THE POLITICAL ECONOMY OF ACID RAIN

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Introduction

Although the relationship is certainly controversial, acid rain is a story about sulfur dioxide (SO_2).[1] The story begins with fossil fuel. Combustion in fossil fuel-fired power plants and chemical processes in other industries generate vast quantities of oxides of oxygen that generally are emitted to the environment as waste. In the case of sulfur dioxide, emissions may be dispersed as far as several hundred miles from the source and along the way become dissolved in atmospheric moisture, forming acid, which is deposited downwind as precipitation (Record 1982). The use of high sulfur coal to produce electricity is not simply a matter of unconstrained choice, however. Federal regulation has prodded producers away from the use of low sulfur coal and natural gas, which would produce little or no SO_2 (Gordon 1978, pp. 44–45). As in many other cases, the demand for one regulation has led to the demand for another.

Highly valued production of electricity in coal-fired utilities in the Midwest begins a process that leads to the deposition of acid rain on valuable resources in the Northeast. At its simplest theoretical level, the problem is one of property rights. There are no fee simple rights to environmental use that can be enforced and traded in markets. Because of this, tension between the Midwest and the Northeast forms the elements of a classic two-party externality struggle. As

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[1]The history of the problem is discussed by Cowling (1982). We recognize that SO_2 is not the only source of acid rain and that debate about the linkages between emissions from industrial sources and acid precipitation still rages. Nonetheless, we have focused our research on the elements of the political debate that have formed around proposals for legislation to control SO_2 emissions. That legislation focuses on stationary emission sources, especially coal-fired generators of electricity.

indicated by Coase (1960), when property rights are not defined and enforced, or when transactions costs are high, the contentious parties can call on government to deal with the issue. Sometimes the gains from trade that might be achieved through a market for rights to environmental use can be converted and used to influence the political mechanism (Buchanan and Stubblebine 1962).

Coase's prediction about political remedies is better remembered than his major insight about the basic problem itself. Coase reminds us that external effects are reciprocal. There would be no acid rain damage were it not for economic activity that values environmental use. Conversely, there would be no discharge of waste, were it not for economic activity that values environmental use. In theory, both parties are identically situated, since both would like to have unencumbered use of the environment at zero price. In spite of Coase's insight about the reciprocal nature of externalities such as pollution, the focus of the acid rain problem is on the producers and users of electricity and the owners of coal deposits and their employees—not on the owners of buildings, property tax collectors, fishermen, recreationists, forest product producers, and a diverse public that desires economic gain by placing restrictions on other environmental users.

Electricity production from burning coal is an important segment of the economies of Illinois, Indiana, Kentucky, Michigan, Missouri, Ohio, Pennsylvania, Tennessee, West Virginia, and Wisconsin, the region that produces the lion's share of SO_2. Forest products, farming, sport fishing, and other recreational activities are important to the economic activity of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont, receivers of unwanted SO_2. The resulting regional conflict has led to appeals to Congress from the receivers of acid rain. For almost a decade, Congress has wrestled with the problem, yet final legislation has not been passed.[2] Forces of supply and demand that might interact in a market for environmental property rights are still being applied to members of Congress. However, while almost 20 bills have been discussed in congressional committees since 1980, only two have received a committee vote.

A careful identification of appropriable rents that might be created or protected by the property rights formed by acid rain legislation

[2]For a summary discussion of the acid rain problem and efforts to resolve it, see Congressional Research Service (1984), U.S. General Accounting Office (1981), U.S. Office of Technology Assessment (1984), Record (1982), and Wetstone and Foster (1983). Crandall (1984) discusses legislative controversies surrounding acid rain control and reports the results of empirical work conducted to explain the design of bills we later analyze. He does not attempt to predict voting behavior, however.

helps to determine the positions taken by economic agents who seek to influence the legislative process. Upon making that determination, predictions of voting behavior can be made and tested. This paper seeks to explain the outcome of committee votes on legislative proposals and why Congress has repeatedly failed to pass acid rain legislation, even though the Clean Air Act of 1970 requires reauthorization and the acid rain issue has national and international implications (Brown 1981). Since one of the committee votes analyzed here occurred in the House and the other in the Senate, we can also identify differences in political behavior that might be explained by economic forces.

The remainder of the paper is organized as follows. First, we provide additional background to the acid rain controversy, discuss various legislative proposals, and address the potential wealth redistribution and cost considerations associated with proposed legislation.[3] Next, we develop a model that explains voting behavior and report the results of several estimation procedures that analyze a vote in each chamber of the 98th Congress. This is followed by some concluding remarks.

The Problem and Its Distributional Consequences

Table 1 reports 1980 data on SO_2 emissions by source category for a 31-state region bordering and east of the Mississippi River and collective data for the remaining states. Most legislative proposals addressing SO_2 reductions have focused on the 31-state region where the heavy production of SO_2 from Midwest states is apparent in the table. The 10 Midwest states mentioned above, which are the largest emitters, produced 10.3 million tons of the 15.7 million tons of SO_2 emitted by all electric utilities in the United States in 1980.

Because of the nature of predominant atmospheric air currents, releases from the Midwest are precipitated in the Northeast, where soil buffering capacity is low and biological effects are substantial.[4] It is of great interest, however, that the receiving states also are producers of SO_2, which is swept away to sea or to Canada. In fact, our calculations of the tons of SO_2 per million kilowatt hours of electricity produced in the 31-state region rank Massachusetts in first

[3]The work to be reported is developed in the tradition of research on regulation and legislation developed by Stigler (1971), Peltzman (1976), Kau and Rubin (1979), Kalt (1983), and Kalt and Zupan (1984).

[4]We recognize the controversial nature of conclusions drawn on the nature of the linkage between SO_2 emissions and acid rain. That and other illustrative examples of damage are discussed in U.S. Department of the Interior (1983a, 1983b).

TABLE 1

ESTIMATED 1980 SULFUR DIOXIDE EMISSIONS
(THOUSANDS OF TONS)

State Emissions	Total Emissions	Utility Combustion	Nonutility Combustion	Process Emissions	Other
31-State Region:					
Alabama	759	543	86	95	35
Arkansas	102	27	32	29	14
Connecticut	72	32	35	0	5
Delaware	109	52	26	25	6
District of Columbia	15	5	8	0	2
Florida	1,095	726	97	159	113
Georgia	840	737	44	14	45
Illinois	1,471	1,126	188	119	38
Indiana	2,008	1,540	290	151	27
Iowa	329	231	57	27	13
Kentucky	1,121	1,008	66	29	18
Louisiana	304	25	76	153	50
Maine	95	16	65	4	10
Maryland	338	223	56	42	17
Massachusetts	344	275	58	1	11
Michigan	907	565	154	152	35
Minnesota	260	177	44	18	22
Mississippi	285	129	48	75	32
Missouri	1,301	1,141	55	81	25
New Hampshire	93	80	10	0	2
New Jersey	279	110	75	42	52
New York	944	480	335	71	59
North Carolina	602	435	116	23	28
Ohio	2,647	2,172	311	118	46
Pennsylvania	2,022	1,466	254	239	63
Rhode Island	15	5	8	0	2
South Carolina	326	213	84	13	16
Tennessee	1,077	934	83	27	33
Vermont	7	1	5	0	1
Virginia	361	164	142	14	41
West Virginia	1,088	944	84	43	16
Wisconsin	637	486	107	5	40
Other 19 States	4,708	1,306	404	2,529	467
U.S. Total	26,557	17,373	3,504	4,296	1,385
Percent of Total	100	65	13	16	5

SOURCE: U.S. Office of Technology Assessment (1984).

place, Vermont second, followed by Florida, New York, and New Hampshire.[5] Four of the five are in the region that expresses the greatest concern about acid rain and environmental quality (Pasztor 1984). The same calculations show that the states targeted for control already have the cleanest output on a per-kilowatt-hour basis.

These calculations suggest that the problem has little to do with a pure environmental ethic but much to do with economic costs. The major emitters of SO_2 are simply exceptionally large producers of electricity. The fact that their output is much cleaner per unit than that of the receiving states indicates that the marginal cost of control likely will be higher for them. It is generally less costly to remove large particles from an environmental discharge than smaller ones.

While there are several ways to reduce the effects of acid rain, the principal methods in use and being discussed are coal washing, flue gas desulfurization scrubbing, and switching to low sulfur coal. The first has the advantage of low capital costs, though it reduces sulfur content by no more than 40 percent. Scrubbing flue gas reduces sulfur oxides very effectively, but has high capital costs and produces large amounts of solid waste. Fuel switching is less expensive than scrubbing but disrupts coal workers and owners of coal deposits in the East. Indeed, the current regulations requiring scrubbers on new coal-burning generators spawned by the 1977 amendments to the 1970 Clean Air Act resulted from successful efforts to protect coal interests in the East (Ackerman and Hassler 1981; White 1981).

Since 1980, seven pieces of major legislation requiring SO_2 reductions have been introduced in the Senate and at least 10 in the House (see Table 2). Most of the proposals have focused on SO_2 emissions in the Midwest and the 31-state region. There are four common proposals found in all the bills:

1. Reductions of SO_2 emissions across all coal-fired plants equal to the difference between an EPA standard and current emission levels, for a total reduction of either 8, 10, or 12 million tons annually.
2. Reductions of SO_2 for all coal-fired plants in the 10-state region with the heaviest emitters; no specified technology for achieving reductions, but with constraints on fuel switching.
3. Reductions of SO_2 for the top 50 emitting plants in the United States, all in the 31-state region; scrubbers or other capital-intensive technology required; reductions across remaining plants to bring the total to 10 million tons annually.

[5]The calculations were based on data on emissions and electricity production from U.S. Office of Technology Assessment (1983).

TABLE 2

ACID RAIN LEGISLATIVE PROPOSALS, 1981–86

Year	Item	Sponsor	Disposition
1981	S723	Tower (R–Tex.)	Referred to committee
1982	HR5555	Waxman (D–Calif.)	Referred to committee, washed out
1983	HR132	Gregg (R–N.H.)	Marked up with HR5314
	HR2794	St. Germain (D–R.I.)	Marked up with HR5314
	HR3400	Sikorski (D–Minn.)	Marked up with HR5314
	HR5314	Waxman	Failed committee vote
		Mitchell (D-Maine)	10 to 9
	S145		Marked up with S768
	S768	Stafford (R–Vt.)	Reported May 3, 1984
1985	HR967	Florio (D–N.J.)	Referred to committee
	HR1030	Conte (R–Mass.)	Referred to committee
	HR1414	Green (R–N.Y.)	Referred to committee
	HR2679	Udall (D–Ariz.), Cheney (R–Wyo.)	Referred to committee
	HR2918	Rinaldo (R–N.J.)	Referred to committee
	S52	Stafford	Referred to committee
	S283	Mitchell	Referred to committee
	S503	Proxmire (D–Wis.)	Referred to committee
1986	HR4567	Waxman	Markup due
	S2203	Stafford	Referred to committee

NOTE: Table 2 includes the major items of legislation introduced into the House and Senate since 1980 to amend the Clean Air Act of 1970 with requirements for acid rain precursor emissions reductions.
SOURCE: Congressional Research Service (1980–86).

4. Taxes to be placed on consumers of electricity to fund the cost of emission control capital.

Some bills establish a superfund to be collected from a per-kilowatt-hour tax imposed on all users of coal-generated electricity, often focusing on consumers in the 31-state region. Others spread the tax across the entire country, and still others require the electrical utilities themselves to fund the costs.

The predicted costs of the various programs also vary, depending on SO_2 reduction amounts, their timing, and the extent to which individual polluters will be allowed to minimize their control costs.

Published annual cost estimates range from \$2.7 billion to \$7 billion (in 1982 dollars).[6] An extensive plant-specific cost study, which considered 24 firms that account for 44 percent of the emissions to be reduced, indicates annual costs of \$5 billion and cumulative capital costs of \$15 billion (National Economic Research Associates 1983). When these additional costs are added to the current \$2.4 billion annual expenditure on SO_2 control, the new annual total ranges from \$5 to \$10 billion for control of one major pollutant.

An analysis of one 1983 House proposal, HR3400 (later marked up with HR5314, analyzed below), gives an indication of the legislation's effect on consumer electricity bills (U.S. Office of Technology Assessment 1983). In an initial phase, all consumers of coal-fired electricity would pay a tax that would fund 90 percent of the capital costs for the 50 largest emitters. During a second phase, there would be a combination of the tax and a price increase. In the last phase, when heavy capital expenditures are completed, consumers served by particular firms will bear emission control costs. Across these three phases, depending on the state involved, consumer electricity bills would increase by as much as 12.9 percent (Indiana) to as little as zero (Arizona). Without the tax and superfund, electricity rates would rise by as much as 19 percent (Indiana). Consumer in several other high emission states would see their electricity bills rise by 12 to 19 percent.

The different distributional effects of the various proposals are obvious. In no case will the beneficiaries of acid rain control be required to pay directly for their gains. At most, consumers in those states will pay a surtax on their electricity bills. It is also rare that public utilities would be required to pass the full cost of the mandated controls to their consumers and investors. The bills generally have the political attraction of providing concentrated benefits to a few with costs spread across many.

Perhaps because of the magnitude of the costs and the competing methods for funding them, only two bills—S768 and HR5314—were actually voted on in committee, and none has been introduced to the floor for a vote (see Table 3). Neither bill allowed fuel switching, and both protected interests in the East. The House version mandated the use of scrubbers, which relates to the continued use of high sulfur Eastern coal, and the Senate version allowed for coal washing, which

[6]A survey of acid rain control cost studies was prepared by Gordon Brady for a conference on the relative merits of emission trading sponsored by the Council on Environmental Quality and the U.S. Department of the Interior, 16–17 July 1984. The data reported here are drawn from Brady (1984).

TABLE 3

COMPARISON OF TWO BILLS TO REDUCE ACID RAIN

Element of Bill	S768	HR5314
Reduction goal	10 million tons	10 million tons
Allocated per state?	Yes, by formula	Yes, by formula
Emission restriction	1.2 lbs/mil Btu	1.2 lbs/mil Btu
Deadline goal	1994	1993
Abatement area	31 state area	31 state area
Abatement method	Any except fuel switching	Scrubbers
Funding	Study proposed	Superfund
Revenue generation	Study proposed	1 mill per kilowatt hour
Targeted emitters	None targeted	50 biggest utility emitters
Trading allowed	Yes, as offsets within region	Yes, as offsets between states
New sources	Must be offset	Must be offset

also protects Eastern coal. Both bills allowed some trading of emission reductions among polluters; that is, those firms that can control emissions at a lower cost would be allowed to sell additional units of reductions to firms that have higher control costs. S768 did not target specific emitters for control, nor did it propose a method for funding and revenue generation. Fundamentally, the two bills aimed to reduce SO_2 emissions from the 1980 level of 24 million tons to 14 million tons. Given an expected linear relationship between emissions and acid rain deposition, both bills anticipated an overall reduction of acid rain by 40 percent.

While the substance of the two bills is very similar, the committee voting patterns clearly are not. In the case of S768, the vote was 16 to 2 in favor, with no abstentions. The proposal for HR5314 failed in committee with a recorded vote of 10 to 9 and no abstentions.[7] Overall voting patterns reflect the distribution of committee members among states with high SO_2 emissions, receivers of damaging acid rain, and

[7]Details on S768 and HR5314 are covered in Davis (1984), O'Donnel (1983), *Major Legislation of the Congress* (1984), and "Environmental Protection Agency Programs: Congressional Activities" (1984).

states that are not directly involved in the controversy. These patterns relate to constituency group pressures or efforts to gain or maintain wealth through the political process.

Our discussion of the acid rain controversy and proposed legislation suggests that there are three groups of economic agents that interact in forming a demand for political action. First, there are the producers of SO_2, primarily regulated monopolies in their respective states. These firms may demand national legislation to gain beneficial results in their requests for rate increases, as well as for subsidies of control costs they would incur in building plants under current regulations. Given their regulated status, however, the electrical utilities have little to gain from the legislation as proposed.

The second group includes environmental groups, owners of land, buildings, and other improvements, state and local governments whose property tax revenues are affected, and other organized groups that represent receivers of acid rain. These less concentrated groups, relative to electrical utilities, represent votes and funds for campaigns. They obviously will provide more support if benefits are provided to them at low cost, and they have the most to gain in terms of enhanced rents from the legislation as proposed.

The third force implied in the discussion comes from labor employed in mining high sulfur coal, organized labor in the power industry, and the owners of capital and resources in the coal industry (White 1981, pp. 72–77). Organized labor and owners of assets in the coal industry have an obvious interest in legislation that could sharply reduce or even eliminate the rents being earned on the specialized factors in their industry. Furthermore, it is in the interest of labor in the generating industry to have capital intensive regulations that reduce the relative cost of labor and increase demand for their services (Miller 1984). Labor is highly organized, has been sensitive to past efforts to control SO_2 emissions, and represents a large voting group. It is highly doubtful that they simply desire SO_2 reductions, since they are not receivers of acid rain. They are arguably more concerned about fuel switching and higher priced electricity that reduces demand for coal. At best, acid rain legislation prospects are negative for this group.

The eventual supply of legislation will come when the number of constituent votes and amount of campaign contributions from environmentalists and receivers of acid rain are large enough to offset the losses of political support from SO_2 producers and coal interests.

Of course, any steps to mitigate the costs imposed on the latter groups strengthen the environmentalists' demands.

Empirical Analysis of the Votes

In a study closely related to our work, Robert Crandall (1984) developed a political economy analysis of the 1983 congressional effort to pass acid rain legislation. His model estimated the relationship between SO_2 reductions included in legislation for each state and ambient air quality, distance from the alleged receivers of acid rain, and the number of legislators from each state who served on the relevant congressional committees. Unlike our research, which focuses on appropriable rents and who gains from them, Crandall's results supported the hypothesis that the legislation was designed to distribute the burden of control costs. He found no relationship between severe SO_2 problems in a local area and the amount of emission reductions targeted for that area, a finding in harmony with our theory.

Several other studies have analyzed the redistribution of costs and voting behavior associated with federal pollution legislation.[8] An overall assessment of these works indicates that political and ideological variables tend to give way in importance to economic ones when the stakes are high. The economic impact of acid rain legislation, like that for the control of surface mining, is extremely high (Kalt 1983). We argue that ideological variables will play a minor role in our analysis and have tested that argument empirically.

Committee member votes on S768 and HR5314 reflect the economic interests of constituents, and may reflect political interests insofar as party guidance and logrolling influence voter behavior. Since we analyze votes in both houses of Congress, we will estimate the effects of party and house, which will allow us to draw inferences regarding the degree to which party direction matters.

Our discussion of the efforts to pass acid rain legislation and the two single items that have been voted on in committee offers predictions of political behavior based on property-rights'-driven appropriable rents. Those legislators representing states in which coal mining for electricity is important are predicted to vote negatively, because a tax on electricity or a cost-induced price increase will have negative effects on rents earned in coal mining. These are mostly the same states that emit large amounts of SO_2. Representatives of states that receive large amounts of acid rain are expected to favor the legislation. There are clearly rents to be gained from the improve-

[8]See Kau and Rubin (1979), Kalt (1983), Kalt and Zupan (1984), Peltzman (1984), Crandall (1984), Silberberg and Nelson (1985), and Frendreis and Waterman (1985).

ments of natural resources and physical structures in those states, and little cost is imposed in exchange for those rents.

Because we were analyzing a yes-no dependent variable, we sought to develop a maximum likelihood logit model assigning values of one to "yes" votes and zero to "no" votes. We tested the specification of explanatory variables using an ordinary least squares regression model, recognizing that the results would be biased but nonetheless similar to those of the logit. The general model for a pooled sample that includes both the House and the Senate vote is written:

VOTE = F(PARTY, SENATE, SO2PRCNT, FPROD, LCVRATE, INCGRWTH, NATLANDS, AIRPOL, WQUAL, REGION),

where the definitions and predictions for each variable are given in Table 4. All variables other than the three indicator variables are for states represented by the congressional committee members. Some of the entries in Table 4 indicate that we make no firm, a priori predictions for coefficients. We do expect PARTY to be positively signed when analyzing the House vote, because the majority party was Democrat in that chamber. We cannot make predictions, however, for the combined sample.

We predict a positive coefficient for FPROD on the basis of cost imposed by acid rain on that industry. Following Crandall (1983), we predict LCVRATE will be positive, assuming that ideology not accounted for by other variables remains unexplained. The prediction for INCGRWTH is based on work by Yandle (1984), where a vote on an SO_2-related amendment was explained partly by using growth in value added in manufacturing, which was negatively signed. The argument for this effect states that rapidly growing regions, which generally have lower levels of income, resist regulations that may impede growth.

The next three variables are also drawn from Crandall (1983). The coefficient on NATLANDS is shown as negative in Table 4, but there are two arguments regarding its effect. A public interest argument states that congressional managers of the public trust will vote to preserve the value of federal lands, assuming acid rain damages forests. The predicted negative sign is based on the obverse effect. Large holdings of government-owned land imply relatively small holdings of privately owned land. Private gains are generated when

[9]Data for the variables are from the following sources: Davis (1984), O'Donnel (1983), Congressional Research Service ([June 1984] 1980–86), "Environmental Protection Agency Programs: Congressional Activities" (1984), U.S. Office of Technology Assessment (1984), U.S. Bureau of Labor Statistics (1982), and Crandall (1983).

TABLE 4

ACID RAIN VOTING BEHAVIOR MODEL

Explanatory Variable	Description	Sign on Coefficient
PARTY	An indicator variable equal to one for Democrat, and zero otherwise.	No prediction
SENATE	An indicator variable equal to one for Senate votes, and zero otherwise.	No prediction
SO2PRCNT	The total metric tons of SO_2 released by electrical utilities in each state as a percent of total national loadings.	Negative
FPROD	The share of state labor employed in forest products industry activities.	Positive
LCVRATE	The League of Conservation Voters rating, where a higher value is presumed to reflect greater sensitivity to environmental issues.	Positive
INCGRWTH	The ratio of state income in 1979 and 1959	Negative
NATLANDS	The percentage of state land owned by the federal government.	Negative
AIRPOL	The percentage of state population living in counties where the SO_2 level exceeds the national standard.	Positive
WQUAL	The average water quality of state streams, where a higher value reflects higher pollution.	Positive
REGION	An indicator variable to separate 31 states in the control region from others, where a control state is set equal to one.	No prediction

private land is protected from acid rain. We chose the special interest argument, not the public interest one. Both arguments assume legislators vote to protect an interest. In the special interest case, however, the resulting rents are appropriable.

The next two variables, AIRPOL and WQUAL, adjust for differences in environmental quality across the states represented by the voters in the two samples. AIRPOL measures the level of human exposure to higher levels of SO_2 emissions, and we predict its coefficient will be positive. This assumes that politicians are sensitive to public health, all else equal. We recognize, however, that it would be difficult to appropriate gains from long-term improvements in human health. We also predict the coefficient on WQUAL to be positive. Since that variable accounts for the quality of fishing waters, we assume the gains from improvements could be more readily captured by special interests than in the case of air quality. Finally, the dummy variable REGION is included to adjust for disinterested legislators, to the extent there are any. The level of disinterest, we argue, will rise for those outside the 31-state control region. We note also that NATLANDS tends to identify Western states, since those states have a larger share of public lands. A significant coefficient on REGION implies a partial effect not captured by NATLANDS.

The results for the OLS regressions are reported in Table 5, which includes an analysis of the merged sample along with separate analyses for House and Senate votes. As indicated, the effect of SO2PRCNT is negative and significant in both the merged vote and House analyses, which indirectly supports the argument that legislators will vote on the basis of special interests. The dummy for Senate is positive, which we interpret to suggest that the Senate followed its leadership. PARTY is positive and significant in the combined test, and the results for the House analysis tell us why: Party membership matters in the House, and the effect is transmitted to the combined sample analysis.

FPROD approaches significance in the merged vote equation, and it becomes significant in the Senate equation. In this case, we have a perverse outcome, one that suggests forest products interests oppose reductions in acid rain. Thinking that the variable used was too inclusive, in that it included pulp and paper mills that are SO_2 emitters, we narrowed the model by limiting FPROD to labor employed in the pulp and paper industry, and modified SO2PRCNT to emissions other than those from electrical generators. Our results were virtually unchanged, although the coefficient on the new FPROD variable had a slightly lower level of significance. Apparently, con-

TABLE 5

OLS REGRESSION RESULTS FOR MERGED AND SEPARATE VOTES ON S768 AND HR5314

Variable	Coefficients for Merged Votes[a]	House	Senate
SO2PRCNT	-0.0656 (-2.224)[c]	-0.0742 (-1.968)[d]	0.0312 (0.573)
SENATE	0.4005 (2.920)[b]		
PARTY	0.3432 (2.409)[c]	0.7335 (3.518)[b]	-0.1146 (-0.915)
FPROD	-0.0543 (-1.107)	0.0192 (0.224)	-0.0739 (-1.983)[d]
LCVRATE	-0.0002 (-0.054)	0.0024 (0.292)	0.0030 (0.877)
INCGRWTH	-0.2522 (-1.082)	-0.3977 (-1.011)	-0.1236 (-0.612)
NATLANDS	-0.9732 (-1.476)	-0.1624 (-0.132)	-2.3557 (-4.286)[b]
AIRPOL	0.0088 (1.518)	0.0049 (0.544)	0.0059 (1.080)
WQUAL	0.0281 (1.447)	-0.0296 (-0.747)	0.0582 (3.606)[b]
REGION	-0.1597 (-0.694)	-0.2609 (-0.718)	-0.4544 (-2.035)[d]
R^2	0.5358	0.7343	0.7838
Adj R^2	0.3572	0.4687	0.5405
F Statistic	3.001	2.764	3.222
N	37	19	18

[a]Values of *t* statistics in parentheses.
[b]Significant at the 1 percent level for a two-tailed test.
[c]Significant at the 5 percent level for a two-tailed test.
[d]Significant at the 10 percent level for a two-tailed test.

cerns about future harsh treatment of SO_2 emissions from the pulp and paper industry are reflected in the negative sign.

The coefficients on NATLANDS, AIRPOL, and WQUAL are not significant for a two-tailed test in the merged vote analysis, though they approach borderline significance for a one-tailed test. NATLANDS has a negative sign, which becomes highly significant in the

Senate vote equation, where WQUAL also becomes significant and positive. We interpret the negative coefficient on NATLANDS to indicate Senate concern for the enhancement of private land values, not for the protection of public lands. WQUAL indicates a concern for physically deteriorated waters, which could reflect an interest in appropriable rents.

The coefficient on AIRPOL is not significant, which implies that the measurements of the proportion of state populations exposed to higher levels of SO_2 are either not accurate or unimportant in motivating votes or that SO2PRCNT adjusts for those effects. In an attempt to isolate the effects of AIRPOL, we made additional estimates omitting SO2PRCNT. The level of significance of AIRPOL was even lower than before. AIRPOL is not highly correlated with SO2PRCNT. These results reinforce our inference that private interests, not public interests, are the motivating forces in the voting behavior analyzed.

The coefficient on REGION, the dummy variable set equal to one for voters representing one of the 31 states in the control region, is not significant in the merged equation but is significant and negative in the Senate estimate. We note that both REGION and NATLANDS are significant in that estimate, which suggests that REGION may isolate an additional Western state effect. We interpret these results to imply disinterest on the part of representatives from outside the affected region. The coefficients on LCVRATE and INCGRWTH are insignificant in all equations, suggesting that ideology does not matter and that income growth is reflected in other variables, perhaps SO2PRCNT.

Table 6 reports the OLS estimates with the statistically insignificant variables removed. These results underline the relative strength of the Senate equation. Finally, we report the truncated logit analysis in Table 7. Unfortunately, the number of observations were too few and the vote so skewed that the logit was unable to converge in estimating the Senate equation. The importance of variables in the merged and House equations is similar to those in the OLS estimates, however.

Caught between having too few observations for a thorough logit analysis on the one hand and statistically biased OLS estimates on the other, we prefer the OLS results, which are confirmed in a limited way by the logit. Although weaker than we would prefer, the statistical analysis of the only recorded votes on acid rain control reveals results supporting predictions based on the political economy of acid rain.

TABLE 6

REGRESSION RESULTS WITH INSIGNIFICANT VARIABLES OMITTED

Variable	Coefficients for Merged Votes[a]	House	Senate
SO2PRCNT	-0.0649 (-2.708)[b]	-0.0612 (-2.944)[b]	
SENATE	0.4112 (3.104)[b]		
PARTY	0.3990 (3.041)[b]	0.8144 (4.777)[b]	
FPROD	-0.0692 (-1.631)		-0.0704 (-2.159)[c]
NATLANDS	-0.6826 (-1.377)		-2.0559 (-4.712)[b]
AIRPOL	0.0070 (1.305)		
WQUAL	0.0305 (1.624)		0.0540 (4.409)[b]
REGION			-0.2323 (-1.684)
R^2	0.5041	0.6208	0.6864
Adj R^2	0.3844	0.5734	0.5900
F Statistic	4.212	13.098	7.115
N	37	19	18

[a]Values of *t* statistics in parentheses.
[b]Significant at the 1 percent level for a two-tailed test.
[c]Significant at the 5 percent level for a two-tailed test.

Conclusion

The analyses of congressional votes on controlling acid rain imply that legislators support laws that protect appropriable rents in the coal producing regions, in the pulp and paper industry, and in the ownership of land. There is competition in the special-interest struggle for potential new property rights. When voting on acid rain bills, legislators in the House follow party guidance, while those in the Senate, which appear to follow chamber leadership, are not affected by party labels. Senators support the laws proposed, holding their political labels and other variables constant.

TABLE 7

LOGIT TEST RESULTS FOR MERGED AND SEPARATE VOTES ON S768 AND HR5314

Variable	Coefficients for Merged Votes[a]	Probability Change	Coefficients House	Probability Change
SO2PRCNT	-0.6896 (-1.50)	-0.15	-0.3685 (-1.79)[d]	-0.09
SENATE	5.3258 (2.22)[c]			
PARTY	4.9713 (2.24)[c]		10.1616 (0.42)	
FPROD	-0.5885 (-1.22)	-0.13		
NATLANDS	-0.0977 (-1.59)	-0.02		
AIRPOL	0.1187 (0.68)	0.03		
WQUAL	0.3884 (1.75)[d]	0.08		
Model Chi^2	26.45[b]		15.40[b]	
N	37		19	

[a]Values of *t* statistic in parentheses.
[b]Significant at the 1 percent level.
[c]Significant at the 5 percent level for a two-tailed test.
[d]Significant at the 10 percent level for a two-tailed test.

The special-interest influences that creep into the voting process from industries not directly affected by the proposed legislation, the pulp and paper industry, appear to reflect concerns about future regulation. The political economy of acid rain is forward looking. We also observe that rents from private land appear to be more important than the protection of federally owned lands, which provide no appropriable rents. The Senate is also sensitive to water quality and acts to protect it, which may be saying that the fishing industry is protected. Again, there are potential private gains from protecting water quality, but we cannot find a similar argument for the protection of air quality. Ambient air quality across states does not seem to affect voting behavior, other things being equal. This is consistent with the lack of importance of ideological factors and the spread of SO_2 across both emitters and receivers of acid rain.

Why has an acid rain bill not come to the floor of Congress? Why has the Clean Air Act not been amended to resolve the acid rain problem? Our analysis suggests that the costs are simply too high. Party politics seems to have driven the votes on the two committee bills analyzed, but economic forces worked against an ultimate floor vote. At the time of the debate, the American economy was involved in significant restructuring, an adjustment process that placed heavy demands on the economies of the Midwest, the region most affected by the proposed legislation. Add to this uncertainty regarding the linkage between SO_2 and acid rain and enough inertia is formed to stall movement of the legislative engine.

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