



Production, Manufacturing and Logistics

## Eco-activities and operating performance in the computer and electronics industry

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## ABSTRACT

Despite the complexity of implementing environmentally sustainable practices, an increasing number of firms have invested in eco-activities. This study investigates the association between eco-activities and operating performance over time. Moreover, this study explores the impact of eco-approaches (eco-collaboration and eco-certification) on operating performance. A difference-in-differences research design is established using operating performance data (COMPUSTAT) and eco-activity data (eco-announcements, eco-certification providers, and ASSET4). Empirical results reveal that eco-activities in the computer and electronics industry are associated with increased margin and revenue performance; however, the realization of benefits takes time (improvement typically occurs within three years of the corresponding eco-announcement). Furthermore, although eco-collaboration tends to be expensive to establish, operating performance is improved over the long term. This study also finds that eco-certification is associated with increased improvement in operating performance delivered by eco-activities.

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### 1. Introduction

The beginning of the 21st century is marked by a significant amount of activity related to environmental sustainability (called eco-activity in this work) by both policy makers and firms. Actions related to eco-activities by policy makers have ranged from publication of assessment reports by the Intergovernmental Panel on Climate Change (IPCC) to passing the Restriction of the Use of Hazardous Substances (RoHS) directive by the European Union (EU) in 2003, which prohibits the use of certain materials in amounts beyond agreed-upon levels. Actions related to eco-activities by companies have ranged from Alcatel-Lucent's development of network processors that perform better and consume less power than earlier processors to the sourcing of products and services by MedAssets Inc. from suppliers that support green initiatives. Fig. 1 displays the number of press releases related to eco-activities (*i.e.*, eco-announcements) in the computer and electronics industry by year. Eco-activity in this industry has clearly increased. The Pearson value for correlations between year and number of eco-announcements is 0.755 ( $p$ -value

< 0.01) over time. Similar increases in eco-activities have occurred in other industries.

Given this increase in eco-activities, understanding how an investment in eco-activities affects firm performance is important. Most of the existing literature has taken a shareholder perspective and focused on the link between eco-activities and stock market performance of the firm. Our goal in this paper is to understand the link between eco-activities and operating performance of the firm. On the one hand, failure to choose the "right" activities or ineffective implementation may negatively impact operating performance. Even when a firm effectively implements an eco-activity, customers may not reward the firm for its effort. Negative links between certain types of eco-activities and stock market performance have been found in the literature. For example, Jacobs, Singhal, and Subramanian (2010) demonstrated that voluntary emission reductions generated a negative market response (stock price) as well as Kroes, Subramanian, and Subramanyam (2012) demonstrated that pollution prevention and pollution control reduced market performance (Tobin's  $q$ ). Conversely, investment in eco-activities can positively affect firms when the activity is favorable to the firm and it is implemented effectively (customers reward firms for this effort). Corbett and Klassen (2006) noted that "environmental excellence is key to improving operations." Evidence of a positive link between eco-activities and stock market performance has also been found in the literature. For example, Dowell, Hart, and Yeung (2000) found

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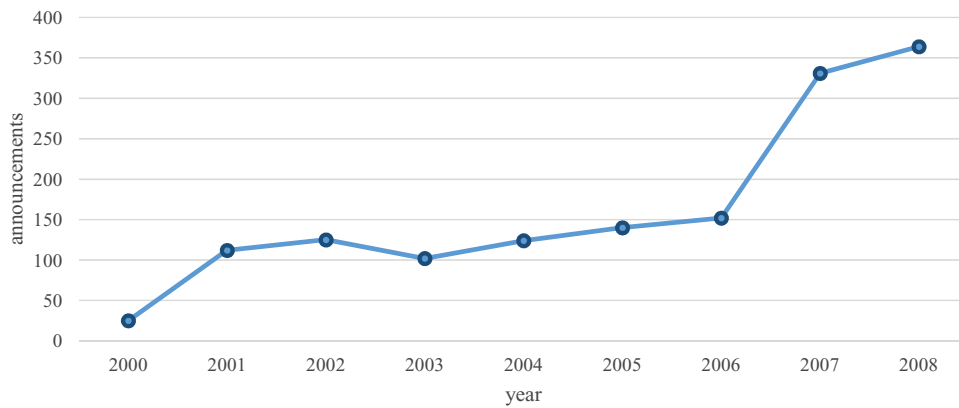


Fig. 1. The trend of eco-announcements.

that adopting a single stringent global environmental standard increased market values (Tobin's  $q$ ) and that the market's reaction to this environmental standard involved no time lag.

Most of the research has found that shareholders react quickly to evidence of eco-activities by firms (whether positively or negatively). This leaves open the question whether shareholders are reacting to anticipated changes in future operating performance or other factors. However, few studies have explored the relationship between eco-activities and operating performance over time. Also, few studies have determined whether eco-approaches (eco-collaboration and eco-certification) are worthwhile for firms.

This research seeks to elucidate the association between corporate efforts in environmental sustainability in the computer and electronics industry and operating performance. Specifically, the association between the eco-activities of firms and their operating performance over time is assessed via a difference-in-differences research design applied to a sample of eco-announcements from the computer and electronics industry. The primary challenge with this design is identifying treated firms (those engaged in eco-activities) and control firms (those not engaged in eco-activities) that are similar. Hence, this work exploits various data sources (eco-announcements, and the ASSET4, and COMPUSTAT databases) to identify the two groups of firms.

Our empirical results reveal that implementing eco-activities is generally associated with positive profitability in the computer and electronics industry. Nevertheless, the realization of benefits takes time. Contrary to anecdotal reporting in the press discussing retailers like Walmart that have implemented sustainability efforts that lowered costs, we have not been able to find significant evidence of sustainability efforts lowering costs in the electronics industry. This may be because changes in the electronics industry have been driven by strengthening regulation, while changes by firms like Walmart were voluntary. As a result, Walmart is more likely to select eco-activities that produce immediate benefit (often in terms of reduced cost) while electronics firms may not always have that choice.

Given the challenges and complexity of implementing eco-activities (Theissen & Spinler, 2014), this study also investigates the effects of eco-approaches on the success of implementations by firms. Eco-approaches in this investigation are eco-collaboration (collaborating with other firms in an eco-activity), and eco-certification (obtaining eco-certifications such as ISO 14000). The essential results of our empirical analysis imply that although eco-collaboration appears to be expensive to establish, operating performance is typically improved over time. Additionally, eco-certification generally increases the extent to which eco-activities improve operating performance.

The remainder of this paper is organized as follows. Section 2 formulates hypotheses. Section 3 describes the research design and data. Section 4 presents empirical results and corresponding discussions. Section 5 draws conclusions and managerial implications.

## 2. Theory and hypotheses

A growing body of literature focuses on environmental issues such as closed-loop supply chains (Georgiadis & Vlachos, 2004; Govindan, Soleimani, & Kannan, 2015), global diffusion of ISO14000 certification (Albuquerque, Bronnenberg, & Corbett, 2007), e-waste and environmental regulations (Atasu & Van Wassenhove, 2012; Plambeck & Wang, 2009), environmental safety stock (Chen & Monahan, 2010), consumer environmental awareness (Liu, Anderson, & Cruz, 2012; Yenipazarli & Vakharia, 2015), industrial ecology (Agrawal, Ferguson, Toktay, & Thomas, 2012), product reuse (Galbreth, Boyaci, & Verter, 2013), carbon footprinting (Caro, Corbett, Tan, & Zuidwijk, 2013), a carbon tax (Plambeck & Taylor, 2013), reverse channel choice (Atasu, Toktay, & Van Wassenhove, 2013), energy efficiency (Muthulingam, Corbett, Benartzi, & Oppenheim, 2013), and a sustainable supply chain network (Cruz, 2008; Devika, Jafarian, & Nourbakhsh, 2014; Faccio, Persona, Sgarbossa, & Zanin, 2014). Furthermore, eco-activities by firms have been identified based on public announcements (Klassen & McLaughlin, 1996), surveys (Sharma & Vredenburg, 1998), eco-certifications (Melnik, Sroufe, & Calantone, 2003) or databases (Sharfman & Fernando, 2008). Metrics of performance have included market value such as stock price (Klassen & McLaughlin, 1996) and operating metrics such as operating income (Hendricks & Singhal, 2005). This work identifies firms engaged in eco-activities via press releases (announcements) in the FACTIVE database, and then measures firm performance using operating metrics such as operating income and cost per dollar for sales.

The natural-resource-based view (NRBV) theory (Hart, 1995) asserts that successful eco-activities provide firms with strategic capabilities that promote sustainable competitive advantage. Hart (1995), using the natural-resource-based view, argued that "firms that adopt sustainable-development strategies will evidence substantial development of new, low-impact technologies and competences." The natural-resource-based view implies that engaging in eco-activities can enhance a firm's competitive advantage, eventually improving operating performance (Hart, 1995; Hart & Dowell, 2011). Several studies have identified a positive relationship between improved environmental performance and stock returns. Flammer (2013) observed that eco-friendly announcements triggered an increase in stock price. Kassinis and Soteriou (2003) applied structural equation modeling (SEM) to survey data from Europe's hospitality industry, concluding that positive environmental practices (such as energy-saving, recycling, and water-saving practices) positively impacted market performance (including growth in profits, revenues, and market share) by enhancing customer satisfaction and loyalty. Some studies have identified the positive impacts of eco-activities on operating performance. Russo and Fouts (1997) observed that good environmental performance (as indicated by

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