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PREDATION THROUGH REGULATION: THE WAGE AND PROFIT EFFECTS OF THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND THE ENVIRONMENTAL PROTECTION AGENCY*

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I. INTRODUCTION

A COMMON error in popular expressions of political economy is the presumption that all firms oppose environmental and safety regulations because these edicts raise business costs. The flaw in this presumption arises from an exclusive focus on what we will call the "direct effects" of regulation—the isolated, partial equilibrium effects of regulation on single firms or individuals.[1] Examples of the direct effects of environmental and safety regulations include increased safety of products and workplaces, decreased emissions of pollutants, and increased manufacturing costs. While direct effects dominate popular perceptions of regulation, the often pronounced heterogeneity among firms gives rise to additional, general equilibrium effects that we will call "indirect effects"—the competitive advantages that arise from the asymmetrical distributions of regulatory effect among different groups of firms and workers. For example, if the cost burden of certain regulations falls heavily on one group of firms and lightly on a second group, then an indirect effect of these regulations is to provide cost advantage to the second group of firms. It is extremely important to recognize that, for many firms and workers, the indirect

* We have benefited from comments made by Robert Leone, Peter Pashigian, Susan Rose-Ackerman, and participants in a seminar at the University of Chicago.

[1] For a more extensive discussion of the direct and indirect effects of regulation, see Ann P. Bartel & Lacy Glenn Thomas, Direct and Indirect Effects of Regulation: A New Look at OSHA's Impact, 28 J. Law & Econ. 1 (1985).

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effects of regulation can outweigh (in terms of economic importance) the direct effects. If the competitive advantage gained through indirect effects is sufficiently large, it can more than offset any direct costs, producing a net benefit for the regulated firm and its workers. The Consumer Product Safety Commission (CPSC) swimming pool slide and mattress standards, new source standards of the Clean Air Act, and the Occupational Safety and Health Administration (OSHA) cotton dust standard are among the many regulations where indirect effects have been shown to predominate.[2]

It has been shown that activities that raise rivals' costs are, in fact, predatory in many circumstances.[3] The three conditions necessary for activities to be regarded as predation are competitor damage, predator benefit, and consumer damage. The first condition—competitor damage—is very likely to be satisfied by OSHA and Environmental Protection Agency (EPA) regulations. The national cost of industrial compliance with these regulations was 3.7 billion dollars for OSHA and 7.7 billion dollars for EPA in 1976,[4] and mounting evidence (discussed below) indicates that this cost burden is asymmetrically distributed among various types of firms.[5] In regard to the second condition—predator benefit—particular groups of firms may well be sufficiently advantaged from indirect effects of regulation to experience increased profits (or wages or both). Whether certain firms actually benefit from EPA and OSHA regulations is an empirical issue and is the focus of this paper. Herein, we econometrically estimate the nature and extent of regulatory effect on industry wages and profits in the manufacturing sector of the U.S. economy.

In a narrow sense, the third condition for predation—consumer damage—is also extremely likely to be satisfied by EPA and OSHA regulations. The cost increases and productivity decreases of these regulations

[2] On the CPSC, see Kip Viscusi, Regulating Product Safety (1984); and Peter Linneman, The Effects of Consumer Safety Standards: The 1973 Mattress Flammability Standard, 23 J. Law & Econ. 461 (1980); on EPA, see Robert Crandall, Clean Air and Regional Protectionism, 2 Brookings Rev. 17 (1983); and, on OSHA, see Michael Maloney & Robert McCormick, A Positive Theory of Environmental Quality Regulation, 25 J. Law & Econ. 99 (1982); and John Hughes, Wesley Magat, & William Ricks, The Economic Consequence of the OSHA Cotton Dust Standard, 29 J. Law & Econ. 29 (1986).

[3] Steven Salop, Introduction, in Strategy, Predation, and Antitrust Analysis (Steven Salop ed. 1981).

[4] Murray Weidenbaum & Robert DeFina, The Cost of Federal Regulation of Economic Activity (Reprint no. 88, American Enterprise Inst. 1978).

[5] There are economic conditions under which these regulatory cost burdens need not damage competitors. See Steven C. Salop & David T. Scheffman, Raising Rivals' Costs, 73 Amer. Econ. Rev. 267 (1983). Competitor damage is thus an empirical issue.

raise prices for immediate consumers and reduce consumer surplus.[6] From a broader, and probably more correct perspective, however, for U.S. environmental and workplace safety regulations to entail consumer damage, these regulations would need to fail a broad test of social cost benefit. No such test of the overall effect of these regulations is attempted in this paper, and thus, in a strict sense, our argument that these regulations are predatory is incomplete. Nonetheless, a wide range of recent studies of OSHA and EPA have concluded that the actual benefits of these regulations are quite limited.[7]

We recognize that public interest theorists will object to our characterization of OSHA and EPA as predatory. From the viewpoint of these scholars, regulations inevitably have heterogeneous effects, and indirect effects are entirely innocent by-products of the public pursuit of workplace safety and environmental quality. We explicitly reject any such defense of OSHA and EPA behavior. While we acknowledge that the behavior of these agencies is complex and cannot be explained by simple capture theories, we nonetheless find ample evidence of OSHA and EPA actions that unnecessarily exacerbate or even artificially create indirect effects for political purposes (what we call enforcement asymmetries).[8] Furthermore, despite mounting evidence of the inefficiency of OSHA and EPA, Congress has continued to be uninterested in adequate monitoring

[6] Salop & Scheffman, *supra* note 5, also argue that there are some cases where, in fact, consumer surplus may increase after rivals' costs are raised.

[7] On OSHA, see Aldona DiPietro, An Analysis of the OSHA Inspection Program in Manufacturing Industries 1972–73 (Draft Technical Analysis Paper, Office of the Assistant Secretary for Policy, Planning and Evaluation, U.S. Dep't Labor 1976); John Mendeloff, An Evaluation of the OSHA Program's Effect on Workplace Injury Rates: Evidence from California through 1974 (Report prepared for the Office of the Assistant Secretary for Policy, Evaluation, and Research, U.S. Dep't Labor 1976); Robert S. Smith, The Occupational Safety and Health Act: Its Goals and Achievements (1976); and Bartel & Thomas, *supra* note 1. On EPA, see Lester Lave & Gilbert Omenn, Clearing the Air: Reforming the Clean Air Act (1981); Robert Crandall, Controlling Industrial Pollution: The Economics and Politics of Clean Air (1983); and Paul MacAvoy, The Record of the Environmental Protection Agency in Controlling Industrial Air Pollution (unpublished manuscript, University of Rochester, Graduate School of Management, March 1984). Consumer damage is usually the most problematic of the three conditions. For example, the recently dismissed antitrust case against IBM contained several controversial allegations of predation against the computer company. Perhaps an appropriate view is that EPA and OSHA are at least as predatory as IBM and other industrial corporations.

[8] Evidence on enforcement asymmetries is cited in Section II, below. We should acknowledge that evidence exists that both OSHA and EPA, in response to protests by small firms, moderated, though did not eliminate, the extremes of heterogeneous regulatory effect against small firms during the mid-1970s. See Bartel & Thomas, *supra* note 1; and Robert Leone & John Jackson, A Case Study of Water Pollution Controls in the Pulp and Paper Industry, in Studies in Public Utility Regulation (Gary Fromm ed. 1981). During the same time period, indirect effects against Sun Belt firms became more pronounced (see Appendix A; and Crandall, *supra* note 7).

of regulatory effect, much less in regulatory reform. All this suggests that indirect effects are far more than innocent by-products—indeed, they may well be the primary political concern.

In the next section, we discuss the effect of indirect effects of regulation on profits and wages and show how the first two conditions for predation—competitor damage and predator benefit—may be satisfied by the enforcement of OSHA and EPA regulations. Section III describes the empirical specifications and data sources used to test the hypotheses regarding indirect effects, with results presented in Section IV. In Section V, we demonstrate that certain industries, in particular those with a high concentration of employment in the Frost Belt or in large firms, have actually gained profits as a result of the enforcement of OSHA and EPA. Hence, we are able to show that predators do indeed benefit from regulation.

II. Direct and Indirect Effects of Regulation

Indirect effects of regulation arise from two possible sources: a compliance asymmetry whereby one firm suffers a greater cost burden per unit of output even when regulations are equally enforced across firms or from an enforcement asymmetry whereby regulations are more vigorously enforced against certain firms. There appear to be two principal sources of compliance asymmetries owing to environmental and safety regulations. First, to the extent that there are economies of scale in compliance, smaller firms suffer a larger unit-cost effect and in fact may be sufficiently disadvantaged that they exit the industry. Pashigian has provided evidence that EPA regulation either reduced the extent of diseconomies of scale or increased the extent of economies of scale. Neumann and Nelson have documented the exit of small mines resulting from enforcement of the 1969 Coal Mine Health and Safety Act, and we have previously documented the strong economies of scale that occur in manufacturing for compliance with OSHA regulations.[9] Second, because their plants tend to be older, firms located in northern and midwestern states (the Frost Belt) will tend to have higher compliance costs with OSHA and EPA regulations than firms in southern and western States (the Sun Belt) when these regulations are evenly enforced.

The second source of indirect effects—enforcement asymmetries—

[9] Peter Pashigian, The Effect of Environmental Regulation on Optimal Plant Size and Factor Shares, 27 J. Law & Econ. 1 (1984); George R. Neumann & Jon P. Nelson, Safety Regulation and Firm Size: Effects of the Coal Mine Health and Safety Act of 1969, 25 J. Law & Econ. 1 (1982); and Bartel & Thomas, *supra* note 1.

arises from the legislation, promulgation, and administration of environmental and safety regulations that are systematically skewed against particular groups of firms or workers and thus reduce competitive advantage for these particular groups. In regard to OSHA, our own earlier study[10] exposed more intensive enforcement (per worker) against small and nonunion firms by the agency. To test for regional enforcement asymmetries by OSHA, we reran regression analyses from our earlier study, now including a variable measuring industrial regional location. These new results are reported in Appendix A and confirm that OSHA enforcement is more intensive against Sun Belt firms. In regard to EPA, the environmental regulations themselves are notoriously riddled with enforcement asymmetries. Especially significant are requirements that new plants meet tighter standards than old plants and that plants in areas of the country that are cleaner than national standards must meet tighter standards than plants in dirty areas.[11] Both of these enforcement asymmetries burden Sun Belt plants by raising their costs relative to those of their Frost Belt counterparts.

Compliance and enforcement asymmetries are thus reinforcing in the case of plant size, with larger plants favored by regulation.[12] These asymmetries are, however, offsetting in regard to regional effect, and, thus, the direction and magnitude of regional indirect effects are empirical issues. Data on EPA compliance costs by region have recently been collected by Pashigian and are reported in Table 1.[13] Note that firms in the first four subregions listed in Table 1 are located in the Frost Belt, while firms in the last five subregions are in the Sun Belt. Table 1 documents the systematically higher costs of EPA regulation for Sun Belt firms and indicates that enforcement asymmetries swamp any compliance asymmetries in regard to the regional distribution of EPA cost.

The effect of EPA and OSHA on total rents for an industry may be positive or negative. In terms of direct effects alone, they are, of course, negative—higher regulation-induced production costs generally lower potential rent. But, if these regulations sufficiently disadvantage small or Sun Belt firms in the industry, then the increase in the industry price that

[10] Bartel & Thomas, *supra* note 1.

[11] Crandall, *supra* note 7.

[12] Sometimes very small plants are exempted from regulations. If they have been granted exemptions from EPA and OSHA regulations, they could benefit from the regulations. Hence, the empirical analysis presented in this paper is particularly valuable to determine which of the two possible effects dominate.

[13] B. Peter Pashigian, Environmental Regulation: Whose Self-Interests Are Being Protected? 23 Econ. Inquiry 551 (1985).

TABLE 1

UNIT POLLUTION ABATEMENT COSTS, 1974–77

	Total Pollution Abatement Operating Costs per $1,000 of Value Added	Air Pollution Abatement Operating Costs per $1,000 of Value Added
United States	8.32	3.40
	(45)	(45)
New England	4.18	1.15
	(6)	(6)
Middle Atlantic	7.81	3.41
	(3)	(3)
East north central	7.42	2.85
	(5)	(5)
West north central	5.36	1.97
	(6)	(6)
South Atlantic	9.12	3.18
	(8)	(8)
East south central	9.74	3.93
	(4)	(4)
West south central	15.09	6.30
	(4)	(4)
Mountain	10.66	7.12
	(6)	(6)
Pacific	8.33	3.85
	(3)	(3)

SOURCE.—Table 7 in Peter Pashigian, Environmental Regulation: Whose Self-Interests Are Being Protected? 23 Econ. Inq. 551 (1985).

NOTE.—In each year, the weighted average ratio was calculated for each region. A simple yearly average of these ratios is reported in this table. Number of states used to calculate mean in parentheses. Deleted states were Alaska, Hawaii, New Mexico, South Dakota, and Wyoming.

results from the upward shift in the supply curve may more than offset the regulatory costs for large or Frost Belt firms.[14]

Some simple algebra clarifies the effects of regulation on total industry profits. The profit margin for an industry may be written as

$$\frac{\Pi}{Q} = P - \sum_{I} AC_i d_i, \tag{1}$$

where Π denotes accounting profits, Q is total output, P is price, AC_i is average cost (per firm), and d_i is the i^{th} firm's share of total output. Using a superscript to denote values after imposition of regulation and no

[14] In other words, the rents of marginal firms will decline and some may be forced to exit, while the rents of inframarginal firms will rise. For an extended discussion, see Salop & Scheffman, *supra* note 5.

superscript to denote preregulation values, we define the effect of regulation on production costs for the i^{th} firm in the industry as

$$X_i = \text{AC}_i^r - \text{AC}_i. \tag{2}$$

We have argued that X_i differs across firms in the industry because of such characteristics as size and location of firm. The industry price will increase because of regulatory costs, but price changes are driven by the high-cost or marginal firm in the industry. Price will rise by less than the increase in average cost for the marginal firm, in part because marginal cost increases owing to regulation for each firm are smaller than average cost increases (hence, the elasticity of scale increases—this phenomenon is what we call economies of scale in compliance) and, in part because of adjustment delays. An important constraint on price increases owing to regulation is the extent to which the U.S. industry faces import competition. If the elasticity of supply of imports is high, then the increase in the domestic price will be mitigated. In our empirical analysis, we can observe only the import share for the industry (IMP), not the elasticity of supply, but we believe that the two are positively correlated across industries and across time. The change in industry price owing to regulation is given in equation (3), where X_{mar} is the increase in average cost for the marginal (or high-cost) firm:

$$\text{P}^r - \text{P} = \beta X_{\text{mar}}(1 - \alpha\text{IMP}), \quad 0 < \beta < 1, 0 < \alpha < 1. \tag{3}$$

The change in average profits for the industry can now be written as

$$\begin{aligned} \frac{\Pi^r}{Q} - \frac{\Pi}{Q} &= \beta X_{\text{mar}}(1 - \alpha\text{IMP}) - \sum_{\text{I}} X_i d_i \\ &= -(1 - \beta)X_{\text{mar}} - \beta\alpha X_{\text{mar}}\text{IMP} + \sum_{\text{I}} (X_{\text{mar}} - X_i)d_i. \end{aligned} \tag{4}$$

Equation (4) shows that we can segregate the effects of regulation on industry profits into three terms: (*a*) a pass-through effect, which is negative, arising because prices do not increase fully with regulation-imposed costs; (*b*) a trade effect, which is negative, caused by the depressing effect of imports on industry price; and (*c*) indirect effects based on the heterogeneity of regulatory cost burdens.

It is our expectation that the magnitude of indirect effects based on firm size is the same in all regions; and, likewise, that the magnitude of indirect effects based on region is the same for all sizes of firms. Expressed differently, we regard the total indirect effect for an individual firm to be the

simple sum of separable firm size and regional indirect effects. Given this additivity, we rewrite equation (4) as

$$\frac{\Pi^r}{Q} - \frac{\Pi}{Q} = -(1 - \beta)X_{\text{mar}} - \beta\alpha X_{\text{mar}}\text{IMP} + (X_{\text{mar}} - X_{\text{large}})d_{\text{large}} + (X_{\text{mar}} - X_{\text{frost}})d_{\text{frost}}, \tag{5}$$

where d_{large} and d_{frost} indicate, respectively, the percentages of industry output from large and Frost Belt firms. The third term in equation (5) defines the indirect effect based on firm size, while the fourth term shows the indirect effect based on region.

It is important to realize that the effect of regulation on industry rents will be shared by wages and profits because much of the increase in windfall profits created by regulatory predation may be expropriated by unionized workers. Freeman, Salinger, Karier, and Voos and Mishel have documented the transfer of rents to unionized workers in a cross-sectional analysis of industry profits,[15] and Moore[16] and others have documented the abilities of unions to force artificially increased wages for regulated firms enjoying windfall profits. In our analysis, we therefore expand equation (5) to allow for union expropriation of the predatory rents created by OSHA and EPA.

In the next section of the paper, we show how equation (5) can be specified econometrically. We also specify a wage equation that allows for the expropriation of regulation-induced wealth by unionized workers.

III. Econometric Specifications and Data Sources

A. *Dependent Variables*

The previous section showed how regulation-induced transfers of wealth affect average profits in an industry. In our empirical analysis, we estimate the effect of OSHA and EPA regulations on wages and profits in three-digit SIC manufacturing industries during the time period 1974–78.[17]

[15] Richard Freeman, Unionism, Price-Cost Margins, and the Return to Capital (unpublished manuscript, Nat'l Bur. Economic Research, July 1983); Michael Salinger, Tobin's *q*, Unionization and the Concentration-Profits Relationship, 15 Rand J. Econ. 159 (1984); Thomas Karier, Unions and Monopoly Profits, 67 Rev. Econ. & Stat. 34 (1985); Paula Voos & Lawrence Mishel, The Union Impact on Profits: Evidence from Industry Price-Cost Margin Data, 4 J. Labor Econ. 105 (1986).

[16] Thomas Gale Moore, The Beneficiaries of Trucking Regulation, 21 J. Law & Econ. 327 (1978).

[17] This time period is chosen because of limited availability of key variables outside the mid-70s. For a complete explanation, see Bartel & Thomas, *supra* note 1.

The wage variable is measured by the average compensation in the industry (wages plus fringes/number of employees) and is obtained from the *Annual Survey of Manufacturers* (*ASM*). The profit variable is the price-cost margin defined as value added less labor costs, all divided by the value of shipments. This is also calculated from the *ASM*. While the industry's price-cost margin is a good proxy for the industry's profits, it suffers several well-known drawbacks as discussed by Liebowitz.[18] In spite of these problems, this measure is widely used because of its ready availability at a level of aggregation that exactly matches the level at which many important industry data are published; also the census price-cost margin data are superior to all other firm data, including Internal Revenue Service (IRS) statistics, because they minimize the extent to which data are contaminated by corporate diversification across industries.

B. Regulation Variables

To estimate the wealth effects of OSHA and EPA, we require measures of annual compliance costs for manufacturing industries. For EPA, each year the U.S. Bureau of the Census publishes for each SIC category gross pollution abatement operating costs, which cover solid waste collection and disposal, depreciation, labor, equipment leasing, materials and supplies, and payments to governments for public sewage use.[19] Pashigian has shown that most of the pollution abatement operating costs incurred from 1974 to 1978 can be considered incremental, that is, induced by the regulatory program.[20] For our analysis of workers' wages, we define a variable PACEMP, which equals gross pollution abatement operating costs in the industry divided by the number of workers in the industry; for analysis of price-cost margins, we change the denominator to the value of shipments and create PACSHP.

For OSHA, data on the actual costs of compliance are very limited. Between 1973 and 1980, McGraw-Hill conducted a survey of capital expenditures related to worker safety and health, but the survey only cov-

[18] S. J. Liebowitz, What Do Census Price-Cost Margins Measure? 25 J. Law & Econ. 231 (1982). The main problem is that the price-cost margin does not deduct such costs as advertising, central office costs, and depreciation. We handle this problem through the inclusion of proxies for most of these variables on the right-hand side of the equation.

[19] Unfortunately, establishments in SIC Group 23, Apparel and other Textile Products, are excluded from the Census Bureau's Pollution Abatement Expenditures survey because, according to the Census Bureau, these establishments operate primarily in rented quarters where the abatement of pollution is generally arranged by the landlord. Hence, we deleted establishments in that SIC category from our analysis.

[20] Pashigian, *supra* note 9.

ered sixteen broad industry sectors in manufacturing. As a better alternative, we proxy compliance costs by the dollar value of penalties assessed against the industry by OSHA.[21] These data are collected by OSHA and are available for detailed industry classifications. In a cross section of industries, compliance costs are positively correlated with penalties because, as we argued in our earlier paper, industries differ in the degree of natural noncompliance with OSHA.[22] Some industries are naturally compliant because their technology involves little capital or few practices that can be regulated. Others are naturally noncompliant because their technology results in a low rate of compliance.[23] Naturally noncompliant industries will have both higher penalties and higher compliance costs, as compared to naturally compliant industries.

The OSHA data used for this study are restricted to the twenty-two states where workplace safety regulations have been continuously enforced by OSHA during the 1970s.[24] Thus, care must be used to match enforcement regions in the denominators and numerators of the computed penalty rates. To examine the effect of OSHA on workers' wages, we divide total penalties assessed by federal OSHA inspectors by the number of workers in the twenty-two states of federal enforcement for each industry and create PENEMP; the number of workers is estimated from County Business Patterns tapes compiled by the U.S. Bureau of the Census. When the dependent variable is the price-cost margin, the denominator of the OSHA variable is changed to the value of shipments (PENSHP). Since in this case the numerator uses data based on twenty-two states while the denominator uses national data, we multiply PENSHP by the ratio of the number of employees in the nation to the number in the twenty-two states, in effect, expanding the numerator to a national basis.

[21] The OSHA penalty data used for our study are associated only with violations of safety standards. Because safety violations generate about 90 percent of total penalties, this limitation is of minor significance.

[22] Bartel & Thomas, *supra* note 1.

[23] The concept of natural noncompliance is distinct from the concept of natural hazardousness which measures the degree of unregulated worker safety. For example, police work is naturally hazardous but is also naturally compliant with OSHA's standards, given the technology of the industry.

[24] Those states are Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Idaho, Kansas, Louisiana, Maine, Massachusetts, Mississippi, Missouri, Nebraska, New Hampshire, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Dakota, Texas, and West Virginia. Two industries (SICs 211 and 302) were deleted from our sample because very few workers in these industries were located in the twenty-two states, producing severe overestimates of OSHA penalty rates. Under provisions of the Occupational Safety and Health Act (OSHAct) of 1970, states may retain responsibility for enforcement of OSHA standards. In 1979, 64 percent of inspections and 25 percent of penalties were generated by state agencies, but state data at the SIC level of detail are not available.

Equation (5) shows how the effects of regulation on industry profits can be segregated into four terms: a pass-through effect, a trade effect, a firm-size indirect effect, and a regional indirect effect. In order to measure the trade effect, we multiply the EPA and OSHA compliance cost variables by the ratio of the industry's net imports to its value of shipments (IMP).[25] Imports and exports were taken from the annual reports of the U.S. Bureau of the Census. The wealth transfers resulting from asymmetries attributable to plant size are measured by multiplying the regulation variables by the percentage of workers in the industry who are in establishments with at least 250 workers (LARGE).[26] This variable is calculated from the County Business Patterns tapes of the U.S. Bureau of the Census. Wealth transfers owing to regional asymmetries are measured by multiplying the regulation variables by the percentage of the industry's employment that is in the Frost Belt (FROST), where the Frost Belt is defined to include states in the Northeast and Midwest. The percentage of each industry's employment in these areas is also calculated from the County Business Patterns data.

The hypothesized expropriation of wealth by unionized workers is measured by $1 + \beta_u$ UNION, where β_u, a negative number, is estimated, and UNION is the percentage of workers in the industry covered by collective bargaining agreements. This measure is calculated from the 1974–77 Expenditures for Employee Compensation (EEC) surveys and is the only unionization measure available on a three-digit SIC basis. Each of the terms in equation (5) will be multiplied by the term $1 + \beta_u$UNION in order to estimate the expropriation of regulation-induced wealth by unionized workers.

There are several limitations to our analysis as outlined above. First, by taking the firm size and regional distribution terms as given, we ignore changes in these distributions caused by OSHA and EPA. Other research suggests that these output effects are as important as the price/profit/wages effects we document here.[27] By ignoring output effects, we understate the firm size and regional effects of OSHA and EPA. Second, implicit in our analysis of equation (5) is the expectation that the $X_{\text{mar}} - X_i$ terms will be nonnegative for all industries. The validity of this expectation requires that OSHA/EPA compliance costs fall most heavily on small

[25] To take account of diminishing returns in the effect of IMP on pricing, we truncated the distribution of IMP so that all values less than -0.4 were set equal to -0.4 and all values greater than $+0.4$ were set equal to 0.4. In addition, we were forced to delete SIC373 because import data for this industry were badly biased by federal restrictions.

[26] Although our model described asymmetries in terms of firm size, our empirical test is based on establishment size because data on firm size are unavailable.

[27] Pashigian, *supra* note 9; Neumann & Nelson, *supra* note 9.

and Sun Belt firms, which indeed occurs as we have argued in Section II. The nonnegativity of the $X_{mar} - X_i$ terms, however, also requires that small Sun Belt firms be the marginal or high-cost firms before regulation begins. Note that, if this last requirement is violated, then regulation will not act to augment preregulatory competitive advantage for large, Frost Belt firms (hence increasing heterogeneity and profits) but rather will reduce preregulatory competitive disadvantage for these firms (hence reducing heterogeneity and profits). While we are comfortable regarding small firms as marginal in each industry,[28] we recognize that Sun Belt firms may not be marginal in all industries. As a consequence, we regard our regional indirect-effects term (but not our firm-size indirect-effects term) as measured with error. This error biases the coefficient on the regional indirect-effects term toward zero and results in an underestimate of the regional redistributive effects of OSHA and EPA. Third, we use average industry compliance costs as a proxy for X_{mar}, $X_{mar} - X_{large}$, and $X_{mar} - X_{frost}$ in equation (5). We regard the cross-sectional variation in average compliance costs as a very reasonable approximation for these more complicated and empirically unavailable terms.

C. *Other Independent Variables*

The wage equation includes the following additional variables. First, we use a set of variables describing the workers in the industry: average education (EDUC), average age and its square (AGE and AGESQ), percentage of production workers (PROD), percentage of male workers (MALE), percentage of scientists and engineers (SCI), and the new-hire rate (NHR). EDUC, AGE, and AGESQ are obtained from the *Current Population Survey*; PROD, MALE, and NHR are from the *Employment and Earnings* files of the Bureau of Labor Statistics, and SCI is from the *Survey of Occupational Employment* conducted by the Bureau of Labor Statistics. Second, we add average establishment size (FSIZE), taken from County Business Patterns tapes of the U.S. Bureau of the Census,

[28] Numerous recent studies find a strongly significant positive relation between market share and profits for firms in an industry (for example, David J. Ravenscraft, Structure-Profit Relationships at the Line of Business and Industry Level, 65 Rev. Econ. & Stat. 22 (1983)). One of the more pessimistic studies of this phenomenon, Richard Caves & Thomas Pugel, Intraindustry Differences in Conduct and Performance: Viable Strategies in U.S. Manufacturing Industries (unpublished manuscript, Salomon Brothers Center, New York Univ. 1980), found that, in seventy-four U.S. manufacturing industries in 1969–72, asset share and profit rates in each industry were significantly positively related (at the 10 percent level) in eight industries, and were significantly negatively related in eight industries. Of these latter eight industries, five are already deleted from our sample: SICs 231, 233, 238—because pollution control data in the textile industries are disclaimed by EPA as of poor quality; SIC 299—due to missing data for imports and unionization; and SIC 373—because government restrictions on foreign competition in ship manufacturing distort import data.

and its square (FSSQ). Third, we consider the effect of production demand in the industry by using average overtime hours (OVER), from *Employment and Earnings*. Fourth, we add two regional variables, FROST, defined previously, and SOUTH, the percentage of the industry's employment in the South. The effect of unions on wages is measured directly by adding UNION to the equation and then testing to see whether the unions' ability to expropriate regulation-induced wealth is the same as its ability to expropriate rents created by the industry's research and development expenditures and its advertising expenditures.[29] This is done by multiplying UNION by RDEMP (research and development expenditures per employee) and ADEMP (advertising expenditures per employee). Research and development expenditures are obtained from Scherer,[30] and advertising expenditures are obtained from the IRS Corporate Sourcebook. Finally, we add four year dummies (D75, D76, D77, and D78).

The price-cost margin equation includes the following additional variables. First, we include a set of variables that measure those expenses that have not already been deducted from total revenues.[31] These are advertising per unit of sales (ADSHP), research and development per unit of sales (RDSHP), the value of inventories per unit of assets (INVSHP), and new capital expenditures per unit of sales (CAPSHP); the last two variables are from the *ASM* of the U.S. Bureau of the Census. Second, the value of assets (plant and equipment) as a ratio to sales is included (ASTSHP) because a more capital-intensive industry must earn more profits per dollar of sales in order for the rate of return on capital to be equalized across industries. Third, since we argued that unions could extract rents created by research and development and advertising, we test for this directly in the price-cost margin equation by multiplying RDSHP and ADSHP by the union interaction term $(1 + \beta_u \text{UNION})$. Fourth, average establishment size (FSIZE) and its square (FSSQ) are added.[32] Fifth, the concentration ratio (CONC), drawn from the *Census of Manufactures,* is used because of the widely hypothesized relationship between concentration and profitability. Sixth, past output growth (SHPDIF) and growth in the cost of materials (MATDIF) are used—both variables are drawn from the *ASM*. The latter is used to test for the effect of increases in fuel and energy costs. The trade variable, IMP, as defined

[29] In his analysis, Salinger, *supra* note 15, found that unions extracted rents associated with R&D and advertising.

[30] F. M. Scherer, Using Linked Patent and R&D Data to Measure Interindustry Technology Flows, in R&D, Patents, and Productivity (Zvi Griliches ed. 1984).

[31] As the numerator is defined, only payroll and the cost of materials have been deducted.

[32] Both Salinger, *supra* note 15; and Karier, *supra* note 15, found that profit rates declined with firm size.

earlier, is also added directly to the equation. Finally, a set of year dummies is used.

IV. Results

A. *Estimation Technique*

In our empirical analysis, we restrict the effects of OSHA and EPA regulation in order to have the same proportional relationship for each of the terms in equation (5). We impose this restriction to simplify reporting and to suppress potential multicollinearity among the regulation terms. A standard F test indicates that this restriction cannot be rejected at the 5 percent level of significance.[33] The price-cost margin and wage equations are each estimated by nonlinear least squares and are specified as follows:

$$\begin{aligned} \text{PCM} = {} & \beta_0 + (1 + \beta_u \text{UNION})\text{PACSHP}(\beta_2 + \beta_3 \text{IMP} + \beta_4 \text{LARGE} \\ & + \beta_5 \text{FROST}) + (1 + \beta_u \text{UNION})(\beta_1 \text{PENSHP})(\beta_2 + \beta_3 \text{IMP} \\ & + \beta_4 \text{LARGE} + \beta_5 \text{FROST}) + (1 + \beta_u \text{UNION})(\beta_R \text{RDSHP} \\ & + \beta_A \text{ADSHP}) + \beta_6 \mathbf{Z} + u_2, \end{aligned} \tag{6}$$

where $\beta_u < 0$; PACSHP and PENSHP = the appropriate measures of EPA and OSHA regulation as described in the previous section; IMP = net imports divided by shipments; LARGE = percentage of employees in large establishments; FROST = percentage of employees in Frost Belt establishments, RDSHP = research and development expenditures divided by sales, ADSHP = advertising expenditures divided by sales, and $\mathbf{Z}$ is a vector of other variables in the PCM equation. A convenient way of rewriting equation (6) to highlight our specification of proportional effects of OSHA and EPA is as follows:

$$\begin{aligned} \text{PCM} = {} & \beta_0 + (1 + \beta_u \text{UNION})\text{PACSHP}\left(1 + \beta_1 \frac{\text{PEN}}{\text{PAC}}\right)(\beta_2 + \beta_3 \text{IMP} \\ & + \beta_4 \text{LARGE} + \beta_5 \text{FROST}) + (1 + \beta_u \text{UNION})(\beta_R \text{RDSHP} \\ & + \beta_A \text{ADSHP}) + \beta_6 \mathbf{Z} + u_2, \end{aligned} \tag{6a}$$

[33] When the wage equation is estimated without this restriction, all regulatory terms are correctly signed and all are statistically significant except the PENEMP term. When the margin equation is estimated without this restriction, all regulatory terms except PENSHPLRG are correctly signed, and all but PENSHPLRG and PENSHPIMP are statistically significant. The mean values for the OSHA penalty variables are approximately 1.7 times the mean values of the associated EPA compliance cost variable. If we regard the PEN/PAC shift term as lying between .05 and .18 (see Tables 2 and 3), then we estimate OSHA effects to be about 8.5 percent to 30.5 percent of EPA effects. We regard these estimates of differential effect to be highly plausible, as a study by Arthur Anderson & Co. (Cost of Government Regulations Study, for the Business Roundtable, March 1979) estimated that OSHA compliance costs were about 9 percent of EPA compliance costs.

where PEN/PAC = the ratio of OSHA penalties to pollution abatement operating costs. Referring back to equation (5), β_2 measures the pass-through effect, β_3 the trade effect, β_4 the firm-size indirect effect, and β_5 the regional indirect effect. Union expropriation of wealth is esimated by the term $1 + \beta_u$UNION. Our analysis predicts that $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 < 0$, $\beta_4 > 0$, $\beta_5 > 0$, and $\beta_u < 0$.

The wage equation is given by

$$\begin{aligned} \text{WAGE} = {} & \alpha_0 + \text{UNION}^* \text{PACEMP}(\alpha_2 + \alpha_3\text{IMP} + \alpha_4\text{LARGE} \\ & + \alpha_5\text{FROST}) + \text{UNION}(\alpha_1\text{PENEMP})(\alpha_2 + \alpha_3\text{IMP} \\ & + \alpha_4\text{LARGE} + \alpha_5\text{FROST}) + \text{UNION}(\alpha_R\text{RDEMP} \\ & + \alpha_A\text{ADEMP}) + \alpha_6\mathbf{X} + u_1, \end{aligned} \tag{7}$$

where PACEMP and PENEMP = our measures of EPA and OSHA as described in the previous section; RDEMP = research and development expenditures per employee; ADEMP = advertising expenditures per employee; and $\mathbf{X}$ = a vector of other variables in the wage equation. Equation (7) can also be rewritten as

$$\begin{aligned} \text{WAGE} = {} & \alpha_0 + \text{UNION}^* \text{PACEMP}\left(1 + \alpha_1 \frac{\text{PEN}}{\text{PAC}}\right)(\alpha_2 + \alpha_3\text{IMP} \\ & + \alpha_4\text{LARGE} + \alpha_5\text{FROST}) + \text{UNION}(\alpha_R\text{RDEMP} \\ & + \alpha_A\text{ADEMP}) + \alpha_6\mathbf{Z} + u_1. \end{aligned} \tag{7a}$$

Equation (7a) specifies that only the unionized workers in the industry are able to expropriate the rents induced by regulation. The regulation terms in equation (7a) are drawn from equation (5): α_2 measures the pass-through effect, α_3 the trade effect, α_4 the firm-size indirect effect, and α_5 the regional indirect effect. Our analysis predicts $\alpha_1 > 0$, $\alpha_2 < 0$, $\alpha_3 < 0$, $\alpha_4 > 0$, and $\alpha_5 > 0$. The results of estimating equations (6) and (7) are reported in Tables 2 and 3, respectively.

B. The Effects of Regulation

In column 1 of each table, we exclude the regulation-interaction terms. This enables us to estimate the effects of OSHA and EPA when the role of indirect effects is ignored. It can be observed that, in this case, OSHA and EPA regulations have a negative and significant effect on the price-cost margin and a positive and significant effect on the average wage. In column 2 of each table, we allow for the hypothesized trade effect and the indirect effects of firm size and region. Our model predicted that the trade effect should be negative because U.S. industries facing vigorous competition from abroad will experience only modest postregulation price increases. Indirect effects were predicted to have a positive relationship.

TABLE 2

REGULATORY EFFECTS ON PRICE-COST MARGINS (Equation (6)), 109 INDUSTRIES, 1974–78

	1		2	
Independent Variable	β	*t*	β	*t*
PEN/PAC (β_1)	.38	1.71	.05	1.60
PACSHP (β_2)	−.03	−2.00	−.25	−4.39
PACSHPIMP (β_3)	...	...	−.86	−5.24
PACSHPLRG (β_4)	...	...	.17	2.97
PACSHPFR (β_5)	...	...	.24	3.80
UNION (β_u)	−.01	−6.77	−.01	−15.59
ADSHP (β_A)	4.88	13.71	5.12	18.27
RDSHP (β_R)	9.21	4.95	8.49	4.96
CAPSHP	.54	2.86	.67	3.89
INVSHP	−.10	−2.18	−.05	−1.31
ASTSHP	.10	4.57	.11	5.66
SHPDIF	.20	3.61	.20	4.01
SHP2DIF	.14	2.48	.13	2.60
MATDIF	−.08	−1.64	−.08	−1.78
MAT2DIF	−.11	−2.12	−.10	−2.15
UNION	−.0002	−.41	.0002	.57
UNSQ	2.82E-06	.69	6.56E-07	.18
FSIZE	−.0002	−7.75	−.0002	−7.30
FSSQ	4.54E-08	6.91	4.28E-08	6.79
CONC	.02	1.19	.01	.52
IMP	−.06	−2.98	.05	2.23
D75	−.01	−1.48	−.01	−1.89
D76	−.01	−1.14	−.01	−1.18
D77	−.01	−2.02	−.01	−2.36
D78	−.01	−1.76	−.01	−2.25
Constant	.02	.60	−.01	−.35
R^2	...	.60	...	.63
N	...	545	...	545

NOTE.—PEN/PAC = ratio of OSHA penalties to pollution abatement operating costs; PACSHP = pollution abatement operating costs divided by value of shipments; PACSHPIMP = PACSHP*net imports/value of shipments; PACSHPLG = PACSHP*percentage of workers in establishments with at least 250 employees; PACSHPFR = PACSHP*percent of workers in Frost Belt; RDSHP = expenditures on research and development divided by value of shipments; ADSHP = advertising expenditures divided by value of shipments; FSIZE = average establishment size; UNION = percent unionized; FSSQ = FSIZE*FSIZE; UNSQ = UNION*UNION; CAPSHP = capital expenditures divided by value of shipments; INVSHP = value of inventories divided by value of shipments; SHPDIF = ratio of this year's to last year's shipments; SHP2DIF = lagged annual change in value of shipments; MATDIF = annual change in materials costs; MAT2DIF = lagged annual change in materials cost; CONC = four-firm concentration ratio; IMP = net imports divided by value of shipments; D75 = 1 if 1975; D76 = 1 if 1976; D77 = 1 if 1977; D78 = 1 if 1978.

TABLE 3

REGULATORY EFFECTS ON AVERAGE-WORKER COMPENSATION (Equation (7)), 107 INDUSTRIES, 1974–78

	1		2	
Independent Variable	β	*t*	β	*t*
PEN/PAC (α_1)	.14	1.56	.18	3.21
PACEMP (α_2)	14.55	8.21	−59.61	−6.54
PACEMPIMP (α_3)	...	...	−39.00	−1.71
PACEMPLG (α_4)	...	...	66.75	7.36
PACEMPFR (α_5)	...	...	72.94	6.63
ADEMP (α_A)	−.90	−.73	−.56	−.49
RDEMP (α_R)	47.33	3.68	47.19	3.44
SCI	28.83	2.56	37.95	3.45
PROD	−28.69	−5.57	−29.41	−6.06
MALE	46.39	15.07	42.44	13.99
EDUC	1.75	3.16	1.94	3.73
AGE	6.93	2.76	5.91	2.46
AGESQ	−.09	−2.71	−.07	−2.44
NHR	−.30	−8.52	−.28	−8.28
OVER	.35	8.57	.49	11.68
UNION	2.01	.77	1.42	.66
SOUTH	−29.00	−6.41	−26.94	−6.05
FROST	6.10	1.35	1.16	.26
FSIZE	.05	10.79	.03	5.93
FSSQ	−.01E-03	−9.84	−.06E-04	−5.32
CONC	14.25	5.34	12.79	5.10
SHPDIF	3.53	.93	1.48	.41
IMP	−1.38	−5.10	−4.74	−1.27
D75	−.23	−.18	.35	.30
D76	2.83	2.52	2.81	2.67
D77	5.65	5.07	4.99	4.77
D78	6.36	5.70	5.49	5.29
Constant	−40.18	−.80	−20.84	−.44
R^2	...	.89	...	.91
N	...	535	...	535

NOTE.—PEN/PAC = ratio of OSHA penalties to pollution abatement operating costs; PACEMP = pollution abatement operating costs per employee; PACEMPIMP = PACEMP* (net imports/shipments); PACEMPLG = PACEMP*percentage of workers in establishments with at least 250 employees; PACEMPFR = PACEMP*FROST; UNION = percent unionized; ADEMP = advertising expenditures per employee; RDEMP = research and development expenditures per employee; CONC = four-firm concentration ratio; SCI = percentage of employees that are scientists or engineers; PROD = percent production workers; MALE = percent male employees; EDUC = average education of workers; AGE = average age of workers; AGESQ = AGE*AGE; NHR = new hire rate; OVER = average weekly overtime hours; FSIZE = average establishment size; FSSQ = FSIZE*FSIZE; SOUTH = share of employment in the South; FROST = share of employment in the Frost Belt; IMP = net imports divided by value of shipments; SHPDIF = annual growth in shipments; D75 = 1 if 1975; D76 = 1 if 1976; D77 = 1 if 1977; D78 = 1 if 1978.

Column 2 of each table also allows for union expropriation of regulation-induced wealth.

In column 2 of Table 2, we find that the predictions of our model are confirmed. The pass-through effect of regulation β_2 is negative and significant, as is the trade effect β_3. The interaction terms with percent LARGE, β_4, and percent FROST, β_5, are positive and significant and indicate the existence of indirect effects caused by the compliance and enforcement asymmetries discussed in Section II.[34] The union coefficient, β_u, is negative and significant; at the mean of UNION, unionized workers expropriate 45 percent of the regulation-induced rents. The effects of regulation on wages are shown in column 2 of Table 3, where all of the coefficients have the predicted signs. Notice that the direct effect of regulation, α_2, is now negative and significant. The trade effect, α_3, is negative while the firm-size and regional indirect-effects interaction terms, α_4 and α_5, are positive. We thus have clear evidence that the wealth transfers produced by the heterogeneity of firms within an industry are shared with unionized workers.

C. *Other Variables*

The regressions in Tables 2 and 3 contain other variables that were used to properly specify the price-cost margin and wage equations. Since the effects of these variables are not our focus, and since other researchers have thoroughly discussed the effects, we do not discuss them in detail here. In the price-cost margin equation, all of the coefficients have the predicted signs. It is interesting to note that unions are able to expropriate the rents created by research and development and advertising, as shown by the significant coefficients on ADSHP and RDSHP.[35] In the wage equation, there is one surprising result—the insignificance of UNION. This insignificance was due to the inclusion of SOUTH; when SOUTH was deleted, UNION became positive and significant.

D. *The Preregulatory Environment*

One possible criticism of our analysis is that the regulatory variables are proxies for other variables that have been left out of the analysis. In order to rule out this possibility, we estimated the margin and wage equa-

[34] Within the context of this study, however, it is impossible to determine the relative contribution of each type of asymmetry.

[35] RDEMP is also positive and significant in the wage equation, and ADEMP is not. Surprisingly, unionized workers' expropriation of rents created by advertising cannot be shown directly in the wage equation.

tions on data from the 1965–69 time period, before OSHA and EPA regulations were in force. Although all of the nonregulation variables for this analysis were from the 1965–69 time period, the regulation variables PACSHP, PENSHP, PACEMP, and PENEMP were from the 1974–78 time period. If the effects that we are attributing to the regulation variables disappear when the same variables are regressed on the preregulation price-cost margin and wage, then we can be confident that the results in Tables 2 and 3 indeed reflect the effect of regulation. The results of estimating the equations for the 1960s are shown in Appendix B. These results provide conclusive evidence that the estimated regulatory effect in the 1970s is valid because the regulation variables are insignificant in the 1960s equations.[36]

V. Conclusions

This paper has documented the importance of studying the indirect effects of OSHA and EPA regulations—the competitive advantages that arise from the asymmetrical distributions of regulatory effect among different types of firms. We have argued that, if the competitive advantage gained through indirect effects is sufficiently large, it can more than offset any direct costs, producing a net benefit for the regulated firm and its workers. The indirect effects of OSHA and EPA regulations arise in two ways. The first source is compliance asymmetries, whereby one firm suffers a greater cost burden even when regulations are evenly enforced across firms. The second source is enforcement asymmetries, whereby regulations are more vigorously enforced against certain firms.

Earlier research has shown that these asymmetries do exist and are based on firm size and regional location. In this paper, we have empirically documented that the indirect effects produced by these asymmetries mitigate the direct costs of regulation for many firms. In particular, large firms in the Frost Belt gain wealth at the expense of small firms in the Sun Belt. In Table 4, we compute the actual effect of OSHA and EPA regulation on profits and wages using the coefficients from column (2) in Tables 2 and 3. The effect is computed by letting IMP (the net import ratio), LARGE (percentage of employment in large establishments), and FROST (the Frost Belt employment share) each take on, in turn, their minimum, mean or maximum values, while the other two variables are set equal to their means. The estimated effect of regulation is then compared to the mean of the dependent variable to calculate the percentage effects of

[36] Note, however, that all of the other variables in Tables B1 and B2 have the right signs and their effects are very similar to those reported in Tables 2 and 3.

TABLE 4

PERCENTAGE EFFECTS OF REGULATION ON PROFITS AND WAGES

Variable	At Minimum	At Mean	At Maximum
Profits:			
IMP	31.0	−7.0	−49.0
LARGE	−17.8	−7.0	2.9
FROST	−20.4	−7.0	9.1
Wages:			
IMP	2.5	.5	−.8
LARGE	−2.5	.5	3.2
FROST	−2.3	.5	3.8

NOTE.—These effects are calculated at the mean of the dependent variable and the mean of PACSHP in the case of profits and PACEMP in the case of wages. The minimum, mean, and maximum values for the listed variables in each row (IMP, FROST, and LARGE) are used alternatively, while the other two variables are set to their means. Minimum values are −.36 (IMP), .0 (LARGE), .0 (FROST); mean values are .0 (IMP), .51 (LARGE), and .43 (FROST). Maximum values are .40 (IMP), .97 (LARGE), and .94 (FROST).

regulation on profits and wages.[37] This exercise enables us to determine the relative importance of the indirect effects created by each of the variables. Further, the exercise is necessary in order to show whether predator benefit indeed derives from the enforcement of OSHA and EPA. The numbers in Table 4 have several important implications. First, in panel A, we see that industries faced with stiff import competition are heavily damaged by regulation; at the maximum net import ratio of 0.4, profits are reduced by 49 percent because of regulation. Second, there is clear evidence that industries that have a very high proportion of their employees in large establishments or in the Frost Belt actually gain profits as a result of OSHA and EPA. At the maximum value for LARGE, we estimate a 2.9 percent increase in profits; at the maximum for FROST, we estimate a 9.1 percent increase in profits.[38] From panel B of Table 4, unionized workers are shown to gain substantial wage increases in those industries that gain from regulation. At the maximum value for LARGE, the wage effect is 3.2 percent, and, at the maximum value for FROST, the wage increase is 3.8 percent. It is well known that labor unions are among the prime supporters of OSHA and EPA, and these results provide an explanation for this union support.[39]

[37] The mean of PACSHP = .3; the mean of PACEMP = .002; the mean of the price-cost margin = .24; and the mean salary = 101.6 (this is measured in hundreds of dollars).

[38] Recall our earlier argument that the regional effect is probably underestimated because of measurement error. This means that the actual effect on profits is even greater than shown in Table 4.

[39] The effect of import competition on unionized wages is considerably smaller than its effect on profits. This could be due to the downward inflexibility of unionized wages.

Overall, we feel that our findings are extremely provocative. We have shown that regulation has become a predatory device that indeed is utilized to enhance the wealth of predators and to reduce the wealth of rivals. Industries with a high proportion of their workers in large establishments or in the Frost Belt have been shown actually to gain profits as a result of the enforcement of OSHA and EPA regulation, while those with a high proportion of workers in small establishments or in the Sun Belt have lost profits. Further, unionized workers have shared in the rents created by the regulations. Discussions about regulatory reform or deregulation can benefit from the insights derived from the model of predation through regulation by gaining more accurate forecasts of the effect of proposed changes on various interest groups.

APPENDIX A

In the absence of existing studies of regional enforcement asymmetries by OSHA, we elected to reestimate regression equations from an earlier study.[40] Explanations of specification and descriptions of data are contained in the 1985 study and are not repeated here. One feature of the data should be noted, however. For reasons discussed in the text of this essay, availability issues limited OSHA enforcement data to a twenty-two-state region of federal enforcement. Other data used for the regression results below were comparably restricted to this twenty-two-state region. Thus, the variables listed below are different from those used in the text as they are drawn from a different sample. The twenty-two states are as follows: (1) Frost Belt—Delaware, District of Columbia, Kansas, Maine, Massachusetts, Missouri, Nebraska, New Hampshire, Ohio, Pennsylvania, Rhode Island, South Dakota, and West Virginia; and (2) Sun Belt—Alabama, Arkansas, Florida, Georgia, Idaho, Louisiana, Mississippi, Oklahoma, and Texas.

Two enforcement variables were examined with OLS results reported in Table A1. The Target Industry Program (TIP) was the focus of OSHA enforcement activities in 1972 and 1973. The determinants of the OSHA decision to include industries in the TIP are examined using data for 1974 only (earlier data for FSIZE and FROST limited to the twenty-two states were not available). For 1974–78, pooled cross-section time-series data are used. Note that enforcement asymmetries against small, nonunion, and Sun Belt firms are documented. Also note that enforcement asymmetries against small firms basically disappeared by 1978, while regional enforcement asymmetries became more pronounced.

[40] Bartel & Thomas, *supra* note 1.

TABLE A1

OSHA ENFORCEMENT ASYMMETRIES

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	TIP	INSPEMP	INSPEMP
LOSTDAY	.155	.350	.334
	(8.69)	(9.77)	(9.93)
CMPLT	−.012	.523	.338
	(−.92)	(19.52)	(8.83)
CMPLT*YR			.115
			(7.08)
FSIZE	−.051	−.322	−.526
	(−4.85)	(−15.04)	(−15.86)
FSIZE*YR			.113
			(8.08)
UNION	−.102	−.080	−.066
	(−6.18)	(−2.40)	(−1.58)
UNION*YR			−.012
			(−.59)
FROST	−.200	−.199	.017
	(−4.55)	(−2.24)	(.11)
FROST*YR			−.094
			(−2.71)
D74	...	1.291	−.745
		(22.44)	(−1.14)
D75	...	1.217	−.264
		(21.03)	(−1.54)
D76	...	.523	−.416
		(9.65)	(−1.31)
D77	...	.205	−.261
		(3.84)	(−1.59)
Constant	−.379	−3.184	−1.852
	(−1.84)	(−7.65)	(−3.72)
R^2	.288	.746	.787
N	118	594	594

NOTE.—TIP = zero-one dummy variable (1974 only) for inclusion of industry in TIP; INSPEMP = OSHA inspections per employee; LOSTDAY = lost workdays per employee; CMPLT = formal complaints to OSHA per employee; FSIZE = average establishment size; UNION = percentage of employees unionized; FROST = percentage of employees in Frost Belt. *YR = left variable is multiplied by (year − 1974); D74, etc. = zero-one year dummy variables. All variables except TIP, Frost, and year dummies are in logarithms. All data are restricted to the twenty-two-state region of federal enforcement. Numbers in parentheses are t-values. The INSPEMP equations are estimated for the 1974–1978 time period; the TIP equation is for 1974 only.

APPENDIX B

This appendix reports the results of estimating equations (6) and (7) using data from the 1965–69 period. Estimates are shown in Tables B1 and B2. Only the regulation, advertising, and research and development variables are taken from the 1974–78 period. Observations were matched by subtracting nine from the values for YEAR; hence, regulation data from 1974 were assigned to 1965 and so on. The variables SCI and CONC were unavailable for the 1960s and are dropped from the regressions. All data sources are identical for the two periods of study except for the regional and firm-size variables. For the regional variables, 1960s values were taken from the *Current Population Survey* for 1967. Values for the firm-size variables (including LARGE) were taken from the 1967 *Census of Manufactures*. Variables from the *Employment and Earnings* files (MALE, PROD, OVER, NHR) were reported for many fewer industries in the 1960s than in the 1970s; hence, the sample size in Table B2 is considerably smaller than that reported in Table 3.

TABLE B1

REGULATORY EFFECTS ON PRICE-COST MARGINS (Equation (6)), 109 INDUSTRIES, 1965–69

Independent Variable	Coefficient Estimate	t
PEN/PAC (β_1)	3.59	.02
PACSHP (β_2)	.0001	.01
PACSHPIMP (β_3)	−.0002	−.01
PACSHPLRG (β_4)	1.3×10^{-10}	.00
PACSHPFR (β_5)	−.0001	−.01
UNION (β_u)	−.00	−9.55
ADSHP (β_A)	5.56	15.01
RDSHP (β_R)	9.03	4.47
CAPSHP	.2	.72
INVSHP	−.004	−.11
ASTSHP	.13	9.96
SHPDIF	.303	3.92
SHP2DIF	.200	2.54
MATDIF	−.226	−3.33
MAT2DIF	−.158	−2.29
UNION	−.0002	−.47
UNSQ	4.8×10^{-6}	1.17
FSIZE	−.14	−5.93
FSSQ	.094	8.17
IMP	−.20	−6.65
D65	−.014	−2.08
D66	−.006	−.92
D67	−.007	−1.03
D68	−.003	−.52
Constant	.058	1.19
R^2	... .665	...
N	... 541	...

NOTE.—Key to variable definitions is at bottom of Table 2. Data here for ADSHP, RDSHP, PACSHP, and PENSHP are from the 1970s.

TABLE B2

REGULATORY EFFECTS ON AVERAGE WORKER COMPENSATION (Equation (7)), 63 INDUSTRIES, 1964–69

Independent Variable	Coefficient Estimate		t
PEN/PAC (α_1)	−.002		−.80
PACEMP (α_2)	.30		.62
PACEMPIMP (α_3)	−.04		−.04
PACEMPLG (α_4)	−.005		−1.65
PACEMPFR (α_5)	1.03		1.20
ADEMP (α_A)	−.004		−4.26
RDEMP (α_R)	.048		3.28
PROD	−2.99		−8.18
MALE	2.23		11.31
EDUC	.36		7.96
AGE	1.00		3.64
AGESQ	−.012		−3.49
NHR	−.18		−6.09
OVER	.22		8.99
UNION	−.00		−.06
SOUTH	−1.26		−3.39
FROST	−.40		−1.03
FSIZE	.78		2.90
FSSQ	.19		1.18
SHPDIF	.91		2.63
IMP	−.10		−.21
D65	−.32		−4.56
D66	−.20		−3.00
D67	−.11		−1.77
D68	−.04		−.58
Constant	−17.75		−3.18
R^2	...	.937	...
N	...	311	...

NOTE.—Key to variable definitions is at bottom of Table 3. Data here for ADEMP, RDEMP, PACEMP, and PENEMP are from the 1970s.

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