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**The Company: Consulting Group**

Environmental Group Study - January 1997



**DOES IMPROVING A FIRM'S ENVIRONMENTAL MANAGEMENT SYSTEM AND ENVIRONMENTAL PERFORMANCE RESULT IN A HIGHER STOCK PRICE?**

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**SUMMARY**

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*Some believe that improved environmental management practices and performance are good for the firm as well as for society, while others believe that environmental improvements and their costs are a drag on the bottom line and should be minimized. So who is right? Both sides provide theory and facts in their favor, but neither has delivered a compelling answer.*

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*We believe that sound environmental management leads to reduced risk to the firm, and that this risk reduction is valued by financial markets. Investments in environmental management lead to better short-term environmental performance as well as the prospect of further improvements in the future. These improvements confer a reduction in the firm's risk, which is the key factor that investors consider when deciding upon the return that they will require for making a particular investment. Lower risks mean lower required returns, and therefore, lower costs for financing the activities of the firm.*

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**Leanne Anama**

**703/934-3669**

*We have developed a conceptual model that links together the environmental activities and performance of the firm, the ways in which these are communicated to investors and others, the firm's riskiness, and its cost of equity capital. This model provides a framework for understanding how corporate environmental activities ultimately are translated into changes in the market value of the firm.*

*We have just completed a thorough evaluation of our ideas using real-world data on more than 300 of the largest public companies in the U.S., and have produced results that validate our hypothesis. As suggested by financial theory, we have computed changes in systematic risk for each firm over two time periods, and related these to a number of financial and environmental variables using multiple regression analysis. We constructed our analysis to explain as much of the variability in observed systematic risk as possible using factors suggested by finance theory and empirical observation. Using this approach, we were able to isolate and quantify the effects of several environmental management and environmental performance measures that have both practical and statistical significance.*

*Our work suggests that environmental improvements such as those we have evaluated might lead to a substantial reduction in the perceived risk of a firm, with an accompanying increase in a public company's stock price, of perhaps*

*five percent.*

*These findings suggest that investments in environmental management and improved performance can be justified, in many cases, on purely financial grounds, and that the net financial impact of prospective environmental investments can now be evaluated more fully than before. Our results show that firms will increase shareholder value if they make environmental investments that go beyond strict regulatory compliance. How much further they should go will vary by company, though this question also may be addressed empirically.*

*Companies can capture more opportunities to improve both their environmental and financial performance by performing a strategic assessment of their operations, building or upgrading an explicit environmental management system, further developing their environmental infrastructure (i.e., tools, methods, and procedures), undertaking knowledge and skill building within their workforce, and enhancing their information management capabilities.*

*Investments in environmental management and performance may be costly. Nonetheless, when appropriately evaluated, many of these investments may be shown to provide substantial, positive returns and lasting value to the firm.*

## INTRODUCTION

A vigorous debate<sup>1</sup> is now occurring around the question of whether initiatives to improve the environmental performance of corporations, either compliance-driven or voluntary, have consistent impacts on the financial performance of these firms.

*The traditional view holds that expenditures on environmental improvement represent costs that (generally) confer no corresponding benefits to the firm, such as improved product quality, productivity, ease of manufacturing, distribution, or use, or other desirable attributes. If this is true, then the rational behavior on the part of corporate managers is to minimize and delay environmental costs as much as possible, so as to reduce their impact on the bottom line. From the perspective of the corporate shareholder (i.e., owner), managers should uphold their fiduciary duty by seeking to maximize shareholder wealth. This means, among other things, minimizing discretionary costs, which in the minds of some, includes environmental expenditures that are not explicitly required by law. In other words, managers are expected to make investments in environmental activities only to the extent that their benefits (pecuniary and non-pecuniary) exceed their costs. The evidence (i.e., deeds rather than words) suggests that the senior managers of most American corporations currently subscribe to this view.*

This is not surprising. Notwithstanding the arguments that have strenuously been advanced by a number of influential members of industry and academia, *the traditional view of environmental activities and their costs continues to reflect a rational (albeit limited) perspective in many corporations.*

Adherents of the major opposing school of thought maintain that environmental performance is fully compatible with superior financial

performance, and that emerging environmental controls often provide a stimulus for process enhancements, product reformulations, and other improvements in the cost-effective manufacture and delivery of the firm's products and services. A large number of case studies support the existence of this phenomenon. Nonetheless, proponents of the idea that well-crafted environmental control regulations help to spur innovation and thus, competitiveness in the global marketplace, have yet to demonstrate that the well-publicized examples that they cite represent a substantial or even meaningful proportion of the range of outcomes that occur when firms are confronted by new environmental regulatory controls or market expectations.

Indeed, a brief review<sup>2</sup> and analysis of the past 25 years of development of and reaction to laws designed to protect human health and the environment produces incomplete and somewhat ambiguous results. On the one hand, the process of internalizing (through regulation) the environmental impacts of corporate activities almost necessarily imposes short-term costs on the affected entity; *longer-term regulatory effects, on the other hand, are strongly influenced by numerous factors, many of which are under the control of the people managing the affected firms.* A sampling of the literature, for example, reveals large numbers of success stories associated with individual pollution prevention initiatives, product life cycle analyses, recycling programs, and other forward-looking environmental management activities. These examples suggest that additional *"low hanging fruit" remains to be harvested within many corporations.* In a few instances, companies have taken their activities in this regard to their logical conclusion by estimating the total costs, savings, avoided costs, and revenues associated with their corporate environmental programs, and some have shown that their programs serve to improve the net bottom line of the firm. Because the owners of the firm gain from these activities and the increases in earnings that they may confer, shareholder wealth and corporate environmental objectives need not be viewed as mutually exclusive.

Despite these noteworthy success stories, at a larger, more general level, *there has been little empirical evidence or analysis regarding the overall impacts of corporate environmental activities on the business success of the firm as a whole, and virtually no meaningful theory or evidence linking wide-spectrum environmental improvement initiatives to either expected or actual enhancements in the firm's sales, earnings, competitive position, investment risk profile, or market value.*<sup>3</sup>

#### *Until now.*

In this paper, we articulate a conceptual model that establishes some of these linkages, and provide the results of a quantitative application of this model to a large and representative sample of the most prominent public companies in the U.S. (more than 300 of the 500 companies within the Standard & Poor's index). Our results suggest that *adopting a more environmentally proactive posture has, in addition to any direct environmental and cost reduction benefits, a significant and favorable impact on the firm's perceived riskiness to investors and, accordingly, its cost of equity capital and value in the market place.*

To test these posited relationships and our conceptual approach, we developed and applied an empirical model. Our results, which are discussed in the sections that follow, strongly suggest that firms that improve both their

environmental management system and environmental performance can increase their stock price by as much as five percent. That is, if a firm's stock price is currently \$100 per share, improvements in both environmental management activities and performance can boost the firm's stock price to as much as \$105 per share. *If the initial capitalization of the company were \$1 billion prior to the environmental improvement, after such improvement, stockholder wealth could increase by as much as \$50 million.*

✓A

Naturally, these values are intended to be illustrative rather than definitive. The ultimate gain accruing to any individual firm depends on many factors, including what activities are actually performed, the amount, distribution, and timing of investments in the environmental management function, and the mode and quality of communications to the investor community. The importance of these issues, and how they may be addressed, are discussed in greater depth at the conclusion of this paper.

The remainder of the paper presents a general description of the substance of our work. **Section II** provides an overview of the model framework. **Section III** defines what is meant by improved environmental management practice and improved environmental performance. **Section IV** describes the concept of signaling and the importance of this activity in articulating the extent to which a firm's environmental risk profile is improving. **Section V** addresses how firm risk is measured while **Section VI** discusses the relationship between a firm's risk, its cost of capital, and its share price. **Section VII** summarizes the empirical results that strongly support our contention that firms that improve their environmental management system and their environmental performance will be rewarded with a lower cost of capital and a higher share price. Finally, a summary, conclusions, and implications for decision makers are presented in **Section VIII**. Further information on our empirical model is provided in an attached appendix.

We believe that *our work provides a radically new and different position from which to join the debate on the financial implications of corporate investments in environmental performance*, and for that matter, on the implications of new environmental regulatory initiatives. Perhaps most importantly, we hope that this work will stimulate further discussion, debate, and analysis on this topic within academia, government, the financial markets, and the board room.

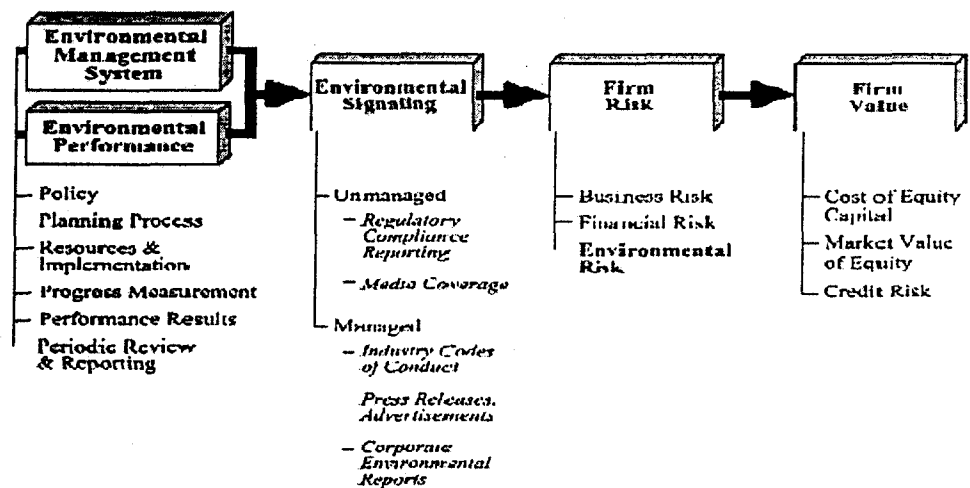
## II. Conceptual Framework

Our model links the evaluation of corporate environmental management systems and environmental performance to the market value of publicly traded corporations. The model consists of five causally linked components:

- Corporate Environmental Management Systems
- Environmental Performance
- Environmental Signaling
- Firm Risk, including Environmental Risk
- Firm Value, including Shareholder Wealth Gains (or Losses) Resulting from Changes in Environmental Risk

The schematic below shows how the various components are related and the

various elements that comprise each individual component. The model framework indicates that in order to obtain the benefits of greater shareholder wealth gains, the firm must improve its environmental management system and/or performance. Improvements are then made public through a series of carefully targeted environmental communications to all stakeholders, but specifically to the financial community. This information becomes the basis for the financial community to assess the extent to which the firm's environmental risk profile has improved. If the assessment is positive, then the firm will be accorded a lower cost of capital because it is now less risky overall. Because a lower cost of capital means that investors are willing to pay more for the firm's future cash flows, its stock price will rise and shareholder wealth will increase. How much the firm's stock price actually rises will depend on the size of the investment necessary to improve the firm's perceived environmental risk, and the magnitude of the resulting risk reduction.



In addition to the benefit produced when an improvement in environmental management and/or performance is clearly signaled to the investment community, *shareholders also benefit when the firm's environmental performance continues to improve over time because of the upgrades to its environmental management system.* Again, once this outcome is clearly signaled to the investment community, another increase in share price will result because there is clear evidence that the firm's environmental risk (i.e., probability of one or more adverse outcomes) has been further reduced.

### III. Corporate Environmental Management Systems and Performance

What is corporate environmental management/performance? The term environmental management as used in this paper extends far beyond the traditional focus on compliance with environmental control law. Instead, *the elements of a state-of-the-art environmental management program are inextricably linked with fundamental corporate activities, such as product design, process engineering, marketing, and supply chain management.* The adjacent schematic lists several key elements of this type of comprehensive environmental management system.

First and foremost is whether the company has developed a corporate environmental policy and demonstrated a commitment to carrying out the policy. Evidence of the extent of this commitment can take the form of several key indicators: a senior corporate official has been assigned to implement the policy; lines of responsibility and accountability have been identified; goals have been defined that are measurable; and adequate resources have been allocated to implement the program. A related key program element is whether the corporation has developed systems to assist in implementing the program and measuring performance, such as environmental accounting systems and monitoring systems that track emissions and discharges of pollution as well as the usage of raw materials, energy, and other inputs to production.

Implementation of the environmental management system requires a range of activities: training to ensure that workers operate equipment and production processes correctly and are proactive with respect to addressing environmental risks; product design and development approaches (e.g., Design for Environment or DfE) that reduce the usage of raw materials, generation of hazardous waste, and environmental risks throughout the product life cycle; monitoring to ensure that manufacturing operations are in compliance with pollutant emission standards and other regulatory requirements; and the creation of a corporate culture in which awareness of and performance related to environmental issues is valued and rewarded.

The *quality* of a corporation's environmental management system *matters*.

Our research on corporate disclosures of environmental management systems and their effectiveness indicates that companies that attained relatively high scores using ICF Kaiser's proprietary rating system obtain greater benefits in terms of lower investment risk, as compared to corporations that appear to have designed and implemented programs primarily to obtain public relations benefits. Our environmental rating system methodology takes into account a wide range of factors, such as how the environmental policy is structured, the level of detail provided by the implementation plan, including lines of responsibility and accountability, the range of activities undertaken to achieve improvements in environmental performance, the level of resources committed to the program, and the extent to which environmental performance is measured and analyzed. We developed the scoring methodology based on our many years of consulting experience on behalf of corporations, government agencies, and international organizations on a range of complex environmental issues.

Even though corporations may have developed superior environmental management systems, ultimately, it is critical that these efforts lead to improvements in environmental performance. *Firms must be able to demonstrate that they are making progress toward reducing pollutant generation and releases and minimizing liability exposure.* At a general level, producing data documenting waste generation, effluent discharges, spills of hazardous substances, and the like is both analytically tractable and, increasingly, required by regulatory agencies and company stakeholders. The best firms in this regard set and achieve goals that are more stringent than those explicitly required by law. In an interesting parallel with corporate financial reporting, some firms have even moved toward obtaining independent audits to enhance the credibility of their stated environmental performance.

Finally, both improved environmental management and improved environmental performance need to be clearly articulated to the investment community. This brings us to the next important component of our model - environmental signaling.

## IV. Environmental

### Signaling

A vital link between a corporation's environmental management activities and performance and its investment risk, which is determined by the capital markets, is what we term "environmental signaling." When conducted most effectively, such communication constitutes *strategic environmental communications*, because it is performed deliberately in support of well defined corporate objectives, rather than randomly or as part of general public relations activities. Indeed, although companies may have implemented robust environmental management programs and are achieving significant and sustained reductions in pollution levels and liability exposure, these efforts may not be fully accounted for in terms of lower perceived risk because they are not widely known among participants in the capital markets, such as institutional investors and equity analysts.

It is well accepted that capital markets operate more efficiently as the level and reliability of information available to investors increases. When there is significant uncertainty in the markets, such as the prospect of future increases in inflation, investors demand additional compensation as a result of this uncertainty. As new information becomes available to market participants that reduces this uncertainty, such as an unemployment or price report, investors are able adjust their expectations appropriately and the effects of this uncertainty on the firm's value are reduced.

As with industry or macroeconomic data, the availability of information about the environmental management/performance of a company also will affect an investor's perception of the firm's risk. Our research indicates that firms that communicate relevant and comprehensive information about both their environmental management programs and performance are generally perceived by investors as having a lower risk compared to similar firms that provide no information in this area.

How do firms engage in strategic environmental communications? Firms have a range of options for communicating environmental management activities and performance to the capital markets, including but not limited to the following: periodic press releases, summaries in annual SEC filings, stand-alone environmental reports, television commercials and newsprint advertisements, and participation in industry-wide programs.

As with financial reporting, the quality of the information that is communicated by the firm will affect investors' perceptions of its credibility and overall usefulness for assessing firm risk. Corporations that provide relevant, detailed, and reliable information on their environmental programs and performance on an on-going basis are more likely to be rewarded with a perceived lower risk as compared to corporations that provide only qualitative information on a few aspects of their program.

How do the investment markets evaluate these strategic communications, and more specifically, how do they incorporate this information into their assessment of the risk profile of the firm? These are questions to which we now turn.

## **V. What is Meant By Firm**

### **Investment Risk and How is it Measured?**

A firm's risk profile can be divided into two components. The first is termed systematic risk and the second specific risk, or risk that is unique to the firm. Financial portfolio theory concludes that investors require a return for accepting systematic risk<sup>4</sup> (and only systematic risk) because firm-specific risk can be diversified away. This means that firms that reduce their systematic risk are rewarded with a lower cost of financial capital, and for a given cash flow, a higher stock price.

A firm's systematic risk is measured by its "Beta." Beta is a measure of a given stock's volatility relative to the overall market, with the market's Beta being assigned a value of 1. The higher a firm's Beta, the greater its systematic risk; stocks with a Beta greater than 1 are more volatile than the market, while those with a Beta of less than 1 are less volatile.<sup>5</sup> Both theoretical developments and empirical evidence (i.e., historical market returns) suggest that Beta is not constant, but changes over time. These changes are related to a number of factors, including changes in the firm's debt to asset ratio (financial leverage), fixed cost base of operation (operating leverage), customer markets served, and product lines, as well as mergers and acquisitions, to name a few. Our empirical model adds to this list another set of variables, described briefly below, designed to measure environmental risk. Thus, as a firm's environmental risk declines (increases) for example, we should expect its Beta, all else equal, to decline (increase).

## **VI. The Relationship Between the Change in Environmental Risk, Change in the Cost of Capital, and the Firm's Stock Price - An Illustration**

To demonstrate the linkages between changes in environmental risk and a firm's stock price, let us consider the case of a nationally known beer company. The company has a market capitalization of one billion dollars and earns a steady annual profit stream of \$100 million which is available to shareholders. The firm has publicly aligned its overall business mission with a set of environmental objectives and publicly acknowledges that its excellent business reputation is in part due to its environmental performance. To further enhance its national reputation as a good environmental citizen, the firm has decided to upgrade its environmental management system with the intention of significantly reducing toxic chemical releases into ambient air and water.

To publicly acknowledge the importance of these environmental activities, the CEO has created a senior environmental officer position. The person filling this position reports to him and also is a member of the Board of Directors. In addition to conducting an audit of the firm's current environmental management system, the senior officer is charged with both



creating a set of environmental principles that will broadly define an upgraded environmental management system and, once approved, disseminating this new environmental information to customers, suppliers, employees, and investors.

The senior management team understands that signaling that the corporation has allocated resources to improve its environmental management and environmental performance is critical to the success of the firm's new environmental strategy. As such, the CEO instructs the firm's investment relations officer to prepare a series of announcements along with several press briefings to articulate what the firm plans to do and how these activities are intended to significantly improve its future environmental performance. Environmental performance will be measured by reductions in hazardous waste generation, and regulated emissions of air and water pollutants.

Prior to these announcements, the firm's cost of equity capital as measured by its corporate finance department using the well known Capital Asset Pricing Model (CAPM) was 10 percent. As information about the firm's new environmental policies is disseminated to various stakeholders and the public generally, the financial markets begin to process this new information. More specifically, investors conclude that the firm's new environmental policies will likely result in the firm being less prone to environmental accidents, and that it is well positioned to be in compliance with any new and more stringent environmental regulations. As a result, the financial markets accord the firm a lower perceived risk in the form of a reduced Beta.

When the firm's corporate finance department inputs this lower Beta into the CAPM, a new lower cost of equity capital of nine percent results. The beer firm's CFO estimates that it will cost about \$50 million annually to achieve the desired environmental results. Given this cost and the new lower cost of capital, the CFO informs the CEO that the value of the firm will increase by \$61 million or \$6.10 per share.<sup>6</sup>

The CFO notes further that this may be only the initial gain in increasing shareholder wealth. If the new environmental management system is as successful as expected, the firm's future environmental performance will meet and perhaps exceed the objectives articulated in the firm's environmental policy. If this occurs, shareholders may be rewarded again as it becomes more clear to investors that the new environmental management system has indeed created a far less risky firm. That is, as evidence begins to build that the firm's upgraded environmental management system is in fact creating the benefits that were initially envisioned, the investment markets will be more certain that the firm's new environmental management system works as planned and further reductions in the firm's Beta and its cost of capital can be expected. More importantly, these reductions will result in an additional share price increase in the future.

## **VII. Does Improving Environmental Management and Environmental Performance Really Pay?**

It is one thing to develop the logic of how improved environmental management systems and improved environmental performance affect shareholder wealth and to provide an illustration such as the foregoing, but it is clearly another to actually measure these impacts. Because we believe that the internal logic of our argument is persuasive, we decided to attempt to

they grapple with decisions regarding whether and how best to deploy corporate resources to upgrade their environmental management systems, with the objective of improving the firm's environmental performance. While others have presented anecdotal evidence that may suggest that efforts to improve environmental performance are likely to yield a variety of secondary, even unexpected, benefits (e.g., new products and more efficient production processes), one cannot reasonably expect senior managers to commit sizable corporate resources to improved environmental performance based simply on the hope that they may encounter such serendipity.

Although many have asserted that corporate environmental activism makes good business sense and/or that a positive environmental image provides a certain cachet in terms of improving public perceptions and stockholder relations, the empirical evidence supporting these ideas has largely been absent. We believe that corporations that are environmentally sound create additional value for stockholders through being less risky business entities and therefore, being accorded a lower cost of capital. In this paper, we have explained and measured this phenomenon and shown that firms that improve their environmental management system and their future environmental performance will be able to increase shareholder wealth by perhaps as much as five percent. In short, *improving corporate environmental performance pays*.

Our findings also lead to the question of how best to seek out, identify, evaluate, and implement the enhancements to the firm's environmental management system that will produce better environmental performance while optimizing use of company resources. Each firm confronts a unique set of environmental and business management challenges, and possesses its own specific complement of technological, financial, human, and other capital. Nonetheless, there are a number of general activities that may be employed to good effect by virtually any organization. These are briefly highlighted below.

An important implication of our research that is reflected in numerous ongoing initiatives<sup>7</sup> to improve environmental performance is that environmental management should be approached systematically. That is, defining what one wishes to accomplish and how objectives will be attained, through a formal strategy development exercise, is necessary to lay the groundwork for any successful EMS. Because, however, it is difficult to define a strategy and measure progress toward goals in the absence of a clear baseline, a *strategic assessment* of key environmental issues is an appropriate place to start for many organizations.

In most companies, a thorough strategic assessment of environmental issues will identify areas of weakness in the environmental management function, which can be addressed through targeted *EMS development/improvement* initiatives. These initiatives are by their nature firm- and context-specific, but often include an assessment and analysis phase and a development and improvement phase, the latter of which is focused on formulating missing elements (e.g., policies, procedures), integrating important EMS principles and tools, and establishing strategies for achieving desired patterns of internal and external information flow.

During the course of EMS development or improvement, several distinct and important EMS functions that are not being performed well or at all may be identified. These deficiencies may be addressed through specific

measure the impacts directly. What we report below are the results of a preliminary but detailed and rigorous analytical application. Our results support the basic tenets of our model. A description of the research design and a summary of the empirical results are presented in the Appendix.

To illustrate the likely impact on Beta and stock price arising from a reduction in environmental risk, we simulate below our empirical model. The simulation shows the magnitude of the Beta decline and the share price increase that result from a 50 percent improvement in a firm's environmental management system and a 50 percent improvement in a firm's environmental performance. The table on the next page reflects three separate impacts--the independent impact of each indicator on Beta and the cost of equity capital, and then their combined influence. This combined effect assumes that the firm's environmental performance registers a 50 percent improvement two years after the firm improves its environmental management system rating by 50 percent.

**IMPACT ON BETA AND COST OF CAPITAL RESULTING FROM A 50% IMPROVEMENT IN A FIRM'S ENVIRONMENTAL MANAGEMENT SYSTEM AND ITS ENVIRONMENTAL PERFORMANCE**

<i>VARIABLE NAME</i>	<i>50% IMPROVEMENT IN VARIABLE NAMED AT LEFT WILL RESULT IN A BETA DECLINE OF</i>	<i>INITIAL BETA</i>	<i>BETA AFTER CHANGE</i>	<i>INITIAL COST OF CAPITAL</i>	<i>COST OF CAPITAL AFTER CHANGE</i>
<i>ENVIRONMENTAL MANAGEMENT SYSTEM</i>	-8.5%	1.0	.915	13%	12.57%
<i>ENVIRONMENTAL PERFORMANCE</i>	-6.5%	1.0	.935	13%	12.67%
<i>COMBINED EFFECT(a)</i>	-13.2%	1.0	.868	13%	12.34%

(a) In this example, we have assumed that the significant improvements in environmental performance occur in year 2. Accordingly, the combined effect on Beta is computed by discounting using the cost of capital (12.57%) that results from the initial improvement in environmental management in year 0.

As the table illustrates, both an improved environmental management system and improved environmental performance result in significant reductions in a firm's Beta. The combined effect indicates that systematic risk can be reduced by a significant amount, about 13 percent, resulting in a reduction in the firm's cost of capital from 13 percent to 12.34 percent.

The table on page 10 demonstrates how declines in the cost of capital may result in a higher stock price and an increase in shareholder wealth. Prior to any improvement in the firm's environmental management system rating or improvement in its environmental performance, the firm has a \$10 million annual cash flow, 10 million shares of common stock outstanding, and a cost of capital of 13 percent. The value of the firm, assuming that the \$10 million annual cash flow can be generated in perpetuity, is \$76.9 million and its share price is \$7.69 (\$76.9 million/10 million shares).

Let us now consider the combined effect on the firm's share price as a result of a 50 percent improvement in its environmental management system

followed two years later by a 50 percent improvement in its environmental performance. Under these conditions, we should expect the value of the firm prior to any investment costs to increase by 5.3 percent. This means that if investment costs associated with making the indicated improvements are small relative to cash flows, the stock price should increase from \$7.69 to \$8.10.

**IMPACT ON FIRM VALUE AND SHARE PRICE RESULTING FROM  
A FIRM IMPROVING ITS ENVIRONMENTAL MANAGEMENT  
SYSTEM AND ITS ENVIRONMENTAL PERFORMANCE**

	Maximum Firm Value (Millions)	Maximum Stock Price (Value per share)	Percent Increase from Initial Position
<b>Initial Position</b>			
<ul style="list-style-type: none"> <li>• # of shares = \$10 million</li> <li>• Annual Revenue = \$100 million/year</li> <li>• Cash flow = \$10 million/year</li> <li>• Risk Free Rate = 8%</li> <li>• Risk Premium = 5%</li> <li>• Beta = 1.0</li> <li>• Cost of capital = 8% + 1.0 (5%) = 13%</li> </ul>	\$76.9	\$7.69	0%
<b>Independent Effect of a 50% Improvement in Environmental Management System</b>			
<ul style="list-style-type: none"> <li>• New Beta = .915</li> <li>• New Cost of Capital = 12.57</li> </ul>	\$79.6	\$7.96	3.5%
<b>Independent Effect of a 50% Improvement in Environmental Performance</b>			
<ul style="list-style-type: none"> <li>• New Beta = .935</li> <li>• New Cost of Capital = 12.67</li> </ul>	\$78.9	\$7.89	2.6%
<b>Combined Effect</b>			
<ul style="list-style-type: none"> <li>• New Beta = .868</li> <li>• Cost of Capital = 12.34%</li> </ul>	\$81.0	\$8.10	5.3%

*It is unlikely, however, that the cost of the required environmental upgrades will be small.* To the contrary, they may well be quite large. To see how this will affect the stock price, let us assume for the moment that environmental investment costs are two percent of annual revenue, or \$2.0 million per year. This is equivalent to what many manufacturing firms have historically spent annually on "pollution abatement capital expenditures," according to U.S. Department of Commerce data. Thus, if the investment is \$2.0 million annually, the share price would rise from \$7.69 to \$7.90 { \$7.69 + [(\$4.1million - \$2.0)/10 million shares] } . It is worthy of note that this increase in share price does not reflect any additional revenue that might accrue to the firm as a result of any incremental goodwill that its improved environmental reputation might confer. Moreover, this calculation does not reflect any additional competitive advantage that would accrue from *allowing the firm to make additional non-environmental strategic investments* that might not be possible if its cost of capital were higher, nor does it capture any operating cost savings (increases in earnings) that might result from its investments in improved environmental performance.

**VIII. Summary, Conclusions, and Implications**

This paper sets out a conceptual framework that can guide senior managers as

*environmental infrastructure enhancements*, or through investments in the capabilities of the organization's human or information management resources. Conducting a purposeful *knowledge/skill building* initiative is often a critical activity on the path toward improved environmental and business performance. Similarly, effective environmental management systems require timely and high quality information, so *information management analysis/improvement* activities can play a pivotal role in helping the organization to meet its environmental improvement goals, and communicate its accomplishments efficiently, clearly, and credibly to all interested stakeholders.

The corporate financial and other resources needed to undertake these activities and enhancements to the environmental management function are likely to be non-trivial for most corporations. As we have shown above, however, the expected return on investment for deploying these resources in this way can be positive and substantial, particularly if financial returns and impacts on shareholder (owner) wealth are evaluated in an appropriate and suitably broad manner.

## APPENDIX

### Research Design

We developed an empirical model designed to estimate whether both environmental management and environmental performance influence a firm's financial risk. This was done in two separate stages. In the first stage, we estimated the Beta for about 330 firms that are included in the S&P 500 stock index. This was done for two separate time periods, 1980-1987 and 1988-1994. The choice of time frames reflected the need to have sufficiently long subperiods to both measure temporal changes in Beta and to accommodate varying availability of corporate financial data for a large number of firms across a broad cross-section of industries. The distinction between the two periods also reflects the emergence of corporate environmental management as a distinct activity, as well as a pronounced increase in the quantity and quality of available data on the environmental performance of corporations (e.g., through reporting under the U.S. EPA's Toxics Release Inventory (TRI) program).

**THE REGRESSION MODEL**

Change in Beta for firm(s) = c1\* change in financial leverage(s) +  
 c2\* change in operating leverage(s) + c3 \* change in productivity (s) +  
 c4\*c change in coefficient of variation of firm revenue(s) +  
 c5\* change in coefficient of variation of firm operating income(s) +  
 c6\* change in standard deviation of operating leverage(s) +  
 c7\* change in correlation between the return on the market portfolio and firm costs (s) +  
 c8\* change in change in operating income(s) +  
 c9\*B(s) [ Beta for firm "s" during 1980-87 period ] + cis\*D(is) +  
 c10 \* environmental performance(s) + c11\* environmental management system rating(s) +  
 c0(s) + e(s)

**where:**

c0(s) = regression constant term for firm "s"

D(is) = industry dummy which equals unity if firm(s)'s primary business is in a particular two digit SIC code and zero otherwise.

e(s) = error from regression for firm(s)

The Betas were estimated by regressing continually compounded daily returns over quarter-year periods against like returns on a stock index made up of all companies trading on the New York and American Stock exchanges. In the second stage, the change in Beta between the two subperiods was calculated for each company and these observations were then regressed against indicators of environmental management, environmental performance, and non-environmental variables. These non-environmental variables included measures of firm financial and operating leverage, variability in operating income, variability in productivity, and other firm performance variables that are designed to capture all known and quantifiable factors of firm risk unrelated to the environment.

The environmental variables are of two types. The first is a qualitative environmental variable designed to measure the presence and quality of the firm's environmental management system. This variable was developed by ICF Kaiser staff and was based on a detailed review of each firm's environmental management practices and philosophy as articulated in the firm's annual environmental reports and other public environmental communications. Each company reviewed was given a score from 1 (poor environmental management system) to 35 (best environmental management system). The second environmental variable was designed to measure actual firm environmental performance. This variable is defined as the average annual change in TRI releases per unit of firm capital (value of property, plant, and equipment). These variables along with the others noted below were included in the regression model.

<b>SUMMARY STATISTICS FOR REGRESSION MODEL</b>		
• R-squared = 28%		
• Adjusted R-squared = 24%		
		<i>Probability that Coefficient</i>
• <i>Coefficient Name</i>	<i>t statistic</i>	<i>Equals Zero @ 99% Confidence Level</i>
<b>1) Environmental</b>		
<b>Management</b>	-2.86	0
<b>2) Environmental</b>		
<b>Performance</b>	2.62	0
• Most non-environmental coefficients were statistically significant, although several of the industry dummy variables were not.		
• <b>F-statistic</b> = 6.73 ; Probability that the coefficients of the model are zero = 0		
• <b>Durbin-Watson Statistic</b> = 1.87		
• Probability of Heteroskedasticity Using White's Test = 2%		

The coefficients of the above model were estimated using multiple regression techniques. A summary of the results of this exercise are shown below.<sup>8</sup>

The coefficients of the model suggest that the changes are in the hypothesized direction, and are clearly material in a financial sense. Statistically, the results indicate that the regression model has significant explanatory power as indicated by the size of the adjusted R-squared and the significance of the equation's F statistic. The environmental coefficients have the correct signs and also are significantly different from zero. The environmental management rating variable indicates that as the firm improves its environmental management system, the firm's financial risk declines. Also, as actual environmental performance improves, as measured by the decline in TRI per unit of capital, firm risk declines.

### FOOTNOTES

1. This debate involves a number of academicians, consultants, regulators, and executives from private industry. Many of the key arguments and supporting facts are articulated in several recent articles by Michael Porter and Claas van der Linde, and on the opposing side, by Paul Portney and colleagues (see the accompanying Bibliography for examples).
2. The literature in this regard is effectively summarized in a recent report entitled "Do Environmental Regulations Impair Competitiveness? A Critical Review of Economic Studies" prepared for U.S. EPA by ICF Kaiser and the Economics Research Group.
3. Nonetheless, several studies have been performed using event methodologies that generally show discernible short-term changes in the market value of publicly traded companies as a function of disclosure of particular environmentally-related phenomena, such as emissions of toxic chemicals, large oil or chemical spills, or receipt of environmental awards. Recent examples of such studies are provided in the Bibliography.
4. Systematic, or market, risk reflects factors that affect all firms in the market simultaneously. These factors include inflation, changes in interest rates, recessions, wars, and the like. Because all firms participating in the market are affected by these

factors, the risks that they pose cannot be eliminated by investing in a more diversified portfolio.

5. In practice, company-specific Beta values are computed from a regression line relating total historic returns (dividend yield plus market gain or loss) of the company's stock to the returns of the overall market. The slope of the line of best fit (regression parameter value using least squares techniques) is defined as the Beta. Beta also may be calculated as the covariance between the returns of the company's stock and the market divided by the variance of market returns.
6. The \$61 million is calculated by first capitalizing the firm's \$100 million profit stream by the new lower cost of capital ( $\$100 \text{ million} / .09 = \$1.111 \text{ billion}$ ) and subtracting the \$50 million cost of the investment. Because there are 10 million shares outstanding, the share price improvement is \$6.10 ( $\$61 \text{ million} / 10 \text{ million shares}$ ).
7. Efforts to bring consistency of approach, terms, and practice to the discipline of environmental management may be seen in the form of industry codes of conduct (e.g., the Chemical Manufacturers Association's Responsible Care Program and the American Forest and Paper Association's Sustainable Forestry Initiative). In addition, several noteworthy domestic and international consortia have been formed that cut across industries, such as the Global Environmental Management Initiative, and the International Chamber of Commerce's Business Council for Sustainable Development, respectively. Many of these organizations and programs not only promote the development and dissemination of standardized approaches to environmental management, they also embrace the concepts of sustainability and eco-efficiency, in which industrial activities are critically examined in terms of raw material, water, energy, and non-renewable resource use, as well as relative to more conventional aspects such as toxic pollutant emissions and waste generation. Finally, the nascent ISO 14000 series of environmental management standards represents a serious attempt to promote global consistency and adherence to a set of forward-looking principles, such as preventing pollution and continual improvement.
8. Because the model is proprietary to ICF Kaiser, the coefficients are not shown, though the t-statistics of the environmental coefficients are provided. For further information on the model, please contact ICF Kaiser.

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