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THE FINANCIAL IMPACT OF ENVIRONMENTAL EVENTS AND ISSUES ON THE FOREST PRODUCTS INDUSTRY

by

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Executive Summary

This paper examines the relationship between environmental performance and financial performance in the forest products industry using three methodologies:

I. Two event studies of capital market performance,
II. An analysis of possible relationships between operating/financial performance and environmental performance at the firm level, and
III. A three company case study.

The event studies are inconclusive. No significant abnormal returns were found for the forest products industry in the stock market for both events examined. The event study methodology appears problematic because of the effects of lack of surprise, market noise, and misidentification of events.

Because a company's stock price is based upon perceptions of discounted future earnings, an analysis was performed to examine the relationship between environmental performance and earnings. Using Toxics Release Inventory (TRI) data as an indicator of environmental performance, a regression analysis was performed for fifteen forest products companies over the years 1989-1994. This analysis indicated a significant negative relationship between short-term (up to three years) operational performance (as represented by net operating cashflow as a percentage of sales and assets) and environmental performance; it also found no significant relationship between short-term financial performance (as represented by net operating cashflow on equity) and environmental performance. Although there are unavoidable problems with the methodology used in the analysis, the results are suggestive.

Given the finding that in this industry poor environmental performance may result in short-term economic gains, it is interesting that many companies would choose to pursue pro-active environmental strategies. This choice is examined through a case study comparison of three companies' actions in the face of regulatory change. The conclusion drawn is that the profitability of long-term investments may depend upon proactive strategies which lower the company's level of risk.

SECTION 1

Introduction

The MEB Competitiveness Program was designed to examine the relationships between regulation and industry competitiveness. The first two studies' findings confirmed the Porter Hypothesis, which argues that tight environmental regulations which are goal-focused and not technology-focused can actually push domestic industries to become more competitive globally. This principle has been stated most simply by Michael Porter and Claas van der Linde:

> Properly designed environmental standards can trigger innovations that lower the total cost of a product or improve its value. Such innovations allow companies to use a range of inputs more productively - from raw materials to energy to labor - thus offsetting the costs of improving environmental impact and ending the stalemate. Ultimately, this enhanced *resource productivity* makes companies more competitive, not less.[1]

Previous studies in the MEB series supported this theory in examinations of the pulp and paper, batteries, and plastics industries, among others. These studies were, out of necessity, qualitative in nature, examining specific regulatory changes and specific companies. Thus, MEB undertook a new series of studies designed to examine the quantitative effects of environmental regulation upon industry.

To quantify the effects of regulation on industry, the best lens for examination may be the capital markets. Any regulatory change that affects a company's expected performance should be reflected by the markets in an efficient manner.

"Fundamental analysts" study companies and look for new information that will affect the valuation of their stock. Because it is in the traders' best interest to be the first to use such information, the markets have become very good at quickly turning new information into changes in stock valuations. Efficient Market theory assumes that the market uses all available information when valuing stocks. This does not mean perfect forecasting ability, only that prices reflect all available information.

By assuming that Efficient Market theory conditions exist, we can test whether specific environmental issues had significant impacts upon the valuation of affected companies' stocks. Since share prices are related, through fundamental analysis, to the total present value of a company, we would then infer that the environmental issues had significant impacts upon the businesses themselves.

This study will begin with an examination of one industry's performance in the capital markets in the face of changes in environmental regulations, and then will examine other methods for measuring the effect of the environment upon business performance.

The forest products industry was chosen as the subject of this study because it has been heavily impacted by environmental regulations, and because it is highly capital intensive, with pulp mills routinely costing over $1 billion to build. Any general effects of environmental regulations should be most visible within industries such as this one; the high capital intensity implies that there will be high costs to switching between processes and equipment. Therefore this industry should be one in which it is relatively easy to spot changes in the capital market valuation of companies as a result of environmental regulation.

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[1] ME Porter and C van der Linde, 1996, "Green and Competitive: Ending the Stalemate," Harvard Business Review, June, 120-134.

SECTION 2

The US Forest Products Industry

The US forest products industry represents a significant portion of the national economy. Each year the average American uses over 700 pounds of paper products and 80 cubic feet of wood products.[2] The principal activity of this industry is the acquisition of logs and their transformation into timber- or pulp-derived products. The industry as a whole is very volatile, with performance closely tied to the health of the national economy. There are three main segments within this industry.

The timberlands segment is primarily concerned with the growing and harvesting of trees. Historically, much of the segment's harvest has been from publicly held land (such as national forests), although by far the biggest ownership of forests in the United States is by small, non-industrial landowners. The trend appears to be for companies in the timberlands segment to own and harvest their own forest lands, or to rely more upon the small non-industrial landowners. On forest industry land in the US, harvests exceeded timber growth by over 20% in 1991.[3]

The pulp and paper segment transforms wood fiber into a wide variety of products. At one end of this segment raw logs and wood waste are made into pulp. Pulp is converted into a wide range of products including writing papers, newsprint, linerboard, personal care products, and rayon. Although there are definite distinctions between categories of pulp, overall wood pulp is considered to be a commodity. Business performance in this industry is affected by high fixed costs, continuous flow processing, and lumpiness in supply, among other factors, and is therefore cyclical. The US pulp and paper industry accounts for annual sales of around $90 billion, or approximately 2% of the GDP.

Finally, the wood products segment supplies primarily the construction industry with lumber. Sawmills convert logs into such products as two-by-fours, plywood, oriented strandboard, or even telephone poles. Because the construction industry is tied to health of the national economy and interest rates, business performance in this segment fluctuates highly as well.

Stock market analysts, in valuing the industry and individual firms, focus strongly on the cyclical nature of its financial performance. In technical terms, this means that the *beta* is higher for the industry because stock prices increase and decrease with greater magnitude in response to national economic changes than does the stock market as a whole.

The capital markets time horizon for the pulp and paper industry is very short-term since prices can be so volatile. In February, 1996, during a period of down cycle for the industry, many analysts speculated as to when prices would improve. Money manager Kenneth Heebner was quoted in the *Wall Street Journal*, stating, "If I'm thinking about possible positive developments, I want those developments to happen within a year."[4]

Stock analyst valuation is simple for cyclical industries like the forest products industry: if the economy is improving and interest rates are down, the country uses more paper, and there are more construction

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[2] 1996, "Managing our Forest Resources," Weyerhaeuser.

[3] RW Haynes, et al., 1995, "The 1993 RPA Timber Assessment Update," USDA Forest Service General Technical Report RM-259, Fort Collins, CO: USDA, March.

[4] KG Salwen, 1996, "Southeast Journal -- Heard in the Southeast: Georgia Pacific, after down cycle in industry, isn't out of the woods," The Wall Street Journal, Feb. 7, p. S2.

projects. If analysts feel the economy will improve shortly, they will buy the stock. If the economy is perceived to be weakening, overall use of paper will be down and the stock should be sold. In the case of construction, if interest rates remain low despite a faltering economy, then the number of projects may remain high enough to support the wood products sector of the industry. It is for these reasons that a series of articles about the industry in the *Wall Street Journal* in February of 1996 did not include substantive analysis of environmental issues. The articles examined the relationship between the capacity of various sectors of the industry and consumer demand. As had occurred in 1990, in 1996 investment in paper manufacturing capacity exceeded demand, creating a glut that drove prices down.

Nevertheless, the forest and paper products industry has indeed been heavily impacted by environmental regulations over the past thirty years. Beginning with the Clean Air Act (CAA) and Clean Water Act (CWA) of the early 1970s, the industry was forced to undertake huge capital expenditures in pollution abatement equipment. These technological "add-ons" were end-of-pipe solutions which involved little, if any, process innovation.

Over a decade later, Title III of the Superfund Amendment and Reauthorization Act (SARA) created the Toxic Release Inventory in 1986. Under this legislation, industry was required to report emissions of certain chemicals. This focus on transparency and disclosure provided an impetus for companies to work on reducing their toxic emissions, efforts which soon naturally turned to eco-efficiency in general. Companies which had not previously begun waste reduction and energy saving measures now began to move in this direction because of the potential cost savings. For example, since 1975, US pulp manufacturers have lowered their mean water use per ton of product from 25,000 to about 15,000 gallons per ton of pulp produced.[5]

Although the body of evidence had been growing for some time, the US Environmental Protection Agency's National Dioxin Study officially linked pulp mills to dioxin production for the first time in 1987. The survey found high levels of dioxin in fish samples downstream from pulp bleaching plants in Wisconsin, Minnesota and Maine.[6] The EPA subsequently conducted the "5 Mill Study" in October to confirm the association of dioxin with the pulp bleaching process. This discovery, further substantiated by the comprehensive "104 Mill Study" completed in 1990, would lead to substantial technological change and innovation in the industry.[7] Although there was firm-level differentiation on the timing for adopting new technology, eventually most firms switched to processes which did not produce dioxin. The National Council of the Paper Industry for Air and Stream Improvement estimates that annual environmental capital expenditures in the segment amounted to $26.40 per ton of installed capacity in 1992. Environmental capital expenditures in the industry have ranged from 4 to 38 percent of total capital expenditures annually since 1970, with a mean of 15.5%.[8] Chart A shows how the percentage of total capital expenditures in the pulp and paper industry accounted for by environmental protection spending has evolved over time.

The Endangered Species Act (ESA) and other laws have had important effects upon supply in the timberlands segment, especially in the last decade. The Northern spotted owl controversy of the 1990s denied loggers access to timber on large sections of the Pacific Northwest, and similar effects were seen with the Red cockaded woodpecker in the Southeast, and even with the American burying beetle in Oklahoma and Arkansas. Further restrictions loom with recent discussions on the status of Coho salmon

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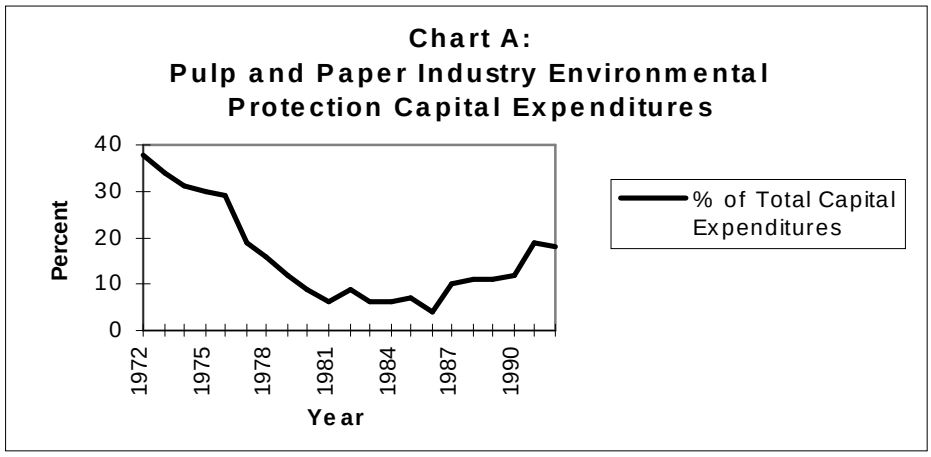
[5] Institute of Paper Science and Technology, personal communication.

[6] US EPA, 1987, National Dioxin Study (August).

[7] B Bonifant, 1995, "Competitive Implications of Environmental Regulations: The Pulp and Paper Industry," MEB.

[8] From NCPIASI, 1993, A Survey of Pulp and Paper Industry Environmental Protection Expenditures - 1992.

and the Marbled murrelet in the Pacific Northwest. As of August 1996, 964 species of plants and animals had been listed as threatened or endangered under the 1973 Act, and an additional 179 species were candidates for ESA listing.[9]



[9] Weyerhaeuser, 1996, "Fact Sheet: Threatened and Endangered Species," October.

SECTION 3

Event Studies

In order to examine the impacts of environmental regulatory change (or the anticipation of regulatory change) on the value of companies, two event studies were performed. Event study methodology is based upon the Efficient Market theory and has been used extensively in empirical studies. Two noted examples are Hamilton's 1995 study of the public release of TRI data[10] and Jones, et al.'s 1991 estimation of the costs of the Exxon Valdex oil spill.[11]

The reasoning for such studies is that an unexpected firm-specific event affects the return on the stock, so that by focusing on the specific event time, and by correcting for general market movements and normal firm variability, the significance of the event can be estimated by the event-related change in stock prices. In other words, if we can identify a significant shock in the stock's price in correlation with our identified event, then we can say that the event had a significant impact, and we can even potentially estimate the magnitude of that impact. We performed two event studies as part of this study, one on the 1987 discovery of dioxin in paper products, and the other on the 1993 Executive Order on recycled paper use by the Federal government.

Methodology

For event studies, the first, and perhaps most important, step is to choose the specific date of the event. Since we are only looking for abnormal returns on the specific day chosen, if the date is chosen incorrectly misleading results will be obtained. Extensive interviews were conducted with industry representatives and stock market analysts, through which two events were chosen.

On October 20, 1993, President Clinton signed Executive Order 12873 revising the executive branch's standard procedures for acquisition, recycling and waste prevention. Section 504 of the Order stipulated that any paper purchased by the government must meet minimum standards of recycled content, stating in part:

> (a) For high speed copier paper, offset paper, forms bond, computer printout paper, carbonless paper, file folders, and white woven envelopes, the minimum content standard shall be no less than 20 percent postconsumer materials beginning December 31, 1994.[12]

This created a new market for recycled-content writing papers since the Federal government consumes huge volumes of paper annually. Companies which could meet the government's demand for recycled paper would gain a competitive advantage in the industry. Therefore, October 20, 1993 was chosen as a date for the first event study.

Perhaps no single issue has impacted the pulp and paper industry more than the dioxin issue. As early as the 1970s, dioxin was known to be a health risk. Pulp mills began to be implicated in the production of dioxin as early as 1983, when the state of Wisconsin was forced to temporarily shut down the commercial carp fishery in the Petenwell Flowage Reservoir as a result of high dioxin levels found downstream from

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[10] JT Hamilton, 1995, "Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data," Journal of Environmental Economics and Management 28, 98-113.

[11] JD Jones, CL Jones, and F Phillips-Patrick,1991, "Estimating the costs of the Exxon Valdex oil spill," Securities and Exchange Commission, October.

[12] 1993, "Federal Acquisition, Recycling, and Waste Prevention," Executive Order 12873.

several pulp and paper mills.[13] In the mid-1980s, the US Environmental Protection Agency began to undertake a series of studies designed to provide a clearer picture of the dioxin threat, define health standards and identify sources. The culmination of these studies, known as the National Dioxin Study (NDS), identified pulp mills as among the principal sources. The public announcement of the NDS results was on September 24, 1987. Most of the NDS results had been leaked prior to this date and were widely known or at least suspected. However, on the same day the industry announced its findings which indicated that trace amounts of dioxin could be found in most paper products. This announcement came as a surprise to the public. Therefore this date was chosen as a date for the second event study.

Several methods have been used to estimate the magnitude and statistical significance of change in stock price caused by an event (Brown and Warner, 1980[14], 1985[15]). For each event, for each stock, we use a maximum of 180 daily return observations for the period around the event; for a stock to be included in the sample it must have no missing data in the last 20 days before the event.

To measure excess returns, the market model was used, which assumes a linear relationship between the expected return of an individual stock and the expected return of a broadly based market portfolio or an index, in this case the S&P 500. The parameters of the model are estimated using ordinary least squares based on the estimation period. The event-induced change, termed "abnormal return," is based on the estimate of the residual for a single event date, or:

Equation 1: $A_{it} = R_{it} - C_i - B_i R_{mt}$, where

A_{it} is the abnormal return for firm i at time t
R_{it} is the return of firm i at time t
C_i is a constant term for firm i
B_i is the slope of the characteristic return of firm i to the market
R_{mt} is the market return at time t.

For the 1993 event 14 companies were chosen for study, and for the 1987 event 13 companies were included. These companies were chosen because of data availability and their importance as leaders within the industry. Stock price data was obtained for the 90 days before and after each event.

As test statistics for statistical significance, standardized abnormal returns were used (Brown and Warner, 1985), so that the actual variables measured were the percentage change in daily prices, not absolute prices. Although recent research (Boehmer, Musumeci, Poulsent, 1991[16]) has attempted to account for changes in the variance of abnormal returns at the time of the event, we found that the estimates of the test statistics changed little after considering event-induced variance. Therefore only the results of the standardized test are reported.

Results

For the 1993 executive order on recycling, the industry as a whole did not show significant abnormal returns, although four individual companies did exhibit significant abnormal positive returns. Chart B provides the results for the 1993 event:

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[13] C Van Strum and PE Merrell, 1987, No Margin of Safety, Greenpeace Great Lakes Toxics Campaign.

[14] SJ Brown, JB Warner, JFE 8 (1980) 205-258.

[15] SJ Brown, JB Warner, JFE 14 (1985) 3-31.

[16] EJ Boehmer, J Musumeci, AB Poulsen, JFE 30 (1991) 253-272.

CHART B October 20, 1993 Event: Executive Order 12873		
Company	Event Day Abnormal Returns (% of Expected Returns)	t-Statistic
Scott Paper Company	0.0452	3.36
International Paper	0.0301	3.04
Westvaco	0.0290	2.65
Champion	0.0195	2.01
Willamette	0.0238	1.30
Industry Average	***0.0079***	***1.26***
Georgia Pacific	0.0086	0.86
Boise Cascade	0.0076	0.71
Louisiana Pacific	0.0077	0.48
Mead	0.0044	0.38
Potlatch	0.0044	0.35
Weyerhaeuser	-0.0018	-0.14
Union Camp	-0.0015	-0.18
Stone Container	-0.0295	-0.94
James River	-0.0373	-1.87

The four companies which exhibited significant abnormal returns (two-tailed test, α=.025, critical t-value = approximately 2) for October 20 were Scott, International Paper, Westvaco and Champion, which are all heavily paper-focused. No firms studied exhibited a negative significant abnormal return on this day.

Although these findings are suggestive, we cannot say with certainty that the Executive Order signing represented a significant event. The industry as a whole did have positive returns relative to the market on that day, but not statistically significant returns. This could be explained if the event had positive effects upon companies with high recycled capacity and negative effects upon companies lacking such capacity, with a near zero-sum result upon the industry. There is little evidence to support this view, however, because several of the companies which exhibited negative abnormal returns were known to have recycled paper product lines. For example, James River's 1992 Form 10-K states,[17]

> "James River also produces numerous recycled business and printing papers including EUREKA!™ copy paper, formsbond and offset printing papers; ECHO™ web offset printing papers; and RECLAIM® formsbond and lightweight opaque web printing papers."

Yet James River exhibited the poorest relative returns for the date studied. In the absence of explanatory

[17] 1992 10-K, p. 5

information, we cannot declare that the October 20, 1993 event was significant. Therefore we cannot say that the regulatory change represented by the Executive Order signing had any significant effect upon the market valuation of the industry.

The 1987 event also failed to demonstrate significant abnormal returns. The announcement that dioxin was present in consumers' paper products should have had a generally negative impact upon the value of the companies in the industry. Chart C provides the results for the 1987 event study:

No company in this event study exhibited either negative or positive abnormal returns for the day. Therefore we can say that any event associated with September 24, 1987 did not have significant effects upon the industry. The market did not appear to assign significant changes in the valuation of the industry as a result of the disclosure of dioxin's presence in paper products.

Lessons Learned

We can find no evidence in the two studies which directly link environmental regulation to changes in the valuation of companies. The Executive Order represented a market-based, positive regulatory change that should have rewarded those companies that were invested in recycling writing papers. Furthermore, the implications of the Porter Hypothesis for Efficient Market theory suggest that the industry's valuation as a whole should have risen, as the industry's competitiveness would have been enhanced and this would have been reflected in the market's valuation of the companies in the industry.

CHART C
September 24, 1987 Event: Dioxin in Paper Products

Company	Event Day Abnormal Returns (% of Expected Returns)	t-Statistic
James River	0.0144	0.94
Weyerhaeuser	0.0092	0.64
Willamette	0.0089	0.63
Boise Cascade	0.0039	0.33
Union Camp	-0.0009	-0.06
Champion	-0.0010	-0.07
Westvaco	-0.0022	-0.16
Mead	-0.0087	-0.38
Potlatch	-0.0131	-0.53
Industry Average	***-0.0051***	***-0.69***
Louisiana Pacific	-0.0198	-0.73
International Paper	-0.0178	-1.03
Georgia Pacific	-0.0137	-1.05
Stone Container	-0.0251	-1.21

The dioxin announcement should have represented a new possibility for regulatory change which historically in this industry has been process-based (BACT standards and the Cluster Rule). Therefore the Porter Hypothesis and Efficient Market theory suggest that we would see a devaluation as a whole for the industry. For both events no significant industry-wide effects were seen.

Our primary conclusion from this effort is that event studies are not well-suited to answer competitiveness questions. Although they have been used successfully in the past on a limited basis, such as for the Exxon Valdez episode, they are not reliable for indicating the valuation changes resulting from regulatory changes. The problems with event studies fall into three major categories: lack of surprise, market "noise," and the misidentification of events.

Efficient Market theory assumes near perfect information within the capital markets. Indeed, few people are as knowledgeable about specific industries as the market analysts who follow them. The market is likely to learn about an "event" before it happens. Therefore, the market will have already reacted to the event by the time it "occurs". Thus no significant reaction will take place on the day chosen for the event. Instead, the event's impact on value will appear gradually in relation to the perceived probability of the event. This dynamic is difficult to evaluate. An event study which concludes that the event in question was not instantaneously significant does not necessarily mean that the impact from the "event" was not important in its effects upon the valuation of the industry or specific companies; it could also mean that the event chosen was not a surprise to the market. The 1987 event provides a good example of this phenomenon, because most of the damaging information for pulp mills within the NDS had been available to the market months, if not years, prior to the public announcement. As Washington Post correspondent Michael Weiskopf reported in October of 1987, the industry had felt months earlier that it was unavoidable that dioxin would be found in everyday paper products at some level, and planned a public relations strategy to diffuse the situation. Weiskopf writes:[18]

> By the time the news broke September 24 that items ranging from disposable diapers to stationery were tainted by dioxin, the strategy had paid off. The industry, which had worked with the Environmental Protection Agency in surveying the pollution of paper mills, independently tested its products. As [the American Paper Institute] announced the findings and played down their public health implications, top EPA officials -- given only sketchy details of the product tests a few days earlier -- had little choice but to agree. Many environmentalists seemed caught off guard.

This example shows not only how such "surprise" events can be anticipated months ahead of time by major players (including, presumably, market industry analysts), but also that this does not necessarily mean that the knowledge of the event will have been passed on to other segments of the public. While we can point to the first mention of the event in the popular media as the date of the "surprise," we cannot know if the market was actually aware of the event before the public. Determining the exact date of the "surprise" to the *market*, as event studies necessitate, is very difficult except in very rare instances such as accidents and natural disasters.

Furthermore, event studies assume that there are only two factors at play in the determination of abnormal returns on the day in question: the market's performance, and the effect of the event. This is unrealistic. For almost every company, even in the forest products industry, environmental issues are but a small part of the overall business. The 1993 event provides a good example of this problem in event studies. Louisiana Pacific was included in the event study because they have a few pulp mills. Yet the focus of Louisiana Pacific's business is on wood products; in 1995 pulp sales made up only 11.64% of the company's total $2.8 billion in sales. The Executive Order may well have had a significant impact upon the

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[18] M Weiskopf, 1987, "Paper Industry Campaign Diffused Reaction to Dioxin Contamination," The Washington Post, October 25, p. A23.

company's pulp business, but the impact may not have been significant when buried in the much bigger value of the company as a whole, upon which the stock price is based. In fact, Louisiana Pacific's stock did show positive returns relative to the market on the day studied, but not to a statistically significant level. Event studies do not give us a complete understanding of the total effect of any event because of all the other factors involved that are unaccounted for, the market "noise" surrounding the event.

Finally, many important events -- from the perspective of impact upon the business -- do not happen in only one day. The dioxin issue is a case in point. Dioxin concern had been building up for years for the pulp and paper industry, and still looms on the regulatory agenda today. Any one-day "event" chosen will only be one step among many toward a final resolution of the dioxin issue for the industry. Gauging the effect of that one step cannot give an accurate picture of the importance of the issue for the industry's performance. Event studies do not appear to be well-suited for studying the effects of broad environmental issues upon industries.

SECTION 4

Effects on Business Performance

As discussed above, we examined the capital market's valuation of the pulp and paper industry because fundamental analysis should fairly accurately reflect the total discounted value of the companies in question. This valuation is based upon the firm's projected discounted value of future earnings. Another way of addressing this question is to examine the direct impact of environmental considerations upon operating and financial performance, which are indicators of future earnings.

This approach has been used successfully in the past by Cohen, et al.[19], Johnson[20], and others. To look specifically at the links between environmental performance and business performance in the forest products industry, we used Hart and Ahuja's study "Does It Pay to Be Green?" as a model.[21] Hart and Ahuja were able to show a positive relationship between environmental performance as represented by TRI emissions reductions and earnings with a multi-year lag period across industries. They argued persuasively that TRI reductions are representative of eco-efficiency changes which pay off later in higher earnings. Using Hart and Ahuja's study as a model, we performed a test on data from the forest products industry for the years 1989-1995.

Methodology

To determine the impact of environmental performance upon business performance within the forest products industry, an ordinary least squares analysis was performed upon data obtained from annual reports, the EPA's Toxic Release Inventory (TRI), and the Compustat database.

Twelve regressions were performed overall. Three separate measures of earnings were used as dependent variables to provide a full analysis. Returns on assets, sales, and equity were studied; however, instead of the typical ROA, ROS, or ROE using net income, Net Operating Cashflow as a percentage of Assets (NOCA), Sales (NOCS) and Equity (NOCE) were calculated for each of the companies and used to measure annual earnings, as net income can be manipulated by accounting methods. Indeed the use of net operating cashflow instead of net income strengthened the explanatory power of the model in preliminary tests.

The effects of the independent variables were examined in four separate regressions for each of the dependent variables, to determine the effects in the year of environmental performance (Year 0), the effects one year later (Year 1), and the effects two (Year 2) and three years later (Year 3).

The explanatory variable used (EMIND) was TRI emissions per dollar of sales, as a percentage of the industry average. Equation 2 was used to calculate EMIND for each company:

$$\text{Equation 2: EMIND} = \frac{[\text{industry average (lbs TRI / \$ sales)}] - [\text{lbs TRI / \$ sales for company}]}{[\text{industry average (lbs TRI / \$ sales)}]}$$

The lower a company scored on this standardized measure, the more emissions they had per dollar of sales relative to the industry as a whole; an EMIND value less than zero implied a "dirtier" company, as

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[19] M Cohen, ...

[20] SD Johnson, 1996, unpublished manuscript.

[21] SL Hart and G Ahuja, 1996, "Does It Pay to Be Green? An Empirical Examination of the Relationship Between Emission Reduction and Firm Performance," Business Strategy and the Environment, Vol. 5, 30-37.

measured by TRI. Therefore TRI emissions are used as a proxy for environmental performance.

Several control variables were used in the study. The percentage of sales of the company attributable to pulp or paper products (PPR) was used to account for different product mixes within the industry. The capital structure of the company (KSTRUCT), as represented by its debt-to-equity ratio, was used to allow for its significant effects upon future earnings. Capital expenditures per dollar of sales (KSALES) was used to control for the fact that companies involved in major capital investments use more modern equipment which generally is more efficient and will therefore permit better operating performance with lower emissions. Finally, the change in inventory as a percentage (INV1) during the year was also used as a control, as it can have immediate but not lasting effects upon performance.

Only fifteen firms were examined, because of the high concentration within the industry and the availability of data. Thus it was necessary to perform the test using a time series cross-sectional system. Data for four consecutive years were used to increase the number of observations used (ie: NOCS data for Year 1 was actually data from the years 1990 through 1993). This means that each company was counted four times as four separate, unrelated observations, one from each of the four years lumped together. The use of this system introduces possible problems that are discussed below. Chart D lists the companies in the study.

Chart D Companies in the Study
Scott Paper Company
International Paper
Westvaco
Champion
Willamette
Georgia Pacific
Boise Cascade
Louisiana Pacific
Mead
Potlatch
Weyerhaeuser
Union Camp
Stone Container
James River
Kimberly Clark

For the Year 3 (three-year time lag) analyses, data was only available for 45 observations. Chart E describes the results of the twelve regressions.

CHART E

PPR = [%] Sales in pulp or paper products as a percentage of total sales
EMIND = [%] TRI emissions (standardized for sales) compared to industry average [<0 means more emissions per dollar than the average]
KSTRUCT = [%] Capital structure, represented as the Debt to Equity ratio
KSALES = [%] Capital Expenditures as a percentage of total sales
INV1 = [%] Change in inventory during the year

Time Series Cross-Sectional Data:
15 firms, each with 4 consecutive years of data (ie: Year 0 = 1989-1992)

NOCS: Net Operating Cashflow on Sales

	Year 0	Year 1	Year 2	Year 3
INTERCEPT	9.813***	10.937***	11.728***	13.312***
PPR	-0.002	0.003	-0.017	-0.031
EMIND	-0.005*	-0.011***	-0.018***	-0.011***
KSTRUCT	-0.015***	-0.023***	-0.024***	-0.028***
KSALES	0.178*	0.033	0.053	0.040
INV1	0.103*	0.054	0.017	-0.019
AdjR2	.445	.496	.513	.642
F	10.443***	12.591***	13.445***	16.772***
N	60	60	60	45

P<.05; P<.01**; P<.005****

NOCA: Net Operating Cashflow on Assets

	Year 0	Year 1	Year 2	Year 3
INTERCEPT	10.336***	11.290***	12.625***	14.806***
PPR	-0.003	0.001	-0.031	-0.051*
EMIND	-0.005	-0.009***	-0.009**	-0.011**
KSTRUCT	-0.016***	-0.023***	-0.022***	-0.025***
KSALES	0.007	-0.133	0.089	-0.100
INV1	0.150***	0.077*	0.031	-0.006
AdjR2	.388	.496	.479	.571
F	8.488***	12.610***	11.851***	12.708***
N	60	60	60	45

P<.05; P<.01**; P<.005****

NOCE: Net Operating Cashflow on Equity

	Year 0	Year 1	Year 2	Year 3
INTERCEPT	30.457***	32.639***	33.103***	41.356***
PPR	-0.042	-0.027	-0.083	-0.111*
EMIND	0.007	0.004	0.004	0.006
KSTRUCT	-0.013	-0.055***	-0.051***	-0.094***
KSALES	-0.308	-0.505	-0.307	-0.409
INV1	0.293*	0.258	0.062	-0.065
AdjR2	.091	.253	.227	.626
F	2.180	4.988***	4.473***	15.740***
N	60	60	60	45

P<.05; P<.01**; P<.005****

Results

The results of the study strongly suggest a negative relationship between environmental performance and operating performance for the time period observed. Each of the regressions except for NOCE Year 0 had sufficiently high F-statistics for overall regression significance.

For Net Operating Cashflow on Sales, the effects of the TRI emissions index, capital structure, capital expenditures and inventory turnover were all significant for Year 0. One year later, the significant variables were emissions and capital structure. This relationship continues through for two more years after the base year, with the effects of emissions peaking at Year 2 and the effects of capital structure rising through Year 3. Adjusted R-squared rises over time as well, from .445 in Year 0 to .642 in Year 3.

For Net Operating Cashflow on Assets, capital structure and inventory turnover show significant effects in Year 0. In Year 1, emissions effects become significant and continue to increase over time along with those of capital structure, while the impact of inventory turnover decreases quickly. In Year 3, the impact of pulp and paper sales becomes significantly negative. Adjusted R-squared again rises for the regressions over time, from .388 in Year 0 to .571 in Year 3.

For Net Operating Cashflow on Equity, only inventory turnover has significant effects in Year 0, but the regression was not significant overall, with an F-statistic of 2.180 and Adjusted R-squared of just .091. In subsequent regressions capital structure's effects are significantly negative, and again rise over time. The effects of pulp and paper sales again become significantly negative in Year 3, but the effects of emissions are never significant. By Year 3 the Adjusted R-squared has risen to .626.

These findings suggest that environmental performance had a *negative* impact upon operating performance for the forest products industry during the period examined. This appeared most prominently with a two to three year lag. The effects were not evident against equity, however.

Hart and Ahuja's work suggests an explanation for the apparent lack of a relationship with return on equity (represented here by NOCE) when there appears to be a relationship between environmental performance and operational performance as measured by returns on assets and sales (NOCA and NOCS). They point out that financial performance, which NOCE measures, is partly dependent upon operational performance, but is also dependent upon the cost of capital. They write, "The environmental profile of a company is known to have an effect on its liability exposure, reputation and market value (Barth and McNichols, 1993[22]; White, 1995[23]). Poor environmental performance may thus affect the firm's cost of capital."[24]

In Hart and Ahuja's cross-industry study, the authors found a positive relationship between operational performance and environmental performance, so there was a complimentary effect between that relationship and cost of capital upon return on equity. In the analysis described here, the relationship between operational performance and environmental performance was found to be *negative*, so it would be in conflict with cost of capital effects from environmental performance. This conflict may explain why no significant relationship was found between NOCE and emissions.

Lessons Learned

This study requires several caveats. First, the use of TRI data as a proxy for "cleanliness" among

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[22] M Barth and M McNichols, 1993, "Estimation and market valuation of environmental liabilities relating to Superfund sites," working paper, Harvard University.

[23] M White, 1995, "Does it Pay to be Green? Corporate environmental responsibility and shareholder value," working paper, University of Virginia.

[24] S L Hart and G Ahuja, 1996, 35.

companies is problematic. Toxic emissions are only a small segment of overall emissions levels. Much of a pulp mill's impact on the environment is not recorded in the TRI, such as organic effluent into a local stream, or water and energy use. TRI has only been fully in use since the late 1980s, which means that the available data is still limited for studies like these. Furthermore, it is possible to reduce TRI emissions through both process changes and end-of-pipe solutions, although these changes can have very different effects upon business performance. End-of-pipe controls imply higher costs for the company, while reductions from process changes, as Hart and Ahuja note, can represent eco-efficiency gains.[25]

Second, the use of a time series cross-sectional data set creates variance errors. Preliminary tests for heteroskedasticity -- unevenness in the variances, which can bias the results -- suggest that the estimates here may be somewhat biased, and it is also likely that the data contains autocorrelative errors, another form of variance errors. Unfortunately, the concentrated nature of the forest products industry and the short period of time for which TRI data is available make these problems unavoidable. The small number of observations per company also does not allow Cochrane-Orcutt or other general least squares corrections to be feasible. The results of this analysis are suggestive, and warrant further study, but similar industry-specific efforts in the future should attempt to find other measures of environmental performance which could be applied for a longer period of time to increase the number of observations and allow for feasible general least squares corrections. Ideally, future tests would also look to expand the number of companies observed in order to avoid such serious variance errors altogether, but this may not be possible for industries like the forest products industry.

Third, with all regression analyses there are problems interpreting the results. Even with no problems in the data, all that the analysis shows is that there is a relationship between two variables. It does not show causality. KSALES shows significant positive effects upon NOCS in Year 0. Does this mean that companies can increase their earnings this year by raising their capital spending? Or that companies with higher earnings can afford to spend more that year on capital investments? We think we know the answer, but the regression does not tell us for sure. Similarly, our conclusions on the causality of other demonstrated relationships may be erroneous.

Nevertheless, the results fit with what would be predicted by the Porter Hypothesis. The forest products industry has historically been the target of technology-specific regulations. As *Pulp & Paper* magazine states, "the U.S. pulp and paper industry has been in an environmental vise for at least the past decade."[26] The magazine goes on to describe some of the anticipated process-based aspects of the air pollution control portion of the upcoming "cluster rules":

- Collection and incineration of...
  - Pulping process vents
  - Oxygen delignification process vents
- Scrubbing of...
  - Bleach plant process vents
- Steam stripping of...
  - Digester foul condensates
  - Evaporator foul condensates
  - Turpentine recovery wastewaters[27]

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[25] For a full analysis of the difficulties inherent in the use of TRI data for such studies, see J Hamilton, 1995, "Pollution as news: media and stock market reactions to the Toxics Release Inventory data," Journal of Environmental Economics and Management, 28, 98-113.

[26] Pulp & Paper, September, 1994, p.51.

[27] *Ibid.*, p. 76

This example shows the level of detail typical of the regulations faced by the forest products industry. Additionally, as Ben Bonifant's earlier study of the pulp and paper industry described, the industry has been subjected to major regulatory shifts over the past two decades.[28] Similar effects are seen in the timberlands and wood products sectors. The Porter Hypothesis predicts that goal-based regulation on an industry will pressure the companies to innovate, thus creating a long-term competitive advantage. As Porter and van der Linde write, however, "In addition to being high-cost, the current system of environmental regulation in the United States often deters innovative solutions or renders them impossible... The current system discourages risk taking and experimentation."[29]

This analysis only examines earnings in the short run. Any efficiency gains through proactive environmental management are likely to be captured over a longer time period. Thus, in a tightly process-based regulatory scheme in which somewhat unpredictable changes are the norm, the affected companies will be able to boost their short term earnings by resisting change and "foot-dragging". They are able to put off capital investments that do not add to productivity, and thus perform better in the short term.

The capital markets have often been criticized for "rewarding" dirty companies. The regression results above explain why companies that perform poorly environmentally might do better than their more proactive competitors in the stock market. If a company's stock price reflects the discounted future earnings of the firm, then the market is accurately reflecting the fact that these companies are achieving higher earnings.

The question remains, however, whether the Efficient Market theory holds true for longer-term valuation of firms. Why would any firm choose to improve its environmental performance voluntarily given the conclusions cited above? Yet some companies in the forest products industries are doing just that.

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[28] B Bonifant (1995).

[29] Porter and van der Linde (1996) 129.

SECTION 5

Three Company Comparison

In order examine the rationale for a company to pursue a proactive strategy under these circumstances, we reviewed how three forest products companies reacted to a regulatory change. The three companies described are Weyerhaeuser, Louisiana Pacific, and Georgia Pacific. The regulatory change at the heart of this qualitative study is the early 1990s investigation of the forest products industry for possible Clean Air Act (CAA) violations in light of a revised EPA guidance document.

Weyerhaeuser was founded in 1900 as the result of a deal to get cheap timberlands from a railroad in need of cash. The company was among the first to grow trees as a crop, and began its High Yield Forestry program in the 1960s, designed to increase the productivity of its tree farms. Today Weyerhaeuser is the world's largest private timberlands owner (the company's holdings include many of the original lands from the railroad purchase), and the world's largest producer of softwood lumber. The company also has a third of its business in pulp and paper production, including substantial investments in paper recycling plants. Weyerhaeuser's 1995 sales totaled $11.8 billion.[30]

Georgia Pacific was founded in 1927 in Georgia. In the 1960s, Georgia Pacific developed technology enabling it to manufacture plywood solely from Southern pine as opposed to Douglas fir. After a period of focus in the Pacific Northwest, the company moved its base back to Atlanta in 1982. Today, the company is the world's largest manufacturer of market pulp, and the largest U.S. manufacturer of communications papers and structural wood panels. In 1995 Georgia Pacific was the 75th largest US company according to *Fortune*, with total sales of $14.2 billion.[31]

Louisiana Pacific was founded in 1972 when the Federal Trade Commission forced Georgia Pacific to divest 20% of its operations. The company is primarily involved in the manufacture of building products, such as structural panels and lumber, although over 10% of its sales are from pulp manufacturing. In 1995 total sales were $2.8 billion.[32]

From 1989 to 1994, Louisiana Pacific was the superior performer among the three companies in the stock markets. All three companies' performance in the capital markets reflected the business cycles of the national economy. Chart F provides a look at the relative performance of the three companies' stocks since 1976.

The market's valuation over this period reflects changes in the companies' earnings. Since 1986 returns for these companies first rose, then fell, and now are on the rise again. Charts G and H show the return on assets and equity over this period.

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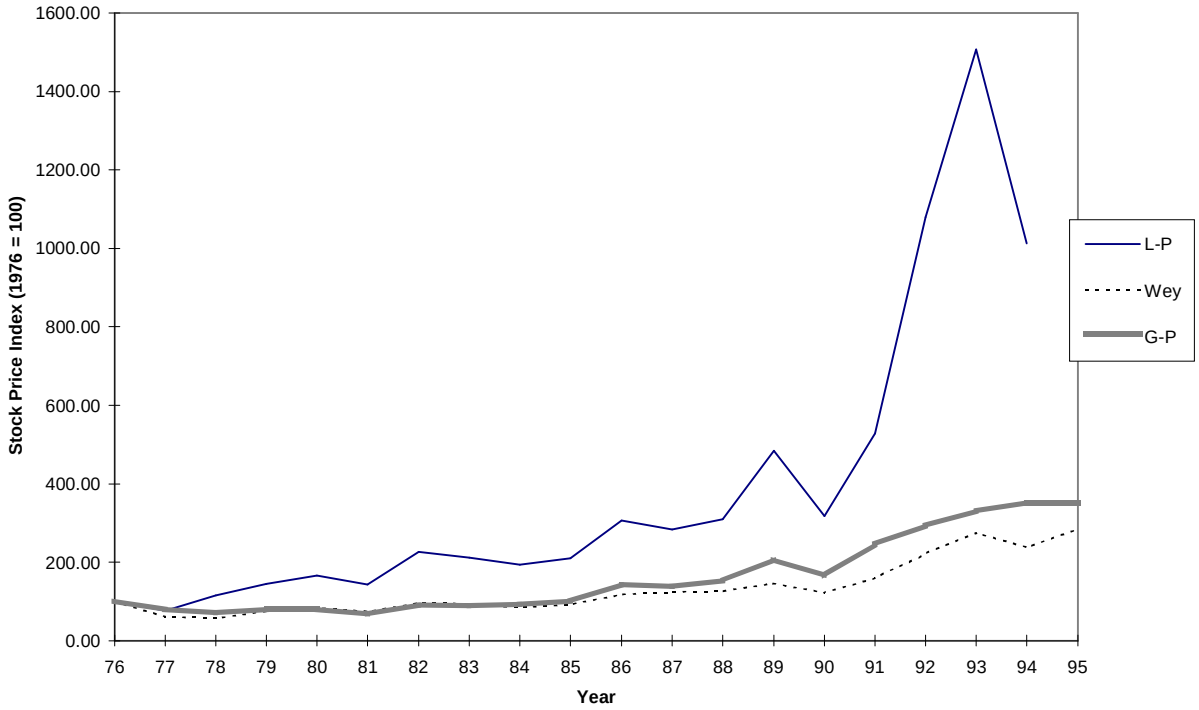
[30] 1995 AR

[31] 1995 AR

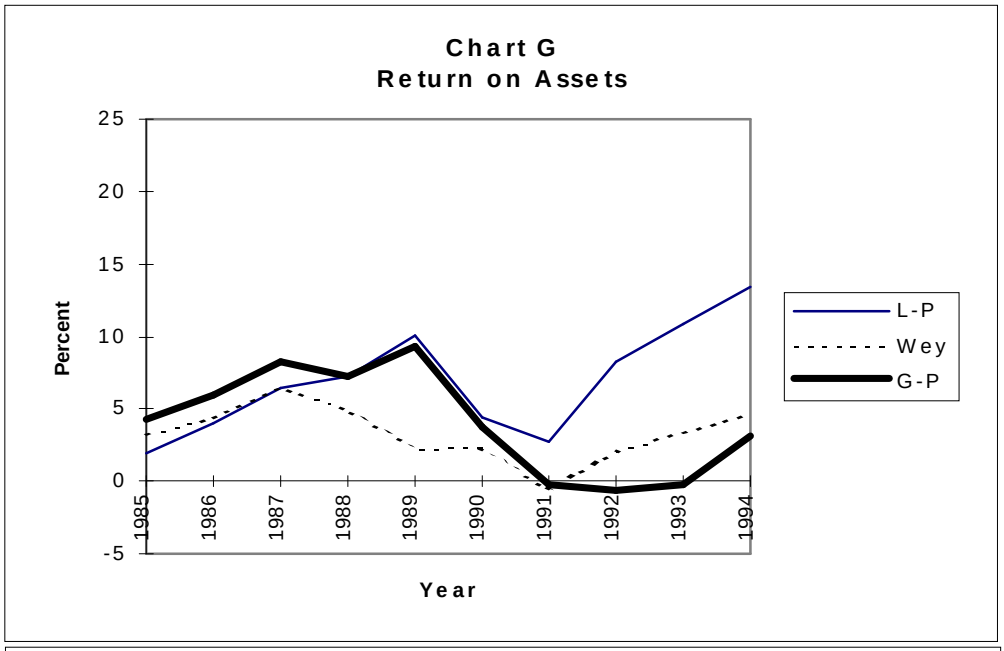
[32] 1995 AR

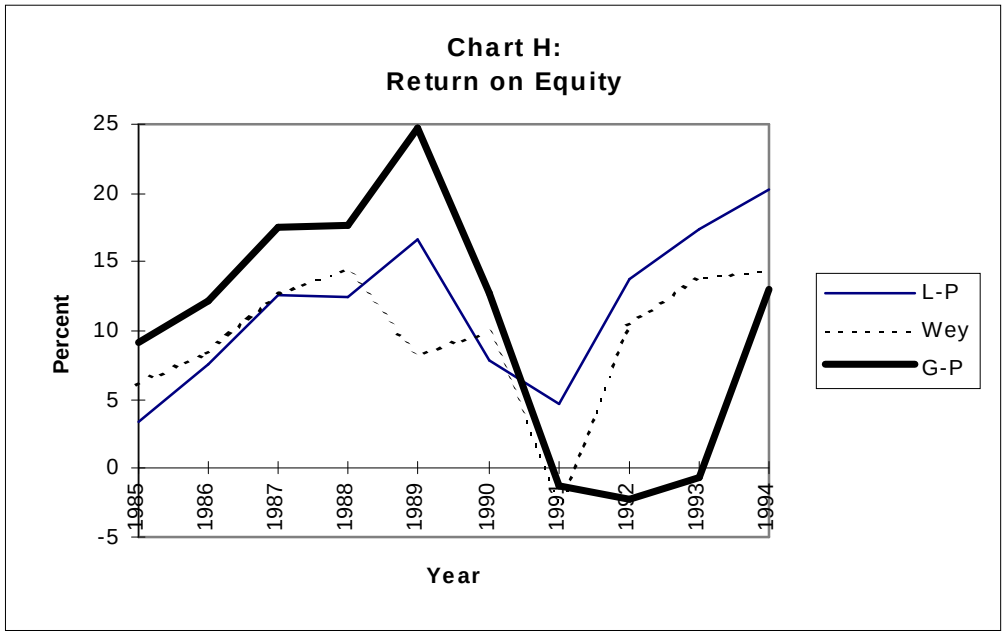
In the early 1990s, the US EPA began an investigation of the wood products industry.[33] Since the early 1980s, EPA had published erroneous guidelines for measuring VOC emissions at plywood manufacturing plants. This mistake led many plywood producers to underestimate their emissions of these smog-forming chemicals, often by a factor of ten. These miscalculations would then cause the firms to break the law by not reporting the higher levels of emissions and installing appropriate controls. There remains much debate over the timing of industry's discovery of the mistake, and whether they knowingly used the Agency's error to break the law. What is interesting about this episode, however, is the three very different responses of Georgia Pacific, Louisiana Pacific, and Weyerhaeuser to the government's investigation.

Chart F:
Stock Performance for 3-Company Comparison



[33] This case is included for the purpose of discussion, not as an indication of good or bad management practices. It is important to note as well that this incident represents only a small part of the three companies' overall environmental strategies.





When Georgia Pacific learned of the government's investigation into the industry, it responded in a manner that could be described as reactionary. The company argued in response to EPA's investigation letter that the revised guidelines now overestimated the VOC emissions levels, and that the agency's retroactive application of revised guidelines was "dubious". They agreed to put emissions control equipment on mills that needed them, but disputed EPA's estimate of the number of plants that required new controls. In the clearest example of the company's reactionary strategy on this policy, Georgia Pacific then went to Capitol Hill and successfully lobbied to have language put into regulatory reform legislation that would prevent EPA

from pursuing its investigation of the industry.

Louisiana Pacific was the original target of the EPA investigation. The agency had begun the examination of the industry when it became aware that Louisiana Pacific had been charged with a number of locally-imposed fines. After looking into some of the company's operations, EPA regulators realized that the emissions estimates used to justify avoiding control equipment installation might be wrong. Fourteen Louisiana Pacific plants were eventually identified as being in violation of the CAA. Less than a year later, the company settled the case with the government, paying fines of $11 million and installing over $70 million in new pollution control equipment at the plants in question. Although the settlement's coverage in the press was fairly negative for the company, Louisiana Pacific was not forced to admit any wrongdoing, and as corporate chairman Harry A. Merlo later described, the company was pleased with "the joint nature of the agreement and the environmental advances we will pioneer."[34]

Weyerhaeuser management became aware that there was a potential problem in late 1991 when a test of one of its facilities showed emissions levels ten times higher than had been reported to authorities. Subsequent tests confirmed this finding. Instead of ignoring these results, however, the company revised its emissions estimates and informed relevant state environmental agencies and filed for CAA permits which would require new pollution control equipment. A Washington Post story written at the time stated, "Weyerhaeuser's senior management felt it would be better to come forward, voluntarily install controls and adopt a 'pro-active' stance that might persuade Federal officials not to file a case."[35] The company also began to quietly discuss public disclosure of the error with representatives of EPA. By then, however, the agency had become aware of the problem through its examination of Louisiana Pacific and the industry-wide investigation was underway. Weyerhaeuser responded by continuing to install pollution control equipment. Furthermore, in a surprise move, the company lobbied against Georgia Pacific's proposed anti-investigation legislation. Such public disputes between fellow forest products companies in Washington are rare, but in this case Weyerhaeuser management felt the move was necessary. The legislation, if enacted, would have had the effect of penalizing the company for taking a proactive stance, because they had already incurred most of the costs from the revision.

Given the results of the TRI study above which suggest that reactionary strategies lead to higher earnings, it seems curious that companies would develop proactive environmental strategies as Weyerhaeuser appears to have done. Georgia Pacific's actions gained the company time and might have even saved it pollution control expenditures. Louisiana Pacific's actions allowed the company to deal with the issue quickly while avoiding even worse possible outcomes; during this period the business was in an upward cyclical trend, and EPA could have shut down some of the company's facilities at any time. Both strategies had immediate payoffs for the two companies.

Weyerhaeuser's strategy, however, could not have paid off in the short run. The reason for such actions may lie in the company's long-term investments. Weyerhaeuser's strength lies in adding value to timberlands through 35-80 years of intensive forest management. Beginning in the 1960s, the company began implementing its High Yield Forestry program on its lands in the US Southeast and Pacific Northwest, and those tree farms will be coming to term around the end of the century, up to doubling the yield of its current harvests. This type of long-term, heavy investment is typical of Weyerhaeuser, and may help explain the company's conservative business strategies and proactive environmental management.

In order to achieve high returns on its long-term investments, Weyerhaeuser needs to keep its risks low. Even on issues that do not directly affect the company's timberlands, senior management realize that it is in the company's best interest to maintain friendly relations with the EPA. Short term gains from "foot-

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[34] S Engelberg, 1995, "Tall Timber and the E.P.A.," The New York Times, May 21, Sec.3, p.1.

[35] *Ibid.*

dragging" could create unacceptable long-term risks. Thus a proactive environmental strategy pays off in sustained earnings over the long run, as opposed to the unsustainable high short-term earnings that result from "foot-dragging."

Since this episode, Georgia Pacific has changed its environmental strategy toward a more proactive stance. As CEO A.D. "Pete" Correll states, "There's a strong correlation between future shareholder value and environmental responsibility, and I thought this was a way to add value."[36] The company outlined specific environmental goals, helped to develop the American Forest and Paper Association's Sustainable Forest Principles, and began partnership programs with the Federal government and the environmental community.

[36] A Goodman, 1996, "Out of the Woods," Tomorrow, Nov.-Dec., p. 20.

Section 6

Conclusions

This study began as an attempt to quantitatively measure the effects of environmental regulatory changes upon the forest products industry through an examination of the capital markets. The principal method for such investigations, event studies, was found to be problematic for extensive industry studies over a wide range of issues. Two event studies performed in the course of the study were inconclusive.

Since capital market performance is highly tied to earnings, the relationship between environmental performance and operational and financial performance within the forest products industry was examined next, using TRI data as a proxy for environmental performance. For the period defined in the data, it was found that poor environmental performance was correlated with better operational performance, although this relationship was not seen in an analysis of the financial performance of the companies. There are significant problems with this analysis method as well, but the results match what could have been expected given current theories.

Nevertheless, many companies choose to pursue proactive environmental strategies. It appears that these companies may be looking to enhance their long-term financial performance instead of short-term earnings. The conclusion of this study is that financial sustainability may require proactive responses to a changing regulatory environment.

The issue of capital market performance remains, however. Why would the stock market not reflect the value certain companies obviously see in pro-active environmental strategies? The answer may simply be a difference in discount rates. In light of its strategy to avoid operational risks, Weyerhaeuser may perceive a low discount, or risk, rate for its investments. The company then plans its investments over a long period of time, by which small differences in discount rate can make the difference between an expected profit or expected losses. If the stock market perceives a higher discount rate than the Weyerhaeuser's planners perceive, they will reach greatly different conclusions on expected future earnings. This effect may explain why environmentally responsible companies may not be "rewarded" by the capital markets, even though the industry trend appears to be a movement toward more pro-active environmental strategies.

This study identifies areas where further study is warranted:

1) Effort should be made to quantifiably link *long-term* financial performance to environmental performance. This may not be possible within a concentrated, investment-heavy industry like the forest products industry, so such efforts might focus on industries with shorter business cycles.

2) Other industries representing different segments of the economy should be examined for similar effects as have been identified here.

3) The effects of cost of capital and operational performance on financial performance should be reviewed. This would compliment current efforts to determine possible relationships between environmental performance and both cost of capital and operational performance.

4) Investigation should be made into the possible discount rate disparity between environmentally proactive companies' financial planning and capital markets' analyses.