How Large and Small Plants Fare under Environmental Regulation

B. Peter Pashigian

I T IS WIDELY THOUGHT that environmental controls are guided by the public-spirited ideal of correcting for "negative externalities"—the pollution costs that spill over from private operations. This view is not wrong, by any means. But it is suspiciously incomplete. After all, there are numerous studies of regulatory programs in other fields that show how private interests have used public powers for their own enrichment. Yet the notion still persists that environmental regulation is different —that in this field, if in no other, private self-interest is what is being controlled, not what is doing the controlling.

Observers who are closer to the scene are more skeptical. Analyses of congressional testimony and of votes on key bills reveal fundamental conflicts over environmental policy between developed and developing regions of the country, between urban and rural areas, and between low- and high-sulfur coal producers, as well as between the environmentalists and both employers and employees in pollution-creating industries. All this should tip us off to the fact that more is involved here than the correction of negative externalities.

Another type of potential interest group conflict over environmental regulation is between large and small plants and companies

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within an industry. There are many reasons why the cost of complying with environmental rules might affect the survival rates of large and small plants differently. Large plants, for example, may enjoy an advantage over small plants because they can comply with the rules more efficiently. On the other hand, small plants could benefit from environmental regulation if they are monitored less frequently and less carefully than large plants.

Surprisingly, there has been no comprehensive and systematic study of these differential effects. Economic impact statements of proposed standards sometimes make a stab at assessing the likely effects on small and large plants, but are limited to particular and usually narrow regulatory areas and at times are superficially done. The Environmental Protection Agency's sporadic reports on the subject conclude that few plant closings are due to environmental regulation. The general view, apparently, is that the effects of environmental regulation on the number and size of plants are small, probably not worth serious inquiry.

An Unlikely Proposition Evaluated

This seems a dubious proposition. To examine it, I first identified manufacturing industries with important emission and water discharge problems and those with few problems, and then made a number of comparisons between those industries. The results are disquieting, for they show, among other things, that envi-

Table 1
INDUSTRIES WITH THE HIGHEST AND LOWEST RATIOS
OF POLLUTION ABATEMENT COSTS TO VALUE ADDED,
1974, 1975, 1977

20 Highest-Cost Industries	Ratio	20 Lowest-Cost Industries	Ratio
Primary copper	8.72	Fabricated pipe and	
Primary zinc	7.14	fittings	0.09
Petroleum refining	5.87	Fabricated structural	
Electrometallurgical		metal	0.09
products	5.75	Conveying equipment	0.09
Inorganic pigment	5.58	Luggage	0.09
Primary lead	5.42	Signs and displays	0.08
Pulp mills	4.74	Women's handbags	0.08
Lime	4.74	Jewelers' materials	0.08
Phosphatic fertilizers	4.71	Blankbooks and loose-	
Explosives	4.68	leaf binders	0.08
Carbon black	4.65	Set-up paperboard	
Hydraulic cement	4.55	boxes	0.07
Paper board mills	4.27	Industrial furnaces, ovens	0.07
Cyclic crudes and		Hoists, cranes, etc.	0.06
intermediates	4.02	Jewelry, precious	
Paper mills (excluding		metals	0.06
building paper)	3.63	Newspapers	0.06
Minerals, ground or		Industrial patterns	0.06
treated	3.38	Special dies & tools	0.06
Primary aluminum	3.13	Book publishing	0.05
Blast furnaces and		Typesetting	0.04
steel mills	2.99	Misc. publishing	0.02
Mineral wool	2.76	Periodicals	0.02
Wet corn milling	2.73	Lace goods	0.00
Average	4.67	Average	0.06

Note: Ratios are weighted averages for the three years.

Sources: U.S. Bureau of Census, *Census of Manufacturing* (1977), *Annual Survey* (various issues), and *Pollution Abatement Costs & Expenditures,* Industrial Reports (MA-200, 1974-1978).

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For a measure of the direct costs of regulation to an industry, I took gross annual pollution abatement costs as a percent of industry value added. (Value added, which is one gauge of industry output, is the difference between the value of sales and the cost of purchased materials.) Table 1 shows the twenty industries (four-digit census manufacturing industries) with the highest ratios of abatement costs to value added for the years 1974, 1975, and 1977, and the twenty with the lowest.* A glance at the table shows that environmental regulation has had a very uneven impact on the manufacturing sector, saddling some indus-

tries with heavy compliance expenditures—as much as 8.7 percent of value added for copper—and others hardly at all.

Table 2 gives descriptive statistics for the two groups of industries and for a larger group of 220 four-digit manufacturing industries.* As of 1977, the plants and companies in our high abatement-cost industries were fewer in number but larger in size than either those of the representative sample or those of the low abatement-cost industries. They also used relatively less labor (comparing the ratios of payroll to value added) and more energy.

Of course, a single snaphot of the different industries cannot prove anything about the effects of environmental regulation. That is why it is important to look at the changes that occurred between 1972 and 1977—the critical period that followed the passage of the Clean Air Act (1970) and the Clean Water Amendments (1972). During that period, as the top half of Table 3 shows, the number of plants and companies in the high abatement-cost industries decreased, while the number of plants and companies in average and low abatement-cost industries increased. Moreover, average plant or firm size more than doubled in the high abatement-cost industries, but rose only about half as rapidly in the other industry groups.

In some ways these are puzzling changes. Note particularly that, of our three groups, the high abatement-cost industries were actually growing the fastest (as measured by value added), even though they ended up with fewer plants and fewer companies than before. Since growth in industry output is usually correlated with growth in the number of plants, this is an unusual outcome and would have to have been caused by some outside factor like regulation.

It should also be noted that labor intensity (payroll as a percentage of value added) de-

*The four-digit census definitions have, of course, varied over time. But all of the industries included in the 20-industry groups and in the 220-industry group had reasonably uniform definitions for, respectively, 1958-77 and 1963-77.

clined more in the high abatement-cost industries. To put the point differently, in the industries with relatively high costs, labor's share of product fell relatively more and capital's share consequently grew more than in the other two groups. There are two reasons why environmental regulation might bring about such an effect. First, compliance itself could be a capital-intensive activity. Second, the fact that pollution restrictions, notably EPA's new source performance standards, are more severe for new than for existing plants has raised the costs of entry for new plants—which, in turn, could have enabled existing plants to earn "rents" (a larger return on their existing capi-

Table 2
SELECTED CHARACTERISTICS OF HIGH AND LOW ABATEMENT-COST INDUSTRIES AND OF 220 INDUSTRY SAMPLE, 1977

Variable	20 High Abatement-Cost Industries	220 Industry Sample	20 Low Abatement-Cost Industries
Number of plants	154	702	1,934
Number of companies	94	626	1,827
Value added per plant (millions)	16.7	5.0	0.9
Value added per company (millions)	34.2	8.3	1.0
Ratio of total payroll to value added	0.34	0.42	0.48
Ratio of purchased energy consumed to value added	0.28	0.07	0.02

Note: Data are mean values.
Source: U.S. Bureau of Census, *Census of Manufacturers,* 1977.

Table 3
PERCENTAGE CHANGES IN SELECTED CHARACTERISTICS BEFORE AND AFTER REGULATION

Variable	20 High Abatement-Cost Industries	220 Industry Sample	20 Low Abatement-Cost Industries
Percent change, 1972 to 1977			
Number of plants	−5.9	5.6	13.6
Number of companies	−4.9	5.1	12.9
Value added per plant	105.9	54.5	44.7
Value added per company	114.9	57.1	64.1
Payroll to value added	−12.2	−6.6	−9.4
Industry value added	84.6	60.2	64.1
Percent change, 1963 to 1967			
Number of plants	9.3	3.2	5.2
Number of companies	−4.9	5.2	1.2
Value added per plant	24.0	33.5	44.6
Value added per company	28.2	35.6	48.1
Payroll to value added	18.5	27.9	38.1
Industry value added	32.7	35.7	50.9

Note: Data are mean values.
Source: U.S. Bureau of Census, *Census of Manufacturers,* 1958, 1963, 1967, 1972, and 1977.

tal than before). That could have had the effect of raising capital's share of industry product.

But it might be reasonably objected that looking at just one period, 1972–77, gives a false picture. Perhaps these trends, though odd and unexpected, were simply a continuation of what was going on before 1972. If the number of plants in the high abatement-cost industries had been declining before 1970, and plant size had been growing more rapidly, environmental regulation might not be the culprit at all, but only a proxy for other unknown factors. To check out this possibility, I also looked at a period before regulation, 1963–67 (bottom of Table 3), and compared it with 1972–77.

It turned out that the number of *companies* in the high abatement-cost industries was already in decline in 1963–67, so the fact that it continued to decline in 1972–77 may not be due solely to environmental regulation. On the other hand, in 1963–67, the number of *plants* was rising more rapidly in those industries than in the 220-industry sample or in the low abatement-cost industries, while plant and company sizes were rising less rapidly than in the other two groups. These trends were reversed in the 1972–77 regulatory period. Finally, labor intensity increased for all groups in 1963–67, whereas it fell for all groups in 1972–77. While it is unclear why labor intensity behaved in this way, its smaller increase in the high abatement-cost industries in the first period and larger decline in the second might be due to factors other than environmental regulation.

A More Rigorous Test

On balance, this evidence seems fairly conclusive. Still, the first half of the 1970s witnessed two other changes—the rise in real energy prices and the creation of the Occupational Safety and Health Administration (OSHA)—that may also have affected manufacturing industries. A more discerning test was required to disentangle the separate effects and to find out whether environmental regulation was merely a proxy for other changes going on at the time or was a significant influence on the outcomes.

Accordingly, I undertook a multiple regression analysis that examined the effects of environmental regulation on labor intensity,

the number of plants, and plant size in the 220 industries for the periods 1963–67 and 1972–77, while controlling for real energy prices, growth in market size, and OSHA regulation. The results showed that environmental regulation had a significant effect during the regulatory period. That is, higher relative abatement costs reduced the number of plants and labor intensity and raised plant size between 1972 and 1977. Moreover, the results made it clear that industries with larger increases in energy costs relative to output had larger decreases in plant size and greater shifts to labor-intensive methods of production. In other words, the impact of higher energy costs tended to offset the trends toward higher average size and capital intensity in the high abatement-cost industries. Finally, OSHA regulation was of less importance than environmental regulation in explaining these changes; indeed, the direction of its effect was uncertain. Overall, compliance with environmental regulation was found to be a major cause of the observed 1972–77 changes in the number of plants, in plant sizes, and in capital intensity for manufacturing industries.

Small-Plant versus Large-Plant Experience

While the number of plants declined in the high abatement-cost industries from 1972 to 1977, average plant size increased, which implies that plant closings came disproportionately from among smaller plants. One way to confirm this implication is to determine what happened to the size distribution of plants in our high and low abatement-cost industries by measuring the dispersion of plant sizes in an industry relative to the average plant size (the coefficient of variation).** If the adverse effects of environmental regulation were felt disproportionately by small plants, the dispersion of plant sizes in the high-cost industries would have declined, and average plant size would have increased in 1972–77 as small plants withdrew. That is, there would be fewer plants at the ends of the spectrum, so the dispersion of plant sizes would be smaller and the average size of the remaining plants would be larger.

Table 4

PERCENTAGE CHANGES IN THE MARKET SHARE
OF SMALL, MEDIUM, AND LARGE PLANTS, 1958–77

	20 High Abatement-Cost Industries			20 Low Abatement-Cost Industries		
	Small plants	Medium plants	Large plants	Small plants	Medium plants	Large plants
Mean market shares[a]						
1958	25	50	25	25	50	25
1963	27.5	47.6	25.1	27.1	47.8	25.1
1967	29.5	45.3	25.2	26.6	45.1	28.3
1972	30.2	42.8	26.9	25.5	47.0	27.5
1977	25.0	45.4	29.7	27.4	46.1	26.6
No. of industries with declining market share						
1958–72	7	16	8	11	15	7
1972–77	12	10	6	6	9	13

a May not add to 100 because of rounding.

The results confirm some of the earlier findings. During the period before regulation, relative plant-size dispersion rose on average by 4.8 percent for the high-cost industries and fell by 2.7 percent for low-cost industries. During the regulatory period, this pattern was reversed, with relative dispersion falling by 7.7 percent in the high-cost group and rising by 2.7 percent in the low-cost group. In other words, in the years before regulation, there was an increasing spread of plant sizes in the high-pollution industries and just the opposite in the low-pollution industries. In the later years, by contrast, the former were losing their smallest plants while the latter were not.

A second test for the effect of environmental regulation on small plants is based on the change in small-plant market share. For this test, plants were divided into three employment-size classes—small, medium, and large—with the limits selected so that in 1958, the base year, 25 percent of the plants in each industry were small and 25 percent large. As Table 4 shows, in the high-cost industries, the mean market share of plants in the small size class rose between 1958 and 1972, with much of the rise coming at the expense of the medium-size plants. In the low-pollution industries, the small-plant share held almost constant, while large plants took a little business away from medium plants. It would thus ap-

**The method used here involved, first, calculating the coefficient of variation for each industry in 1958, 1972, and 1977, and then calculating the percentage change in this coefficient of variation for each industry for 1958–72 (the pre-regulatory period) and for 1972–77 (the regulatory period).

pear that, before regulation, small plants were actively entering the market and competing successfully in industries that were to incur relatively high abatement costs.

But after 1972 the picture changed. By 1977, the small-plant share had dropped back to where it had been in 1958, 25 percent. Moreover, this decline did not reflect a general decline for small plants throughout the manufacturing sector, because they improved their share in the low-pollution industries between 1972 and 1977. The lower part of Table 4 shows the number of industries in which the market shares of plants in particular size classes declined. We see that, from 1958 to 1972, small plants lost market share in seven of the twenty high-pollution industries, and in eleven of the twenty low-pollution industries. After 1972, however, the pattern was reversed. The small plants' share fell in twelve of the twenty high-pollution industries and in only six of the low-pollution industries. The market shares of medium and large plants increased in the high abatement-cost industries during regulation.

To sum up, analysis of the historical record shows that compliance with environmental regulation was the major reason for the decline in the small plants' market share, in high-pollution industries after 1972. Furthermore, using the results of a regression analysis,

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Without environmental regulation, the market share of small plants would have been ... higher in 1977. ...

I found that, without environmental regulation, the market share of small plants would have been about 32 percent or seven percentage points higher in 1977, while the shares of medium and large plants would have been lower by four and three points respectively.

What Now?

This study suggests that environmental regulation has had a large impact on the size of manufacturing plants—much more, for example, than has the regulation of worker health and safety. Environmental rules have not only reduced the number of plants in the affected industries but have made it more diffi-

cult for small plants to compete with large. While the study cannot definitely determine that environmental regulation has harmed *both* large and small plants, it does show that small plants have been harmed relative to large plants. It also shows that more funds are being allocated to capital compared to labor.

An important question remains unanswered: do the plants remaining in high-pollution industries now earn a higher rate of return on capital because the new source performance standards have made it more costly for new plants to come into the market to compete? These findings alone do not give us the answer to that question; it is a subject for another study.

What we can be sure of is that the owners of small plants cannot be counted among the beneficiaries of federal environmental regulation. The disproportionate burden placed on small plants in the high abatement-cost industries may be a recognized and accepted consequence of that program or it may be an unintended effect. If these effects were unintended, it is surprising that no serious effort has been made to modify them. Congress and the Environmental Protection Agency usually respond promptly to the vocal complaints of small business. But special treatment for small plants would produce determined opposition from owners of large plants (as well as from environmental groups). While owners of large plants may not be thrilled with environmental regulation, they have gained, by way of compensation, a reversal in the growth of the small plants' share of the market. The interesting question is whether this compensation was, for them, an unintended side-effect of the regulation, or whether any of them had foreseen it from the beginning. ∎

Selected References

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