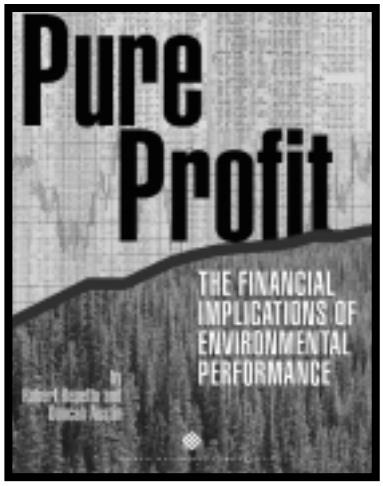
PURE PROFIT: THE FINANCIAL IMPLICATIONS OF ENVIRONMENTAL PERFORMANCE



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While recogni ing he con rib ion of ho e men- ioned abo e, he a hor alone bear ole re pon i- bili for he opinion e pre ed in hi repor .

R.R.
D.A.

FOREWORD

In recen ear , in e or and companie ha e become increa ingl a are of he man a ha en ironmen al i e affec heir b ine - e , pre en ing bo h challenge and oppor ni ie . En ironmen al i e genera e b ine ri k ha ha e o be caref ll managed. Reg la ion aimed a pro ec ing h man heal h and he en ironmen con- an l e ol e and of en crea e ncer ain ie for firm i h ignifican implica ion for heir financial performance. Con mer reac ion , o ic or , and o her en ironmen all mo i a ed li iga ion crea e erio non-reg la or ri k ha ma red ce a com- pan marke or ndermine i balance hee .

A he ame ime, rich re ard are increa ingl a ailable o companie able o ran form en iron- men al concern in o marke oppor ni or compe - i i e ad an age. Some companie ha e recogni ed ne demand for green prod c and e abli hed ne marke niche . Some companie find heir rep- a ion are enhanced and heir earning increa ed b adop ing cleaner prod c ion echniq e or facili- ie . Companie ha e e en made a changing reg la- or frame ork in o a o rce of compe i i e ad an- age b pre-emp ing en ironmen al reg la ion and ol n aril going be ond compliance on heir o n erm , kno ing ha ri al ill likel be compelled o reac la er. In man differen a , he en iron- men i direc l affec ing he bo om line, of en i h er differen con eq ence for companie e en i hin he ame ec or.

All he e ri k and oppor ni ie carr direc l o er in o he capi al marke . S ock price mo e in re pon e o ario en ironmen al e en falling, ome ime drama icall , in he ake of oil pill , acciden , and ne la i ; ri ing on he back of a good en ironmen al image fo nded on green prod c and green proce e . Gi en he e rend , in e or kno ledgeable eno gh o di cern good en ironmen al performer from bad ho ld ee a be er re rn on heir por folio.

There i a problem for in e or ho eek o re pond o en ironmen al i e , ho e er. E en a capi al marke come o recogni e he impor ance of en ironmen al ma er for financial perfor- mance, en ironmen al i e remain o ide he main ream of financial anal i and al a ion ha pro ide he fo nda ion for in e men deci ion and corpora e ra eg . For he mo par , f ndа- men al ool of financial anal i and in e men deci ionmaking are no being applied o en iron- men al i e , impeding he abili of in e or o make o nd choice hen he en ironmen po e financial ri k or oppor ni . Thi i largel beca e of he lack of a fea ible me hodolog for ran la ing en ironmen al performance in o financial erm . In par ic lar, no approach ha adeq a el ran la ed en ironmen al ri k in o he dollar -and-cen erm i h hich in e or and b ine e are ed o orking. In ead, en ironmen al i e are of en red ced o checkli , q ali a i e creen , or compli- ance-ba ed deci ion .

In *Pure Profit: The Financial Implications of Envi- ronmental Performance,* WRI economi Rober Repe o and D ncan A in pre en a ne approach ha fill hi gap. The o line a me hodolog ha in e or and anal co ld e o e al a e ho ncer ain ie a ocia ed i h f re en ironmen al i e can be ran la ed in o financial erm and in egra ed in o e abli hed deci ion-making frame- ork . The approach i for ard-looking, readil adap able o a range of en ironmen al i e and differen ec or , and con i en i h echniq e

alread idel ed b in e or and manager o a e con en ional b ine ri k .

Moreo er, in appl ing he me hodolog o he p lp and paper ec or he a hor demon ra e h e al a ing en ironmen al i e ho ld be a cen ral par of in e men anal i . Looking a j a b e of he alien en ironmen al i e ha firm in hi ind r ill confron o er he ne fi e or en ear , he d re eal ignifican financial impli-ca ion for man companie ha ho ld be of in er-e o an in e or, irre pec i e of hi or her in ere in he en ironmen . Thi e idence direc l chal-lenge he no ion ha en ironmen al i e are oo mall o meri Wall S ree a en ion and reinforce he no ion ha he en ironmen pre en a ne dimen ion in hich difference in he rela i e al e of companie can be di cerned, and e ploi ed, b in e or .

A a ime hen en ironmen al i e are becom-ing more and more prominen , and hen he pro pec of policie o addre ne i e , ch a clima e, loom large, in e or ignore he e i e a heir peril. In r ing o make en e of he e i e in financial erm , he approach de cribed in hi repor ho ld pro ide a ef l fo nda ion for bo h in e or and companie .

Thi repor i he la e in a erie of WRI p bli-ca ion aimed a impro ing he managemen of en ironmen al i e b he pri a e ec or, incl d-ing *The Next Bottom Line: Making Sustainable Devel-opment Tangible; Green Shareholder Value: Hype or Hit?*; and *Green Ledgers: Case Studies in Corporate Environmental Accounting*. WRI remain commi ed o helping he pri a e ec or impro e i en iron-men al performance and o enco raging corpora e leader hip in he area of en ironmen al pro ec ion.

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JONATHAN LASH
PRESIDENT
WORLD RESOURCES INSTITUTE

EXECUTIVE SUMMARY

This report demonstrates how environmental initiatives can be successfully integrated into corporate financial analysis. It explains a newly developed methodology derived from fundamental principles of financial analysis and demonstrates the approach by applying it empirically to companies in the U.S. pulp and paper industry. The results clearly show that companies within this industry face environmental risks that are of material significance and that can vary considerably in magnitude from firm to firm. These risks are not evident in companies' financial statements nor are they likely to be incorporated in current market valuations.

The methodology consists of a framework developed by analyzing conventional business risks and opportunities, and avoids some of the limitations of other approaches currently used to relate environmental and financial performance. The approach is forward-looking and scenario-based, recognizing that financial markets are concerned more with the future than with the past. It deals explicitly with uncertainties regarding future environmental policies and other environmental pressures on the firm, rather than merely assigning past and present levels of environmental performance. Its standard techniques of financial analysis to derive measures of expected environmental impacts on shareholder and financial measures of environmental risk. It focuses on how environmental issues are deemed most important by industry experts and how such data are readily available.

This tool will be of interest to professionals in both environmental and corporate communities. Investors can use it to integrate environmental risk more fully into financial analysis in evaluating potential merger and acquisition, in security analysis and portfolio building, in credit rating, and in insurance underwriting. Environmental managers can use it to quantify their environmental performance and risk; to benchmark their companies (or facilities) against industry leaders; to identify which investments in environmental control would most reduce their outstanding environmental risk; and to move beyond compliance-based environmental action toward more forward-looking and strategic approaches. Managers and CFOs could use it to gauge how much cash they would be worth pending investments in self-insurance to eliminate certain environmental risks, or as part of a strategic management system emphasizing real options.

APPLYING THE METHODOLOGY

We have tested the methodology by applying it to 13 companies in the U.S. pulp and paper industry. In this industry, environmental developments will significantly affect future material and energy costs, earnings, and balance sheets. This industry:

- depends on forests for harvested and recycled paper for its raw materials;
- is one of the most energy-intensive of all industries;
- emits a wide range of toxic and conventional pollutants to air, water, and land;
- is one of the largest contributors to the solid waste stream;
- identified in the public mind with pollution and resource degradation;

i bjec o an enormo range of en ironmen- al and na ral re o rce reg la ion and li iga- ion; and

m alloca e ignifican por ion of in e men and opera ing o la o en ironmen al con rol program .

To an e en eq aled b fe o her , he en iron- men can ignifican l affec he financial re l of companie in he p lp and paper ind r .

Mainl a a re l of deci ion aken in ear pa for broader b ine rea on , companie ha e po i- ioned hem el e differen l i h re pec o pending en ironmen al i e . *Where* mill and fore land are loca ed, *what* prod c he rn o , and *what* echnologie are imbedded in he capi al ock are hi orical fac or ha largel de ermine companie e po re o impending en ironmen al i e . The legac of pa deci ion make ome firm lnera- ble o cer ain i e and o her ir all imm ne.

The ep in he me hodolog are

a. iden if ing alien f re i e ;

b. b ilding cenario aro nd each;

c. a igning probabili ie o cenario ;

d. a e ing compan e po re o he e i e ;

e. e ima ing financial impac con ingen on cenario ; and

f. con r c ing o erall mea re of e pec ed impac and ri k.

S ep (a) o (c) ere nder aken i h he a i - ance of ind r repre en a i e a ell a o ide e per o en re ha priori ind r i e ere iden ified. Informa ion a collec ed on impending air and a er q ali reg la ion , fiber ppl i e , and clima e change i e . Scenario ere genera ed reflec ing po ible de elopmen in he e area and probabili ie a igned o each.

In ep (d), firm-b -firm informa ion a collec ed on he priori i e . Informa ion a compiled from p blicl a ailable o rce , incl ding ann al repor , Sec ri ie and E change Commi ion (SEC) filing , and o her relea e b he companie hem- el e ; ne repor ; p lp and paper ind r direc- orie ; and En ironmen al Pro ec ion Agenc (EPA) p blic da a file on facili -b -facili en ironmen al performance.

In ep (e), he companie e po re o he ari- o en ironmen al cenario ere ran la ed in o financial impac . For each compan and each ce- nario, he financial impac on re en e , prod c ion co , in e men pending, and he al e of o ned a e ere e ima ed indi id all for all ear of he foreca period, hen red ced o di co n ed pre en al e ing an e ima e of he eigh ed a erage co of capi al. The e pre en al e ere hen added o ob ain a ne financial impac for he ce- nario and he compan in q e ion. The financial impac a hen e pre ed a a percen age of a com- pan c rren marke al a ion.

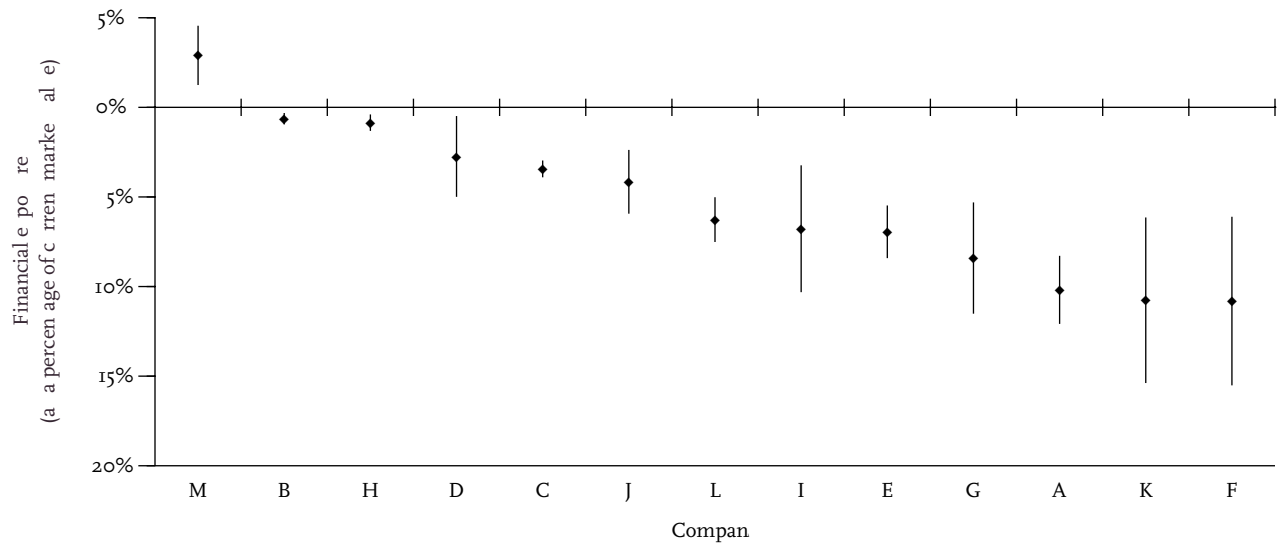
In ep (f), he financial impac of indi id al ce- nario ere aggrega ed for each compan i h prob- abili eigh ing o arri e a o erall mea re of e po re and ri k for he range of en ironmen al i e e amined.

RESULTS AND CONCLUSIONS

The cenario o lined in hi repor o ld ha e b an iall differen financial implica ion acro companie . For ome firm , ho ld a par ic lar ce- nario come o pa , he financial impac o ld be ignifican ; for o her , he impac o ld be in ignifi- can or e en oppo i e in direc ion.

S ch difference are clear hen mmar a i - ic for all he companie in he d are arra ed oge her. (*See Figure A.*) The mo likel o come for each compan i repre en ed b a do , indica ing he e pec ed impac on i hare al e of impending en ironmen al i e . A fe companie can rea on- abl e pec an in ignifican l mall po i i e or nega- i e effec le han hree percen one a or he o her. A he o her e reme, hree companie co ld, a hi poin , e pec q i e a ignifican nega i e impac grea er han 10 percen of heir o al mar- ke al e. The o her face a mo likel impac of be een 4 and 8 percen of hare al e.

FIGURE A. **FINANCIAL EXPOSURE TO PENDING ENVIRONMENTAL ISSUES OF 13 U.S. PULP AND PAPER COMPANIES**



The range of po en ial o come al o arie grea l from one compan o ano her. The ariance of impac , a a mea re of financial ri k ari ing from e po re o he e en ironmen al i e , i le han 1 percen of hare al e for hree companie in he gro p. A he o her e reme, i i grea er han 9 percen of hare al e for o o her companie . The former gro p i effec i el hedged again en ironmen al ri k, in he en e ha i f re earning ill no be highl en i i e o he o come of he i e i face . The la er companie are grea l a ri k; heir earning ill depend hea il on he a he e i e de elop.

Of co r e, he fig re reflec c rren e pec a ion of he magni de of en ironmen al i e and heir likel occ rrence, bo h of hich are bjec o change o er ime. Compan al e on en ironmen al i e ill be con in all e ol ing, j a compan al e are con in all adj ed on he ock marke . Thi ool pro ide a a o rela e a firm en ironmen al performance deci ion o i al e and ri k o hareholder .

The informa ion on en ironmen al e po re and ri k in hi paper goe b an iall be ond ha companie repor in heir financial a emen . Companie end o repor onl on capi al co o be inc rred o compl i h en ironmen al andard and reg la ion ha ha e alread been i ed in final form and on remedia ion co for hich he compan ha alread been implica ed hro gh EPA ac ion. In o r gro p of 13 companie , onl hree men ioned in heir mo recen ann al financial repor *any* of he en ironmen al i e anal ed here. All hree of ho e companie offered onl q ali a i e di c ion.

Companie al o a me ha reg la ion ill affec o her firm in he ind r eq all . Se eral companie offered a emen o he effec ha [he compan] doe no an icipa e ha compliance i h [en ironmen al] a e and reg la ion ill ha e a ma erial ad er e affec on i compe i i e po i ion ince i compe i or are bjec o he ame a e and reg la ion o a rela i el imilar degree. The re l in hi paper demon ra e ha ch a emen are erroneo and po en iall mi leading. The ame en ironmen al andard are likel o ha e q i e differen impac acro companie in he ind r .

Financial anal co ld gain addi ional in igh in o companie b ing he approach o lined here. Ho e er, o do o ill req ire a grea er flo of compan - pecific informa ion han i c rren l a ailable. The EPA, he SEC, and he companie hem el e co ld all help in hi regard.

1

INTRODUCTION

This report demonstrates how environmental issues can successfully be integrated into financial analysis. It explains a newly developed methodology derived from fundamental principles of financial analysis and demonstrates the approach by applying it empirically to companies in the U.S. pulp and paper industry. The results show clearly that companies within this industry face environmental risks that vary widely in magnitude from firm to firm. These risks are not evident in companies' financial statements, nor are they likely to be incorporated in current market valuations.

The report addresses several important issues. It answers the need for a tool with which to assess the potential impact of environmental performance on shareholder value and investors' risk. With this tool, financial analysts can evaluate environmental pressures facing the companies they scrutinize in a quantitative framework consistent with that used to analyze other business risks and opportunities. Further, they can estimate environmental risks and potential liabilities before their impacts are felt on earnings and balance sheets.

In many industries, environmental issues have implications that can significantly affect companies' financial results.

This tool also enables business managers to analyze environmental investments and risks in a financial framework consistent with those used for other business decisionmaking processes. With it, they can make forward-looking, rational, economic decisions regarding environmental risk reduction that go beyond reactive compliance with promulgated regulations. In addition, they can communicate their strategy effectively to external stakeholders.

If financial markets do not accurately incorporate the risks to corporations from environmental exposures, then securities are likely to be mispriced and capital misallocated.

These capabilities are important because in many industries environmental issues are becoming "value drivers;" that is, issues with implications that can significantly affect companies' financial results (Cairncross, 1995). Unless environmental issues are dealt with inside the corporation in ways similar to those used to manage other business risks and opportunities, environmental control in such industries will remain an internal regulatory function superimposed on the company's core business concerns rather than part of the process of maximizing shareholder value (Smart, 1992).

These capabilities are important to financial analysts as well, because if financial markets do not accurately incorporate the risks to corporations attendant on their environmental exposures, then securities are likely to be mispriced and capital misallocated. Though the perfect market hypothesis suggests that environmental issues are already reflected in current stock market valuations, the response of financial analysts and industry experts to the findings in this report indicates that that is

not always the case. Assessing prospective environmental issues in detail may reveal sources of previously unrecognized value or risk.

Assessing prospective environmental issues in detail may reveal sources of previously unrecognized financial value or risk.

In addition, if financial markets do not accurately evaluate environmental risks, then corporate executives will lack an important market incentive for sound environmental management (Schmidheiny, 1992). According to a recent study by a professor at the School of Management at Yale University, companies can reciprocally affect the way analysts evaluate their environmental issues "by developing a consistent internal position on how the environment adds value to their business; linking environmental performance data to key financial valuation criteria; collecting broader data on the financial implications of environmental risk and opportunity; developing better techniques for quantifying and comparing the financial impacts of environmental risks and opportunities; and placing relevant environmental financial data into the mainstream of their communications with analysts and investors" (Gentry and Fernandez, 1997). The approach demonstrated here can help companies to do just that.

For these reasons, we hope that CEOs, CFOs, and senior Environment, Health, and Safety (EHS) executives in industrial companies will find this report useful because it shows how to quantify environmental risks and the costs and benefits of reducing them. According to a survey of the CFOs of the top 100 British companies, the main reason why CFOs have not dealt adequately with environmental issues so far has been the difficulty of measuring the potential financial costs of environmental risks (Schmidheiny and Zorraquin, 1996). A more recent survey of financial institutions reinforces this point: "the most significant obstacle cited to advancing integration of environmental issues into credit and investment analysis was the translation of environmental impacts into financial implications" (UNEP, 1999).

Analysts in the financial community may find the report useful in helping to measure potential environmental liabilities in familiar financial terms and to evaluate them using commonplace measures of risk. This capability will enable them to integrate environmental risks more fully into financial analysis in evaluating potential mergers and acquisitions, in securities analysis, in credit rating, and in insurance underwriting.

Financial intermediaries and asset managers providing environmentally screened investment options—and their clients—will find the report useful because it shows how to identify significant impending environmental issues affecting an industry, to discriminate among companies within the industry with respect to their exposures to these issues, and to prioritize those issues in terms of their possible and probable financial impacts on individual companies.

The approach this report presents treats environmental issues like other business issues potentially affecting companies' revenues, production costs, and balance sheets. It

- is forward-looking and scenario-based, recognizing that financial markets are concerned more with the future than with the past;
- deals explicitly with uncertainties regarding future environmental policies and other environmental pressures on the firm;
- assesses company exposures to environmental issues, recognizing that a given issue will affect companies within the same industry very differently; and
- uses standard techniques of financial analysis to derive measures of expected environmental impacts on share values and financial measures of environmental risk.

The steps in the methodology are

a. identifying salient future issues;

b. building scenarios around each;

c. assigning probabilities to scenarios;

BOX 1 ALTERNATIVE APPROACHES FOR RELATING ENVIRONMENTAL AND FINANCIAL PERFORMANCE

A variety of analytical approaches has been used in trying to relate environmental and financial performance (Reed, 1998; Adams, 1997). These approaches face severe limitations of one kind or other.

The most common approach—used by many portfolio managers and research centers that provide environmental information on companies to Wall Street—measures a company's environmental performance and exposure through a set of performance indicators and checklists. Indicators are selected largely because comparable data are available for many companies from public data sources, such as EPA's Toxic Release Inventory. Typically, the same indicators are used across many different industries, even though they may be much more relevant to some industries than to others and may miss crucial aspects of performance and exposure in particular sectors. These performance indicators are sometimes supplemented by measures of the quality of environmental management, such as adherence to International Standards Organization (ISO) standards, the use of Environmental Health and Safety (EHS) audit systems, or the existence, rank, and staffing of environmental management functions within the company.

This approach is severely limited because the performance indicators are neither tailored to nor reflective of the issues faced by the individual company or industry. They reflect past and present environmental concerns and may miss important upcoming issues. Neither are such indicators prioritized nor weighted in accordance with their potential financial significance. Moreover, the coverage and quality of indicators tend to be limited by the data in public databases. The information on environmental management doesn't signify management effectiveness nor does it distinguish between proactive and reactive organizational responses. However, the severest limitation of this approach is the absence of any direct linkage between such indicators and any measure of shareholder value or financial risk. This approach leads to parallel measures of environmental and financial performance, rather than to an integrated evaluation.

A second, related, approach constructs an environmental rating system from these indicators analogous to Standard & Poor's (S&P) or Moody's financial ratings. This approach weights the various indicators through a regression analysis correlating the environmental performance and management indicators to returns to stocks of companies included in the S&P500. Then, companies are ranked into categories (e.g., AAA) based on their aggregate scores.

This approach is also quite limited because similar indicators are assumed to be applicable to all industries. Since the underlying regression studies are proprietary, it is impossible to assess the extent and robustness of correlations and regression coefficients or other statistical issues. The regression analysis ignores issues of causality, such as whether firms do poorly financially because of poor environmental performance, or vice versa. Since the analysis is historical and retrospective, it has little applicability in identifying future environmental issues and their potential impact on the future financial results of particular firms. Even more seriously, unlike the financial ratings constructed by Moody's and other rating agencies, there is no empirical verification that companies with relatively favorable environmental risk profiles on this scale face lower financial or default risks.

A third approach attempts to establish a linkage between environmental and financial performance through correlation and regression analysis. A number of such studies appear in the literature (e.g. Feldman, Soyka, and Ameer,

2

ENVIRONMENTAL SCENARIOS FOR THE U.S. PULP AND PAPER INDUSTRY

WHY CONSTRUCT SCENARIOS?

Scenarios are a valuable tool of financial analysis because they help analysts envision the future. Financial analysts must peer into the future, however dim the light, because the value of any investment depends on the stream of *future* free cash flows that it yields.[1] A company's past performance is relevant only insofar as it provides some clue to its likely future.

Scenarios are a valuable tool of financial analysis and can help identify potential environmental "value drivers."

Today, when interest rates are low and the average stock in the S&P500 index trades at over 30 times the current year's earnings and several times the book value of its net assets, investors are banking on a stream of consistently growing earnings far into the future. Events that may significantly affect a company's success 5 to 10 years in the future can still strongly affect that company's fundamental value.

The uncertainty surrounding such events is also a prime determinant of the riskiness of an investment. The greater the uncertainty about events that determine future earnings, the greater the investment risk. In the scenarios that follow, even industry experts are highly uncertain regarding the outcomes of impending environmental issues with significant financial implications for companies in their own industry. This implies a great deal of environmental risk.

In some industries, such as the pulp and paper industry, environmental developments will significantly affect future materials and energy costs, earnings, and balance sheets. This sector depends on forest harvests and recycled paper for its raw materials; is one of the most energy-intensive of all industries; emits a wide range of toxic and conventional pollutants to air, water, and land; is one of the largest contributors to the solid waste stream; is identified in the public mind with pollution and resource degradation; is subject to an enormous range of environmental and natural resource regulation and litigation; and must allocate significant portions of investment and operating outlays to environmental control programs. In this sector, to an extent equaled in few others, the environment can be a "value-driver." Scenarios can help identify these potential environmental value drivers, including new regulatory initiatives, new fiscal measures enacted for environmental purposes, potential future liabilities arising from past or current activities, and demand shifts arising from changing customer preferences or mandated product standards.

In some industries, environmental developments will significantly affect future materials and energy costs, earnings, and balance sheets.

Scenarios are important because "the future is not what it used to be." In the pulp and paper industry, the 1970s were dominated by efforts to deal with conventional air and water pollutants,

while the 1980s and 1990s focused on dealing with dioxins and other toxic emissions. The next decade may be dominated by quite different environmental concerns—perhaps the effort to reduce greenhouse gas emissions.

WHAT ARE SCENARIOS?

A scenario is an ordered sequence of key events that constructs a plausible vision of the future. Unlike a forecast, which represents the forecaster's best prediction about the future value of key magnitudes in the light of their past trends and those of other correlated variables, scenarios must include several alternatives that delineate a range of plausible future developments. They must differ substantially from one another, in order to explore the boundaries of important uncertainties. Forecasts aim for the *peak* of the probability distribution of future outcomes, or the "best guess," while scenarios explore the *slopes* of the probability distribution. Developing multiple scenarios is most valuable when uncertainty about the future is great. A single-valued forecast is less useful than an understanding of the various ways the future might turn out.[2]

Though the probability distributions of certain market variables, such as prices and interest rates, can be estimated from data on past fluctuations, many of the future developments that scenarios attempt to describe are *unprecedented*. Though scenario building is most useful in envisioning these *new* forces affecting a company's future, their likelihood can only be gauged through subjective probability judgments compiled from expert opinion and other "soft" estimation methods.

HOW SCENARIOS WERE CONSTRUCTED

The first step was to identify environmental and economic forces that are likely to have significant financial impacts on the industry. Significant environmental issues in the pulp and paper industry might emerge throughout the product life cycle from raw material supply to post-consumer product disposal. These possibilities can be categorized in a matrix such as that represented in Figure 1.

The industry association and its members from leading companies cooperated with the World Resources Institute (WRI) to identify and characterize potential future environmental pressures within these categories.[3] The Environmental Protection Agency (EPA) and other government agencies, environmental advocacy groups, and environmental scientists were also consulted, along with an extensive published literature, including detailed reports by international and domestic agencies, industry consultants, academics, and non-governmental organizations.

The next step was to rank these issues according to their likely significance for future earnings and risks. Three key criteria were used:

1. **Magnitude of the potential impact on earnings stream:** potentially "big ticket" items are obviously more critical to include in scenarios.

2. **Anticipated timing of an event or issue.** Other things being equal, the further in the future the impact of an environmental issue is likely to be, the less its impact on shareholder value.

3. **Likelihood or probability of an event happening.** Though a nearly certain event might have significant financial implications, it may nonetheless be of lesser significance in a scenario-building exercise because those implications will probably already be recognized by the industry and reflected in financial valuations. Thus, the newly signed "cluster rule" for kraft paper mills, which combines regulatory provisions aimed at reducing releases to both air and water, has likely been assimilated by financial markets even though the implementation deadlines still lie ahead. Indeed, many companies have now disclosed their expected compliance costs for this rule. The risks are greater when the likelihood of a significant event is evenly balanced than when the likelihood is near zero or near one.

All else being equal, an issue is more important as a potential value driver and ought to be given more attention in scenario-building when it has a greater potential impact on earnings, when it could occur sooner rather than later, and when it has a greater degree of uncertainty.

Once priority issues were identified, the next step was to define the range of plausible outcomes

FIGURE 1. **MATRIX FOR IDENTIFYING "VALUE DRIVERS" OVER THE RANGE OF THE PRODUCT CYCLE**

		Stages of the Product Cycle			
		Fiber Supply	Manufacturing Process	Product Output	Post-consumer and Disposal
Source of Change	Market forces (e.g., prices, availability, and acceptability)				
	Regulations				
	Fiscal changes (e.g., taxes and subsidies)				
	Liabilities				

associated with each issue. Experts from both within and outside the industry were consulted to formulate scenarios representing favorable and unfavorable outcomes (from industry's standpoint) for each event. These experts also provided their judgments on the likelihoods of these scenarios. Outcomes were then quantified in terms that can be translated into the elements of a financial analysis: impacts on prices, costs, revenues, expenditures, investment requirements, and balance sheet liabilities.

Scenarios were developed for issues in three main categories: pending air and water quality regulations that will affect pulp and paper manufacturing processes; regulatory and market developments that will influence future fiber availability; and climate policies that may affect energy prices and timberland asset values. Unfortunately, though climate scenarios were developed, analysis of company exposure on this issue was not possible with the public databases presently available. (*See below.*)

SCENARIOS ARISING FROM FUTURE REGULATIONS

The new environmental regulation that has preoccupied the industry for at least the past five years has been the "cluster rule," an attempt at integrated rulemaking covering both air and water emissions of toxic and conventional pollutants. That rule has now been promulgated for the largest segments of the pulp and paper industry (kraft and sulfite mills), removing much regulatory uncertainty. Compliance costs are fairly well understood but options incorporated into the regulation for firms to go beyond compliance confront companies with significant decisions, choices that hinge on other future regulatory developments.

Apart from the cluster rule, the industry will be affected by an impressive array of other environmental regulations now in various phases of development. Not all these regulations will impose independent environmental requirements on the industry. For example, reductions carried out to comply with the ozone/fine particulate standard

will contribute to improved visibility under the regional haze program. Nonetheless, their cumulative impacts on the pulp and paper industry will be financially significant. Moreover, their impacts will be felt differentially by mills according to their location, technology in place, and input structure. Table 1 briefly describes the most significant pending environmental regulations affecting the industry's manufacturing processes. High-priority issues are identified in boldface type. They have received the most attention in scenario building, but other environmental issues may be very important for particular mills. Scenarios are elaborated below.

Air Quality Issues

Control of Hazardous Air Pollutants (MACT I-III): As part of the integrated cluster rule, EPA has issued proposed and final regulations setting national emissions standards for hazardous air pollutants (NESHAPS) from the pulp and paper industry (U.S. EPA, 1998a). The Clean Air Act requires EPA to determine and adopt the maximum achievable control technologies (MACT) as the basis for regulations. EPA has issued final rules covering emissions from the pulping and bleaching processes for chemical pulp mills using kraft, semichemical, sulfite, and soda processes (MACT I), and for mills using mechanical pulping, secondary fiber, non-wood pulps, or purchased market pulp (MACT III). Essentially, the standards require mills to enclose all process emissions sources, convey the waste gases through leak-proof closed venting systems to treatment facilities, and there eliminate almost all of the hazardous air emissions.

For the industry as a whole, EPA estimates that compliance will require a capital investment approaching $2 billion (U.S. EPA, 1998a). EPA has also proposed standards for combustion sources at pulp and paper mills, such as chemical recovery furnaces and lime kilns (MACT II). These regulations aim to control emissions of heavy metal particulates, including arsenic, mercury, and chromium, as well as gaseous emissions. The rules require strict emissions limits or stringent emissions controls.

There is little remaining uncertainty regarding these regulatory developments. Firms have reported on their estimated compliance costs, so they could be excluded from scenario development *except for* the compliance options built into the cluster rule. The MACT requirements are included in the Voluntary Advanced Technology Incentive Program (VATIP) described under the water quality regulations. (*See below.*) Mills that choose to commit to stricter technologies than those prescribed as the cluster rule's baseline or minimal standards can defer compliance with the MACT standards for an additional 3 years, as long as they achieve certain interim milestones. This flexibility confronts firms with economic decisions that depend in part on expected future regulatory developments. The prescribed pollution controls also reduce emissions of volatile organic compounds (VOCs), smog precursors subject to future regulation in states that don't meet the newly adopted ozone standards. Technological choices in the control of air and water emissions are also interrelated, since alternative bleaching sequences have different air and water emissions profiles.

The pulp and paper industry will be affected by an impressive array of environmental regulations now in various phases of development.

Long-Range Transport of Smog Precursors (NO_x controls): The EPA has also promulgated regulations that will require 22 eastern states and the District of Columbia to reduce emissions of nitrogen oxides (NO_x), a smog precursor partly responsible for the long-distance northeastward drift of summertime air pollution in the eastern United States (U.S. EPA, 1998b). The 22 states include many in the Southeast (Alabama, Georgia, North and South Carolina, Kentucky, Tennessee, Virginia, and West Virginia) and in the North (Wisconsin, Michigan, Pennsylvania, and New York) where paper mills are located, but the impact of these regulations on the industry will be uneven: mills located in the Northwest and far Northeast (e.g., Maine) are unaffected because they are too distant upwind or too far downwind. Final rules that prescribe state-by-state overall limits on NO_x emissions have been challenged in court, leading downwind states to bring suit to force emission reductions by midwestern

TABLE 1. **SIGNIFICANT PENDING REGULATORY PRESSURES ON PULP AND PAPER MANUFACTURING**

AIR QUALITY REGULATIONS	
Cluster Rule Air Quality Provisions MACT I, III for process emissions MACT II for combustion sources	Will require maximum available control technology for air toxics from pulping and bleaching lines, boilers, recovery furnaces, kilns, etc.
Long-Range Transport of Smog Precursors	Will require mills located in 22 eastern states to reduce nitrogen oxide emissions by 50 to 75 percent.
Ozone & PM2.5 Standard	Will require substantial reductions in emissions of nitrogen, sulfur aerosols, and fine particles.
Regional Haze Rule	May require mills located near national parks and wilderness areas to reduce emissions of fine particles and aerosol precursors.
Compliance Assurance Monitoring	Requires monitoring to ensure that pollution control equipment is always functioning.
Credible Evidence Rule	Expands EPA access to and use of company data in enforcement actions.
WATER QUALITY REGULATIONS	
Compliance Options under Cluster Rule	Provides longer compliance periods for mills that install technologies beyond compliance.
Total Maximum Daily Loads	May require effluent reductions beyond currently permitted levels to remediate impaired waterbodies.
Sediment Remediation	Could require clean-up of polluted aquatic sediments causing water pollution downstream of mills.
Endangered Species Act	Could require effluent reductions to protect endangered aquatic species in specific locales.
Great Lakes Initiative	Will take coordinated action to reduce deposition and release of mercury and other toxic, bioaccumulative pollutants and nitrogen into the Great Lakes and important estuaries.
Cooling Water Intake	Will require mills to protect cooling water intake points from entrainment.
Sector Facility Index	Will expand the information mills must make public regarding pollutant releases.

power plants. The EPA has appealed the lower court ruling.

Depending on how environmental issues unfold, they could imply varying degrees of change to companies' revenues, production costs, and balance sheets.

Though States are to develop their own implementation plans, EPA's estimates are based on drastic cuts in emissions from electric utilities and large industrial boilers, such as those used in the pulp and paper industry. According to the proposed rule, mills would have to lower summertime emissions by 50 to 75 percent, mainly by retrofitting low-NO_x burners onto industrial boilers. However, EPA has also recommended that states jointly develop a cap-and-trade system similar to that being used in the sulfur emissions control program. This would allow sources with low-cost abatement options to cut emissions by more than is prescribed, selling the extra "credits" to sources without such options. Emissions trading could lower total compliance costs substantially, as would a compromise rule requiring more moderate emission reductions. These regulations could evolve in ways that have substantially different cost implications for the pulp and paper industry:

Scenario A: (Deemed more likely) *The EPA rule is affirmed on appeal and states fail to create a workable cap-and-trade program and impose large percentage NOx reduction requirements on pulp and paper mills in the designated states at average abatement costs of approximately $4,000 per ton.*

Scenario B: (Deemed less likely) *A region-wide cap-and-trade program lowers compliance cost to about $2,300 per ton by allowing mills to substitute purchased permits for their most costly internal compliance options. Alternatively, a more moderate emissions reduction rule is finally adopted.*

Water Quality Issues

Compliance Options under the Cluster Rule: The cluster rule poses important choices for companies by offering incentives to those that agree to install advanced technologies that will reduce effluents more than required in the basic regulation. Under the Clean Water Act, the rule requires existing mills to adopt Best Available Technology (BAT), which calls for complete substitution of chlorine dioxide for elemental chlorine in the bleaching process in order to eliminate detectable levels of dioxins in the effluent and for improvements in spill controls and wastewater treatment. The rule's innovative element is a Voluntary Advanced Technology Incentive Program (VATIP) that offers longer compliance periods, reduced monitoring and non-compliance penalties, and public recognition for mills that commit themselves to meet more stringent performance standards by adopting advanced technology (U.S. EPA, 1998c). Depending on the level of performance, designated as Tier I, Tier II, and Tier III, mills would have an additional 3 to 13 years to achieve their ultimate performance standards, but would be required to meet interim standards at least as strict as the rule's basic requirements along the way.

The successive higher standards move mill technology increasingly toward "closure" with respect to effluents by removing more of the lignin from the pulp before bleaching it and by reducing water use and increasing recycling of process water in both the pulping and bleaching stages of pulp production. Achieving these higher standards would involve substantially higher capital expenditures than just complying with the basic requirements of the cluster rule (adopting BAT), but could also achieve savings in operating costs through reduced chemical and water use, reduced wastewater flow, and savings in purchased energy. Most mills are adopting BAT, which the industry strongly favored. However, firms that consider it likely that they will be subject to further restrictions on conventional and toxic releases in the future—because they are located on impaired waterways subject to total maximum daily loads (TMDLs) or because of other water quality concerns—may find that adopting advanced effluent reduction technologies will appear more attractive. Moreover, those firms that expect higher fiber costs in the future may find installing an oxygen delignification system (in order to reduce lignin in the pulp without extended cooking) more attractive, because this technology permits higher pulp yields than one based on longer pulping to eliminate lignin prior to bleaching.

Total Maximum Daily Loads (TMDLs): Section 303(d) of the Clean Water Act calls on regulatory agencies to establish maximum pollution loadings on watercourses where technology-based effluent limits are inadequate to achieve water quality goals. Currently, approximately 15,000 miles of watercourses still fail to meet such goals (e.g., fishable and swimmable) despite 25 years of technology-based pollution control. Environmental groups have initiated legal action against at least 29 state regulatory agencies to force them to identify impaired waterways and then to impose TMDLs. Many of these states—in the Southeast, the Northwest, Northeast, and Great Lakes regions—are centers of industrial timberland and pulp and paper production.

Further reductions in total pollution loadings will probably be required to improve water quality on impaired waterways. For the pulp and paper industry, the issue is what these reductions will be. In many watersheds, nonpoint sources such as farming and animal husbandry are now responsible for the largest share of pollution loadings through run-off and erosion. Moreover, best management practices on farms and construction sites can often reduce effluent discharge at a small fraction of the incremental cost faced by industrial and municipal dischargers that have already installed secondary waste treatment systems (Faeth, in press). Nonetheless, imposing regulations on farms and other nonpoint sources is politically and administratively more difficult than tightening regulations on existing point sources. EPA is encouraging states to develop permit trading systems that would allow point and nonpoint sources to contract for effluent reductions. Therefore, two scenarios with very different cost implications for the evolution of TMDLs can be envisaged:

Scenario A: (Deemed more likely) *States impose additional effluent reduction requirements on municipal and industrial dischargers, largely exempting nonpoint sources. Mills located on sensitive waterways would be forced to adopt enhanced waste treatment systems and/or additional water recycling and spill control measures.*

Scenario B: (Deemed less likely) *States impose best management practices on farms and other nonpoint sources and initiate effluent trading systems that enable mills to contract with nonpoint sources for discharge reductions at a small fraction of their own incremental pollution abatement costs in lieu of undertaking further pollution controls in the mill.*

Some firms charged with sediment remediation in the past have engaged in lengthy litigation, at considerable risk to their corporate reputations and community relations.

Contaminated Sediment Remediation: On many waterways, sediments contaminated with persistent pollutants such as heavy metals, PCBs, dioxins, furans, organochlorine pesticide residues, and other persistent toxics contribute to water quality impairment. As sediments are disturbed, pollutants become exposed in the water or enter the food chain. The EPA has compiled inventories of waterways in which contaminated sediments are a problem as well as inventories of point sources of pollution, including some pulp and paper mills (U.S. EPA, 1997). The EPA is developing a strategy to mitigate the problem, which may require remediation of some sediments. Sediment remediation can be expensive, not only because of the expenses of dredging and removal without exacerbating pollution problems, but also because of the expense of disposing of dredge material containing toxic or hazardous wastes. Some firms charged with sediment remediation in the past have engaged in lengthy and costly litigation, at considerable risk to their corporate reputations and community relations. Again, two distinct scenarios were constructed:

Scenario A: (Deemed equally likely) *EPA decides that the best strategy in most cases is to eliminate sources of further contamination and to leave sediments undisturbed or to rely on low-cost biological treatment options* in situ.

Scenario B: (Deemed equally likely) *EPA adopts a strategy calling for extensive and careful removal of contaminated sediments, requiring dredge material to be treated and disposed of as hazardous wastes. Pulp*

and paper mills are identified as responsible parties with significant financial obligations.

SCENARIOS RELATING TO FIBER SUPPLY ISSUES

Timber Supply Issues

Fiber is the most important single cost item for most mills and a key source of competitive advantage. Most fiber still comes from wood wastes—logging residues or woodchip residues from sawmills—or from trees grown for pulp. Recycled fiber use has been increasing steadily and now constitutes 34 percent of total fiber input for the U.S. pulp and paper industry (Franklin Associates, 1997).

Though the underlying determinants of fiber availability and prices are complex and subject to strong cyclical forces, the basic projection for U.S. fiber price movements over the next decade is upward, with the biggest single influence being likely reductions in domestic timber availability. A decade of high market demand for fiber and harvest restrictions in national forests has led to heavy cutting on private timberlands, depleting stocks and raising the possibility of timber shortages in the next decade.

Timber stocks in the U.S. South contribute 55 percent of total U.S. harvest and support over 70 percent of U.S. wood pulp capacity. Some studies suggest that stocks in this region may have been seriously depleted in recent years, especially in softwoods (Lyddan, 1997; Ekstrom, 1997). Current harvest rates are substantially above the most recent U.S. Forest Service projections and nearly 15 percent above forest growth rates (Haynes et. al. 1995). Moreover, some of the remaining inventory is located in ecologically sensitive areas and may not be harvestable. For example, of the 15 million acres of forestland in Virginia, only 55 percent is available for harvest. The other 45 percent is classified as "urban" or as unsuitable due to slope, fragmented acreage, or spatial arrangement (Virginia Department of Forestry, 1995). Similarly, for the South as a whole, available timber may be 25 to 50 percent less than the overall inventory when one takes into account the stock in unsuitable areas and the objectives of the non-industrial private landholders who own two thirds of Southern timber (Lyddan, 1997). The region will probably experience softwood timber shortages over the next decade until new plantations and forest management practices bear fruit.

The Pacific Coast, where two thirds of the timber inventory is on public lands, contributed 22 percent of the timber harvested in the United States in 1991 (Ekstrom, 1997). Since then, harvests on public lands in the Pacific Northwest have fallen drastically—down 90 percent from their highs in the mid-1980s. Though timber is relatively plentiful, much of it is now off-limits and is likely to remain so. The Northern states contribute 17 percent of the U.S. harvest, though this region's inventory is less important for long-term supply because its productivity is lower than the South's or the Pacific Northwest's.

Offsetting these trends, the industry is using increasing amounts of non-fiber binders and fillers as materials as well as recycled fiber, taking advantage of substitution possibilities. In addition, fiber, pulp, and paper markets are increasingly global. Low-cost timber from Asia and Latin America supplies large, new, efficient mills that are increasing their share of world markets for market pulp and some paper grades. However, future world fiber supplies are also uncertain. Supply forecasts for industrial roundwood in 2010 range from near their present level of 1.5 billion cubic meters (m^3) up to 2 billion m^3 (Nilsson, 1996). Corresponding price forecasts for 2010 range from today's level to a level up to three times higher (FAO, 1997). On balance, the baseline forecast for global fiber prices is for increases over the next decade.

Environmental pressures may exacerbate the upward price trend. Table 2 identifies the main environmental issues that may affect U.S. virgin fiber supply. The potentially more significant issues are printed in boldface type.

State and Local Forestry Regulations: Timber harvesting can cause erosion, sediment runoff, and degradation of receiving waters and aquatic ecosystems. As suburbanization, prosperity, and vacation homes have spread, the number of state and local regulations affecting private timberlands have increased, aimed at safeguarding water quality, wetlands and endangered species, protecting abutting property, or minimizing site degradation. Requirements

TABLE 2. ENVIRONMENTAL INFLUENCES ON U.S. VIRGIN FIBER SUPPLY

Regulations on Private Lands	**Stricter state and local forest regulations may limit harvests from private timberlands.**
Actions under the Endangered Species Act (ESA)	**A reauthorized ESA may limit harvests in specific regions, especially if extended to sub-species and vigorously enforced.**
Carbon Sequestration	**Incentives to sequester carbon in forests for climate purposes would encourage increases in the standing timber stock.**
Harvests on Public Lands	Harvests from public lands have declined dramatically and may not recover.
Environmental conflict over intensive silviculture, plantations, "fiber farms" and bioengineering	Environmental opposition may create barriers to intensive silvicultural practices and arboreal bioengineering.
Nonpoint source permitting for water quality protection	TMDL restrictions on nonpoint sources may raise forest management costs near impaired waterways.
Forestry Certification and Product Eco-labeling	Certification and eco-labeling schemes could raise fiber costs or reduce virgin fiber supply.
Tax treatment of private lands	Changes in estate, land, and capital gains taxes could affect fiber supplies from private non-industrial lands.

under these laws include best management practices (to minimize erosion and sedimentation), buffer zones along riparian areas, forest management plans, improved slash management, and limits on clearcutting.

Southern watersheds have become the latest focus for environmental groups pressing for increased environmental regulation. Such regulation could lower anticipated timber harvest by 10 percent over the next five years (Greene and Siegel, 1994). Elsewhere, endangered species and forest protection regulations in the Pacific NW could particularly affect softwood supplies held on non-industrial private lands, while in the North, hardwood stocks are most likely to be restricted by water quality regulations. Overall, future regulations could lead to a 12 percent reduction in private harvest of hardwoods and an 8 percent reduction for softwoods in the next 10 years (Haynes et al., 1995).

However, more stringent regulation may not be inevitable. Industry may prefer comprehensive state regulations that would be more predictable and might avoid the excesses of local regulations. As an alternative to further regulations, the AF&PA has promoted its own Sustainable Forestry Initiative (SFI), under which firms commit to certain practices and standards, though not to third-party certification. It is estimated that the SFI will raise delivered wood costs by about 7 percent.

Scenario A: (Deemed less likely) *Few new local regulations are passed and state forestry codes largely conform to the industry's sustainable forestry initiative. Overall, fiber prices continue their modest upward*

trend, rising at a rate of 3 percent per year in nominal terms in most areas of the U.S. and at 3.5 percent in the South.

Scenario B: (Deemed more likely) *Many new state and local regulations are enacted, raising the costs of timber operations and reducing timber supply from private forest lands. Prices rise by as much as 5.2 percent per year in the South and over 4 percent per year elsewhere. Companies face significant harvesting restrictions on their timberlands.*

Endangered Species Act: Future private timber harvests could be further affected by the Endangered Species Act (ESA), especially if the reauthorized Act afforded protection to sub-species and specific populations. Areas of potential conflict between timber operations and species protection include Florida, the Southern Appalachians, and the Pacific Northwest. Congress has been trying unsuccessfully to reauthorize the ESA since it came up for renewal in 1992, but legislators have been caught between environmental groups eager to see changes to improve implementation and to hasten species recovery, and landowners and industry groups concerned about land use restrictions.

The official pending list for species includes 109 proposed and 164 candidate species (compared to over 1,100 species already listed as endangered or threatened). Adding these species would probably reinforce land use restrictions on existing "hot spots" rather than create new protected areas, and would have relatively small additional effects on timber supply (Flather, 1998). However, were future listings to be extended to sub-species, distinct populations, or to individual salmon stocks, then new areas would be affected, most likely in the Pacific Northwest and Southeast. Developments on this scale are unlikely over the next 10 years.

Another key issue in ESA reauthorization is the extent to which landowners will be protected from economic losses. The Clinton Administration has sought to cooperate with private landowners in developing Habitat Conservation Plans (HCPs) incorporating "No Surprises" policies. Under these collaborations, landowners can agree on a long-term land management plan with state authorities and are then exempt from future new conservation obligations. The "No Surprises" policy has popularized HCPs among industrial landowners, but environmentalists fear they will be insufficient to protect certain species and may inhibit future species recovery steps, should such steps be necessary.

Scenario A: (Deemed more likely) *The ESA reauthorization is further delayed, during which time landowners can continue to draw up HCPs with "No Surprises" provisions. Eventual reauthorization mandates "No Surprises" elements. Few species are added to the lists of endangered or threatened species. Overall, the impacts on timber supply are relatively small.*

Scenario B: (Deemed less likely) *The ESA is reauthorized and administered more stringently, listing some sub-species and populations in important timber areas, particularly in the Southeast and Northwest. The effect is to limit timber harvests or raise timber management costs on some private lands.*

Public Harvests: Most industry experts agree that the decline in harvests from public lands over the 1990s is permanent, because of the change in Administration policy, the strength of advocacy groups, and the steady erosion of the Forest Service's harvesting capability. However, pressures may build to increase public harvests again within 10 years, mainly as an instrument for managing forest ecosystems to maintain a mixed-age forest cover (Haynes, 1998). Moreover, rising prices in the face of a timber shortage from private lands might also encourage greater harvests from public forests. Public harvests could drift upwards over the next decade, perhaps from 4 to 6 billion board feet (14 million to 21 million m^3) between 2005 and 2010 (Haynes, 1998). This would mostly affect softwood supplies in the West, but would represent a small fraction of overall timber supply for the United States. Because of the likely small impact and its timing, scenarios for changes in public harvests were not elaborated in this analysis.

Recycled Fiber Issues

Assessing future recycled fiber trends requires distinguishing between impacts on the paper *recovery rate*, or how much is recovered from the waste stream, and the fiber *utilization rate*, or how much of the recovered fiber is channeled back into final

products in this country.[4] In the United States, the recovery rate was 40 percent (or 33 million tons) in 1995, while utilization was at 34 percent (Franklin Associates, 1997).

Paper is 32 percent of the municipal solid waste stream by weight. Because of its large share in municipal waste, paper recovery programs were stimulated in the 1980s by apparent shortages of landfill capacity (Franklin Associates, 1997). Those shortages have since abated and tipping fees for non-hazardous solid waste have fallen, but most forecasts expect paper recovery rates to keep increasing gradually.

U.S. paper recovery rates could be affected by source reduction policies for packaging, such as Extended Producer Responsibility (EPR), which places greater physical and financial responsibility for recovery and re-use of materials on the upstream supply chain. EPR programs, such as Germany's Green Dot program, are now common in Europe. Already, some U.S. states (e.g., California, for plastics) are looking into similar programs. However, industry opposition could slow progress towards EPR regulations.

Other measures to divert waste from landfills include bans for paper products, landfill surcharges or fees, and a range of collection initiatives. Rhode Island, for example, bans all recyclable materials from landfills and many other states have banned specific paper products, most commonly old newspapers or telephone directories. Other states (e.g. Florida and Minnesota) have preferred to raise land disposal fees to make landfill dumping more expensive and to generate revenue to fund recycling programs.

Trends suggest that over half the states will have bans in place for some products by 2010 and all states may have some price-raising measure or capacity limitations that will make land disposal more expensive (Alig, 1993; Ince 1996). Nonetheless, the recovery rate ultimately runs up against economic constraints, such as high collection and shipping costs from isolated rural communities. A recovery rate of 60 percent, though still well above the present recovery rate for all paper categories, may be a realistic ceiling.

A decade of high market demand for fiber has led to heavy cutting on private timberlands, depleting stocks and raising the possibility of future timber shortages.

In the United States, household and commercial demand for paper from recycled fiber has been limited, so manufacturing costs have largely determined recycled fiber utilization. However, government mandates and incentives may play a larger role in the future. States are now focusing more on developing markets and technologies for recycled material (Ince, 1996). By 1994, tax credits or incentives for developing recycling technologies were available in 28 states and 16 states had market development councils to promote recycling. EPA's ongoing "Jobs Through Recycling" program provides funds for state groups to develop recycling businesses.

The federal government may extend Executive Order 12873, which instructs all federal agencies to give preference in procurement and acquisition to environmentally preferable goods and services, but the direct impact will probably be small. Government consumption of office papers still constitutes only 3 percent of total consumption, and many government agencies already use recycled office paper (Ince, 1996). Were federal actions to be emulated by state and local governments, other public and non-profit institutions, and private companies, they could indirectly stimulate economy-wide demand.

A potentially competing influence would be the increased use of low-grade recovered paper as a renewable energy source, displacing fossil fuels in waste-to-energy plants. This might happen if climate policies raised fossil fuel prices and fiber prices fell.

Environmental influences bear on both the demand and supply side of the recovered materials market, and have quite different price and cost implications. Supply influences, such as restrictions

on landfill disposal and subsidized municipal wastepaper recovery programs, will raise recovery rates and *reduce* recovered materials prices. Demand influences, such as mandatory recovery fiber content regulations, may also stimulate higher recovery rates but will *raise* recovered materials prices.

To explore company sensitivity to recycled fiber prices in general, high- and low-price scenarios were created, reflecting possible limits of future recycled fiber prices.

Scenario A: (Deemed equally likely) *Demand and supply influences combine to raise recycled prices by 2.25 percent per year in nominal terms.*

Scenario B: (Deemed equally likely) *Demand and supply influences are such that prices increase at a higher rate of 3.25 percent per year.*

SCENARIOS RELATING TO CLIMATE POLICIES

The climate issue is potentially significant for the paper industry. Pulp and paper mills are energy-intensive and production costs are sensitive to energy price changes. Mills differ substantially in the degree to which they can meet their energy needs by burning their own organic wastes and in their external fuel sources, creating differences in exposure. Moreover, many paper companies own large timber tracts, on which significant additional amounts of carbon could be sequestered in forests if incentives were provided. Some of these tracts are outside the United States.

The issues in climate policy on which scenarios were constructed were whether the Kyoto Agreement would be ratified and implemented; whether carbon permit trading would be initiated as the main implementing mechanism and, if so, whether paper companies would have to purchase permits or would get them free; whether credits would be granted for carbon sequestration in forests, both domestically and internationally; and whether international trading in carbon permits through joint implementation and similar mechanisms would lead to much lower permit prices. The answers to these questions are highly significant to the paper industry's financial fortunes over the next 15 years.

Unfortunately, however, data on individual companies' energy usage, energy self-sufficiency, and fuel mixes were inadequate to carry out an exposure assessment based on climate scenarios. Few companies report on their energy usage and sources in any detail. Data on timber holdings and forestry practices are also scanty. For this reason, further analysis of the climate issue proved infeasible with the public databases now available. Consequently, climate scenarios are not discussed in detail at present, though future work will address this gap. The consequence of this omission for the subsequent analysis is to understate the environmental exposures and risks, both positive and negative, that paper companies face.

SUMMARY

The issues examined here constitute the main environmental "value drivers" facing the U.S. pulp and paper industry, as perceived by those most knowledgeable about the industry. Issues were identified, and scenarios developed, through consultation with company representatives, regulators, industry consultants and members of environmental advocacy groups. The scenarios are summarized in Table 3, which also illustrates the consensus probabilities attached to each issue as determined through polling of industry experts.

As these issues develop, the playing field for pulp and paper production will change. Depending on how they unfold, they could imply varying degrees of compliance expenditure and further operating costs, increases or decreases in the asset value of timberlands, and changes in input costs and product prices. Understanding ahead of time how individual companies are exposed to these issues will be crucial for analysts seeking to evaluate firms correctly.

TABLE 3. **SUMMARY OF ENVIRONMENTAL SCENARIOS AND CONSENSUS PROBABILITIES**

Issue	Scenario A	Probability	Scenario B	Probability
Regulatory Issues				
NO_x regulations	Large reductions required of pulp and paper mills at a cost of $4,000 per ton of NO_x	55%	Cap-and-trade program or less stringent ruling imposes compliance costs of $2,300 per ton of NO_x	45%
TMDLs on 303d Rivers	Further effluent reductions demanded from large point sources requiring enhanced waste treatment systems	60%	Cap-and-trade programs involving non-point sources lower costs for pulp and paper mills	40%
Contaminated Sediments	Low-cost treatment	50%	High-cost treatment	50%
Fiber Supply Issues				
State and Local Regulations	Few new regulations and moderate fiber price growth only	35%	Many state and local regulations forcing more rapid price increase	65%
Endangered Species Act	ESA reauthorization is delayed and final impacts are small	60%	ESA reauthorization limits harvest and management costs on private lands	40%
Recycled Fiber Prices	Low-price scenario	50%	High-price scenario	50%

3

DIFFERING EXPOSURES OF COMPANIES TO ENVIRONMENTAL ISSUES

INTRODUCTION

Even among the larger multi-plant firms in the U.S. pulp and paper industry, the scenarios outlined in the previous chapter would have substantially different financial implications. For some firms, should a particular scenario come to pass, the financial impact would be significant. For others, the impact would be insignificant or even opposite in direction. This chapter explores in detail the extent to which 13 major U.S. pulp and paper companies are exposed to these environmental issues.[5]

Companies have positioned themselves differently with respect to these environmental issues mainly through decisions taken in years past for broader business reasons. *Where* mills and forestlands are located, *what* products they turn out, and *what* technologies are imbedded in the capital stock are historical factors that largely determine companies' exposure to impending environmental issues. The legacy of past decisions makes some firms vulnerable to certain issues and others virtually immune.

The unevenness with which environmental issues strike across the industry makes them potential sources of competitive advantage and disadvantage. Some firms may have to spend more of their revenues on compliance or suffer greater input cost increases than others. Since particular scenarios would impose significant costs on only some firms within the industry and not on other competing firms, it is less likely that such cost increases would be passed along through product price changes.

No company is at a competitive disadvantage on all environmental fronts. Typically, companies are relatively poorly positioned on some and in better shape on others. Yet, it is true that some firms face a larger array of potentially costly environmental issues and therefore much more environmental risk than other competing firms do.[6] Their future earnings are subject to more contingencies dependent on the outcomes of more environmental issues, so the potential variance of those earnings is wider.

HOW INFORMATION ON FIRMS' EXPOSURES WAS COMPILED

Firm-by-firm information was collected on the priority issues identified in the scenario-building process. Information was compiled from publicly available sources, including annual reports, Securities and Exchange Commission (SEC) filings, and other releases by the companies themselves; news reports, pulp and paper industry directories; and EPA public data files on facility-by-facility environmental performance. For details on general and specific sources of information, see the Reference section of this report.

Geographic Information Systems (GIS) mapping overlay techniques were used to analyze locational data. These techniques mapped the location of companies' mills and timberlands onto the regions of concern under impending environmental regulations, many of which have quite specific areas of applicability. These GIS techniques were useful in determining which mills would be subject to compliance actions. Aggregating mill data by company shed light on companies' potential overall liability.

Assessing companies' exposures in this way demonstrates that enough relevant information is

publicly available to shed useful light on the potential competitive impact of environmental issues. Of course, more detailed and more timely information is available within the companies themselves and potentially available to financial professionals who follow the industry. Much of this information was unavailable to us. However, this assessment demonstrates the feasibility of the analysis, even though based on limited public data sources.

Understanding ahead of time how individual companies are exposed to pending environmental issues will be crucial for those seeking to value firms correctly.

Partly as a consequence of outdated and incomplete data, and also to focus attention on the methodology, companies are not identified by name in this analysis.

AIR QUALITY ISSUES

Nitrogen Oxide Emissions Reduction

The recently promulgated regulations to reduce the long-range transport of smog precursors illustrates the importance of locational factors in determining exposure. This regulation will require utilities and large industrial point sources in 22 eastern states to reduce nitrogen oxide emissions by 50 to 75 percent. Many pulp and paper mills are located outside this region and will not be affected. (*See Figure 2.*)

One company (M) has all its facilities outside the compliance region; while A and F have all or nearly all their plants inside the region and will be significantly affected. The remaining companies have varying percentages of their productive capacity located within the compliance region. (*See Figure 3.*) Clearly, this potentially costly regulation will have quite uneven impacts across companies in the industry.

Moreover, companies differ substantially in the volume of nitrogen oxide emissions they generate per ton of product turned out by mills inside the 22-state region. (See *Figure 4.*) Though the data are somewhat old, company C's plants within the region apparently emit nearly twice as much NO_x per ton of output than the industry average; those of D and I, less than half. This can be attributed to a variety of factors, including product mix, fuel source, and mill technology. It implies that company C may face a greater compliance burden than locational factors alone would suggest, while D and I may face less.

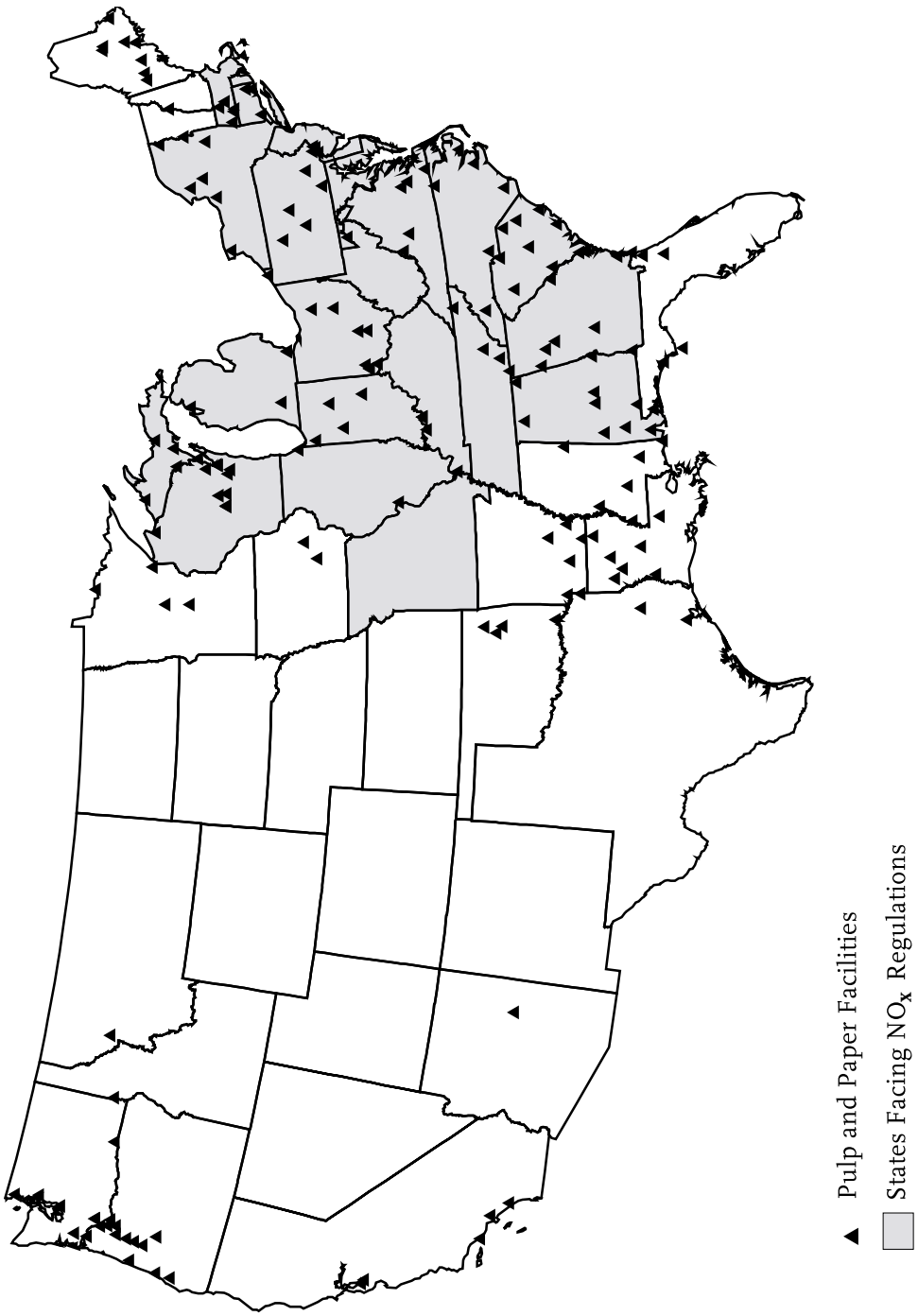
WATER QUALITY ISSUES

Cluster Rule Compliance Options

Now that Phase I of the cluster rule has been promulgated, many companies have reported their expected compliance costs. The incidence of the cluster rule varies across firms in the industry because its core "best available technology" (BAT) requirement, the elimination of elemental chlorine from bleaching sequences, has already been largely achieved by some firms but not by others. Some firms are relatively little affected by this cluster rule provision, either (a) because they rely on market pulp or recycled fiber and manufacture little virgin pulp themselves (e.g. A, F and M); (b) because of their product lines (C and K, for example, manufacture mostly unbleached pulp); or (c) because they have previously eliminated elemental chlorine from most of their bleaching plants (B and C). (*See Figures 5–7.*) At the other extreme, two firms (A and D) face conversion of all of their pulping capacity to elemental chlorine-free bleaching sequences and face relatively higher compliance burdens.

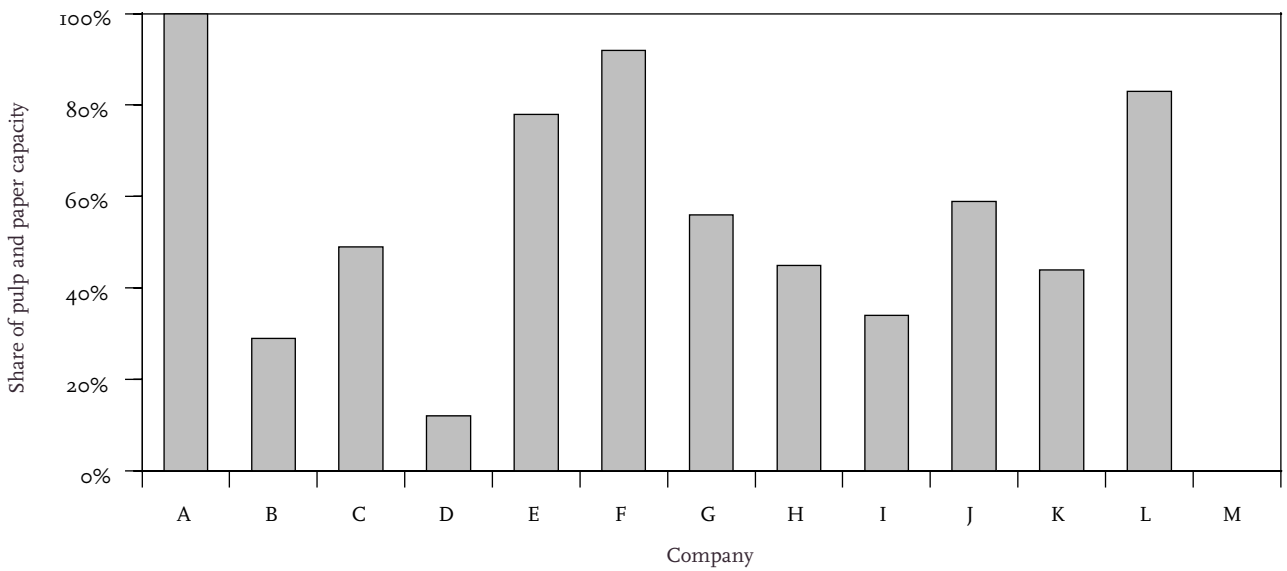
Companies also differ substantially in their ability to take advantage of the cluster rule's Voluntary Advanced Technology Incentive Program, which offers longer compliance periods for mills that go beyond BAT toward closure of the pulping and bleaching processes to water effluents. Company G has already installed oxygen delignification equipment on more than half of its chemical pulp capacity (40 percent of its total capacity), and others (B and E) have installed it on 35–45 percent of their chemical pulping capacity. (*See Figure 8.*) Oxygen delignification allows more lignin to be removed from wood fiber during pulping and thus reduces the amount of subsequent bleaching needed. These pulping and bleaching lines may be able to qualify

FIGURE 2. EXPOSURE OF PULP AND PAPER MILLS TO NO_x REGULATIONS



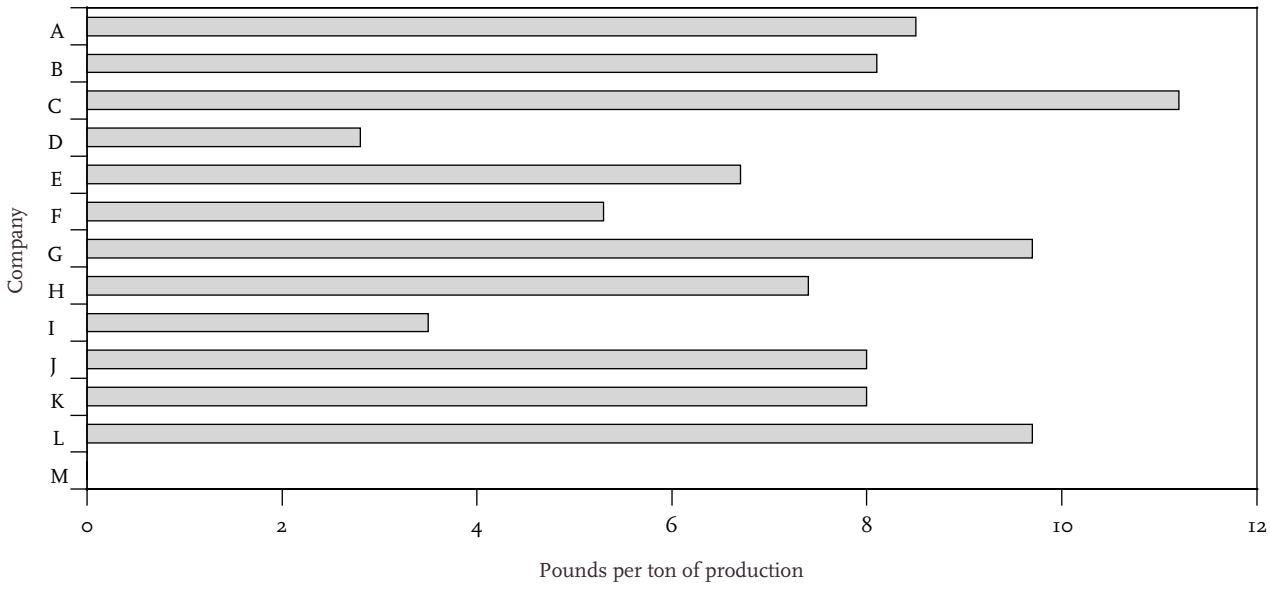
Source: Dyer, 1997; U.S. EPA, 1998b

FIGURE 3. SHARE OF PULP AND PAPER CAPACITY LOCATED IN 22 STATES FACING NO_x REGULATIONS



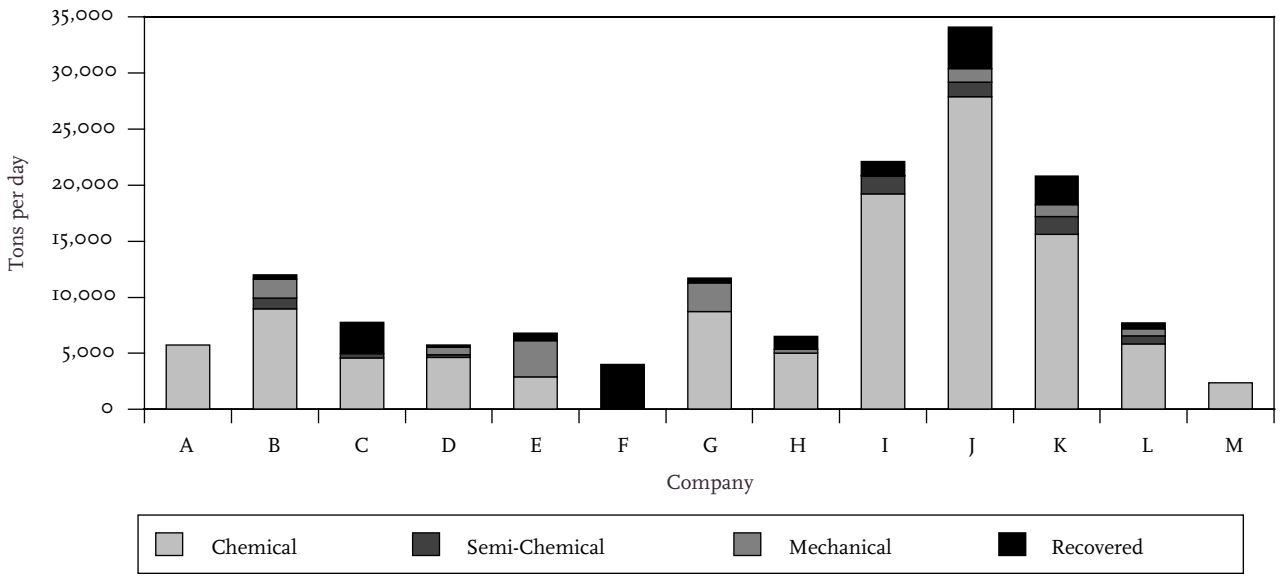
Note: Company M has no capacity in these states.
Source: Dyer, 1997; U.S. EPA, 1998b

FIGURE 4. NO_x EMISSIONS PER TON OF PRODUCT FOR FACILITIES WITHIN THE 22 REGULATED STATES



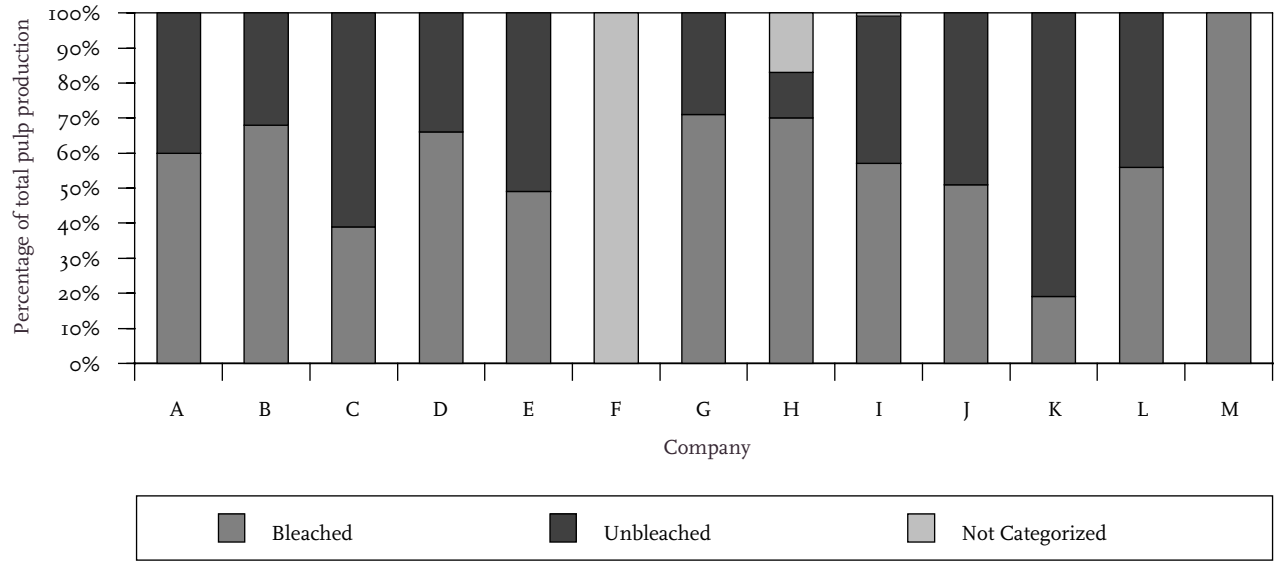
Note: Company M has no capacity in these states.
Source: IRRC, 1996a

FIGURE 5. QUANTITY AND TYPE OF PULPING



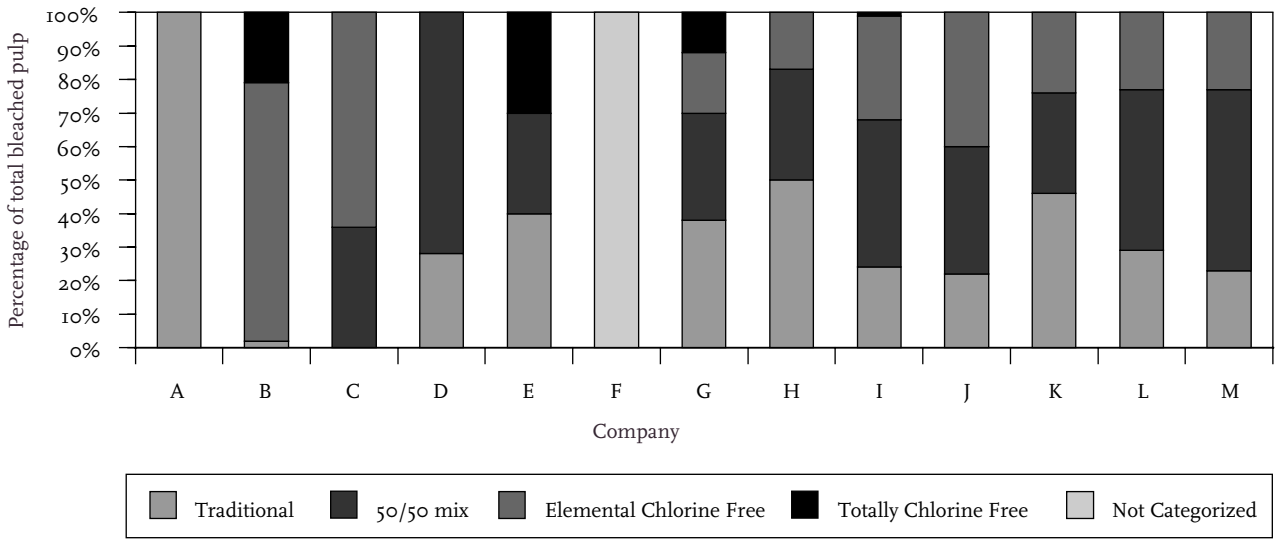
Source: Dyer, 1997

FIGURE 6. COMPOSITION OF PULPING CAPACITY



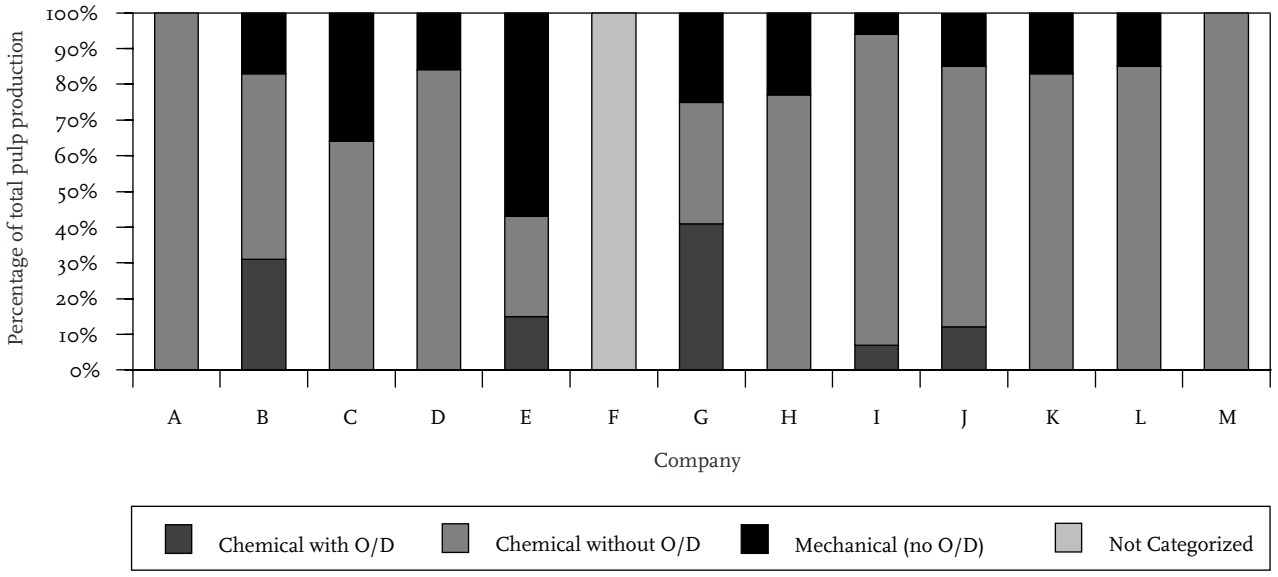
Source: Dyer, 1997

FIGURE 7. MIX OF BLEACHING TECHNOLOGIES



Source: Dyer, 1997

FIGURE 8. USE OF OXYGEN DELIGNIFICATION IN PULP PRODUCTION



Source: Dyer, 1997

readily for the deferred compliance option under the cluster rule with little additional expenditure, a considerable advantage.

Water Quality Improvement on Impaired Waterways

Actions under Section 303(d) of the Clean Water Act may force mills located on impaired waterways to reduce effluents or to contract with farmers and other nonpoint sources for effluent reductions. Some companies are more exposed to state regulatory actions under this provision because more of their mills are located on impaired waterways. For such mills, the required effluent reductions may or may not be proportional to their contribution to the impairment.

Some companies (A,C, E and H) have all or nearly all of their capacity for producing paper and market pulp on impaired waterways subject to remedial actions. (*See Figure 9.*) These companies are likely to face higher future compliance costs. At the other extreme, company M has less than 20 percent of its capacity located on waterways that have been designated as impaired, while L has only 40 percent of its pulping and papermaking capacity in that position. This environmental regulation, like others, will have markedly uneven incidence across firms in the industry.

This conclusion is reinforced by data suggesting that some companies release conventional water pollutants at higher rates than others, as indicated by levels of biochemical oxygen demand (BOD) and total suspended solids (TSS) measured per ton of product. (*See Figure 10.*) Three companies (A, H and J) have most of their mill capacity located on impaired waterways and also release one of these waterborne pollutants at above average rates, relative to production volumes.[7] On the other hand, company F owns few mills on impaired waterways and has effluent rates well below the industry average.

Sediment Remediation

Similar locational factors determine companies' exposure to possible future sediment remediation requirements. The EPA has identified "areas of probable concern" in which releases from contaminated sediments are threatening in-stream water quality. (*See Figure 11.*) Pollution sources within these areas may be required to take action to mitigate this problem. Pulp and paper mills, along with other industrial sources, have released persistent and toxic compounds in effluent waters, including dioxins and heavy metals. However, heavy exposure to this problem is evidently limited. (*See Figure 12.*) Only F and G have more than half of their production capacity in these areas. G produces the majority of its pulp within areas of probable concern and over 60 percent of its pulping capacity uses some elemental chlorine in the bleaching sequences. Other companies have less than 20 percent of their pulping capacity on such waterways, and four have none at all.

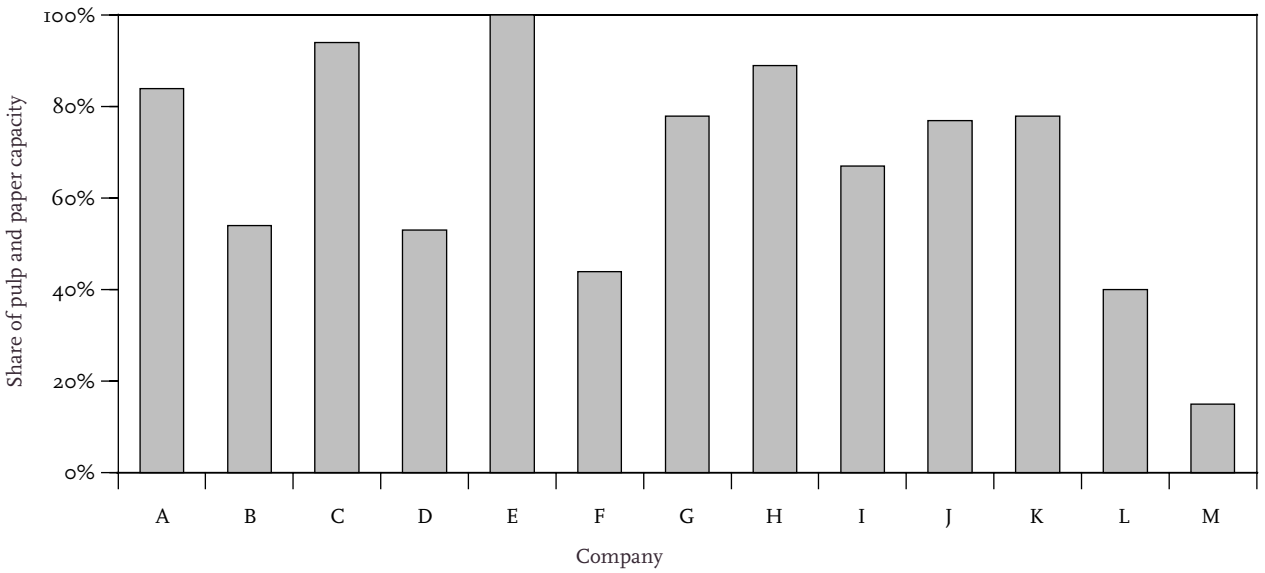
The unevenness with which environmental issues strike across the industry makes them potential sources of competitive advantage and disadvantage.

CUMULATIVE IMPACT OF REGULATORY ISSUES

Apart from the cluster rule, whose main impacts are fairly well known and are likely to have been incorporated into financial analysis and valuations, companies' cumulative exposure to the impending air and water regulations discussed above varies considerably. The regulations concerning water effluents on impaired waterways and atmospheric emissions of nitrogen oxides will have the widest incidence, affecting 60 percent and 54 percent respectively of the plants owned by the companies reviewed here. Of the three regulatory issues mentioned above (NO_x reduction, impaired waterways, and contaminated sediments) one company (M) has more than 80 percent of its plant capacity immune to these regulations, while G has 30 percent of its capacity exposed to all three. Other companies are arrayed in intermediate positions. (*See Figure 13.*)

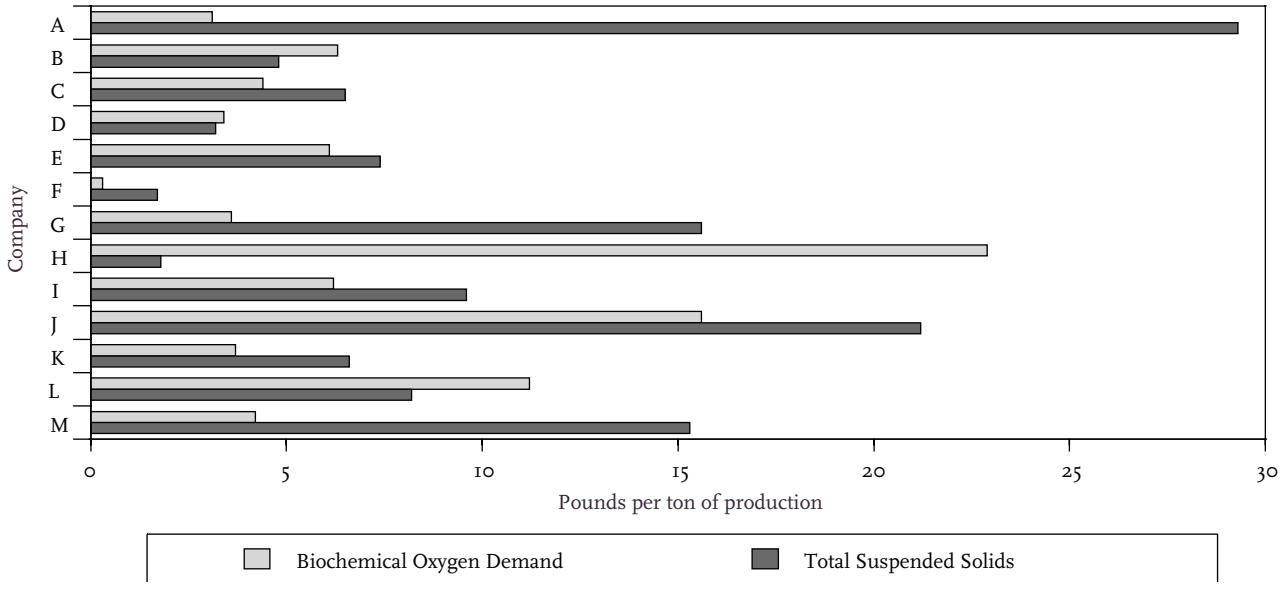
The more of a company's capacity exposed to significant impending regulations that have not yet taken final form, the more environmental risk that company bears. If each regulation may, with certain

FIGURE 9. SHARE OF PULP AND PAPER CAPACITY LOCATED ON 303d WATERWAYS



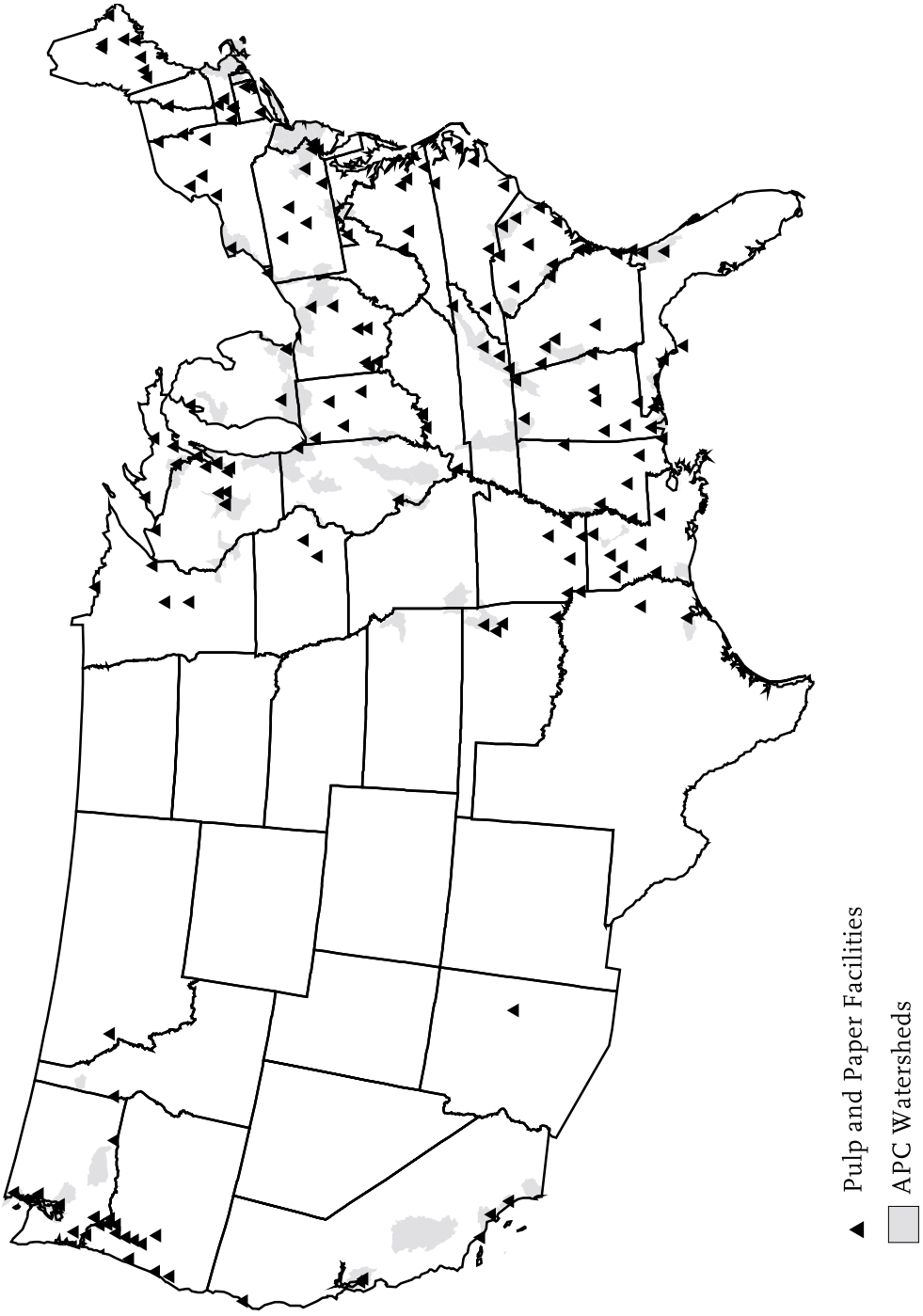
Source: Dyer, 1997; State Submissions, various years

FIGURE 10. DISCHARGE OF CONVENTIONAL WATER POLLUTANTS PER TON OF PRODUCTION



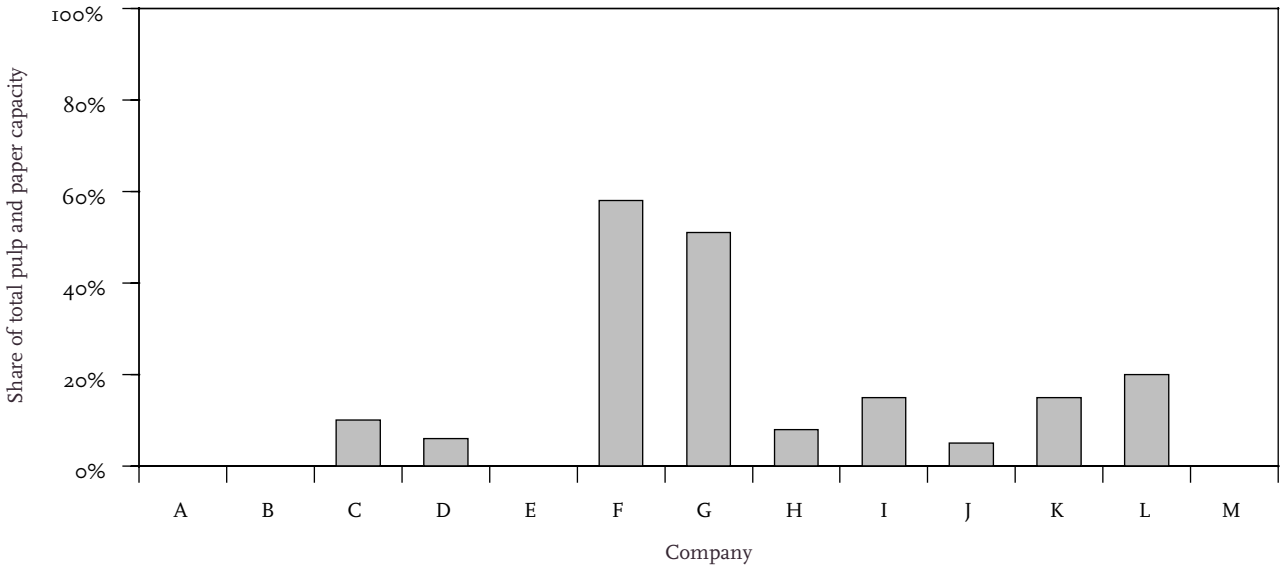
Source: IRRC, 1996B

FIGURE 11. **LOCATION OF PULP AND PAPER MILLS AND "AREAS OF PROBABLE CONCERN" FOR CONTAMINATED SEDIMENTS**



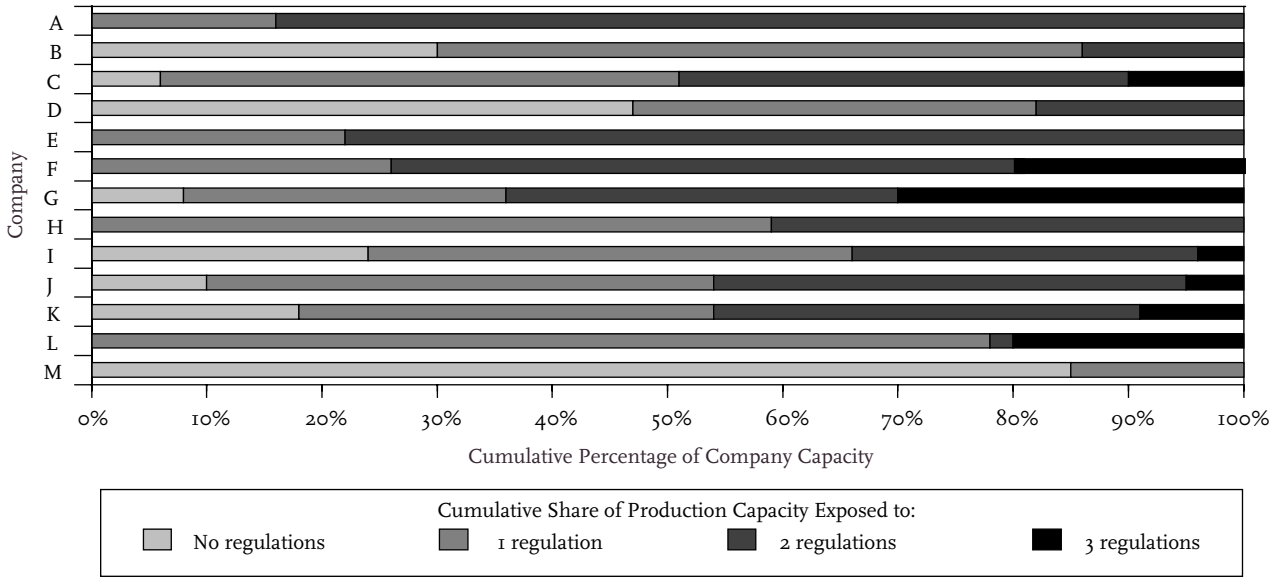
Source: Dyer, 1997; U.S. EPA, 1997

FIGURE 12. SHARE OF PULP AND PAPER CAPACITY LOCATED IN "AREAS OF PROBABLE CONCERN" FOR CONTAMINATED SEDIMENTS



Source: Dyer, 1997; U.S. EPA, 1997

FIGURE 13. EXPOSURE OF COMPANY PRODUCTION CAPACITY TO SELECTED AIR AND WATER REGULATIONS



Source: See text for details

probabilities, be written in forms that imply more or less cost to the company, then the overall variance in earnings at risk to environmental regulation is greater, the larger the fraction of a company's capacity that is subject to those uncertainties. Within the pulp and paper industry, some companies are considerably more exposed to regulatory risk than others; other companies are sheltered from impending environmental regulations to a much greater degree.

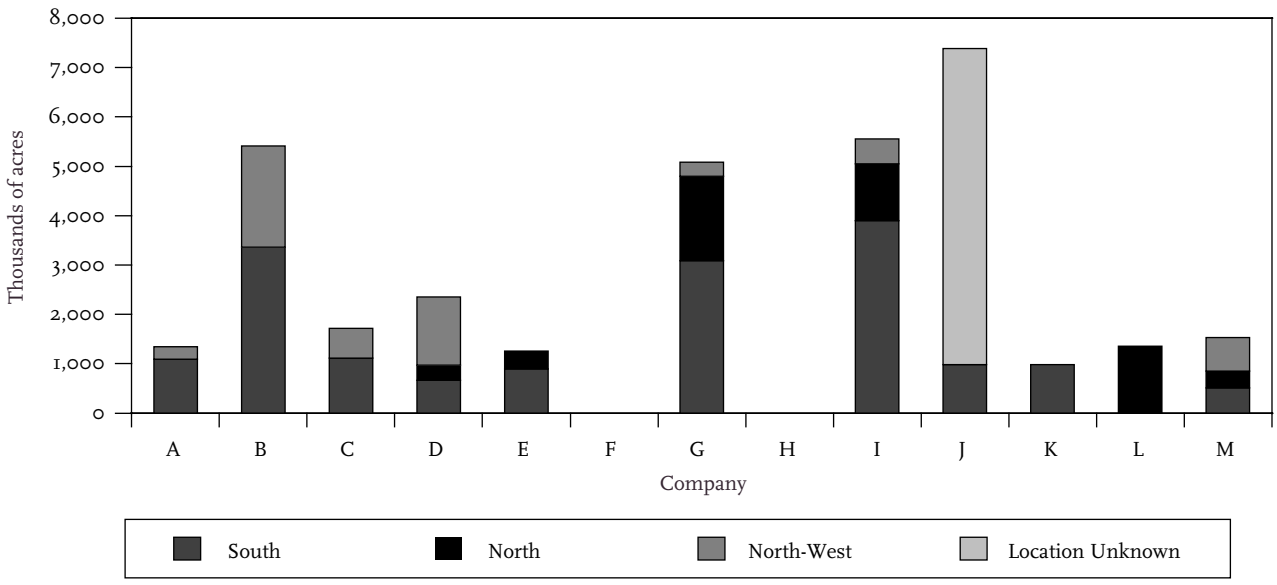
FIBER SUPPLY ISSUES

Fiber supply issues include the possibility of overall fiber scarcity; the likelihood that harvesting on private forest holdings will be affected by state forestry regulations, by actions under the Endangered Species Act, or by carbon sequestration incentives implemented as part of U.S. climate policy; and the likelihood of continued restrictions on fiber availability from national forests. In addition, both supply and demand contingencies may affect the availability and price of recycled fiber.

Companies also differ in their exposure to these issues. Some companies have chosen to be "long" on virgin fiber by owning or taking on long-term leases on relatively large amounts of timberland. Others have gone "short" on virgin fiber, with the capacity to produce much less from their own holdings than they consume annually. These companies purchase pulpwood from private suppliers, purchase market pulp, or rely heavily on recycled fiber. Among the companies that appear to be relatively "long" on virgin fiber, with substantial timberland holdings relative to their production volumes and estimated fiber requirements are B, G, I, and J.[8] (*See Figure 14.*) Several companies are largely self-reliant for fiber on their own timber holdings and may own or lease foreign timberlands as well.

At the other extreme, some companies have insignificant timber holdings, preferring to rely on market pulp and recycled fiber (e.g., F and K). At least one major paper company is in the process of "going short" on fiber by divesting its U.S. timberland holdings and pulp mills in order to concentrate on

FIGURE 14. LOCATION OF COMPANY TIMBERLANDS IN THE UNITED STATES



Note: Company F has no timberland holdings. No data was available on timberland holdings for company H.
Source: Company Annual Reports and SEC filings

its downstream manufacturing and marketing business.

Implicitly, companies have taken positions on future fiber availability. Should real fiber prices rise substantially, those companies that are "long" should be at an advantage; but, should real prices rise more slowly, their investments in timber holdings will bring a relatively low return. Similarly, should climate policy bring significant incentives for carbon sequestration on private timber holdings, companies that are relatively long on timberland will be in a position to benefit, but companies that are short may find this contingency a further restriction on fiber availability.

The regional distribution of fiber supplies also affects companies' exposure to other land use and forestry regulations and restrictions. Private holdings in the South and in the Northern states are more likely to be affected by state forestry regulations. Companies located in the Northwest are more likely to be affected directly or indirectly by decisions on harvesting public forests in the United States and Canada. Here again, companies are positioned quite differently, with differing regional distributions of their timberland holdings. These locational differences alone imply that companies maintain different exposures to fiber supply issues, many of which are locally or regionally specific in nature.

A finer-grained assessment of companies' exposure to the effects of future actions under the Endangered Species Act can be developed by comparing the location of their mills with the habitat and ranges of currently listed species and species proposed for listing. (*See Figures 15a and 15b.*) Since information on the precise location of companies' landholdings is unavailable, the location of their integrated mills has been mapped instead, under the assumption that companies typically draw their fiber from within a reasonable radius around their pulp mills to hold down transportation costs.

The potential impact of new listings under the Endangered Species Act varies widely from company to company. At one extreme, none of company E's mills are within 100 miles of counties that provide habitat for species proposed for listing. At the other extreme, more than 70 percent of mill capacity for Company K falls within a 100-mile radius of counties that provide habitat for species that may be listed.

Of course, not all of this mill capacity will be equally exposed. Exposure will vary depending on the total number of proposed species within the mill's locality—often more than one—and the total area that might be affected by rules to protect proposed species, since some habitats extend further than others. Hence, company exposure can be approximately estimated by calculating the average density per county of proposed species within a 100-mile radius of company mills. (*See Figure 16.*) Companies B, D and M appear to be located in areas where there are multiple proposed species that occupy relatively large amounts of area surrounding its mills. Hence there is a relatively high density of proposed species adjacent to their facilities. Company A, on the other hand, has 60 percent of its capacity within 100 miles of at least one species, but only a small fraction of the overall area adjacent to mills is actually affected and probably not by multiple species.

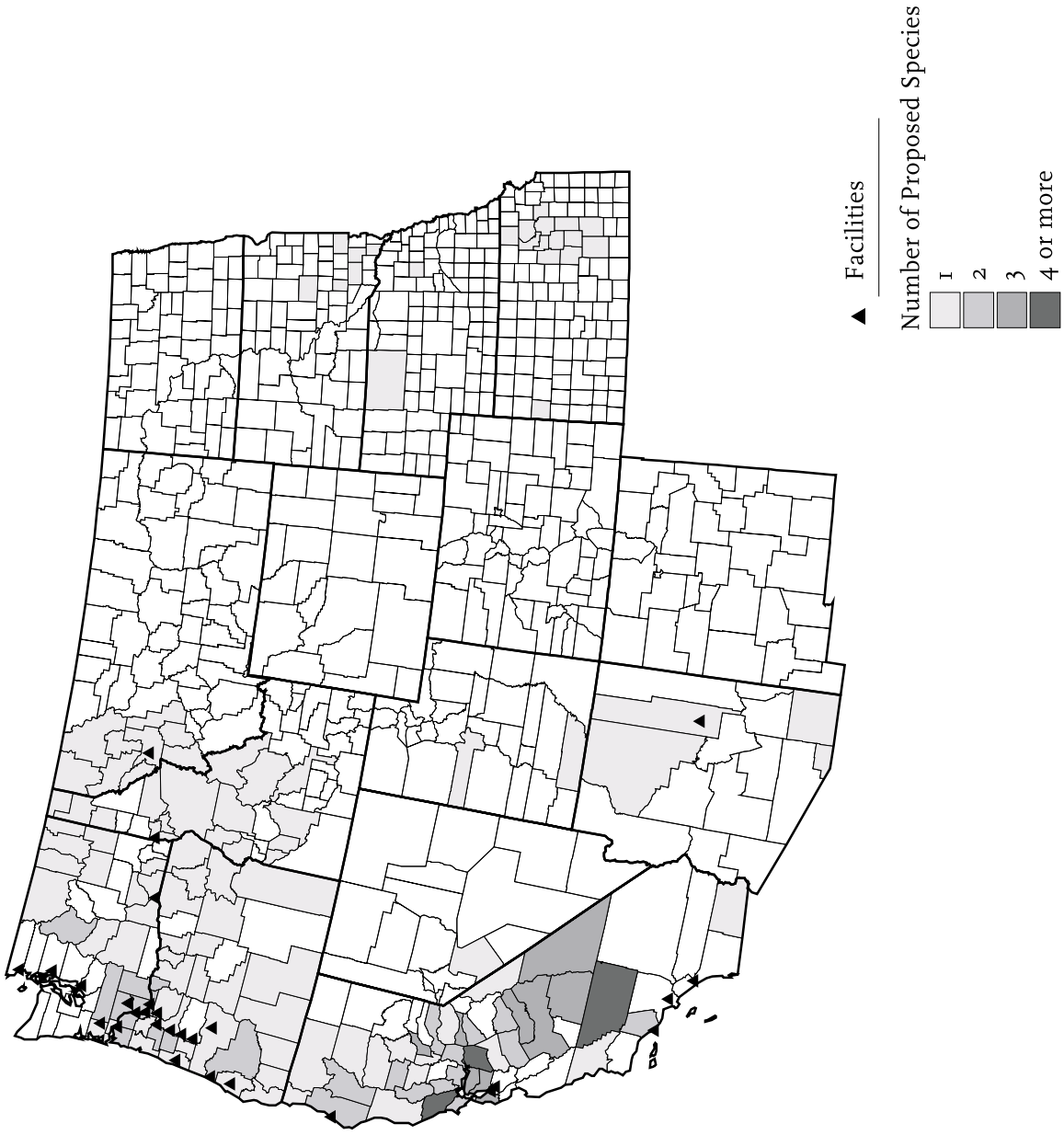
On the assumption that mills typically draw timber from the surrounding area to minimize transportation costs, these figures indicate that potential land use or timber harvesting restrictions under the Endangered Species Act are much greater threats to some companies than to others.

Finally, companies differ in their exposure to the fluctuations of the recycled fiber market. Like other secondary materials markets, recycled fiber prices are relatively volatile. When low, they may provide an attractive alternative to virgin fiber, but when supplies are squeezed and prices jump, companies that rely heavily on this fiber source may find their profits disappearing. One of the companies included in this analysis has based its production predominantly on recycled fiber. Other companies rely to varying degrees on recycled fiber.

SUMMARY

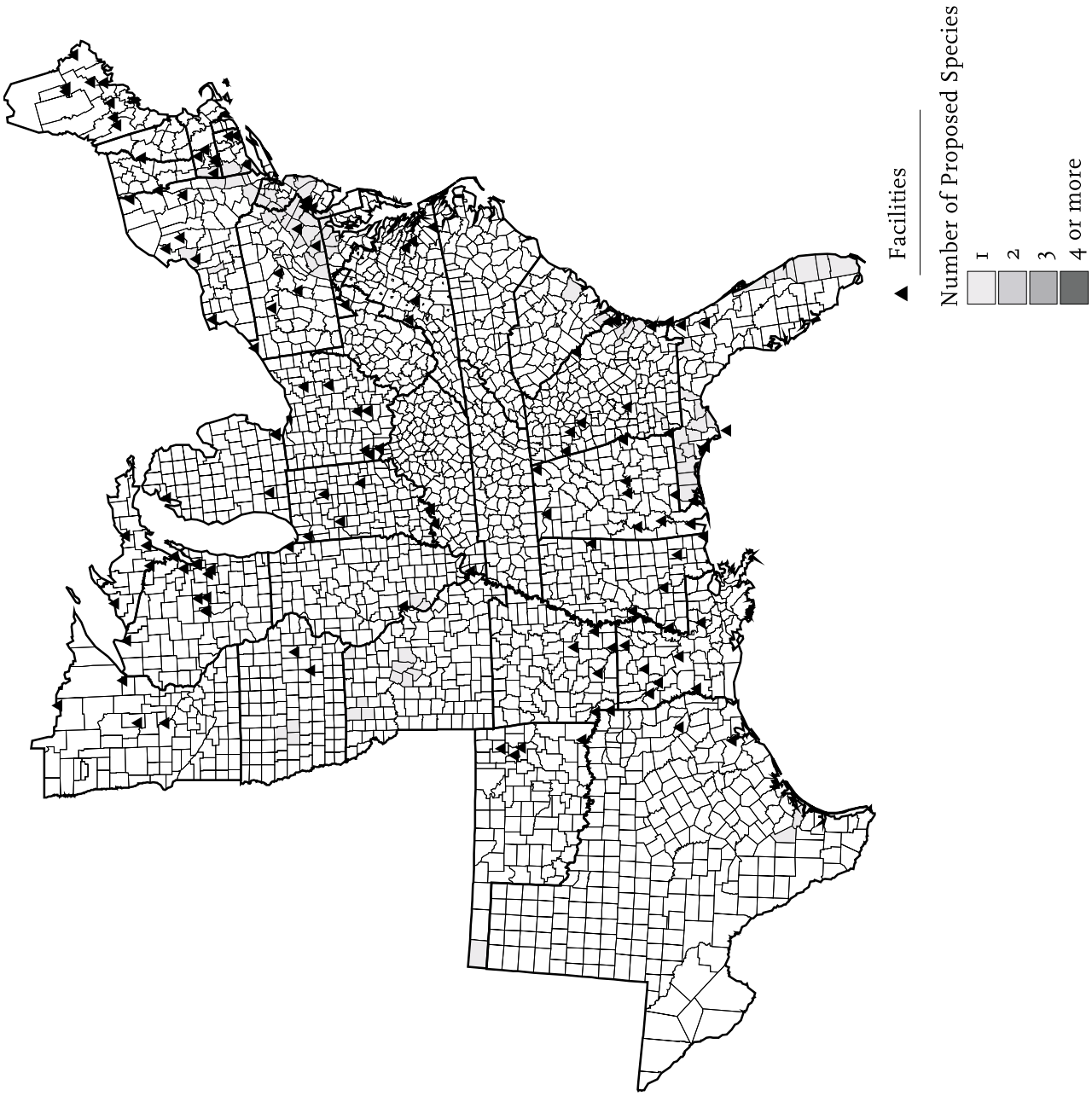
The foregoing comparisons demonstrate that the impending environmental issues identified in the preceding scenarios have the potential to affect companies within the industry quite differently. If the more stringent versions of regulatory

FIGURE 15a. **DISTRIBUTION OF PROPOSED SPECIES AND LOCATION OF MILLS (WESTERN UNITED STATES)**



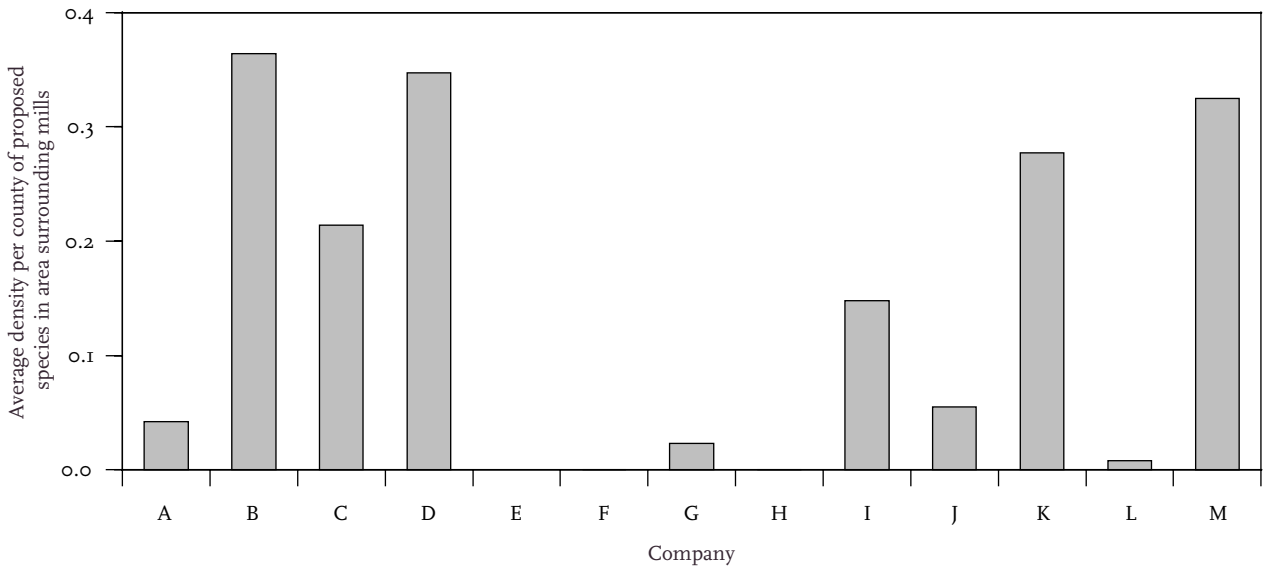
Source: Dyer, 1997; U.S. EPA 1998d

FIGURE 15b. **DISTRIBUTION OF PROPOSED SPECIES AND LOCATION OF MILLS (EASTERN UNITED STATES)**



Source: Dyer, 1997; U.S. EPA 1998d

FIGURE 16. **EXPOSURE OF COMPANY TIMBERLANDS TO POTENTIAL EXTENSION OF THE ENDANGERED SPECIES ACT**



Note: Company F has no timberland holdings. No data was available on timberland holdings for company H.
Source: See text

outcomes are put in place, some firms will face relatively heavy compliance burdens and others, by virtue of lesser exposure, will not. Heavier compliance burdens can mean higher operating costs or higher capital expenditures, or both. These differential exposures to future environmental policy decisions can create competitive advantages and disadvantages, since highly exposed firms may be unable to pass costs along in price increases and may find themselves handicapped in budgeting other important capital expenditures.

The scenario-building exercise demonstrated that considerable uncertainty remains regarding the likely outcomes of impending environmental issues. This means that companies with significant exposures to many of the issues are subject to a relatively large number of potentially significant variances to future earnings. Consequently, they are subject to a greater degree of environmental risk than are companies that have more limited exposures.

4

FINANCIAL ANALYSIS

The preceding two chapters have explained the process of developing scenarios around impending environmental issues and assessing companies' exposures to them. The next step, explained in this chapter, was estimating, issue-by-issue, the financial impacts each company would incur if particular scenarios came to pass. Once the financial implications of all scenarios were assessed, they were combined using probability weights for each scenario. Alternatively, they could be aggregated in accordance with "macro-scenarios" or used individually to analyze specific issues.

To be useful to analysts, the financial implications of environmental issues must be conveyed in such a way that they can be incorporated into conventional valuation frameworks.

THE FINANCIAL FOUNDATIONS

To be useful to analysts, the financial implications of environmental issues must be conveyed in such a way that they can be incorporated into the valuation frameworks currently used to assess conventional business risks and opportunities. Fortunately, the disaggregated approach of mainstream valuation techniques facilitates the integration of environmental and conventional sources of value.

Many of the prominent valuation techniques—including McKinsey's entity discounted cash flow (DCF) model, Stern Stewart's Economic Value Added (EVA) model, and others—equate the value of a company to the sum of the discounted present values of all its separate cost and revenue streams. This property of linear additivity in discounted present values is important for our purposes because it enables us to estimate the incremental impact of specific cost and revenue changes on the company's value without estimating the value of the company as a whole. Since many of the companies in the U.S. pulp and paper industry have significant non-paper businesses and non-U.S. operations, estimating the incremental impact of environmentally related developments is a more compact, feasible, and relevant approach than one that attempts to encompass all of a company's entities, whether in the U.S. paper business or not.

Moreover, these models require that analysts forecast all of a company's value drivers, those that largely determine future revenues, costs, investment and financing streams over the forecast period. Prediction is unavoidable because a firm's value depends on its future earnings and free cash flow. In some industries, including the pulp and paper industry, environmental issues and exposures can be significant value drivers that should be forecast explicitly.

BUILDING FINANCIAL MODELS OF INDIVIDUAL COMPANIES

The companies' financial reports, as reported to the SEC, were the starting point for constructing discounted cash flow models for each firm in our sample. We based our estimates of financial impacts as well as exposures to environmental issues on publicly available data, because publicly available

information is supposedly the basis for valuation and risk assessment in financial markets.

The data in companies' financial reports were supplemented by other publicly available information gleaned from the consulting and trade literature, manufacturing survey and census data, government and academic research studies, EPA databases, and other sources. Such information was needed, among other purposes, to estimate the composition of companies' cost of goods sold for various product categories and to estimate the costs of meeting future environmental requirements.

Baseline forecasts of industry-wide output growth trends and output price trends were taken and adapted from trade sources. Baseline forecasts of fiber and other input price trends were taken from public and trade sources. When appropriate, the impacts of environmental scenarios were estimated as deviations from these baseline forecasts. Given projected output trends, input quantities were forecast using estimates of single-factor and multi-factor productivity in the industry (Repetto et al., 1996).

Several qualifications to the financial projections should be stated, beyond the fact that the information on which they are based becomes increasingly dated as time passes.[9] For most companies, self-reported data on the composition of production costs were scanty and so this composition had to be estimated from available public sources (undoubtedly with margins of error). Moreover, though the industry is highly cyclical, no attempt was made in the baseline projections to predict business cycle fluctuations over the period 1998–2010. Rather, the baseline forecasts represent longer-term trends. Finally, though the industry is in the midst of a significant consolidation and restructuring phase, the baseline projections make no attempt to predict future mergers, acquisitions, divestitures, or consequences thereof.

ESTIMATING FINANCIAL IMPACTS OF ENVIRONMENTAL SCENARIOS

The assessment of each company's exposure to the various environmental scenarios form the building blocks for the analysis of financial impacts. This analysis took into account the locations of each firm's facilities, their product mixes, installed technologies, input and cost structures, and other relevant factors on which information is publicly available. For each company and each scenario, the financial impacts on revenues, production costs, investment spending, and the value of owned assets were estimated individually for all years of the forecast period, then reduced to discounted present values using an estimate of the weighted average cost of capital. These present values were then added to obtain a net financial impact for the scenario and the company in question. The financial impact was then expressed as a percentage of a company's current market valuation.[10]

Environmental issues create winners and losers among companies with different exposures.

It should be noted that estimates of the financial impacts of environmental exposures did not take into account all possible responses that a particular facility might make to achieve a least-cost solution to an environmental problem, such as shutting down the facility or adopting some innovative process or product change. Publicly available information was insufficient to make such detailed predictions. It was assumed that all plants would remain in operation and make the required remediation or abatement expenditures. Similarly, our estimates of abatement and remediation costs represent averages for facilities of particular types. Detailed information on the peculiarities of particular plants that might lead to positive or negative deviations from these average figures was not available.

Even with these qualifications, it was not possible to carry through a financial analysis of all the salient impending environmental issues identified in Chapter 2. Most important, having to omit companies' exposure to climate issues for want of data leads to an underestimation of the potential range of outcomes and, consequently, of the financial risks arising from environmental issues that companies face. That is, omitting from the "worst-case" outcomes a climate scenario in which companies

would have to purchase carbon permits on the market to meet their purchased energy needs, and omitting from the "best-case" outcome a climate scenario in which companies are awarded carbon permits free and could earn additional salable credits by sequestering carbon in tree growth, narrows the range of potential financial outcomes and reduces estimated financial risks.

FINANCIAL IMPACTS OF INDIVIDUAL ENVIRONMENTAL ISSUES

For each of the following regulatory issues, sub-scenarios were constructed. These assumed either that most of the aggregate industry costs of compliance would be passed forward to customers in the form of higher product prices, or that few of these costs would be passed forward. These sub-scenarios made use of estimates of demand price elasticities for paper products. The probability of offsetting price adjustments over the coming years depends in large part on the recovery of world demand for commodities and the absorption of excess capacity created by the Asian and Latin American economic crises. Should that happen, given the absence of excess or even normal profits in much of the U.S. industry, price adjustments to industry-wide cost pressures become more likely.

To reflect this uncertainty, two sub-scenarios were developed allowing different levels of "pass-through" of cost increases. In the first set of sub-scenarios, demand price elasticity is high and few environmental costs can be passed along. In the alternative sub-scenarios, a lower price elasticity allows companies to recover more of their costs by making possible a greater increase in product prices.[11] (The impacts of different demand elasticities are illustrated in the Figures that follow.)

In both sub-scenarios, companies with relatively low compliance costs may experience *increases* in net operating incomes because revenues increase by larger percentages than costs do. Thus, environmental issues create winners and losers among companies with different exposures.

Control of Nitrogen Oxide Emissions

In the exposure analysis reported in Chapter 3, emissions from mills in the 22-state region subject to regulatory control were estimated and converted into emissions rates per ton of product. Required emissions reductions were estimated from the proposed rule. Estimates of the costs per ton of reducing nitrogen oxide emissions were estimated from detailed databases of the various NO_x emissions sources and their average per-ton control costs in representative mills. In the absence of trading, virtually all emissions points in a representative mill would have to be controlled in order to achieve the required 75 percent reduction in summertime emissions. Consequently, the average control cost of achieving the emissions reduction is estimated to be relatively high in the absence of trading, approximately $4,000 per ton of NO_x reduction. (The option of reducing emissions by taking extensive downtime at the plant was not taken into consideration, but this would be a very expensive option in a highly capital-intensive and profitable facility.)

In the trading scenario, the estimated permit price was derived from a region-wide economic study of the prospects of permit trading among utilities and major industrial facilities. Though this study forecasts that the permit price will also be high, in the vicinity of $4,000 per ton of NO_x, trading would still greatly reduce the compliance costs of typical pulp and paper mills. With the possibility of trading, mills could implement only their relatively low-cost internal control options, forgoing their more expensive options, and then could achieve full compliance by buying additional NO_x emissions permits on the trading market. Trading would then lower the average compliance cost of a representative mill to the vicinity of $2,300 per ton of NO_x reduction. This lower cost was also used to reflect a more modest emission requirement that may result from challenges being made to the rule.

These estimates, combined with the results of the exposure assessment, lead to widely differing financial impacts among firms in all scenarios. In some cases, firms whose facilities are mostly or entirely located outside the 22-state region end up as net gainers from the rule, benefiting from industry-wide price increases but incurring minimal control costs. (*See Figure 17.*)

FIGURE 17. **FINANCIAL IMPACT OF ALTERNATIVE NO_x REGULATORY SCENARIOS**

Figure A: NO_x Regulations (Scenario A)

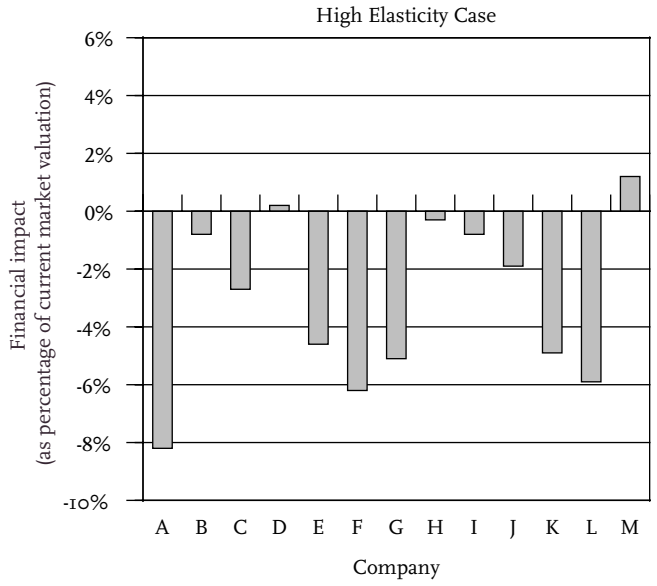


Figure B: NO_x Regulations (Scenario B)

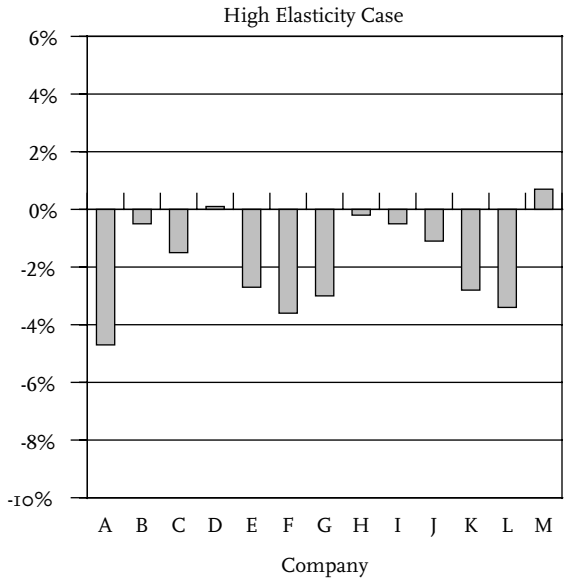


Figure C: NO_x Regulations (Scenario A)

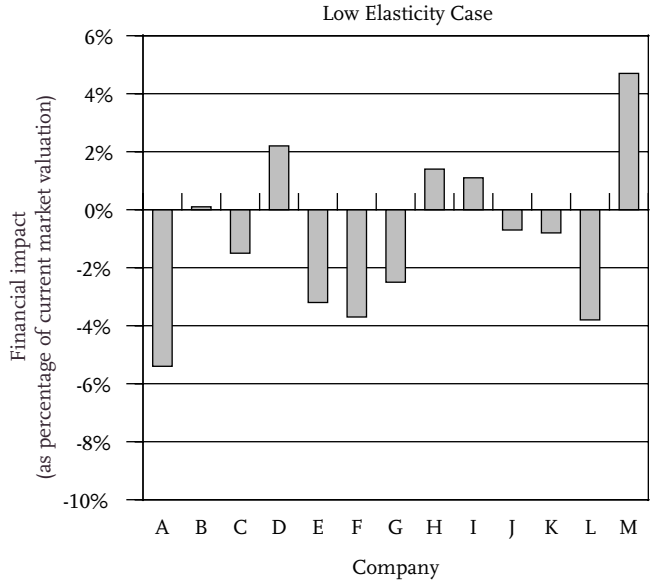
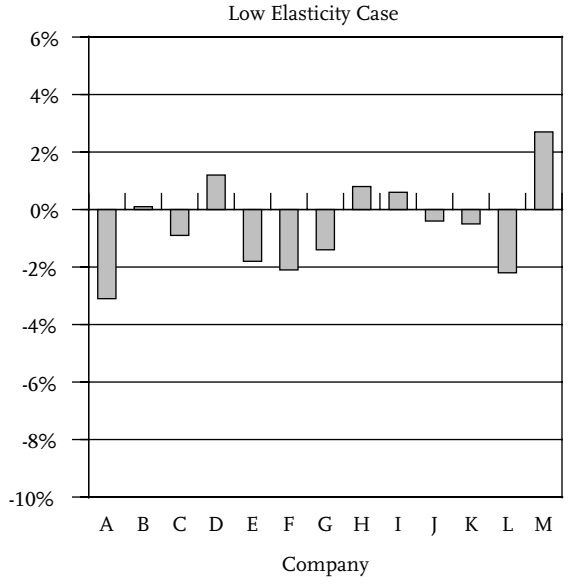


Figure D: NO_x Regulations (Scenario B)



Imposition of Total Maximum Daily Loads on Impaired Waterways
As indicated in Chapter 3, Geographic Information Systems analyses were used to locate individual mills on or off waterways designated as impaired in the latest available state inventories. Effluent rates for conventional pollutants were calculated from EPA databases and converted to rates per ton of product. The required effluent reductions for mills located on impaired waterways were assumed to be at least 50 percent, for purposes of constructing trading scenarios.

The average per-ton compliance costs for non-trading scenarios were estimated from the costs of upgrading effluent treatment plants from secondary to tertiary status, which would also reduce releases of trace non-conventional pollutants. Cost estimates took into account parameters of scale, flow rate through the treatment plant, etc., and include both incremental capital and operating costs.

By contrast, average per-ton compliance costs for trading scenarios were estimated from an ongoing WRI economic study of waterways in the Upper Midwest in which effluent trading systems between point sources, such as pulp and paper mills, and nonpoint sources, such as agricultural operations, are being designed (Faeth, in press). Nonpoint sources have heretofore not faced regulatory abatement requirements and can reduce effluents at much lower incremental costs per ton than industrial sources can. Mills were assumed to purchase permits from nonpoint sources, much the cheaper compliance option. The resulting arrays of financial impacts for trading and non-trading scenarios, are illustrated below. (*See Figure 18*.)

Sediment Remediation
In the exposure assessment, mills located on water bodies designated by EPA as "Areas of Probable Concern" were identified using a GIS analysis of EPA data and maps. A public EPA database on the costs of completed remediation projects formed the basis for the estimates of mill remediation costs (U.S. EPA, 1998e). The data on approximately three dozen completed projects were arrayed from least expensive to most expensive and the 25th, 50th, and 75th percentiles of costs per completed project were identified.

For the low-cost scenario, it was estimated that firms would incur remediation costs on each contaminated site at an average project cost equal to the 25th percentile of completed project costs in the historical record. This figure could be interpreted in one of several ways: that a mill located on an APC would bear half the total costs of the average project or have a 50 percent chance of being assessed the average project cost or that, on average, its project completion costs would be half the average. For the high-cost scenario, it was estimated that firms would incur remediation costs on each contaminated site at an average project cost equal to the 75th percentile of completed project costs. The 25th and 75th percentile of project costs amount to $1.35 million and $16 million per project, respectively. These costs were then weighted by production capacity to account for differences in the size of facilities. Under these assumptions, exposures to the possibility of sediment remediation liabilities varies among paper companies mainly in accordance with the percentage of their mills located in areas of possible concern. (*See Figure 19*.)

Cluster Rule Compliance Options
It is assumed that following promulgation of the final cluster rule, for which most companies have disclosed their estimated compliance costs, financial markets have already assimilated the costs and financial impacts of meeting the basic and advanced technology standards the rules embody. Similarly, it is assumed that financial markets are aware of which mills already have installed technologies that qualify for delayed compliance under the advanced technology option. Consequently, in analyzing the possibilities for savings under the advanced technology standard, we focussed on facilities that do not currently have advanced technology in place but might find it advantageous to adopt it.

Mills were categorized into types used in a study providing estimates of capital and operating costs for each mill type to achieve Best Available Technology standards for water effluent control (Option A) and advanced technology for which delayed compliance and other compliance incentives are offered in the rule (Option B) (Eastern Research Group, 1996). Some mills already qualify for Option B by virtue of technology already installed. For the remainder, the discounted present value of capital

FIGURE 18. **FINANCIAL IMPACT OF ALTERNATIVE 303d REGULATORY SCENARIOS**

Figure A: 303d Regulations (Scenario A)

High Elasticity Case

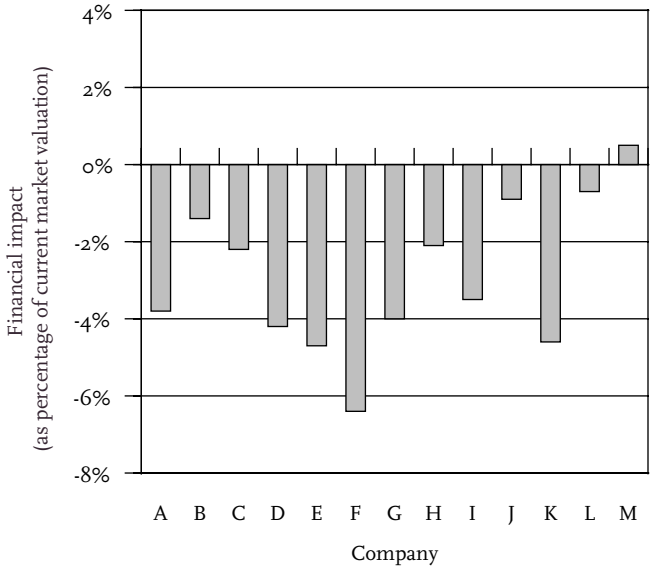


Figure B: 303d Regulations (Scenario B)

High Elasticity Case

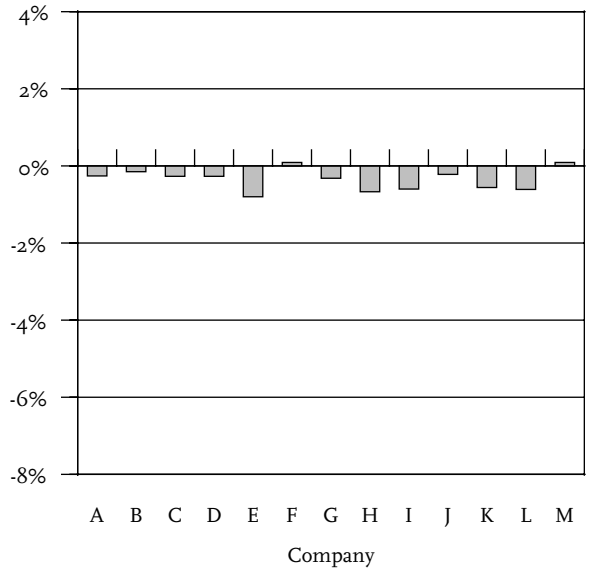


Figure C: 303d Regulations (Scenario A)

Low Elasticity Case

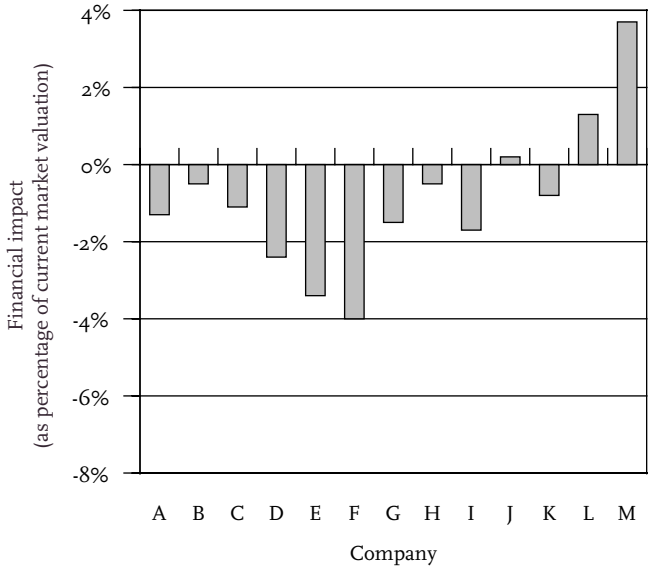


Figure D: 303d Regulations (Scenario B)

Low Elasticity Case

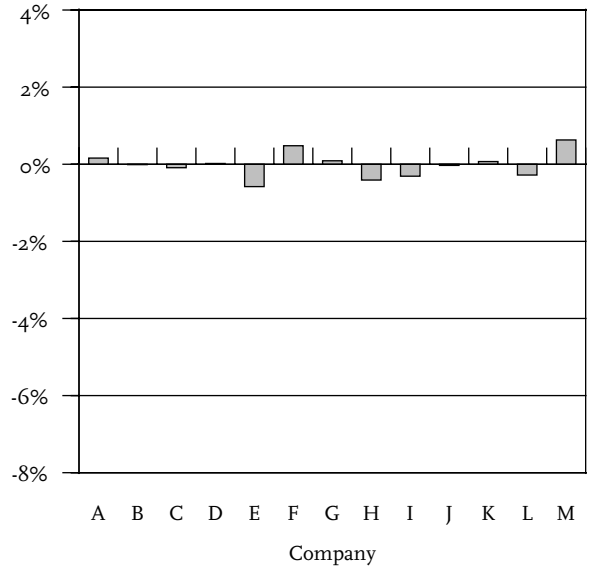


FIGURE 19. **FINANCIAL IMPACT OF ALTERNATIVE CONTAMINATED SEDIMENT REGULATORY SCENARIOS**

Figure A: Contaminated Sediments (Scenario A)

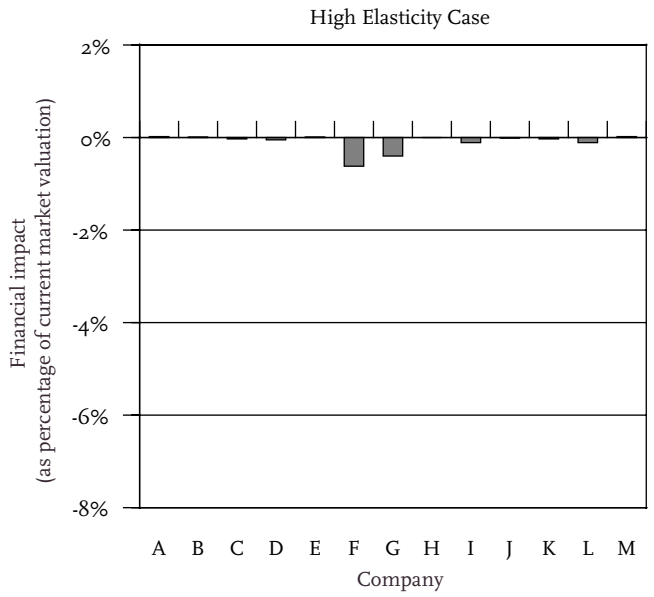


Figure B: Contaminated Sediments (Scenario B)

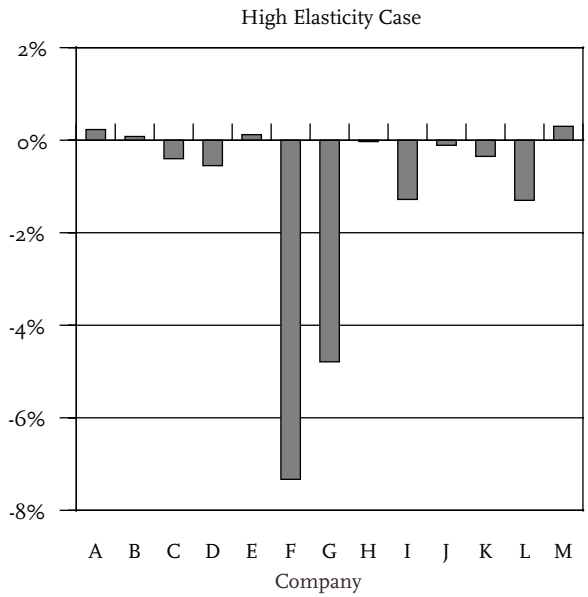


Figure C: Contaminated Sediments (Scenario A)

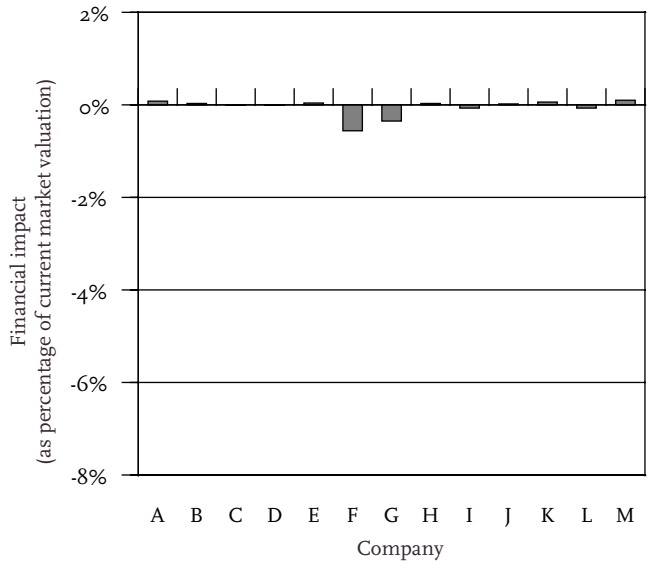
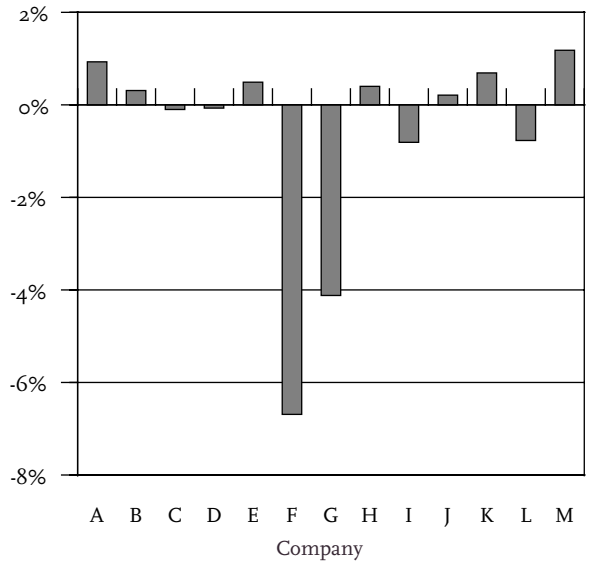


Figure D: Contaminated Sediments (Scenario B)



and operating costs of installing Option A and Option B were compared, taking into account the fact that expenditures associated with Option B could be deferred to take advantage of the longer compliance period.

Then, mills were classified into three new categories: (1) those in which Option A would be least expensive; (2) those in which it would be cheapest to install Option B immediately to gain operating cost advantages; and (3) those in which it would be cheapest to install Option B eventually, taking advantage of delayed compliance.

The savings from cluster rule compliance options were then estimated for mills in categories (2) and (3) as the difference in discounted present value costs between the preferred option and Option A. This is consistent with the assumption that financial markets have already assimilated the basic costs of the cluster rule but not the less obvious potential savings from the advanced compliance options. Potential savings were aggregated by company across their mills of various types. (*See Figure 20.*)

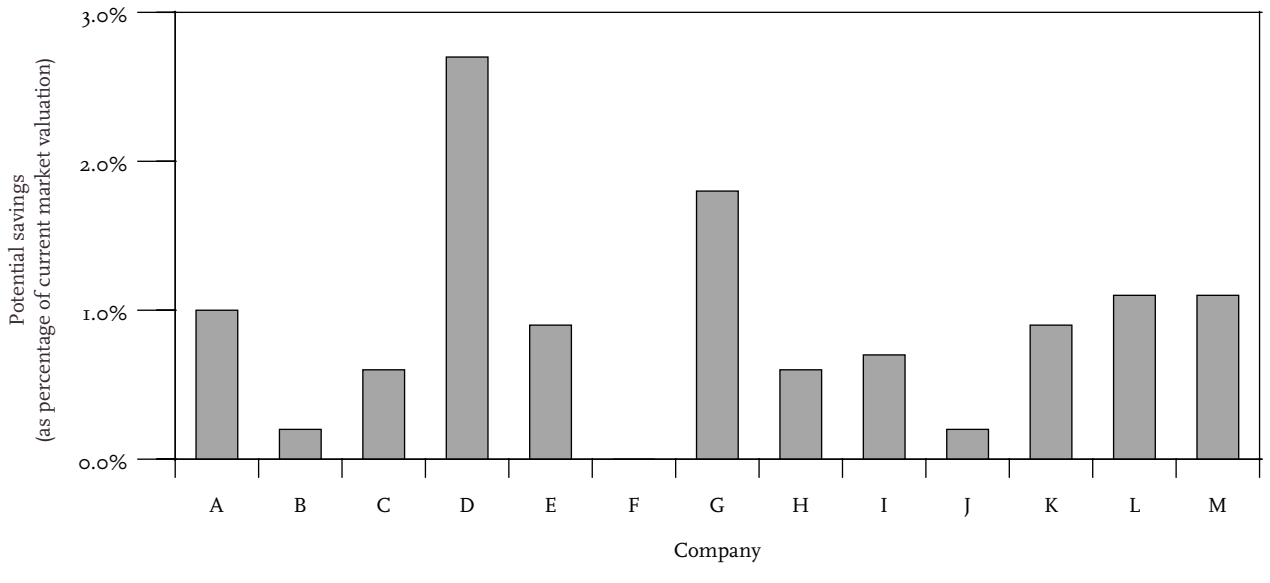
Timberland Regulations

Each company's timberland holdings were estimated from annual reports, trade journals, and other sources. To the extent possible, these holdings were broken down regionally into acreages in the Northwest, the North Central, the Northeast, and the Southeast. The estimated change in harvestable timber in each region due to heightened land use and silvicultural regulation was derived from a U.S. Forest Service study (Greene and Siegel, 1994). It was assumed that these changes applied equally to all timber holdings within a region.

The same Forest Service study estimated the changes in fiber prices that would result from these supply restrictions. The percentage increases implied by this study were applied to our baseline fiber-price projections. Companies' purchased-fiber costs were consequently adjusted upward correspondingly in scenarios reflecting tighter future regulations.

This procedure then required adjustments to companies' reported timberland asset values

FIGURE 20. **POTENTIAL SAVINGS FROM ADVANCED COMPLIANCE OPTIONS UNDER THE CLUSTER RULE**



Note: Insufficient data prevented analysis of possible savings for Company F.

because harvesting restrictions would reduce the amount of harvestable timber but higher fiber and wood prices would raise the stumpage value of the remaining timber that could be harvested. The former effect, the reduction in harvestable timber, was estimated region-by-region. Remaining timberland asset values were then adjusted once again to reflect higher stumpage values, using a formula relating harvest price trends to stumpage values. The net effect of these two offsetting asset value adjustments was small for most companies. Companies vary in their exposure to potential future regulations on forestlands and practices mainly to the extent that they are "long" or "short" on timber. Companies that purchase most of their fiber input are more exposed to future price increases; those that have extensive timber holdings are more exposed to changes in timber asset values.

Future Actions under the Endangered Species Act

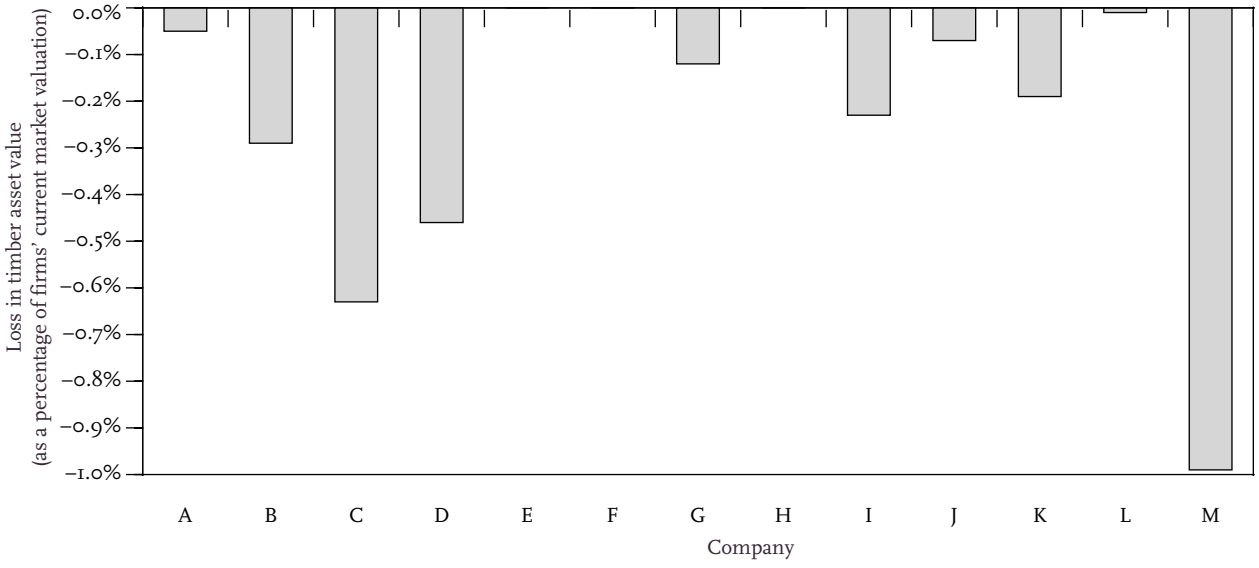
Exposure to possible new listings under the Endangered Species Act was based on the number of proposed species located within 100 miles of company mills, and the relative area occupied by those species. An index was created for each plant showing the average density of proposed species within a 100-mile radius. An index for each company was calculated by taking the average index for each of its mills, weighted by capacity.

In the absence of reliable estimates on the impact of new species on timber management and harvesting, it was assumed that the company most exposed to new listings would face harvesting restrictions or increased management costs sufficient to reduce reported timber asset value by 5 percent. The timber asset value of other companies was scaled back by an amount proportional to their own exposure. The losses in asset value were then expressed as a percentage of each company's current market value. This procedure generated conservative estimates of cost impact that did not exceed 1 percent of a company's current market valuation. (*See Figure 21.*)

Recycled Fiber Prices

Finally, the impact of alternative projections for recovered fiber prices was evaluated by adjusting

FIGURE 21. **POTENTIAL FINANCIAL IMPACT OF NEW LISTINGS UNDER THE ENDANGERED SPECIES ACT**



Note: No data was available on timberland holdings for Company H.

the purchase price facing companies, in line with the scenarios developed earlier. Changes in the forecast price of recovered fiber affect companies differentially, depending on the degree to which they make use of recovered fiber as an input. Companies whose production is predominantly based on recovered fiber have their future earnings significantly exposed to any price increases.

DERIVING OVERALL FINANCIAL RESULTS

One way in which these findings for individual issues could be combined is through macro-scenarios, as explained in Chapter 2. One might ask, "What if a new federal election led to heightened environmentalism across the board?" for example. One would then choose among the individual issue scenarios in accordance with this overall perspective.

Another, perhaps more interesting, way is to combine the individual scenarios in an overall risk assessment. When industry and environmental experts participated in scenario development, they were asked to use their best judgments to assign probabilities to the occurrence of each scenario. We combined these judgmental probabilities into overall consensus probabilities. (*See Table 3.*) Those consensus probabilities for individual scenarios were then used to construct a likelihood distribution across all scenarios. For example, using probabilities for individual scenarios, the joint probability of all the worst-case, most costly, outcomes coming to pass was computed. Then, the joint probability of all the best-case (from the companies' perspective), least-costly outcomes coming to pass was computed. Finally, all the intermediate cases—representing the many different combinations of possible outcomes of the individual scenario elements—were filled in.[12]

Though this procedure seems subjective, it is actually necessary because most of the scenarios pertain to unique future events about which no historical record exists from which one could compile a frequency distribution of past occurrences. One cannot assess the probability that a state government will institute a point/nonpoint source permit trading system for water quality control by counting the percentage of times that it or other states have done so in the past because it is a new policy innovation. Estimated probabilities can readily be updated, however, in the light of more recent information.

When such probability distributions were constructed for each company from the information in the preceding sections of this report, substantial differences among companies became evident, as can be seen from a comparison of companies C and K. (*See Figure 22.*) Even though the underlying scenario and probability assumptions are the same for both companies, the probability distributions differ substantially with respect to the range of likely outcomes (variance) and with respect to the most likely outcome (mean). Distributions also vary in their degree of imbalance toward negative or positive outcomes (skewness). These differences are entirely due to differences in their exposures to the underlying environmental issues.

Such differences are clearer still when summary statistics for all the companies in the study are arrayed together, as shown in Figure 23. The most likely outcome for each company is represented by a dot, indicating the expected impact on its share value of impending environmental issues. A few companies can reasonably expect an insignificantly small positive or negative effect—less than 3 percent one way or the other. At the other extreme, three companies could, at this point, expect a negative impact of greater than 10 percent of their total market value. The others face a most likely impact of between 4 and 8 percent of shareholder value.

The range of potential outcomes also varies greatly from one company to another. The variance of impacts, as a measure of financial risk arising from exposure to these environmental issues, is less than 1 percent of share value for three companies in the group.[13] At the other extreme, it is greater than 9 percent of share value for two other companies. The former group is effectively hedged against environmental risk, in the sense that its future earnings will not be highly sensitive to the outcome of the issues it faces. The latter companies are greatly at risk: their earnings will depend heavily on the way these issues develop.

FIGURE 22. **PROBABILITY DISTRIBUTIONS OF FINANCIAL EXPOSURE TO ENVIRONMENTAL ISSUES FOR 2 COMPANIES**

Figure A: Company C

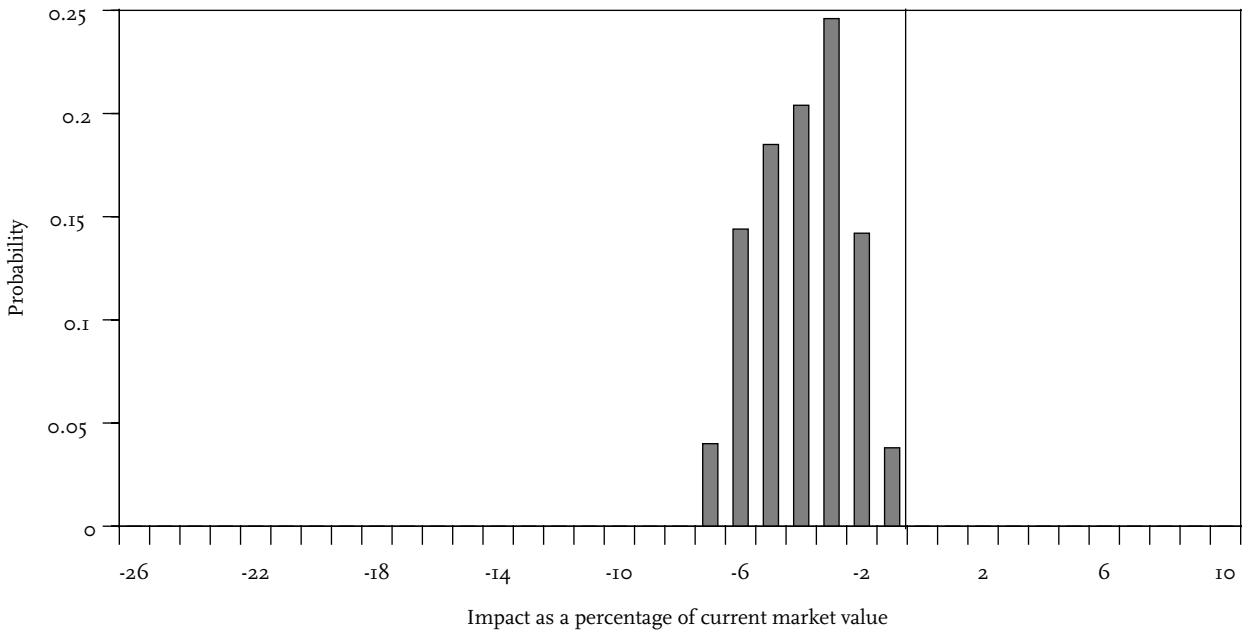


Figure B: Company K

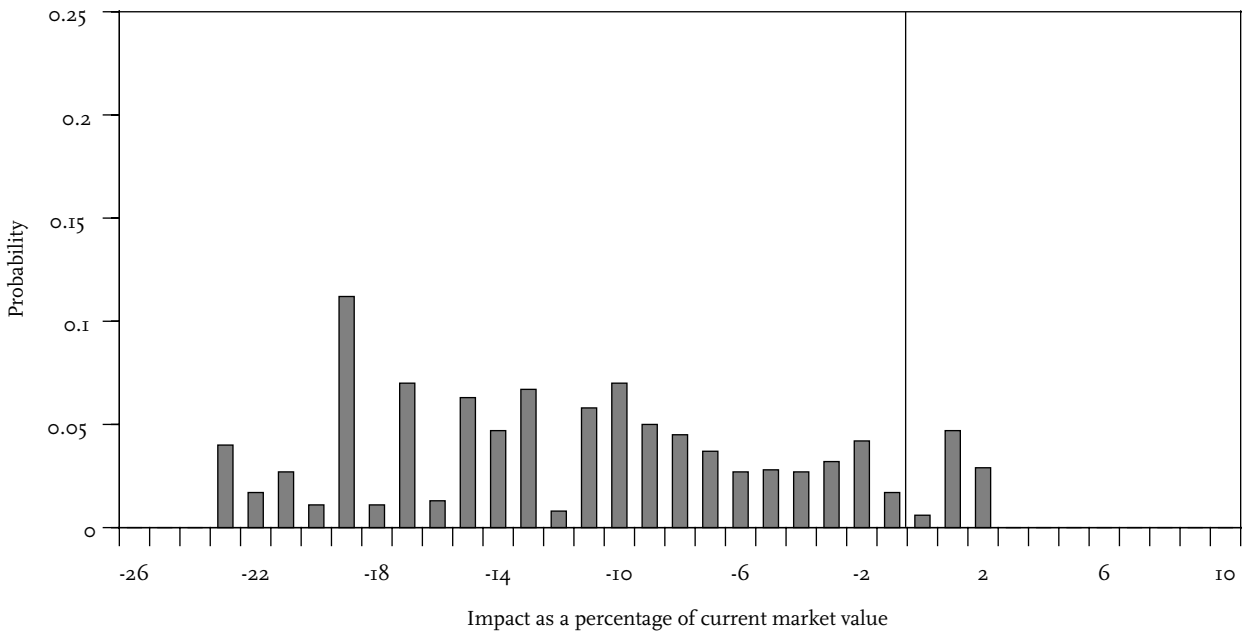
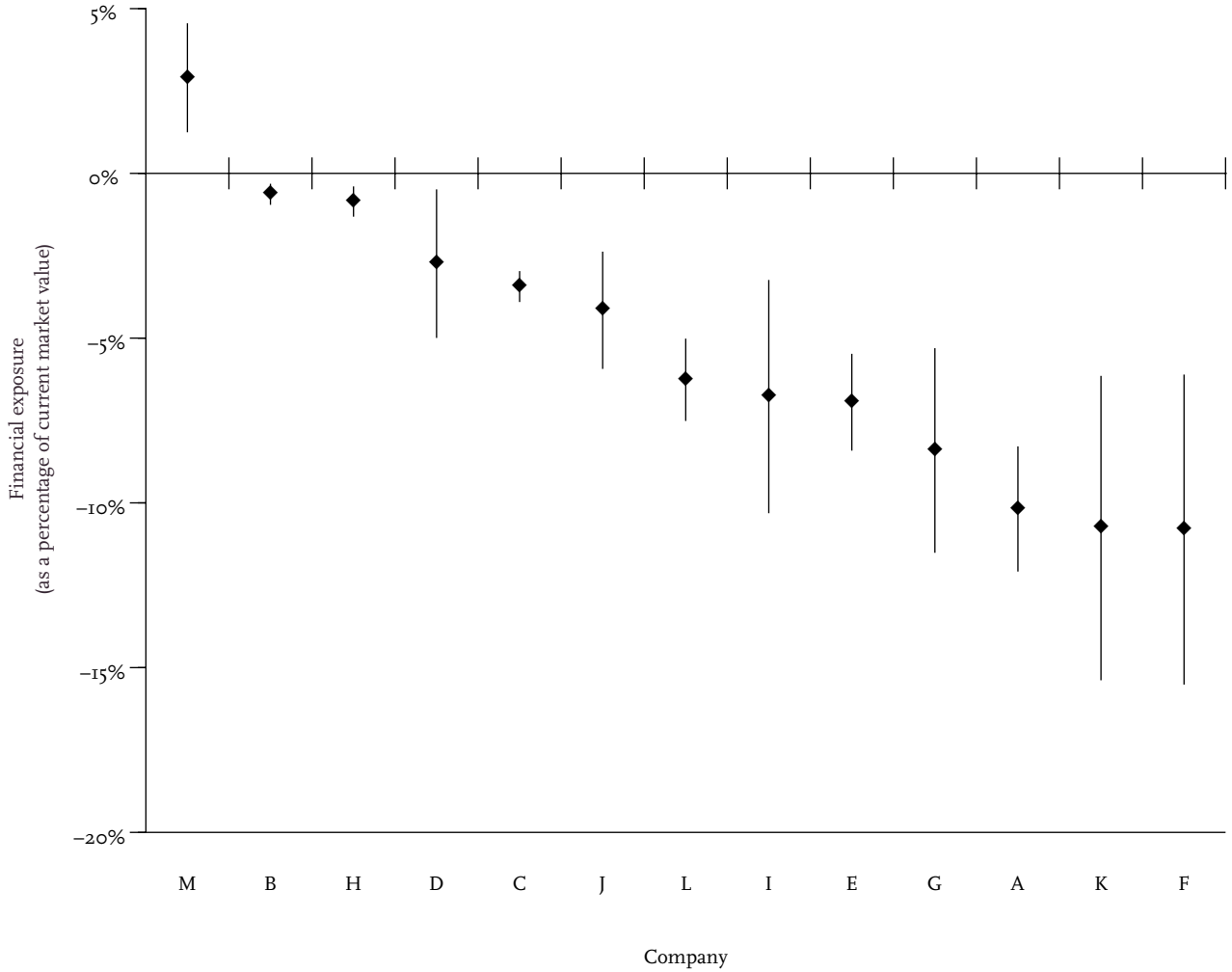


FIGURE 23. **COMPANIES' AGGREGATE FINANCIAL EXPOSURE TO PENDING ENVIRONMENTAL ISSUES**



ARE THESE EXPOSURES ALREADY INCORPORATED INTO MARKET VALUATIONS?

The question immediately arises whether these differences are already factored into the market valuations of individual companies. There is no way to answer that question definitively, since one cannot fully explain the differences among companies' market valuations. However, here are some potential clues.

Obtaining the data on which analysis was built involved a great deal of digging in obscure, though public, data sources. In conversations with analysts, research firms providing environmental information to analysts, and with company representatives, we did not find that comparable studies on these environmental issues had been carried out by others. Therefore, we believe it unlikely that findings like these have previously been conveyed to investors.

The future environmental expenditures and contingencies reported by companies in their financial statements bear little relation to the magnitudes and exposures estimated in this report. Companies differ in their reporting practices. Most do not report financial impacts that are still considered to be uncertain, as are all the scenarios underlying this analysis. A typical statement, (extracted from the annual financial report of one of the most exposed companies), would be that "...it is difficult to predict with certainty the amount of capital expenditures that will ultimately be required to comply with future standards." End of statement. Such companies only report on capital costs to be incurred to comply with environmental standards and regulations that have already been issued in final form and on remediation costs for which the company has already been implicated through EPA action. Even fewer report potential changes in operating costs or input prices that might arise from environmental pressures.

A few companies discuss a potentially important impending environmental issue such as the Endangered Species Act in general terms without providing any quantitative estimates, or conclude that the issue is not expected to affect the company's operations significantly in the coming year but might do so in the future. In our group of 13 companies, only three mentioned in their most recent annual financial report *any* of the environmental issues analyzed in this study, even though all the companies participated in identifying those issues as among those with the greatest potential financial impacts. All three companies offered only qualitative discussion.

Several companies offered statements in their annual financial reports to the effect that "In the opinion of...management, environmental protection requirements are not likely to adversely affect the company's competitive industry position since other domestic companies are subject to similar requirements"; or that "[Company X] does not anticipate that compliance with [environmental] statutes and regulations will have a material adverse affect on its competitive position since its competitors are subject to the same statutes and regulations to a relatively similar degree." The results in this and the preceding chapter demonstrate that such statements are erroneous and potentially misleading. The same environmental standards are likely to have quite different impacts, individually and collectively, across companies in the industry. Ironically, companies making such statements tended to be among the most exposed within the sector.

Finally, there are companies in the group that differ substantially in their environmental exposures and risks but that have quite similar valuations, as indicated by price-earnings and price-to-book ratios. Though this proves nothing, when taken together with the indications discussed above, it suggests that perhaps markets may not have fully assimilated companies' environmental risks. (*See Table 4.*)

TABLE 4. MEASURES OF COMPANY EXPOSURE TO ENVIRONMENTAL RISKS AND PRICE-EARNINGS RATIOS

Company	Expected Value (percentage of current market value)	Variance (percentage of current market value)	P-E ratios
A	-10.2%	3.6%	17
B	-0.6%	0.5%	37
C	-3.4%	0.8%	47
D	-2.7%	4.4%	14
E	-6.9%	2.8%	–
F	-10.8%	9.3%	11
G	-8.4%	6.1%	53
H	-0.9%	0.8%	14
I	-6.8%	6.9%	60
J	-4.2%	3.4%	84
K	-10.8%	9.1%	–
L	-6.3%	2.4%	27
M	2.9%	3.2%	27

5

APPLICATIONS AND POLICY RECOMMENDATIONS

APPLICATIONS FOR INVESTMENT PROFESSIONALS

How might investment professionals use these results or use this approach in their work? Although environmental risks are only one of many considerations to be taken into account when investing in a company, financial analysts might use results from this approach as an additional factor in evaluating the potential returns and risks from an investment in a company's securities. Other things equal, an analyst would prefer to recommend a company facing lower financial risks and better expected outcomes from its environmental exposures. Similarly, analysts involved in credit ratings might take into consideration the potential outcomes from such environmental exposures on a company's earnings, cash flow, and balance sheets while forming an overall judgment of a company's financial risks.

Other things equal, an analyst would prefer to recommend a company facing lower financial risks and better expected outcomes from its environmental exposures.

Investment bankers might incorporate this approach with greater specificity and detail in due diligence investigations of a potential acquisition, merger, or securities issue. Taking into account environmental exposures is now commonplace for potential Superfund liabilities, but perhaps not as widespread for the broader range of environmental risks a company or facility faces.

Managers of screened portfolios might use this approach to determine which companies in a sector face the potentially most serious environmental problems. If a sector is included in a portfolio for diversification purposes and only one or two companies are selected, then a screen that combines environmental performance and exposure with their financial implications might be useful.

APPLICATIONS FOR ENVIRONMENTAL MANAGERS AND CFOs

Environmental managers might use an approach like this to quantify their environmental exposures and risks or to benchmark their companies (or facilities) against rivals. This approach might be useful because it integrates three major elements of environmental risk: exposure, likelihood, and financial impact. Correspondingly, environmental managers might use this approach to help identify which investments in environmental control would do most to reduce their outstanding environmental risks. These applications might help them in moving beyond a compliance-based system toward a more forward-looking and strategic approach.

Managers and CFOs might use a self-insurance model to estimate how much it would be worth annually to spend on control measures as a self-insurance quasi-premium in order to eliminate the likelihood of a loss due to environmental factors greater than a certain percentage of share value. Many companies purchase insurance against various business risks as part of overall risk management strategies. Taking those premiums as benchmarks, CFOs might gauge how much it would be worth spending in self-insurance to eliminate comparable risks.

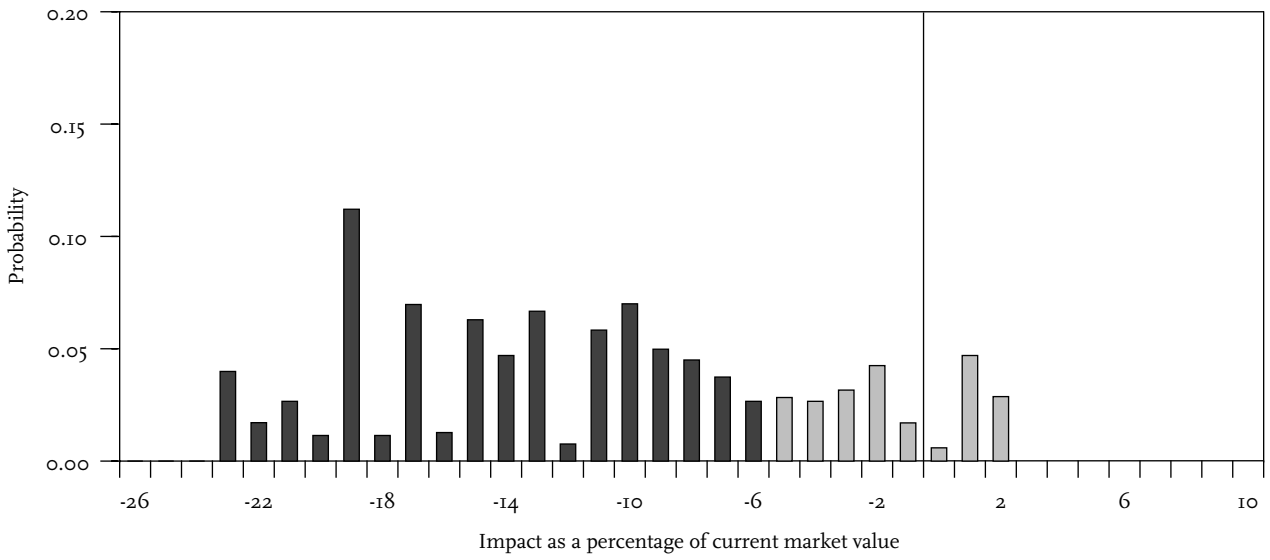
Improving the flow of company-specific information on environmental issues would enable financial analysts and investors to evaluate environmental risks and opportunities more accurately.

For example, referring to the distribution of outcomes below, suppose company K wished to eliminate all likelihood of negative environmentally related impacts greater than 5 percent of share value and could identify the control investments to do so, how much would it be reasonable to spend for that purpose? Taking the expected value of the impacts from that part of the distribution below 5 percent of market value, and applying a conservative loading factor, it is easy to calculate that this company could reasonably spend $217 million per year over five years to eliminate these business risks. (*See Figure 24.*)

Finally, this approach lends itself to a strategic management system emphasizing real options. Given these probability distributions, the value of flexibility to deal with environmental issues once more information regarding the likelihood of various scenarios becomes available can be estimated. Relevant flexibility might include the ability to switch among fiber sources or fuel sources; the ability to add technologies to existing plants; options to acquire or divest timberlands; and so on. Several current business writers now represent strategic management as the management of real options; evaluating such options requires knowledge of the underlying probabilities and financial outcomes (e.g., Copeland et al., 1996, Amram and Kulatilaka, 1999).

In all these ways, the approach presented and illustrated in this study might become a useful tool with which to relate environmental exposure and performance to investor value and risk. It answers a question that many have asked but few, if any, have been able to answer satisfactorily. This approach is sufficiently broad to be applied to other sectors in

FIGURE 24. **INSURING AGAINST LOSSES OF GREATER THAN 5 PERCENT OF CURRENT MARKET VALUE—COMPANY K**



which environmental factors can be value drivers. It is sufficiently general that it can encompass not only the costs of meeting environmental standards but also the opportunities afforded by providing solutions to environmental problems.

POLICY RECOMMENDATIONS

Data availability limited the application of the methodology for this study. For example, lack of data on companies' energy sources and timber holdings precluded full evaluation of the impact of climate policy scenarios. Improving the flow of company-specific information on environmental issues would enable financial analysts and investors to evaluate environmental risks and opportunities more accurately. The EPA, the SEC, and the companies themselves could all help in this regard.

Though theoretically in the public domain, much of EPA's data, especially on facility performance, is inconsistently formatted, difficult to retrieve, and often incomplete and out of date. This study demonstrates how valuable such information could be if databases were accurate, timely, well maintained, and readily accessible. The creation of the Sector Facility Index, which brings such information together in one publicly available data file, is a positive step. We recommend that EPA take further steps to provide accurate, timely and easily accessible information on company performance and facility exposure to environmental issues.

Company reporting of environmental issues in annual reports and other filings fails to provide investors with sufficient information to make fully informed decisions. For example, more complete and consistent reporting of companies' timberland holdings, forestry practices, and fiber sources would have permitted better analysis of potential impacts of land use regulations, the Endangered Species Act, and of carbon sequestration policies. Consistent industry-wide environmental reporting of the kind proposed by the Canadian Pulp and Paper Association under their "EcoProfile" initiative would be potentially very useful to financial analysts. We recommend that firms be more forthcoming on environmental exposure and performance, perhaps through the development of a standardized reporting protocol.

Company reporting of environmental issues also falls far short of the full and adequate disclosure required for material issues, as set out in SEC rules and guidelines. Item 101 of SEC Regulation S-K requires specific disclosure of the material effects that compliance with federal, state, and local environmental laws may have upon the capital expenditures, earnings, and competitive position of the company. Although there is room in the regulations for interpretation, implementation of these requirements leaves much to be desired. Of the companies reviewed here, there was inadequate reporting on pending environmental issues, which this report suggests may be material. Consequently, we urge the SEC to devote more attention to the implementation of its current rules on disclosure.

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NOTES

1. Free cash flows are defined as cash not retained and reinvested in the business.

2. The use of scenario analysis in the business context was pioneered by Royal Dutch Shell in the early 1970s, and has since been acknowledged by academics and practitioners as a valuable corporate decisionmaking tool. There is now an extensive literature on both the theory and application of scenario planning and analysis. See, for example, Schwartz (1991), Schoemaker (1995), and Earle and Rhodes (1995). In addition, Schoemaker and Schoemaker (1995) use scenario analysis to estimate prospective environmental risks and financial consequences for a single large pulp and paper company.

3. We gratefully acknowledge the cooperation of the American Forest & Paper Association and member companies in engaging in a scenario-building session with us. They bear no responsibility for the material presented here, however.

4. Both measures are calculated as the ratio of paper and board recovered (or utilized in paper and board products) to total consumption of paper and board products.

5. The companies included in this analysis are Boise Cascade, Bowater, Caraustar, Champion, Fort James, Georgia Pacific, International Paper, Mead, Potlatch, Smurfit Stone, Westvaco, Weyerhaeuser and Willamette. Figures for Weyerhaeuser do not reflect the recent takeover of Macmillan-Bloedel. Companies are not identified by name, nor are they ordered alphabetically in the figures in this report.

6. This analysis is focussed on companies' pulp and papermaking operations, not on their paper converting plants, on the grounds that the former give rise to most environmental issues.

7. The EPA data underlying Figure 10 and this statement refers to 1994, the latest year available, and may be out of date.

8. Integrated forest products companies might be expected to have relatively large timber holdings relative to their pulp and paper output alone.

9. The most recent information in this report dates from early 1999 when we began to write up the findings. Some data used in the analysis is considerably less recent. Consequently, readers are cautioned against relying on the information reported here as up-to-date forecasts of likely future developments. What we wish readers to take away is an understanding of the approach.

10. Underlying market valuations date from the end of the first quarter of 1999, save for that of International Paper which dates from May 1999 to reflect its merger with Union Camp.

11. We used high and low demand elasticities of (–)0.8 and (–)0.2 respectively.

12. In this exercise, the probabilities associated with one issue were assumed to be independent of the probabilities associated with all other issues. For example, developments on TMDL regulations were considered to be independent of developments on contaminated sediment rulemaking. Alternatively, it would be feasible

to develop estimates of conditional probabilities for specific issues, contingent on the outcome of other issues, reflecting likely correlations between related regulatory issues. Another alternative for structuring scenarios would be to develop a probability "tree" of sequential events. For example, this could be an appropriate way to portray the different ways in which climate policies may evolve.

13. Variance is a statistical measure that gives an indication of how closely or widely the individual values in a probability distribution are spread around the mean.

REFERENCES

A. GENERAL SOURCES

Over a two-year period, we consulted hundreds of separate information sources that would be impractical to list in full. Besides the specific references given below, several more general sources of information proved to be invaluable.

To keep abreast of developments in the paper industry, we regularly consulted industry journals, including *Pulp and Paper Online*, the *TAPPI Journal*, *International Woodfiber Report, and Pulp & Paper Week*, and financial newspapers, most notably *The Financial Times,* and *The Wall Street Journal*. Information on the individual companies was compiled from annual reports, other SEC filings, and occasional environmental reports; from trade directories; and from various equity research materials produced by investment firms. The American Forest and Paper Association's website (www.afandpa.org) has a comprehensive listing of relevant books, journals and magazines, as well as links to companies, consulting firms, and organizations associated with the industry.

To build up a picture of environmental pressures facing the industry, we consulted many documents and data sources produced by the U.S. Environmental Protection Agency and the U.S. Forest Service. Forecasts of price and materials trends in the industry came from conference materials, reports prepared by the financial and consulting communities, and from industry surveys in trade journals.

Details of the most important sources follow.

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