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ECONOMIC DEVELOPMENT AND ENVIRONMENTAL REGULATIONS: THE IMPACT OF STATE ENVIRONMENTAL REGULATORY CLIMATES ON STATE MANUFACTURING EMPLOYMENT

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Introduction

On January 1, 1970 President Richard Nixon signed the National Environmental Policy Act. This act ushered in a decade of comprehensive, specific, instrumental, and ceremonial environmental legislation at both the state and federal levels. These environmental laws were viewed by many as important public policies designed to limit or terminate activities associated with the degradation of the ecosystem. These laws also concerned many who believed excessive environmental regulations might have a negative impact on economic development. The stage for an envirobusiness struggle was set.

This study focuses on one aspect of the envirobusiness struggle: the impact of state environmental regulations on state manufacturing employment. If the trade-off between environmental integrity and economic development is legitimate, states with tougher environmental laws or more stringent environmental regulatory climates should dissuade the location of new manufacturing firms or instigate an exodus of existing firms.

Previous studies of the environment versus development debate have ranged from surveys of industrial leaders concerning the importance of state environmental regulations on the location decision (Stafford, 1985) to analysis of the relationship between specific environmental regulations on changes in the number of firms or employment (Bartik, 1988; McConnell and Schwab, 1990).

Most surveys on firm location find that environmental regulations rarely are mentioned as the most important locational determinant. A 1977 survey by *Fortune* magazine asked executives of the 1,000 largest United States industrial corporations to rank the factors that had influenced their location decisions in the past five years. Only 11 percent of the executives ranked environmental regulations (such as the

processing of environmental impact reports and state posture on environmental controls) among the top five factors.

A 1981 study prepared for the United States Department of Housing and Urban Development surveyed the largest 410 domestic manufacturing companies concerning their location decisions. The study reveals that 17 percent of the companies opening new plants state that the ability to obtain environmental permits is an important regional or state locational determinant, while 8 percent of the firms relocating find the environmental permit acquisition process an important locational influence. The same study finds that 8 percent of the companies closing plants cite compliance with environmental and workplace regulations as the main reason.

The most comprehensive survey to date concerning the impact of environmental regulations on industrial location was conducted by Howard Stafford. His study examines whether traditional locational influences such as labor and market proximity remain the dominant factors in the locational search process or if environmental regulations have become or are becoming the new dominant influence. Environmental regulations do not rank as one of the top ten determinants in the site selection process. When environmental regulations are examined at different levels of the location search (region, state, local), however, environmental regulations matter. Environmental regulations are considered by the firms surveyed as the second most important locational influence at the state level. Stafford concludes that although there are many situations where environmental regulations influence the site selection process at the state level, the regulations are less likely to have an impact on the selection of a specific site within a state.

Stafford also suggests that certain states have gained as a result of less stringent environmental regulations. Areas that have gained in locational attractiveness include the sunbelt states; areas that have become less attractive include California, the northeast, and north central states.

A second method for examining the effect of state environmental regulations on firm location is regression analysis. Bartik, using conditional logit analysis, tests the influence of state environmental variables such as state air and water pollution control expenditures, compliance costs, allowable particulate emissions, and percent reduction required in particulates on the location of manufacturing branch plants of *Fortune* 500 companies. Bartik finds that none of the variables used to measure state environmental regulations have a significant influence on the location decision.

McConnell and Schwab, also using conditional logit analysis, examine the effects of state and county environmental variables on the location of firms in the motor vehicle industry. The variables at the state level include abatement operating costs, permitted pounds of volatile

organic compounds, and total abatement capital expenditure as a proportion of new capital expenditures. Similar to Bartik, McConnell and Schwab find that environmental variables have no significant influence on the location of firms at the state level.

Although previous studies have been unable to verify any influence of environmental regulations on firm location, the discussion is not closed. Because of the multitude of possible variables to reflect state environmental regulations and the contention among survey respondents that state environmental regulations reflect a state's business climate, further study is needed.¹

Methodology

This study examines the impact of state environmental regulations on state economic development by developing an index of state environmental regulatory climate and using this index to measure changes in state manufacturing employment. Although state manufacturing employment will change regardless of firm location decisions, manufacturing employment is a good proxy for indicating a state's manufacturing climate (Plaut and Pluta, 1983).

The time period selected for this analysis is of critical importance. The 1970s often are referred to as a decade of environmental legislation. After the enactment of the National Environmental Policy Act, the Federal Clean Air Act of 1970, and the Federal Clean Water Act of 1972, states began to establish environmental policy acts, adopt various federal provisions into state law, and develop environmental regulations. By the end of the 1970s states had distinct environmental regulatory climates. The state environmental regulatory climate index developed in this study reflects the states' climates as of 1980.

State Environmental Regulatory Climate Index

Business climate indices such as the *Annual Study of General Manufacturing Climates for the Forty-Eight Contiguous States of America* by Grant Thornton (formerly Alexander Grant), *Inc.* magazine's ranking of state business climates, and *Making the Grade: the Development Report Card for the States* published by the Corporation for Enterprise Development suggest that the various influences on the location decision (such as labor costs, labor productivity, union membership, physical infrastructure, state fiscal policies, and various amenities) differ from state to state. These organizations rank the

¹ The contention that a state's environmental regulations reflect the state's business climate is supported by responses from Stafford's survey, by responses from this study's survey, and by the fact that the Grant Thornton ranking gives a negative factor weighting to the percentage of state expenditures devoted to environmental control.

states according to the attractiveness of each state's business climate by assigning weights to each of the various influences. The methodology employed to develop these business climate indices is similar to that of the development of the state environmental regulatory climate index.

The state regulatory climate index is based on the following environmental regulations and policies:

- The extent of each state environmental policy act (SEPA);
- Whether states have implemented steps consistent with the federal Clean Air Act (including a new source review program (NSRP), emission standards for hazardous pollutants, a non-compliance penalty program for stationary sources, and required a stationary source permit fee);
- Whether states have developed a national pollution discharge elimination program (NPDES) consistent with the Clean Water Act;
- Wetland permit requirements;
- The level of opacity or visible emissions standards;
- Standards for monitoring visible emissions of stationary sources; and
- State per capita spending on air and water pollution control programs.

A description of the variables used to develop the state environmental regulatory climate index is contained in Appendix A.

The extent of the state environmental policy act and wetland permit requirement variables are included to reflect the concerns firms have with regard to a cumbersome state permit acquisition process. An extensive permit acquisition process may dissuade firm location.

The development of a NSRP, emission standards for hazardous pollutants, a noncompliance penalty program, a major stationary source permit fee requirement, and a state level NPDES program reflect a state's willingness to incorporate various sections of the Federal Clean Air Act and Clean Water Act in state law. States that incorporate these regulations may be seen by firms as creating additional environmental regulatory bureaucracy or as states that have too much concern for regional environmental protection.

Opacity standards directly indicate a state's statutory requirement. Continuous monitoring regulations reflect state regulations as well as a state's concern for airborne emissions. States with strict standards and extensive monitoring requirements reflect a more aggressive state attitude toward environmental protection.

Per capita spending on air and water pollution control programs is used as an indicator of the stringency of a state's environmental regulatory climate because states that have higher per capita spending are more involved with inspection and enforcement activities. High per

capita spending also may reflect the extent of state involvement in other pollution control projects.

To determine the appropriate weighting of each variable in developing the environmental regulatory climate index, each state's environmental protection office and economic development office were surveyed. Because the state environmental protection offices are directly involved in the regulatory process, their knowledge (feedback) of both the intended and realized impacts of environmental regulations is necessary in the development of the index. The responses from the economic development offices provide information regarding the impact of various environmental regulations from the business perspective. The survey contains a description of the ten environmental regulatory variables and a survey response sheet. Each state office was asked to indicate the extent to which they believe each variable reflects the stringency of a state's environmental regulatory climate. The responses range from 1 to 10, with 1 indicating no influence and 10 indicating a significant influence.

The response rate for the state environmental protection offices is 56 percent. The response rate for the state economic development offices is 33 percent. The combined response rate is 45 percent.

The weighting of each variable is based on the survey responses of the state environmental protection and economic development offices. The results of the survey are given in Appendix C. Appendix D provides the weighting of the index based on the survey responses.

Lower cumulative scores indicate a more stringent environmental regulatory climate, while higher scores are linked to states with a more lax environmental regulatory climate. Possible scores range from 10 to 50. Table 1 lists each states' stringency score and ranking.

Empirical Analysis

Rank Correlation

The states are ranked from 1 to 48 according to the environmental regulatory climate index listed in Table 1. States with lower environmental regulatory climate index scores receive the highest ranking. For example, Minnesota and California tie for the lowest regulatory climate score and therefore receive a ranking of 1.5, while Arizona has the highest regulatory climate score and is ranked 48th. The states also are ranked according to their percentage change in manufacturing employment over various time periods. States with the greatest percentage increase in manufacturing receive the highest ranking. For example, Arizona had the greatest percentage increase in manufacturing from 1980 to 1987 and therefore is ranked first.

If a more stringent environmental regulatory climate dissuades the location of new manufacturing firms or instigates the exodus of existing

Table 1—State Environmental Regulatory Climate, Scores and Ranking

State	Rank	Score
California	1	14.00
Minnesota	1	14.00
Delaware	3	18.00
Washington	3	18.00
Virginia	5	19.00
Colorado	6	22.00
Maryland	6	22.00
Connecticut	8	23.00
North Carolina	8	23.00
Wisconsin	8	23.00
Michigan	11	24.00
Indiana	12	25.00
New York	12	25.00
South Carolina	12	25.00
Alabama	15	26.00
Nebraska	15	26.00
Oregon	15	26.00
Vermont	15	26.00
North Dakota	19	27.00
Georgia	20	28.00
Kentucky	20	28.00
Tennessee	20	28.00
West Virginia	23	29.00
New Jersey	24	30.00
Nevada	24	30.00
Texas	24	30.00
Maine	27	31.00
Ohio	28	32.00
Rhode Island	29	33.00
South Dakota	29	33.00
Louisiana	31	35.00
Pennsylvania	32	36.00
Montana	32	36.00
Massachusetts	34	37.00
New Mexico	35	38.00
Mississippi	36	39.00
New Hampshire	36	39.00
Florida	38	40.00
Illinois	38	40.00
Missouri	38	40.00
Idaho	41	42.00
Oklahoma	41	42.00
Iowa	43	43.00
Utah	43	43.00
Arkansas	45	44.00
Wyoming	46	45.00
Kansas	47	46.00
Arizona	48	47.00

Table 2—Rank Correlation Coefficients

Time period for measuring the percentage change in manufacturing employment	Rank Correlation Coefficient	t-statistic
1979 - 1985	.065	.442
1979 - 1986	.107	.730
1979 - 1987	.128	.875
1980 - 1985	.092	.627
1980 - 1986	.109	.744
1980 - 1987	.109	.744
1980 - 1988	.029	.197
1981 - 1985	.079	.537
1981 - 1986	.095	.647
1981 - 1987	.087	.592
1981 - 1988	.037	.251

firms, the rank correlation coefficient should be negative. Table 2 shows rank correlation coefficients for various time periods.

The results indicate that there is a positive relationship between more stringent state environmental regulatory climates and increases in state manufacturing employment. The t-statistics, however, indicate that the coefficients are not significantly different from zero at a 20 percent confidence level.

Regression Analysis

Although the rank correlation analysis suggests that there is a positive but insignificant relationship between states with more stringent environmental regulatory climates and increases in manufacturing employment, a model that includes other locational influences is warranted.

The explanatory variables used in the regression analysis include the average hourly wage rate for workers in manufacturing, the percent of the state labor force unionized, the state's unemployment rate, the median years of education in each state, state per capita income, a measure of the states' tax climate, state spending as a percent of personal income on both education and welfare, climate, and electric costs. The data sources for the variables used in the regression analysis are listed in Appendix B.

Dummy variables are used to divide the states into three and four groups according to the state environmental regulatory climate index. When the states are divided into three groups, group 1 consists of states with stringency scores of 14.00 to 25.00, group 2 consists of states with scores of 26.00 to 35.00, and group 3 comprises the remaining states (the base group). When the states are divided into four

groups, group 1 consists of states with scores of 14.00 to 24.00, group 2 consists of states with scores of 25.00 to 29.00, group three consists of states with scores of 30.00 to 38.00, and the remaining states form group 4, the base group.

If the states with a more stringent environmental regulatory climate (groups 1 and 2 in the three group case and groups 1, 2 and 3 in the four group case) are associated with a smaller increase or greater decrease in the percentage change in manufacturing employment than that of the base group, the contention that a more stringent environmental regulatory climate may have a negative impact on state economic development is supported. Such a pattern would be reflected by a negative coefficient on the dummy variables in the regression results. The group of states with the lowest stringency scores should have the largest negative coefficient.

The regression results when the states are divided into three levels of environmental stringency are given in Table 3. The variables showing the most influence on the percentage change in state manufacturing are wages, education, and state welfare spending.

Table 3—Regression Results With Three Environmental Regulatory Climate Groups (Dependent variable is the percentage change in state manufacturing employment 1980 - 1987)

Explanatory Variables	Parameter Estimate	t-statistic
Wage Rate	-3.626	-1.929*
Unionization	-0.162	-0.468
Unemployment Rate	1.883	1.350
Education	36.818	2.893**
Per Capita Income	-4.209	-1.786*
Tax Climate Index	1.794	1.222
Welfare Expenditures	-7.135	-2.668**
Education Expenditures	-1.545	-0.963
Climate	0.027	0.204
Electric Costs	0.003	0.846
Environmental Climate Index		
Group 1	7.419	2.050**
Group 2	2.747	0.867
Constant	-389.903	-2.695**
R ²	.5523	
Adj. R ²	.3988	

** Significant at the 5 percent level

* Significant at the 10 percent level

The results concerning environmental variables indicate that states with the most stringent environmental regulatory climates are associated with a greater percentage increase in manufacturing employment than states with lax environmental regulatory climates. Group 2 is not significantly different from the base group.

Table 4 shows the regression results when states are divided into four levels of environmental stringency. As expected, the signs on the explanatory variables are identical to the three group case. The group of states with the most stringent environmental regulatory climate again is associated with a greater percentage increase in state manufacturing employment.

Table 4—Regression Results With Four Environmental Regulatory Climate Groups (Dependent variable is the percentage change in state manufacturing employment 1980 - 1987)

Explanatory Variables	Parameter Estimate	t-statistic
Wage Rate	-4.077	-2.194**
Unionization	-0.021	-0.059
Unemployment Rate	1.716	1.269
Education	31.278	2.519**
Per Capita Income	-4.964	-2.117**
Tax Climate Index	2.129	1.469
Welfare Expenditures	-8.457	-3.041**
Education Expenditures	-1.385	-0.882
Climate	0.018	0.140
Electric Costs	0.004	1.072
Environmental Climate Index		
Group 1	9.736	2.174**
Group 2	-0.658	-0.172
Group 3	0.237	0.067
Constant	-310.922	-2.174**
R ²	.5858	
Adj. R ²	.4275	

** Significant at the 5 percent level

* Significant at the 10 percent level

For the most part, the signs on the explanatory variables when the dependent variable is derived from other time periods are consistent with the 1980 to 1987 results. The exceptions are the climate and unionization variables which have different signs in different time periods. Wage rates, education, per capita income, and welfare spending are significant in every time period. The only other variables that

become significant are the climate, tax, and electric costs variables. The coefficient on the dummy variable representing the group 1 states is positive and significant in every time period.²

Conclusion

This study examines one specific aspect of the environment versus development debate. This research attempts to determine whether environmental regulations influence firm location.

The findings indicate that state environmental regulations, in the aggregate, do not dissuade plant location or influence relocation. This supports previous studies that examine the impact of state environmental regulations on state economic activity. Unlike previous studies, however, this study finds that a more stringent environmental regulatory climate is associated with increases in manufacturing employment. One cautiously may conclude that firms are attracted to states with a more stringent environmental regulatory climate.³ Another possible conclusion is that states with a less stringent environmental regulatory climate simply have fewer environmental problems.

A safer conclusion is that the more traditional factors (such as wage rates, extent of unionization, and level of unemployment) that influence firm location may outweigh the influence of environmental regulations. Whatever one concludes from this and previous environment versus development studies, the debate will continue and more studies are warranted.

² The estimation results when the dependent variable is derived from other time periods may be obtained from the author.

³ One survey respondent echoed this conclusion, stating "In (the state), the chief complaint of businesses is not the stringency of environmental regulations. As prudent corporate citizens, they understand environmental regulations will not only provide long-term "sustainable growth", but also foster a preventative climate that will reduce their liabilities associated with pollution cleanup."

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Appendix A—Environmental Variables

Variable: State Environmental Policy Acts

Source: The Council on Environmental Policy, *The Tenth Annual Report of the Council of Environmental Quality* (Washington D.C.: GPO, 1979), pp. 595-602.

Explanation: The 1979 report of the Council on Environmental Quality ranked the various SEPAs according to the comprehensiveness of their statutory requirements. There were four levels: 1) comprehensive application, which requires EIS for all state and private activities affecting the environment; 2) general application, which requires EIS for state projects and some private projects; 3) limited application, which requires EIS for some specific state agencies; and 4) no application.

Variable: New Source Review Program

Source: U.S. General Accounting Office, *Federal-State Environmental Programs - The State Perspective* (Washington D.C.: GPO, 1980), p. 3.30.

Explanation: This variable indicates whether a state had implemented a NSRP by 1979 consistent with section 110 of the Clean Air Act.

Variable: Emission Standards for Hazardous Pollutants

Source: U.S. General Accounting Office, *Federal-State Environmental Programs - The State Perspective* (Washington D.C.: GPO, 1980), p. 3.30.

Explanation: This variable indicates whether a state had developed a procedure by 1979 consistent with section 112 of the Clean Air Act.

Variable: Noncompliance Penalty Program

Source: U.S. General Accounting Office, *Federal-State Environmental Programs - The State Perspective* (Washington D.C.: GPO, 1980), p. 3.30.

Explanation: This variable indicates whether a state had developed this program by 1979.

Variable: Permit Fee Requirement

Source: U.S. General Accounting Office, *Federal-State Environmental Programs - The State Perspective* (Washington D.C.: GPO, 1980), p. 3.31.

Explanation: This variable indicates whether a state had developed this program by 1979.

Appendix A—Environmental Variables (continued)

Variable: NPDES Program

Source: John Quarles, *Federal Regulations of New Industrial Plants* (New York: Practising Law Institute, 1978), pp. 49-50.

Explanation: This variable indicates whether a state had developed a federally approved NPDES program by 1978 consistent with section 402 of the Clean Water Act. The NPDES requires new water pollution sources to obtain a discharge permit. The permit contains effluent limitations, a compliance schedule to achieve final effluent limitations, and self-monitoring and reporting requirements.

Variable: Wetland Permit Requirement

Source: Council on Environmental Policy, *Eleventh Annual Report on Environmental Quality* (Washington D.C.: GPO, 1980), pp. 490-491.

Explanation: This variable indicates whether a state had enacted legislation by 1979 that required the acquisition of a permit for any activity affecting wetlands.

Variable: Opacity Standards

Source: U.S. Environmental Protection Agency, *Compilation and Analysis of State Regulations for SO₂, NO_x, Opacity and Continuous Monitoring* (Washington D.C.: GPO, 1978), Table II-1.

Explanation: This variable measures state opacity standards in 1978 for all existing sources. The standards range from 20 percent opacity to 40 percent opacity.

Variable: Monitoring Regulations

Source: U.S. Environmental Protection Agency, *Compilation and Analysis of State Regulations for SO₂, NO_x, Opacity and Continuous Monitoring* (Washington D.C.: GPO, 1978), Table III-1 and III-22.

Explanations: The United States Environmental Protection Agency's Office of Enforcement classified states into five categories concerning the extent of their continuous monitoring regulations. This variable indicates the extent to which the states had adopted the monitoring requirements set forth in appendix P of CFR 51 by 1978.

Appendix A—Environmental Variables (continued)

Variable: Per Capita Spending on Pollution Control

Source: U.S. Department of Commerce, Bureau of the Census, *Environmental Quality Control: State and Local Special Studies* (Washington D.C.: GPO, 1982), pp. 6-8.

Explanation: This variable measures 1980 per capita spending on pollution control activities. These activities include the licensing and inspection of industrial plants, waste treatment operations, the collection and disposal of trash and hazardous waste, and establishing and enforcing air pollution policies.

Appendix B—Explanatory Variables

Variable: Hourly Wage Rate for Manufacturing Workers

Source: U.S. Department of Commerce, *Census of Manufacturers* (Washington D.C.: GPO, 1982).

Variable: Percent of State Labor Force Unionized

Source: U.S. Department of Labor, Bureau of Labor Statistics' *Directory of National Unions and Employee Associations* (Washington D.C.: GPO, 1979), p. 72.

Variable: State Unemployment Rate

Source: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the U.S.* (Washington D.C.: GPO, 1981), p. 392.

Variable: Median Years of Education

Source: U.S. Department of Commerce, Bureau of the Census, *1980 Census of Population* (Washington D.C.: GPO, 1981).

Variable: Per Capita Income

Source: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the U.S.* (Washington D.C.: GPO, 1991).

Variable: State Tax Climate

Source: The measure of a state's tax climate is taken from an index developed by William Wheaton. Wheaton's index measures the ratio of state business taxes (such as industrial property tax, corporate income tax, unemployment payroll tax, and corporate license fees) to the value of the state's manufacturing capital stock.

Variable: State Spending on Education

Source: Advisory Commission on Intergovernmental Relations, *Significant Features of Fiscal Federalism 1980-1981 edition* (Washington D.C.: GPO, 1981), pp. 98-199.

Variable: State Spending on Welfare

Source: Advisory Commission on Intergovernmental Relations, *Significant Features of Fiscal Federalism 1980-1981 edition* (Washington D.C.: GPO, 1981), pp. 98-199.

Variable: Climate

Source: Climate is measured as the mean January temperature. Climate data were obtained from the *Statistical Abstract of the U.S.*

Appendix B—Explanatory Variables (continued)

Variable: Electric Costs

Source: U.S. Department of Energy, *Typical Electric Bills* (Washington D.C.: GPO, 1981), p. 191.

Appendix C—Survey Results

Environmental Variable	Environmental Protection Offices N = 27 (ave.) (rank)		Economic Development Offices N = 16 (ave.) (rank)		Combined N = 44 (ave.) (rank)	
	SEPA	5.15	6	5.69	5	5.35
NSRP	6.48	1	6.94	1	6.65	1
Hazardous emissions	6.37	2	6.81	2	6.53	2
Noncompliance penalty	5.63	4	6.25	4	5.86	4
Permit fee	4.33	9	5.06	9	4.60	9
NPDES	5.89	3	6.31	3	6.05	3
Wetlands permit	5.07	7	5.50	6	5.23	7
Opacity	5.56	5	5.38	8	5.49	5
Continuous monitoring	4.93	8	5.44	7	5.12	8
Per capita spending	3.85	10	4.75	10	4.19	10

Appendix D—State Environmental Regulatory Climate Index Weighting

SEPA Extent	
Comprehensive application	1 pt.
General application.....	2 pts.
Limited application.....	3 pts.
No application.....	4 pts.
New Source Review Program	
Implemented by 1979.....	1 pt.
Not implemented by 1979.....	7 pts.
Emission Standards for Hazardous Pollutants	
Implemented by 1979.....	1 pt.
Not implemented by 1979.....	7 pts.
Noncompliance Penalty Program	
Implemented by 1979.....	1 pt.
Not implemented by 1979.....	6 pts.
Permit Fee Requirement	
Implemented by 1979.....	1 pt.
Not implemented by 1979.....	3 pts.
NPDES program	
Implemented by 1978.....	1 pt.
Not implemented by 1978.....	6 pts.
Wetland permit requirement	
Implemented by 1979.....	1 pt.
Not implemented by 1979.....	4 pts.
Opacity standards	
20% standard.....	1 pt.
30% standard.....	3 pts.
40% standard.....	5 pts.
Monitoring regulations	
Class I.....	1 pt.
Class IA.....	2 pts.
Class II.....	3 pts.
Class III.....	4 pts.
Class IV.....	5 pts.
Per Capita Spending	
\$7.01 and above.....	1 pt.
\$4.01 to \$7.00.....	2 pts.
\$0.00 to \$4.00.....	3 pts.