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# Environmental Policy Performances for Sustainable Development: From the Perspective of ISO 14001 Certification

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## Abstract

This study investigated the financial performances of environmental policy by using the long-term effect of ISO 14001 certification. Drawing on a natural-resource-based view of the firm, this study examined abnormal performances of ISO 14001 certified firms on the New York Stock Exchange (NYSE) and National Association of Securities Dealers Automated Quotations (NASDAQ) in the USA during the period 1996–2010 employing a rigorous event study methodology. The results indicate that the profitability variables showed immediate positive abnormal effects after firms applied for the ISO 14001 certification, while the market benefit variable showed gradual improvements after obtaining the certification. However, ISO 14001 did not show significant effect on the internal process improvement. Overall, ISO 14001 was found beneficial to the firm in the long run from the perspectives of profitability and market benefits.

**Keywords:** environmental policy, ISO 14001, sustainable development, event study

## Introduction

Over the past few decades, green management has been increasingly proposed as a new driving force which can improve not only environmental performance but also economic outcome of the firm (Hart, 1995; Zhu *et al.*, 2010). Recognizing the potential of environmental management, several firms have implemented various environmental management practices. Among these practices, ISO 14001 is the world's most widely accepted environmental management standard which provides general guidelines for the environmental management system. As of 2015, ISO 14001 has been implemented by more than 300,000 organizations in 171 countries (ISO, 2015). Although the rate of ISO 14001 certified firms in the United States is not high among the developed countries, several US firms apply for the ISO 14001 certification every year to guide their green processes.

Although many buyers require their suppliers to adopt ISO 14001 standards to ascertain they have the capability to produce green product (Heras-Saizarbitoria *et al.*, 2011), there have been conflicting views regarding the financial effects of environmental management (Castro *et al.*, 2016). While the dominant view is that environmental management potentially contributes to improving firms' financial performance (Klassen & McLaughlin, 1996; Kitazawa & Sarkis, 2000; Handfield *et al.*, 2005; Barnett & Salomon, 2006; Vachon & Klassen, 2006), either negative (Walley & Whitehead, 1994; Gomez & Rodriguez, 2011) or at least inconclusive views (Boiral, 2007; Jacobs *et al.*, 2010) also exist. These various points of view imply that there is a definite need for a rigorous study regarding the relationship between environmental management and firm performance.

While several researchers have been increasingly interested in the economic benefit of ISO 14001, there has been a paucity of studies which investigated this issue by using the objective secondary data of US public firms. Most previous ISO 14001-related studies have collected data from surveys or interviews (Darnall, 2003; Potoski & Prakash, 2005; Boiral, 2007), which may lead to biased extrapolation inference since self-reported data often fail to reveal the real financial benefit of ISO 14001. Considering the market scale and the importance of the USA in the global economy, the financial impact of ISO 14001 should be studied among US public firms.

Furthermore, previous studies have not used a comprehensive set of firm performance variables. They focused on the contextual effect of the certification (Kitazawa & Sarkis, 2000; King *et al.*, 2005; Arimura *et al.*, 2011) or on a limited scope of firm performance (Potoski & Prakash, 2005; Curkovic & Sroufe, 2011; Heras-Saizarbitoria *et al.*, 2011). However, partial improvement of economic outcomes does not provide a compelling rationale for implementing ISO 14001 certification in terms of management decisions.

The primary motivation for this study is to examine the relationship between ISO 14001 and firm performance based on comprehensive and longitudinal perspectives. To the best of our knowledge, this is the first study which investigated the long-term financial effects of ISO 14001 by using the financial data of US public firms with the event study methodology. This study measured the long-term financial performance in various aspects (i.e., Return on Assets (ROA), Return on Sales (ROS), Stock price, COGS/Sales, and Sales growth rate (SGR)), to empirically verify how ISO 14001 certification is associated with a firm's profitability, internal process improvement, and market benefits.

This study is organized as follows. We first review previous studies related to general environmental management and those focused on ISO 14001. Based on the relevant previous studies, research hypotheses are developed. The methodology section describes the data collection and control procedures, and methods used to test the hypotheses. Next, we discuss results of the hypotheses tests and in then articulate the implications of the study results. Finally, we conclude the study with the limitations and possible future research directions.

## Issues and Hypotheses Development

Environmental sustainability has increasingly drawn attention from both management researchers and practitioners (Kouvelis *et al.*, 2006). Implementation of environmental management practices has become an important driver to gain competitiveness, contrary to the traditional concept that green processes are cost centers requiring sizable investments (Zhu *et al.*, 2010). From the traditional economic perspective, implementing green management practices burden the

firm with increased operating costs and decreased speed of the value chain as such programs require investment and process improvement (Friedman, 2007). For practicing managers, environmental management was considered compliance with environmental regulations, and there was a trade-off between environmental and economic outcomes.

However, going green is not just about being ecofriendly any more but having a business sense (Endrikat *et al.*, 2014; Reyes-Rodriguez *et al.*, 2016). A growing number of firms have adopted environmental management systems for improved competitiveness and higher profits (Wu & Pagell, 2011). The reason for implementing environmental management has changed from being just environmentally friendly to better profitability (Srivastava, 2007). Firms even began to consider green management as a business value driver to obtain sustainable competitive advantage (Wilkerson, 2005).

There has been an active debate among researchers regarding whether a firm can remain economically viable while pursuing environmental management (Orsato, 2006; Ambec & Lanoie, 2008). Several studies have showed the positive financial effect of environmental management (Florida & Davison, 2001; Barnett & Salomon, 2006; Peng & Lin, 2008). In this stream, corporate eco-friendly efforts can create proactive intangible assets and dynamic capabilities that contribute to improved firm performance (Russo & Fouts, 1997; Teece, 2007; Mzembe *et al.*, 2016). Environmental management can even be a source of superior financial performance of supply chain members (Rao & Holt, 2005; Srivastava, 2007; Zhu *et al.*, 2010; Lai & Wong, 2011).

However, not all studies have presented consistent results. Some studies have shown negative (Walley & Whitehead, 1994; Gomez & Rodriguez, 2011) or at best inconclusive (Boiral, 2007; Jacobs *et al.*, 2010) relationships between environmental management and financial performance. Testa and Iraldo (2010) suggested that the effect of green supply chain management on commercial performance is ambiguous. Zhu *et al.* (2007) also showed that green supply chain management did not provide clear economic benefits to supply chain members while it improved environmental and operational performance.

Over the past decades, studies have employed ISO 14001 certification as a proxy measure for environmental management. Zhu and Sarkis (2004) employed ISO 14001 as a measurement tool for green supply chain practices of Chinese enterprises. King *et al.* (2005) used

ISO 14001 management standards to investigate the individual actor's strategic motivation and the function of decentralized institutions. These studies indicated that the adoption of ISO 14001 would be successful when its implementation is appropriately supported by organizational resources. Stakeholders' participation in designing ISO 14001 implementation plans would build a firm's environmental ecosystem which cannot easily be imitated by competitors (Delmas, 2001). With a proper implementation, ISO 14001 can be a powerful tool for improving competitiveness (Sarkis, 1995).

The theoretical basis for developing the research hypotheses in this study is the natural-resource-based view of the firm (Hart, 1995; Hart & Ahuja, 1996). The firm's relationship with the natural environment plays a significant role in building sustainable competitive advantage (Aragon-Correa & Sharma, 2003). Although previous studies have not shown consistent results, the literature indicates that ISO 14001 is positively related, either directly or indirectly, to firm performance. ISO 14001 is expected to influence a firm's financial performance in three ways: profitability, internal improvement, and market benefit (Corbett *et al.*, 2005). By using ISO 14001 as a proxy measure for environmental management, we developed hypotheses in the tripartite framework following these three perspectives.

First, ISO 14001 certification potentially leads to a positive financial market reaction and improves a firm's profitability. It can serve as a comprehensive environmental framework to gain operational, managerial, and competitive benefits (Rondinelli & Vastag, 2000). Based on the literature which shows the positive financial impact of ISO 14001 (Chen, 2005; González-Benito & González-Benito, 2008; Potoski and Prakash, 2005; Arimura *et al.*, 2011), Hypotheses 1 and 2 are proposed. A firm's profitability was measured by ROA and ROS. ROA is defined as operating income divided by total assets to reflect the operating activities of the firm. ROS is defined as operating income divided by sales.

**Hypothesis 1.** *ISO 14001 certification is positively associated with the firm's ROA.*

**Hypothesis 2.** *ISO 14001 certification is positively associated with the firm's ROS.*

An increase in return on investment usually becomes a significant positive driver to influence valuation in the stock market. An environmental award such as ISO 14001 certification can potentially impact on the marketplace and the public to expect continued strong performance and increased future profits for the firm (Klassen & McLaughlin, 1996). Also, the improved corporate image by implementing green processes can affect valuation of a firm (Friedman, 2007). Since stock price is dependent on the expectation of the marketplace, it may increase after ISO 14001 certification. Therefore, Hypothesis 3 is proposed:

**Hypothesis 3.** *ISO 14001 certification is positively associated with the firm's stock price.*

ISO 14001 can enhance internal business processes as a tool to improve task visibility and reduce environmental uncertainty (Jiang & Bansal, 2003). Such internal improvements can lead to decreased costs related to material handling, training expenditure, treating scrap, and material loss, and other expenses associated with green innovation. Also, the adoption of ISO 14001 might be the reflection of organizational proactivity that supports innovation in operational processes (Florida & Davison, 2001). Although green management start-up costs can be sizable due to establishment of new facilities and systems, the firm's ultimate costs can decrease as its internal procedures improve process times. Thus, Hypothesis is suggested. Following Corbett *et al.* (2005), this study used the ratio of cost of goods sold to sales (COGS/Sales) to estimate such internal improvement.

**Hypothesis 4.** *ISO 14001 certification is negatively associated with the firm's COGS/Sales.*

Stakeholders usually impose normative and coercive pressures on the firm and these institutional pressures lead to adopting environmental management beyond regulatory compliance (Delmas & Toffel, 2004). A firm's proactive attitude to implement environmental management can be shown to customers as commitment to corporate social responsibility (Arlow & Cannon, 1982). Implementation of ISO 14001 may not only help firms comply with regulations but also



improve corporate image, leading to an increase in sales (Potoski & Prakash, 2005). Several global firms require their suppliers to secure ISO 14001 certification or use it as a minimal requirement for being their suppliers (Chen, 2005). Such business environment implies that ISO 14001 certification has a potential to increase the sales volume. Therefore, Hypothesis is suggested.

**Hypothesis 5.** *ISO 14001 certification is positively associated with the firm's SGR.*

The relative sales growth rate is defined as follows:

$$\text{SGR} = [\text{Sales}(t) - \text{Sales}(t - 1)] / \text{Sales}(t - 1) \quad (1)$$

## Methodology

This study employed the event-study methodology to measure the long-term financial effect of ISO 14001 certification. In general, event study is a methodology for investigating how a certain event, such as an announcement of a firm's policy or strategy, influences an organization's performance. This methodology is based on the efficient market theory. Fama (1991) stated that an efficient market fully incorporates all publicly available information. Under the hypothesis of market efficiency, at least with respect to publicly available information, investors cannot expect to gain abnormal returns from the impact of a certain event through the firm's stock price (Fama, 1998). Thus, the effect of an event can be measured by simply observing stock prices. This methodology can be used for both short-term and long-term analysis. Short-term analysis is typically done through measuring security prices over a relatively short-term period, while the long-term analysis can be done using productivity related measures over months or years of observation (MacKinlay, 1997). The typical event study employs stock prices reflecting the value of common equity, but various other types of securities such as debt securities can be used depending on the purpose of the study.



### **Data Collection**

Because the goal of this study is to investigate the long-term financial effect of the ISO 14001 certification, we needed the information of the existing certified firms with their certification dates instead of announcement dates when they decided to pursue the certification process. Also, the rate of ISO 14001 certification of US firms is not high among developed countries, we needed to collect data from the possible largest representative sample. Thus, this study examined all the listed companies in NYSE and NASDAQ. As of 2015, the total number of companies listed in both stock exchanges was 5189: 2317 in NYSE and 2872 in NASDAQ (NASDAQ, 2015; NYSE, 2015).

To gather the necessary data, this study searched articles from *The Wall Street Journal*, *The New York Times*, *Chicago Tribune*, and *The Washington Post*, and information from LexisNexis and Internet search engines using all listed firms from 1996 to 2010. In addition, the corporate websites of all listed firms were mined for data regarding whether the firm was certified, the first date of the certification, and the contact information. All ISO 14001 certified companies were contacted by emails or phone calls to obtain and confirm the initial date of certification when this data was not available on the Internet. When the initial date of certification of a firm could not be found through the entire search process, then the firm was dropped from the sample. Altogether, this study identified 331 ISO 14001 certified firms during 1996 to 2010 among all the listed public firms in the USA. For those firms, we could find the initial date of certification for only 174 firms. This study could not focus on one industry (e.g. manufacturing) because the sample of existing ISO 14001 certified firms in a single industry would be too small to perform any meaningful study. Thus, all 174 firms with initial certification dates were used as the study sample.

The entire process took over two years of intensive work including data analysis. The first certification date found was in 1996, and thus this study used Compustat Quarterly Financial data from 1994 to 2010. While the typical previous event studies used one day as the time window, our study used a year as the time window to measure the long-term effect of ISO 14001. This study investigated the performance variables of the firms two years prior to the certification

quarter through two years after the certification quarter, considering that the preparation for the environmental management system generally takes about eight to nineteen months (Babakri *et al.*, 2003). The quarter in which the ISO 14001 certification was actually granted was used as the event quarter. This study used quarterly Compustat data because financial statements are reported quarterly. For stock prices, we used the average stock price of the quarter to avoid the biased effect of extreme stock price fluctuations. This study employed multiple dependent variables (ROA, ROS, Stock price, COGS/Sales, and Sales growth rate) to measure the comprehensive long-term effect of the certification from diverse perspectives.

### **Control**

This study employed the one-to-one matching method. In the one-to-one matching approach, each certified firm is paired with a control firm which has the closest pre-event traits among all listed firms in NYSE and NASDAQ. For each sample firm, three control firms are selected (a total of 522 control firms), based on the following criteria: (i) Industry and ROA; (ii) Industry and Assets; (iii) Industry, ROA, and Assets. The first control firm is the one which has the closest pre-event value of ROA to the matched sample firm in the same industry. Although the control firm's ROA is the closest, it's meaningless if its ROA is too far from that of the certified firm. Therefore, the control firm's ROA is restricted to lie between 90% and 110% of a certified firm's ROA. The second and third criteria to create control firms followed the same process. The second control firm is the one with the closest pre-event value of total assets to the matched sample firm in the same industry. The third control firm has the closest pre-event distance in the two-dimensional space of z-scores (x-axis: ROA, y-axis: Assets) to the matched sample firm in the same industry (Corbett *et al.*, 2005). If no suitable control firm exists, the observation was eliminated from the analysis.

The industry was classified based on the standard industry code (SIC) of the USA and the first two digits of SIC code were used to identify the same industry. No one best way exists in creating control firms. Hendricks and Singhal (2005) employed size, prior performance, the market-to-book ratio of equity, and industry for control

variables to investigate the long-term effect of supply chain disruption. Corbett *et al.* (2005) used industry, size, prior performance, and their combination for control variables. In any case, the control firm should have the closest pre-event value based on the control criteria.

## Results

Table 1 shows the descriptive information of 174 ISO 14001 certified firms in the sample. The mean values of the sample firms represent the total asset of \$13,868.5 million, liabilities of \$9,932.6 million, equity market value of \$22,231.9 million, annual sales of \$2,695.9 million, annual operating income of \$407.6 million, and annual net income of \$172.2 million. Table 2 shows the number of firms that received the certification in each year during 1996–2010. The number of certified companies has generally increased during the period. Although the number of firms receiving ISO 14001 certification is relatively smaller in the US as compared to Europe and other developed countries, its number is expected to steadily increase in the future.

This study tested hypotheses using a two-tailed parametric t-test, which assumes that the null hypothesis indicates no abnormal performance. While we expected a certain direction of each variable's movement in our hypotheses, variables could show unexpected movements which were statistically significant. In addition, because parametric test is quite sensitive to extreme outliers (McWilliams, 1990), this study also employed non-parametric tests such as Wilcoxon signed rank test and sign test. Tables 3–17 present the results of the certified firms' abnormal performance in terms of ROA, ROS, stock price, COGS/Sales, and Sales growth rate (SGR). 'N' stands for the total number of certified firms used for the analysis. To make the analysis clear, we created 'Mean' and 'Median' columns. 'Mean' and 'Median' columns show positive or negative abnormal performance with the *p*-value of t-test, Wilcoxon signed rank test, and sign test in 't-test', 'WSR', and 'sign' column, respectively. There are 10 rows that are classified according to time periods. We computed the abnormal performance change over a four-year period, which divided into ten time periods for the analysis (every year, two years, three years, and the entire four year periods). Year (t) is the event point (event quarter)

when the first ISO 14001 certification was granted. For instance,  $t - 2$  to  $0$  period indicates the abnormal performance from two years prior to the certification through the certification point. Some companies in the sample did not have complete financial data over the four-year period, as some data is missing. These companies were dropped from the analysis.

The results from the profitability model are shown in Tables 3–7. Each profitability variable (ROA, ROS, stock price) had three result tables corresponding to the three control types, i.e., (i) Industry and ROA; (ii) Industry and Assets; (iii) Industry, ROA, and Assets. Because there are too many result tables to show all these matches, we report only one result table (result table for the third control type) for some variables (ROA, ROS, COGS/Sales, and Sales growth rate). This study calculated the means and medians to show comprehensive effects of ISO 14001 certification according to 10 time periods.

The means and medians of abnormal ROA during  $t - 2$  to  $t + 2$  period (two years prior through the two years after the certification) were positive and statistically significant in most test results of all three one-to-one match groups (Table 3). Especially, the first time period ( $t - 2$  to  $t - 1$ ) in all three match groups and the third time period ( $t$  to  $t + 1$ ) in the second and third match groups showed definitive positive abnormal performance, which might lead to the overall positive abnormal performance during the  $t - 2$  to  $t + 2$  period. The results of ROS (Table 4) also showed positive abnormal performance in many time periods. It implies that firms gradually reap the benefits of the certification during the preparation and implementation of environmental management.

Stock price also showed the corresponding results (Tables 5 and 6). In all tests and match groups, the results during  $t - 2$  to  $t - 1$  period showed significant positive abnormal performance. However, the following period presented significant negative abnormal performance in stock price, implying that the investment community regarded the stock price increase in the previous year as overreaction to the news. As a result, the long-term effect of ISO 14001 certification over the four-year time period ( $t - 2$  to  $t + 2$ ) was not definite for stock price although fluctuations were observed in the short term.

To test the internal improvement model, we measured abnormal performance in COGS/Sales and the results are shown in Tables 8. All

three matches showed negative abnormal returns during  $t - 2$  to  $t - 1$ . Considering the time and resources required for ISO 14001 certification, the efforts to meet the criteria for the certification may begin years before the actual certification date. These efforts could reduce production costs through improved processes. The negative significant results (decrease in cost ratio) in the  $t - 2$  to  $t - 1$  period indicate that the efforts to meet the criteria are reflected in costs much earlier than actual certification date. This internal improvement might be the cause of the increase in the profitability variables such as ROA and ROS in early periods. However, the following period presented positive abnormal returns (increase in cost ratio) in all three matches, implying that cost ratio increased as the certification date approached. As a result, all three one-to-one match results did not show significant long-term abnormal performance during the  $t - 2$  to  $t + 2$  period. Thus, the effect of earlier efforts for the certification is gradually tapered off as time progresses.

The results of the certification effects on market benefit variable (sales growth rate) were presented in Table 9. Most mean and median values of abnormal performance in sales growth rate were significant during the  $t - 2$  to  $t + 2$  period. Also, all significant long-term results during  $t - 2$  to  $t + 2$  showed positive abnormal performance. Therefore, it is conjectured that ISO 14001 certification increases the sales volume in the long run. It should be noted that the increase in the sales growth rate generally occurred after the certification, different from previous profitability and internal improvement models. It implies that the market benefit from the certification is realized gradually after the ISO 14001 certification. Also, we can conjecture that the long-term increase in the certified firm's profitability is due to the sales increase rather than cost savings.

## **Discussion**

This study provides a broad evidence of performance improvement due to ISO 14001 certification. While some measures did not show immediate results after the firm was certified, the overall effects of ISO 14001 certification presented a positive association with a firm's long-term financial performance. Table 10 shows the summary of t-test results of one-to-one matches on industry, ROA, and assets.

In terms of profitability, ROA showed significant positive abnormal performance improvement during the  $t - 2$  to  $t + 2$  period. Also, ROA presented a short-term significant effect (e.g.  $t$  to  $t + 1$ ;  $t - 1$  to  $t + 2$ ;  $t$  to  $t + 2$ ;  $t - 1$  to  $t + 2$ ), implying that the benefits of ISO 14001 certification are obtained gradually through the timeline. The abnormal performance after the firm decided to seek ISO 14001 represents the improvement of the firm's processes when it started to reengineer them. For certification, the firm needs to reduce its waste and/or minimize processing time. This is consistent with the results of COGS/Sales which showed significant reductions before the certification. However, in the long run, COGS/Sales did not show any significant change, either positively or negatively. While process reengineering reduces the cost, the increased investment to achieve the certification might increase the costs.

ROS showed the long-term cumulative performance improvement by presenting significant abnormal positive performance in most periods as shown in Table 10. This means that firms reap financial benefits even during the process of preparing for ISO 14001 certification. Also, it implies that improved margin would be the source of improved profitability. In terms of the short-term stock market reaction, there was consistent positive abnormal performance in stock prices during the  $t - 2$  to  $t - 1$  period, which means that market reacts positively when firms began preparing for the certification. Therefore, it is conjectured that the information that the firm is initiating preparations for ISO 14001 certification sends a positive signal to the market place and it reacts accordingly. However, the next period ( $t - 1$  to  $t$ ) presented consistent negative abnormal performance in stock prices. It might be because investors thought that the market overreacted to the initiation of process improvements for ISO 14001 certification in the previous year. The matches with all three control groups (i.e., Industry and ROA; Industry and Assets; Industry, ROA, and Assets) showed the same trend. As a result, during the study's four-year duration, stock price did not show consistent significant long-term performance improvement in all three matches. It suggests that ISO 14001 certification is not associated with the long-term valuation of the certified firm.

Among the benefits derived from the market due to ISO 14001 certification, the sales growth rate appears to be important because it stands for the firm's potential to grow. In the long run, a significant



sales volume growth was observed among the certified firms. Especially, the sales growth rate increased after the certification, implying that there is a time lag between the preparation process for the certification and the real sales growth since the information about obtaining the certification needs to be spread. Considering the limited improvement in the cost ratio, it is conjectured that the increased sales and margin represent the major source of the certified firms' profitability improvement.

Overall, firms generally showed a significant abnormal performance improvement after they announced their intention to seek ISO 14001 certification. Also, their long-term performance was positively significant in the cumulative improvement period. Because firms can reap the benefits from the increased sales volume and margin, their short-term and long-term profitability would improve. Therefore, we can conclude that ISO 14001 certification provides benefits to the firm in terms of profitability and market benefits. However, the market value of the firm did not change in the long run, implying that there might be other elements which negatively affect the valuation of the firm regarding implementing environmental management practices. Although the certification appeared to be positively associated with improvements in sales growth and profitability, it might have triggered unexpected problems as well (e.g., disappointment of the investment community and an increase in equity risk due to the equity structure change), causing possible negative stock market reactions to these potential risks.

### **Limitations and Future Research Needs**

This study has several limitations. First, this study used ISO 14001 certification as a proxy measurement of environmental management. However, we could not investigate the history of each firm's environmental management efforts (e.g. other EMS certifications or awards). If a firm has implemented different types of green strategies, and ISO 14001 certification is just one of them, there might be limited impact of ISO 14001 certification on corporate performance. Thus, if there is an available source for public firms' green history, it would be interesting to include the effect of such green history in the future study.



Second, the sample of this study included firms in various industries due to the small number of ISO 14001 certified public firms in NYSE and NASDAQ. If a study can focus on a single industry (e.g. manufacturing), more consistent and meaningful results might be observed. Third, this study employed a one-to-one match for control variables, while portfolio match using multiple firms' average performance might provide more extensive insights. As such, replicating this study by using the portfolio match would complement this study's results.

**Table 1.** Sample description (\$ million)

<i>Measure</i>	<i>Mean</i>	<i>Median</i>	<i>Std. Dev.</i>	<i>Max</i>	<i>Min</i>
Total Asset	13,868.5	1,747.4	44,781.6	449,639.8	8.2
Liabilities	9,932.6	932.5	40,078.9	431,171.6	0.5
Equity Market Value	22,231.9	1,999.7	66,514.0	408,990	2.3
Sales	2,695.9	367.7	6,767.9	523,69.5	0.6
Operating Income	407.6	60.6	1,069.8	9,570.8	-45.0
Net Income	172.2	13.5	576.2	3,896.7	-1368

**Table 2.** Distribution of certified dates of 174 ISO14001 certified firms

<i>Year</i>	<i>Number of certified firms</i>	<i>% of certified firms</i>
1996	7	3.85%
1997	9	4.95%
1998	5	2.75%
1999	6	3.30%
2000	15	8.24%
2001	9	4.95%
2002	12	6.59%
2003	11	6.04%
2004	15	8.24%
2005	16	8.79%
2006	13	7.14%
2007	18	9.89%
2008	16	8.79%
2009	25	13.74%
2010	5	2.75%
1996–2010	174	100.00%

**Table 3.** Abnormal performance in ROA; Control for industry, ROA, and assets

<i>Time</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>t-test</i>	<i>WSR</i>	<i>Sign</i>
t - 2 to t - 1	158	0.2%	0.3%	0.008***	0.015**	0.002***
t - 1 to t	161	0.1%	0.1%	0.049**	0.021**	0.000***
t to t + 1	149	0.3%	0.3%	0.000***	0.001***	0.000***
t + 1 to t + 2	124	0.1%	0.2%	0.252	0.211	0.718
t - 2 to t	158	0.3%	0.4%	0.001***	0.003***	0.047**
t - 1 to t + 1	147	0.4%	0.4%	0.000***	0.000***	0.000***
t to t + 2	125	0.3%	0.3%	0.008***	0.006***	0.005***
t - 2 to t + 1	144	0.6%	0.6%	0.000***	0.000***	0.003***
t - 1 to t + 2	122	0.4%	0.4%	0.002***	0.001***	0.011**
t - 2 to t + 2	119	0.7%	0.5%	0.000***	0.000***	0.006***

\*\* p &lt; 0.05

\*\*\* p &lt; 0.01

**Table 4.** Abnormal performance in ROS; Control for industry, ROA, and assets

<i>Time</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>t-test</i>	<i>WSR</i>	<i>Sign</i>
t - 2 to t - 1	157	0.4%	0.5%	0.095*	0.087*	0.632
t - 1 to t	160	0.4%	0.5%	0.147	0.129	0.006***
t to t + 1	149	0.6%	0.7%	0.025**	0.013**	0.001***
t + 1 to t + 2	123	0.5%	0.6%	0.084*	0.109	0.124
t - 2 to t	157	0.8%	0.5%	0.022**	0.035**	0.202
t - 1 to t + 1	146	0.8%	0.9%	0.040**	0.056*	0.282
t to t + 2	124	1.0%	1.1%	0.005***	0.004***	0.015**
t - 2 to t + 1	143	1.2%	0.1%	0.005***	0.016**	0.019**
t - 1 to t + 2	121	1.4%	1.1%	0.004***	0.007***	0.146
t - 2 to t + 2	118	1.9%	1.7%	0.000***	0.001***	0.013**

\*p &lt; 0.1

\*\*p &lt; 0.05

\*\*\*p &lt; 0.01

**Table 5.** Abnormal performance in stock price; Control for industry and ROA

<i>Time</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>t-test</i>	<i>WSR</i>	<i>Sign</i>
t - 2 to t - 1	151	6.1%	4.6%	0.006***	0.004***	0.000***
t - 1 to t	150	-7.1%	-6.7%	0.002***	0.001***	0.000***
t to t + 1	145	-1.7%	-1.9%	0.536	0.666	0.740
t + 1 to t + 2	124	-0.6%	-0.4%	0.817	0.701	0.788
t - 2 to t	149	-0.9%	-0.4%	0.759	0.828	0.870
t - 1 to t + 1	139	-8.6%	-9.9%	0.017**	0.014**	0.007***
t to t + 2	120	-3.7%	-4.3%	0.383	0.448	0.523
t - 2 to t + 1	138	-2.8%	-7.6%	0.488	0.320	0.148
t - 1 to t + 2	115	-9.8%	-3.5%	0.045**	0.075	0.263
t - 2 to t + 2	114	-4.1%	-5.2%	0.393	0.399	0.640

\*\* p &lt; 0.05

\*\*\* p &lt; 0.01

**Table 6.** Abnormal performance in stock price; Control for industry and assets

<i>Time</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>t-test</i>	<i>WSR</i>	<i>Sign</i>
t - 2 to t - 1	151	11.6%	9.7%	0.000***	0.000***	0.000***
t - 1 to t	153	-3.7%	-4.8%	0.098*	0.018**	0.000***
t to t + 1	141	6.4%	4.6%	0.008***	0.005***	0.002***
t + 1 to t + 2	119	4.3%	3.2%	0.122	0.222	1.000
t - 2 to t	151	8.0%	8.0%	0.012**	0.018**	0.143
t - 1 to t + 1	137	2.5%	5.3%	0.420	0.241	0.393
t to t + 2	116	9.9%	5.8%	0.011**	0.021**	0.051*
t - 2 to t + 1	135	13.9%	17.6%	0.001***	0.001***	0.006***
t - 1 to t + 2	113	4.7%	0.7%	0.302	0.625	1.000
t - 2 to t + 2	112	16.2%	13.8%	0.002***	0.007***	0.073*

\* p &lt; 0.1

\*\* p &lt; 0.05

\*\*\* p &lt; 0.01

**Table 7.** Abnormal performance in stock price; Control for industry, ROA, and assets

<i>Time</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>t-test</i>	<i>WSR</i>	<i>Sign</i>
t - 2 to t - 1	154	8.2%	6.2%	0.000***	0.000***	0.000***
t - 1 to t	152	-5.8%	-7.4%	0.004***	0.001***	0.000***
t to t + 1	142	6.1%	6.4%	0.010**	0.003***	0.000***
t + 1 to t + 2	119	1.4%	-4.6%	0.596	0.681	0.582
t - 2 to t	152	3.2%	2.9%	0.261	0.241	0.570
t - 1 to t + 1	137	0.2%	2.6%	0.949	0.766	0.608
t to t + 2	116	5.8%	2.7%	0.117	0.106	0.164
t - 2 to t + 1	137	8.9%	11.2%	0.021**	0.027**	0.145
t - 1 to t + 2	112	0.7%	-3.7%	0.875	0.955	0.925
t - 2 to t + 2	112	9.3%	10.5%	0.052*	0.087*	0.508

\* p &lt; 0.1

\*\* p &lt; 0.05

\*\*\* p &lt; 0.01

**Table 8.** Abnormal performance in COGS/SALES; Control for industry, ROA, and assets

<i>Time</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>t-test</i>	<i>WSR</i>	<i>Sign</i>
t - 2 to t - 1	163	-0.3%	0.0%	0.068*	0.168	0.693
t - 1 to t	164	1.0%	1.2%	0.000***	0.000***	0.000***
t to t + 1	157	-0.4%	-0.2%	0.044**	0.061*	0.025**
t + 1 to t + 2	141	-0.2%	-0.1%	0.292	0.290	0.497
t - 2 to t	162	0.6%	0.5%	0.043**	0.030**	0.033**
t - 1 to t + 1	155	0.5%	0.5%	0.094*	0.118	0.196
t to t + 2	138	-0.6%	-0.5%	0.043**	0.063*	0.168
t - 2 to t + 1	153	0.3%	0.2%	0.453	0.538	0.871
t - 1 to t + 2	137	0.3%	0.6%	0.399	0.334	0.389
t - 2 to t + 2	135	0.0%	0.5%	0.968	0.970	0.862

\* p &lt; 0.1

\*\* p &lt; 0.05

\*\*\* p &lt; 0.01

**Table 9.** Abnormal performance in sales growth rate; Control for industry, ROA, and assets

<i>Time</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>t-test</i>	<i>WSR</i>	<i>Sign</i>
t - 2 to t - 1	160	1.2%	0.9%	0.242	0.298	0.813
t - 1 to t	161	-3.6%	-5.1%	0.015**	0.008***	0.000***
t to t + 1	162	3.7%	3.2%	0.003***	0.005***	0.000***
t + 1 to t + 2	157	5.1%	4.3%	0.000***	0.000***	0.001***
t - 2 to t	159	-2.1%	-2.4%	0.279	0.183	0.341
t - 1 to t + 1	160	0.3%	1.4%	0.861	0.558	0.236
t to t + 2	154	8.1%	5.7%	0.000***	0.000***	0.001***
t - 2 to t + 1	158	1.8%	2.9%	0.443	0.210	0.047**
t - 1 to t + 2	152	4.8%	3.4%	0.048**	0.043**	0.224
t - 2 to t + 2	150	5.8%	6.2%	0.039**	0.030**	0.018**

\*\* p &lt; 0.05

\*\*\* p &lt; 0.01

**Table 10.** Significance of Abnormal Performance (controlled for industry, ROA, and assets)

<i>Time</i>	<i>ROA</i>		<i>ROS</i>		<i>Stock price</i>		<i>COGS/SALES</i>		<i>Sales growth</i>	
	<i>N</i>	<i>sig</i>	<i>N</i>	<i>sig</i>	<i>N</i>	<i>sig</i>	<i>N</i>	<i>sig</i>	<i>N</i>	<i>sig</i>
t - 2 to t - 1	158	***	157	*	154	***	163	*	160	
t - 1 to t	161	**	160		152	***	164	***	161	**
t to t + 1	149	***	149	**	142	**	157	**	162	***
t + 1 to t + 2	124		123	*	119		141		157	***
t - 2 to t	158	***	157	**	152		162	**	159	
t - 1 to t + 1	147	***	146	**	137		155	*	160	
t to t + 2	125	***	124	***	116		138	**	154	***
t - 2 to t + 1	144	***	143	***	137	**	153		158	
t - 1 to t + 2	122	***	121	***	112		137		152	**
t - 2 to t + 2	119	***	118	***	112	*	135		150	**

\* p &lt; 0.1

\*\* p &lt; 0.05

\*\*\* p &lt; 0.01

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