilities that had an EMS prior to 1996 (reducing our sample to 3300 facilities). An alternative specification using only those that did not have such an EMS delivered similar results.

Estimates from this model (see the far right column in Table 3) confirm the findings presented in Table 2. We again find support for both H1a and H1b – facilities with more distant and more foreign buyers are more likely to certify. We again find support for our hypothesis that certification will be higher for facilities in industries with ongoing vertical relationships with buyers (H3). Finally, we find strong evidence to disconfirm Hypothesis 2 – facilities with lower (not higher) environmental performance are more likely to certify.

Our two-stage approach allows us to differentiate the sources of EMS adoption from the causes of certification. Comparing the two columns of Model 5, some important differences appear. In general, we find that technical, regulatory, and experience differences explained differences in the tendency to have an EMS. In contrast, factors influencing the need for communication with buyers about improvement efforts influenced certification.

Specifically, as shown in Table 3 column 2, technical and regulatory differences strongly influence EMS adoption (but less so certification with ISO 14001). *Regulatory Pressure* and *Industry Waste Generation* have a significant effect on implementing an EMS. Likewise, facilities that transfer waste to public or private outside processors (*Offsite Waste Transfer, POTW Waste Transfer*) tend to have an EMS. This pattern of results seems to suggest that facilities facing greater demand from regulators or waste handling stakeholders tend to adopt an EMS. This may suggest greater ability among these stakeholders to directly monitor EMS activities and environmental performance. In contrast, only *Offsite Waste Transfer* has a significant effect on ISO 14001 certification. Unlike in Model 3, *POTW Waste Transfer* is no longer significant, suggesting that the results found in Table 2 may have been confounded by an unobserved EMS selection problem.

Consistent with previous studies (King & Lenox, 2001), we find that ISO 9000 certification is associated with the adoption of environmental practices – in this case a functioning EMS. We also find evidence that *Responsible Care Participants* are more likely to have an operating EMS, but can find no evidence that these facilities have a higher propensity to certify with ISO 14001. This seems to suggest that participants in the Responsible Care program are indeed implementing some of the associated environmental management practices. However, we find evidence that facilities in industries with many RC participants have a lower propensity to certify with ISO 14001 -- suggesting that conflicts or substitution exist between the two programs.

Our results suggest that organizations with lower relative environmental performance are more likely to implement an EMS. The implementation of a formal management system may reflect a desire to catch up among industry laggards. Interestingly, we find that suppliers that tend to have *ongoing vertical relationships* with their buyers are less likely to adopt an EMS. This is consistent with our hypothesis that without a credible means of monitoring actions at suppliers, buyers have difficulty encouraging real investments in performance improvement. Our other independent variables (*Distance to Buyers, Foreign Buyer*, and *Vertically Integrated Buyer*) have no significant effect on adopting an EMS.

Performance Improvement Analysis

We can now turn to testing our final hypotheses in support of a theory that ISO 14001 allows buyers to monitor improvement efforts at suppliers. To analyze whether EMS adoption or ISO certification is associated with improvement (H4a and H4b), we specify a cross sectional time series regression predicting waste generation in the next year (see Model 6 in Table 4). We include facility and year fixed effects to control for underlying facility heterogeneity and time effects. Because we also control for this year's waste generation, this model represents a form of the highly conservative and robust differences-in-differences approach. We also include a log count of the number of non-management source reduction changes reported for each facility (*Pollution Reduction Activity*). This variable uses TRI information.[8] To ensure robustness, it was coded in three different ways: 1) as a binary variable, 2) as a count variable, and 3) as a log count variable. The reported results use the last formulation but the sign and significance of the reported results are robust to all formulations. Including this variable helps to ensure that our measure of EMS does not simply reflect change activities.

We find that the existence of an EMS in year t is associated with significant increases in environmental performance in year t+1 (H4a). With respect to Hypothesis 4b, we do not find significant evidence that certification is associated with such improvement. The coefficient for ISO 14001 certification is significant at only the $p<0.05$ level. In a sample of this size, such a finding must be viewed with great caution. Thus, we have strong support that adoption of an

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[8] Source of change that indicated technological change activity included external pollution prevention opportunity audits, employee recommendations independent of a formal company program, state and federal government technical assistance programs, trade association/industry technical assistance programs, and vendor assistance.

EMS provides evidence of improvement, but we do not find evidence that certification itself is associated with improvement.

Insert Table 4 about here

This lack of evidence may suggest that ISO certification does not itself cause improvement but merely provides credible evidence of an underlying and possibly pre-existing EMS that causes improvement. We should be careful, however, not to commit a type-II error and confuse a lack of a finding with disconfirming evidence. The short timeframe over which most organizations have been certified makes it very difficult to estimate ISO 14001 generated improvements. For now, all we can say is that a facility's certification with ISO 14001 is associated with having an EMS (both logically and statistically), and having an EMS is itself related to improvement.

DISCUSSION

In summary, we find evidence that organizations certify with ISO 14001 to reduce information asymmetries with supply chain partners. In particular, we find that geographically and culturally remote suppliers are more likely to seek certification. We do not find evidence that certification serves as a signal of superior environmental performance. Rather, our findings suggest that suppliers use certification to communicate about environmental improvement efforts. Specifically, we find that in the face of high switching costs and in the absence of market incentives - aspects that are inherent in more integrated governance structures like long term contracts or vertical integration – certification may serve to fulfill the greater need for monitoring supplier behavior.

Our results are robust to a large number of controls and specifications. We attempt to control for unobserved heterogeneity by including industry and year fixed-effects. We utilize a two-stage selection model to address potential concerns about self-selection. While we only investigate one certified management standard, our sample covers a wide number of industries, which gives us greater confidence in the external validity of our findings.

Despite our conservative approach to our analysis and our robustness tests there are reasons to interpret our findings cautiously. Scale and chemical emission thresholds for reporting to the Toxic Release Inventory could cause a potential sample selection problem. Our sample may fail to pick up facilities with superior environmental performance that are not required to report to the TRI. We have investigated this problem statistically and believe our results to be robust. Nevertheless, we believe care should be exercised in extrapolating our findings to predict the behavior of firms of all sizes and industries.

Another potential confound is that we measure the existence of an EMS through a facility's report on pollution reduction activities. This could cause a measurement error for facilities that have an environmental management system in place but do not routinely make changes to production processes or that have made a number of pollution reducing improvements in the past and no longer have the need to further reduce pollution levels. Fortunately, the effect of this bias should be conservative, because it should make it harder to find a relationship between adoption of an EMS and improvements in environmental performance.

Finally, ISO 14001 is still in its relatively early stages of diffusion. As the standard diffuses and more facilities seek certification, the profile of those seeking certification may change. In particular, as the number of ISO 14001 certifications rises, the pressure on non-certifiers to certify will likely increase. As these pressures increase, the marginal costs and benefits will shift such that organizations that face relatively low information asymmetries may seek certification. While this does not contradict our fundamental thesis that the desire to monitor and communicate about behavior is driving certification decisions, it suggests caution in extrapolating our analysis to all temporal periods of the adoption process.

CONCLUSION

In this article, we explore the drivers of ISO 14001 certification and we answer specific questions about how this certified management standards may function. We theorize that certification with ISO 14001 provides one way of reducing asymmetric information. We develop hypotheses for when organizations will use certification to communicate credible information to supply chain partners. We then explore what kind of information is conveyed by certification.

Our findings suggest that organizations certify with ISO 14001 to overcome problems of asymmetric information. We find that certification does not provide evidence of superior organizational performance (as expected by many of its creators). Instead, we find evidence that suppliers use certification to communicate improvement efforts to long-term supply chain partners (buyers).

Our research should not be interpreted to support an overly simplified functionalist notion of the ISO 14001 standard. Evidence suggests that many of the framers of this new standard expected it to serve a different social purpose than it came to have. Many expected ISO 14001 to provide a means of credibly differentiating organizations with better environmental performance (Mazza, 1996). Our analysis suggests that this expectation went unfulfilled. Yet it also suggests that the standard came to play an alternative functional role.

Our research emphasizes a fundamental paradox in the design of certified management standards like ISO 14001. It suggests that standards that include beneficial practices may seldom act as a market signal. For a certified management standard to be useful as a market signal, high performing organizations must benefit from certification, while low performers must not. If low performers gain significant operational benefits from certifying, this condition will not hold. Moreover, if supply chain partners target their incentives to organizations where improvement can most easily be achieved, they may tend to encourage the worst performers to adopt and certify. Thus, our research suggests that the more an environmental management standard provides direct operational benefits, the less likely it will provide a means of signaling superior performance.

Our findings suggest avenues for future research. First, our analysis suggests the need for additional consideration of the design of management standards. In future research, we hope to analyze other attributes that cause standards to function either as a tool for improvement or as a means to signal. Second, future research could extend our analysis to other stakeholder relations. Our study focused on the potential of management standards to address problems of asymmetric information within supply chains but provides hints that management standards may also play a critical role in reducing information asymmetries within firms. We found that facilities in larger corporations and those that were foreign owned tended to certify with ISO 14001. This may suggest that managers use certification as a signal in the market for corporate resources, or that corporate parents employ certification as a means to monitor their facilities. Future research should assess how certified management standards are used within firms, and whether internal use alters their function.

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TABLE 1a
Descriptive Statistics

Variable	Description	Mean	Std Dev	Min	Max
Distance to Buyers	Log of geographic distance to nearest buyer	2.23	1.29	0	6.22
Foreign Buyers	Log percent of industry production shipped to buyers outside the U.S.	1.42	0.75	0	4.06
Environmental Performance	King & Lenox (2000) measure of environmental performance	-0.06	0.98	-4.34	4.08
Ongoing Vertical Relationship	Log of industry percentage of suppliers with vertically integrated buyers.	0.37	0.34	0	2.39
$EMS_{(t-1)}$	Binary variable indicating existence of an environmental management system	0.46	0.50	0	1
Responsible Care Participant	Binary variable indicating facility owned by a member of Resp. Care	0.09	0.29	0	1
ISO 9000 Certified	Binary variable indicating ISO 9001 certification	0.25	0.43	0	1
Offsite Waste Transfer	Binary variable indicating the facility transfers waste offsite (not to POTW).	0.83	0.37	0	1
POTW Waste Transfer	Binary variable indicating a facility is connected to public water treatment	0.34	0.47	0	1
Auto Supplier	Binary variable indicating facility supplies the automotive industry	0.06	0.24	0	1
Industry Waste Generation	Log average total waste generation for sector in which the facility operates	4.84	1.46	1.15	11.89
Regulatory Pressure	The regulatory stringency of the facility's state.	0.13	0.02	0.11	0.21
Affluence	Average family income within the facility's zip code.	10.2	0.28	6.16	13.11
RC Industry	Percentage of facilities in industry that are owned by RC members.	0.09	0.12	0	0.67
Facility Size	Natural log of facility employees. (normalized by industry and year)	0.07	0.95	-4.79	5.73
Foreign Owned	Binary variable indicating that a facility is foreign owned	0.04	0.20	0	1
Vertically-Integrated Buyer	Binary variable indicating a potential buyer shares the same corporate parent	0.58	0.49	0	1
Firm Size	Count of firm facilities	1.49	1.43	0	5.32

n = 49413

TABLE 1b
Descriptive Statistics: Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Distance to Buyers	1.00																	
2. Foreign Buyers	0.00	1.00																
3. Environmental Performance	-0.01	0.00	1.00															
4. Ongoing Vertical Relationship	-0.05	0.26	0.01	1.00														
5. $EMS_{(t-1)}$	0.01	0.11	-0.11	0.02	1.00													
6. Responsible Care Participant	-0.04	0.13	-0.04	0.15	0.14	1.00												
7. ISO 9000 Certified	0.01	0.17	-0.04	0.09	0.11	0.12	1.00											
8. Offsite Waste Transfer	-0.02	0.01	-0.17	-0.04	0.13	0.03	0.10	1.00										
9. POTW Waste Transfer	-0.03	0.06	-0.05	0.02	0.12	0.02	0.09	0.32	1.00									
10. Auto Supplier	0.09	0.12	-0.01	-0.03	0.02	-0.06	0.03	0.05	0.06	1.00								
11. Industry Waste Generation	0.00	0.21	0.02	0.46	0.13	0.24	0.03	0.04	0.04	0.00	1.00							
12. Regulatory Pressure	-0.16	-0.07	0.05	-0.05	0.01	-0.05	-0.01	0.06	0.05	-0.04	-0.09	1.00						
13. Affluence	-0.12	0.04	0.01	-0.03	0.04	0.02	0.04	0.05	0.04	0.00	-0.02	0.15	1.00					
14. RC Industry	-0.07	0.29	0.00	0.33	0.13	0.44	0.07	-0.02	0.01	-0.13	0.55	-0.09	0.02	1.00				
15. Facility Size	0.03	0.01	0.00	0.00	0.16	0.12	0.16	0.14	0.13	0.00	0.00	-0.04	0.04	0.00	1.00			
16 .Foreign Owned	-0.02	0.04	-0.02	0.03	0.06	0.05	0.04	0.05	0.01	-0.02	0.06	-0.02	0.05	0.20	0.04	1.00		
17. Vertically-Integrated Buyer	0.07	0.20	-0.07	0.15	0.12	0.23	0.16	0.10	0.06	0.08	0.14	-0.11	0.00	0.15	0.21	0.12	1.00	
18. Firm Size	0.06	0.17	-0.06	0.15	0.14	0.34	0.13	0.09	0.07	0.10	0.18	-0.13	-0.01	0.21	0.22	0.14	0.58	1.00

n = 49413

TABLE 2. Predicting Certification with ISO 14001, 1996-2002
(Discrete Time Random Effect Logistic Model)

	Model 1		Model 2		Model 3	
Distance to Buyer			0.09	*	0.08	*
			(0.03)		(0.03)	
Foreign Buyer			0.19	*	0.15	
			(0.06)		(0.07)	
Environmental Performance			-0.09		-0.09	
			(0.04)		(0.04)	
Ongoing Vert. Relationship			0.51	**	0.66	**
			(0.13)		(0.14)	
$EMS_{(t-1)}$	0.33	**	0.32	**	0.31	**
	(0.09)		(0.09)		(0.09)	
Responsible Care Participant	-0.29		-0.26		-0.27	
	(0.16)		(0.17)		(0.17)	
ISO 9000 Certified	0.80	**	0.72	**	0.72	**
	(0.08)		(0.09)		(0.09)	
Offsite Waste Transfer	0.29		0.30		0.36	
	(0.17)		(0.17)		(0.18)	
POTW Waste Transfer	0.28	*	0.27	*	0.27	*
	(0.09)		(0.09)		(0.09)	
Auto Supplier	1.45	**	1.42	**	1.41	**
	(0.10)		(0.11)		(0.22)	
Industry Waste Generation	0.03		-0.02		0.01	
	(0.03)		(0.04)		(0.04)	
Regulatory Pressure	-4.11		-2.33		-2.27	
	(2.99)		(3.03)		(3.07)	
Affluence	0.09		0.16		0.15	
	(0.15)		(0.15)		(0.16)	
RC Industry	-2.57	**	-2.87	**	-3.09	**
	(0.53)		(0.54)		(0.61)	
Facility Size	0.36	**	0.38	**	0.38	**
	(0.05)		(0.05)		(0.05)	
Foreign Owned	0.65	**	0.72	**	0.66	**
	(0.17)		(0.17)		(0.17)	
Vertically-Integrated Buyer	0.48	**	0.42	**	0.41	**
	(0.12)		(0.12)		(0.12)	
Firm Size	0.19	**	0.18	**	0.18	**
	(0.03)		(0.03)		(0.03)	
Constant	-5.50	**	-6.74	**	-6.89	**
	(1.54)		(1.59)		(1.62)	
Year Dummies	included		included		included	
Industry Dummies					included	
Log Likelihood	-2756.15		-2736.62		-2727.86	
Δ Chi square	-		39.07 (4)^{oo}		17.51 (13)	
(Nested Comparison Model)	(constant)		(Model 1)		(Model 2)	

Number of facilities = 8358; Number of observations = 49413
** $p < 0.001$; * $p < 0.01$; ^{oo} Change in Chi square significant at $p<0.01$

TABLE 3. Predicting Certification with ISO 14001, 1995 cross section
(Probit and Heckman Corrected Probit Models)

	Model 4		Model 5			
	ISO 14001 Certification		EMS (Selection)		ISO 14001 Certification	
Distance to Buyer	0.06	**	0.01		0.07	*
	(0.02)		(0.06)		(0.03)	
Foreign Buyer	0.12	*	0.06		0.21	**
	(0.04)		(0.07)		(0.07)	
Environmental Performance	-0.10	**	-0.15	**	-0.17	**
	(0.02)		(0.02)		(0.04)	
Ongoing Vertical Relationship	0.34	**	-0.14	*	0.34	*
	(0.08)		(0.06)		(0.12)	
$EMS_{(t-1)}$	0.15	*				
	(0.05)					
Responsible Care Participant	-0.12		0.21	**	-0.07	
	(0.09)		(0.06)		(0.13)	
ISO 9000 Certified	0.11		0.17	**	0.17	
	(0.07)		(0.05)		(0.09)	
Offsite Waste Transfer	0.24	**	0.24	**	0.43	*
	(0.08)		(0.04)		(0.14)	
POTW Waste Transfer	0.13	*	0.16	**	-0.07	
	(0.05)		(0.03)		(0.07)	
Auto Supplier	0.85	**	-0.22		0.99	**
	(0.14)		(0.11)		(0.18)	
Industry Waste Generation	0.03		0.14	**	0.04	
	(0.02)		(0.02)		(0.04)	
Regulatory Pressure	-0.49		3.97	**	0.23	
	(1.63)		(1.00)		(2.25)	
Affluence	0.10		0.06		0.09	
	(0.08)		(0.06)		(0.12)	
RC Industry	-1.40	*	-0.52		-1.62	*
	(0.32)		(0.20)		(0.44)	
Facility Size	0.19	**	0.17	**	0.20	*
	(0.03)		(0.02)		(0.04)	
Foreign Owned	0.31	*	0.06		0.25	
	(0.10)		(0.07)		(0.14)	
Vertically-Integrated Buyer	0.20	*	0.03		0.26	*
	(0.07)		(0.04)		(0.10)	
Firm Size	0.08	**	0.05	**	0.06	*
	(0.02)		(0.01)		(0.03)	
Industry Dummies	included		included		included	
Observations	7899		7899		3300	
Rho[9]					0.08	
Chi Square	629.85	**			297.50	**

** $p<0.001$, * $p< 0.01$, + SIC 22 and SIC 39 removed because perfectly predicts no ISO certification

9 *Rho* is the correlation between the disturbance terms in the selection and certification models. That this correlation is not statistically significant does not preclude the potential for biased estimates in uncorrected analyses.

TABLE 4. Predicting Environmental Performance, 1995-2002
(Fixed-Effects Specification)

	Model 6	
$EMS_{(t-1)}$	0.04	*
	(0.01)	
ISO 14000 $Certification_{(t-1)}$	0.03	
	(0.02)	
Environmental Performance $_{(t-1)}$	-0.35	**
	(0.00)	
Pollution Reduction Activity $_{(t-1)}$	-0.02	
	(0.01)	
Year Dummies	included	
Facility Dummies	included	
N	54138	
Facilities	10080	
F-stat	662.05	**

** $p<0.001$, * $p<0.01$

Participation in Voluntary Programs,

Corporate Reputation, and Intangible Value:

Estimating the Value of Participating in EPA's ENERGYSTAR® Program

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Abstract

This paper estimates the market value of the ENERGYSTAR® Buildings program to companies that participate in the program and the market value associated with energy efficiency in general. To do this, we specify econometric models of the relationship between intangible value, as measured by Tobin's *q*, and participation in the ENERGYSTAR® Buildings program. As part of our modeling effort, we also attempt to control the influence of two unobservable factors: corporate reputation and a company's "inherent" energy efficiency. We use data on 124 Real Estate Investment Trust (REITs) measured quarterly from 1999 to 2001. Our results indicate ENERGYSTAR® partnership results in a return of $16,026 per million dollars in assets owned, compared to not being a partner. This return represented 3.66 percent of the market value of these companies. Additionally, our models indicate that energy efficient REITs earn a return of $45,564 per million dollars of assets owned above less energy efficient REITs. The return for energy efficiency represented 10.4 percent of the market value of these companies. Finally, we estimate the "lost opportunity" of not joining the ENERGYSTAR® Buildings program (i.e., the value non-participants would have earned if they had joined). In the sample of REITs, 121 were not a partner for at least one quarter. Of these 121, 50 would have been better off as an ENERGYSTAR® partner at some point during the sample period. Of these 50, 20 of them would have been better off for the entire sample period. Furthermore, the lost value from not joining represented close to 10 percent of the asset value of these companies.

1. Introduction

In the past decade voluntary environmental programs have been increasingly utilized as a public policy tool because they provide greater flexibility than traditional command-and-control regulations and they enable public agencies such as the U.S. EPA to influence corporate decision-making in areas where they do not have a statutory mandate. One of the key challenges facing voluntary environmental programs is how to quantify the program's value to participants. In this paper, we develop a model that relates participation in the EPA ENERGYSTAR® Buildings Program to Tobin's *q*, a measure of corporate intangible value. We develop statistical models to explore this relationship and then estimate the value of the ENERGYSTAR® program to participants and the market value of energy efficiency in general.

The lack of evidence that a link in fact exists between participation and firm financial performance affects program recruitment efforts. By definition, voluntary programs rely on firms to make commitments to join the program. Although some companies may join voluntary environmental programs out of altruistic reasons, reliance on such altruism is not a viable strategy to increase and maintain program membership. Most companies will require some benefit to participation, whether it be tangible or intangible. Without some benefit, managers of public companies may be violating their fiduciary responsibility to shareholders if the programs result in significant cost for the companies. Prior evaluations of voluntary programs have cited "reputational value" as one of the key benefits reported by program participants (e.g., Wells, 2000; Reed, 2001). Still other studies have noted that public perception, a key component of reputation, has a significant influence on the decision to join voluntary programs (Khanna and Damon, 1999; Videras and Alberini, 2000; Arora and Cason, 1995, 1996). Companies report that they are able to translate their participation in such programs—and any associated public recognition—into an enhanced corporate reputation, which has a real (albeit intangible) value to them (Wells, 2000).

Public programs such as ENERGYSTAR® now operate in a period of increased emphasis on accountability. Voluntary programs can no longer rely on numbers of participants as a measure of success, but must now demonstrate positive results. For ENERGYSTAR®, key results would include reductions in greenhouse gases associated with the improved energy efficiency of participating companies. Another important result, however, would be to provide a mechanism that increases the market value of the participating companies. Voluntary programs that increase the value of participating companies and that reduce environmental impacts are successful on two scales. Additionally, there is an important connection between the two goals: programs that create value for participants will attract more companies leading to additional environmental improvements.

Finally, participation in a voluntary environmental program reflects a company's commitment to reducing its impact on the environment. Quantitative information on the relationship between voluntary program participation and financial performance would provide financial analysts and investors with a ready measure of how participation in these programs affects market value. That is, participation in ENERGYSTAR® may indicate which firms are energy efficient and thus provide a better investment opportunity. This would be the case if participation in the program is associated with higher levels of intangible value, after controlling for other relevant factors.

To investigate the relationship between financial performance and participation in the ENERGYSTAR® program, we construct econometric models that relate participation in the program to Tobin's q, a financial measure of intangible value. We use a sample of 124 Real Estate Investment Trusts (REITs) measured quarterly from 1999 through 2001. Our sample represents 75 percent of the equity REITs and more than 80 percent of market capitalization among equity REITs. In addition to controlling for a number of factors that influence financial performance, we also control for self-selection into the ENERGYSTAR® program. Based on our statistical results, we derive estimates of the market value of (1) participating in the ENERGYSTAR® program, (2) building energy assessments (i.e., benchmarking), and (3) energy efficiency in general.

ENERGYSTAR® is set of voluntary programs that are designed to protect the environment by promoting energy efficiency. The program covers products, construction of new homes, improvement of existing homes, commercial real estate, and corporate real estate. We focus on the ENERGYSTAR® Buildings Program, which is primarily concerned with improvements to commercial and corporate real estate. The program provides a comprehensive set of technical resources on ways to make buildings more energy efficient. The *Buildings Upgrade Manual*, for example, provides information on upgrades that can be made to lighting, fan systems, heating and cooling systems, and other building systems. ENERGYSTAR® also provides guidance on developing energy efficient purchasing policies and on developing energy efficient operations and maintenance policies. The program also supplies information and tools on how to assess the financial viability of upgrades. Finally, the program provides an online tool called Portfolio

Manager that can be used to benchmark a building's energy usage against similar buildings. Companies enter building-specific information into Portfolio Manager which then generates a score between zero and 100 that rates the building's energy efficiency compared to similar buildings.[1] Buildings that have a score exceeding 75 and that meet other requirements can then apply for a "label" from the ENERGYSTAR® program that certifies the building as one the most energy-efficient in the country. Combined, these resources provide a set of valuable resources for companies looking to improve the energy efficiency of their buildings.

Companies can become ENERGYSTAR® partners by submitting a "partnership letter" to the program. The letter must be signed by the Chief Executive Office or Chief Financial Officer of the company (or equivalent). In the letter, the company commits to:

- Measuring, tracking, and benchmarking its energy performance using the tools provided by ENERGYSTAR®;
- Developing a plan to improve energy performance; and
- Educating its staff and the public about being an ENERGYSTAR® partner.

Commitments are voluntary and the ENERGYSTAR® program does not monitor implementation of the commitments.[2] Additionally, partnership with ENERGYSTAR® is not a prerequisite for access to the energy-related tools discussed above. Those tools and resources are freely available to the public. Rather, joining ENERGYSTAR® is an outward statement by companies of their commitment to improving energy efficiency.

[1] The Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) provides a set of buildings against which the Portfolio Manager database makes comparisons.

[2] Additionally, companies are not removed from the program for failure to meet commitments.

2. Previous Literature

There is growing body of literature that looks at the relationship between environmental performance and financial performance.[3] Although our study is related to and draws from this literature, the studies are substantially different from what we are doing in this paper. First, we are looking at how good energy performance, rather than good environmental performance, relates to financial performance. Energy performance has significant financial implications, especially for REITs, which are the subject of this paper. Certainly, environmental performance can also have financial impacts, but these effects are different than those of energy performance. Firms pay directly for energy usage resulting in a direct impact on costs. Improving environmental performance, on the other hand, usually has a more indirect effect on financial performance such as reducing penalties or future regulatory requirements. Second, we are looking at the financial benefits of joining a public voluntary program. To our knowledge, only one other study (Khanna and Damon, 1999) has addressed this issue. Most studies in this area look at some measure or measures of environmental performance and relate those measures to financial performance. Part of our study follows this path: we use participation in the ENERGYSTAR® program as a measure of energy performance and relate that to financial performance. Our analysis, however, goes beyond that and provides an estimate of the value of the program to participants.

Despite the differences between studies of the environmental-financial performance link and our study, these other studies still inform our work. In short, these studies tend to find a significant positive relationship between good environmental performance and good financial performance, although the validity of the results is often questionable. An overriding concern in these studies is whether or not the observed relationship reflects some other factor such as reverse causation (good financial performance leads to good environmental performance), good managerial practices, or other firm- or industry-specific considerations. This paper attempts to address these issues using statistical techniques and detailed data. In contrast to most of these studies, we focus on only one industry (REITs). Although this focus limits the applicability of the results to other sectors, we expect that is also represents an advantage over some of the other studies that used samples from a wide-ranging set of industries. By focusing on one sector, we can more easily control for some of the factors which influence firm value.

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[3] Koehler and Cram (2001) provide an extensive review of this literature. We provide a review of only those studies that are directly relevant for our work in this paper.

Three papers are particularly relevant for our work: Konar and Cohen (2001), King and Lenox (2001), and Khanna and Damon (1999). Konar and Cohen (2001) look at the relationship between Tobin's *q* and environmental performance for 321 firms in 1989. After controlling for a number of firm-specific factors, they find that firms with better environmental records have higher values of Tobin's *q*. To measure environmental performance, they use Toxic Release Inventory (TRI) emissions and the number of environment-related lawsuits pending against each firm. A distinctive feature of the paper is that the authors translate their estimates into the monetary value associated with environmental performance. They find that the average firm suffered a $380 million loss in intangible market value associated with environmental performance. That is, if firms had zero TRI emissions and no pending lawsuits, the market value of the average firm would have been $380 million higher. This number represented nine percent of the asset value of these firms. The amount also varied by industry, with chemical firms suffering a loss worth 31.2 percent of their asset value. Thus, environmental performance can account for a substantial portion of a firm's value.

King and Lenox (2001) attempt to answer a number of unresolved questions in the debate over the environmental-financial performance link by using a long panel of data. They use a sample of 652 firms measured annually from 1987 to 1996. In using a panel data set, they can control for firm-specific effects through panel data methods (e.g., fixed and random effects models). They attempt to address whether or not it "pays to be green" or whether it "pays to be in a green industry." They find that a firm's environmental performance, relative to other firms in its industry, is positively related to Tobin's *q*, after controlling for industry-level environmental factors and other firm-specific factors. Another statistical specification, however, contradicts this relationship to some degree. Additionally, they were unable to conclude that causation runs from environmental performance to financial performance. Thus, King and Lenox (2001) demonstrate that the relationship between environmental and financial performance is not a simple one. They conclude that the statistical relationship between the two is influenced heavily by model specification and choice of sample.

Khanna and Damon (1999) is the most closely related to this paper. They look at the relationship between participation in EPA's 33/50 program, reduction in the releases of toxic chemicals covered by the program, and financial performance. They focus on firms in the chemical industry and control for self-selection into the program. They begin by modeling participation in the 33/50 program. This model is later used to formulate controls for self-selection into the program. Next, they relate participation in the program to reductions in releases of chemicals covered under the program. They find that 27.9 percent of these reductions from 1991 to 1993 are attributable to the participation in 33/50. Khanna and Damon then relate participation in the program to two measures of financial performance: return on investment (ROI) and excess value as a percentage of sales (EV/S). ROI is measured as the ratio of income to total invested capital and is a good measure of the current financial performance of a firm. EV/S is measured as the difference between the market and book value of a firm divided by sales and is a measure of future prospects for a firm. They find that participation in the program is significantly and negatively related to ROI, but significantly and positively related to EV/S. Thus, Khanna and Damon conclude that firms suffer losses in the short-term from program participation, but gain over the long term. The estimates translate into a 1.2 percent decline in ROI and a 2.2 percent increase in EV/S.

In addition to the literature on the environmental-financial performance link, we also draw from the literature on participation in public programs. This literature is relevant for our model of decisions to participate in the ENERGYSTAR® program. Khanna and Damon (1999) make a contribution to this literature, but we also draw from Videras and Alberini (2000), Arora and Cason (1995, 1996), Henriques and Sadorsky (1996), and DeCanio and Watkins (1998). In brief, these studies relate participation in voluntary programs to a number of firm-related factors such as financial health, threat of future regulation, and past environmental performance. In developing our model of participation decisions by REITs we provide reference to these studies to justify our model.

3. REITS

Real Estate Investment Trusts (REITs) are companies that own and in most cases operate income-producing real estate. For the most part, they are public companies that are openly traded on the major stock exchanges. The REIT corporate structure was authorized in 1960 by an act of Congress which intended to make large-scale, income-producing real estate holdings available to small investors. REITs played a relatively minor role in the real estate sector until the Tax Reform Act of 1986 made REITs a more attractive investment option. Following the Tax Reform Act, the number of REITs began to grow significantly.

To be classified as a REIT, companies must meet three main requirements. First, a majority of the company's assets must be in real estate held for the long term. Second, the company must earn most of its income from real estate. Finally, the company must return 90 percent of its taxable income to shareholders. The primary advantage of organizing as a REIT is the reduced tax burden. The primary disadvantage to companies organizing as a REIT is the restriction on retained earnings. REITs can be divided into three general categories: equity, mortgage, and hybrid. Equity REITs primarily own and manage real estate. Mortgage REITs, on the other hand, primarily own loans or other obligations that are backed by real estate. A hybrid REIT is a company that engages in both equity and mortgage investment strategies. In our analysis, we focus on equity REITs because these are the companies that own property and thus have an interest in reducing energy costs.

The REIT market has grown substantially since the early 1970s. In 1971 there were 34 REITs with a total market capitalization of $6.5 billion ($2001) (NAREIT, 2003).[4] By 2001, there were 182 REITs worth a total of $161.9 billion ($2001) (NAREIT, 2003). Based on these numbers, the average market capitalization per REIT increased almost five-fold between 1971 and 2001, from $191.1 million ($2001) in 1971 to $889.8 million in 2001 ($2001).

Energy is an important component of a REIT's operation. Innovest (2002) notes that energy expenditures are a major part of a REIT's operating cost. Parker and Chao (1999) note that energy costs for REITs can represent between 20 and 40 percent of the company's total operating cost. This substantial reliance on energy makes REITs a good case study for looking at the relationship between energy efficiency and intangible value. Presumably, being an ENERGYSTAR® Buildings partner should provide some benefits to REITs given their substantial energy needs.

4. Conceptual Considerations

In this section we develop a conceptual framework to characterize the relationship between participation in ENERGYSTAR® and intangible value. To accurately model this relationship, however, we must also account for the influence of two other factors on intangible value: corporate reputation and a

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[4] The market capitalization value was converted from 1971 dollars to 2001 dollars using the Consumer Price Index.

REIT's propensity to be energy efficient. We begin with a general discussion of intangible value and its relationship to energy efficiency. We then develop a more formal model of the relationship between intangible value and participation in ENERGYSTAR®. We complete this section by developing a model of a REIT's decision to join ENERGYSTAR®, which we use to control for self-selection into the program.

Intangible Value

The market value of any firm can be viewed as the sum of two components: value derived from *tangible* assets and value derived from *intangible* assets (Konar and Cohen, 2001). Energy performance should influence both sources of value. Tangible value is derived from tangible assets such as buildings and other capital items, as well as a company's earnings. Intangible value is derived from intangible assets, which include anything that can be linked to future earnings but which does not appear on a standard corporate balance sheet. Generally, such assets are neither accounted for internally nor externally, hence it is difficult to assess their magnitude using standard accounting practices (Lev, 2001). By some estimates, however, intangible assets can make up as much as 80 percent of a company's value (Reed, 2001).

Lev (2001) groups intangible assets into three categories, related to:

- Discovery—The ability to innovate to capture market share.
- Organizational practices—Better and smarter ways of doing business.
- Human resources—Having better-trained and better-qualified people than competitors.

We expect that ENERGYSTAR® participation, or good energy performance in general, is most closely related to the second of these, i.e., it adds value because it represents a better way of doing business.[5]

[5] Certainly, energy efficiency could manifest itself in other ways, including those related to discovery and human resources. For example, a REIT could develop a new way of operating buildings that is more energy-efficient, representing a business innovation that feeds into its intangible value (discovery).

For REITs, adapting better business practices as a result of ENERGYSTAR® participation leads to a number of intangible benefits. First, energy efficient buildings cost less to operate, which should result in bottom-line benefits for REITs. Furthermore, lower operating costs increase the net operating income (NOI) which in turn increases the property value for a building.

Second, energy efficient buildings provide a more attractive space and work environment. Romm and Browning (1998) found that energy efficient lighting upgrades led to productivity improvements in a series of case studies. This can lead to better tenant retention and the ability to charge a premium for the improved space. Third, through its ENERGYSTAR® participation the company starts to gain recognition as an environmentally conscious business. This leads to improved public perception, which has been identified as an important source of value for companies joining voluntary programs (Wells, 2000; Khanna and Damon, 1999; Videras and Alberini, 2000; Arora and Cason, 1995, 1996).

Third, efficient energy management may improve the long-term sustainability of the company. That is, alliance with ENERGYSTAR® may help build intellectual capital in the company with regard to energy management techniques. Those techniques can provide insulation against energy shocks, supply interruptions, or price spikes. Finally, competency in energy management may be interpreted as an indicator of superior overall management (Innovest, 2003). Energy is a complex management issue, requiring an ability to recognize and address emerging issues. Companies that manage energy issues effectively may find that their overall management reputation is enhanced.

To formalize our notion of intangibles, we write a firm's market value (*MV*) as the sum of tangible and intangible value:[6]

$$MV = V_T + V_I \tag{1}$$

If we divide through by V_T in equation (1), we get

$$\frac{MV}{V_T} = 1 + \frac{V_I}{V_T} \tag{2}$$

The left-hand side of equation (2) can be interpreted as Tobin's q, the ratio of market value to replacement value of tangible assets. Thus, based on (2), a firm's q value is determined by the ratio of intangible to tangible values. A firm with no intangible value ($V_I = 0$) will have a q value equal to one.

[6] The following treatment of q draws from Konar and Cohen (2001).

Following Hirsch and Seaks (1993) and Konar and Cohen (2001) we specify V_I/V_T as a linear function of a set of explanatory variables:

$$\frac{V_I}{V_T} = \boldsymbol{X}\beta + \varepsilon \tag{3}$$

where $\boldsymbol{X}$ is a matrix of explanatory or control variables, β is a vector of regression coefficients on the $\boldsymbol{X}$ variables (including a constant term), and ε is an error term. Thus, we get the following expression for a regression model for Tobin's *q*:

$$q = 1 + \boldsymbol{X}\beta + \varepsilon \tag{4}$$

This model can be estimated using either *q* or *q*-1 as the dependent variable.

The Relationship Between Intangible Value and ENERGYSTAR® Participation

The goal of our analysis is to examine the relationship between intangible value and participation in ENERGYSTAR®. Our central hypothesis then is that participation in the program will lead to higher levels of intangible value. We expect that participation in the ENERGYSTAR® program represents a smarter way of doing business, resulting in higher intangible value. Decisions to join ENERGYSTAR®, however, are not random, but reflect a decision process on the part of companies. To accurately capture the impact of participation in the program on intangible value we must account for this self-selection into the program.

There are two other considerations that we expect to be important in looking at the relationship between participation in ENERGYSTAR® and intangible value: energy efficiency and corporate reputation. In regards to the first, it is clear that companies can pursue energy efficiency goals in the absence of the ENERGYSTAR® program. There may be some level of management commitment to energy efficiency for business reasons (e.g., lowering cost) or for social reasons (e.g., reducing impacts on the environment). Regardless of the reasons, a company's "inherent" propensity for energy efficiency will influence its intangible value independent of the ENERGYSTAR® program. Additionally, a company's energy efficiency will both influence and be influenced by its decision to join ENERGYSTAR®.

Corporate reputation is a more encompassing concept than energy efficiency, but will also exert an influence on the relationship between intangible value and ENERGYSTAR® participation. Companies with better reputations will have higher levels of intangible value as the market is willing to pay more to hold the stock of companies with better reputations. Thus, reputation will exert an influence on *q*. We might also expect reputation to have a positive influence on decisions to join ENERGYSTAR® and on energy efficiency: i.e., companies with better reputations may be more likely to join ENERGYSTAR® or be more energy efficient. Although these tend to be correlational rather than causal relationships, we need to address them in our modeling in some form.[7]

Although we expect both energy efficiency and reputation to be important factors influencing the relationship between intangible value and ENERGYSTAR® participation, we do not have data to objectively measure either energy efficiency or reputation. Nevertheless, we expect that both reputation and a propensity to be energy efficient will influence intangible value *and* decisions to join ENERGYSTAR®. Our solution is to assume that joining ENERGYSTAR® and not joining ENERGYSTAR® represent completely different scenarios for companies which must be represented by completely different regression models. The two different scenarios stem from the fact that corporate reputation and energy efficiency make companies that join ENERGYSTAR® significantly different than those that do not. Empirically, this is a switching regression model and we can write this as

$$q = \boldsymbol{X_1}\beta_1 + u_1 \qquad for\ D = 1 \tag{5a}$$

$$q = \boldsymbol{X_2}\beta_2 + u_2 \qquad for\ D = 0 \tag{5b}$$

where *D* is a binary variable equal to one if the company is an ENERGYSTAR® partner and zero if the company is not a partner, $\boldsymbol{X}_1$ and $\boldsymbol{X}_2$ are matrices of explanatory variables, β_1 and β_2 are vectors of regression coefficients, and u_1 and u_2 are regression error terms. The "program effect" in this model can be calculated by comparing the predicted *q* value from (5a) to the predicted *q* value from (5b) *for companies that join the program*. This is discussed in more detail in the econometric methods section.

[7] The converse might also be true: joining ENERGYSTAR® or being energy efficient will lead to an improved corporate reputation. That is, participation in ENERGYSTAR® or being energy efficient leads society to place a higher reputational value on those companies. This is partly what we are measuring in our statistical models.

This structure allows the set of explanatory variables ($\boldsymbol{X}_j$) to differ between partners and non-partners, although we expect that a number of common factors are relevant for both groups. As discussed below, however, two program-related activities (benchmarking and labeling) may influence partners' intangible value, but they are irrelevant for explaining variation in non-partner *q* values. Additionally, this structure allows the coefficient values (β_j) to differ between partners and non-partners for factors that are common to both regression models. Thus, we let the relationship between *q* and the explanatory factors differ completely between the two groups. We expect that the relationship between *q* and its determinants (i.e., the variables in the ***X*** matrices) will be substantially different for partners than for non-partners and that the difference between the two stems from energy efficiency and corporate reputation considerations. In other words, companies that join ENERGYSTAR® differ from those that do not join ENERGYSTAR® with respect to energy efficiency and corporate reputation. Without objective data to measure these differences, we need to model them separately.

An alternative to the switching regression model in (5a) and (5b) is to pool the partners and non-partners and use a binary indicator to capture the effect of being an ENERGYSTAR® partner. This is a standard program evaluation model and can written as:[8]

$$q = \boldsymbol{X}\beta + \alpha D + u \tag{6}$$

where α reflects the effect of participating in the ENERGYSTAR® program. Although this model appears to be more tractable, the estimated value of α will be biased if we exclude corporate reputation and a REIT's propensity for being energy efficient because each will have a positive influence on both intangible value and decisions to join ENERGYSTAR®. As discussed in more detail in the econometrics methods section, however, the biased estimate will incorporate both a "reputation effect" and a "propensity for energy efficient effect" into the estimated coefficient. Based on this, the biased estimate of α in an estimation (6) provides a measure of how energy efficiency in general affects *q* values, with "energy efficiency" being the sum of a program effect, reputation effect, and propensity for being energy efficient effect. In essence, a biased estimate will still be valuable because we have an idea about where the bias is coming from and we can therefore give the estimated coefficient a broader interpretation.

[8] The '1' and '2' subscripts are removed to reflect that we have pooled the data.

We develop empirical models based on both (5a) and (5b) and (6). The estimates from (5a) and (5b) are used to develop an estimate of the program effect: i.e., the intangible value of the ENERGYSTAR® program to REITs. The estimated value of α from (6) is interpreted more broadly as the intangible value of energy efficiency, as proxied by ENERGYSTAR® partnership. In both sets of models, we control for self-selection of REITs into the program. This is discussed in more detail in the econometric methods section.

As noted above, there are two program-related activities that may affect a REIT's intangible value. First, companies that join ENERGYSTAR® are encouraged by the program to benchmark their buildings. Benchmarking involves entering building-specific information into EPA's Portfolio Manager database which then generates a score for the building.[9] Benchmarking is voluntary for the partners, but reflects a desire on the part of REITs to understand the energy efficiency of their buildings relative to similar buildings. Companies that own low-scoring buildings should be motivated to improve the buildings' energy efficiency because the benchmark score indicates that similar buildings are more efficient and thus operating at lower cost. The number of buildings that a company benchmarks, however, is not public knowledge. Thus, benchmarking acts more as an indicator of energy efficiency concern (among partners) than as an outward sign of energy efficiency. We measure benchmarking by calculating the percentage of total square footage owned that each REIT benchmarked in the previous year (*BENCH*).[10]

Buildings that achieve a score of 75 or higher can receive a label from the ENERGYSTAR® program, provided they meet other requirements, entitling the owner to display a bronze plaque bearing the ENERGYSTAR® logo.[11] A label is a certification by the ENERGYSTAR® program that the building meets high energy efficiency standards. Thus, labeled buildings represent the best performing buildings of their

[9] Portfolio Manager ranks the building's energy efficiency (kwH per square foot) against a national database of buildings, developed by the Department of Energy, adjusted for building type, occupancy patterns, and climate (location).

[10] We have quarterly observations, so this measure can change from quarter to quarter. For example, for the third quarter of 1999, we calculated the percentage of total square footage that had been benchmarked between fourth quarter 1998 and third quarter 1999. Our presumption is that a benchmark score is valid for one year.

[11] To receive the label, the building owner must complete an application letter and a Statement of Energy Performance (provided by EPA) and then have a Professional Engineer certify that the data entered into the Portfolio Manager database is accurate and that the building conforms to industry standards for indoor environment.

type and are among the most energy-efficient in the country. Furthermore, EPA publishes lists of labeled buildings, making a label a form of public recognition for energy efficient operation. To the extent that the market acknowledges this public recognition, a label acts as an indicator to the market that the REIT owns and operates energy-efficient buildings. Thus, there may be some intangible value associated with building labeling. Similar to benchmarking, we measure labeling as a percentage of total square feet owned by the REIT (*LABEL*).

In addition to these energy-related factors, there are a number of other factors that will influence a company's intangible value. These other factors make up the ***X*** matrices in the equations above and can be divided into three groups: market conditions, firm-specific financial factors, and firm characteristics. We expect that better market conditions for REITs will result in higher intangible values, all else equal. To measure market conditions, we use the quarterly return to the National Association of Real Estate Investment Trust (NAREIT) index for equity REITs. The NAREIT Equity Index tracks the market performance of all equity REITs. We expect that this will act as a good proxy for general market conditions for our sample of REITs. For each quarter in the data, we calculated the percentage change in the NAREIT index from the previous quarter and used that as a measure of market growth or decline. We label this variable *NRET* in our empirical model.

There are a number of firm-specific financial characteristics that can have an influence on a firm's intangible value. First, we use the REIT's return on assets (ROA) as a measure of REIT profitability. We measure ROA both concurrently to q and lagged by one quarter. Second, the riskiness of a REIT's stock may also influence the value the market places on its intangible assets. To measure this, we calculated each REIT's stock market beta (*SBETA*) for the 1996-2001 time period and used that as a measure of riskiness.[12] Finally, we control for each REIT's baseline level of intangible value. We expect that each REIT's intangible value during the sample period (1999-2001) will be positively influenced by its intangible value in the period leading up to the sample period. If REITs with higher intangible values prior to the sample period are concentrated among partners, then we may find that partnership is significantly associated with higher q values than non-partners when such a relationship actually does not exist. In other words, good performance in terms of intangible value may carry over from the pre-sample

[12] Thus, there is *one* calculated value of beta for each firm which is used to measure riskiness in *each* quarter.

period to the sample period. To measure this, we calculated the average value of Tobin's q for 1996-1998 for each REIT and refer to this variable as q_b.[13]

Intangible value can also be influenced by a number of firm-specific non-financial characteristics. Studies of intangible value often use the size of the firm, measured as the number of employees, as a control variable. We use the total square footage owned by the REIT as a measure of firm size rather than the number of employees. Previous studies of Tobin's q values for REITs have also accounted for the concentration of a REIT's holdings in one sector (e.g., office, retail) (Capozza and Seguin, 1999). Our meaure of the concentration (*CONC*) is a Herfindahl index and is defined as:

$$CONC = \sum_{j=1}^{7} \left(\frac{s_j}{S} \right)^2$$

where s_j is the square footage owned by the REIT in sector j, and S is the total square footage owned by the REIT.[14] Finally, we also expect that the sector where a REIT has concentrated its holdings may influence q values. In equation (6), we control for the two major sectors in the data: office (*OFFICE*) and retail (*RET*) using binary control variables set equal to one if the REIT had more than 75 percent of its square footage in either the office or retail sector, respectively.[15]

Based on these considerations, we can write equation (6) as

$$\begin{aligned} q &= f(D,\ BENCH,\ LABEL,\ NRET,\ TSQFT,\ ROA, \\ &\quad ROA_{t-1},\ q_b,\ SBETA,\ CONC,\ OFFICE,\ RET) \end{aligned} \tag{7}$$

where D is the binary variable equal to one if the REIT was a partner and all variables are as defined above. Equation (5a) excludes D and equation (5b) excludes D, *BENCH*, and *LABEL*. We measure total square feet (*TSQFT*) in natural logarithm form to reduce the influence of any large square footage values. We discuss our implementation of this model more fully in the econometric methods section below.

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[13] Similar to the stock market beta, there is only one value, the pre-1999 q value, for each REIT.

[14] The seven sectors covered in our analysis are: office, retail, industrial and warehouse, health care, lodging, residential, and self-storage.

[15] We were unable to include the sector-specific controls in the switching regression model due to multicollinearity issues in the estimations.

Decisions to Join ENERGYSTAR®

We also expect that the decision to join ENERGYSTAR® is not random and can be represented by the following equation:

$$D^{*} = \boldsymbol{Z}\gamma + \varepsilon \tag{8a}$$

where D^* is the net benefit from joining ENERGYSTAR®, $\boldsymbol{Z}$ is a set of explanatory variables that influence the net benefits, and γ is a vector of coefficients. We expect that companies will join ENERGYSTAR® if the net benefits of joining exceed zero and will not join if the net benefits are negative. Thus, assignment into the two regression equations for q (i.e., (5a) and (5b)) can be written as

$$D = 1 \ \mathit{if} \ D^{*} > 0 \tag{8b}$$

$$D = 0 \ \mathit{if} \ D^{*} \leq 0 \tag{8c}$$

This specification assumes that the decision of whether or not to join ENERGYSTAR® reflects some assessment of the net benefits of joining the program by each REIT. If the REIT determines that the net benefits are positive, then it joins the program. We do not expect that each REIT performs a detailed net benefit calculation for this, but rather more of a subjective calculation. The goal of characterizing the decision to join is to include a set of factors in a statistical model of equation (8a) that reflects the net benefits of joining the ENERGYSTAR® program. We expect that four sets of factors are relevant: market conditions, company size, the firm's financial health, and the company's primary sector.

Improvements in the market conditions affecting REITs should have a positive influence on the decision to join ENERGYSTAR®. As overall conditions improve, REITs as a group will have more resources to allocate to voluntary programs such as ENERGYSTAR®. As conditions worsen, on the other hand, REITs would be expected to focus their energies on weathering the down market rather than joining voluntary programs. Videras and Alberini (2000) found that increases in industry-level sales were positively associated with an increased probability of joining EPA's Green Lights program, but were not associated with joining EPA's WasteWise or 33/50 programs. DeCanio and Watkins (1998) found that an increase in industry earnings per share was positively related to joining Green Lights. In our statistical model of the decision to join ENERGYSTAR®, we control for market conditions by using the quarterly return in the NAREIT equity REIT index discussed above.

Larger REITs may also have an incentive to join compared to smaller ones. The larger the REIT, measured either in terms of square footage or total assets, the more opportunity there is to reduce costs through energy efficiency programs. Previous studies that looked at voluntary program participation decisions all used some measure of company size (Khanna and Damon, 1999; Videras and Alberini, 2000; Arora and Cason, 1995, 1996; Henriques and Sadorsky, 1996; and DeCanio and Watkins, 1998). We control for REIT size in the model of participation decisions by including the total square footage owned by the REIT and the total assets owned by the REIT. In our statistical models, we measure each in logarithmic form to reduce the influence of large values.

REITs that are doing better financially relative to their sector peers should also be more likely to join ENERGYSTAR®. A number of other studies have examined this issue, but each found no relationship between financial health and participation (DeCanio and Watkins, 1998; Videras and Alberini, 2000; and Arora and Cason, 1995). We measure firm profitability by ROA concurrently and lagged by one quarter. Additionally, we also include the average q value for 1996-1998, the period preceding our sample period. We expect that firms that had a higher levels of intangible value at the beginning of the sample period will be more likely to join the program. We also include the firm's stock market beta as a measure of risk faced by owning the firm's stock. We expect that the riskiness of a firm's stock should affect decisions to join ENERGYSTAR®, but the direction of that effect is left to the empirical model.

Finally, decisions to join ENERGYSTAR® will be influenced by the types of buildings that are owned by the REITs. For example, in interviews with 33 REITs, Parker, Chao, and Gamburg (1999) found that in the retail sector the tenants tend to pay for energy costs while in the office sector the REIT tends to pay for energy costs. Additionally, the energy requirements and opportunities for energy efficiency upgrades will differ markedly across the sectors we use in our analysis (office, retail, industrial and warehouses, health care, lodging, residential, and self-storage). These sector differences may influence decisions to join ENERGYSTAR®. Finally, early recruitment efforts of the ENERGYSTAR® Buildings Program focused on office properties. Both Videras and Alberini (2000) and DeCanio and Watkins (1998) use industry sector controls in their analyses. Therefore, we include a set of binary variables that reflect the sector that each REIT operates in.

Based on these considerations, our model for joining ENERGYSTAR® can be written as

$$D = f(NRET,\ TSQFT,\ TA,\ ROA,\ ROA_{t-1},\ q_b,\ SBETA,\ SECTOR) \tag{9}$$

where *TA* is total assets, *SECTOR* is a set of control variables for the sectors in our data, and all of the variables are defined as above. We use a probit model to estimate this equation. The following section discusses our econometric method, which involves using the model of decisions to join ENERGYSTAR® in equation (9) to adjust for self-selection into the program.

5. Econometric Methods

In this section, we review the econometric issues involved in estimating the models discussed in the previous section. There are two models that we discuss: the switching regression model of (5a) and (5b) and the pooled model of (6). The switching regression model is used to derive estimates of the program effect of ENERGYSTAR® for REITs while the pooled model is used to derived the intangible value associated with energy efficiency overall. In this section, we also provide reasoning for this interpretation of the pooled model.

Switching Regression Model With Endogenous Switching

The model in (5a) and (5b), along with the self-selection into ENERGYSTAR® described by equations (8a)-(8c), is a switching regression model with endogenous switching. To begin, we specify the model formally as:

$$q_{1it} = \beta_1^{/} \boldsymbol{X_{1it}} + u_{1it} \qquad for\ D_{it} = 1 \tag{10a}$$

$$q_{2it} = \beta_2^{/} \boldsymbol{X_{2it}} + u_{2it} \qquad for\ D_{it} = 0 \tag{10b}$$

$$D_{it}^{*} = \gamma^{/} \boldsymbol{Z_{it}} + \varepsilon_{it} \tag{10c}$$

$$\begin{aligned} D_{it} &= 1 \ \ if\ D_{it}^{*} > 0 \\ D_{it} &= 0 \ \ if\ D_{it}^{*} \leq 0 \end{aligned} \tag{10d}$$

where all variables and parameters are as defined above and i indexes REITs and t indexes time. Estimation of (10a) and (10b) in their present form will result in biased estimates because the error terms in both equations will have non-zero expectations due to the selection mechanism defined in (10c) and (10d) (Maddala, 1983).

To estimate this system, we follow the two-step procedure outlined in Maddala (1983). First, we define the following two ratios:

$$W_{1it} = \varphi(\gamma^{/} Z_{it}) / \Phi(\gamma^{/} Z_{it}) \tag{11a}$$

$$W_{2it} = \varphi(\gamma^{/} Z_{it}) / [1 - \Phi(\gamma^{/} Z_{it})] \tag{11b}$$

where φ and Φ are the density and cumulative distribution function of the standard normal distribution. The W ratios represent the conditional probabilities of joining ENERGYSTAR® and not joining ENERGYSTAR®, respectively, based on the values of the variables affecting the decision to join

ENERGYSTAR® ($\boldsymbol{Z}$) and the coefficients associated with those variables (γ). These ratios can be computed for each observation in the sample. We can now redefine equations (10a) and (10b) as[16]

$$q_{it} = \beta_1^{/} \boldsymbol{X_{1it}} - \sigma_{1\varepsilon} W_{1it} + v_{1it} \qquad for\ D_{it} = 1 \tag{12a}$$

$$q_{it} = \beta_2^{/} \boldsymbol{X_{2it}} + \sigma_{2\varepsilon} W_{2it} + v_{2it} \qquad for\ D_{it} = 0 \tag{12b}$$

where $\sigma_{1\varepsilon}$ is the covariance between u_1 and ε, $\sigma_{2\varepsilon}$ is the covariance between u_2 and ε, and v_{jit} $\{j = 1, 2\}$ are new residuals with zero conditional means.

The new equations can now be estimated using a two-stage process. First, we estimate a probit model for decisions to join ENERGYSTAR® ((10c) and (10d)), using D values in place of the unobserved D^* values. This provides a consistent estimate of γ which we call $\hat{\gamma}$. Next, we generate estimates of $\hat{W}_{1it}$ and $\hat{W}_{2it}$ by substituting $\hat{\gamma}$ for γ in (11a) and (11b). In the second stage, we estimate our equations for Tobin's q, (12a) and (12b), using $\hat{W}_{1it}$ and $\hat{W}_{2it}$ in place of W_{1it} and W_{2it}, respectively. The estimated coefficients for $\hat{W}_{1it}$ and $\hat{W}_{2it}$ will be consistent estimates of $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$, respectively (Maddala, 1983).

As we noted in Section 4, we expect both corporate reputation and a REIT's propensity for being energy efficient to affect both partnership decisions and intangible value. The switching regression model, however, mitigates the effects of these omitted variables by separating the partners from the non-partners. To see this, we write our two q equations as

$$q_{1it} = \beta_1^{/} \boldsymbol{X_{1it}} + \theta_1 R^* + u_{1it} \qquad for\ D_{it} = 1 \tag{13a}$$

$$q_{2it} = \beta_2^{/} \boldsymbol{X_{2it}} + \theta_2 R^* + u_{2it} \qquad for\ D_{it} = 0 \tag{13b}$$

where R^* is an unobserved measure of corporate reputation and θ_1 and θ_2 measure the impact of reputation on q. We will focus this discussion on reputation because the propensity for energy efficiency can be handled in an analogous manner. Next, we can assume that corporate reputation and partnership have a simple relationship such as (ignoring i and t subscripts and any error term):

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[16] The detailed derivation of these equations, along with a more detailed account of this method, can be found in Maddala (1983, pp. 223-228).

$$R^{*} = b_0 + b_1 D \tag{13c}$$

where b_0 and b_1 are regression coefficients. To see how having this unobserved relationship affects (10a) and (10b), we substitute (13c) into (13a) and (13b) and use the condition for D_{it} for each relationship:

$$q_{1it} = \beta_1^{\prime} \boldsymbol{X_{1it}} + \theta_1(b_0 + b_1) + u_{1it} \qquad for\ D_{it} = 1 \tag{14a}$$

$$q_{2it} = \beta_2^{\prime} \boldsymbol{X_{2it}} + \theta_2 b_0 + u_{2it} \qquad for\ D_{it} = 0 \tag{14b}$$

Thus, the terms $\theta_1(b_0 + b_1)$ and $\theta_2 b_0$ are unmeasured effects of corporate reputation on q.[17] Corporate reputation, however, is likely to have a significant firm-specific component, especially when measured over time in a panel. If we assume that b_0 can be written as b_i instead (i.e., as a firm-specific effect) then our unmeasured effects of corporate reputation can be handled with a panel data method such as random effects and by assuming that the remaining effect is subsumed into the error term. Thus, in the partner model, we are assuming that some of the reputation effect (i.e., $b_1\theta_1$) is randomly distributed among partners after controlling for other factors included in $\boldsymbol{X}$. This same assumption is not valid for a pooled model because reputation affects both decisions to join *and q* values.

Pooled Model For Valuing Energy Efficiency

The pooled model from equation (6) can be written more formally as

$$q_{it} = \boldsymbol{X_{it}}\beta + \alpha D_{it} + u_{it} \tag{15}$$

where α is once again the program effect of ENERGYSTAR® on intangible value. To account for self-selection into the program, we combine (15) with the REITs' decisions to join ENERGYSTAR® modeled in (10c) and (10d). Estimation of (15) without controlling for self-selection into ENERGYSTAR® will result in biased estimates of α due to the relationships in (10c) and (10d) (Maddala, 1983). To avoid this, we

[17] The other unmeasured factor that we consider important, a REIT's propensity for being energy efficient, can be handled in a similar manner, resulting in additional terms similar to the ones for corporate reputation in (14a) and (14b).

follow a path similar to the switching regression modes above and add the inverse mills ratio as a new regressor to our model.[18] This can be written as

$$q_{it} = \boldsymbol{X_{it}}\beta + \alpha D_{it} + \beta_w W_{it} + v_{it} \tag{16}$$

where $W_{it} = \varphi(\gamma' Z_{it})/\Phi(\gamma' Z_{it})$ is the inverse mills ratio, β_w is a regression coefficient,[19] and v_{it} is an error term with zero expectation.

This model can be estimated in a manner similar to the switching regression model. First, we estimate a probit model for (10c) using (10d) as observations on D^*. This provides a consistent estimate of γ that we can use to get an estimate of W_{it}. Second, we use our estimated W_{it} values in (16) to get consistent estimates of β, α, and β_w.

Our estimate of α in this form, however, will be a biased estimate of the *program effect* due to the unobserved influence on corporate reputation and energy efficiency. The nature of bias, however, allows us to make a broader interpretation of our estimated coefficient. To derive this broader interpretation, we begin by writing (16) with the unobserved value R^* as part of the equation:[20]

$$q_{it} = \boldsymbol{X_{it}}\beta + \alpha D_{it} + \theta R^* + u_{it} \tag{17}$$

where θ measures the reputation effect on intangible value. Substituting (13c) into (17) and collecting terms we get

$$q_{it} = \boldsymbol{X_{it}}\beta + (\alpha + \theta b_1) D_{it} + \theta b_0 + u_{it} \tag{18}$$

In our estimation, we will not be able to separate θ, α, and b_1 from one another because we have too many unknowns in too few equations. Thus, a regression of q on $\boldsymbol{X}$, D, and W will result in one value for the

[18] The derivation of this correction for self-selection can be found in most advanced econometrics texts, such as in Greene (1993, pp. 706-710), or in Maddala (1983).

[19] In statistical terms, β_w is equal to the covariance between u_{it} in (15) and ε_{it} in (10c) multiplied by the standard error of ε_{it} in (10c).

[20] Once again, energy efficiency can be handled analogously to corporate reputation.

coefficient on D, say $\hat{\alpha}$, which will equal $(\alpha + \theta\, b_1)$. In other words, the estimated coefficient on D in (18) will be the sum of the program effect (α), a corporate reputation effect ($\theta\, b_1$), and the "propensity for being energy efficient" effect. Given that we cannot separate out the pure program effect, we interpret our estimated coefficient in (16) as the intangible value of energy efficiency, operating through participation in ENERGYSTAR®, corporate reputation, and the efforts of REITs to operate in an energy efficient manner. A final point is that even if we assume that b_0 can be written as a firm-specific random effect b_i, we will still be unable to separate out the program effect from the other two unobserved influences. Nevertheless, we assume that there are firm-specific factors that are unmeasured in this model and use the random effect procedure in the estimations.

In both the switching regression model and the pooled model we use predicted probabilities from a first stage probit model. The first stage probit model contains many of the variables also in the second stage switching regression model and the pooled model. In order for our predicted probabilities to have some independent variation, we need to include a variable in the first stage probit model that acts as an instrument for joining ENERGYSTAR®. We use total assets as our instrument since it satisfies the criteria for a good instrument: it is related to the probability of joining ENERGYSTAR®, but is not correlated with the outcome variable (i.e., Tobin's q).

6. Data

Data for our analysis come from a variety of sources. We began by obtaining data from Standard and Poor's Compustat database for all companies in Standard Industrial Code 6798 (Real Estate Investment Trusts). This included 198 REITs active between 1996 and 2001. We then restricted the sample to equity REITs that had sufficient financial data over the sample period.[21] Next, we collected information on square footage by property type owned by the REITs from the companies' Security and Exchange Commission (SEC) filings and from corporate annual reports. This also resulted in some loss of companies from the sample due to missing or inadequate data. Additionally, some REITs were considered out of scope for this analysis and were also dropped.[22] Our final sample includes 124 equity REITs.

[21] Information on which REITs were classified as equity REITs was taken from NAREIT's web site (http://www.nareit.com).

[22] These were REITs primarily involved in manufacturing and development of homes.

Information on ENERGYSTAR® partnership and building benchmarking and labeling were obtained from EPA's ENERGYSTAR® Buildings Program. This included a list of partners in the Commercial Real Estate sector and the dates on which each partner joined the program. Information on benchmarking and labeling were taken from the program's Portfolio Manager database which tracks those activities. This information was matched to our sample of 124 REITs.

We followed the method proposed by Chung and Pruitt (1994) to calculate Tobin's *q*. Their measure of *q* can be written as

$$q = \frac{(MVE + PS + DEBT)}{TA} \tag{19}$$

where *MVE* is the market value of common stock (share price multiplied by shares outstanding), *PS* is the liquidating value of the firm's outstanding preferred stock, *DEBT* is the value of a firm's short term liabilities net of its short term assets plus the book value of the firm's long-term debt, and *TA* is the book value of the firm's total assets. This is a common formulation of *q* in the literature.

To calculate the stock market betas (*SBETA*), we used end-of-month stock prices for the period 1996 through 2001. For each REIT, we regressed the monthly stock price return on the monthly return to the Standard and Poors 500 Index. The estimated slope coefficient from these regressions are, by definition, stock market betas.

Our final data set is comprised of 124 REITs with quarterly observations spanning 1996 through 2001. In our statistical models, however, we restrict the sample to 1999 through 2001, since recruiting for ENERGYSTAR® did not begin until 1999. This results in a potential panel size of 1,488 observations (124 REITs × 12 quarterly observations). Due to missing data, however, our workable sample size was 1,434 observations. Of the 1,434 observations, 202 were for the partners and the remaining 1,232 were for non-partners.

There were 23 REITs (19 percent) that became partners over the course of the sample period. Companies could be in both the partner and non-partner samples since partnership was defined as being a partner at a specific time. Thus, a company that joined after the beginning of the sample period, but before the end of the period, would be in both samples. Of the 23 partners in the sample, only three were partners for the entire sample period.

Table 1 provides definitions and summary statistics for our data. The average value of Tobin's *q* for the 124 REITs during the sample period was 0.923. Partners had an average *q* value of 0.945 and non-partners had an average *q* value of 0.917, a difference that is not statistically significant. Over the sample period, 202 observations (14.1 percent) corresponded to REITs being partners. The average REIT in our sample owned 32.6 million square feet and had $1.6 billion in assets. Additionally, on average the REITs property type holdings tended to be very concentrated with an average Herfindahl concentration index of 0.89.[23] Finally, more than half of all the observations corresponded to retail REITs. The office and retail sectors combined for a total of 64 percent of all observations.

7. Econometric Results

In this section we present the results of estimating our equations for Tobin's *q* and the decision to join ENERGYSTAR®. We begin by discussing the probit model for REIT's decisions to join ENERGYSTAR® since this model is used to generate our control for self-selection into the ENERGYSTAR® program for both the switching regression model and the pooled estimation. We then review the results for our regression models for Tobin's *q*. In the section that follows, we translate the regression results into dollar values associated with the ENERGYSTAR® program.

[23] The construction of the index implies that values can range from 0.14 (equal diversification across property types) to one (complete concentration in one sector).

Decisions to Join ENERGYSTAR®

Table 2 presents the results of the probit model for decisions to join ENERGYSTAR®. We present both the estimated coefficient and the marginal effects of each variable on the probability of joining ENERGYSTAR®. The probit model was run for the sample of 124 REITs measured quarterly from 1999 to 2001 for a total of 1,434 observations. In the probit model we include a set of dummy control variables for the sectors using the retail sector as the base.

The estimated coefficient for the return to NAREIT index indicates that general market conditions are significantly and positively related to joining ENERGYSTAR®. Although significant, the actual impact on the probability of companies joining ENERGYSTAR® is small. The marginal impact for the return to the NAREIT index indicates that a one percentage point increase in the index increases the probability of the average company joining ENERGYSTAR® by 0.35 percentage points.

In terms of REIT size, the amount of assets owned by REITs is significantly and positively related to joining ENERGYSTAR®, but the total square footage is not related to the probability of companies joining the program. The marginal effect for total assets indicates that a one percent increase in the average company's total assets increases the probability of joining ENERGYSTAR® by 5.6 percentage points. The positive relationship between participation and size is consistent with previous studies that look at voluntary program participation (Khanna and Damon, 1999; Videras and Alberini, 2000; Arora and Cason, 1995, 1996; and DeCanio and Watkins, 1998).

The four REIT-specific financial characteristics that we used in the analysis are all significantly related to joining ENERGYSTAR®. Return on assets, both concurrently and lagged by one quarter, has a positive impact on joining ENERGYSTAR®. That is, firms that are doing better financially are more likely to join the program. This differs from previous studies which found little effect of financial health on decisions to join voluntary programs (Videras and Alberini, 2000; Khanna and Damon, 1999). Additionally, if we also take ROA as a measure of management effectiveness, firms that are better managed are more likely to join. Firms that had higher intangible values in the period leading up to our sample period, as measured by pre-1999 Tobin's *q* values, were also more likely to join ENERGYSTAR®. Finally, joining ENERGYSTAR® was positively related to firm-specific risk associated with the REITs' stock prices. REIT stocks, however, tend to be low-risk relative to the stock market. Our estimated betas ranged from 0.127 to 0.363. Thus, the finding that riskiness increases the probability of joining ENERGYSTAR® may be limited to our sample given the small range of betas.

Finally, the sector in which the REIT owned most of its property played a significant role in determining the probability of joining ENERGYSTAR®. We included controls for six of the seven sectors, making retail, the largest of our sectors, the base sector in the analysis. REITs in the residential, industrial and warehousing, lodging, health care, and self-storage sector were all less likely to join ENERGYSTAR® than retail REITs. Office REITs, on the other hand, were much more likely to join ENERGYSTAR® than retail REITs.

The estimated model in Table 2 was used to generate a values for $\hat{W}_{1it}$ and $\hat{W}_{2it}$.[24] For each observation, we calculated the value of $Z_{it}\gamma$ using each observation's values for Z_{it} and the estimated coefficients in Table 2 for γ. We then calculated $\varphi(Z_{it}\gamma)$, the standard normal density function, and $\Phi(Z_{it}\gamma)$, the standard normal cumulative distribution function, for each observation. Finally, we calculated the ratios $\hat{W}_{1it}$ and $\hat{W}_{2it}$ for each observation, using our values for $\varphi(\cdot)$ and $\Phi(\cdot)$. These two ratios are added to the models for Tobin's q to control for endogenous selection into the ENERGYSTAR® program.

Intangible Value

Table 3 presents the results for the switching regression model and the pooled regression model. The switching regression equation for partners had 202 observations and covered 23 REITs, while the non-partner equation had 1,232 observations and included 121 REITs. The pooled model contained all 1,434 observations and all 124 REITs. All three models were run using quarterly observations running from 1999:1 to 2001:4. In this section we discuss the statistical results. In the next section we derive quantitative measures of the value of the ENERGYSTAR® program and the value of energy efficiency based on these models.

We will start by discussing the non-program variables. Market conditions for REITs, as measured by the return to the NAREIT index, are positively related to q values. The coefficient is significant in the

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[24] Note that W_{1it} in the switching regression model and W_{it} in the pooled model are defined identically and are even calculated from the same probit estimation (Table 2). They are defined over different samples, however.

pooled sample and for non-partners, but the coefficient is not significant in the partners' model.[25] The magnitude of the effect, however, is small. A one percentage point increase in the return to the index increases *q* values by slightly more than 0.003 points, or 0.32 percent of the average *q* value for the sample period.

The riskiness of a REIT's stock has a significant negative effect on *q* values. That is, REITs with more volatile stock prices tend to have lower *q* values. The effect of volatility is more than four times larger among partners than non-partners. REITs, however, tend to be lower risk stocks and thus it is not possible to extrapolate this result beyond REITs.

Pre-1999 Tobin's *q* values are highly significant and exert a positive influence on *q* values in the sample. Larger values of the coefficient indicate a stronger influence of pre-1999 *q* on sample period *q* values. The relationship is strongest for partners with a coefficient of 0.83. Thus, partners that had high intangible values in the pre-sample period would also have high values in during the sample period. The use of pre-1999 Tobin's *q* controls for this carry-on effect of good performance.

Return on assets, both contemporaneous and lagged, is negatively associated with Tobin's *q* in our sample. The estimated coefficients, however, are only significant in two of six cases. In those two cases, they are significant only at the 10 percent level. Nevertheless, the prevalence of the negative signs does seem to indicate a negative relation. We expected that REITs with better profitability would have higher *q* values, so this result runs counter to our expectations.

The size of the REIT is significantly and positively related to *q* values. In the pooled model, a one percent increase in total square footage owned by a REIT increases *q* values by 0.024 points. The relationship is larger among partners compared to non-partners, however. A one percent increase in total square footage increase *q* values by 0.059 points for partners, but among non-partners the increase n *q* is only 0.027.

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[25] The lack of significance in the partner model may be caused by too few observations for partners. Specifically, the coefficient estimate on *NRET* for partners is (numerically) close to the estimated values in the non-partners and pooled models, but the standard error in the partners model is too large to generate a significant coefficient.

The concentration of a REIT's holdings across sectors is also positively related to *q* values. That is, REITs that are less diversified across property types tend to have higher *q* values. This result confirms previous research on the relationship between REIT property type concentration and firm value (Capozza and Seguin, 1999). This relationship, however, is not significant for partners. The pooled model also contains two sector controls: one for the office sector and one for the retail sector. Both control variables are negative and significant, indicating that non-office, non-retail REITs fared better over the sample period than REITs concentrated in the office and retail sectors.

The set of program-related variables (participation, benchmarking, and labeling) differs between the three equations. The non-partner model contains none of the program-related variables and the pooled model contains all three. In the pooled model we find that the partnership variable is significantly and positively associated with higher *q* values. As noted in the econometric methods section, however, this estimated coefficient reflects the sum of three influences: the direct effect of partnership on *q*, a reputational effect, and the effect of a company's propensity for being energy efficient. Combined, we interpret this coefficient as the effect of energy efficiency, as proxied by partnership in ENERGYSTAR®, on *q*. Thus, after controlling for market conditions, firm-specific financial factors, firm characteristics, and primary sector, we find a significant effect of energy efficiency on *q*. In the next section we translate the estimated coefficient in this model to a measure of the value of energy efficiency.

Our measure of benchmarking activity is included in the partner model and the pooled model. In both models benchmarking is associated with significantly larger *q* values. The estimated coefficient is larger in the partner-only model than in the pooled model because the pooled model contains non-partners that perform no benchmarking. The result says that REITs that benchmark a larger proportion of their buildings have higher *q* values. Benchmarking, however, is not something that is observed by the market. Thus, the market must be reacting to an outcome associated with benchmarking. Given that we have controlled for several other factors (firm-specific financial factors and pre-1999 *q*), we expect that the significant coefficient on *BENCH* reflects the market's valuation of energy efficient building operation. Energy efficient building operation will manifest itself in increased profits for these companies. Thus, companies that benchmark larger proportions of their buildings operate those buildings efficiently and this leads to higher intangible values by increasing profitability. Another possibility is that the market recognizes which REITs are more energy efficient and places some value on that energy efficiency. If the more energy-efficient REITs also tend to benchmark more of their buildings, then our significant coefficient on *BENCH* reflects the value of energy efficiency. In either case, the market is placing some intangible value on energy efficient operation.

Our measure of labeling, included in both the pooled model and the partner model, is not significant. This would seem to indicate that the market does not recognize an outward, objective sign of energy-efficient building operation. We expect that a statistical reason may also be leading to insignificance of the labeling variable. First, if we remove *BENCH* from either equation, *LABEL* is both positive and significant.[26] Second, all labeled buildings are also benchmarked ones. This implies that when we include both measures in the same model, we are measuring almost identical events.[27] The benchmarking variable has a larger variation and therefore consumes almost all of the explanatory power of the combined measure.

Before we turn to estimating the value of the program and energy efficiency in general, we note that the results associated with self-selection are mixed between the two formulations. In the pooled model, the self-selection term is significant—indicating that self-selection is a significant factor in explaining *q* values. In the switching regression models, the self-selection controls provide no explanatory power—indicating that self-selection plays almost no role in explaining *q* values. Nevertheless, we retain the self-selection framework because of the pooled model result and because there are good theoretical reasons to believe that self-selection will be important component of this evaluation.

8. Estimates of Market Value

In this section we translate the regression estimates from Section 6 into estimates of the market value of the ENERGYSTAR® program and of energy efficiency in general. There are four measures of participation in the program that we are interested in:

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[26] These results are not reported here, but are available from the authors upon request.

[27] The correlation between the two measures is 0.78.

- The value of being an ENERGYSTAR® partner;

- The value of benchmarking for ENERGYSTAR® partners;

- The value of energy efficiency, as proxied by ENERGYSTAR® partnership; and

- The value that non-partners would have earned had they joined ENERGYSTAR®.

The first of these, the value of ENERGYSTAR® partnership, is calculated using the ratio of the two equations in the switching regression model. The value of benchmarking is calculated using the partner's model in the switching regression model. The value of energy efficiency, is calculated using the pooled model. The last measure, which we refer to as the lost opportunity of not joining ENERGYSTAR®, is calculated using the switching regression model in a manner analogous to the first measure.

To calculate these values we begin by calculating the "premium" associated with each measure of participation. The premium is the defined as the q value associated with each participation measure relative to the q value associated with not participating. For example, for valuing the ENERGYSTAR® program, the premium measures the value of q for being a partner relative to not being a partner. A general expression for the premium can be written as:

$$Premium = \left[\frac{E[q \mid Participation]}{E[q \mid No\ Participation]} - 1 \right] \times \$1\ million \tag{20}$$

where $E[\cdot]$ is the expected value operator. Thus, the premium is the ratio of two predicted q values and is converted into millions of dollars of a REIT's assets. To understand our formulation of this premium consider the following. Before subtracting off one and multiplying by $1 million, the premium reflects how much larger, in percentage terms, Tobin's q is for those participating in the program compared to those who do not participate in the program. Tobin's q reflects the value the market places on a firm's assets. Thus, before we multiply by $1 million, the premium reflects the percentage markup the market places on the assets of those firms performing the activity. Subtracting one and multiplying by $1 million converts the percentage to the value per million in assets.

We then multiply the premium by the average level of assets for the REITs that are participants to estimate the market value associated with the measure of participation. This follows from the fact that *q* values provide the market's valuation of a firm's assets. Thus, multiplying by the level of assets converts the premium into a market value. We begin by discussing the estimated premiums and market values for joining ENERGYSTAR®, benchmarking, and energy efficiency in general. We follow that with our estimate and discussion of the lost opportunities of not joining ENERGYSTAR®.

Value of Joining ENERGYSTAR®, Benchmarking, and Energy Efficiency

We estimate the value of the ENERGYSTAR® program by using the estimated switching regression model. The structure of this model allows us to estimate *q* values for partners if they had not joined ENERGYSTAR®. Thus, we can compare the *q* associated with partnership to the *q* associated with not being a partner for each partner in the sample at each time period. The *q* value associated with partnership is calculated by generating predictions from the partner model for each partner observation. The *q* value of partners *had they not joined the program* is calculated by generating predicted values for the partners using the non-partner model. Maddala (1983) suggests looking at the difference between these two numbers to gauge a program's effect. We use the ratio instead because relative *q* values are more easily interpreted as ratios. That is, for partner *i*, the benefit of participating in the program at time *t* can be calculated as

$$\frac{E[q_{1it}|D_{it} = 1]}{E[q_{2it}|D_{it} = 1]} = \frac{\boldsymbol{X_{1it}}\beta_1 - \sigma_{1\varepsilon}\hat{W}_{1it}}{\boldsymbol{X_{1it}}^*\beta_2 - \sigma_{2\varepsilon}\hat{W}_{1it}} \tag{21}$$

where $\boldsymbol{X}_1^*$ is the $\boldsymbol{X}_1$ matrix with *BENCH* and *LABEL* removed.[28] The average of equation (21) over all observations where $D_{it} = 1$ provides an estimates of the average benefit of participating in the ENERGYSTAR® program. We use this average ratio in calculating the ENERGYSTAR® premium.

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[28] In calculating (21) it is necessary to adjust the matrix $\boldsymbol{X}_1$ in the denominator or the vector β_2 so that their dimensions make multiplication possible. Specifically, *BENCH* and *LABEL* do not have corresponding coefficients in β_2. To handle this, we remove those variables from $\boldsymbol{X}_1$ and re-label the new matrix $\boldsymbol{X}_1$*.

To value benchmarking, we use the estimated model for partners in Table 3 to predict a q value associated with some level of benchmarking (say $\bar{B}$) and compare that to a predicted q value associated with not benchmarking any buildings. This can be written as

$$\frac{E[q_{1it} \mid BENCH = \bar{B}]}{E[q_{1it} \mid BENCH = 0]} \tag{22}$$

We use the median level of benchmarking among partners to compute the numerator of (22) and evaluate all other variables also at their median levels. Equation (22) provides an estimate of the increase in q values for partners that perform a median level of benchmarking, compared to performing no benchmarking.[29]

As discussed in the econometric methods section, the estimated coefficient for the partnership variable in the pooled model will reflect the sum of three separate effects: the direct effect of ENERGYSTAR® on q, the reputational effect associated with partnership, and the effect of a company's propensity for being energy efficient on q. We interpret this combined effect as the effect of energy efficiency, as proxied by ENERGYSTAR® partnership, on intangible value. To calculate this value, we use the pooled model and predict the q value associated with partnership ($D = 1$) and compare that to the q value associated with not being a partner ($D = 0$). The ratio of these predicted q values can be written as

$$\frac{E[q_{it} \mid D = 1]}{E[q_{it} \mid D = 0]} \tag{23}$$

To calculate these predicted values, we set each variable in the equation equal to its mean value except for *D*, *BENCH*, and *LABEL*. We set *BENCH* and *LABEL* both equal to zero to remove the influence of these other program-related variables on our measure.

Table 4 provides our estimates for each of the three measures discussed above. We estimate that the ENERGYSTAR® premium is $16,026 per million dollars of assets for REITs that are partners. That is, for every million in assets, ENERGYSTAR® partners earned an average return of $16,026 in intangible

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[29] The median amount of benchmarked space among the partners in our sample is 1.9 percent of total floorspace per quarter per REIT. In constructing the benchmarking variable, a building was considered to be "benchmarked" in a certain quarter if a benchmark score had been generated for it within the last year. The average amount of benchmarked space in our sample of partners was 9.2 percent of total floorspace per quarter.

value above what they would have earned had they not joined the program. Based on our formulation and our use of the switching regression model, we attribute this premium directly to a REIT's partnership in ENERGYSTAR®. Multiplying by the average level of assets for REITs that are partners, this premium translates into an average market value of $51.67 million, representing 3.66 percent of the average market value of these companies.

We estimate that benchmarking has earned partners a premium of $6,437 per million in assets. Thus, partners performing a median level of benchmarking (i.e., 1.9 percent of total square footage) earned an average return of $6,437 for every million in assets beyond what they would have earned if they performed no benchmarking. This translates to an average market value of $20.75 million for partners that benchmark, representing 1.47 percent of the average market value for these companies.

The estimated premium associated with benchmarking also indicates that active participation in the ENERGYSTAR® program has benefits. Not all ENERGYSTAR® partners benchmark their buildings. Our estimates indicate that a small amount of benchmarking (1.9 percent of total square footage) earns a return of 0.64 percent on assets. This return is *in addition to* the return earned for being a partner. Thus, a partner benchmarking about two percent of its floorspace earns a premium of $22,463 per million in assets, or a return of 2.2 percent. This translate to $72.42 million in market value, representing 5.13 percent of the market value of REITs that are partners.

Finally, we estimate that energy efficiency earns REITs a premium of $45,564 per million in assets. That is, taking participation in ENERGYSTAR® as a measure of energy efficiency, REITs that are partners earned a return of $45,564 for every million in assets above that of REITs that are not partners, and presumably less energy efficient. This translates into a market value of $146.89 million, representing 10.4 percent of the market value of these companies.

Lost Opportunities from Not Joining ENERGYSTAR®

We now look at the extent to which REITs that did not join the program lost intangible value from not joining.[30] Above, we estimated the intangible value that partners would have had if they had not

[30] The switching regression model assumes that partners and non-partners self-select into their respective groups, with self-selection based on an evaluation of the (unobserved) net benefits of joining.

joined ENERGYSTAR®, which provided a means of assessing the program benefits. In a similar manner, we can use our estimated models to predict the *q* value for non-partners if they had joined the program. We can calculate this in a manner analogous to equation (21). This can be written after making the appropriate substitutions as:

$$\frac{E[q_{1it}|D_{it} = 0]}{E[q_{2it}|D_{it} = 0]} = \frac{X_{2it}^{*}\beta_1 + \sigma_{1\varepsilon}\hat{W}_{2it}}{X_{2it}\beta_2 + \sigma_{2\varepsilon}\hat{W}_{2it}} \tag{24}$$

In calculating (24), we need to make an assumption on how much benchmarking and labeling each non-partner would have done under the program. Given that both are program-related activities, we think it reasonable to assume that non-partners would have done no benchmarking or labeling. Thus, we add two columns of zeros to $\boldsymbol{X}_2$ that correspond to these variables and call the new matrix $\boldsymbol{X}_2^{*}$. The average over all *i* and *t* where $D_{it} = 0$ will provide information on whether or not non-partners were better off not participating in the program. A more interesting measure, however, is the average of all observations where (24) is greater than one. These observations represent cases where the non-partners would have been better off as a partner and can be called "lost opportunity."

We calculated equation (24) for each of 1,232 non-partner observations. The average value for that calculation was 0.901, implying that, on average, non-partners had higher intangible value from not joining ENERGYSTAR®. There are, however, 377 observations (30.5 percent of the 1,232) in which the ratio exceeded one, implying that in those cases non-partners would have been better off by joining ENERGYSTAR®.[31] These 377 observations were distributed across 50 different REITs (41 percent of the non-partners). Thus, there were 50 REITs that would have been better off at some point between 1999 and 2001 had they joined ENERGYSTAR®. Of these 50, 20 of them would have been better off as a partner for the whole sample period. The average value of the ratio for observations that exceeded one was 1.099, which translated to an average lost premium of $98,925 per million in assets for those observations.[32] Thus, not joining ENERGYSTAR® resulted in a significant level of lost value for non-partners.

Finding cases where non-partners would have had higher intangible values had they joined ENERGYSTAR® does not invalidate that assumption because intangible value is only one component of the net benefit calculation.

[31] Once again, an observation corresponds to a REIT in a specific quarter. Thus, there were 377 quarters in which REITs could have had higher intangible values by joining ENERGYSTAR®.

[32] This estimate is large, but reflects only observations that exceed one.

9. Summary and Conclusions

This paper looks at the relationship between participation in the EPA ENERGYSTAR® program and a firm's intangible value. We used a sample of REITs measured quarterly from 1999 to 2001. We constructed models of the relationship between Tobin's q, a measure of intangible value, and participation in the ENERGYSTAR® program. Our models controlled for a number of factors, including self-selection into the ENERGYSTAR® program by companies, market conditions, firm characteristics, and firm-level financial factors. We found that the REITs involved in the ENERGYSTAR® program received a return of $16,026 for every million in assets above the amount they would have earned had they not joined the program. Based on the modeling procedure that we used, we attribute this return to the ENERGYSTAR® program. We also found that ENERGYSTAR® partners that benchmark a small number of buildings (1.9 percent of their total floorspace in a quarter) earn a return of $6,437 per million in assets. We attribute this benefit to activities that are associated with building benchmarking, such as efficient building operation. Finally, we found that energy efficiency, as proxied by participation in the ENERGYSTAR® program, earned partners a return of $45,564 per million in assets. This return translated into 10.4 percent of the market share of these companies. Thus, for REITs, where energy is a substantial concern, energy efficiency represents 10.4 percent of the market share of the energy efficient companies.

Our results are applicable to three distinct areas. First, we have provided estimates of the value created by a public voluntary program for program participants. The 1993 Government Performance and Results Act (GPRA) requires federal agencies to assess their performance. Our results are directly relevant to assessments of program performance under GPRA. Our results indicate that REIT partners earn a return of $16,026 per million in assets for being a partner. Furthermore, these results are directly attributable to the ENERGYSTAR® program. Although the key results for the ENERGYSTAR® program are related to reducing energy-related environmental effects, our results provide valuable information on the market value created by the program.

The results of this paper are also directly relevant for program recruitment efforts. The key for voluntary environmental programs to improve environmental conditions is recruit participants that take an active role in the program. Our results indicate that both joining the program and being an active participant create value for REITs. As noted above, REITs that join ENERGYSTAR® earned an average return of $16,026 per million in assets. Thus, joining ENERGYSTAR® has value. Additionally, REITs that took an *active role* in the program, as measured by benchmarking buildings, earned an *additional* return of $6,437 per million in assets for only a modest level of benchmarking (1.9 percent of total floorspace in any given quarter). Thus, a partner benchmarking about two percent of its floorspace earns a premium of $22,463 per million in assets. Both of these results should provide valuable information for the program's recruiting efforts.

Finally, our results should be directly relevant for investors and analysts that follow the REIT industry stocks. The results from our pooled model indicates that energy efficiency earned REITs a return of $45,564 per million in assets. This translated to a market value that represented 10.4 percent of the value of these companies. To measure energy efficiency in our model, we used whether or not the REIT was an ENERGYSTAR® partner. Thus, partnership in ENERGYSTAR® offers a convenient measure of which companies earn superior returns for their energy efficiency.

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Table 1. Definitions and Summary Statistics for Variables Used in the Analysis

Variable	Definition	Mean	Standard Deviation
Tobin's *q*		0.9231	0.2084
Partners	Ratio of market value to replacement value of assets.	0.9453	0.2188
Non-Partners		0.9174	0.2062
PART	Equal to one if REIT *i* was a partner in quarter *t* and zero otherwise	0.1409	0.3480
BMRATIO	Percentage of buildings that are benchmarked for REIT *i* in quarter *t*.	0.0151	0.0748
LBRATIO	Percentage of buildings that are labeled for REIT *i* in quarter *t*.	0.0041	0.0376
NRET	Quarterly return for NAREIT's Equity REIT Index, multiplied by 100.	2.887	6.001
SBETA	Stock market beta calculated over the 1996-2001 time period using end-of-month stock prices.	0.1271	0.0969
TSQFT	Total square feet owned by the REIT (millions).	32.59	70.57
Ln(*TSQFT*)	The natural logarithm of total square feet.	16.523	1.301
TA	Total assets in millions of dollars.	1,558.8	2,255.3
Ln(*TA*)	The natural logarithm of total assets.	6.933	1.175
CONC	Herfindahl index of property-type concetration.	0.8935	0.1790
q_b	Average value of Tobin's q between 1996 and 1998.	0.9076	0.3106
ROA	Return on assets	0.0104	0.0323
OFFICE (office)	Equal to one if more than 75 percent of the REIT's total square footage was in the office sector and zero otherwise.	0.1262	0.3322
RET (retail)	Equal to one if more than 75 percent of the REIT's total square footage was in the retail sector and zero otherwise.	0.5160	0.4999
IND (industrial/ warehousing)	Equal to one if more than 75 percent of the REIT's total square footage was in the industrial and warehousing sector and zero otherwise.	0.0753	0.2439
HC (health care)	Equal to one if more than 75 percent of the REIT's total square footage was in the health care sector and zero otherwise.	0.0635	0.2439
LODGE (lodging)	Equal to one if more than 75 percent of the REIT's total square footage was in the lodging sector and zero otherwise.	0.0962	0.2950
APT (residential)	Equal to one if more than 75 percent of the REIT's total square footage was in the residential sector and zero otherwise.	0.1632	0.3670
STOR (self-storage)	Equal to one if more than 75 percent of the REIT's total square footage was in the self-storage sector and zero otherwise.	0.0251	0.1564

Table 2. Results for Probit Model For Joining ENERGYSTAR® Program (N = 1,434)

Variable	Estimated Coefficient	Marginal Effect On Probability of Joining ENERGYSTAR® [a]
Constant	-4.402*** (-4.02)	-
Return to the NAREIT Equity Index (*NRET*)	0.026*** (3.01)	0.0035
Log of total square feet (ln(*TSQFT*))	-0.038 (-0.352)	-0.0051
Log of millions of total assets (ln(*TA*))	0.418*** (3.14)	0.0557
Return on assets (*ROA*)	1.364* (1.85)	0.1817
Return on assets, lagged one quarter (ROA_{t-1})	1.551*** (2.02)	0.2065
Pre-1999 Tobin's q (q_b)	0.749*** (4.573)	0.0997
Stock market beta (*SBETA*)	1.294*** (2.32)	0.1723
Residential sector (*APT*)	-7.883*** (-55.16)	-0.0961
Industrial and warehousing sector (*IND*)	-0.386* (-1.86)	-0.0506
Lodging sector (*LODGE*)	-7.343*** (-47.64)	-0.0961
Health care sector (*HC*)	-7.343*** (-47.64)	-0.0961
Office sector (*OFFICE*)	1.202*** (9.94)	0.3634
Self-storage sector (*STOR*)	-7.664*** (-55.54)	-0.0961
Log-likelihood	-366.70	-
Likelihood Ratio Statistic	432.54***	-

Note: The base sector in this table is retail.
[a] This is the effect of each variable on the probability of joining the ENERGYSTAR® program. For the continuous variables (*NRET*, ln(*TSQFT*), ln(*TA*), *ROA*, ROA_{t-1}, q_b, and *SBETA*), this is measured at the mean value for each variable. For the remaining binary variables, this reflect the change in probability associated with setting the binary variable equal to one.

Table 3. Estimated Regression Models for Tobin's q

Variable	Switching Regression Model: Partners (N = 202)	Switching Regression Model: Non-Partners (N = 1,232)	Pooled Regression Model (N = 1,434)
Constant	-0.8087** (-2.10)	-0.0340 (-0.52)	0.0709* (1.82)
ENERGYSTAR® partnership (*D*)	-	-	0.0417*** (3.82)
Benchmarking (*BENCH*)	0.2966** (2.10)	-	0.1445*** (2.19)
Labeling (*LABEL*)	-0.0460 (-0.20)	-	0.0950 (0.78)
Return to the NAREIT Index (*NRET*)	0.0034 (1.48)	0.0031*** (4.04)	0.0030*** (7.34)
Stock Market Beta (*SBETA*)	-0.4166* (-1.96)	-0.0995* (-1.96)	-0.1939*** (-7.15)
Log of Total Square Feet (ln(*TSQFT*))	0.0593*** (2.83)	0.0269*** (7.41)	0.0243*** (11.83)
Concentration (*CONC*)	0.0327 (0.33)	0.1907*** (6.04)	0.1789*** (9.35)
Pre-1999 Tobin's Q (q_b)	0.8300*** (9.98)	0.3810*** (25.64)	0.3974*** (49.8)
Return on Assets (ROA_t)	-2.7518* (-1.78)	-0.1291 (-0.95)	-0.1522* (-1.81)
Return on Assets, previous quarter (ROA_{t-1})	-1.508 (-0.97)	-0.081 (-0.59)	-0.0966 (-1.14)
Office Properties Sector	-	-	-0.0623*** (-5.00)
Retail Sector	-	-	-0.0469*** (-5.668)
Self-Selection Correction (W_{1it}, W_{2it}, W_{it})	-0.0111 (-0.29)	0.0015 (0.06)	-0.0066*** (-5.62)
R^2	0.8382	0.8184	0.8046
Adjusted R^2	0.8298	0.8172	0.8028

Asymptotic t-ratios appear in parentheses.
*** Significant at the one percent level.
** Significant at the five percent level.
* Significant at the ten percent level.

Table 4. Estimated Premiums and Market Value for ENERGYSTAR® Program, Benchmarking, and Energy Efficiency.

Measure	**Estimated Premium (Value Per Million Dollars of Assets)**	**Market Value (Millions)**	**Percentage of Total Market Value**
Value of Being an ENERGYSTAR® Partner	$16,026	$51.67	3.66%
Value of Benchmarking Buildings for Energy Performance	$6,437	$20.75	1.47%
Value of Being an ENERGYSTAR® Partner and Benchmarking Buildings (Active partnership)	$22,463	$72.42	5.13%
Value of Energy Efficiency	$45,564	$146.89	10.40%

Session IV: Evaluation of Voluntary Programs
Discussant No. 1: Charles Griffiths, U.S. EPA, NCEE
COMMENTS ON:

The ISO 14001 Management Standard:
Exploring the Drivers of Certification

Andrew King
Darmouth College

and

Participation in Voluntary Programs, Corporate Reputation, and Intangible Value: Estimating the Value of Participating in EPA's ENERGY STAR® Program

Lou Nadeau
ERG, Inc

April 27, 2004

Recently, two of my colleagues, Ann Wolverton and Keith Brouhle, and I were asked to write a book chapter on U.S. voluntary programs. We have been working on ways to evaluate the effectiveness of voluntary programs, so this was a good way to review the literature. Our conclusion was that the current economic literature has not produced strong evidence of improved environmental performance due to voluntary programs. Some programs have been recognized as improving performance, but, in general, voluntary programs have not yet been shown to produce dramatic improvements. We do recognize, however, that there are a number of objective, other than improved environmental performance, that might justify a voluntary program. Objectives such as improved economic efficiency (that is, the program might produce greater net benefits to society); savings in administrative, monitoring, and enforcement costs for the same environmental impact; the inducement of innovation; or increased environmental awareness.

As you might guess, the response from individuals in the voluntary program offices was mixed. Two responses, however, are of interest. First, one individual said that economists are obsessed with economic efficiency. If it doesn't look and smell like cap-and-trade, then they don't like it. His concern seemed to be that there are other, non-economic and non-quantifiable objectives for these programs that economists miss. The second comment was that the text was very negative. After recognizing that the economic literature may not have found much environmental impact of these programs, I was asked if I could include a sentence along the lines of "that said, well designed voluntary approaches can be a highly effective tool for environmental protection." The review offered no additional basis for the inclusion of this sentences, but I understood that it reflected a deep belief that voluntary programs are an important component of the EPA mission, even if the economists can't quantify it.

Certainly there has been a growth in voluntary programs. Our chapter identifies 55 voluntary programs administered by the EPA and established since 1991. There is also anecdotal evidence that they have had some impact. As one reviewer of our chapter informed me, Robert J. Eaton, when he was chairman of Daimler Chrysler and chair of the National Academy of Engineering said, "Life Cycle Management had convinced us that 'pollution prevention pays.' Not only doe it pay, but it can be a competitive advantage."

In this session, we have heard two excellent papers that attempt to get at the advantages of voluntary programs. Both are econometrically sophisticated. King, Lennox, and Terlaak (2004) explicitly take into account the correlation between establishing an EMS and ISO 14001 certification. Personally, I expected to see a two stage approach, particularly if we believe that ISO certification follows the establishment of an EMS. One approach would be to use an inverse Mills ratio as in the next paper. Nadeau, Cantlin, and Wells (2004) use this approach to explicitly account for self-selection into a program. In this paper, I would suggest allowing the participation variable to affect the slope term as well as the constant.

If we look at the left hand side variables in these papers, we see a very common construction, and one which I would like to talk about. Both studies looked at some outward mark of participation in a voluntary program, but not necessarily at the environmental improvements that this participation produces. King, et al. examine the establishment of an EMS or ISO 14001 certification in the majority of their paper, and only look at the effect on environmental performance at the end. Nadeau, et al. looked at the market value of participation in Energystar and not the environmental benefit of the program. Both sets of authors recognize this point. Nadeau, et al. state that they "... are looking at how good energy performance, rather than good environmental performance, relates to financial performance." The decision to look at this relationship, rather than environmental performance, may be related to the difficulty in finding measurable environmental gains due to participation in these programs. As King, et al. note regarding their program, "many expected ISO 14001 to produce a means of credibly differentiating organizations with better environmental performance. Our analysis suggests that this expectation went unfulfilled."

A more careful look at these analyses, however, may suggest a more complicated story. In King, et al., regulatory pressure affects the establishment of an EMS and an EMS is a statistically significant determinant of environmental improvements. EMSs, then, are important but are a less transparent measure of corporate environmental actions. In contrast, the outward mark of good environmental management, ISO 14001 certification, is not statistically affected by regulatory pressure and does not have a significant impact on environmental performance. Similarly, in Nadeau, et al., the measure of good environmental activity which is not witnessed by the market, benchmarking buildings, is a significant factor in the Tobin's q premium. The outward label of Energystar, on the other hand, is not statistically significant. So, while the outward mark of environmental performance, ISO 14001 certification and the Energystar building label, is not a significant driver in environmental or financial performance, the less evident measure is significant.

Why is this important? Because the outward mark is measurable and is often the only thing available for evaluation. It is, however, confounded by the fact that it could simply be a measure of EPA's efforts in recruiting partners. This has been the recent concern of OMB and others, that voluntary programs shouldn't measure success by the number of partners they recruit, since it is measuring the desired output, environmental gains, by measuring inputs, the success in recruiting partners. This may be why some researchers have not found big environmental gains by measuring participation in voluntary programs – it is confounded by the effort in recruiting those partners. The participation variable may be a noisy indication of the actual, unobservable measure of environmental performance. To the degree that participation requires or increases the unobservable measure of good corporate environmental activity, an EMS or benchmarking, then the voluntary program is responsible for improved environmental performance. It may be difficult to evaluate, however, because of a lack of appropriate data.

In this case, the authors were lucky to the appropriate data. King, et al. had TRI data, which included a measure of EMS activity. Nadeau et al. had internal Energystar benchmarking data. Many times, however, this type of data is not available, and it is precisely this lack of data that my coauthors and I have found as a limiting factor for evaluating voluntary programs. It is hard to avoid the conclusion that researchers have, so far, not found big environmental gains from voluntary programs. The point is that this may be due to the fact that the outward mark of environmental performance may only be a noisy indicator of actual underlying corporate activity. In other words, and as my reviewers were trying to emphasize, there may be unquantified factors that economists sometimes miss and perhaps we shouldn't be so negative about voluntary programs. Only more accurate, underlying data and additional research will tell.

Session IV: Evaluation of Voluntary Programs
Discussant No. 2: Jorge Rivera, George Mason University
COMMENTS ON:

The ISO 14001 Management Standard:
Exploring the Drivers of Certification

Andrew King
Darmouth College

and

Participation in Voluntary Programs, Corporate Reputation, and Intangible Value: Estimating the Value of Participating in EPA's ENERGY STAR® Program

Lou Nadeau
ERG, Inc

1. Strategic enactment of a new institution: Exploring the causes of certification with the iso-14001 management standard. By King, Lenox, and Terlaak

This is an excellent paper from both the theoretical and empirical perspectives. Using a strategic analysis approach the manuscript develops a conceptual framework and hypotheses to explain under what circumstances corporate facilities are more likely to certify with ISO-14000. The authors argue that supply chain's information asymmetries, which make the exchange of credible environmental reputation difficult, are one of main reasons why facilities decide to obtain ISO-14000 certification. These hypotheses are then tested using a proportional hazard model and 1995-2002 panel data for a sample US-based facilities.

Their findings suggest that ISO-14000 certification is used as a signal of environmental improvement efforts rather than an indication of superior environmental performance. Certification is more likely for facilities that are more distant in terms of geography and culture and for those with long term or vertically integrated associations to downstream buyers. My main criticism to King, Lenox, and Terlaak's approach is that they use US-based facilities to assess ISO-14000, an international standard whose participants are mostly outside the US.

2. Participation in voluntary programs, corporate reputation, and intangible value: Estimating the value of participating in EPA's Energy Star Program. By Nedeau, Canting, and Wells.

This paper relies on quarterly 1999-2001 data of 124 real investments trusts to estimate the market value (measured as Tobin's q) of the Energy Star Building program. The authors suggest that the Energy Star provides its partners with benefits of about sixteen thousand dollars per each million dollars of assets.

I believe that the manuscript uses a very good approach and valuable data to try to answer a critical question regarding the use of voluntary environmental programs as an alternative policy tool to promote environmental protection. Yet, I would encourage the authors to improve the paper in the following areas:

1. The review of the literature needs to incorporate the research on voluntary programs published in the management and public policy journals.
2. Given its focus on intangible assets and capabilities, the authors may find it valuable to incorporate arguments from the resource view of firm to support their hypotheses, discussion, and conclusions.
3. The authors put a big emphasis on the importance of reputation but only use an instrumental variable that accounts for this and other constructs. Thus, it is necessary to incorporate a direct measure of reputation in the analysis.
4. The issue of reverse causality needs to be addressed in the discussion and conclusions.
5. Finally, the authors need to include a section that explicitly highlights the limitations of their approach and findings.

Summary of the Q&A Discussion Following Session IV

Matt Clark (U.S. EPA, Office of Research and Development)
For people who are looking for money for data, I understand the Japanese and European economies are doing pretty well right now. [laughter]

I'm relaying a question from William D'Alessandro from Crosswinds Bulletin—one of the people who have joined in on the phone and the internet: Mike, could you re-state, for Bill's benefit, why companies certify ISO 14001?

Michael Lenox (Duke University)
In responding to this question, Dr. Lenox clarified that their research indicates that certifying "seems to be signaling simply that you have an EMS in place and *not* signifying some secure, underlying environmental quality."

Eric Otis (University of Pennsylvania)
Addressing the first of two questions to Dr. Lenox, Dr. Otis referred to the literature that TRI commonly uses and asked "whether a footnote isn't appropriate there as to what it really is measuring, because [he thinks] it's at least possible to say that EMS's and ISO 14000 programs actually are providing some environmental performance benefits that are not captured by the TRI measure." Characterizing the TRI measure as "very high level, gross information," Dr. Otis said he doubted whether this was the best measure for gauging firm-level environmental performance, and he advised Dr. Lenox to "at least qualify your result on that point."

Dr. Otis directed his second comment to Louis Nadeau regarding the correlation between "better firms, in terms of monitoring conditions, etc." and participation in the Energy Star Program. Dr. Otis questioned the assumed causation direction of the correlation and said he believes the causation can go both ways. In other words, since it is as likely that "better firms can afford to be doing Energy Star" as it is that "Energy Star [participation] is worth more money, . . . you really wouldn't want to conclude that there's a huge amount of value in Energy Star. It may be going the reverse direction—those firms that are better managed already can afford to do Energy Star Programs, which may be providing environmental benefits, but it's not then as clear what follows from what." Dr. Otis wondered whether Dr. Nadeau had accounted for "that potential reverse causation," which, he believes, "shows up in a lot of other studies as well."

Michael Lenox
Dr. Lenox responded that because they were dealing with manufacturing firms . . . at the facility level, "at *some* level, emissions is a *good* measure of facility-level environmental liabilities." He went on to acknowledge that what Dr. Otis said is "absolutely correct," in that the researchers used this measure "as a *proxy* for some kind of unobserved environmental quality, and there could be a number of attributes and elements in that."

Dr. Lenox went on to say that he and his colleagues, and other researchers as well, really *should* have been and really *need* "to be curious about the correlation between TRI measures and things like NO_x-SO_x emissions, accidents, violations and the like." He closed by saying that it was his hope and speculation "that there is *some* significant correlation between these various metrics," but he isn't aware of anyone who has actually performed an analysis of that as yet.

Lou Nadeau (ERG, Inc.)
Dr. Nadeau responded to the second question from Dr. Otis pertaining to the probable bi-directional nature of causation between a firm's participation in the Energy Star Program and that firm's financial health by saying, "It's a valid point—clearly, better companies tend to join Energy Star, and so any sort of correlation in compliance needs to be interpreted in that light." He said that they used the Heckman self-selection tool in the first stage of the study to capture the first level of causation, *from* corporate value *to* participation in Energy Star, and are "hopefully getting at the causation running *from* participation *to* value" in the second stage of the study. He closed by affirming that the team is attempting to control for as many things as possible.

Jon Silberman (U.S. EPA, Office of Enforcement and Compliance Assurance)
Mr. Silberman opened by stating, "First, I'd just like to point out that there is, in fact, an extensive amount of research out of Europe that also looks at the question of ISO 14000 certification and its relationship to performance, but since we have one of the leading European researchers, Chris Howes from the United Kingdom Environment Agency, waiting to speak at the other microphone, so I'll just stop there."

Mr. Silberman continued, directing this comment to Dr. Lenox: "I'm wondering if ISO 14000 coupled with certification is not functioning very similar to how a rule might function as a mandatory requirement out of government followed by inspections." He clarified this idea by adding, "if people who adopt EMS's without certification are doing better than people who certify, *is* the certification process potentially dumbing down people's EMS's by making them managed towards achieving a piece of paper that, based on my ISO 14001 auditor training and years of experience with ISO 14000, is *quite* easy to get and *totally* dissociated from actual performance?"

Michael Lenox
In response to the availability of data from Europe, Dr. Lenox commented that these data are often difficult to use from a researcher's perspective due to the lack of comparability across the data sets. As an example, he suggested that finding a European measure "that maps very nicely to TRI . . . would require some coordination that . . . would be very difficult to achieve."

Addressing Mr. Silberman's second issue, Dr. Lenox stated that "suggesting that the EMS is great and then the certification dumbs it down . . . would be an incorrect interpretation of our findings. It's simply the fact that there are forces that are driving the adoption of EMS's *independent* of certification, and that often the existence of an EMS makes it much easier, then, for you to get certification."

Chris Howes (Environment Agency, England and Wales)

Mr. Howes cited two European studies of environmental management systems—one that looked at performance data and compliance history from over 2,500 regulated sites, and another pan-European industry study that looked at data from 450 sites. He said these two studies had fairly common findings: basically, "there is no correlation between good environmental performance or compliance and certification with ISO 14001, or indeed registration to EMAS," (a European program that Mr. Howes characterized as "ISO 14000 *plus*"). Mr. Howes went on to say that "the very clear message with regard to *legal* compliance is: If we as a regulator wanted to target sites based on whether or not they had EMS's, which seems to be sensible thing to do, . . . we should target those sites *with* ISO 14001 *or* EMAS because they are *more* likely to have noncompliances and they are more likely to have poor environmental performance."

Citing a current 3-year project being managed by the Environment Agency (the REMAS Project—more information available at www.remas.info), Mr. Howes advocated looking at broad "benchmark performance and the existence, or otherwise, of EMS's at a much greater level of sensitivity" than is typical with ISO or REMAS. "It's looking at the elements of a management system that are in place and comparing those to compliance and to the normally regulated issues in terms of emissions to air, land, and water." Mr. Howes also mentioned the more recent regulatory categories for major industry in Europe of energy efficiency and resource efficiency. Getting to his main point, Mr. Howes asked, "if certification and registration in the U.S. and the rest of the world doesn't add value, shouldn't *this* be the issue for all stakeholders in ISO 14001—the public, regulators, and industry? . . . Shouldn't we be pushing for *outcomes*, not *process*, from ISO—from the accreditation bodies, from registrars?"

According to Mr. Howes, UKAS, the accreditation service in the U.K. that is somewhat equivalent to RAB [Registrar Accreditation Board, established in 1989 by the American Society for Quality], has recently come out and said that, essentially, "ISO 14001 is not driving improvement; . . . the qualifications of offices aren't good enough; the accreditation bodies aren't good enough." Ultimately, Mr. Howes wonders, "What are we [including the U.S. EPA and others] going to do about this?"

Jay Benforado (U.S. EPA, National Center for Environmental Innovation)
Before turning to the paper writers for their responses, Mr. Benforado paraphrased the question as: "Could you foresee some utility in certification of *performance* rather than certification of *process*?"

Michael Lenox
Dr. Lenox responded, "First of all, I take a little issue with the idea that certification doesn't add value. The question is: *Who* does it add value to and *to* what ends? I think it

does probably add value for those in the supply chain who want to try to have some, perhaps, management over those facilities. From a public *policy* standpoint, does this lead perhaps to a reduction in environmental emissions and the like? Once again, we're finding that might not be working the way we had hoped. So, *should* public policy perhaps get involved and step in and try to put more teeth in something like ISO 14001? Perhaps, *but* to the extent you're interested in self regulation, it begins not to look like self regulation much anymore, obviously, with the EPA stepping in and mandating and dictating."

Allison Christie Sajan (Natural Resources Canada)
Ms. Christie Sajan said that Natural Resources Canada has been looking at many of these same questions and that the companies they have heard from who have applied various types of environmental management tools, such as EMS's, believe they are realizing real benefits from these efforts. She commented that they are in the first phase of a 3-year study of companies that have *not* employed an EMS and would welcome any dialogue or suggestions.

Madhu Khanna (University of Illinois)
Dr. Khanna raised a question "related to the result . . . that firms who have an EMS *did* show some improvement in environmental performance but not the ones that actually got certified." She went on to say, "If I understand correctly what you're doing, you're looking at firms that just started that have an EMS, and the second group is firms that have an EMS but also got certified." Dr. Khanna concluded by saying she was "really intrigued by why it is that firms that actually went ahead and got the certification, which presumably verified that their EMS had all the right elements and so on, did *not* achieve the environmental improvements that the other firms did."

Michael Lenox
Dr. Lenox replied, "I apologize for that—that is not correct—the interpretation is that *that* is the pool of *all* who get EMS, not just the ones who *don't* get certified. So, we're looking at two pools here—those who get EMS and that effect on improvement, and then *certification*, which is a *sub-sample* of those who have an EMS. So, the argument, which is not surprising actually, is that certification in and of itself *does not* lead to any improvement, and I'm not sure why it would be expected to. If you have a functioning EMS, *that's* what should lead to improvement—not the certification per se. So, to be clear on that, in that pool of [firms with an] EMS is both those who get certified and those who don't get certified."

Madhu Khanna
Dr. Khanna then suggested investigating whether having an EMS and certification *together* is better than just having an EMS.

Michael Lenox

Dr. Lenox responded that "supposedly the certification variable tries to pick that up, and we *don't* find that. . . . Again, to be clear, there are incentives, perhaps, to improve environmental performance that drive you to adopt an EMS. There are *other* kinds of incentives that are dangled giving you incentives to certify that are not necessarily commensurate with that."