Is Pollution Profitable?

Environmental Virtue and Reward: Must Stiffer Pollution Controls Hurt Profits?

by Joseph H. Bragdon, Jr. and John A. T. Marlin

Corporate executives sometimes act as if making profits today, under tighter environmental laws, is like stealing cheese from a mousetrap. Is the cheese always in a trap, or is a sound environmental policy sometimes fully compatible with company profits?

Proponents of the mousetrap position argue that corporate managers can either control pollution or maximize profits but that the former can be accomplished only at the expense of the latter. From the investor's perspective, this in turn implies that he can either invest in a profitable company or a "good" company (which protects its environment) but that no company is likely to be both.

Since this attitude is derived from economic theory, we will first review orthodox theories which suggest that pollution control must be a drain on profits, and will then suggest alternative theories. Moving on to the evidence in the pulp and paper industry, we will conclude that at least in this industry there is a strong correlation between companies with a good record in pollution control and companies with a good profit record. We explain the relationship as a reflection of lower costs associated with better pollution control or of differences in management ability. In any case, the good pulp and paper guys (as defined by environmental virtue) win (as defined by financial reward); there is no mousetrap.

Orthodox Economic Model: More Pollution Always Means Less Private Costs

In its most elementary form, economic theory concerns itself with choices among scarce economic goods, for example, between guns and butter. A given society can produce either a certain number of guns *or* a certain number of pounds of butter, *or* some combination of quantities of the two. The usual solution determines how the society can maximize total value by some combination of guns and butter. The solution is almost never to produce one or the other exclusively because the last unit of one will be at the expense of an enormous number of units of the other. The actual amount to be produced depends on the relative prices of each.

This formulation exhibits a great many well-recognized shortcomings, such as the fact that the obviously political issues that are involved (hawks vs. doves) are left out of the model; many more arise as we examine environmental questions and talk of the tradeoffs among goods that do not have established prices, such as producing "clean water" instead of butter. The economist is to be congratulated for forcing the realization that there are always tradeoffs, but he has not been able to provide an adequate answer to the public's question about the impact of pollution control on business and society generally. Only a tangential response has been provided: An estimate of the investment required to meet new pollution control standards (a widely cited estimate by McGraw-Hill for 13 industries in 1971 totalled $16 billion).

As an introduction to the lessons of economics, let us consider two models relating pollution to costs. The first model is an adaptation of the basic two-factor input model, showing how a firm combines two inputs to produce the maximum amount of its output of a given product.[1] We can look at "clean water" as a land input (which is used up when the water reaches a certain degree of saturation with pollutants) along with "investment in pollution control equipment" as the other (capital) input. Economic theory tells us that the tradeoff faced by the firm when pollution control taxes or standards are legislated is: Invest in pollution control equipment or reduce output.

Another model with the same kind of conclusion to this problem is one that appears in an elementary economics text. It shows the costs associated with different pollution levels. The idea is that society doesn't suffer when pollution is low, but that the firm has to spend a great deal to keep it low. At higher levels of pollution the firm's costs are lower, but society has to foot the bill in the form of health hazards, disposal costs, discomfort, and so forth. Private costs are continuously declining, social costs are continuously increasing. The optimum is viewed as a compromise whereby the firm and society each bear an equal cost, because this minimizes total costs. The pollution level (measured by the amount of

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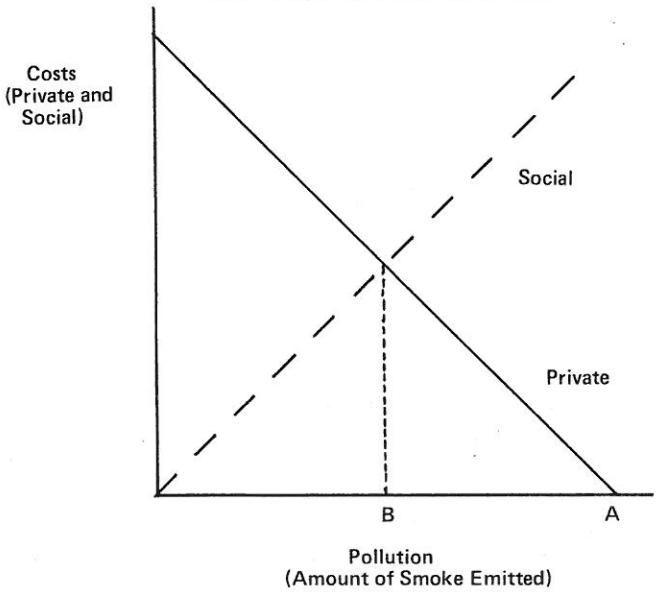
smoke emitted) is then at B, as shown below in Figure 1. The firm would prefer to be at point A; society would prefer to be at the zero pollution point.[2]

Figure 1
Costs of Pollution
Continuously Declining Private Costs



The problem with the model is that it doesn't allow for the possibility at any point that the interests of society and the interests of the firm may be coincident, i.e., that the firm may *sometimes* find that its costs are increasing with pollution and that it may be profitable to reduce that pollution. In the next section we shall look at some of the a priori reasons why it might be reasonable to expect an economic model to allow for this possibility. The following sections will introduce such a model and provide some evidence from the pulp and paper industry in support of the underlying principle.

The Case For the Coincidence of Environmental Virtue and Reward

Since orthodox economic models are all cast in the form of tradeoffs between pollution control and profits, they imply that a manager going beyond (or even complying with) legislation must always be doing so at the expense of profits.

This approach ignores some of the facts of life of the production process, which allows four ways to reduce pollution, only one of which is customarily regarded as a drain on profits: (1) Increase the "conversion rate", i.e., the efficiency with which inputs are processed during production (the lower the wastage, the higher the conversion rate); (2) Sell waste as byproducts for input into other production processes; (3) Buy or accept free the waste of others (including one's own disposed of products) for use as an input; and (4) Treat waste before emitting into the air or water, or discarding to the garbage dump.

Whereas the fourth category, involving scrubbers, electrostatic precipitators and the like, has occupied the attention of economists, the first three are also enormously important and play little part in economic models relating to the environment. Better conversion rates could be achieved by internal recycling, better monitoring of the production cycle, or more efficient equipment. Selling wastes as byproducts constituted the growth stimulus of the petrochemical industry, in which one plant's waste becomes another's mainstay. For example, sulfur removed from oil is used as an input by other industries, including pulp and paper producers. Finding more uses for waste is a tremendous contribution to environmental health, since it makes it easier to reduce the volume of such wastes discharged into the air or into rivers.[3]

The key significance of the environmental movement may be the impetus that it gives to the development of better conversion systems and use of byproducts (including the use of one plant's disposable products as inputs for another plant's recycling). Dow Chemical has said that its pollution control investments have not only paid for themselves but have actually yielded a profit.[4] In part, Dow's achievement is based on the fact that it is including investments made to achieve higher conversion rates as pollution control expenditures, whereas other companies may include only waste treatment; but Dow's method of accounting is surely a fair one from the point of view of society.

There are three arguments that support the view that pollution control and profitability are compatible: (1) Pollution control reduces costs and increases revenues, which together more than offset the investment in equipment or redesign of production processes; (2) Firms with higher profits are better able, and thus more likely, to invest in cleaner plants; and (3) Good managements are likely both to earn higher profits and to be more careful in protecting the environment. Let us look at each of these in turn.

Pollution Control Increases Profits

There are four major ways that a company's pollution control investment can reduce operating costs, and two other ways that profits might be

increased:

1) Lower costs of *raw material inputs* per unit of production, because of recovery and recycling in better designed production processes. In the paper industry, we could point to recovery of wood chips and chemicals.[5]

2) Lower *labor* costs, resulting from improvements in morale, performance, health, lower turnover (with consequently lower training expenses and operating requirements), and reduced health insurance premiums. The incidence of health and accident claims can be expected to be higher for the firms which have records of employees suffering from emphysema and asthma caused by particulate air pollution; unconsciousness, hallucination and amnesia caused, in the paper industry for example, by sulfuric acid mists; and other illnesses caused by consumption of polluted water. Over time, health insurance premiums must reflect these claims. It must be admitted that these potential cost savings become less important in highly industrialized areas for companies that reduce pollution unilaterally. If the company contributes only 1% of the air pollution, its own actions are not likely by themselves to have a significant impact on the working environment of its employees.

3) Lower *taxes and legal* costs, since companies with a good pollution control record are less likely to have long drawn-out battles with community groups and government environmental agencies, incur fines and penalties from government and private suits, and bear increased local taxes resulting from the departure of neighboring taxpayers. At the same time, companies attempting to protect their environment benefit from federal tax write-off provisions and other concessions related to the installation of pollution control equipment

4) Lower costs for *plant and equipment* purchase and maintenance. Companies which attempt to postpone adequate pollution controls will be more likely to have to install pollution control equipment on an emergency basis, after the plant is built. Such equipment can be as much as three times as expensive as it would be if incorporated in a plant from the beginning.[6] Furthermore, better pollution controls may reduce plant maintenance costs: Sulfuric acid mist or sulfur dioxide, for example, have a corrosive effect on equipment. There is a great potential for explosion in plants where there are significant amounts of gas, dust and auxiliary fuel emissions in the air. Grossly unpleasant working conditions also increase the likelihood of employee vandalism, thereby raising maintenance costs. As mentioned above under labor costs, however, there may be a limit to what a company can do to improve its environment on its own.

5) Lower *financing* costs, as a company's good record in the environmental area facilitates the raising of new equity and the funding of debt. There are a number of elements involved here. From the shorter term perspective, commercial banks are looking carefully, in considering loans, at whether pollution control expenditures will hurt projected cash flows (Chase Manhattan, for example, does this on a routine basis for commercial loans); they also may be more willing to commit funds for pollution control expenditures than for other uses (Chemical Bank widely advertises this fact), sometimes at special interest rates. From the longer term perspective, investors in stocks and bonds are becoming increasingly worried about the downside risk associated with companies having a poor pollution control record. This may reduce the price that investors will pay, thereby increasing the cost of capital for companies that pollute.

6) *Higher revenues* from the sale of byproducts which had formerly been discharged as waste, from the sale of regular products to new customers who have switched from companies that pollute, and from the sale of recycled products. In the pulp and paper industry, for example, M.I.T. Press not long ago announced that it would direct its purchases to paper suppliers who showed greater environmental concern. The director of the Press, Howard Webber, implemented this policy to the extent made possible by a report of the Council on Economic Priorities, a New York-based non-profit research organization (CEP), Paper Profits, (which the Press will publish in late 1972), and by personal visits to the plants of suppliers to the Press. A number of large companies used recycled paper for their 1971 annual report, federal and local governments are specifying recycled paper, and at least four publishers either are now using or are considering using recycled paper.[7]

Profits Permit Pollution Control

There are two kinds of arguments for saying that a company's pollution control record is a function of its prior profitability. The first, and weaker, argument is that it takes money to buy pollution control equipment and only the richer companies can afford such a luxury. This argument is weak because higher conversion rates and sale of byproducts reduce costs and even gross costs of waste treatment systems are unlikely to exceed 10% of total investment when amortized over their lives. Furthermore, in the pulp and paper industry at least, profits were fairly high at the turn of the decade (16 of the 17 companies we shall be analyzing earned at least 4% on net assets), and they are understated because of unrealized gains in timber holdings. More important, even in situations such as the steel industry where profits are not high, we must ask the question: What were companies doing when profits were higher? Failure to modernize steel company plants and raise conversion rates re-

sulted both in higher pollution and lower profits. In the paper industry, the two pollution control leaders (as evaluated by CEP), Weyerhaeuser and Owens-Illinois, both adopted their environmental stance in the 1940s, long before they also became profit leaders. By contrast, International Paper was a profit leader for many years without cleaning up its mills. It is true that all of the 17 paper companies which we will discuss below are registered on the New York Stock Exchange, and are therefore preselected as being older and larger firms; but within this size range there does not seem to be any basis for saying that any of the companies was too poor in the 1960s to afford new pollution control equipment. That is, pollution control does not seem to have been limited by profits; it seems to have been an independent management decision.

A second, more sophisticated, argument carries more weight: Rapidly growing firms will have a greater proportion of their investment turning over. The average age of their plants is therefore likely to be lower than for stable firms, and the equipment in use is likely to be newer and better designed (i.e., with higher conversion rates) than that of older firms. Since older equipment is less efficient both because of wear and tear and because of obsolescence, one would expect less rapidly growing firms to be using less efficient, and therefore more polluting, production methods. Profits, however, provide a measure of and impetus to the growth of a firm, so that there is a possibility that better pollution control results from profits via the firm's capital growth.[8]

Pollution Control and Profits Depend on Management

We have looked at the possibility that pollution controls affect profits, and the possibility that profits affect pollution controls. There is a third possible way of explaining a relationship between a good profit record and a good pollution control record: Both are a consequence of good management. Creativity in dealing with pollution problems is likely to follow from general management competence, understanding of the ability to influence their environment, and an ability to respond creatively to public pressures for change.

We can see these elements at work in the case of the steel industry, which failed to modernize in the postwar period and thereby chalked up a poor record in both pollution control and profitability. While Japanese and European firms were investing in new equipment with high conversion ratios (and therefore lower pollution levels), American steel companies refused to change over to the new technology. The problems of the steel industry today must be viewed as a consequence of poor management and not as a good argument for permits to continue their past levels of pollution.

A New Economic Model: The U-Shaped Private Cost Curve

In view of the three arguments relating good environmental policies to good profits, there seems to be some justification for modifying economic models to allow for the possibility that reducing pollution can, under certain conditions, be profitable.

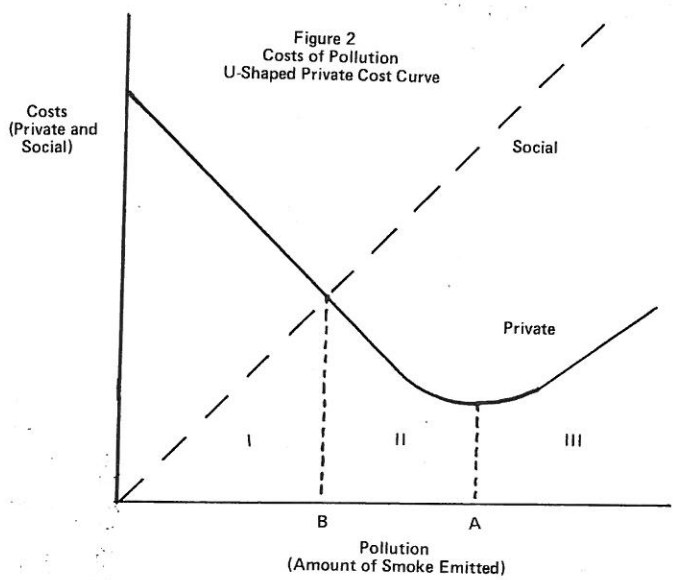
Except in the unlikely event that society were to shift entirely to an economy based on crafts, agriculture and services, approaching zero pollution would mean a tremendous drop in employment, personal income and consumption. To a certain extent, therefore, private costs correspond to a kind of social cost, namely the cost of reducing society's standard of living. When we speak of social cost, therefore, we must be understood as restricting ourselves primarily to health and waste disposal costs (i.e., of consumer goods or packaging). If we were to draw in a social welfare cost line, it would correspond to the private cost line, so it is enough to point out that such a cost is a real one and that to this extent what is good for business is also what is good for society.

Turning to the private cost line, we could argue that there is a point of extreme pollution at which the costs to the firm of pollution stop going down and begin to turn up: That is, when the firm's nest is so fouled that production is impeded, employees become significantly less productive, and society takes countermeasures such as legislation or private law suits. We have already discussed at length the kinds of costs that can increase with extreme levels of pollution.

If private costs stop falling, we can identify point A where they are at a minimum. At point B, private and social costs are equal. In Stage I, up to point B, the situation is much as in the orthodox model, although the income or living standard costs are not taken into account. In Stage II, the difference is that private costs start to fall at a slower rate. In Stage III private costs start to increase. This is shown in Figure 2.

The reason for the increase in private costs in Stage III is that a company's poor pollution record will hurt its ability to attract financing or good employees; employee productivity will be reduced; regulatory agencies and community groups will begin to take action against the company; consumers may buy elsewhere; and so forth.

Our main purpose has been achieved by the model in Figure 2. We can now explain the phenomenon of pollution control being profitable as a move from some point in Stage III toward either a minimum private cost point (A) or toward a private-social optimum (B). We can now proceed to an examination of the evidence regarding the relationship between pollution control and profitability in the pulp and paper industry.



The Case of the Pulp and Paper Industry

Let us examine the evidence against the mousetrap view, that pollution control is incompatible with profits in the pulp and paper industry. The industry was selected for two reasons: First, it is one in which corporate executives do have some control over their own environment. Most paper mills are located in one-company towns away from industrial centers. Pollution by a paper company is easily identified with the company, and has a strong and corrigible impact on working and living conditions in the area. Other industries would find it more difficult to affect their environment unilaterally.

Second, pulp and paper is the only major industry on which good information has been made available comparing company pollution records. A study was conducted assessing the pollution control records of 131 virgin pulp mills of 24 pulp and paper companies by CEP. The CEP will also be releasing similar studies of the electric utilities and steel industries this year, but in the meantime only one well documented pollution study is available.

Data and Methodology

For our study, we excluded seven of the 24 companies covered by the CEP, thereby removing 21 mills from the total of 131. The companies were excluded on the grounds that they were too small in some cases (two companies had only one mill each; none had more than five), that they had a small proportion of their sales in the pulp and paper sector (American Can and Continental Can, for example), and that in all cases their pollution control records were considered average by the CEP.

The pollution records of the 17 companies were compared to their profit records. Pollution control adequacy is measured by three indices derived from the CEP study. The percentage of plants with adequate water pollution controls was calculated for each company. The same was done for two measures of air pollution: Particulates, and a combined measure of gas and odor emissions. Using an average of the three percentages gives us Index A. Weighting the percentage for water pollution twice as heavily as each of the air pollution percentages gives us Index B. Index C is a number from 1 to 3 indicating good, average, or poor, signifying CEP's evaluation of companies' overall performance in pollution control.[9]

Profits are measured in five different ways: Earnings growth during the 1965-70 period; average earnings per share growth (estimated) between 1970 and 1971; average return on equity (ROE) 1965-70; average return on capital (ROC) 1965-70; and earnings net worth (ROE) 1970.[10] These measures of earnings each provide a slightly different view of a firm's profitability. The three five-year averages have the advantage that they show sustained profitability. The two single-year figures (one projected in 1971) indicate a firm's most recent profit record and its profit potential. Earnings figures related to equity or capital (equity plus long-term debt) show the return on shareholders' and bondholders' investment.

The study was complicated by two considerations. First, some of the companies were heavily involved in mergers during the 1965-70 period. This is important because the pollution records of the companies that merged may have been quite dissimilar, as was the case with Great Northern and Nekoosa Edwards, which merged into Great Northern Nekoosa, and also because the mergers may have had a significant impact on earnings (the company may have bought "cheap" earnings, a firm with a lower P/E ratio). See Appendix I for further information on merger activities.

Second, the proportion of pulp and paper sales to the total sales of the different firms varies. Ideally, we would have liked to separate out the pulp and paper sales of the different companies, and obtain a profit figure for this division of each company.

However, the companies do not have uniform methods of reporting on their pulp and paper profits. The average proportion of pulp and paper sales to total sales, on the other hand, is over 60%, so that we can say with some confidence that the companies are by and large pulp and paper companies. Furthermore, it can be argued that the four companies with proportions less than 40% — Owens-Illinois, Weyerhaeuser, Boise Cascade and Georgia Pacific — have all shown consistent patterns of environmental behavior throughout their operations, so that one would expect the pollution control indices to reflect top management attitudes rather than divisional decisions. Further details on the importance of pulp and paper operations in the different companies are shown in Appendix II.

TABLE 1

EARNINGS AND POLLUTION CONTROL INDICES
COMPANIES LISTED IN ORDER OF EPS GROWTH

Company (no. of plants investigated)	EPS Growth 1965-70[f] %	EPS Growth 70-71(est.)[a] %	Average ROE 1965-70[f]	Average Return on Capital 1965-70[f]	ROE 1970[s]	Pollution Control Indices (%)[b] A	B	C
Weyerhaeuser (10)	9.4	28.3	13.7	11.7	13.2	73	71	Good
Georgia-Pac (9)	5.7	34.6	15.8	8.3	12.6	53	59	Ave.
Union Camp (3)	5.0	7.3	12.2	8.8	11.2	50	47	Ave.
Grt Nor Nekoosa (6)[m]	4.9	-0.5	n.a.	n.a.	7.7	30	30	Ave.
Owens-Illinois (4)	3.9	15.4	11.6	7.0	8.9	96	95	Good
Diamond Int (4)[m]	2.3	5.1	15.0	13.1	12.6	25	25	Poor
Int'l Paper (15)	1.4	2.7	9.6	8.7	7.8	37	39	Ave.
Kimberly Clark (5)	0.9	6.7	9.5	7.9	6.7	21	26	Ave.
Scott (10)	0.9	2.1	11.6	9.4	9.5	51	32	Ave.
St. Regis (9)	0.4	-3.9	7.6	6.1	6.0	34	36	Poor
Crown Zellerbach (9)	-1.8	1.7	10.3	7.3	7.5	71	70	Ave.
Hammermill (4)	-2.3	17.6	10.2	7.2	6.1	33	30	Ave.
Westvaco (6)	-2.4	-25.9	9.2	6.7	6.5	51	48	Ave.
Boise Cascade (6)[m]	-3.1	45.8	n.a.	n.a.	4.0	30	30	Ave.
Potlatch (2)	-8.9	n.a.	6.9	5.6	8.8	25	20	Poor
U.S. Ply-Champion (2)[m]	-10.7	44.3	10.2	7.3	6.4	66	60	Ave.
Mead (6)[m]	-12.3	64.3	7.7	6.8	2.9	61	63	Ave.

a. Source: H.C. Wainwright & Co. and Standard & Poor's, as of mid-1971.
b. Source: Council on Economic Priorities, *Economic Priorities Report,* 1:6 (December-January, 1971), Tables 4-6, pp. 21-23 (for Indices A and B) and pp. 13-14 (for Index C). In calculating Indices A and B, the percentage of plants for which pollution controls were adequate was determined for each company in three categories: (1) Water pollution, (2) Particulate air pollution, and (3) Gas and odor emission. For Index A, an average is used weighting each of the three percentages equally. For Index B, water is weighted twice as heavily as each of the two air pollution categories, giving water equal importance with air.
f. Source: *Forbes Magazine.* Twenty-third Annual Report on American Industry, January 1, 1971. Average of previous five years' growth in earnings per share, return on equity (net worth), and return on capital (debt plus equity).
m. These five companies were heavily involved in mergers during the period 1965-70.
s. Source: Standard & Poor's.

TABLE 2

RELATIVE EARNINGS AND POLLUTION POSITIONS[a]
COMPANIES LISTED IN ORDER OF EPS GROWTH

Company (tons of pulp produced daily by plants investigated)	EPS Growth (per cent) 1965-70	EPS Growth (per cent) 70-71 (est.)	Average ROE 1965-70	Average ROC 1965-70	ROE 1970	Pollution Control Indices A	B	C[b]
Weyerhaeuser (6,150)	1	5	3	2	1	2	2	1
Georgia-Pac (5,470)	2	4	1	6	2	6	6	2
Union Camp (5,000)	3	8	4	4	4	9	8	2
Grt Nor Nekoosa[m] (5,190)	4	14	—	—	9	13	12	2
Owens-Illinois (2,830)	5	7	5	11	6	1	1	1
Diamond Int[m] (630)[x]	6	10	2	1	2	15	16	3
Int'l Paper (16,520)	7	11	10	5	8	10	9	2
Kimberly Clark (2,019)	8	9	11	7	11	17	15	2
Scott (4,634)	9	12	5	3	5	7	11	2
St. Regis (5,655)	10	15	14	14	15	11	10	3
Crown Zellerbach (6,205)	11	13	7	8	10	3	3	2
Hammermill (1,360)	12	6	8	10	14	12	12	2
Westvaco (5,004)	13	16	12	13	12	7	7	2
Boise Cascade[m] (4,015)	14	2	—	—	16	13	12	2
Potlatch (1,255)	15	—	15	15	7	15	17	3
U.S. Ply-Champion[m] (2,165)	16	3	8	8	13	4	5	2
Mead[m] (1,675)	17	1	13	12	17	5	4	2

a. For sources, see Table 2. Pulp production figures are from CEP, *Economic Priorities Report,* 1:6, p. 16.
b. A score of 1 is highest, indicating a CEP rating of "good" for performance in controlling pollution; 2 is average; and 3 is lowest, indicating rating of "poor" for pollution control.
m. These five companies were heavily involved in mergers during the period 1965-70.
x. Production figures for only two out of four plants.

Results

Tables setting forth the results of the comparison are provided on the facing page. Table 1 shows the actual percentage growth in earnings per share, the percentage of plants which are adequately controlled, and the overall rating. Table 2 shows the relative position of the different firms compared to other firms in the industry.

First, three general comments about the two tables: Of the top five performers as measured by *1965-70 earnings growth*, four had above-average pollution control records (using Index B). The one company which had a bad overall pollution record, Great Northern Nekoosa, was the result of a merger between two companies with distinctly different environmental records (Great Northern having a good record, Nekoosa Edwards not).

Of the top five performers in *1970-71 expected earnings growth*, four had above-average pollution records using Index A or Index B. The exception, Boise Cascade, is again one of the companies with heavy merger involvement, and Boise's 1970 earnings were understated because of a write-down of losses on real estate operations.[11]

Finally, both of the firms given an overall good rating by CEP for their environmental record (Index C) were among the top five earnings performers during 1965-70. The worst-rated company, Potlatch, had the lowest earnings performance during the period except for two companies heavily involved in mergers.

The above "eyeball" comments, however, do not represent a valid statistical test. For the latter we must calculate correlations between pollution control records and measures of financial performance. Since our primary interest is in the *relative* performance of the different companies, we can correlate the ranks of the different companies for each measure. If pollution control were incompatible with profitability, one would expect significant *negative* coefficients. If it is compatible, the coefficients should be significantly *positive*. If there is no relationship one way or another, the coefficients will have mixed signs and will not be significant.

If we correlate the pollution control indices with the profitability indices for all 17 companies, our results are not very interesting. All of the coefficients are positive, supporting the thesis that pollution control and profitability are compatible, but Index C is the only one with coefficients significant at the 90% confidence level.

However, if we exclude the five firms which were heavily involved in mergers, for the reasons outlined earlier in this section, the results change dramatically. Two-thirds of the coefficients are now significant at the 95% confidence level, as shown in Table 3.

TABLE 3

RANK CORRELATIONS: POLLUTION CONTROL VS. PROFITS[a]

(Merged Firms Excluded)

	EPS Growth		ROE		ROC
	65-70	70-71	65-70	70	65-70
Index A	.514[b]	.223	.682[b]	.546[b]	.329
Index B	.560[b]	.227	.623[b]	.434	.259
Index C	.628[b]	.557[b]	.691[b]	.502[b]	.544[b]

a. For the original data, see Tables 1 and 2. The values are Spearman rank correlation coefficients, based on the rank of each company relative to the other eleven companies in the sample. Tied values were averaged, so that two 8s would average to 8.5 (average of 8 and 9).

b. Significant at 95% confidence level, one-tailed test.

All of the profitability measures correlate at the 95% confidence level with Index C. All of the pollution control indices correlate at the 95% confidence level or higher with EPS Growth 1965-70 and ROE 1965-70.

Conclusions

In the paper industry, at least, the gross evidence seems to refute the mousetrap view of the incompatibility between environmental virtue and financial reward. Obviously it would be desirable to try to pinpoint the relationship more closely. To what extent does pollution control really reduce costs? One would like to relate profits on a plant basis to the capacity utilization (production/investment) of that plant, to the density of population in the area, to product mix, and age of plant as well as an overall measure of pollution control. However, information on profits is not available by company division, let alone plant.

Another direction for further study is the coverage of a larger number of firms. Without more companies, it is difficult to apply statistical tests to such questions as the simultaneous determination of pollution control by age of plant, and age of plant by growth in profits.

In the meantime, however, we hope that we have made a step in the direction of laying to rest the economic model which poses the alternative, on the level of the firm, of either increasing pollution control or increasing profits. Some degree of pollution control is likely to increase profits. The cheese of better environmental performance is there with no traps attached. Virtue in this case is not its own reward.

FOOTNOTES

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1. For Example, see Richard H. Leftwich, *The price System and Resource Allocation* (New York: Holt, Rinehart and Winston, 1966), pp. 117-125.
2. Royall Brandis, *Principles of Economics* (Homewood, Illinois: Irwin, 1972), p. 579. Private costs can be thought of as per unit operating expenses, and social costs as per person medical and garbage disposal costs. To avoid complex diagrams, marginal costs have been assumed to be equal to average costs: The optimum at pollution level B is based on marginal cost analysis (if the costs shown were average costs, the optimum would be at a lower pollution level), while the private cost minimum at pollution level A in Figure 2 is based on average cost analysis (if the costs shown were marginal costs, the minimum would be at a higher pollution level). A complete diagram and discussion is available from the authors. See also Abba P. Lerner, "The 1971 Report of the President's Council of Economic Advisers: Priorities and Efficiency," *American Economic Review,* LXI:4 (September, 1971), pp. 527-530.
3. Some progress in this direction has been made by the pulp and paper industry. Conversion from the sulfite to the kraft process reduces waste because the latter process produces a lower volume of waste. Sulfite liquor has been used to make vanillin (a synthetic byproduct from softwoods) and a new wonder drug, L-DOPA, developed by Georgia-Pacific's labs in Bellingham, Washington *(Pulp and Paper,* July, 1971, p.99). Kraft liquor has been used for over 20 years to make tall oil, which is broken down into fatty and resin acid, and turpentine; more recently, a Crown Zellerbach mill has produced DMSO, a drug for skin treatment, from its kraft liquor. The most interesting development of all is, perhaps, the use of municipal garbage as an input into paper production in the St. Regis plant in Franklin, Ohio (St. Regis Made Paper from Fiber Retrieved out of Raw Garbage," *Wall Street Journal,* January 14, 1972), producing a high-quality paper which is 30-50% garbage.
4. "Dow Cleans Up Pollution at No Net Cost," *Business Week,* January 1, 1972, pp. 32-35.
5. Virtually all pulp and paper companies now recycle wood chips, in part because of an increase in their value and in part because of new state laws against past methods of burning them. An economic survey by the Northwest Pulp and Paper Association states that 75% of the raw materials for pulp and paper plants in Oregon and Washington in 1970 were in the form of wood chips or sawdust *(Pulp and Paper,* September, 1971, p. 17).
6. Council on Economic Priorities, *Paper Profits,* researched and written by Leslie Allan, Eileen Kohl Kaufman and Joanna Underwood (New York: CEP, 1970), p. 34.
7. Bank of America, Coca Cola and Canada Dry used recycled paper in 1971 annual reports. New York City ordered $350,000 in recycled paper. The Government Printing Office, Western Electric (publisher of millions of phone books), Simon & Schuster, McGraw-Hill, Encyclopedia Britannica and Harcourt, Brace and Jovanovich were either using or considering using recycled papers in 1971. *Business Week,* July 17, 1971, p. 86.
8. See footnote 6 above. The full-length report was summarized in CEP, *Economics Priorities Report,* 1:6 (December-January 1971).
9. CEP, *Economic Priorities Report,* 1:6, Tables 4-6, pp. 21-23, and pp. 13-14.
10. Most of the profitability information is from *Forbes Magazine,* Twenty-Third Annual Report on American Industry, January, 1971.
11. Boise Cascade 1970 losses were largely due to the underestimation of consumer and environmentalist reaction to their real estate developments and new state and federal environmental regulations. These factors created public relations and new development costs that reduced profit margins. Since the Boise-Burnett real estate subsidiary was heavily debt-financed, the costs and delays of these circumstances forced liquidations to meet amortization costs, at unfavorable prices. In terms of our theory that the relative pollution records of company paper and pulping divisions reflect broad company policy, the Boise-Burnett example is interesting. The parent company shows a poor pollution control rating in terms of Indices A and B.

APPENDIX I

SIGNIFICANT MERGER AND ACQUISITION ACTIVITIES, 1965-1970

EPS Effects Evaluated 1971

1. **Boise Cascade** merged: Minnesota and Ontario Paper Co. (1965), R.C. Can Corp. (1967), Divco Wayne Corp. (1968), and Union Lumber Co. (1969). Acquisitions include: Ebasco Industries (1969), CRM Corp. (1970); various real-estate and recreational land operations were acquired in 1966-68. Effects on EPS: favorable through 1969 (in 1970 the company began realizing losses on some real estate operations).
2. **Diamond International** acquired Heekan Can Company (1965), merged Penobscot Co. (1967), acquired Groveton and Mohawk Cos. (1968), and acquired U.S. Playing Card (1969). In particular, Groveton, Heekan and U.S. Playing Card helped 1970 results. Effects on EPS: favorable.
3. **Great Northern Nekoosa** was formed in 1970 by the merger of Great Northern Paper Company and Nekoosa Edwards Paper Co. The merger is expected to strengthen long term prospects. Effects on EPS: neutral to favorable.
4. **Mead** acquired 15 companies during 1968/69. Two major acquisitions, Woodward Corp. and Stanley Furniture, and some of the minor acquisitions have suffered setbacks since consolidation, contributing to significant earnings per share deterioration. Effects on EPS: unfavorable.
5. **U.S. Plywood-Champion** was formed in 1967 by the merger of U.S. Plywood Corp. and Champion Papers, Inc. Acquisitions include: Drexel Enterprises (1968), Birmingham Ornamental Iron and Trend Industries (1969), Roberts Consolidated and Path Fork Harlan Coal Co. (1970). Effects on EPS: neutral to unfavorable.

APPENDIX II

IMPORTANCE OF PAPER/PULP OPERATIONS IN COMPANIES' SALES

Company	Paper/Pulp and Related Products as % of Total Sales[a]	
Crown Zellerbach	nearly 100%	(various paper products)
International Paper	nearly 100%	(various paper products)
Hammermill	nearly 100%	(paper, packaging, pulp)
Westvaco	nearly 100%	(paper, paperboard)
Scott	85%	(paper, tissues)
Kimberly Clark	38-80%	(paper, consumer products)
St. Regis	74%	(paper, paperboard, packaging)
Potlatch[c]	63%	(paper, paperboard, packaging)
Diamond International	62%	(paper, pulp, packaging, consumer)
Great Northern Nekoosa	50%	(paper, newsprint, containerboard)
Union Camp	47%	(primary paper mill products)
Weyerhaeuser	22%-44%	(pulp, paper, paperboard)
Mead	42%	(paper, paperboard)
U.S. Plywood-Champion	40%	(paper and allied products)
Georgia Pacific	29%	(pulp and paper)
Boise Cascade	28%	(paper and packaging)
Owens-Illinois[b]	19%	(forest products)

a. Source: Moody's *Handbook of Common Stocks,* 1971 editions (except for Potlatch).
b. Owens-Illinois' forest Products Division manufactures mostly containerboard, pulpwood and bags. Plywood and composite cans are included in the 19% figure.
c. Source: Standard & Poor's Corp., *NYSE Stock Reports,* 38:170.