Environmental and Financial Performance: Are They Related?*

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ABSTRACT

Prior research has been contradictory on the relationship between financial and environmental performance. There are both theoretical and empirical reasons for this lack of consensus. Complying with environmental regulation is costly and thus might hurt a firm's bottom line. On the other hand, a firm that is efficient at pollution control might also be efficient at production. Moreover, a firm that does well financially can afford to spend more of its resources on cleaner technologies. Among the reasons for the past discrepancy in empirical findings is the lack of objective criteria to evaluate environmental performance. Some authors have looked at subjective rankings by public interest groups, others have examined pollution control expenditures across industries, while others have compared the market returns of socially conscious mutual funds to overall market trends. This study reports on a new objective data set detailing the environmental performance of the Standard and Poor's 500 companies. We construct two industry-balanced portfolios and compare both accounting and market returns of the "high polluter" to the "low polluter" portfolio. Overall, we find either no "penalty" for investing in the "green" portfolio, or a positive return from green investing. The paper also examines the stock market reaction to new information on the environmental performance of individual firms, and provides a preliminary analysis of which comes first - good financial performance or good environmental performance.

I. Introduction

Prior research has been contradictory on the relationship between financial and environmental performance. There are both theoretical and empirical reasons for this lack of consensus. Complying with environmental regulation is costly and thus might hurt a firm's bottom line. On the other hand, a firm that is efficient at pollution control might also be efficient at production. Moreover, a firm that does well financially can afford to spend more of its resources on cleaner technologies. Among the reasons for the past discrepancy in empirical findings is the lack of objective criteria to evaluate environmental performance. Some authors have looked at subjective rankings by public interest groups, others have examined pollution control expenditures across industries, while others have compared the market returns of socially conscious mutual funds to overall market trends. This study reports on a new objective data set detailing the environmental performance of the Standard and Poor's 500 companies. We construct two industry-balanced portfolios and compare both accounting and market returns of the "high polluter" to the "low polluter" portfolio. *Overall, we find either no "penalty" for investing in the "green" portfolio, or a positive return from green investing.* We also examine the stock market reaction to new information on the environmental performance of individual firms, and provide a preliminary analysis of which comes first - good financial performance or good environmental performance.

The subject of corporate environmental performance -- what it means, how to measure it and why it matters -- is rapidly gaining prominence among business leaders, academics and investors. A key element in this debate is the question of how an individual firm's environmental performance impacts its financial performance. Does a company that strives to attain good environmental performance gain advantages over competitors, or is environmental performance just an extra cost for these firms? Answers to these questions have important implications for the role that corporations can be expected to play in promoting pollution reduction efforts and the use of cleaner technologies.

Historically, investments by corporations in environmental protection measures have tended to be viewed as a drag on financial performance. For the U.S. economy as a whole, the EPA estimates that total annualized costs for all pollution control activities in the United States amounted to $115 billion in 1990, or about 2.1 percent of the nation's GNP. Moreover, EPA expects this annual cost to increase to $171 billion (in 1990 dollars) by the year 2000, or 2.6 percent of estimated GNP (U.S. EPA, 1990). Environmental investments were often viewed by business as a necessary evil: necessary to meet societal standards for controlling pollution and protecting public health, but evil because they resulted in lower overall profitability by diverting resources to a fundamentally non-productive use.

In recent years, this premise has come under increasing attack, however, not only by environmental advocates, but also by important business and academic leaders and investors. Perhaps this is not surprising, since until recently firms had looked towards end-of-pipe treatment as the main method of pollution control. More recent trends toward pollution prevention may have shifted some of the debate away from compliance costs toward competitiveness.

The notion that environmental performance is an important component of competitive advantage has found acceptance by a growing number of corporate leaders over the last several years. For example, Ben Woodhouse, director of Global Environmental Issues at Dow Chemical, states that "the degree to which a company is viewed as being a positive or negative participant in solving sustainability issues will determine, to a very great degree, their long-term business viability" (Schmidheiny 1992, p. 11). "Monsanto's ability to develop new products, enter new markets, sell our current products and operate our manufacturing facilities profitably depends upon continuous improvement in environmental performance," adds Richard J. Mahoney, Chairman and CEO of Monsanto Co. (Monsanto, 1991). Finally, according to Richard Druckman, Vice-President for Strategic Planning for Bristol-Myers Squibb Co., "continuous improvement of environmental management throughout the organization is a key factor for our competitiveness in the 1990s. Each business group and division now incorporates strategies to address environmental management improvement in its strategic plan," (Bristol-Myers Squibb Co., May 1993.)

This paper offers new evidence on whether or not firms that perform well on environmental criteria also perform well financially. Previous research on this issue has been limited in scope due to lack of data availability. Unlike previous research, our analysis is based on a relatively comprehensive list of companies - the Standard and Poor's 500. In addition, the environmental performance measures are based on actual government records or government-mandated securities filing disclosures. Unlike previous studies, we do not rely on subjective or anecdotal analysis to characterize environmental performance. The primary source of data was published by Investor Responsibility Research Center (1992). Although these environmental performance measures are based on publicly available information, they have not previously been available to researchers in an accessible format.

Although there are many ways in which one could compare environmental and financial performance, this paper is concerned with whether or not "green investing" provides a positive financial return relative to a more neutral investing strategy. Unlike previous authors, we define green investing to be investing in companies that are the environmental leaders in their respective industries. This would allow for investing in oil and chemical companies and firms in other heavy polluter industries. We construct two "portfolios" consisting of the "low pollution" and "high pollution" firms in their respective industries. Our main finding is that the "low pollution" portfolio does as well as - and often better than - the "high pollution" group.

It is important to state at the outset, however, that any relationship that is found does not necessarily imply the direction of causation. For example, a finding that good environmental performance is correlated with high earnings does not necessarily mean that firms who improve their environmental performance will also improve their earnings. It is possible that causation runs the other way - that firms are good environmental citizens because they are strong financially and are able to afford to be good citizens.

Section II provides a brief literature review and some background into the empirical evidence on the relationship between financial and environmental performance. Section III describes the IRRC and financial performance data used in the analysis, as well as the empirical tests employed. Section IV presents the main results of the paper, comparing the financial performance of "low polluter" portfolios to industry-matched "high polluter" portfolios . Section V considers the question of which comes first - good environmental performance or good financial performance. Some concluding remarks and suggestions for further research are reserved for Section VI.

II. Prior Evidence on Environmental and Financial Performance

The premise that corporate environmental performance may be linked with financial performance has attracted limited academic research. Most of the research in this area has focused on the performance of socially-screened portfolios relative to broader market indices. A firm's social performance has typically been quantified using reputational indices. These indices have been of two types: those which combine a firm's social performance reputation on a variety of issues into a single rating of social performance, or those which focus on a single aspect of social performance, such as involvement in South Africa or environmental performance.

Results from these earlier studies have been mixed; see for example Vance (1975), Bowman (1975), Cochran and Wood (1984), and McGuire, Sundgren and Schneeweis (1981). In one recent study, Covenant Investment Management attempted to rate 1,000 companies on 36 different social and environmental criteria, sorted companies into three social performance tiers, and then compared the performance of the three groups for a five-year period. The 200 companies with the highest social performance scores produced a 100 percent return to investors over five years, compared to a 92 percent return by the 600 middle tier companies and a 76.6 percent return by the 200 bottom tier companies. On a capitalization-weighted basis, the financial performance of the top tier companies came out virtually identical to the performance of the S&P 500.

On the other hand, White (1991) tracked the performance of a group of six mutual funds that employ social responsibility screening criteria and found that for the one-year period ending June 28, 1991,

the funds slightly underperformed the S&P 500 index on both a nominal and a risk- adjusted basis. Even if this finding holds up over time, it is not necessarily evidence that firms who are socially responsible underperform financially. Whether or not social/environmental mutual funds perform well financially may have more to do with the ability of fund managers to pick stocks, than with whether or not environmentally conscious firms perform well in general.

A second group of studies has addressed more directly the relationship between environmental performance and financial performance. Most of the early work in this area was based on a series of industry studies published by the Council on Economic Priorities (CEP) in the early 1970s, that examined the pollution control records of the petroleum refining, steel, pulp and paper, and electric utility industries. Bragdon and Marlin (1972) and Spicer (1978) found significant correlations between CEP's measures of firm environmental performance in the pulp and paper industry and firm financial performance. However, Chen and Metcalf (1980) using the same original data, argued that environmental performance was not related to financial performance when differences in firm size were taken into account.

More recently, Erfle and Fratantuono (1992) analyzed CEP's reputation indices of environmental performance, which classified 49 companies as high, medium or low environmental performers based on anecdotal information about regulatory compliance and the existence or lack of proactive environmental programs such as recycling or waste reduction programs. They concluded that environmental performance for these firms is positive and significantly correlated with return on assets, return on equity and return on investment.

However, Mahaptra (1984) concluded just the opposite, using a larger sample and time period. He compared pollution control expenditures across six different industries to the average market returns in those industries and concluded that pollution control expenditures are a "drain on resources which could have been invested profitably, and do not 'reward' the companies for socially responsible behavior." Of course, higher firm expenditures on pollution control does not necessarily translate into better environmental performance.

There are many reasons why previous authors could find opposite results, not the least of which is that most of their samples are rather small. In fact, however, the results are not necessarily contradictory. It is possible that comparisons made across industries would find a negative effect - as all firms in one industry are called upon to "internalize" their externalities, we expect product prices to increase and profits to decrease for all firms in that industry. However, there may still be an important differential effect within an industry that could work to either the benefit or detriment of "green" firms. This paper does not compare financial performance across industries. Instead, as described below, we construct industry-balanced portfolios. Thus, we are not asking whether or not environmental regulation drains an industry, but whether or not environmental performance is related to financial performance within an industry.

III. Description of Data and Statistical Tests

This section describes both the environmental performance and financial performance variables. It also describes the methodology used for constructing portfolios of companies based on their environmental performance. In each case, two portfolios were constructed, one consisting of "high polluter" firms and the of "low polluter" firms. These portfolios will form the basis of our comparison in a subsequent section.

A. Environmental Performance Variable Definitions

The environmental performance data consists of nine different measures for each of the firms in the sample. Eight of these measures come directly from government data; one is taken from corporate 10-K filings as required by the U.S. Securities and Exchange Commission. In all cases, we measure environmental performance as the average over three years, 1987-1989. This is done primarily to ‘smooth out’ any variations due to one-time data miscoding or random fluctuations. For example, large spills or government enforcement actions are relatively infrequent events, and the TRI data were not reported consistently during its earliest years.

The environmental performance variables differ in the extent to which they depend on recent

actions or firm culpability. Some variables, such as Superfund sites, have virtually nothing to do with either current environmental performance, and may simply be liabilities that the firm has incurred. Other variables, such as fines, are more likely to be correlated with firm compliance efforts. A brief list of these variables follows.

Number of environmental litigation proceedings -- The number of government or other legal proceedings related to environmental matters that the company disclosed in its Form 10-K reports during the period 1987-1989.

Superfund sites -- The number of National Priority List hazardous waste cleanup sites at which the company, or its subsidiaries, had been named a Potentially Responsible Party (PRP) by the U.S. Environmental Protection Agency as of November 1990.

Number of noncompliance penalties -- The number of federal noncompliance penalties assessed against the company or its subsidiaries under nine major federal environmental statutes for the three-year period 1987-1989. These include civil, criminal and administrative penalties.

Dollar value of noncompliance penalties -- The value of federal noncompliance penalties assessed against the company or its subsidiaries under nine major federal environmental statutes for the three-year period 1987-1989.

Volume of toxic chemical releases (TRI) -- The sum of the reported 1988 emissions of approximately 300 selected toxic chemicals from domestic manufacturing facilities owned by the company or its subsidiaries and required to be reported under the Emergency Planning and Community Right to Know Act.

Number of oil spills -- The number of reported oil spills exceeding 10,000 gallons in volume attributable to the company or its subsidiaries for the period 1987-1989.

Volume of oil spills -- The estimated volume of all oil spills exceeding 10,000 gallons attributable to the company or its subsidiaries for the period 1987-1989.

Number of chemical spills -- The number of reported chemical spills exceeding 10,000 pounds attributable to the company or its subsidiaries for the period 1987-1989.

In all cases, the environmental measure of interest was divided by the firm's revenues to adjust for firm size. The rationale for this is twofold. First, firm size contributes to the ability of a firm to absorb the financial consequences of environmental risks. Second, firm size has been previously shown to affect environmental performance because larger firms are likely to be exposed to greater risk of environmental accidents, emissions and incidents of non-compliance. Thus, the study variables effectively measure the relative environmental performance of a firm’s operations, not its absolute environmental impacts.

B. Selection of Portfolios

The basic approach used throughout the analysis was to construct two portfolios - one containing firms with "low" values of the environmental measure of interest and another with "high" values. The portfolios were designed to contain a matched group of firms, where the matching was based on industry category. This approach controls for the level of polluting activity inherent in specific industrial processes. It also controls for the market risk inherent in different industries. Any remaining variation is likely due to pollution-related factors or other factors that are correlated with the pollution measures we use, such as age of a firm's plant capacity.

The procedure used to generate these two portfolios was as follows: First, companies were sorted into 85 different groups based on the industry categories used by Standard & Poor's Corp. to classify companies in the S&P index. Within each industry, firms were ranked by the environmental variable of interest. A dummy variable was constructed equal to 0 if that firm's environmental measure was below the median for its industry group, and 1 if its measure was higher than the median. In instances where there were an odd number of firms in the industry, the median value was excluded from the analysis. In industries where all firms ranked equally on the environmental measure of interest (which occurred only when all values for the environmental measure was zero), all firms in that industry were excluded from the analysis. In many industries, although the median value of the environmental variable was zero, there were also positive values of the environmental measure. In these instances, all firms with a zero on the environmental measure were coded 0, all others were coded 1.

Table 1 presents some summary statistics from this initial stage. All environmental variables were measured so that a "low" value indicated they were a "good" environmental actor or had relatively little environmental liability. A "high" value indicated the firm had a relatively larger environmental liability. For example, the median number of environmental lawsuits for those in the "low litigation portfolio" is 0, while it is 6 for the "high litigation portfolio." As seen in Table 1, the variation across firms is quite large for some environmental variables. Note, however, that Table 1 does not report the environmental performance measures after adjusting for firm size. As noted earlier, when constructing the portfolios, "low" and "high" were measured relative to volume of sales.

Table 2 compares firm size and beta for the "low" and "high" group for each of the nine pollution measures. Since our environmental variables have been measured per dollar of revenue, we would not expect there to be any significant size difference between the two portfolios. This is true for litigation, superfund and toxic releases. However, it appears that large firms are more likely to be in the high pollute category for oil and chemical spills and government-imposed fines. There is also a statistically significant difference in beta for the chemical spill portfolios.

C. Financial Performance Variable Definitions

Throughout the analysis, two different types of firm performance measures were used: accounting returns and stock market returns. Accounting returns were measured using return on assets (ROA) and return on equity (ROE). Stock market performance was measured utilizing the total return to a common shareholder, both before and after adjustments for risk. Both types of measures are widely used in previous studies. All financial performance data were taken from the Compustat database published by Standard & Poor’s Corp. A brief discussion of each measure follows:

Return on assets (ROA) is widely used by market analysts as a measure of firm performance, as it measures the efficiency of assets in producing income. For purposes of this analysis, we calculated ROA as aftertax income plus interest expense, divided by average total assets. Interest expenses are added back to income because we want to know the total income generated by the firm per dollar of assets -- irrespective of whether equity or debt financing is used.

Return on equity (ROE) is a measure of the performance of the firm relative to shareholder investment. Since this is a measure of shareholder returns rather than overall firm profitability, interest

expenses are subtracted out of income for this measure.

Total risk-adjusted return to shareholders was measured based on cash dividends paid out plus stock market share price appreciation. Returns were adjusted for stock-price variability by using the standard firm-specific "beta" calculated directly from stock prices. To the extent that risk is associated with environmental performance, controlling directly for it will tend to reduce the significance level of any results relating the effect of differences in environmental performance on firm performance.

For our purposes, stock market returns are a better measure of firm performance. First, they represent true gains to shareholders, through both dividends paid out and appreciated stock prices. In contrast, accounting returns cannot be directly realized by shareholders. Second, stock market returns are more directly comparable across firms, as they are not subject to the accounting manipulations of items such as taxes and depreciation. Finally, those who adhere to an efficient markets theory of stock prices would argue that they are a good measure of future profits. Of course, we are measuring changes in the stock prices - not their absolute levels. Thus, market returns in this context refer to the sum of current shareholder returns (cash dividends and changes in stock prices) plus improvement in the long-run prospects of the firm.

D. Statistical Tests

The main hypothesis being tested in this paper is whether or not firms that perform well in the environmental arena also perform well financially. Operationally, this is a rather simple test, in which we ask whether the "low pollution" portfolio performs differently from the "high pollution" portfolio, where "low" and "high" refer to each of the environmental measures. For example, we want to know if an investor would benefit from choosing firms with fewer environmental lawsuits relative to other firms in the industry. Since the portfolios were constructed by matching firms within industry groups, we are able to control directly for industry specific risk and return variation. Thus, we employ a simple statistical test to determine whether mean financial performance is higher, lower or the same in the high versus low pollution portfolios.

Although environmental performance is measured over the three year time period 1987-1989, we measure financial performance over three different time frames: 1987-1989, 1990 and 1991. The reason for including the subsequent time periods is to test for lag structures in the returns data. For example, a firm that is sued in period one may experience an immediate stock price reaction, but the accounting returns may only be affected several years later if the litigation results in substantial legal or compliance costs. Similarly, although a firm may emit toxic chemicals in one year, this information is only released to the public with at least a one year lag.

IV. Are Better Environmental Performers Also Better Financial Performers?

This section reports on the main empirical tests in this paper, the hypothesis being that good environmental performers are also good financial performers. Tables 3 through 5 compare the financial performance of the "low polluter" versus "high polluter" portfolios - using the different environmental performance measures as the defining characteristic of each portfolio. Table 3 compares these firms using risk-adjusted market returns. Table 4 examines return on assets, while return on equity is shown in Table 5.

There are a total of 54 comparisons made in the three tables, with each table comparing six different measures of environmental performance over three different time periods. In over 80% of the portfolio comparisons (44 out of 54), the "low polluter" portfolio performs better than the "high polluter" portfolio. If we restrict the comparison to only the risk-adjusted stock returns, about 75% (13 out of 18) of the "low polluter" portfolios performed better. Thus, it does not appear that investors who construct a balanced portfolio of good environmental performers will pay a penalty in terms of market performance. Only about 20% of these comparisons, however, are statistically significant. Thus, this result should not be interpreted as strong evidence of a ‘green investing premium.’ Instead, it is strong evidence that there is not a ‘green investing penalty.’

The finding of no ‘green investing’ penalty is contrary to much of the earlier literature on socially conscious investing. However, as mentioned above, most of the previous analysis has been limited to socially conscious mutual funds that are actively managed. Few mutual fund managers (regardless of their investment style or objective) consistently outperform the market. Moreover, it is important to note that the "low" and "high" portfolios constructed here are made within each industry category. Thus, for example, a chemical company that is one of the top 25 toxic chemical emitters in the country might also be one of the lowest emitters on a per dollar basis in the chemicals industry, and will thus be classified in the low polluter portfolio. Few environmentally screened mutual funds invest in this manner, often preferring firms that pollute less in absolute, rather than relative, terms. In contrast to the socially conscious mutual funds, since our portfolios are balanced subsets of the S&P 500, it is possible to closely mimic the performance of such an index while at the same time choosing only those firms that are in the upper half of their industry’s environmental performance distribution. Such a strategy does not appear to penalize investors in the way that a socially conscious mutual fund investment does.

Although not reported here, similar results obtained for the number of oil spills, number of chemical spills and number of fines. Instead, we report the volume of oil spills, volume of chemical spills and dollar value of fines. Similar (and often slightly stronger) results were also obtained by limiting the two contrasting portfolios to the upper and lower quadrant of firms in an industry instead of the upper and lower halves of each industry.

A brief discussion of the relationship between each of the individual environmental performance measures and the financial performance measures follows:

(a) Environmental Litigation

Firms with a relatively large number of environmental lawsuits as compared to their industry cohorts are likely to earn a lower level of return on assets and return on equity. However, this finding is statistically significant in only one case. Differences in ROA range from 1.0% to 6.0% per year, while ROE differs very little, from a low of 0.4% to a high of 2.0%.

Despite these lower accounting returns, there were no differences in stock market returns. In fact, risk adjusted market returns in 1987-9 were actually higher in the "high litigation" portfolio than in the "low litigation" group, although this difference was not statistically significant. Thus, it appears that despite slightly lower current earnings, the market does not react to 10-K disclosures of pending environmental lawsuits. To the extent that environmental litigation is a good proxy for environmental performance, this finding is not consistent with a "good environmental=good financial performance" hypothesis. However, it is consistent with a weaker hypothesis that being a good environmental actor does not hurt the bottom line. Further, the litigation variable is not the best proxy for environmental performance, as it is not an objective measure of pollution, but a measure of legal activity.

(b) Superfund Sites

IRRC identified 313 firms (or majority-owned subsidiaries) out of the 500 S&P firms that were listed as being a "potentially responsible party" (PRP) to a National Priority List (NPL) site. NPL sites are abandoned waste disposal sites which EPA has ranked as posing the greatest threats and thus requiring remediation. As of 1989, when these data were reported, very few sites had been cleaned up, yet future costs were estimated to be substantial. A recent study estimates the cost of cleanup of NPL sites in the U.S. to range from $30 billion to $120 billion (Dixon et al., 1993, p. 3).

Being listed as a PRP does not implicate current environmental management practices in any manner, since disposal activities that caused the Superfund site took place many years ago. Moreover, PRP's often disposed of their wastes under completely legal and/or state-of-the art disposal practices at the time. Nevertheless, being listed as a Superfund PRP may be an indicator of past environmental performance, since firms who polluted more are more likely to become PRPs. More importantly, given the high cost of cleanup, being listed as a PRP may have an impact on future earnings.

As seen in Table 3, the "low site" portfolio outperformed the "high site" portfolio between 1987-

1989: 18.1% to 16.0% on a risk adjusted market return basis. It also outperformed the "high site" portfolio in 1990 and 1991. However, these differences are not statistically significant at $p < .05$. Although not shown here, these results are stronger when the portfolios are constructed using the upper and lower quartiles of the number of Superfund sites. For example, risk adjusted returns in 1987-9 were 20.6% for the low site portfolio and 14.9% for the high site portfolio (with significance level at $p<.05$). These results are consistent with the hypothesis that the market anticipates significant Superfund cleanup expenditures for these firms in the future.

(c) Fines

Although civil and criminal environmental penalties are sporadically reported in leading newspapers, administrative penalties - which constitute the majority of the compliance data IRRC collected - are much less frequently reported in the press. They are also seldom mentioned in 10-K submissions. Thus, although we might anticipate some impact on accounting returns, we would not expect a large stock market reaction to the fines themselves. Instead, we would expect any difference in financial earnings to be due to additional compliance expenditures or other actions that the firm is required to undertake as part of the administrative or court action.

Indeed, as shown in Table 3, the stock market reaction is relatively small and not significant. In the 1987-1989 time period, risk adjusted returns were 17.2% for the "low fine" portfolio compared to 16.2% for the "high fine" portfolio. However, as shown in Table 5, we find that during the time these fines were being assessed, 1987-9, ROE was significantly higher for the "low fine" portfolio than the "high fine" portfolio, 16.0% versus 12.9% ($p < .05$).

(d) Oil Spills

Although the few very large oil spills attract significant media attention, most spills are smaller and do not get noticed in either the national or business press. All of the spills reported in the IRRC dataset, however, are of some consequence, being over 10,000 gallons. The firms in these portfolios represent 20 different industries ranging from oil and chemical companies, natural gas and electric companies, truckers, as well as other manufacturing and fabricating industries.

As shown in Table 3, although risk adjusted returns are lower in the 1987-1989 time period (18.1% versus 20.2%), these differences are not statistically significant. There are significant differences in 1990, however, as the low spill portfolio earns a -4.2% compared to -14.2% for the high spill portfolio ($p< .05$). It is possible that this large lagged stock price reaction is due to an unanticipated time lag in expenditures, as the most significant oil spills in our sample occurred in 1989. Perhaps more likely, oil spills may be a "leading indicator" that a firm is undergoing a management problem of some sort. Future research on this issue would be of interest. As shown in Tables 4 and 5, return on assets and return on equity are also generally lower for the high oil spill portfolio. The differences are quite large and statistically significant.

(e) Chemical Spills

Chemical spills are similar to oil spills in terms of their reporting rates and media attention, as IRRC data only include spills larger than 10,000 gallons. As we found for oil spills, the difference in risk adjusted market returns (Table 3) are not statistically significant. In fact, the "high spill" portfolio actually had higher returns than the "low spill" portfolio. On the other hand, as shown in Tables 4 and 5, in both the years of chemical spills, 1987-9, and the two subsequent years, 1990 and 1991, accounting returns are significantly lower for firms in the high spill portfolio than in the low spill portfolio. These differences are generally significant.

(f) Toxic Chemical Releases

Public disclosure of TRI emissions was mandated by the Emergency Planning and Community Right-to-Know Act of 1986. The first public disclosure of TRI emissions was made in June 1989, for 1987 emissions. Subsequent disclosure of 1988 emissions followed shortly thereafter, between the end of 1989 and early 1990. Public pressure followed immediately after the first disclosures, as environmental groups (notably the Natural Resources Defense Fund) publicized the highest emitters and called for community-

based protests.

Our findings for TRI are quite provocative. As shown in Table 5, risk adjusted returns in 1987-9 were significantly lower for the "high toxic" portfolio, 14.9% compared to 18.3%. Although not shown here, virtually all of this difference is due to 1989, the year in which TRI emissions were first announced. In that year, the low toxic portfolio return was 32.1%, compared to 23.7% for the high toxic portfolio ($p < .01$). This result is consistent with the findings of Hamilton (1995) and Konar and Cohen (1996), in which a significant negative stock market effect is shown on the day of the announcement of TRI emissions for firms who were relatively high toxic emitters in their industry.

Perhaps more interesting, however, is what happened to accounting returns in the years following the first announcement of TRI emissions. As shown in Tables 4 and 5, in 1990, both ROA and ROE were significantly lower for the "high TRI" portfolio, although not statistically significant. Thus, 'dirtier' firms had lower earnings. However, in 1991, ROA was actually 3% higher for the "high TRI" portfolio, 7.9% versus 4.9% ($p < .02$). Recall that the 1991 financial performance measures are based on a "high TRI" portfolio that is measured as of 1987-1989. Thus, one possible explanation for this finding is that firms who emitted high levels of toxic chemicals in 1987-1989 subsequently found low cost ways to emit less, thereby saved money previously wasted on raw materials that ended up as toxic releases. Although this is a very tentative finding, it is consistent with the findings of Hart and Ahuja (1996) who find efforts to prevent pollution and reduce emissions in a sample of S&P 500 companies has positive financial results (ROS, ROA and ROE) within 1-2 years of initiation.

V. Does Good (Bad) Financial Performance Precede Good (Poor) Environmental Performance?

Although we have shown that firms that perform well on environmental dimensions also perform well financially, that analysis was entirely static. We did not ask the question of which comes first or why this correlation might exist. This section briefly considers the question of why firms are good or bad environmental performers. Economists have often been interested in a related question - why firms comply with government regulation. In a world of rational utility maximizing individuals with profit maximizing firms, the only reason we would expect compliance is if the expected cost of noncompliance exceeded the cost of compliance. Similarly, the only reason we would expect firms to 'overcomply' with regulations is if the benefits to the firm exceed the costs.

The theory of optimal penalties is generally the starting point for most economic analysis of compliance or overcompliance. This theory relies on the simple proposition that firms will base compliance decisions on the probability of detection and the expected penalty if detected. This often stated proposition is not simple to operationalize. For example, when a risk neutral firm faces a bankruptcy constraint, it acts as though it is risk loving and might be less likely to comply than otherwise. When the firm compliance decisions are made by an agent of the firm owners, moral hazard might distort the incentives facing the firm managers. Many observers have noted that government-imposed sanctions are too small to deter noncompliance, suggesting either that they need to be higher or that there are other sanctions already in operation such as the threat of future more stringent enforcement actions, losing firm reputation and goodwill, or for gaining strategic competitive advantage over competitors.

Previous empirical work that attempts to understand why firms comply with the law have focused on the role of government enforcement and/or penalties in reducing observed pollution or noncompliance. Data availability in most of these studies is rather limited. Thus, they have seldom been able to examine a large number of firms or a comprehensive set of environmental performance variables. Moreover, previous work has generally focused on enforcement issues, not on the underlying firm characteristics that might influence environmental performance.

Based on the above discussion, the following factors are likely to affect environmental performance for an expected profit maximizing firm:

Environmental Performance = F (Probability of Detection, Expected Sanction if Detected,

Cost of Compliance, Reputation Cost of Noncompliance,

Likelihood of Bankruptcy)

Environmental performance is expected to be positively related to the probability of detection, expected size of sanction, and firm reputation loss from lack of a good environmental record. It is expected to be negatively related to the cost of compliance and firm financial difficulties such as high probability of bankruptcy or capital constraints.

Although a complete investigation of the determinants of environmental performance is beyond the scope of this paper, as a preliminary exploration we report on a reduced form equation taking into account the theoretical model. We operationalize the enforcement variables (e.g. probability of detection and expected sanctions) by including a measure of past environmental performance as measured by fines for environmental violations. The cost of compliance is proxied by age of assets of the firm (since older plants may have more costly control technologies). The likelihood of bankruptcy is proxied by the prior financial performance of the firm. Thus, environmental performance is hypothesized to be a function of the age of firm assets, prior year financial performance, and growth in market value of the firm in the years prior to measurement of environmental performance. We expect firms with older assets and those with worse financial performance to perform worse on environmental variables.

Tables 6 lists the main variables entered into two different regression equations explaining environmental performance. Table 7 reports on a Tobit regression equation, where the dependent variable is the natural log of TRI emissions in 1988. Since TRI emissions are not normally distributed, and involve a few very large emissions levels, they have been converted to natural logs. TRI emissions cannot be negative; thus the distribution is truncated at zero, and we employ a Tobit regression model for estimation. The first column of Table 7 reports on the natural log of 1988 TRI emissions, while the second column shows the same equation with the dependant variable being the natural log of TRI emission per dollar of sales. After controlling for 22 different industry categories, this table regresses TRI emissions on size of firm, superfund sites, prior year government enforcement activities (fines), age of assets, and prior year financial performance. The industry dummies - which are primarily control variables - are not reported here.

The main finding in Table 7 is that prior financial performance does not help explain TRI emissions. Neither prior year risk adjusted returns (BTOT87) nor prior 5-year growth in market value of firm (GR8286) offer any significant explanatory power. Instead, as shown in Table 7, the key explanatory variables for TRI emissions appear to be the number of Superfund sites, volume of sales, and age of assets, all of which were significant at $p < .01$. Thus, as we would suspect, high TRI emissions occurred at older, larger firms that had a large number of Superfund sites. Also consistent with the above theoretical discussion, prior year government fines are negatively related to emissions ($p < .05$). That is, government imposed fines against illegal emissions are related to a subsequent lowering of TRI emissions (which are legal).

Table 8 reports on one final measure of environmental performance, the number and size of government imposed fines in 1987. Since many firms were not fined during that year, and we are using fines as a proxy for environmental performance, the dependant variable is truncated at zero, and a Tobit regression model is used. As expected, firms with higher TRI emissions and more Superfund sites also had more and higher levels of fines. That is, our different measures of environmental performance are related. Now, however, one of the financial performance measures is significant. Firms that were growing rapidly in the 1982-1986 time period (as evidenced by change in market value) had fewer and lower dollar fines than firms that were not growing very rapidly or were declining. Thus, it appears that financial distress may be a precursor to poor environmental performance, at least in terms of regulatory compliance. This is consistent with the findings of Alexander and Cohen (1996) in the context of corporate criminal actions.

VII. Concluding Remarks

This study has presented new evidence on whether or not so-called "green" investors need to pay a premium for their convictions. The answer appears to be no. Investors who choose the environmental leaders in an industry-balanced portfolio were found to do as well (or better) than choosing the environmental laggards in each industry. Based on this finding, one could construct a well-balanced portfolio that tracked the S&P 500 index and included only the environmental leaders in each industry category. Such a portfolio would be expected to meet or exceed the market returns of the S&P 500.

Of course, the above finding is tentative and based on historical data on environmental and financial performance. Global concern for the environment is a relatively new and fast changing issue. Indeed, little if any of the information on environmental performance used in

this study was available in any systematic manner until recently. As environmental issues have taken on more and more importance, we would expect the relationship to become even stronger. This is especially true as firms adopt pollution prevention technologies and as the cost of waste disposal continues to rise. Thus, a follow up study could examine whether environmental leaders are outperforming their environmental laggard counterparts. Ultimately, however, whether the market will more heavily value or discount firms based on their environmental records in the future remains to be seen.

This paper has only begun to address the issue of causation. The fact that greener firms are doing as well or better than their more polluting counterparts may be due to the fact that firms with more efficient manufacturing processes also pollute less. On the other hand, firms that pollute less might do so because they can better afford to invest in pollution control technologies. Put differently, high polluter firms might simply be those who cannot afford to comply. Finally, it is also possible that there are other underlying reasons for any association we find. We have examined this issue somewhat, by controlling for age of assets and the existence of older Superfund sites. However, to examine which explanation is more plausible would require considerably more time-series data than available for this study.

TABLE 1

Summary Statistics on Pollution Portfolios, 1987-1989

Environmental Performance Variable	"Low" Pollution Portfolio	**"High" Pollution Portfolio**
Litigation: Number of Firms	189	104
Mean number of lawsuits	.47	2169
Median	0	6
Min - Max	0- 20	1- 114,752
Superfund Sites: Number of Firms	230	186
Mean number of Superfund sites	2.7	8.0
Median	0	4
Min - Max	0 – 45	1- 51
Monetary Fines: Number of Firms	239	194
Mean number of Fines	3.7	150
Median	0	7.5

Min - Max	0 – 177	1 - 5610
Dollars of Fines: Number of Firms	238	194
Mean dollar value of fines	$30,134	$384,811
Median	0	50,210
Min - Max	0 - 1,449,527	100- 9,486,120
Toxic Releases Number of Firms	240	173
Mean pounds of toxic releases	3,700,270	28,897,520
Median	0	3,879,357
Min - Max	0 – 76,054,075	1 - 718,262,639
Oil Spills: Number of Firms	117	32
Mean number of oil spills	.315	6.6
Median	0	2
Min - Max	0 – 16	1 - 41
Volume of Oil Spilled: Number of Firms	129	35
Mean gallons of oil spilled	21,669	2,248,185
Median	0	35,700
Min - Max	0 - 1,698,000	11,000 - 55,346,980
Chemical Spills: Number of Firms	197	109
Mean number of chemical spills	.8	7.8
Median	0	3
Min - Max	0 – 39	1 - 108
Volume of Chemical Spills: Number of Firms	203	112
Mean gallons of chemicals spilled	106,038	2,086,390
Median	0	193,494
Min - Max	0 - 6,549,150	10,830 - 34,223,367

Portfolios are industry-balanced subsets of the S&P 500, consisting of the "lowest" or "highest" polluting firms in their respective industry categories. Since portfolios were constructed based on the median levels of the environmental performance measure of interest, and the median company in a given industry might have zero fines (for example), portfolios do not contain equal number of companies. See text. SOURCE: IRRC Corporate Environmental Profiles.

TABLE 2

Comparison of Firm Size & Beta for High/Low Portfolios

Environmental Performance Variable	"Low" Pollution Portfolio	**"High" Pollution Portfolio**	**p-value**
Litigation:			
Revenue (millions)	$5,070	$6,405	.30
Ave. Beta	1.07	1.06	.81
Superfund Sites:			
Revenue (millions)	$5,476	$5,706	.81
Ave. Beta	1.12	1.07	.19
Monetary Fines:			
Revenue (millions)	$4,894	$6,730	.06*
Ave. Beta	1.12	1.09	.35
Dollars of Fines:			
Revenue (millions)	$4,875	$7,028	.03**
Ave. Beta	1.12	1.08	.24
Toxic Releases:			
Revenue (millions)	$5,308	$6,985	0.14
Ave. Beta	1.08	1.13	0.09*
Oil Spills:			
Revenue (millions)	$6,768	$11,649	.19
Ave. Beta	0.925	0.979	.43
Volume of Oil Spilled:			
Revenue (millions)	$6,469	$13,117	.10*
Ave. Beta	0.919	1.00	.18
Chemical Spills:			
Revenue (millions)	$4,570	$9,159	.003***
Ave. Beta	0.97	0.97	.002***
Volume of Chemical Spills:			

Revenue (millions)	$4,015	$9,271	.001***
Ave. Beta	1.09	0.99	.10*

Portfolios are industry-balanced subsets of the S&P 500, consisting of the "lowest" or "highest" polluting firms in their respective industry categories. Since portfolios were constructed based on the median levels of the environmental performance measure of interest, and the median company in a given industry might have zero fines (for example), portfolios do not contain equal number of companies. See text. SOURCE: IRRC Corporate Environmental Profiles.

* p < .10; ** p< .05; *** p < .01

TABLE 3

Risk-Adjusted Market Returns

Comparison of High versus Low Pollution Portfolios

Environmental Performance Variable	"Low" Pollution Portfolio	"High" Pollution Portfolio	t-test	Number of firms
Litigation 1987-1989 (ave)	.1750	.1926	.425	288
1990	-.0538	-.0634	.754	289
1991	. 2727	.2713	.978	289
Superfund Sites 1987-1989 (ave)	.1808	.1598	.215	404
1990	-.0513	-.0734	.366	406
1991	.2915	.2674	.534	408
Total Value of Fines 1987-1989 (ave)	.1721	.1625	.571	417
1990	-.0446	-.0644	.421	419
1991	.3077	.2510	.140	421
Oil Spill Volume 1987-1989 (ave)	.2024	.1813	.550	158
1990	-.0417	-.1425	.047**	161
1991	.2940	.2016	.088	162
Volume of Chemical Spills 1987-9 (ave)	.1747	.1954	.328	305

1990	-.0481	-.0420	.841	308
1991	.2552	.3061	.334	309
Toxic Releases 1987-1989 (ave	.1829	.1498	.044**	401
1990	-.0657	-.0464	.439	404
1991	.2854	.2538	.391	406

Portfolios are industry-balanced subsets of the S&P 500, consisting of the "lowest" or "highest" polluting firms in their respective industry categories. Since portfolios were constructed based on the median levels of the environmental performance measure of interest, and the median company in a given industry might have zero fines (for example), portfolios do not contain equal number of companies. See text. SOURCE: IRRC Corporate Environmental Profiles.

* p < .10; ** p< .05; *** p < .01

TABLE 4

Return on Assets

Comparison of High versus Low Pollution Portfolios

Environmental Performance Variable	Low Pollution Portfolio (Returns)	High Pollution Portfolio (Returns)	t-test	Number of firms
Litigation 1987-1989 (ave)	.086	.076	.125	293
1990	.127	.067	.26	292
1991	.065	.048	.45	291
Superfund Sites 1987-1989 (ave)	.086	.076	.078*	414
1990	.121	.077	.371	414
1991	.042	.066	.142	409
Total Value of Fines 1987-1989 (ave)	.087	.079	.088*	430
1990	.122	.069	.261	431
1991	.054	.072	.386	422
Oil Spill Volume	.081	.064	.034**	163

1987-1989 (ave)				
1990	.072	.058	.083*	163
1991	.059	.047	.253	163
Volume Chemical Spills 1987-9 (ave)	.094	.076	.005***	314
1990	.130	.068	.348	313
1991	.053	.051	.931	311
Toxic Releases 1987-1989 (ave	.086	.079	.212	410
1990	.117	.071	.353	411
1991	.049	.079	.021**	407

Portfolios are industry-balanced subsets of the S&P 500, consisting of the "lowest" or "highest" polluting firms in their respective industry categories. Since portfolios were constructed based on the median levels of the environmental performance measure of interest, and the median company in a given industry might have zero fines (for example), portfolios do not contain equal number of companies. See text. SOURCE: IRRC Corporate Environmental Profiles.

* p < .10; ** p< .05; *** p < .01

TABLE 5

Return on Equity

Comparison of High versus Low Pollution Portfolios

Environmental Performance Variable	Low Pollution Portfolio	High Pollution Portfolio	t-test	Number of firms
Litigation 1987-1989 (ave)	.145	.129	.27	293
1990	.100	.121	.66	292
1991	.097	.093	.90	291
Superfund Sites 1987-1989 (ave)	.161	.132	.07*	414
1990	.120	.105	.66	414
1991	.118	.087	.15	409
Total Value Fines	.160	.129	.05**	430

1987-1989 (ave)				
1990	.123	.107	.59	431
1991	.116	.092	.27	422
Oil Spill Volume 1987-1989 (ave)	.169	.102	.082*	163
1990	.132	.091	.12	163
1991	.059	.047	.253	163
Volume Chemical Spills 1987-9 (ave)	.180	.124	.009***	314
1990	.121	.149	.50	313
1991	.109	.098	.70	311
Toxic Releases 1987-1989 (ave)	.154	.139	.33	410
1990	.126	.117	.76	411
1991	.114	.092	.32	407

Portfolios are industry-balanced subsets of the S&P 500, consisting of the "lowest" or "highest" polluting firms in their respective industry categories. Since portfolios were constructed based on the median levels of the environmental performance measure of interest, and the median company in a given industry might have zero fines (for example), portfolios do not contain equal number of companies. See text. SOURCE: IRRC Corporate Environmental Profiles.

* p < .10; ** p< .05; *** p < .01

TABLE 6

Variable Definitions for Tables 7 and 8

Variable Name	Description
AGE87	Net (depreciated) Assets divided by Gross Assets, 1987; Ranges from 0-1, with higher numbers indicating newer plant & equipment
BTOT??	Risk Adjusted Stock Market Returns, 19?? (dividends plus end of year stock appreciation as percentage of beginning year

	stock value)
FINE87	Dollar Value of Fines imposed in 1987
GR8286	Growth in Market Value of Firm (share price x shares outstanding) from 1982 to 1986
SALES8789	Average Revenue for years 1987-1989
SFUND	Number of Superfund Sites
SFUNDADJ	Number of Superfund Sites divided by SALES8789
TOXIC	Aggregate 1988 TRI emissions
TOXADJ	TOXIC divided by SALES8789

TABLE 7

TRI Emissions in 1988

(Tobit Model)

Variable	Dependent Variable: Ln(TOXIC)	Dependent Variable: Ln(TOXICADJ)
Ln(SFUNDADJ)	2.94 (0.43)***	1.69 (0.22)***
Ln(SALES8789)	3.69 (0.40)***	1.52 (0.19)***
Ln(AGE87)	-5.59 (1.87)***	-3.01 (0.91)***
GR8286	-0.0007 (.0005)	-0.000069 (0.00023)
FINE87	-0.89 E-06 (.46 E-.06)**	- 0.42 E-06 (0.23 E-06)*
BTOT87	-0.23 (1.21)	0.085 (0.60)
Constant	1.67 (3.09)	2.62 (1.54)*
Sample Size	375	375

NOTE: standard errors in parentheses; * p <.10; ** p< .05; *** p<.01

Industry dummy variables were included but are not reported in table.

TABLE 8

Government-imposed Fines, 1987

(Tobit Model)

Variable	Dependent Variable: Number of Fines	Dependent Variable: Dollar Value of Fines
SFUND	14 (3.9)***	47,455 (10,130)**
Ln(SALES8789)	42 (28)	68,210 (51,890)
AGE87	522 (248)**	446,200 (450,000)
GR8286	-5.2 (2.6)**	-9,128 (4729) **
BTOT86	-65 (85)	204,430 (154,800)
Constant	-1045 (254)***	-1,496,700 (459,500)***
Sample Size	368	368

NOTE: standard errors in parentheses; * p <.10; ** p< .05; *** p<.01

Industry dummy variables were included but are not reported in table.

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