



The impact of environmental expenditures on performance in the U.S. chemical industry



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ABSTRACT

This study analyzes chemical industry companies with environmental expenditures to determine which ones have better financial performance. In addition, this study uses Data Envelopment Analysis to evaluate the efficiency of firms with and without environmental expenditures. This study also utilizes the Malmquist productivity index (MPI) to analyze firms' productivity change and a bootstrap method to test whether the indexes are statistically significant. Finally, this study divides chemical industry companies into three main categories, based on their products. The results of this study provide significant evidence of a relationship between environmental expenditures and financial performance. The findings suggest that firms with environmental expenditures have better efficiency and productivity. Hence, the study encourages companies in the industry to put more effort into protecting the environment that can be through practicing cleaner production to create higher benefits.

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1. Introduction

Statistics prepared by the American Chemistry Council (ACC, 2012) demonstrate that the business of chemistry is one of America's most significant manufacturing industries, worth \$760 billion annually, and that it is a leader in production, providing over 15% of the world's chemicals. Thus, the chemistry industry is essential to the U.S. economy. However, U.S. chemical companies face health, safety and the environmental expenses equal to 1–5% of their total sales.

The Securities and Exchange Commission (SEC) regulates standards for the disclosure of qualitative non-financial information and publishes complete financial reports of companies so that the public can have information about these companies. According to Item 101 (Description of the Business), companies have to disclose the material impact that complying with environmental regulations has on their capital expenditures. Many companies state their local and foreign environment, health, and safety policies in their Form 10-K annual reports and also report the environmental protection or environmental remediation expenditures that they make

in order to meet the standards set by government authorities, such as the U.S. Environmental Protection Agency.

In addition, many studies have researched the effect of firms' environmental expenditures on their environmental and financial performance (Johnston, 2005; Patten, 2005; Sueyoshi and Goto, 2009; Charles et al., 2012). Handfield et al. (1997) suggested that those industries which put environmentally friendly ("green") policies into practice within their operation's management value chains achieve better industry-wide performance. This demonstrates that increasing operations and maintenance expenditures and conducting environmental assessments of capital projects can benefit the environment, thereby moving the overall economy toward "sustainable" development (Gupta et al., 1995). Therefore, environmental management may help firms to improve their performance. This study assumes that chemical industry firms that put more effort into environmental protection will also benefit from it. This study also attempts to evaluate environmental expenditures of chemical industry firms in order to determine the relationship between environmental expenditures and the financial performance of firms.

Data Envelopment Analysis (DEA) has long been utilized to measure operational performance. Furthermore, DEA efficiency measures in combination with the concept of environmental DEA technology have been widely adopted in environmental performance measurement in recent years (Sueyoshi and Goto, 2010, 2011; Zanella et al., 2012). Sueyoshi and Goto (2010) found that

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large firms have managerial capabilities that can enable them to improve their operational and environmental performance, which can, in turn, enhance their financial performance. In DEA, there are several methods for measuring efficiency changes over time, such as the Malmquist productivity index (Färe et al., 1994). Productivity growth and its components are also calculated using the Malmquist productivity index. Therefore, this study uses DEA and the Malmquist productivity index to calculate the performance variation of chemical industry firms with and without environmental expenditures.

Few researchers have discussed the effect of environmental expenditures within the chemical industry and used the following methodology to evaluate performance difference between firm with and without environmental expenditures. Firstly, this study aims to use DEA methodology to evaluate chemical industry companies' environmental expenditures in order to determine their influence on the companies' performance.

Secondly, this study uses the Malmquist productivity index to compare companies' efficiency across two time periods. The index is also employed to measure productivity growth. Simar and Wilson (1999) extended the Färe et al. (1994) approach by giving a statistical interpretation of their Malmquist productivity index and by presenting a bootstrap algorithm that can be used to estimate confidence intervals for the indices. Bootstrapping can determine the accuracy of estimators. In addition, considering the statistics of examining the productivity angle for input environmental expenditures within the chemical industry can help to increase the accuracy of the estimators. To use such method also help companies of certain productivity will grow, or decline significantly.

Finally, this study divides companies into three types, chemical materials manufacturing, chemical products manufacturing, and plastic & rubber products manufacturing, based on chemistry industry production. The three types are evaluated to determine their relationships to the industry's efficiency along with environmental expenditures. The results can provide insight into what causes imperfect competitive conditions within chemical industry.

This paper is organized as follows. Section 2 presents the literature review. Section 3 describes the data and research method. Section 4 documents the empirical results. Section 5 summarizes this study and draws conclusions.

2. Literature review

2.1. Environmental sensitive industry – chemical industry

The chemical industry has engaged in a major self-regulatory "Responsible Care" initiatives in order to protect the environment and ensure public health and safety (Howard et al., 1999; Givel, 2007; Evangelinos et al., 2010). Environmental safety, public health, and security performance can be improved via Responsible Care, which includes ISO 9000, ISO 14000, ISO 14001 etc. Howard et al. (1999) examined whether and how the adoption of Responsible Care influenced company practices and suggested that chemical companies have changed what they do as a result of Responsible Care.

With Responsible Care, the chemical industry not only protects the environment and health but also wards off any negative corporate externalities related to severe health effects and environmental quality. As a result, private profits increase (Givel, 2007). The objectives of the chemical industry can be divided into several dimensions, i.e., economic, ecological, and social. Furthermore, success in business is based on paying attention to the environment and society, which are integrated into the goal of obtaining profits (Mendivil et al., 2005).

2.2. Environmental and financial performance

Al-Tuwaijri et al. (2004) empirically researched the association between environmental and economic performance by means of the ordinary least squares (OLS) equation model. A positive relation between economic and environmental performance was subsequently found. The research identified unexpected earnings, growth opportunities, and profit margin as variables, and found a positive connection with environmental performance. In addition, previous studies have measured environmental information using several indicators, e.g., the environmental performance index, toxic waste, chemical spills, and environmental fines and penalties (Al-Tuwaijri et al., 2004; Mendivil et al., 2005; Villiers and Van Staden, 2011).

Other important research has analyzed information about corporate environmental disclosure and financial markets. Villiers and Van Staden (2011) pointed out that corporate environmental performance has been more important to investors. Thus, environmental disclosures are vital because they provide environmental performance information and influence capital markets. The result of their research suggests that enhancing the level of environmental disclosure leads to more precise earnings forecasts, particularly for members of environmentally sensitive industries (Aerts et al., 2008; Villiers and Van Staden, 2011).

González-Benito and González-Benito (2005) tackled the relationship between environmental proactivity and business performance. This relationship was studied by examining the abundant connections between dimensions and measures. Their results clearly support the idea that environmental management can bring about competitive opportunities for companies. The competitive advantage derived from proactive environmental management can most probably improve financial performance.

2.3. Environmental expenditures

Prior studies used different environmental information to measure environmental disclosure. Environmental disclosure has many different definitions; most of them use capital expenditures on pollution control technology and risk, laws and regulations, pollution abatement, sustainable development, remediation, and environmental management to summarize a score (Patten, 2002; Aerts et al., 2008). Patten (2002) found that firms that expect to make environmental disclosures could budget for environmental spending. By lowering pollution production and raising expenditures on environmental protection, firms can promote their environmental performance and make more profits to achieve better financial performance (King and Lenox, 2001; López-Gamero et al., 2009).

Environmental capital expenditures can be categorized as regulatory or voluntary. Johnston (2005) divided total environmental capital expenditures into estimates of regulatory and voluntary components. Then he examined the relations between regulatory and voluntary environmental capital outlays regarding future abnormal earnings, stock prices, and stock returns. Market-based tests indicate that the regulatory component of environmental capital expenditures is negatively priced. This suggests that voluntary environmental capital expenditures and regulatory environmental capital expenditures have different firm-specific economic consequences (Johnston, 2005). Leiter et al. (2011) also explored environmental expenditure, but they used it as a proxy for environmental regulation. They analyzed the role of environmental regulation in European industrial investment and suggested that the replacement of environmental regulation with environmental expenditures and revenues from environmental taxation is positively related to investment (Leiter et al., 2011).

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