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RULES VERSUS DISCRETION: THE PRODUCTIVITY CONSEQUENCES OF FLEXIBLE REGULATION

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Using data from electric utilities, this study shows that spending on well-designed regulations has a positive productivity impact but that spending on less well-designed regulations has a negative effect. Better-designed regulations are flexible and grant firms latitude on how to meet goals, allow them time to deploy new means to meet goals, and set ambitious goals that stretch them beyond current practices.

Many scholars have noted that there are both positive and negative aspects to the growing legal regulation of organizational processes and structure (Sitkin & Bies, 1994). Although impersonal legal norms may be at odds with the efficient utilization of resources (Albrow, 1970), if well designed (March & Olsen, 1989) these rules can have both quantitatively and qualitatively different results. Theory and empirical study need to be developed. The question of how to improve the design of regulations is an important one. The United States, for instance, spends approximately $100 billion a year on environmental regulations alone (Jaffe, Peterson, Portney, & Stavins, 1995; Rutledge & Vogan, 1994).

Since 1970, when the modern environmental movement was born with the enactment of the U.S. Clean Air Act, the nation has spent over $1 trillion. Yet theory (Pethig, 1975; Yohe, 1979) and industry-level empirical studies (Barbera & McConnell, 1990; Gollop & Roberts, 1983; Gray, 1987; Jaffe et al., 1995) conducted by economists show that high levels of environmental spending can lead to a decline in productivity. Conversely, business strategists (Hart, 1995; Porter, 1991; Porter & van der Linde, 1995a, 1995b; Shrivastava, 1995) have stated that spending on environmental regulations may induce firms to utilize alternative operational processes and enhance productivity. On the basis of case studies (Berube, Nash, Maxwell, & Ehrenfield, 1992; Parkinson, 1990), business strategists have concluded that well-designed environmental rules and regulations can increase a firm's competitiveness. This view has found sympathy with environmentalists like Albert Gore (Gore, 1992) and journalists such as Cairncross (1991).

The goal that motivated this study was to determine the effects of different kinds of regulations. We aimed to transcend the debate between the economists and the strategists. Both groups hold that with improvements in regulatory design, the positive effects of spending on environmental regulations will go up. The criteria for well-designed regulations include flexible approaches that focus on outcomes and not technologies (Porter & van der Linde, 1995b). Such regulations stretch firms to go beyond what they are currently doing. They create incentives for innovation. They give firms the time to develop and implement new technologies. Decision making is in the hands of firms as opposed to the government. Both the strategists and the economists are critical of aspects of the Clean Air and Clean Water Acts that require changes in production technology based on government-established "best available technology" (BAT) standards. These regulations fail to give firms sufficient decision-making flexibility.

This article shows that spending on different types of regulations affects productivity differently. Electric utilities are the setting for this study because they are major polluters whose activities are heavily controlled. Productivity is a critical indicator of competitive advantage (Banker, Chang, & Majumdar, 1996; Hall & Winsten, 1959; Majumdar, 1998) and is this article's focus. To establish new directions for research and theory, we evaluate the relationship between utilities' expenditures on different categories of regulation and their productivity.

THEORY AND HYPOTHESES

Views on Environmental Spending

A negative impact. Spending on environmental regulations has a negative effect (Jaffe et al., 1995) because firms, changing their operations in response to environmental regulations, introduce less efficient processes. High-quality environmental inputs are in short supply and drawn from the same pool as inputs used for more productive ends. Using inputs in environmental projects results in their withdrawal from more rewarding efforts (Gray, 1987). The evidence on whether mandated pollution control investments crowd out investments in more productive plant, however, is mixed (Rose, 1983). Other arguments are that because pollution control regulations conform to engineering rather than business standards (Wells, 1973), they induce unnecessary capital investments and prevent good siting decisions. Many environmental regulations also exempt older plant and equipment, penalizing newer-generation equipment and discouraging investments that could reap efficiency gains. Lengthy permit-acquiring processes add to the inefficiency (Barbera & McConnell, 1990).

The alternative view. The idea that expenditures on environmental regulations positively affect firm efficiency is revisionist (Jaffe et al., 1995). This argument is that pollution, like quality defects, reveals inefficient use of inputs and flaws in product design and production. Regulation-induced spending helps improve production and root out these inefficiencies (King, 1994). The investments lower the costs of raw materials and their handling and conversion. They increase the value of products by raising their quality and requiring that end users spend less on disposal. The efforts undertaken to minimize pollution spawn changes throughout a firm (Porter, 1991; Porter & van der Linde, 1995a, 1995b). Firms in jurisdictions with more ambitious goals, therefore, are likely to innovate more than firms in jurisdictions with less ambitious goals (Porter & van der Linde, 1995b). In a world where these goals are constantly rising, firms in the more progressive jurisdictions should be able to achieve first mover advantage.

The advantages of flexible regulation. If regulations allow ample implementation time and impose challenging performance goals, they can create pressures for efficiency (Majumdar, 1997; Porter & van der Linde, 1995a). Without adequate time, however, it is difficult to develop new means and to phase in new technologies and, without challenging goals, competitive advantage benchmarks do not exist. Economists and strategists, therefore, agree that although spending on less flexible regulation retards productivity, spending on more flexible regulation enhances it. The more that choices are exercised within a situation of constraints, the better the results are likely to be (Marcus, 1988). If implementers can customize external demands, then productivity is likely to go up. Implementation of rules and regulations will be with the spirit and not just with the letter of the law.

More flexible approaches to regulation have many advantages. (Bourgeois & Brodwin, 1984). A body of research (Beyer & Trice, 1978; Marcus, 1988; Strebel, 1987) shows that allowing firms flexibility enhances performance because entrepreneurship and risk taking are stimulated. On the other hand, excessive procedures and a rule-centered culture stifle innovation (Eisenhardt, 1989). More flexible approaches allow implementers to move beyond compliance to identification and internalization (Kelman, 1961). When those who implement requirements play an active role in their design, the results are better. Implementers given greater flexibility have greater knowledge of contradictory demands and conflicting imperatives at the delivery point (Thomas, 1979). Imposed decisions increase resistance and delay and reduce the quality of decisions (Guth & MacMillan, 1986). They also negatively affect the dispositions of implementers (Van Meter & Van Horn, 1975), who then engage in routine and mechanical implementation (Fidler & Johnson, 1984).

Electric Utilities

The setting for this study is the electric utility industry. It has a large impact on the environment. In a 1993 report, the Environmental Protection Agency (EPA) estimated that this industry generated 70 percent of all U.S. sulfur dioxide emissions and 30 percent of all U.S. nitrogen oxides. It contributed to greenhouse gases by releasing more than 500 million tons of carbon per year (EPA, 1993). We discriminate among different kinds of regulation, separating the effects of less flexible regulations from the effects of more flexible ones. We propose that when regulations are flexible, utilities' investments in pollution control systems will enhance productivity. When investments are made on the basis of regulations that severely restrict utilities' choices, we expect a negative impact on productivity.

We divided electric utilities' environmental expenditures into two categories—flexible and inflexible—to capture these different levels of regulatory control (Percival, Miller, Schroeder, & Leape, 1992). Air and water pollution controls are examples of inflexible regulation. In their case, Congress has pursued a deliberate technology-forcing strategy (Percival et al., 1992). Emitters have been forced to conform to such standards or else face closure. In the case of air pollution, they have been subject to stringent standards for the best available control technology (BACT) and lowest achievable emission rate (LAER). These standards are technically determined by the Environmental Protection Agency, with economics not being allowed to enter into the calculation. In the case of water pollution control, the same type of technology-forcing strategy is in effect. Emitters have had to comply with what is technologically feasible. The expectation is that they will rely on best available technology (BAT) "end-of-pipe" treatment. BAT is defined by the EPA as the "very best control measures that have been or are capable of being achieved" (Percival et al., 1992: 769). The EPA determines a BAT standard for each industry. Then, under the National Pollution Discharge Elimination System, the agency establishes specific levels of performance for every discharge. The Environmental Protection Agency thereafter provides strict mechanisms to assure compliance.

The air and water pollution control programs are governed by strict timetables. When the EPA was created, Congress looked for "handles" that would guarantee that polluters complied with the law. It addressed the problem of vague delegation of authority in prior laws with statutes that had specific implementation dates. Instead of Congress in effect saying "Here is the problem, deal with it," it granted the EPA explicit authority to demand compliance by a specific date. The amount of choice available to air and water polluters is very limited. The standards the government sets are end-of-pipe requirements. There is no reason to look for pollution prevention opportunities, because under the requirements the government establishes it would be difficult to obtain a waiver.

Where investments in air and water pollution control plant are mandated by the regulatory authorities, regardless of whether these plant items are relevant to a utility's operations, then the likelihood that such spending will be negatively related to productive efficiency will be high. In such a case, firms do not have operational control over plant investments. These investments can add to costs as opposed to providing higher-quality output or superior operating performance. Thus, we advance the following hypothesis:

Hypothesis 1. Utilities that spend relatively greater amounts on air and water pollution equipment will be relatively less efficient than other utilities.

Although the air and water rules allow little room for discretion, the solid waste requirements are examples of flexible regulation. They permit autonomy within a system of constraints. These laws are administered at the local level, not at the national level (Percival et al., 1992), and the states are not subject to binding timetables that are in any way similar to the timetables that constrain the EPA with respect to air and water pollution control. In effect, the states have been granted the discretion to deal with the problem as they see fit, subject to achieving the challenging pollution prevention goals the federal government has established. The federal government exempts the remains of fossil fuel combustion from nationally enforced hazardous waste requirements. Regulatory responsibility has been assigned to the states subject to guidelines that make source reduction the preferred solution. In the hierarchy of goals that the federal government has set, source reduction comes first, followed by recycling and land filling (Marcus, 1993).

Thus, the utilities, depending on local conditions, have the latitude to pursue programs of varying degrees of economic benefit to themselves. They can reduce pollution at the source by changing fuels (for instance, by buying and using different grades of coal or natural gas) or by investing in alternative production processes. Depending on how close they are to local markets and how much demand there is, they can recycle wastes. The fly ash that remains from coal combustion can be made into gypsum. The bottom ash can be converted into concrete. The utilities also can build, operate, and upgrade their own ash ponds, landfills, and other systems for removing waste, or they can pay someone else to transport, manage, and dispose of it. Overall, the solid waste requirements are less rigid than the air and the water pollution laws. These requirements set ambitious goals but do not fix timetables. Firms have discretion in deploying waste pollution prevention equipment. They are likely to deploy those pieces of equipment compatible with their overall operations. Utilities are, therefore, unlikely to deploy equipment that will detract from operating performance. Rather, given the flexibility to do so, utilities will invest in equipment that has positive operating performance consequences. Thus, we advance the hypothesis:

Hypothesis 2. Utilities that spend a relatively greater amount on waste pollution equipment will be relatively more efficient than other utilities.

METHODS

Setting

In 1990, the year of this analysis, the U.S. electric utility industry consisted of 3,241 firms. Of these, 267 were owned by private investors, 2,011 were publicly owned by state and municipal authorities, 10 were federally owned, and 953 were cooperatives. Although the 267 investor-owned utilities represented only 8 percent of the electric utilities in the nation, they accounted for 79 percent of all revenues from sales of electricity to ultimate consumers.

We concentrated our analysis on the 150 largest of these investor-owned utilities for which complete data sets were available. Our sample had full cross-sectional variation and included a large percentage of the electric power produced and distributed by private utilities in the United States. In the year used for the empirical study, the total revenues of the investor-owned utilities in the U.S.A. were $155 billion, and the total revenues of the largest 150 utilities of which our sample consisted were $150 billion. We intentionally chose to exclude the smaller utilities because of differences in pollution problems, spending patterns, and productivity factors. The source for our data was the Federal Energy Regulatory Commission's *Statistics of Investor-Owned Electric Utilities*.

We chose 1990 as the year for the analysis, because in that year, after a long period of criticism, Congress amended the Clean Air Act of 1970. Up until 1990, this act was a nearly pure case of an inflexible command-and-control regime. The 1990 amendments introduced a pollution-trading scheme that altered the utilities' incentive to invest in pollution control equipment. The new law combined command-and-control requirements with elements of choice previously not available. It provided a degree of flexibility that formerly did not exist. Only by carrying out our analysis in the period before 1990 could we test our hypotheses that less flexible regulation tends to retard utilities' productivity and that more flexible regulation tends to enhance it.

Measures

Efficiency measurement. Productive efficiency was estimated with data envelopment analysis (Banker, Charnes, & Cooper, 1984; Charnes, Cooper, & Rhodes, 1978; Majumdar, 1998). Following past research on investor-owned utilities (Nelson, 1989; Roberts, 1986), we used total sales and dispositions of energy in megawatt hours as outputs in the estimation. The inputs were spending on total production, transmission, distribution, and general plant plus the total number of employees and the amount of purchased power.

Explaining efficiency variations. We examined variations in firm-level productive efficiencies using regression analysis in which measures of environmental spending were the primary explanatory variables. This approach, first measuring and then explaining variations in productive efficiency, was consistent with prior work (Majumdar, 2000). The regression model estimated to evaluate the impact of environmental regulatory factors on the productive efficiency of electric utilities was: ln *efficiency = f (air pollution; water pollution; waste pollution; noise pollution; esthetic pollution; size; R&D; residential customers; nuclear power; proportion generated; regional effects controls).*

Air pollution was the ratio of each utility's air pollution plant value to total plant value; *water pollution* was the ratio of each utility's water pollution plant value to total plant value; and *waste pollution* was the ratio of waste pollution plant value to total plant value. These variables captured utilities' investment exposure to different types of pollution control requirements. Capturing environmental spending as the values of different categories of plant dedicated to dealing with different types of pollution control activities was consistent with the literature (Barbera & McConnell, 1990; Jaffe et al., 1995; Jaffe & Palmer, 1997). Firms' spending on different types of pollution control activities was a proxy for differences in the flexibility of various regulations. Firms' spending was reflected as investments made in different types of plant and equipment whose specific functions had differing effects on firms' productivity.

Control variables for other environmental expenditures were *noise pollution* and *esthetic pollution*. They captured investment exposure for the prevention of noise pollution and the maintenance of the utilities' external premises. An examination of the legal basis (Percival et al., 1992) for these expenditures did not clearly indicate whether they were flexible or inflexible. Most arguments about inflexible rules (Jaffe et al., 1995; Porter, 1991; Porter & van der Linde, 1995a, 1995b) have explicitly mentioned the BAT standards in the air and water pollution requirements as causes of great concern, but noise or esthetic pollution expenditures have not been so designated.

A set of variables was used to control for other important facets of electric utilities' activities that affected productivity. Utility *size* was measured using the natural logarithm of total sales or revenues. In the electric utility industry, the relevant evidence (Roberts, 1986) suggested that the size and productive efficiency relationship was positive. The *R&D* variable was constructed as the ratio of research and development expenditures to total operational expenditures. It was a key control variable because the R&D and productivity link has been considered important in the productivity literature (Griliches, 1988). Further, density effects are important in influencing electric utilities' performance with respect to transmission activities. Where customers were large and concentrated, as are business customers, operating costs were likely to be lowered. Low costs were found to exist particularly for distribution to business users (Salvanes & Tjotta, 1994). Use of the *residential customers* variable, which was constructed as the ratio of residential customers to total customers, controlled for such effects.

Nuclear power production accounted for a fifth of electric power produced in the United States in the year of the study. Nuclear power generation led to efficiencies relative to fossil-fuel-based power generation (Kamerschen & Thompson, 1993). As important as this controversial finding was, using nuclear power as a control allowed us to focus on the fossil-fuel-generating units where air, water, and solid waste pollution were most relevant. The *nuclear power* variable was constructed as the ratio of nuclear power production expenses to total operating expenses and was a good proxy for the proportion of nuclear power generated by each utility.

A distinguishing feature of electric utilities was the extent of boundary spanning across generation and transmission activities. These activities were distinct. Yet there were possible scale- and scope-related vertical economies (Kaserman & Mayo, 1993) to be exploited if an utility did engage in both generation and transmission activities. Conversely, a utility could just generate electric power to be supplied to other utilities. The number of such independent power producers was increasing in the United States. On the other hand, some utilities could buy the power that they sold. We controlled for the impact of vertical economies on utilities' productivity by introducing the variable *proportion generated*, measured as the amount of electric power sold by a utility that was actually generated by that utility.

We also controlled for secondary regional effects. Regional variations in regulatory policies existed in the United States. Of course, other than policy variations that occurred between regions of the United States, geography and climatic factors that were unique to a region also affected the operating performance of the electric utilities. We controlled for these effects by incorporating these dummy variables: *Northeast, Northwest, Southeast, Southwest, Midwest, Northwest, Central,* and *Atlantic*. The omitted base case was the Western region of the United States. The inclusion of these dummy control variables helped account for these important regional factors.

RESULTS

The efficiency scores ranged from a minimum of 0.32, on a scale of 0 to 1, to a maximum of 1.00. The mean score for the 150 electric utilities was 0.78; however, the standard deviation of the score was 0.24, with an associated coefficient of variation of 0.29. Additional evidence of heterogeneity was available from a review of the interquartile deviation for the efficiency score (0.42). We estimated the model using a heteroskedasticity correction procedure for all the observations (Davidson & MacKinnon, 1993). Table 1 contains details of the descriptive statistics and correlations for the regressors. Table 2 contains the regression results.

As shown in columns 1 and 2 of Table 2, the

TABLE 1
Descriptive Statistics and Correlations

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Efficiency[a]	−0.30	0.33																	
2. Air pollution	4.41	4.86	.05																
3. Water pollution	1.74	2.15	.06	.44															
4. Waste pollution	0.77	1.11	.16	.38	.57														
5. Noise pollution	0.05	0.15	−.01	.05	.07	.06													
6. Esthetic pollution	1.47	4.61	.06	.07	.02	.09	.26												
7. Size	13.06	1.39	.12	.17	.35	.22	.07	.15											
8. R&D	0.62	1.02	.18	.01	.09	.06	.01	.08	.40										
9. Residential customers	0.34	0.11	.25	−.20	−.02	−.05	−.07	0.00	.19	.05									
10. Nuclear power	0.10	0.15	.06	.19	.37	.06	−.09	−.06	.43	.08	.10								
11. Proportion generated	0.68	0.33	.11	.36	.38	.36	−.01	.03	.54	.17	−.01	.39							
12. Northwest	0.03	0.18	.06	.10	.03	.06	.01	−.05	−.05	−.06	−.05	−.04	.03						
13. Midwest	0.27	0.44	.12	.13	−.07	.03	−.05	−.11	−.19	−.05	−.14	.01	.12	−.11					
14. Northeast	0.20	0.40	−.15	−.30	−.10	−.12	.04	.03	−.12	−.07	−.11	−.08	−.31	−.09	−.30				
15. Central	0.05	0.21	−.01	.02	.10	.26	−.03	.03	−.02	−.02	.10	.01	.12	−.04	−.13	−.11			
16. Atlantic	0.14	0.35	.03	.15	.09	.07	.15	.03	.16	−.03	.10	.15	.01	−.08	−.24	−.20	−.09		
17. Southwest	0.07	0.25	.08	.09	.15	−.04	−.04	−.08	.08	−.10	.01	.09	.06	−.05	−.16	−.13	−.06	−.11	
18. Southeast	0.18	0.39	.07	−.06	−.01	.02	−.07	−.08	.04	.03	.11	−.08	.06	−.09	−.28	−.23	−.10	−.19	−.13

[a] Logarithm.

TABLE 2
Results of Regression Analyses[a]

	Heteroskedasticity-Consistent Least Squares Estimates			Tobit Estimates	
Variable	***b***	***t***	**β**	***b***	***t***
Constant	−0.65 (0.08)	8.32***	0.00	1.11 (1.21)	0.94
Air pollution	−0.01 (0.00)	5.25***	−0.13	0.04 (0.02)	1.82*
Water pollution	−0.02 (0.01)	3.53***	−0.12	0.06 (0.06)	1.02
Waste pollution	0.06 (0.00)	7.22***	0.19	−0.21 (0.12)	1.84*
Noise pollution	−0.05 (0.02)	2.12*	−0.02	0.23 (0.69)	0.33
Esthetic pollution	0.00 (0.00)	0.06	0.00	−0.01 (0.02)	0.41
Size	0.03 (0.01)	5.03***	0.13	−0.10 (0.10)	1.01
R&D	0.08 (0.01)	9.86***	0.23	−0.42 (0.15)	2.83**
Residential customers	−0.10 (0.07)	15.11***	−0.33	4.30 (0.10)	4.31***
Nuclear power	0.14 (0.06)	2.17*	0.06	−0.55 (0.75)	0.74
Proportion generated	−0.07 (0.03)	2.61**	−0.07	0.41 (0.38)	1.07
Northwest	0.20 (0.10)	2.11*	0.11	−0.54 (0.62)	0.86
Midwest	0.36 (0.04)	8.48***	0.48	−1.13 (0.44)	2.55**
Northeast	0.17 (0.05)	3.37***	0.21	−0.40 (0.44)	0.90
Central	0.30 (0.07)	4.03***	0.19	−1.20 (0.59)	2.02*
Atlantic	0.34 (0.05)	6.82***	0.36	−1.22 (0.48)	2.55**
Southwest	0.46 (0.06)	7.82***	0.35	−1.93 (0.59)	3.28***
Southeast	0.36 (0.05)	7.67***	0.42	−1.22 (0.46)	2.67**
Log likelihood	−46,316.20			−62.05	

[a] Standard errors are in parentheses.
* $p < .05$
** $p < .01$
*** $p < .001$
All one-tailed tests.

impacts of the air pollution ($t = 5.25$, $p < .001$) and water pollution ($t = 3.53$, $p < .001$) variables were negative and significant. Waste pollution ($t = 7.22$, $p < .001$) had a significant and positive impact on productivity. Of the two negative pollution abatement variables, air pollution ($\beta = -.13$) had more of a negative impact on productivity than water pollution ($\beta = -.11$). The impact of these variables, however, was overshadowed by the magnitude of the impact of waste pollution ($\beta = .19$).

In other words, on the average the greater the relative value level of pollution abatement plant that was dedicated to solid waste pollution in electric utilities, the higher was their productive efficiency. The opposite relationship was true when the plant expenditures that were being evaluated were those relative values dedicated to air and water pollution abatement activities.

We included the control variables noise pollution and esthetic pollution because of our interest in disaggregating environmental spending into its components. These variables turned out to be negative, and noise pollution turned out to be significant ($t = 2.12$, $p < .05$).

These results suggested that only when actors had choices within a situation of constraints, as they did with solid waste pollution expenditures, did regulation have a positive impact on productivity. In all other cases, the effects of regulatory expenditures on productivity were negative. Of the control variables, size ($t = 5.03$, $p < .001$), R&D ($t = 9.86$, $p < .001$), and residential customers ($t = 15.11$, $p < .001$) were all significant and of the expected sign. These results were consistent with theory and our prior expectations. This gave us confidence that the overall model and analysis made sense. The relative impacts of size ($\beta = .13$), R&D ($\beta = .23$) and residential customers ($\beta = -.33$) on productivity were also quite substantial. Nuclear power was positive and significant ($t = 2.17$, $p < .05$). This result was also consistent with our expectations, but proportion generated was negative and significant ($t = 2.61$, $p < .01$).

An alternative test. The dependent variable, measuring the productive efficiency of each electric utility, ranged between 0 and 1. Therefore, the distribution was "censored." In our regression estimation the dependent variable was expressed in logs because taking the log of a half-normally distributed variable ranging between 0 and 1 made the resulting distribution log-normal. A way to approach the censoring problem was to estimate a

Tobit model (Davidson & MacKinnon, 1993). We carried out an alternative test to determine how robust our results were, calculating the relative inefficiency of each observation as 1 minus the efficiency score. Perfectly efficient sample firms, therefore, had an *inefficiency* score of 0. These were the observations at the limit. Thereafter, a Tobit model was estimated to determine the extent to which the various regulatory expenditures influenced the relative inefficiencies of the utilities. In the Tobit model that we used, to avoid biased and inconsistent parameters (King, 1988), we used a log-likelihood score rather than an adjusted multiple squared correlation coefficient (R^2) to test the overall fit of the model.

Columns 4 and 5 in Table 2 provide the Tobit estimates of the determinants of inefficiency. Here, a negative coefficient meant that a variable had a positive impact on efficiency. Air pollution and water pollution were both positive, signifying that they had a negative impact on efficiency. However, only air pollution ($t = 1.18$, $p < .05$) was significant. In other words, firms that spent more on these items were inefficient relative to the other firms. In the case of solid waste expenditures, the impact of waste pollution ($t = 1.84$, $p < .05$) on inefficiency was significantly negative. Again, using an alternative method of estimation, we found that spending more on waste pollution made firms more efficient than the other utilities. This alternative test provided us with confidence that data support was available for the idea that the more choice actors exercised within a situation of constraints, the better the results were likely to be.

DISCUSSION

Prior studies on law, rules, and regulations (Sitkin & Bies, 1994) show that they have both positive and negative impacts. The positive impacts are the protection of rights and the ensuring of fairness, equal treatment, and predictability. The negative impacts are the creation of rigidities and the erosion of trust, learning, and cooperation. The proposition that this study examines is that the more actors exercise choice within a situation of constraints, the better the results are likely to be. Regulations that are better designed give actors more choices. Better-designed regulations set goals that are ambitious enough to stretch firms beyond their current practices, but they also provide sufficient time for firms to develop and deploy new means to meet goals. The advantages of rules designed in this fashion are that they encourage entrepreneurship, creativity, and risk taking. Such rules lead to internalization and identification. They permit implementers to play an active role in policy design, and they draw on implementers' advanced understanding of circumstances at the point of delivery.

Laws play an important role in framing internal organizational decision processes. Our findings suggest that too much law is as problematic as too much discretion. An appropriate balance between rules and discretion is needed. The aim should be to design laws and rules that let the actors effectively exercise choice within a system of constraints. This perspective is different from the classic assertion by economists that markets are always superior (Weitzman, 1974).

Limitations

Our study has a number of limitations. To start with, relying on 1990 data leads to an analysis that is based on what used to be rather than what is. Even though we had good methodological reasons for using these data, the data are over ten years old. It is not clear if these data can be generalized to what is happening currently, especially in light of the changes in the Clean Air Act that went into effect in 1990. Indeed, Marcus and Geffen (1998) found that these changes, which were in the direction of greater flexibility, did stimulate positive innovations that led to environmental improvements and economic benefits for the companies involved.

Air pollution regulations today are clearly not as rigid and poorly designed as they used to be. In addition, the EPA is making the effort through such programs as Project XL (Excellence in Leadership) to demonstrate increased flexibility throughout its programs so long as superior environmental and economic results are guaranteed. The solid waste regulations, moreover, are not as uniformly well designed as our aggregate analysis suggests. In some localities, there is no question that some rigidities exist. The solid waste laws are not perfect models for the better rules we would like to see introduced.

We also believe that our anomalous findings about spending on noise and esthetic pollution have to be explained. With respect to noise pollution, it is not clear when and in what ways the requirements are flexible. They take into account a broad body of law that is not as discrete as the air and water pollution requirements that apply to the electric utilities.

Areas for Future Research

Other expenditure categories induced by regulatory enactments should be investigated to assess the generalizability of our findings. These categories do not have to come from the environmental area alone. The full gamut of regulations, from rules on occupational safety and health to rules on discrimination in employment, is a worthy topic for investigation. For example, although our findings about regulatory flexibility are consistent with previous research on the telecommunications sector (Majumdar, 1997), more recent regulatory changes in that sector are likely to significantly impact firms' behavior. The impact of these changes is a topic worth researching. Another issue that we readily acknowledge is that to advance theory and empirical study, more complete models with additional controls are needed. In the case of each regulatory setting, the models have to be appropriate. They might have to be somewhat different.

In general, we believe that there is growing recognition of the need for greater flexibility within a system of constraints and that there has been some movement in this direction. However, the effort to design better rules has not advanced as rapidly as its proponents had hoped. It often stalls quickly because of continued legal rigidities and the activities of vested interests. In the environmental area, the difficulties arise because existing statutes were established in a period when end-of-pipe controls were dominant. Opportunities for pollution prevention were insufficiently understood and appreciated. By its very nature, pollution prevention requires a code of flexibility subsumed within a system of constraints. Ambitious goals have to be tempered by granting latitude in how these goals are to be achieved.

The design of such a system is not at all obvious. A fruitful line of future research would center on appropriate regulatory design in different settings. How can the right balance of freedom and control be achieved? Another area of future research toward which our work points is comparison of the neoclassical assumption of perfect knowledge with the revisionist neoclassical assumption of imperfect knowledge (Leibenstein, 1976). To what extent would better-designed rules cause managers to pay attention to costs previously ignored, as King (1994) suggested, and to tighten up organizational slack and "x-inefficiency"? Is there a point at which slack will be absorbed into higher productivity when all the "low lying fruit" has been picked and easy environmental waste has been eliminated, or can effective regulation stimulate firms to continue to find innovative ways to internalize environmental externalities by raising the bar periodically? In other words, to what extent can regulators establish ambitious enough goals with sufficient discretion to set up environmental innovation as an arena in which industry rivals can vie for competitive advantage? This issue comes down to the question of whether productivity is an absolute or a relative concept. Is there a point at which all the slack has been absorbed, or can well-designed regulations continue to act to influence firms to internalize externalities until some theoretical point when all externalities have been internalized?

Conclusion

Well-designed regulations provide sufficient time for firms to do R&D and develop new technologies. They require that firms comply with strict goals so long as the means for reaching these goals remain in the firms' control, and they are flexible in terms of means of implementation, with no best available technology requirements. The electric utility industry context has provided a useful testing ground for evaluating the effects of laws on industry productivity since it has different types of regulatory constraints and structures. It has enabled us to investigate more carefully when and under what circumstances Porter and van der Linde's (1995b) argument about environmental regulations having a positive effect on productivity applies. When utilities have greater discretion to fashion a regulatory response that is sensitive to different local conditions, these regulations are more likely to result in competitive advantage. When utilities are legally bound to install a particular technology—for example, an end-of-pipe add-on device like a scrubber—the utilities are likely to pay a heavy price, with no gain in productivity.

We found that utilities' spending on conforming with air and water pollution regulations tended to retard productivity but that their spending on the solid waste requirements tended to enhance it. To a much greater extent than is the case with air and water pollution requirements, the solid waste regulations were designed with flexibility in mind. Companies had more discretion to choose how they would comply. Therefore, the effect of solid waste regulations on productivity was positive, and the effect of the air and water pollution controls on productivity was negative. The difference between these sets of requirements was in the degree of flexibility they allowed.

Given the controversy about the impact of environmental regulation on industrial productivity, these policy differences are extremely interesting. The main condition set by Porter and van der Linde (1995b) about when environmental requirements can contribute to productivity is that there be options available to industry. Without options available, firms cannot figure out how best to minimize wastes and prevent pollution.

This study adds empirical support to Porter and van der Linde's (1995b) widely quoted thesis regarding the influence of environmental regulatory design on firm performance. The productivity focus of this article adds a new dimension to this body of literature. We have shown that the apparent controversy between economists and Porter and van der Linde begins to dissolve when consideration is given to regulatory design. Some regulations inhibit productivity. Other regulations can enhance it. The key difference is the extent to which the regulations set challenging goals and grant firms compliance discretion.

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