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Legitimacy in Green: Pollution vs. Profit in Canadian Oil Refineries

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Abstract

This paper examines the correlation of financial and environmental performance in the petroleum refinery sector. Emissions fell while profits rose over a ten-year period. Ongoing efforts to legitimize companies in light of changing societal expectations have created an external environment that encourages the development of new technologies that promote cost efficiencies and good environmental performance simultaneously. Russo and Fouts (1997) argued that industries subject to rapid technological advance are well suited to respond to these changes in the external environment. The findings of this paper suggest that the petroleum refinery sector of the oil and gas industry may be meeting the challenge of the environmental movement.

Key words: *environmental performance, environmental accounting, legitimacy theory*

Introduction

Societal concern for environmental protection has triggered a host of new challenges to corporate managers in the form of new regulation and stakeholder expectations. Both have triggered costs that profoundly affect the business sector. For example, there are capital costs for pollution control equipment, ongoing monitoring costs to ensure that emissions stay within allowable limits, and penalties and court costs if they do not. Insurance is harder to obtain, and more expensive. Debt servicing costs are higher for companies that do not comply with environmental regulation. Stakeholders demand better disclosure of environmental management information, and put downward pressure on equity prices for companies that do not comply.

There are two competing views on the impact of the environmental movement

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on business activity. One says that pollution abatement efforts divert resources from the production of marketable output and lead to a decline in profit (Gollop & Roberts, 1983). The other says they lead to modernization of operations and higher profits (Freedman & Stagliano, 1991). Empirical studies have produced mixed results. This paper explores this question within the context of the Canadian oil and gas industry. It is an integrated industry that begins with the upstream exploration and recovery activities. Some oil is recovered in Canada by conventional means, however the country is known for its oilsands operations that entail the removal of vast areas of forested land so the layers of earth can be mined for the deposits of crude trapped in the soil. The downstream operations include the petroleum and petrochemical refineries, which emit a variety of chemicals into the air, earth, and water. The refineries are energy intensive operations, responsible for a substantial portion of the greenhouse gases in this country. The largest firms in this industry participate in both upstream and downstream operations, as well as the production, transportation and distribution of end product to the wholesale and retail markets. Large, high profile firms such as these are subject to considerable public scrutiny and may be targeted specifically by calls for regulation (Watts & Zimmerman, 1990). The demand for controls on environmental impacts has been growing for several years. Walden & Schwartz (1997) said that 1989, the year of the Exxon Valdez oil spill, sparked the public demand for corporate accountability for environmental impacts.

This paper focuses on the petroleum refinery operations, which is considered to be part of the manufacturing sector. This sector accounts for 18% of Canada's gross domestic product, and employs 2.3 million people at salaries that are 22% above the Canadian average (Myers, 2005). The refineries are particularly targeted for regulation. For example, despite the fact that existing refineries are operating at full capacity, and that recovery operations in the Alberta oilsands are expected to triple in by 2015 (Ollenbeger, 2005), no new refineries have been built on the North American continent in the past 25 years. The Ministry of Natural Resources said that regulation is the primary disincentive to build in Canada (Brethour, 2005). The costs of regulation can be difficult to assess (World Resources Institute, 1995). They are known, however, to be substantial. For example, in 1993 the costs for refineries to satisfy environmental regulations in the US were estimated to be $152 billion (National Petroleum Council, 1993). In Canada, the cost of sulphur reduction regulation alone is estimated to be $5.3 billion (Purvin & Gertz, 2004).

This research uses National Pollutant Release Inventory information (NPRI) as a proxy for environmental management, and examines the correlation of NPRI releases with profitability over a ten-year period beginning in 1993. A regression of profitability on emissions, company size, and other independent variables shows an inverse relationship between refinery profits and NPRI releases.

The results of this study suggest that compliance with societal expectations can be accompanied by improvements in efficiency, as was suggested by Freedman & Stagliano (1991). The key to these findings may lie in technological advances that have been inspired by changing societal expectations, and by companies' efforts to legitimize themselves in light of these changing demands. Russo & Fouts (1997) argued that in industries subject to rapid technological development, good environmental management and profitability can be pursued simultaneously. Further examination of the relationship of environmental and financial performance in other sectors of the oil and gas industry, or other countries, would be a natural extension of this current work.

Literature Review

Prior research investigating the economic impact of regulation in general, and environmental regulation in particular, has tended to focus on three questions:

1. How do shareholders react to the threat of new regulation?
2. How do they react to the implementation of new regulation?
3. How does regulation affect profitability or productivity?

This current work focuses on the third question. However, the literature that examines the earlier questions must also be reviewed since the results of this current work may affect the interpretation of these earlier studies.

How do shareholders react to the threat of new regulation?

Prior literature examining this question has employed empirical tools of modern finance theory, particularly those pertaining to stock valuation models. Capital market theory says the price of a share today is derived from the discounted stream of expected cash flows (Fama, 1965). These cash flows, in the form of dividends or capital gains, will at some time accrue to the shareholder. Changes in those expectations will affect share price. For example, a decline in price may be caused by a reduction in the cash flows expected from future operations, or by an increase in the correlation of the individual stock returns with the returns of the overall market (This correlation is referred to as the stock's *beta)*. Based on the assumptions that events which directly involve one company will trigger industry information transfers throughout the capital markets, thereby affecting the shares of other companies in the same industry (Clinch & Sinclair, 1987), and that anticipated changes in legislation (as could occur in the aftermath of an accident) affect investors' expectations of future economic performance (Blacconiere & Patten, 1994), numerous studies have looked for evidence that certain events affect share prices across an entire industry.

One methodology often employed in a study of shareholder response is the *event-study*, where the event is defined as an information shock in the capital markets. Share behavior immediately after the event is contrasted with the behavior prior to the event. Using event-study methodology, Blacconiere & Patten (1994) observed a price decline in the shares of chemical companies immediately after the Union Carbide gas leak in Bhopal, India. Share prices fell for electrical utility companies with nuclear capacity in the days following the Three Mile Island accident in 1979 (Hill & Schneeweis, 1983). A separate study of that same accident showed evidence of an increase in beta for competing companies (Bowen et al., 1983). A tailings dam failure at a Placer Dome mine in 1996 was immediately followed by a decline in the price of gold mining company shares (Magness, 2007). Shareholder reactions like these may be caused by fears that a public outcry will trigger a legislative backlash with new cash flow impacts on economic performance.

How do shareholders react to the implementation of new regulation?

When an accident occurs – such as the gas leak, the nuclear accident, or the dam failure – the nature, timing, and extent of the new regulation, if any, is unknown. This means that when shareholders react to the threat of legislation, they act with uncertainty. When legislation finally comes, new information is available to the market, thereby prompting investor reaction once again. Several event-studies have examined share reaction to new legislation. For example, Moreschi examined the share reaction of pulp and paper companies in response to the Federal *Water Pollution Control Act Amendments* introduced by the U.S. Environmental Protection Agency. He observed price declines, as well as beta changes (Moreschi, 1988). Other studies observed negative price reactions in the chemical industry, when the *Superfund Amendments and Reauthorization Act* was changed to expand the reporting requirements for firms that release hazardous materials into the environment (Blacconiere & Northcut, 1997); in the electrical utilities industry, when it was targeted by the *Clean Air Act Amendments* (Hughes, 2000); and in the textile industry, in response to *Occupational Safety and Health* regulation that reduced allowable cotton dust limits (Freedman & Stagliano, 1991).

These reactions are consistent with shareholders' fear that new regulation has a dampening effect on future cash flows. Company managers appear to share this fear. In some industries, companies respond proactively to the threat of new regulation by policing themselves to show that additional legislation is unnecessary (LaBar, 1988).

How does regulation affect profitability or productivity?

The previous discussion suggests that share reaction is at least partially driven by assumptions about the answer to this third question, as this one focuses directly on economic impacts. Ironically, this final question has received the least attention: the basis for the argument that shareholders do not like regulation because regulation lowers future cash flows has not been thoroughly evaluated. Some companies within an industry may actually benefit while others suffer, depending on the nature and structure of the market. Differential responses may be attributed to incremental profits accruing to some companies when regulatory changes create barriers to entry (Pashigan, 1984; Maloney & McCormick, 1982). In slow growing markets, established companies are in a better position to satisfy new regulations than newer (smaller) competitors (The Economist, 1994). On the other hand, new legislation may specifically target the larger firms. This could be because the larger firms have the financial resources needed to implement new control standards without undue restriction in operations (Watts & Zimmerman, 1990). Furthermore, larger firms are subject to greater public scrutiny and may be targeted specifically by calls for regulation (Watts & Zimmerman, 1990). These issues make the overall financial impact of environmental regulation unclear.

There are two competing views on how business is affected by environmental regulation. One says that environmental legislation diverts resources from the production of marketable output, and leads to a decline in profitability (Bragdon & Marlin, 1972). The other says it leads to modernization of operations, thus increasing plant efficiency and profit (Freedman & Stagliano, 1991). Klassen & McLaughlin (1996) proposed a theoretical model linking strong environmental performance with good financial performance. Efforts to identify a consistent positive correlation of environmental performance with financial performance, however, produced conflicting results. For example, pollution abatement reduced productivity in both the brewing industry (Smith & Sims, 1985) and the electrical utilities industry (Gollop & Roberts, 1983). Klassen & McLaughlin (1996) identified a positive correlation in a sample of companies including manufacturing firms, electrical utilities, and oil and gas extraction firms using share returns as a proxy for investors' expectations of future financial performance. However, Freedman & Jaggi (1992), using a variety of financial performance indicators such as return on equity, return on assets, cash flow to equity and cash flow to assets, and found no evidence to support claims that it hurt profitability in the pulp and paper industry. On the other hand, Spicer (1978) found that better pollution control was associated with return on investment for these companies.

Legitimacy theory and stakeholder theory together provide a conceptual foundation for a relationship between environmental management and financial performance. Legitimacy theory espouses a social contract between the corporation and society. A company's survival and growth depend on its ability to deliver desirable ends: to distribute economic, social or political benefits to the groups from which it derives its power (Shocker & Sethi, 1974). A company's right to exist can be revoked if it breaches any of the terms of its social contract (Deegan, 2002). This revocation may be accomplished by consumers reducing demand for the company's product or service, by suppliers limiting access to labor or financial capital, or by stakeholders lobbying for legislation that would impact company cash flows (Terreberry, 1968). Stakeholder theory maintains that shareholders benefit when management meets the demands of multiple groups (Ruf et al., 2001). However, while the social contract contains explicit terms, spelled out in the form of legal requirements, it also has implicit terms, which include non-legislated societal expectations (Gray et al., 1996). Because these terms are by their nature implied, managers vary in their interpretation of these social requirements, and in their response. Furthermore, these terms are subject to change.

Earlier empirical studies that examine the legislative repercussions of the environmental movement and its impact on profitability have employed a variety of proxies for the key independent variables, such as,

- the *number of environmental charges* a company has faced;
- the *number convictions* a company has faced;
- the *size of monetary penalties;* and
- the direct *cost of complying with regulation*.

Each has its limitations. For example, the number of charges is driven as much by enforcement efforts as by company actions, and thus may not truly measure the way managers are addressing environmental concerns (Illinitch et al., 1998). Fines and convictions are driven by regulatory efforts too, as well as by companies' efforts to defend themselves in court (LaPlante & Lanoie, 1994). For this reason neither infractions nor fines and convictions reflect the pervasive impact on operations of the environmental movement. C*ompliance costs* would be a better proxy, but this cost information is not easily obtained. Financial statements rarely show this information clearly. While it may be possible to obtain this information directly from some of the companies, managers do not always have accurate data. For example, managers at an Amoco refinery in Virginia initially believed the cost of complying with environmental regulation was about three percent of non-crude operating costs. A two-year study reassessed the figure at twenty-two percent (World Resources Institute, 1995).

Russo & Fouts (1997) argued that some of the earlier studies of the relationship between environmental and economic performance can be challenged on methodological grounds, for failing to control for industry-specific factors that contribute to profitability. They suggested that a company can obtain a competitive advantage by nurturing internal competencies (a combination of tangible items such as plant and equipment, and intangibles such as human resources, technology, culture, and management skill) into a proprietary resource. However, the value of such a resource is driven at least partly by the interaction of the company with its external environment (Collis & Montgomery, 1995). This means that the correlation between environmental and economic performance may be driven to some extent by societal demand, which changes over time. Walden & Schwartz (1997) said that 1989, the year of the Exxon Valdez oil spill, marked a turning point in the public demand for corporate accountability for environmental impacts. If they are correct, the external environment appropriate for the development of a competitive advantage based on effective environmental management may have developed in the 1990s. For this reason, the relationship between environmental and economic performance should be revisited.

In summary, prior research has examined the economic impact of environmental regulation by focusing on investor response to the threat – and the implementation – of legislation. In both cases, negative share reaction is interpreted to reflect investors' assumption that regulation is bad for business. Evidence as to the accuracy of this assumption has thus far been inconclusive. Changes in societal expectation of company performance, however, along with the changes in technology that these expectations may have engendered, mean that effective management of environmental resources may now be an important factor in determining company success.

Model design

This research explores the hypothesis that *environmental management can be good for business* within the context of the Canadian oil and gas industry – specifically, in oil refinery operations. Oil and gas companies have a high public profile among environmental groups, and are therefore specifically targeted for regulation. Furthermore, as part of the natural resource industry, petroleum refineries play a significant role in the Canadian economy. The findings of this study are therefore relevant to parties both inside and outside the industry.

A rough configuration of the statistical model to examine the foregoing hypothesis is as follows:

$$Profit_{t-} = B_0 + B_1 EnvirPerformance + B_2 Control\#1 + B_3 Control\#2 + \ldots$$

Prior work has often measured environmental performance in terms of legal actions against a company, or the related court costs. Problems associated with these choices of proxy have already been discussed. Furthermore, shareholders have been known to react when companies respond to environmental concerns, even when regulatory action is not involved. For example, shares of McDonalds rose when the company announced it would reduce waste (McMillan, 1996). Pulp and paper companies with better pollution control records have higher price–earnings ratios, and lower share price volatility than companies with poor records (Spicer, 1978). Whether these capital market responses mean investors are expressing concern that current (legal) behavior may in the future be challenged by expanding regulation, or are merely expressing their personal values is a matter of speculation. Nevertheless, these results argue in favor of a measure for environmental performance that goes beyond regulation or the cost of compliance to include voluntary efforts as well.

Two US studies have examined reactions to the first public release of *Toxic Release Inventory* (TRI) data. This is a US database disclosing the volume of emissions of numerous substances from manufacturing facilities operating under SIC codes 20-39, with 10 or more employees. These companies are required to report their annual on-site releases and off-site transfers of each of over 300 specific chemicals. Hamilton (1993) noted an abnormal negative share price response in companies that reported unexpectedly high emissions in 1989, the first year the data were released. Konar & Cohen (1997) found that those companies whose shares suffered the most responded by reducing emissions more than their peers. The authors used these findings to argue that public information is "quasi-regulatory." In other words, by releasing information that might be used to organize boycotts, lobby for additional regulation, or bid share price down, the government has effectively raised the cost of pollution, thereby giving companies an economic incentive to reduce emissions.

More recent studies have used TRI data to investigate the relationship between financial and environmental performance (King & Lenox, 2001a; 2001b; 2002). For example they found that financial performance, as measured by *Return on Assets* and Tobin's *q*, is driven by waste prevention (King & Lenox, 2002). The Canadian equivalent of the TRI is the *National Pollutant Release Inventory* (NPRI). Like TRI emissions, NPRI emissions are not illegal. Environment Canada collects the data not to punish companies, but as a means of assessing trends over time. Furthermore, emissions reduction is not a legislative requirement. In this sense, it can be argued that the NPRI reporting requirements embody the objectives of the environmental movement, and reflect the extent to which companies address some of the implied terms of the social contract. NPRI data are reported annually, quantified, and available electronically, all of which simplifies the data collection process. For these reasons, the volume of NPRI emissions is used as the key dependent variable in this study.

The data collected span the years 1993 (the first year that NPRI data were available) to 2002. A statistically significant and negative emissions factor would support anecdotal reports that investments in effective environmental management earn superior long-term returns (Israelson, 1998). On the other hand, a significant and positive coefficient would support investors' assumption that efforts to reduce emissions decrease economic performance.

Control variables

The petroleum refinery process transforms crude oil, which is virtually useless in its natural state, into a wide variety of products such as propane, automotive and aviation fuel, furnace oil, lubricants, and asphalts. It is important to identify **c**ontrol variables that capture the specifics of the operation. For example, each refinery is configured to produce a complement of products that maximizes profit margins. This involves taking the proximity of nearest markets into consideration, and it implies that two refineries will not necessarily be designed to produce the same outputs. This means that volume of output cannot be used as an activity control variable. However, the main feedstock for each of these refineries is the crude itself. In this analysis, the total volume of crude processed will be used as a size control variable. Refinery-specific data were unavailable, so the data were collected on a per-company basis. A positive correlation with profit is anticipated.

Productive capacity is tied to investment in refinery assets. The refinery operation is capital intensive, with the cost of energy being the second highest operating cost. Capital employed will be used as a second control variable, to capture the impact of company size. The direction of correlation of this variable with profit is expected to be positive.

Time is included in this paper as a trend variable, to capture the impact of unidentified factors that may be correlated with the dependent variable (Gujarati, 1995) These factors could include changes in technology, energy efficiency, or the cost of labor. The direction of association is indeterminate because the time variable $Year_t$ captures the aggregate impact of numerous factors.

The model for this analysis is as follows:

$$NetInc_{i,t} = B_0 + B_1 NPRI_{i,t} + B_2 Crude_{i,t} + B_3 CapEmp_{i,t} + + B_4 Yr_t \quad [1]$$

where:

$NetInc_{i,t}$	is the net income (in millions of Canadian dollars) from refinery operations of company *i* in year *t*;
$NPRI_{i,t}$	is total NPRI emissions (in metric tons) from company *i* refineries in year *t*;
$Crude_{i,t}$	is the volume of crude oil input (in millions of barrels) processed by company *i* in year *t*;
$CapEmp_{i,,t}$	is total capital employed (in millions of Canadian dollars) in refinery operations for company *i* in year *t*; and,
Yr_t	is the year, ranging from 1993 to 2002.

Data description and discussion of variables

Total petroleum refinery capacity in Canada (measured in volume of crude oil input) is about 1,855,850 barrels per day in 2004. There were 19 petroleum refineries in Canada in 2003, owned by 10 organizations. This excludes refineries classified as upgraders, as well as petrochemical refineries. Of the 19 petroleum refineries, those operated by private companies were eliminated from this study because of difficulty in obtaining financial performance data. Refineries belonging to US companies were also eliminated, in order to avoid complications that could arise from the differences between US and Canadian financial reporting guidelines. Data were

Table 1
Companies Included in the Regression Analysis

Company Name	No. Refineries	Total production capacity (barrels of crude input per day)
Husky	2	35,250
Imperial Oil	4	502,200
Parkland	1	6,000
Petro-Canada	4	313,200
Shell	3	299,200
Sunoco	1	78,000
Subtotal	15	1,233,850

Companies Excluded (Each with one refinery)

Company Name	Total production capacity (barrels of crude input per day)
Valero (a US company; formerly Utramar, in Quebec)	215,000
Irving Oil (private Canadian company in New Brunswick)	250,000
North Atlantic Refinery (private Canadian company in Newfoundland)	105,000
Chevron/Texaco (US company operating in BC)	52,000
Subtotal	622,000

collected from the remaining six companies (15 refineries) identified below:

1. Husky Energy, with refineries in Lloydminster and British Columbia;
2. Imperial Oil, with operations in Nova Scotia, Ontario, and Alberta;
3. Parkland Industries, in Alberta;
4. Petro-Canada, with refineries in Alberta, Ontario, and Quebec;
5. Shell Canada, in Quebec, Ontario, and Alberta; and
6. Sunoco, in Ontario.

The refineries included in this study account for a production capacity of 1,233,850 barrels per day (see Table 1), or about 66% of total capacity in Canada.

Refineries classified as *upgraders* use a higher density feedstock which is much heavier and cheaper than the crude used by the petroleum refineries. For example, in early October 2004, Cold Lake heavy crude cost about $29 US per barrel, compared to about $54 US for the lighter West Texas Intermediate crude used by the petroleum refineries. Upgraders were excluded from this study because the influence on profit of these diverse input costs would complicate the analysis. Petrochemical refineries were also excluded. This is a separate production process downstream from petroleum refinery operations.

Most of the refineries are owned by large integrated companies whose operations include exploration and recovery, petroleum refining, petrochemical refining, and retail marketing. Ten years of data (1993 to 2002) were collected for all of the integrated companies except Husky Oil and Parkland Industries. Husky did not become a publicly traded company until 2000. Husky's annual reports contain sufficient historic information to provide data for the years 2000 to 2002 only. Parkland required special treatment (discussed below) because of its size. Parkland sold its refinery in 2000. For this reason only eight years of data are available for this company.

Based on the six companies included in this analysis, the total dataset includes 51 company-year observations. Additional detail about the measurement of the individual factors in model [1] is provided below.

$NetInc_{i,t}$ For the integrated companies, the net income from refinery operations is shown in the segmented disclosures either in the financial statement notes, or in the *Management Discussion and Analysis* section of the annual report. The annual report of Parkland Industries, the smallest company in the analysis, did not provide the level of detail provided by the other companies. While Parkland operated one refinery up until 2000, its main business was marketing gasoline, and the company did not disclose petroleum refinery operations as a separate segment. For this reason an estimate of $NetInc_{i,t}$ for Parkland Industries was based on the proportion of sales volume for which cost of sales was produced internally.

$NPRI_{i,t}$ Each refinery has a specific NPRI Site Identification number. The annual emission volumes (in metric tons) of each reported substance are aggregated into a single figure. For companies with more than one refinery the NPRI emissions from each refinery are aggregated into a single number. (This adjustment was necessary because refinery-specific financial performance information was not available.)

$Crude_{i,t}$ Volume of crude processed was obtained from the annual reports.

$CapEmp_{i,,t}$ This is the investment cost of refinery assets less accumulated amortization. (Technological innovation requires ongoing investment in these assets, as discussed later in this paper, such that net investment increases over time.) The integrated companies provided this information in their segmented disclosures. For Parkland, the information came directly from the balance sheet.

Summary statistics are shown for the independent variables in Table 2. Given that refineries are built to accommodate a specified crude input capacity, that management wants to run the refineries at or near full capacity each year, that higher volume of production means greater emissions, and that volume is a factor in model [1], correlations between $Crude_{i,t}$, $CapEmp_{i,,t,.}$ and $NPRI_{i,t.}$ are likely to be high. The correlation matrix in Table 2 confirms this expectation. In order to avoid issues arising from multicollinearity in the data, $CapEmp_{i,,t,.}$ and $NPRI_{i,t}$ are each regressed against volume ($Crude_{i,t}$), and the residuals from each regression are used in place of the original data in model [1].

Table 2
Summary Statistics for Independent Variables
N = 51

Variable	Mean	St. Dev.	Minimum	Maximum
$NPRI_{i,t}$	4600	11963	21.52	77482
$CapEmp_{i,t}$	1361	946	24	3027
$Crude_{i,t}$	76	58	1.6	164

Description of Variables

$NPRI_{i,t}$	Total National Pollutant Release Inventory emissions (metric tons)
$CapEmp_{i,,t}$	Total cost of capital employed, in Canadian dollars (millions).
$Crude_{i,t}$	Barrels of crude input as feedstock (millions)

Correlation Matrix

$NPRI_{i,t}$	1.000		
$CapEmp_{I,t}$	0.3031	1.000	
$Crude_{i,t}$	0.3029	0.9561	1.000
	$NPRI_{i,t}$	$CapEmp_{I,t}$	$Crude_{i,t}$

4. Results

Regression results are shown in Table 3. All control variables are statistically significant at α = 0.05 or less, with signs in the direction anticipated. About sixty-six percent of the variation in $NetInc_{i,t}$ is explained by variation in the independent factors identified in this model. The key independent variable $NPRI_{i,t}$ is statistically significant at α = 0.05, and negative. These results argue that when aggregate NPRI emissions drop by one metric ton (while size of operation and volume of crude input are controlled), the income from petroleum refinery operations rises by about two thousand dollars.

Table 3

Results of Linear Regression Analysis

$$NetInc_{i,t} = B_0 + B_1 NPRI_{i,t} + B_2 Crude_{i,t} + B_3 CapEmp_{i,t} + B_4 Yr_t$$

where:

$NetInc_{i,t}$ is the net income from refinery operations in Canadian dollars (millions)
$NPRI_{i,t}$ is total NPRI emissions (in metric tons), adjusted for volume
$Crude_{i,t}$ is the volume of crude oil input in barrels
$CapEmp_{i,,t}$ is total capital employed in refinery operations in Canadian dollars (millions), adjusted for volume
Yr_t is the year, ranging from 1993 to 2002

		Expected sign	Coefficient	t-value
B0i	*Intercept*	+/–	-28,878	-3.922***
B1i	$NPRI_{i,t}$	+/–	-0.002	-2.451**
B2i	$Crude\text{-}_{i,t}$	+	0.001	8.854***
B₃i	$CapEmp_{i,t}$	+	0.087	2.545**
B4i	Yr_t	+/–	9.878	2.779***

Significant at: α = 0.01*** α = 0.05**
R----^{2} = 0.66

These results conflict with the "dead loss expenditure" argument that says environmental legislation channels cash toward expenses that satisfy environmental performance expectations, but does nothing to enhance the financial performance of the company (Gollop & Roberts, 1983). An explanation for these findings is not immediately obvious. After all, just as minimum wage, pay equity, and child labor laws increase the costs of doing business, environmental regulation also increases the cost of doing business. A reconciliation of the intuitively unacceptable finding that rising costs mean higher profit may come from Freedman & Stagliano, (1991), who suggest that the modernization of operations to meet environmental control requirements leads to increases in plant efficiency and profit. It should be noted that the correlation between these two performance measurements, profit and emissions, is driven at least partially by external factors such as societal expectations (Russo & Fouts, 1997). Possibly the ongoing effort to legitimize business operations has triggered the demand for technological advancements that include environmental impact considerations in the quest for higher production efficiencies. If this is the case, the conclusions drawn in earlier studies that shareholders are opposed to calls for environmental management are not incorrect. They are, however, interpretations made in light of current-day technology and current-day mores. Changing social expectations affect not only the regulatory environment, but also the drive for technological advancements. It is through such advancements that profitability and environmental performance – once considered irreconcilable – can now be considered simultaneously.

5. Summary, discussion and suggestion for future studies

Prior literature shows that shareholders factor the perceived repercussions of environmental legislation into share price. Regulation that limits allowable emissions restricts volume of activity and/or commits a company to significant capital cost and operating expenditures. For this reason, the environmental movement has been accused of subjecting firms to costs that satisfy legislative requirements at the expense of financial performance. On the other hand, it has also been argued that given the appropriate internal and external environment, modernization of production facilities can lead to cost efficiencies as well as improvements in environmental performance.

Prior studies of the relationship between financial and economic performance have produced equivocal results. Russo & Fouts (1997) said these findings are inconclusive because they are derived from statistical models that fail to control for factors that contribute to profitability. This study addresses that issue by focusing on a single industry segment, and by identifying profit related control factors specific to that segment. The findings of this study support the conclusion that over the ten-year period from 1993 to 2002, a decline in NPRI reportable emissions has been associated with growing profits. In other words, there is a positive relationship between environmental and financial performance.

Russo & Fouts (1997) also argued that industry growth plays a role in determining when good financial performance and good environmental performance can be pursued simultaneously. While the use of new, unproven technologies involves pay-off uncertainties, technological innovation is accelerated for industries in a growth phase. While no new petroleum refineries have been built in North America since 1980 (in fact, some have been shut down) core petroleum technology continues to be developed, and net refinery capacity continues to keep up with a growing demand through incremental expansion and technological upgrades in existing refineries. For example, the introduction of a patented process to improve the performance of the catalytic cracking units present in most refineries has increased the yield of gasoline per unit feedstock from 55% liquid yield to over 75% (Orr ,2004).

Another reason that some of the earlier literature reported contrary results – a negative correlation of environmental with financial performance – could be time-related. A long-term orientation toward environmental stewardship calls for a commitment at all company levels, including production planning, performance measurement, and product/process design, and management expertise in environmental stewardship can, over time, evolve into a proprietary resource. However, the value of such a resource is driven at least partly by external factors (Collis & Montgomery, 1995). As societal demand for cleaner technologies has grown over time, these technologies have become increasingly available. For example, the process of *scanfining* was introduced about five years ago. This process removes virtually all sulphur from gasoline at about one-third the energy costs of older processes, thus helping refineries to meet new regulatory requirements while reducing their second highest operating cost. It can therefore be argued that the environmental movement is a major social force that not only presents new challenges to business, but also the opportunity to satisfy those challenges. In this way, environmental management has become a legitimizing, value-creating activity, at least in some industry segments.

Many questions remain unanswered. No effort has been made in this study to test whether or not the best environmental performance (lowest emissions) is associated with the best financial performance. This paper does not attempt to find evidence in support of Hart's *natural resource perspective* (1995), which argues that a positive correlation between environmental performance and profit can be a distinct competitive advantage available only to certain companies. Clarkson et al., (2006) have made some progress here, with findings that a company's financial liquidity and R&D expenditures contribute toward the determination of a competitive advantage across the US manufacturing sector. An examination of this nature would be a logical extension to the current study. Furthermore, this study looks only at the petroleum refinery section of the oil and gas industry, and no assumption is made that these findings extend to other parts of the industry.

The findings of this paper could also tie into a related branch of environmental accounting research – the examination of disclosure versus environmental performance. The disclosure studies have produced evidence that is once again, inconclusive. It has been argued on the one hand that companies use environmental disclosure to explain poor financial results (Neu et al., 1998; Freedman & Jaggi, 1988). On the other hand, Cormier & Gordon (2001) found that companies in good financial health made greater financial disclosures. Possibly the correlation is industry specific. In their analysis of social and environmental disclosure, Gray et al. (2001) have also identified time and industry segment as important factors. By identifying those industries for which environmental performance has become a profit creating activity, as this current paper begins to do, efforts to better capture the disclosure decision making process may be possible.

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