Does Improving a Firm's Environmental Management System and Environmental Performance Result in a Higher Stock Price?

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A vigorous debate is occurring on 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 on the firm in terms of improved product quality, productivity, ease of manufacturing, distribution, or use, or other desirable attributes. If this is true, then rational management behavior would be 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 shareholder (i.e., owner), managers should seek to maximize shareholder wealth. This means, among other things, minimizing discretionary costs, which, in the minds of some, include 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 suggests that the senior managers of most American corporations currently subscribe to this view.

This is not surprising. Notwithstanding the arguments of a number of influential members of industry and academia, the traditional view of environmental activities and their costs continues to be the norm in many corporations.

Some who disagree 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. Many case studies support the existence of this phenomenon.

Nonetheless, proponents of this idea have yet to demonstrate that the examples 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 review and analysis of the past twenty-five years of development of and reaction to laws designed to protect human health and the environment produces incomplete and somewhat ambiguous results (see "Do Environmental Regulations Impair Competitiveness?" [1995]). On the one hand, the process of internalizing the environmental impacts of corporate activities (through regulation) 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 many 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 estimated the total costs, savings, avoided costs, and revenues associated with their corporate environmental programs, and have shown that their programs serve to improve the bottom line. 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 thus need not be viewed as mutually exclusive.

Despite these noteworthy success stories, 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 there is virtually no meaningful theory or evidence linking large-scale environmental improvement initiatives to either expected or actual enhancements in the firm's sales, earnings, competitive position, investment risk profile, or market value.[1]

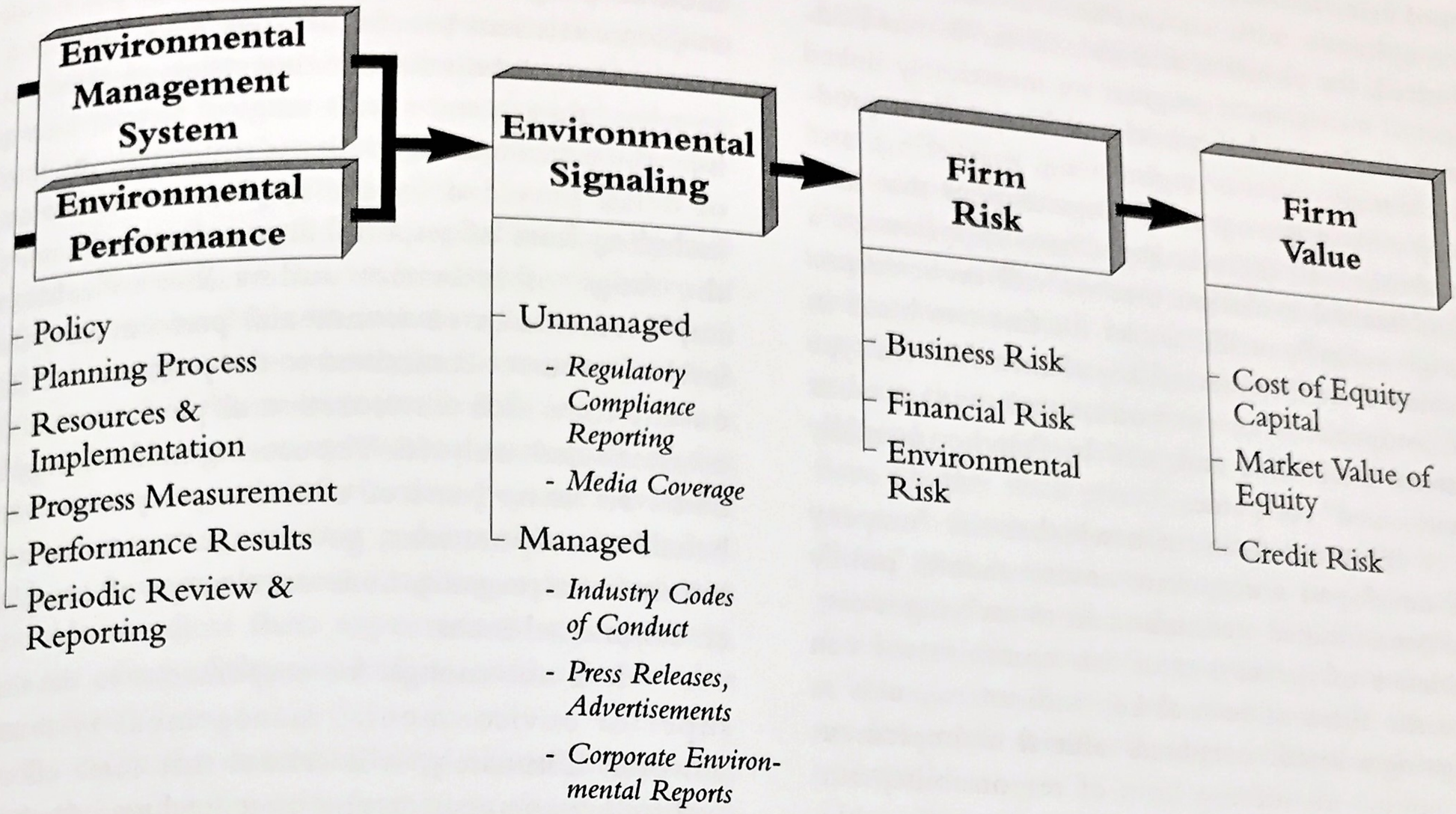
We articulate a conceptual model that establishes some of these linkages, and provide the results of a quantitative application of this model to a large and representative sample of the most prominent public companies in the U.S. Our results suggest that adopting a more environmentally proactive posture 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 marketplace.

The results strongly suggest that firms that improve both their environmental management system and environmental performance can increase their stock price by as much as 5%. For a firm with a capitalization of $1 billion, this represents an increase in stockholder wealth of as much as $50 million.

These values are 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 here as well.

We believe our work provides a radically new and different position from which to join the debate on the financial implications of corporate investment

EXHIBIT 1
SCHEMATIC REPRESENTATION OF MODEL



in environmental performance, particularly the implications of new environmental regulatory initiatives. Perhaps most important, we hope this work will stimulate further discussion, debate, and analysis on the topic.

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 has five 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.

Exhibit 1 shows how the components are related as well as the various elements in 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 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, the firm will experience a lower cost of capital because it has become 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.

Shareholders also benefit when the firm's environmental performance continues to improve over time because of the upgrades to its environmental management system. Once this outcome is clearly signaled to the investment community, another increase in share price should result because there is clear evidence that the firm's environmental risk (i.e., the probability of one or more adverse outcomes) has been further reduced.

CORPORATE ENVIRONMENTAL MANAGEMENT SYSTEMS AND PERFORMANCE

The term "environmental management" as

used here extends far beyond the traditional focus on compliance with environmental control laws. 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. Organizations that have established all these linkages have experienced a fundamental evolution that we call *environmental transformation™*, or ET. Under the first two boxes in Exhibit 1 are listed several key elements of this type of comprehensive environmental management systems established and used by "environmentally transformed" companies.

First and foremost is whether the company has developed a corporate environmental policy and demonstrated a commitment to carrying it out. Evidence of the extent of this commitment can take the form of several key indicators, such as assigning a senior corporate official to implement the policy; identifying lines of responsibility and accountability; defining goals that are measurable; and allocating adequate resources 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) 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 are 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 attain relatively high scores using a proprietary ET 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 or employee 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. The scoring methodology is based on many years of consulting experience on behalf of corporations, government agencies, and international organizations on a range of complex environmental issues.

It is not enough for corporations to develop superior environmental management systems, however. 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 doable 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. 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.

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*. That is, 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 achieved 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 capital market participants, such as institutional investors and equity analysts.

It is well accepted that capital markets operate more efficiently as the amount and reliability of information available to investors increase. 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 to adjust their expectations appropriately, and the effects of this uncertainty on the firm's value are reduced.

As in the case of 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 investors see firms that communicate relevant and comprehensive information about both their environmental management programs and performance as less risky than similar firms that provide no such information.

How do firms engage in strategic environmental communications? There are a range of options for communicating environmental management activities and performance to the capital markets, including but not limited to periodic press releases, summaries in annual SEC filings, standalone environmental reports, television commercials and print advertisements, and participation in industrywide programs.

As in the case of 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 ongoing basis are more likely to be rewarded through reduced risk assessment than those that provide only qualitative information on a few aspects of their programs.

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?

WHAT IS MEANT BY FIRM INVESTMENT RISK, AND HOW IS IT MEASURED?

A firm's risk 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 (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 reduced cost of financial capital and, for a given cash flow, a higher stock price.[2]

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 beta 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.[3]

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 designed to measure environmental risk. Thus, as a firm's environmental risk declines (increases), we should expect its beta, all else equal, to decline (increase).

ILLUSTRATION OF MODEL RELATIONSHIPS

To demonstrate the linkages between changes in environmental risk and a firm's stock price, let us consider a hypothetical nationally known beer company. The company has a market capitalization of $1 billion, and earns a steady annual profit stream of $100 million that 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 indicate the importance of these environmental activities, the CEO has created a senior environmental officer position. The person filling this position reports to the CEO and is a member of the board of directors. The environmental officer conducts audits of the firm's current environmental management system, develops environmental principles that will broadly define an upgraded environmental management system, and disseminates this new environmental information to customers, suppliers, employees, and investors.

The senior management team understands that signaling this commitment is critical to the success of the firm's new environmental strategy. The CEO therefore instructs the firm's investor 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 improve its future environmental performance. Environmental performance will be measured by reductions in hazardous waste generation and regulated emissions of air and water pollutants.

As information about the firm's new environmental policies is disseminated to various stakeholders and the public generally, the financial markets begin to process the 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 lower risk in the form of a reduced beta.

Prior to the announcements, the firm's cost of equity capital as measured by its corporate finance department using the capital asset pricing model (CAPM) was 10%. When the firm's corporate finance department inputs the lower beta into the CAPM, a new lower cost of equity capital of 9% results. The beer firm's CFO estimates that it will cost about $50 million 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.[4]

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

EXHIBIT 2
IMPACT ON BETA AND COST OF CAPITAL RESULTING FROM A 50% IMPROVEMENT IN A FIRM'S ENVIRONMENTAL MANAGEMENT SYSTEM AND ITS ENVIRONMENTAL PERFORMANCE

VARIABLE	50% IMPROVEMENT IN VARIABLE WILL RESULT IN A BETA DECLINE OF	INITIAL BETA	BETA AFTER CHANGE	INITIAL COST OF CAPITAL	COST OF CAPITAL AFTER CHANGE
Environmental Management System	–8.5%	1.0	0.915	13%	12.57%
Environmental Performance	–6.5%	1.0	0.935	13%	12.67%
Combined Effect*	–13.2%	1.0	0.868	13%	12.34%

*Assuming 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.
Note: Exhibit results are simulations based on multiple regression analysis data from 1980–1994.

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 important, these reductions will result in an additional share price increase in the future.

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; 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 measure the impacts directly. The results of a preliminary but detailed and rigorous analytical application 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.

The simulation in Exhibit 2 shows the magnitude of the beta decline and the share price increase that result from a 50% improvement in a firm's environmental management system and a 50% improvement in a firm's environmental performance.

EXHIBIT 3
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
Initial Position			
• Number of Shares = 10 million			
• Annual Revenue = $100 million/year			
• Cash Flow + $10 million/year			
• Risk-Free Rate = 8%	$76.9	$7.69	0%
• Risk Premium + 5%			
• Beta = 1.0			
• Cost of Capital = 8% + 1.0 (5%) = 13%			
Independent Effect of a 50% Improvement in Environmental Management System			
• New Beta = 0.915			
• New Cost of Capital = 12.57	$79.6	$7.96	3.5%
Independent Effect of a 50% Improvement in Environmental Performance			
• New Beta = 0.0935			
• New Cost of Capital = 12.67	$78.9	$7.89	2.6%
Combined Effect			
• New Beta = 0.868			
• New Cost of Capital = 12.34	$81.0	$8.10	5.3%

Note: Exhibit results are simulations based on multiple regression analysis data from 1980-1994.

Exhibit 3 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% improvement two years after the firm improves its environmental management system rating by 50%.

As Exhibit 2 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%, resulting in a reduction in the firm's cost of capital from 13% to 12.34%.

Exhibit 3 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%. 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% improvement in its environmental management system followed two years later by a 50% 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%. 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.

It is unlikely, however, that the costs of the required environmental upgrades will be small. To the contrary, it 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 2% 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 + [($4.1 million – $2.0 million)/10 million shares]}.

It is worth noting 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.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

We have established a conceptual framework that can guide senior managers as they grapple with decisions regarding whether to deploy and how best to apportion 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 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 obtaining a lower cost of capital. We have explained and measured this phenomenon, and shown that firms that improve their environmental management system and their future environmental performance should be able to increase shareholder wealth by perhaps as much as 5%. In short, *improving corporate environmental performance pays.*

Our findings raise the question of how best to seek out, identify, evaluate, and implement 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 a 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.

An initiative to improve environmental performance requires a systematic approach to environmental management. That is, a definition of 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. A strategic assessment of key environmental issues is an appropriate place to start for many organizations.[5]

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 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 not performed at all may be identified. These deficiencies may be addressed through specific environmental infrastructure enhancements, or through investment in the capabilities of the organization's human or information management resources.

Knowledge and skill building 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 and 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, 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 manner.

APPENDIX
Research Design

Development of the empirical model proceeded in two separate stages. In the first stage, we estimated the beta for about 330 firms in the S&P 500 stock index for two separate time periods, 1980–1987 and 1988–1994.

EXHIBIT A
Summary Statistics for Regression Model

- R-square = 28%
- Adjusted R-square = 24%

Coefficient	t-statistic	Probability that Coefficient Equals Zero @ 99% Confidence Level
Environmental Management	–2.86	0
Environmental Performance	2.62	0

- Most non-environmental coefficients are statistically significant, although several of the industry dummy variables are not.
- F-statistic = 6.73; probability that the coefficients of the model are zero = 0.
- Durbin-Watson Statistic = 1.87.
- Probability of Heteroscedasticity Using White's Test = 2%.

Because the model is proprietary, the coefficients are not shown, although the t-statistics of the environmental coefficients are provided.

The choice of time frames reflects the need to have sufficiently long subperiods both to 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 betas are 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 is calculated for each company, and these observations are then regressed against indicators of environmental management, environmental performance, and non-environmental variables. The non-environmental variables include 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, developed by ICF Kaiser staff, is 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 is given a score from 1 (poor environmental management system) to 35 (best environmental management system) based upon the ET Rating™ system.

The second environmental variable is 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 are included in 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 × 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 Cost (s) +
c8 × Change in Operating Income (s) +
c9 × B (s) [Beta for Firm s During 1980–1987 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 that equals unity if the firm's primary business is in a particular two-digit SIC code and zero otherwise; and e(s) = error from regression for the firm.

The coefficients of the model are estimated using multiple regression techniques. A summary of the results of the exercise appears in Exhibit A.

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-square 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, its financial risk declines. Also, as actual environmental performance improves, as measured by the decline in TRI per unit of capital, firm risk declines.

ENDNOTES

[1]Some studies using event methodologies do show discernible short-term changes in the market value of publicly traded companies as a function of disclosure of particular environmental-related phenomena, such as emissions of toxic chemicals, large oil or chemical spills, or receipt of environmental awards. See, for example, Blacconiere and Patten [1994] and Hamilton [1995].

[2]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.

[3]In practice, company-specific beta values are computed from a regression 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.

[4]The $61 million is calculated by first capitalizing the firm's $100 million profit stream by the new lower cost of capital ($100 million/0.09 = $1.111 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 million/10 million shares).

[5]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 consortiums 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. Many of these organizations and programs not only promote the development and dissemination of standardized approaches to environmental management, but also embrace the concepts of sustainability and eco-efficiency, examining industrial activities in terms of raw material,

water, energy, and non-renewable resource use, as well as more conventional aspects such as toxic pollutant emissions and waste generation. Finally, the new ISO 14000 environmental management standards represent an attempt to promote global consistency and adherence to a set of forward-looking principles, such as preventing pollution and continual improvement.

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