

Department of Economics

Working Paper Series

The Impact of the Clean Air Act Amendments of 1990 on Electric Utilities and Coal Mines: Evidence from the Stock Market

Christopher Knittel
University of California, Davis

Shulamit Kahn
Boston University

June 02, 2002

Paper # 05-28

If new environmental regulation imposes significant costs on firms, it should be detected in their stock prices. We use event study methodology to analyze whether President George H. Bush's Clean Air Act Amendment (CAAA) proposals of June 1989, which were quite different from what had been expected, depressed stock prices in affected electricity generating and coal mining companies. We find that shares of 35 electric generating companies owning Phase I power plants did not noticeably fall in value after the Bush June 1989 announcement, nor after three other possibly relevant events during the preceding year. In fact, these shares increased in value during June and July of 1989. In contrast, stock prices of 11 of the 12 coal mining companies fell after Bush announced his proposals, while stock prices of a large majority of these coal companies fell after two of the other three events (although significance levels make these results not entirely conclusive). We argue that expected profits of electric generating companies did not fall because the regulated price of electricity was typically allowed to increase with costs. In the electricity industry, the costs of the CAAA were expected to be borne entirely by consumers in the form of higher prices.

UCDAVIS

Department of Economics
One Shields Avenue
Davis, CA 95616
(530)752-0741

http://www.econ.ucdavis.edu/working_search.cfm

**The Impact of the Clean Air Act Amendments of 1990 on Electric Utilities
and Coal Mines:
Evidence from the Stock Market**

Shulamit Kahn and Christopher R. Knittel¹

June 2002

¹We thank Julie Schultz for her excellent assistantship and the participants of the Boston University Dept. Of Economics Empirical Micro Seminar for their helpful comments. Kahn: Department of Finance and Economics, Boston University, 595 Commonwealth Ave, skahn@bu.edu. Knittel: Department of Finance and Economics, Boston University, 595 Commonwealth Ave, knittel@bu.edu.

Abstract

If new environmental regulation imposes significant costs on firms, it should be detected in their stock prices. We use event study methodology to analyze whether President George H. Bush's Clean Air Act Amendment (CAAA) proposals of June 1989, which were quite different from what had been expected, depressed stock prices in affected electricity generating and coal mining companies. We find that shares of 35 electric generating companies owning Phase I power plants did *not* noticeably fall in value after the Bush June 1989 announcement, nor after three other possibly relevant events during the preceding year. In fact, these shares increased in value during June and July of 1989. In contrast, stock prices of 11 of the 12 coal mining companies fell after Bush announced his proposals, while stock prices of a large majority of these coal companies fell after two of the other three events (although significance levels make these results not entirely conclusive). We argue that expected profits of electric generating companies did not fall because the regulated price of electricity was typically allowed to increase with costs. In the electricity industry, the costs of the CAAA were expected to be borne entirely by consumers in the form of higher prices.

I. Introduction

Compliance with environmental regulation is costly. Therefore, new environmental legislation should hurt the future profitability of polluting companies. Economists have pursued different approaches to document financial impacts of environmental legislation on polluting companies and industries, with mixed results. Since share prices reflect the net present value (NPV) of future profits, a direct way to measure financial markets' expectations of the profitability impacts of new environmental legislation is to examine how share prices respond to its passage. This event-study approach has not been taken in the past because successful legislation typically unfolds over months or even years, with the likelihood of its passage gradually increasing over this period. Consequently, it is impossible to separate the impact of regulation from the myriad of other factors affecting companies.

However, occasionally specific events suddenly and radically increase the likelihood of a law's passage, making it conceivable to discern any sudden abnormal negative movements in share prices of polluting companies. In this paper, we argue that such an event occurred on June 12th, 1989, when President George H. Bush surprised the markets by announcing proposed Clean Air Act Amendments (CAAA) quite different from what had been expected even a few days previous. The acid rain sections of the proposed legislation would have increased the costs of a limited group of electric generating companies – those owning Phase I power plants required to lower polluting emissions within five years. Since one way to comply with this new clean air legislation was to substitute from high to low sulphur coal, expectations of the demand for high sulphur coal-mining companies similarly would have fallen radically as a result of this announcement, lowering their share prices as well.

These two industries – electricity generation and coal mining – operated in very different

environments in 1989. During the eighties and nineties, the price of electricity was controlled at both the wholesale electricity-generation stage and at the retail electricity stage by governmental regulatory bodies. Regulators typically allowed generators and utilities to pass-through both capital and fuel cost increases to consumers in the form of price hikes.² While the proposed clean air legislation would increase costs for the impacted electricity generators, if the electricity regulators allowed complete pass-through of these higher costs such that the return on capital remained constant, share prices of the electric generating companies would have had little reaction to the June 12th event. In contrast, coal-mining companies were unregulated and, unlike electricity companies, were not subject to the same regulatory constraints when maximizing profits. Therefore, coal-mining firms did not have the ability to pass through reductions in profits through higher regulated prices. Since substitutes exist (including low sulphur coal) for the medium and high sulphur coal restricted by the proposed CAAA, we would expect profits of these firms to fall.

In addition to studying stock price movements around the June 12th, 1989 Bush speech, this paper considers three events in the preceding year that may also have caused a sudden and hence measurable change in the probability of new acid rain regulations: (1) Bush's first major environmental campaign speech (August 31, 1988) followed the next day by his famous attack on Dukakis's dirty Boston Harbor, (2) the election itself (November 8, 1988), and (3) the January 31, 1989 speech of the nominated EPA director William Reilly indicating the administration's commitment to immediately develop and support an acid-rain proposal. Using event study methodology, we look at abnormal stock returns in the period surrounding all four of these dates. The next section gives a short review of the work on environmental regulation and profitability. Section III then discusses the four different

²With rate-of-return regulation, price increases would also counteract any revenue impact of demand responses. The key exception to complete cost pass-throughs were cost overruns at nuclear construction projects. Note that beginning in 1998, some states began deregulating the electricity generation industry. All electricity firms analyzed in this paper were regulated during period studied.

events culminating in the Presidential submission of the proposed Clean Air Act Amendment. The empirical event study appears in Section IV. Summarizing our findings, we do indeed find that many of these events seemed to depress stock prices of several Eastern coal mining companies, while tending to have a zero or *positive* effect on the Phase I electricity generating plants. Section V discusses interpretations of these findings.

II. Literature on Environmental Impacts on Profitability

Within the environmental economics literature, a variety of approaches have been used to understand the impact of environmental legislation on industries and firms. Most of this literature does not look at profit changes directly, but instead measures the impact of environmental regulation on a variety of company decisions. When companies change their behavior in response to regulations, standard neoclassical theory suggests that they must of necessity be departing from their profit maximizing choices. Many recent authors find that environmental regulation does deter plant/company location and entry and encourage exit (for instance, Becker and Henderson 2000, Biorn et al. 1998, Dean et al. 2000, Greenstone 1998, Gray and Shadbegian 1998, List and Co 2000) although impacts are typically small, while some studies of the 70s and 80s (reviewed in Jaffe et al. 1995) find no statistically significant effect.

Michael Porter has suggested that “properly designed environmental standards can trigger innovation that may partially or more than fully offset the costs of complying with them.” (Porter 1995 p.98) Others dispute that this is typically true, based on empirical studies of research and development (for instance, Jaffe and Palmer 1997).

Productivity also may be affected by environmental regulation. Early studies considering productivity impacts found that 8% to 16% of the decline in 1970's manufacturing productivity was due

to environmental legislation. (Studies reviewed in Jaffe et al. 1995.) More recently Berman and Bui (2001) find that environmental regulation of oil refining increased productivity, presumably by requiring new state-of-the-art investments, while Boyd and McClelland (1999) find environmental constraints on paper plants decreased the per unit materials needs while not affecting labor productivity. Of course, even if both labor and materials productivity increase, this does not indicate increased NPV because the initial capital costs of new investments must be factored in as well. Related literature measures *costs* of environmental regulation. A recent article in this vein is Becker and Henderson (1999), which finds 10% - 18% higher manufacturing costs in areas with stringent environmental relations.

One study that addresses profitability directly with cross-sectional data is Austin, Alberini and Videras (1999). In any cross sectional study of profitability and environmental regulation, omitted variables are likely to bias results. This paper deals with this bias by trying to identify causality using lags, but is unable to identify any particular direction of causality. Other authors have studied profitability changes in response to regulatory changes (for instance, Chiles and Clark 1999).

There have been a handful of event studies in environmental economics. These papers have primarily considered the impact on share prices of news about a company's poor environmental performance (e.g. Harper and Adams 1996, Laplante and Lanoie 1994, Khanna, Quimo and Bojilova 1998) rather than the market impact of passage of the environmental regulation itself.

The present study uses the event study methodology to look for abnormal stock returns resulting from surprising events which lead to eventual passage of new environmental legislation. An event study of environmental regulation has advantages over other approaches. It is far less likely than cross-sectional analysis to be affected by reverse causality or omitted variables bias. In addition, it addresses the profitability issue directly, rather than considering plant location and other indirect impacts or considering productivity but ignoring capital costs.

III. The Evolution of the Clean Air Act of 1990³

Throughout the 1980's, environmentally-conscious members of the House and the Senate tried to pass amendments to the Clean Air Act to expand the 1970 Clean Air Act and its 1977 Amendments, in order to address a variety of new or continuing air quality concerns including acid rain, urban air quality, toxic pollutants and vehicle pollution. President Reagan did not support new environmental regulation, and Congress was sufficiently divided to create a stalemate, despite the fact that 1987 was the lapsed deadline for local areas to comply with clean-air standards. After George H. Bush and Michael Dukakis emerged from the primaries as the presidential nominees in spring of 1988, few expected whichever candidate won to quickly and vigorously pursue acid rain legislation. However, by August of 1989, there was near universal certainty that some such legislation would pass likely to impose additional costs on the dirtiest power plants. What during the ensuing year caused this change?

With Dukakis leading in the polls, George H. Bush needed to attract moderate independent voters in key states. On August 31st, 1988, breaking from the Reagan past, Bush positioned himself as an environmentalist who planned to address the acid rain issue and other environmental problems early in his Presidency. The following day he gave his famous Boston Harbor speech, attacking Dukakis's environmental record. Market observers may have interpreted these speeches as a signal of increased likelihood of environmental regulation of electric power plants. On the other hand, expectations may have changed little because it was only a campaign promise and therefore of little value, and because of Republicans' general tendency to prefer business incentives to command-and-control regulation.

³ Many facts in this section are from Cohen's (1992) detailed history of the political process culminating in passage of the Clean Air Act of 1990. The rest of the history is taken from reports in the popular and industry press (made available from Lexis/Nexis) as well as from public records of Bush's speeches, press releases and the bill itself as submitted on July 21, 1989.

Indeed, judging by accounts in the contemporaneous general and industry press, during the campaign people were uncertain whether Bush would follow through on his campaign promise to make the environment a priority. After the previous Clean Air Act Amendments died in Congress in October, Senator Rudman ruminated that “It might be another eight years before something (about clean air) happens again,” while Senator Mitchell agreed that “It may not be next year or the year after that. But ultimately it will happen.” (*Boston Globe*, October 5, 1988.)

The election outcome may have changed probabilities of new acid rain regulation, but during the week before the election news analysts could not predict which candidate would make such regulation more likely. “Who is the Cleanest Mr. Clean?” *Newsday* asked four days before the election. (Mark McIntyre, *Newsday*, November 3, 1988.) While Dukakis’s platform included the goals for SO₂ and NO_x reduction incorporated within the CAAA that had just failed in October, Bush also sought reductions of “millions of tons” of these of acid-rain precursors, but within some kind of market-based context. Nevertheless, most environmentalists preferred Dukakis, while most business and industry leaders preferred Bush’s environmental views.

Uncertainty about whether, and when, Bush would act on acid rain and what these actions would entail continued during the period between the election and the inauguration. The January edition of *Coal* reported on the coal industry’s expectations. While the industry seemed to expect some acid rain legislation in the next Congress, they were “cautiously optimistic” that the Bush administration would back clean-coal technology development but would not back emissions controls that would impose large costs on both the coal and the electric utility industry. The January 5th *Public Utilities Fortnightly* reported that, “Opinions vary regarding the changes of reauthorization of the Clean Air Act” and itself assumed that Bush would pursue clean-coal technology rather than emissions control. On the eve of the inauguration, an editorial in the January 19th *Engineering News-Record* read, “The

appetizers on Bush's environmental plate should be clean air and acid rain legislation..... The question is, will the gargantuan deficit stifle the new President's appetite?" Thus, there was considerable uncertainty about whether Bush would propose any Clean Air Act at all, and most people in the industry seemed convinced that any approach Bush would take would not include new controls.

The first clear signal that the Bush administration was planning to act on the Clean Air Act Amendments – and particularly acid rain – came in a speech by the EPA director, William Reilly, at his confirmation hearings on January 31, 1989. In this speech, Reilly promised that acid rain controls would be 'first out of the box' of White House legislative proposals. He gave no additional details about who would pay for improvements, what level of reductions were intended or how improvements would be pursued. A spokesperson from the industry association Edison Electric Institute expressed little concern, citing the difficulty in drafting a bill that would pass Congress (Thomas Spears, *The Toronto Star*, February 2, 1989.)

Bush continued to signal that he was planning action on acid rain. In his budget speech to Congress on February 9, he personally promised that "I will send to you shortly legislation for a new, more effective Clean Air Act." He specifically asked for \$385 million more in the new budget for acid rain cleanup (Walter Robinson and Stephen Kurkjian, *The Boston Globe*, February 10, 1989). At the same time, he assured the utility industry that utilities would be able to choose the "least cost" compliance method. This commitment to acid rain legislation was reiterated at a February 10th meeting with Canada's Prime Minister and in Reilly interviews with *ABC* and *USA Today* later that month. Although behind the scenes, a high-level cross-department team was working intensely on designing this legislation, there were no leaks on specifics reported in the media.

Beyond occasional statements from Reilly and others that any acid rain legislation would allow industry to choose least-cost methods through market forces, there were no concrete developments on

acid rain made public by the White House for almost three months. Judging from reports in the press, people increasingly expected *some* acid rain legislation that would in *some* way regulate utilities. By May, the expectations were that Bush would unveil his environmental proposals within a month. Yet as late as the week of June 5th, industry groups still did not know details of Bush's plan. On Friday June 9th, government sources started leaking some of the details of the plan, including emissions controls at the dirtiest power plants. Even then, these sources said that Bush was still deciding whether to further regulate the 20 worst or the 100 worst power plants.

Bush revealed his proposal on June 12, 1989. White House press releases describing the proposal's details said that 107 older power plants with SO₂ emissions greater than 2.5 pounds per million BTU's would be regulated in the first phase of increased acid rain controls beginning in 1995. Phase II, beginning in 2000, would further lower emissions standards to 1.2 pounds and affect an additional 200 power plants. The Bush proposal allowed these power plants to achieve emissions goals at least cost through a market system of tradable allowances to emit SO₂ and NO_x pollution.

Over the next 6 weeks, both industry and environmental groups lobbied to change the details of the President's proposal. During the first week of July, the administration circulated a written draft legislative proposal to interested parties to elicit their feedback on the specifics.⁴ As a result of this feedback as well as additional internal negotiations, some details of the bill were changed. On July 21st, the Bush administration submitted its proposed legislation to Congress.

After July 21st, the legislature wended its course through Congressional committees, the floor of the House and Senate, and the Conference Committee. Various compromises and deals were struck. The list of Phase I power plants changed repeatedly. The process essentially ended October 22, 1990, the day that the conference committee agreed on a compromise between the House and Senate

⁴This circulation did not occur on a precise date. Cohen (1992) reports that the White House staff circulated the draft to interested parties over a period of several days.

versions.⁵ Figure 1 summarizes the major events described above. The process took twenty-one months from the first statement of intention at the end of January 1989 through its final adoption. Throughout that period, informed investors continued to revise upward their estimate of the likelihood that the dirtiest power plants would face substantial emissions controls.

However, as early as the end of July 1989, contemporaneous reports indicated that the industry press and investment analysts believed it almost certain that Congress would adopt acid rain legislation affecting these 107 worst power plants and that the form would be very similar to that in Bush's proposed legislation. These provisions of the acid rain legislation were expected to impose a considerably financial burden on the companies, particularly if these power plants comprised a large percentage of the company's total business. Within a year, the probability of these 107 power plants being subject to new costly regulation had moved from very low levels to close to 100%.

The event study in the next section analyzes the four major events of that year discussed above, each of which may have led people to make sudden re-evaluations of their priors on the likelihood of acid rain legislation. The four events windows are:

1. Bush's August 31st and September 1st, 1988 environmental campaign speeches.
2. The presidential election of November 8, 1988.
3. Reilly's January 31st, 1989 speech on Bush environmental priorities.
4. Bush's June 12th, 1989 speech announcing his Clean Air legislative package, and its subsequent July 21st submission.

Given the historical record, we hypothesize that of the four events, the June 12th, 1989 Bush speech is most likely to have had a measurable *cumulative abnormal return*, or CAR.

⁵Those interested in learning more about the events between July 1989 and October 1990 can refer to Cohen (1992). For details on the subsequent history of the CAAA acid rain regulations and the market for emission allowances, see Ellerman et al. 2000.

Since relevant information was revealed across the entire 6 week period between this speech and submission of the proposal to the legislature in late July, we consider two versions of window 4, one based on the speech only and the other based on both the speech and submission. The election is likely to have had the least impact of the four events, since people were unclear on which candidate would move most quickly on acid rain.

IV. Event Study Analysis

A. Data and Methodology

Event studies predict expected stock returns as a function of overall market returns over an extended period called the *estimation window*, and use this to calculate any abnormally high or low returns during the *event window*.

In our study, market returns are measured by the S&P 500 index. In the electricity analysis, we also use a market index of electric utilities' returns. We constructed this index for electric utilities based on the companies listed in the CNNfn's Market Guide electric utilities sector, eliminating both the companies we analyze in this paper and other companies with data problems.⁶

Standard procedure in event studies is to begin each event window five trading days prior to the event to allow for the possibility of prior information leakages, and extend it ten trading days following the event to allow time for informed shareholders to learn about the event and analyze its implications, and for markets to equilibrate. We have adopted this general procedure except for the "June 12, 1989 speech through July 21 legislative submission" window, where we include not only the

⁶Obtained from <http://cnfn.marketguide.com/mgi/>. We could not use the cnfn index itself, since it includes many of the electricity and coal companies we are modeling. Instead, we construct our own index averaging the rates of return of the companies in the cnfn, excluding (a) companies that own Phase I power plants or coal mines (b) companies either going public or leaving standard stock exchanges during the study period and (c) companies with low share prices and hence large swings in returns representing only changes of a single tick.

5 prior and 10 subsequent trading days, but also the entire period between these dates. Table 1 lists the windows and gives additional details about the event study.

Besides measuring cumulative abnormal returns for each of the four windows separately, we also measure abnormal returns for all four event windows combined, in case this longer period captures the changed market sentiment caused by all of the above events combined even though each company's stock may have adjusted at only some of these events. In this "all windows" specification, intermediate periods between the four event windows are dropped, since they are likely to add noise due to other contemporaneous incidents that would swamp any small changes in expectations of environmental regulation.

The estimation period, the period over which we measure the normal relationship between each stock and market returns, covers the year prior to the earliest of these 4 events. From this year, we have cut out nineteen observations of atypical market movements surrounding Black Monday (October 19, 1987), and added an additional 19 observations in the beginning of the window, so that the estimation window begins on July 28, 1987. One coal company, Ashland Coal, traded publicly beginning in August 1988. CARs for this company were estimated separately from the other companies, with a shorter estimation window, and only for events beginning with and subsequent to the election in 1988.

Some event studies include the time period after the event as part of their estimation window. We do not, both because the relationship of share prices to the overall stock market may have been permanently changed by the events studied and because there were further developments regarding acid rain legislation after our "final" event window, culminating in the passage of the conference report's version of the Clean Air Act Amendments on October 27th, 1990.

Originally, event studies in finance separated the estimation of the market relationship from the

measurement of the abnormal returns. More recently many authors have combined these two steps to aid in calculation of correct standard errors. This is accomplished by including as observations all days in either the estimation or event windows and capturing the event's impact by a right-hand-side indicator variable for days within the event window. The coefficient of the indicator variable is interpreted as the abnormal return.⁷ This method, however, can lead to incorrect estimation since the normal market relationship is estimated based on days within the event window as well as days within the earlier estimation window. However, as Salinger (1992) points out, the event itself may alter the relationship between market and company returns during the event window, biasing the coefficients. The bias would be particularly problematic for long event windows. We instead use the approach suggested Salinger (1992) which requires separate dummy variables for each day during the event window.⁸ While this vastly increases the dimensionality of the estimation, it allows accurate measurement of the event's impact and its standard error.

We study abnormal returns during these events for 12 publicly owned companies coal mining companies and 35 publicly-owned companies electricity generating companies⁹. Each of the 35 electricity generating companies owned one or more of the 107 Phase I power plants named in the bill submitted by President Bush to Congress on July 21st, 1989. Daily end-of-day share prices for each company were obtained from the CRSP data base. We estimate the CARs in each industry as a

⁷One of the first papers to take this approach was Binder, 1985. MacKinlay, 1997, discusses general issues in the estimation of event studies.

⁸Specifically, we estimate the CARs with a seemingly unrelated regression of the separate companies within each industry over all estimation and event period observations. These returns are regressed on the S&P 500 returns and on a dummy variable for each event day t . The dummy variable takes on a value of 1 on day t and -1 on the previous day. Using this method, the coefficient on the t 'th dummy is the CAR from the event's start until time t and its standard error accurately measured. Because of the large dimensionality with some of the windows considered here, we often estimate in two stages using the Frisch/Waugh/Lovell method of partialing out the effect of the CAR.

⁹Many of these companies have since merged with others.

seemingly unrelated regression of the separate companies.

The amount of electricity generated by these companies ranged from 2.1 billion KWh per year to 137.0 billion KWh per year. The power plants were generally situated in a vertical swathe of the US from Wisconsin and Michigan in the North to Georgia and Alabama in the South, areas from which SO₂ and NO_x can drift eastward and create acid rain. Some Eastern and Southern states also had the dubious distinction of appearing in this list.¹⁰ Many of these 35 companies owned several Phase I power plants, often in several different locations. Often, they also owned non-Phase I power plants as well. Finally, some of these 35 companies also operated other businesses besides electricity generation – most commonly natural gas utilities.

Some specifications described in the results use the percentage of company revenues generated by Phase I power plants. The calculation of this percentage was straightforward for companies whose only business was electricity generation. For these companies, we calculated the percentage of electricity produced in Phase I plants as a proportion of all electricity generated by the company. Electricity generated at the Phase I power plants were taken from the FERC Form 1 Data. The companies' total electricity generation was obtained from their Annual Reports to Shareholders or 10K reports to the SEC.¹¹

For companies that did other business in addition to electricity generation, the percentage of total revenue was calculated by multiplying the percentage of the company's electricity generation in

¹⁰Power plants were located in Alabama, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Missouri, New Jersey, New York, Ohio, Pennsylvania, West Virginia and Wisconsin. A minority of the 107 power plants were owned by private companies or governmental units such as the Tennessee Valley Authority; because these were not publicly traded, they could not be included in our analysis.

¹¹Obtained from *Lexis/Nexis*.

Phase I plants by the percent of company revenues derived from electricity sales.¹² The 12 publicly owned coal mining companies were chosen on the basis of data availability – they had to be traded on a stock exchange with historical CRSP data¹³ and to be companies where coal was not a minuscule part of the company's business.

Some specifications required a measure of the percentage of the coal mining companies' revenues from high and medium sulphur coal. The revenues from coal as a percent of total revenues were obtained from companies' Annual Reports to Shareholders or 10K reports to the SEC. The proportion of the coal mined by the company that had high or medium sulphur content was more difficult to quantify, and was based on descriptions in Annual Reports to Shareholders, other reports about the companies' prospects, and as a last resort by the location of the mines themselves, since sulphur content differs by region.

B. Cumulative Abnormal Returns (CARs)

Electric Generating Companies

Tables 2 and 3 summarize results of the event study of the various windows between August 1988 and August 1989 for electricity and coal companies respectively. The estimation in Table 2 predicts movements in the 35 electric generating companies' share prices based on their recent historical relationship to returns of both the S&P500 index and to the index of electric utilities (described earlier). The latter variable ensures that we are measuring movements in these 35 Phase I companies' share prices as they differed from other companies in the electricity industry, thus

¹²Revenue figures by plant or unit were not available. Note that these figures were from 1989, before the legislation was passed.

¹³This excludes, among other categories, stocks traded over-the-counter, stocks traded on the pacific exchange, privately held companies, etc.

controlling for factors affecting the whole industry. Note that this method would not capture any impact the events had on the entire electricity industry. However, results of estimation controlling only for the S&P 500 (available from authors) do not qualitatively differ from estimation with both controls in Table 2.

Four of the 35 Phase I companies also owned coal mines. Share prices of these four companies may reflect impacts of events on both industries and are reported separately from the other 31 companies.

The first row of Table 2 gives details about the cumulative abnormal return over all four different events combined into a single window. Of the 35 company coefficients, very few were statistically significant. In fact, only 3 of the 35 had t statistics greater than 1. More of the companies (21=18+3) had positive points estimates of the CAR than had negative ones (13+1). All four of the companies in electricity generation and coal mining businesses simultaneously had coefficients essentially zero (p-value > .5). The mode in Figure 2a, a histogram of the company coefficients from the combined events, is slightly above zero and the overall distribution seems to be relatively symmetric around this near-zero point.

In a separate specification, the estimation was constrained to require that the impact of events on the expected profits of the Phase I plants were identical. Since the Phase I plants represented very different percentages of the company, the constraint imposed identical CARs *had* the Phase I plants represented 100% of revenues.¹⁴ The constraint did not encompass the 4 companies in the coal and electricity businesses simultaneously, since they are expected to respond differently than the other 31. The results are in the first column of Table 2. The positive coefficient of .0360 in the first row

¹⁴Note that this does not constrain all companies to have the same cumulative abnormal return for any day in the event window except the final one. This corresponds to the assumption that the market implications for the different companies affected may be revealed at different points in time.

represents this single CAR, expressed as if the Phase I plants comprised 100% of the company.¹⁵ In other words, these clean air act developments overall increased the share prices of these 31 electric generating companies by 3.6%. This coefficient, with a p-value of .48, is not differentiable from zero. A Wald test does not reject the joint constraints.

The remaining rows of Table 2 present results for each of the four separate events. We had hypothesized that if the CAAA was bad news for the Phase I companies, negative abnormal returns would be observed for the fourth event window, and perhaps for the first and third event windows as well since they each contained events that increased the likelihood of power plant emissions regulation. On the other hand, we had no clear prediction on the election's impact. Looking at the single constrained coefficients in the first column to get a general sense of the events' impacts, nothing preceding Bush's June 12th, 1989 announcement of his proposed acid rain legislation had a significant impact, with p-values all greater than .5.

The rest of the columns in the table give some information on the estimated CARs of separate companies in unconstrained analysis. Again considering the first three windows, more companies' stock prices reacted negatively – some at marginally significant levels – than reacted positively, to Bush's summer 1988 environmental campaign speeches. Reactions to the election window and to Reilly's January 1989 confirmation speech were more mixed and ambiguous. A few of the negative company impacts from these earlier windows but none of the positive ones achieved statistical significance. Finally, share prices of the four companies in coal and electricity generation simultaneously, described in the farthest right columns, did not seem to react to any of the events.

However, the fourth window, the June 12th speech and subsequent Bush legislative submission, brought the 31 (non-coal) companies significantly *positive* abnormal returns, with a p-value of .061 for

¹⁵For instance, if a Phase I plant represents .2 of the company owning it and has a 1% abnormal return, the “as-if-100%” abnormal return would be 1/.2 or 5%.

the constrained coefficient in variant b (the window including both speech and submission) and .150 in the 16 days around the speech alone.¹⁶ No estimate of separate company CARs had reached this significance level for either window variant, but 23 (a) or 25 (b) of the 31 companies with positive point estimates combined to generate overall statistical significance. One way to evaluate the likelihood of this number of companies with positive CARs is to calculate the probability of this result assuming the following: the true average impact is zero, but there is a 50% chance of getting a positive or negative result respectively. In this case, the likelihood of getting 25 or more positives out of 31 trials is a mere .00044.¹⁷

Coal Mining Companies

Table 3 presents results of the coefficients from a similar analysis for coal mining companies. They stand in stark contrast to the results for electricity generating companies. Stocks of 9 of 11 coal companies (82%) had negative cumulative reactions to the four events combined (1st row). Four of these 9 companies have p-values <11% while a fifth has a more ambiguous 20% p-value. Figure 2b illustrates the predominant negative and large impact of these events, quite different from the preceding histogram of electricity CARs.

Which specific events impacted coal companies, and was the impact of each event negative? Again, the presidential election's impact was almost evenly divided between positive and negative impacts (with 58% negative coefficients), although only the negative impacts had any statistically significant results. For each of the other three events, negative impacts predominate, suggesting that the markets interpreted these events as bad news for these coal companies. The June 12th speech and subsequent submission was again the most extreme event, in the sense that 11 of the 12 companies

¹⁶Here, too, a Wald test does not reject the constrained model.

¹⁷This calculation is made using a binomial distribution and assuming that the coefficients are not correlated.

experienced negative cumulative abnormal returns. If the true average CAR during this event window was 0, and positive and negative coefficients equally expected, the likelihood of at least 11 being negative was .00317.

To calculate a single coefficient for all (11) companies, we made very rough estimates of the percentage of the companies' revenues derived from medium to high sulphur coal as opposed to either low sulphur coal or other businesses. With these estimates, we constrained the CARs to be equal if the high/medium versus low sulphur part of the company had instead been 100%. Far less faith should be put in these numbers than in the constrained CARs for electricity, because accurate estimates of the percentage high/medium sulphur coal were not available, and because this approach ignores any positive impact likely to be experienced by sellers of low sulphur coal.¹⁸ For the four events combined, the constrained impact is estimated to be negative, with a p-value of .23 and a whopping point estimate of -28.75%. For the June/July 1989 speech/submission window, the point estimate is much smaller and indistinguishable from zero (-3.0 %, p-value=.85), despite 11 negative coefficients. Dropping the single company with a positive value, Pyro Energy Corporation, transforms the overall CAR point estimate to a much larger -22.2% with a p-value of .226.

Summarizing, shares of the electric generating companies owning Phase I power plants did not noticeably fall in value during any of the events up to and including George H. Bush's submission of his proposed Clean Air Act Amendments. In fact, these shares increased in value during Bush's announcement and submission of his specific legislative proposal listing Phase I power plants, suggesting that the Bush proposal was if anything good rather than bad news to these companies. In contrast, stock prices of coal mining companies predominantly fell.

¹⁸This second effect would imply that for companies owning coal reserves with diverse sulphur content, the separate negative impact on the company from owning high sulphur coal is higher than the estimated CAR suggests.

V. Interpreting These Results

In this paper, we have analyzed the effect of an unexpected increase in the likelihood of acid rain legislation on the two industries most likely to be adversely affected, the electricity and coal-mining industries. We use the impact on share prices of a sudden shift in George H. Bush's environmental focus to measure how this new legislation was expected to influence the profitability of firms within these industries.

The different market environments in which electricity and coal-mining firms operate provide us with a useful comparison of the effects of environmental legislation on regulated and unregulated firms. In 1989, electricity firms operated under a strict regulatory regime, where prices, and to a large extent profits, were tightly regulated. In contrast, coal-mining firms were able to maximize profits free from such constraints.

A priori, we would expect increases in environmental legislation to have vastly different effects on these two industries. Indeed, we would expect environmental legislation that made medium and high sulphur coal a less attractive input into electricity generation to have a clear negative effect on firms that mined medium and high sulphur coal (although any simultaneous ownership of low sulphur mines might counteract some or all of this effect).

Conversely, electricity firms operate in a rate-of-return regulatory environment, where regulators set prices so firms can earn a "normal" rate of return. Thus, prices are set below the profit-maximization level but above the break-even level. Therefore, if electricity firms are always at or near this normal rate of return, any increases in costs will be entirely passed through to consumers.¹⁹

¹⁹We realize that a large literature exists beginning with Joskow (1974) that questions this view, giving evidence that profits are not always constrained to be at the allowed rate of return. However, even if profits are allowed to deviate from the allowed rate of return over small time periods, a large decline in expected profits induced by new acid rain legislation would likely trigger a rate hearing, resulting in the pass-through of cost increases.

Furthermore, if electric utilities were not regulated but allowed to set profit-maximizing prices, electricity demand's inelasticity would nevertheless once again place the great bulk of the burden on electricity consumers. Therefore, we would expect new environmental legislation to have a small impact, if any, on the profitability of electricity firms.

Our empirical results confirm our priors. We find that, on average, electricity firms were not adversely affected by the Clean Air Act Amendments (CAAA) of 1990, while coal-mining firms were. In particular, we find that only one of the 35 firms owning Phase 1 electricity generating plants had a statistically significant response to the evolution of the legislation and that this response was positive, rather than negative. Indeed, fewer than half of the firms (fourteen) had negative coefficients. The analysis of the separate major events during this time suggests the same, with the most marked market response being after the Bush June 12th speech announcing his legislative proposal. Thus, consumers were expected to bear the entire burden of the costs that the CAAA imposed on power plants in the form of higher electricity prices.

The results with respect to the coal-mining firms, while not entirely conclusive, are in sharp contrast to the electricity firms. Nine of 11 coal firms had a negative response to the events leading up to the impending legislation, 3 significantly so. In addition, in each of the separate events analyzed, a majority of firms were negatively affected by the event. Most notably, only 1 of the 12 coal firms did *not* have a negative CAR as a result of Bush's June 12th speech and legislative submission. Taken in total, the results are suggestive that profits of coal-mining firms fell as a response to the increased likelihood of acid rain legislation.

These results underline the importance of evaluating the effect of environmental regulation on firms and consumers on a case-by-case basis. If the coal mining industry is typical, financial markets believe that environmental legislation imposing new costs lowers firm profits in industries facing without

price controls and facing at least somewhat elastic demand. However, in industries with rate-of-return price regulation, financial markets believe this legislation has no impact on profits. Consumers of these industries' products bear the entire cost of environmental compliance, making it more likely that these costs will exceed the environmental benefits they enjoy.

Figure 1: Timetable of Developments in Acid Rain Legislation

August 1988 -November 1990

8/31/88: Bush positions himself as an environmentalist. He gives the “Boston Harbor” speech the following day.

11/8/88: Bush wins election.

1/31/89: EPA Director William Reilly promises that acid rain controls would be “first out of the box” from the White House.

2/9/89: To Congress, Bush promises that he will send legislation for a “new, more effective Clean Air Act.”

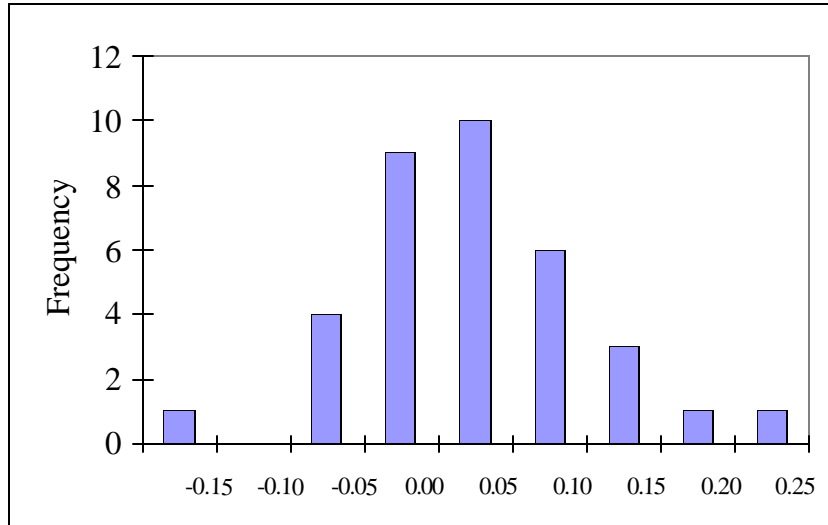
6/12/89: Bush unveils his proposal, naming 107 specific plants.

7/21/89: Bush submits his proposal to Congress.

11/22/90: Conference Committee agrees on a compromise between the House and Senate versions.

**Figure 2: Distribution of Estimated Cumulative Abnormal Returns
All Windows Combined**

a. ELECTRICITY



b. COAL MINING

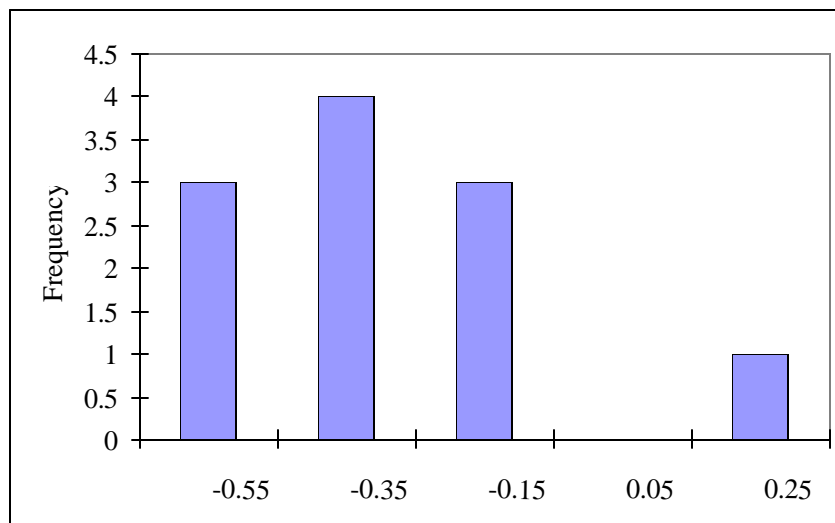


Table 1: CAAA Event Windows

August 1988 -July 1989

Window 1: Bush's August 31st and September 1st, 1988 environmental campaign speeches

Event window: August 24 - September 16, 1988.

Window 2: The presidential election of November 8th, 1988

Event window: November 1st - November 22nd, 1988.

Window 3: Reilly's January 31st, 1989 speech on the administration's environmental priorities at his confirmation hearings

Event window: January 24 - February 14, 1989.

Window 4. Bush's June 12th speech announcing his Clean Air legislative package, and its subsequent July 21st submission

Event window:

Variant a: The speech plus 5 days before and 10 days after, June 5th - June 26th, 1989.

Variant b: 5 days before the speech until 10 days after submission of the proposed legislation, June 5th - August 4th, 1989.

For all events, the estimation window is July 28, 1987 - August 23, 1988 (excluding October 6, 1987 through October 30, 1987, the period encompassing Black Monday that exhibited large swings in the S&P 500 .)

Event windows include 5 trading days preceding and 10 days following the events themselves. The only exception was Variant b of Window 4, which for the coal industry extended only 6 trading days beyond the July 21st submission because of data availability.

Table 2: Summary of Results on CARs for Phase I Electricity Generating Companies

Predicted returns based on CNNfn Electric Utilities and S&P 500

All event windows include 5 days preceding and 10 days following main events.

Period and Main Events	31 Phase 1 Companies not integrated into coal industry				4 Phase 1 Companies integrated into coal industry				
	Single CAR (s.e.) for all companies	Separate CARs for each company				Separate CARs for each company			
		<i>negative CARs</i>		<i>positive CARs</i>		<i>negative CARs</i>		<i>positive CARs</i>	
	number	# 10% sig. (additional t>1)	number	# 10% sig. (additional t>1)	number	# 10% sig. (additional t>1)	number	# 10% sig. (additional t>1)	
All windows combined	0.0360 (0.0515)	13	0 (1)	18	1 (1)	1	0 (0)	3	0 (0)
Individual windows									
1. Bush's Aug. 31 & Sept.1,1988 environment campaign speeches Aug. 24 - Sept. 16, 1988.	-0.0158 (.0220)	22	1 (4)	9	0 (1)	2	0 (0)	2	0 (0)
2. Presidential election Nov. 8, 1988 Nov. 1- Nov. 22, 1988.	-0.0065 (0.0214)	14	0 (1)	17	0 (1)	2	0 (0)	2	0 (0)
3. Reilly's Jan. 31, 1989 speech on Bush environment priorities Jan. 24 - Feb. 14, 1989	-0.0080 (.0214)	17	2 (1)	14	0 (1)	3	0 (0)	1	0 (0)
4. Bush's June 12, 1989 speech on CAAA & July 21st submission									
a. Speech window only June 5 - June 26, 1989	0.0307 (.0213)	8	0 (0)	23	0 (2)	2	0 (2)	2	0 (0)
b. Speech through submission June 5 - August 4, 1989	0.0664 (.0354)	6	0 (0)	25	0 (4)	3	0 (0)	1	0 (0)

Table 3: Summary of Results on CARs for Coal Companies

Predicted returns based on S&P 500

All event windows include 5 days preceding and 10 days following main events.

Period and Main Events	Single CAR (s.e.) for all 11 companies	Separate CARs for each company			
		<i>negative CARs</i>		<i>positive CARs</i>	
		number	# 10% sig. (additional $t > 1$)	number	# 10% sig. (additional $t > 1$)
		out of 11 companies*			
All windows combined	-0.2875 (0.2388)	9	3 (2)	2	0 (0)
Individual windows					
1. Bush's Aug. 31 & Aug. 24 - Sept. 16, 1988.	0.0622 (.1044)	8	0 (3)	3	0 (0)
		out of 12 companies			
2. Presidential election Nov. 8, Nov. 1- Nov. 22, 1988.	-0.0642 (0.1013)	7	2 (2)	5	0 (0)
3. Reilly's Jan. 31, 1989 Jan. 24 - Feb. 14, 1989	-0.1321 (.1012)	9	1 (0)	3	1 (0)
4. Bush's June 12, 1989 speech on clean air legislation & July 21st submission					
a. Speech window only June 5 - June 26, 1989	0.0864 (.1012)	9	1 (1)	3	1 (0)
b. Speech through legislative June 5 - August 4, 1989	-0.0302 (.1600)	11	0 (4)	1	0 (1)

* Ashland Coal became a separate public firm in August 1988; it is included in counts for all windows following Estimation windows are of necessity shorter for this company.

References

- Austin, David, Anna Alberini, and Julio Videras. "Is There a Link between a Firm's Environmental and Financial Performance?" Prepared for NBER Summer Institute Public Economics Workshop: Public Policy and the Environment, August 1999.
- Becker, Randy A. and J. Vernon Henderson. "Effects of Air Quality Regulations on Polluting Industries." *Journal of Political Economy* 108(2), April 2000, 379-421.
- Becker, Randy A. and J. Vernon Henderson. "Costs of Air Quality Regulation." *National Bureau of Economic Research Working Paper*: 3708, 1999.
- Berman, Eli and Linda T.M. Bui. "Environmental Regulation and Productivity: Evidence from Oil Refineries." *Review of Economics and Statistics* 83(3), August 2001, 495-510.
- Binder, John J. "Measuring the Effects of Regulation with Stock Price Data." *Rand Journal of Economics* 16(2), Summer 1985, 167-83.
- Biom, Erik, Rolf Golombek and Arvid Raknerud. "Environmental Regulations and Plant Exit: A Logit Analysis Based on Establishment Panel Data." *Journal of Environmental Economics and Management* 11(1), January 1998, 35-59.
- Boyd, Gale A and John D. McClelland. "The Impact of Environmental Constraints on Productivity Improvement in Integrated paper Plants." *Journal of Environmental Economics and Management* 38(2), September 1999, 121-142.
- Chiles, Ted W. And Joy Clark. "Environmental Regulation and the Spatial Distribution of Capital and Resources." *Review of Regional Studies* 29(1), Summer 1999, 51-61.
- Cohen, Richard E. *Washington At Work: Back Rooms and Clean Air*. New York: Macmillan, 1992.
- Dean, Thomas J, Robert L. Brown and Victor Stango. "Environmental Regulation as a Barrier to the Formation of Small Manufacturing Establishments: A Longitudinal Examination." *Journal of Environmental Economics and Management* 40(1), July 2000,56-75.
- Ellerman, A. Denny, Paul L. Joskow, Richard Schmalensee, Juan-Pablo Montero and Elizabeth Bailey. *Markets for Clean Air: The U.S. Acid Rain Program*. Cambridge UK and NY: Cambridge University Press, 2000.
- Gray, Wayne B and Ronald J. Shadbegian. "Environmental Regulation, Investment Timing, and Technology Choice." *Journal of Industrial Economics* 46(2), June 1998, 235-256.

Greenstone, Michael. "The Impacts of Environmental Regulations on Industrial Activity: Evidence from the 1970 and 1977 Clean Air Act Amendments and the Census of Manufactures.: Princeton Industrial Relations Section Working Paper: 408, November 1998.

Harper, Richard K. and Stephen C. Adams. "CERCLA and Deep Pockets: Market Response to the Superfund Program." *Contemporary Economic Policy* 14 (1), January 1996, 107-115.

Jaffe, Adam B., Steven R. Peterson, Paul R. Portney and Robert Stavins. "Environmental Regulation and the Competitiveness of U.S. Manufacturing." *Journal of Economic Literature* 33 (1), March 1995, 132-163.

Jaffe, Adam B. and Karen Palmer. "Environmental Regulation and Innovation: A Panel Data Study." *Review of Economics and Statistics* 79(4), November 1997, 610-19.

Joskow, Paul. "Inflation and Environmental Concern: Structural Change in the Process of Public Utility Price Regulation." *Journal of Law and Economics* 17(2), 1974, 291-327.

Khanna, Madhu, Wilma Rose H. Quimo, and Dora Bojilova. "Toxics Release Information: A Policy Tool for Environmental Protection." *Journal of Environmental Economics and Management* 36 (3), November 1998, 243-266.

Laplante, Benoit and Paul Lanoie. "The Market Response to Environmental Incidents in Canada: A Theoretical and Empirical Analysis." *Southern Economic Journal* 60 (3), January 1994, 657-672.

List, John A. And Catherine Y. Co. "The Effects of Environmental Regulations on Foreign Direct Investment." *Journal of Environmental Economics and Management* 40(1), July 2000, 1-20.

MacKinlay, A. Craig. "Event Studies in Economics and Finance." *Journal of Economic Literature* 35 (1), March 1997,13-39.

McIntyre, Mark. "Who Is the Cleanest Mr. Clean?" *Newsday* November 3 1988, News Section page 4. (from Lexis-Nexis.)

Porter, Michael E. "Toward a New Conception of the Environment-Competitiveness Relationship." *Journal of Economic Perspectives* 9 (4), Fall 1995, 97-118.

Salinger, Michael. "Standard Errors in Event Studies." *Journal of Financial and Quantitative Analysis* 27(1), March 1992, 39-53.