An Industry-Adjusted Index of State Environmental Compliance Costs

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July 29, 1999

Suggested running header: Index of State Environmental Costs

Prepared for
National Bureau of Economic Research, Inc. (NBER)
and Fondazione Eni Enrico Mattei (FEEM)
Conference on the Distributional and Behavioral Effects of Environmental Policy
June 11-12, 1999, Milan, Italy

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Abstract

This paper describes a new, industry-adjusted index of state environmental compliance costs from 1977 to 1994. The index has two principal advantages: It controls for states' industrial compositions, and it can be calculated for 17 years, thus facilitating comparisons both among states and within states over time. Several notable facts emerge. First, differences in states' industrial compositions play a large role in determining their environmental compliance costs. Second, after controlling for industrial composition, the variance across states in compliance costs declined steadily between 1977 and 1994. Third, this cost index is negatively correlated with subjective indices of state environmental efforts compiled by various environmental organizations. In sum, the cost index described here provides some new data on historical trends in state regulatory differences, differs from the conventional wisdom regarding states' relative environmental efforts, and provides a useful tool for researchers exploring the effects of compliance costs on economic activity.

Acknowledgments

This paper has benefitted from funding provided by the National Science Foundation, helpful comments by Wayne Gray, Kevin Hassett, John List, and Domenico Siniscalco, and research assistance by Victor Davis and Joe Hendrickson.

An Industry-Adjusted Index of State Environmental Compliance Costs

I. Introduction.

This paper describes a new industry-adjusted index of state environmental compliance costs that can be used to compare regulations both across states in a given year and within states over time.[1] It compares that index to others used in the environmental economics literature, and uses the index to answer several often-raised questions about the pattern of environmental regulations in the United States and how that pattern has changed over time. Finally, the paper describes an application of the index, as used to assess the effect of environmental regulatory stringency on foreign direct investment to U.S. states.

There are three key motivations for creating this index. First, the EPA has worried publicly that some states are laggards in enforcing federal standards.[2] The index described here documents the variation across states in their environmental compliance costs. Second, since 1980, responsibility for monitoring and enforcement of environmental regulations has been devolving from the federal government to state and local regulators. In theory, this could cause states to become less or more similar in their standard stringency as they are freed to set their own level of stringency and to compete with neighbors to attract industry or clean their environments. This index provides data on the degree of convergence in state standard stringency over time. Third, analysts studying the effects of environmental regulations on local and national economies have been hampered by the difficulty of accurately measuring and comparing the stringency of those regulations (Jaffe *et al.*, 1995). In particular, studies of the effect of regulations on local economies rely almost exclusively on cross-section data,[3] subjective indices of state standards, or on cost-based measures that do not control for industrial composition.

Existing measure of environmental regulatory stringency take two forms. First, there are the environmental groups' rankings of states. These are subjective, and typically only measure perceptions of states' efforts at one point in time, so intertemporal comparisons are not possible. Most analysts have therefore relied on the Census Bureau's Pollution Abatement Costs and Expenditures (PACE) survey data to construct measures of statewide compliance costs per unit of output. These measures, however, fail to control for states' industrial compositions. Consequently, states with a lot of polluting industry have relatively high environmental compliance costs, regardless of their regulations.

To address these concerns, the next section describes the new, industry-adjusted index, and reports findings about relative stringency and how it has changed over time. Section III describes existing, subjective measures of environmental standard stringency, and compares them to the industry-adjusted index. Section IV describes an application of the index to assess the effect of environmental stringency on foreign direct investment to U.S. states.

II. An industry-adjusted index of state environmental compliance costs.

Many researchers have relied on the Census Bureau's Pollution Abatement Costs and Expenditures (PACE) survey to construct indices of state environmental regulatory stringency. The PACE survey collected data from manufacturing establishments about their pollution abatement operating and capital costs from 1977 to 1994, when it was discontinued.[4] Most commonly, studies use these costs divided by some measure of state economic activity, such as total employment or gross state product.[5] The most significant problem with such measures is that they fail to adjust for industrial composition. States that have pollution-intensive industrial compositions will incur high pollution abatement costs, whether or not they have stringent regulations. Ideally, one would use the pollution abatement costs in the relevant industry as an index of regulatory stringency. While abatement costs by state *and* industry are published annually by the Census Bureau, so many of the observations are censored to prevent disclosure of confidential information that the data are not comparable year-to-year or state-to-state.[6] Therefore, this paper proposes an alternative index.

The index compares the *actual* pollution abatement costs in each state, unadjusted for industrial composition, to the *predicted* abatement costs in each state, where the predictions are based solely on nationwide abatement expenditures by industry and each state's industrial composition.[7] Let the actual costs per dollar of output be denoted

$$S_{st} = \frac{P_{st}}{Y_{st}} \tag{1}$$

where P_{st} is pollution abatement costs in state *s* in year *t*, and Y_{st} is the manufacturing sector's contribution to the gross state product (GSP) of state *s* in year *t*. S_{st} is the type of unadjusted measure of compliance costs commonly used. By failing to adjust for the industrial composition of each state, it likely overstates the compliance costs of states with more pollution-intensive industries and understates the costs in states with relatively clean industries.

To adjust for industrial composition, compare **(1)** to the *predicted* pollution abatement costs per dollar of GSP in state *s*:

$$\hat{S}_{st} = \frac{1}{Y_{st}} \sum_{i=20}^{39} \frac{Y_{ist} \; P_{it}}{Y_{it}} \quad , \qquad \textbf{(2)}$$

where industries are indexed from 20 through 39 following the 2-digit manufacturing SIC codes,[8] Y_{ist} is industry *i*'s contribution to the GSP of state *s* at time *t*, Y_{it} is the nationwide contribution of industry *i* to national GDP, and P_{it} is the nationwide pollution abatement operating costs of industry *i*. In other words, $\hat{S}_{st}$ is the weighted average pollution abatement costs (per dollar of GSP), where the weights are the relative shares of each industry in state *s* at time *t*.

To construct the industry-adjusted index of relative state stringency, S_{st}*, I compute the ratio of actual expenditures in **(1)** to the predicted expenditures in **(2)**[9]

$$S_{st}^{*} = \frac{S_{st}}{\hat{S}_{st}} \quad . \qquad \textbf{(3)}$$

When S_{st}* is greater than 1, that indicates that industries in state *s* at time *t* spent more on pollution abatement than those same industries in other states. When S_{st}* is less than 1, industries in state *s* at time *t* spent less on pollution abatement. By implication, states with large values of S_{st}* have relatively more stringent regulations than states with small values of S_{st}*.[10]

Table 1 presents the average values of various environmental indices. The first column contains the average unadjusted index, S_{st}, from 1977 to 1994 (omitting 1987, when the PACE data were not collected). The second column contains the industry-adjusted index, S^*_{st}.[11] Table 2 contains the rankings of these indices. Several striking facts can be seen from comparing the indices. First, the ranking of state regulatory stringency according to the industry-adjusted index (S^*) is often quite different from the ranking according to the unadjusted index (S). For example, New Jersey manufacturers spent a relatively large amount on pollution abatement, causing the state to be ranked 20th in terms of the average unadjusted index in column (1) of Table 2. However, when New Jersey's relatively pollution-intensive industrial composition is accounted for, the state's ranking falls to 34th. In contrast, when Oregon's relatively clean industrial composition is accounted for, that state's ranking improves from 24th to 12th. Similar reordering takes place for other states, supporting the conclusion that using abatement costs without adjusting for industrial composition yields a misleading picture of states' relative regulatory compliance costs.

A second fact that emerges from the industry-adjusted index is that while most state rankings are relatively stable, a few change significantly over time. The appendix tables present the annual figures. From 1977 to 1991, Florida dropped from the 4th most costly state to the 25th most costly. By contrast, during the same time period Illinois rose from the 32nd most costly state to the 23rd.

Third, each of these statements should be tempered by the observation that there is considerable noise in the data, both in the adjusted and unadjusted indices, and especially for the smaller states. For example, it is hard to imagine that Rhode Island leapt from the 42nd most costly state in 1986 to 4th in 1988. Most likely, some of the year-to-year variation in the indices results from sampling error in the PACE survey or from the small size of some states.

Despite the noisiness of the data for small states, some consistent patterns emerge. To study trends in the data, I regressed *S** on year dummies and a time trend, and plotted the residuals. As an example, Figure 1 plots *S** for four large states. Compliance costs in Arizona and Florida declined between 1977 and 1994, relative to the changing compliance costs in other states. Note that because *S** is already normalized on an annual basis, the downward trend in *S** does not mean that Arizona and Florida have become less expensive in absolute terms, only less expensive relative to other states. By contrast, over the same period relative compliance costs rose in Illinois and Massachusetts

Another important fact discernible from this index is that the variation among states in their regulatory stringency is decreasing. It has often been speculated that pressure from federal regulators and national attention is forcing a convergence in state regulatory stringency. This index provides the first simple evidence of that convergence. Figure 2 depicts the coefficient of variation in both time series' from 1977 to 1994. The coefficient of variation of the industry-adjusted index drops from 0.44 in 1977 to 0.29 in 1994. Meanwhile variation in the unadjusted index falls much less, from 0.66 to 0.59. Taken together, these two time series' suggest that while states' industrial compositions have become more dissimilar over time, their regulatory stringency has become more similar.

Appendix Table 2 makes clear that despite the convergence of states' stringency, there remains substantial variation among states, even as late as 1994. Expenditures on pollution abatement in 1994 ranged from 0.5 percent of GSP in Nevada, to 6 percent in Louisiana. While much of this difference is accounted for by differences in the two states' industrial compositions, the industry-adjusted index for the most expensive state (Maine) remains 1.7 times the national average, and 4.13 times as large as for the least expensive state (Nevada).

Before comparing this index to others, it is important to note a few caveats. First, this index is not necessarily a measure of regulatory *stringency* alone. Other state characteristics may well drive up the cost of pollution abatement. For example, if the wages of environmental engineers vary state-to-state, they will affect the relative pollution abatement costs. Furthermore, this index is not intended to be a measure of environmental quality. Many of the nations most polluted regions also have the strictest regulations.

Second, this industry-adjusted index makes no attempt to control for the relative *age* of different states' manufacturers. This is important because many state environmental standards are more strict for new sources of pollution than for existing sources. Consequently, states that have relatively new manufacturing bases also have relatively high compliance costs, even after controlling for their industrial compositions. Conversely, states that have relatively old manufacturers will experience lower compliance costs. There is, therefore, potentially a positive correlation between the amount of new investment and this industry-adjusted index of regulatory compliance costs. However, there is also reason to believe that this bias is small. In another paper (Levinson, 1996), I regressed pollution abatement expenditures at the plant level on plant characteristics, including an indicator for plants built in the last five years. The new plant indicator, though positive, was small and statistically insignificant.

Third, this industry-adjusted index of environmental stringency, S^*, controls for states' industrial compositions at the level of 2-digit SIC codes. While this surely accounts for a lot of the differences among states, there is equally certain to be heterogeneity among states *within* 2-digit classifications. For example SIC 26, pulp and paper, includes both pulp mills, which are among the most pollution-intensive manufacturers, and envelope assemblers, which emit very little pollution. To the extent that some states contain relatively more pulp mills, and others merely assemble envelopes, if the former experience high abatement costs that will likely be due to differing industrial compositions rather than more stringent environmental regulations. In other words, the index *S** retains some of the bias due to industrial compositions -- in particular heterogeneity of industrial compositions *within* any given 2-digit SIC code.

III. Existing indices of state environmental regulatory effort.

Attempts to quantify state environmental regulations have taken numerous forms over the years. Many environmental organizations have compiled indices for this purpose, and these indices form a standard against which the industry-adjusted index can be compared.

Conservation Foundation Index. In 1983 the Conservation foundation attempted to measure each state's "effort to provide a quality environment for its citizens" (Duerkson, 1983). They compiled an index from 23 components including environmental and land-use characteristics such as the League of Conservation Voters' assessment of each state's Congressional delegation's voting record, the existence of state environmental impact statement processes, and the existence of language specifically protecting the environment in state land-use statutes. Conservation Foundation staff assigned weights to each component based on subjective assessments of their importance, and the weighted sum comprises an index ranging from 0 to 63.

Minnesota and California received the best scores, while Missouri and Alabama received the worst.

FREE Index. The Fund for Renewable Energy and the Environment (FREE, 1987) published an index of the strength of state environmental programs. The components of the index include state laws regarding air quality, hazardous waste, and groundwater pollution. Wisconsin and California scored the highest, while West Virginia and Mississippi received the lowest marks.

Green Index. Hall and Kerr (1991) compiled the widely cited "Green Index" of "state environmental health" from 256 measures of public policy and environmental quality. Oregon and Maine lie at the top of the ranking, while Louisiana and Alabama are last.

Southern Studies Index. The Institute for Southern Studies (1994) ranked the states based on 20 environmental measures such as air quality, state spending on the environment, pollution and waste generation, and energy efficiency, and then added up the 20 rankings of each state to get a composite index. Vermont and New Hampshire had the best scores, while Texas and Louisiana had the worst.

League of Conservation Voters (*LCV*). Each year, the LCV assigns each U.S. senator and representative a score, from 1 to 100, based on their voting record on environmental bills chosen by the LCV. Some researchers have used these scores as a measure of the environmental sentiment in each state (Gray, 1997). To compare these scores to the compliance cost index, I averaged each state's House and Senate delegation's environmental voting records. Each record is the average voting record for each member of the state's delegation. Thus, for states with more

House members than Senate members, the Senate votes are weighted more heavily (and vice versa).[12]

Table 1 reports the values of each environmental index for each state. Table 2 presents each index's ranking of states. The rankings of the subjective indices conform loosely to anecdotal evidence and to reports in the popular press. Alabama, Mississippi, and Louisiana consistently receive the lowest grades from environmental organizations, while Massachusetts, Wisconsin, Minnesota and California receive the highest grades. I suspect that few policy analysts, environmental regulators, or industry representatives would be surprised by these rankings, and I therefore refer to these indices as the "conventional wisdom" regarding states' relative environmental efforts.

In the last column of Table 1, I present an index calculated from the confidential plant-level Census of Manufactures, as described in Levinson (1996). Using the raw, establishment-level 1988 PACE data, I regressed the log of gross pollution abatement operating costs on the log of the book value of capital, the log of the number of production workers, the log of value added, a dummy for new plants, dummies for 4-digit SIC codes, and individual state dummies, all from the 1987 Census of Manufactures.[13] The state dummy coefficients are reported in column (8) of Table 1. A high point estimate for a state dummy coefficient indicates that, all else equal, plants in that state spend more on pollution abatement operating costs than otherwise similar plants in the omitted state, New York.

Oddly, this plant-level index is not highly correlated with the more aggregate industry-adjusted index. The correlation between the plant-level index and the industry-adjusted index in 1988 is only 0.19. There are several possible explanations. The plant-level index is from a regression of 1988 PACE data on 1987 Census of Manufactures data for the same firms. (The PACE were not collected in 1987.) This mismatch may account for some of the discrepancy. Also, the plant-level index controls for plant vintage with a new-plant indicator, to account for the age bias discussed above, though its coefficient is small and statistically insignificant.

Table 3 presents correlations among the two cost indices and the 5 conventional indices. Though they were compiled at different times with widely different sets of components, the five conventional indices are highly positively correlated. Except for the League of Conservation Voters index, the conventional indices are all fairly *ad hoc*. Each is based on a list of component measures, with no objective guide as to what criteria are included or excluded from the index. Furthermore, each index either adds up the unweighted ranks of the separate components, or weights the separate scores according to the subjective judgement of the index's authors. Nevertheless, there is remarkable consistency across the indices.

On the other hand, the two cost-based indices are negatively correlated with the conventional indices. While the adjusted and unadjusted indices are correlated with each other, they are both negatively correlated with each of the conventional indices. While the conventional indices may measure something systematic about states, it is not correlated with industrial pollution abatement expenditures.

There are several reasons for the negative correlation between the compliance-cost-based measures and the environmental organizations' indices. The environmental organizations' indices often include the quality of the environment in each state as part of their measure. The *Green* and *Southern Studies* indices include measures of ambient air and water quality, and pollution emitted. In many cases, environmental quality is *inversely* associated with compliance costs, as plants in the dirtiest states are required to spend more effort cleaning up. Los Angeles, for example, has both the most polluted air and the toughest emissions standards in the U.S. (Berman and Bui, 1997).

Another explanation has to do with the fact that the *LCV* index, which is itself included in the *Conservation Foundation* index, ranks states according to their congressional delegations' voting records on *national* legislation, rather than state legislation. Furthermore, U.S. senators and representatives appear to vote for more strict regulations when they are imposed on *other* states (Pashigian, 1985). Finally, many of the indices contain elements unrelated to manufacturers' pollution abatement costs: items such as curbside recycling programs, spending on public parks, and automobile inspection programs. While these state characteristics may indicate something about the overall environmental sentiment in a given state, they are not necessarily related to the compliance costs faced by manufacturers.

In general, the two groups of indices measure different concepts. The compliance cost index measures how much it costs to locate a manufacturing facility in any one state, relative to others, in terms of pollution abatement costs. The subjective indices combine many different measures, including the quality of the environment, national delegations' voting records, and environmental effort unrelated to the manufacturing industry.

IV. An application: The effect of regulations on foreign direct investment.

As an example of the type of work that this index facilitates, in Table 4 I present regressions of foreign direct investment (FDI) on characteristics of U.S. states, including their industry-adjusted indices of environmental regulatory stringency, S^*.[14] Several studies have examined the effects of environmental regulations on FDI. However, all of the existing studies have either used a cross-section of data, some unadjusted measure of regulatory stringency, (like *S* in equation **(1)**), or both (Co and List, 1998; Friedman *et al.*, 1992). Table 4 examines property, plant, and equipment investment by foreign-owned manufacturers, from the Bureau of Economic Analysis (BEA), as a measure of foreign direct investment (FDI). It presents regressions of FDI on state characteristics using a time series of data and the industry-adjusted index of environmental regulatory stringency.

The first column of Table 4 presents means and standard deviations of the regressors. As a benchmark to compare to the previous literature, columns (2) and (3) contain pooled, OLS regressions of FDI in the manufacturing sector and the chemical industry, respectively, on the industry-adjusted index of environmental stringency and other covariates. Controlling for other state characteristics, FDI appears to be positively correlated with stringency. In column (3) I examine FDI for the chemical industry (SIC 28). This is one of the only relatively pollution-intensive, 2-digit SIC codes for which this measure of FDI is reported consistently by the BEA. Here, the coefficient on S^* remains positive, though it is smaller and statistically insignificant. These results, however, are based largely on the cross-section comparison of states. (Most of the variation in S^* is across states rather than within states over time.) These cross-section results are likely biased if states have unobserved characteristics correlated with both FDI and regulatory stringency. To control for those characteristics, and to exploit the panel of data, consider a dynamic model.

Suppose that a reduced form relationship for FDI can be characterized by the following equation:[15]

$$FDI_{st} \ = \ \delta FDI_{s,t-1} \ + \ \gamma S*_{st} \ + \ X_{st}^{/}\beta \ + \ u_{st} \qquad \textbf{(4)}$$

where X_{st} is a vector of characteristics of state *s* at time *t*, and u_{st} is an error term composed of two parts, $u_{st}=\mu_s+v_{st}$. Equation **(4)** states that *FDI* is a function of current state characteristics and lagged values of *FDI*. Both FDI_{st} and $FDI_{s,t-1}$ are functions of μ_s, and therefore OLS estimates of **(4)** will be biased because $FDI_{s,t-1}$, a regressor, is correlated with the error term.

Arellano and Bond (1991) suggest a GMM estimate of **(4)** that uses lagged values of $FDI_{s,t-1}$ as instruments, and first differences to eliminate the fixed state effects μ_s. First, take first differences of **(4)**:

$$\Delta FDI_{st} \ = \ \delta\Delta FDI_{s,t-1} \ + \ \gamma\Delta S*_{st} \ + \ \Delta X_{st}^{/}\beta \ + \ \Delta\nu_{st} \qquad \textbf{(5)}$$

where Δ symbolizes first differences. Since $FDI_{s,t-2}$ is correlated with $\Delta FDI_{s,t-1}$, but not correlated with ΔFDI_{st}, it is a valid instrument. In fact, all past values $FDI_{s,t-3}$, $FDI_{s,t-4}$, and so on are valid instruments for $\Delta FDI_{s,t-1}$.

Columns (4) and (5) of Table 4 present GMM estimates of **(5)** using Doornik *et al.* (1999).[16] When equation **(5)** is estimated using all manufacturing FDI, in column (4), the large spurious positive coefficient on *S** disappears. Instead, the coefficient (2.4) is tiny and statistically insignificant, though still positive. Turning to the chemical industry, in column (5), the coefficient (−338) is negative and statistically significant. This suggests that the positive coefficients found in the cross-section evidence in this study and others are spurious, and are based on unobserved characteristics correlated with both environmental regulations and economic activity.

To interpret the size of these coefficients consider the following. The fixed-effects coefficient in column (5) suggest that a one-unit increase in the stringency index is associated with a decline in chemical industry FDI of $338 million. The standard deviation of this index within states over time ranges from 0.04 for Wisconsin to 0.56 for Colorado, and averages 0.18. So the coefficient suggests that a one standard deviation increase in the index, for the average state, is associated with a decline of FDI investment by foreign-owned chemical manufacturers of $61 million. This amounts to about 6 percent of the annual average chemical industry FDI investment of $1017 million per state.

The industry-adjusted index plays two important roles in the regressions in Table 4. First, because the index spans 18 years, it is possible to use changes in the variables year-to-year to control for unobserved fixed state characteristics that may be correlated with both stringency and FDI. The stringency coefficients in these first-differenced specifications are negative, while those in the pooled specification are positive, suggesting that these unobserved state characteristics are extremely important. Second, by adjusting for industrial composition, the index avoids merely measuring concentrations of polluting industries, and instead assesses average abatement costs holding industrial composition constant.

While these results are meant only as an example, they do suggest that an index like the one described has considerable advantages over empirical approaches taken thus far.

V. Conclusion.

The research described here creates an industry-adjusted index of state environmental compliance costs from 1977 to 1994. The index supports several conclusions. First, industry composition plays an important role in determining spending on environmental compliance costs for different states. Rank orderings of states by pollution abatement spending look very different once their industrial compositions have been controlled for. Second, differences among states are exaggerated by differences in their industrial compositions. The coefficient of variation of the unadjusted index is 0.65, while the coefficient of variation of the industry-adjusted index is 0.37. Third, once industrial composition has been accounted for, states appear to be converging in their environmental standard stringency. Fourth, when compared to conventional indices of state environmental regulations, these cost-based indices have opposite implications for the relative stringency of states. The two types of indices are negatively correlated across states. Finally, when used in an analysis of the effect of regulatory stringency on economic activity (FDI in this case), time-series analyses using the industry-adjusted index have more sensible results than cross-sectional analyses, or than analyses using the unadjusted index. Together, these results imply that using conventional indices or unadjusted cost indices to analyze state environmental policies can lead to misleading conclusions about the effects of those policies on economic activity.

Endnotes

1. Interested readers can find a Stata© file containing the index at www.ssc.wisc.edu/~alevinso/index.dta.

2. See, for example, the New York Times, 12/15/96 and 1/30/97.

3. Because most studies examine differences among jurisdictions at one time, they cannot distinguish between the simultaneous effects of regulations on economic growth and that of economic growth on regulations. Notable exceptions include Gray (1997), Greenstone (1998), and Becker and Henderson (1997).

4. Recently, it appears that the EPA and the Census Bureau have agreed on plans to renew collecting the PACE data. Unfortunately, there will have been a minimum of five years during which the data were not collected. The PACE data collected from 1973 to 1976 are incompatible with later surveys in their treatment of small plants. Also, the PACE data were not collected in 1987.

5. See, for example, Crandall (1993), Friedman *et al.* (1992), or Co and List (1998). Consulting firms specializing in industrial siting decisions have also relied on such simple indices of environmental regulatory stringency (Alexander Grant & Co., 1985).

6. Several papers have used the confidential plant-level PACE data to construct such indices (Levinson, 1996; Gray, 1997). However, those data are unavailable to most researchers, and the purpose here is to construct an easily accessible resource for analysts. Below, I do compare the index created from the confidential data to that compiled from the published data.

7. For two reasons, I use pollution abatement *operating expenses* (as opposed to *capital expenses*) in the index. First, operating expenses for pollution abatement equipment are easier for PACE survey respondents to identify separately. Abatement capital expenses may be difficult to disentangle from investments in production process changes that have little to do with pollution abatement. Second, abatement capital expenditures are highest when new investment takes place. So states that have thriving economies and are generating manufacturing investment tend to have high levels of abatement capital expenses, regardless of the stringency of those states' environmental laws. Operating costs are more consistent year-to-year.

8. SIC code 23 (apparel) is omitted because it is relatively pollution-free, and as a result no data for that industry are collected by the PACE survey.

9. Note that the state's GSP is in both the numerator and the denominator of **(3)**. Equation **(3)** can thus be expressed as $S_{st}{*}=P_{st}/\hat{P}_{st}$, where $\hat{P}_{st}$ is the summation term in **(2)**.

10. I have also calculated the index described by equations **(1)**, **(2)** and **(3)** using the number of production workers in each 2-digit SIC code to control for industrial composition, instead of

using each industry's share of GSP. The broad conclusions are similar, though the rankings of some states do change. Also, annual employment totals by state and industry are more often censored to prevent disclosure of confidential information.

11. Appendix Table 1 presents annual values of the industry-adjusted index (*S**) and its ranking of states. Appendix Table 2 presents annual values of the unadjusted index (*S*) and its rankings.

12. See http:\www.lcv.org. For the Senate votes, the years 1977-78, 1979-80, 1983-4, 1985-86, and 1987-88 each had only one scorecard. Therefore, the voting records for these pairs of years were entered separately for each year. For the House votes, the years 1987-88 had only one scorecard. Here also the same value was entered for both years. The LCV has a House scorecard for 1985 and for 1985-86. The information from the 1985 scorecard was used to disaggregate the 1985-86 scorecard by a weighted average.

13. Implicit in this specification is a Cobb-Douglas production function in which output (Y) is estimated as a function of capital (K), labor (L), and pollution (P), with dummy variables for new plants, industries, and states: $Y = A \cdot K^{\beta_1} \cdot L^{\beta_2} \cdot P^{\beta_3}$. This estimation substitutes pollution abatement, which is observable, for pollution, takes the logarithm of both sides, and inverts the function to estimate abatement as a function of the other variables.

14. This work is taken from Keller and Levinson (1999), where more details are provided.

15. This discussion is based on Baltagi (1995) and Arellano and Bond (1991).

16. Doornik, Bond, and Arellano's GMM estimation is written for the computer package Ox, and may be downloaded from http://www.nuff.ox.ac.uk/Users/Doornik/. See Doornik (1998) and Doornik *et al.* (1999).

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Table 1. Indices of state environmental effort.

	Un-adjusted Cost (S_s) Avg. 1977-94[a] (1)	Adjusted Cost (S_s*) Avg. 1977-94[a] (2)	Conser-vation Foundati on (3)	FREE Index (4)	Green Index (5)	Southern Studies (6)	LCV Avg. 1977-4[a] (7)	Levinson (1996) (8)
AL	0.0219	1.19	10	16	8658	681	24.4	−0.035
AZ	0.0148	1.39	24	27	7342	567	29.2	−0.232
AR	0.0168	1.17	27	18	8353	579	43.7	−0.072
CA	0.0121	0.90	46	48	4931	423	57.4	−0.149
CO	0.0113	1.01	26	24	6110	377	48.0	−0.384
CT	0.0079	0.67	32	44	5483	442	74.0	−0.001
DE	0.0344	1.30	29	24	6821	518	67.8	−0.273
FL	0.0138	1.21	31	41	6320	461	50.3	0.022
GA	0.0127	0.91	25	26	7488	544	43.3	−0.194
ID	0.0181	1.66	16	18	6513	425	17.2	−0.004
IL	0.0132	0.91	28	41	7052	563	60.3	0.055
IN	0.0196	1.14	36	36	7939	687	45.9	0.013
IA	0.0106	0.96	29	39	6541	491	54.5	−0.034
KS	0.0115	0.76	23	29	7732	625	35.5	−0.330
KY	0.0146	0.99	34	28	7694	594	32.3	0.065
LA	0.0538	1.51	21	21	8383	708	25.7	−0.102
ME	0.0237	1.55	32	36	4892	331	77.1	−0.041
MD	0.0185	1.17	37	34	5585	413	70.6	0.148
MA	0.0067	0.67	44	41	5076	389	86.6	−0.109
MI	0.0121	1.01	30	43	6297	541	67.9	0.084
MN	0.0092	0.66	47	38	5000	381	64.9	−0.209
MS	0.0213	1.47	15	14	8299	612	20.1	−0.255
MO	0.0104	0.79	14	31	7006	530	42.6	−0.195
MT	0.0341	1.49	37	23	6546	559	49.9	0.110

(continued)

Table 1 (continued)

	Un-adjusted Cost (S_s) Avg. 1977-94[a] (1)	Adjusted Cost (S_s*) Avg. 1977-94[a] (2)	Conser-vation Foundation (3)	FREE Index (4)	Green Index (5)	Southern Studies (6)	LCV Avg. 1977-4[a] (7)	Levinson (1996) (8)
NE	0.0088	0.83	22	31	7001	520	40.9	−0.196
NV	0.0072	0.63	22	23	6670	434	38.1	−0.239
NH	0.0072	0.75	21	32	5803	310	58.6	−0.276
NJ	0.0158	0.82	45	47	5790	464	78.6	0.117
NM	0.0306	1.64	18	23	6998	533	30.0	−0.500
NY	0.0087	0.77	37	43	5419	424	64.4	0.000
NC	0.0088	0.82	25	42	6772	578	34.2	−0.144
ND	0.0105	0.77	22	16	6833	458	43.8	−0.566
OH	0.0139	0.82	30	36	7411	586	61.5	0.056
OK	0.0103	0.58	19	29	7644	588	27.5	−0.396
OR	0.0139	1.22	42	35	4583	395	53.9	0.122
PA	0.0169	0.91	28	32	6905	511	55.1	0.022
RI	0.0075	0.72	26	30	5105	397	79.8	−0.247
SC	0.0160	0.99	25	31	7407	611	41.4	−0.184
SD	0.0056	0.68	30	23	6965	396	51.1	−0.020
TN	0.0165	1.10	23	29	8151	698	43.2	−0.078
TX	0.0311	1.39	22	26	8197	703	28.3	−0.151
UT	0.0164	0.93	23	16	7122	556	17.5	−0.494
VT	0.0065	0.66	32	28	4921	282	83.8	−0.111
VA	0.0118	0.96	28	33	7055	521	33.8	−0.097
WA	0.0196	1.37	39	29	5473	430	56.3	−0.182
WV	0.0433	1.58	23	15	8117	652	54.4	−0.115
WI	0.0110	0.89	37	49	5478	379	69.8	−0.186
WY	0.0259	0.72	23	16	7445	601	16.8	−0.412

[a]Averages omit 1987, when the PACE survey was not collected.

Table 2. Rankings of state environmental effort.

	Un-adjusted Cost (S_s) Avg. 1977-94[a] (1)	Adjusted Cost (S_s*) Avg. 1977-94[a] (2)	Conser-vation Foundation (3)	FREE Index (4)	Green Index (5)	Southern Studies (6)	LCV Avg. 1977-4[a] (7)	Levinson (1996) (8)
AL	9	14	48	44.5	48	44	44	19
AZ	21	9	31	31	33	33	40	38
AR	16	15	25	41.5	46	35	28	21
CA	29	29	2	2	4	12	16	29
CO	32	20	26.5	34.5	15	4	25	44
CT	42	44	14	4	11	17	6	15
DE	3	11	20.5	34.5	23	23	10	2
FL	25	13	16	9	17	19	23	11.5
GA	27	28	29	32.5	37	29	29	34
ID	14	1	45	41.5	18	14	47	16
IL	26	26	23	9	30	32	14	10
IN	12	17	11	14	41	45	26	13
IA	34	24	20.5	11	19	21	19	18
KS	31	38	34	26.5	40	42	35	43
KY	22	22	12	29.5	39	38	38	8
LA	1	5	41.5	40	47	48	43	24
ME	8	4	14	14	2	3	5	20
MD	13	16	8.5	17	12	11	7	3
MA	46	43	4	9	6	7	1	25
MI	28	19	18	5.5	16	28	9	7
MN	38	46	1	12	5	6	11	37
MS	10	7	46	48	45	41	45	41
MO	36	35	47	22	29	26	31	35
MT	4	6	8.5	37.5	20	31	24	6

(continued)

Table 2 (continued)

	Un-adjusted Cost (S_s) Avg. 1977-94[a] (1)	Adjusted Cost (S_s*) Avg. 1977-94[a] (2)	Conser-vation Foundation (3)	FREE Index (4)	Green Index (5)	Southern Studies (6)	LCV Avg. 1977-4[a] (7)	Levinson (1996) (8)
NE	40	31	38.5	22	28	24	33	36
NV	44	47	38.5	37.5	21	16	34	39
NH	45	39	41.5	19.5	14	2	15	42
NJ	20	34	3	3	13	20	4	5
NM	6	2	44	37.5	27	27	39	47
NY	41	36	8.5	5.5	8	13	12	14
NC	39	33	29	7	22	34	36	28
ND	35	37	38.5	44.5	24	18	27	48
OH	23	32	18	14	35	36	13	9
OK	37	48	43	26.5	38	37	42	45
OR	24	12	5	16	1	8	21	4
PA	15	27	23	19.5	25	22	18	11.5
RI	43	41	26.5	24	7	10	3	40
SC	19	21	29	22	34	40	32	32
SD	48	42	18	37.5	26	9	22	17
TN	17	18	34	26.5	43	46	30	22
TX	5	8	38.5	32.5	44	47	41	30
UT	18	25	34	44.5	32	30	46	46
VT	47	45	14	29.5	3	1	2	26
VA	30	23	23	18	31	25	37	23
WA	11	10	6	26	9	15	17	31
WV	2	3	34	47	42	43	20	27
WI	33	30	8.5	1	10	5	8	33
WY	7	40	34	44.5	36	39	48	1

Equal observations receive the average rank.
[a]Averages omit 1987, when the PACE survey was not collected.

Table 3. Correlations among indices of state environmental effort.

	Unadjusted Avg. Cost (S_s) (1)	Adjusted Avg. Cost (S_s*) (2)	Conservation Foundation (3)	FREE Index (4)	Green Index (5)	Southern Studies (6)	League of Conservation Voters (7)
Unadjusted Cost Index	1.00	0.75	−0.20	−0.45	−0.43	−0.53	−0.29
Adjusted Cost Index		1.00	−0.19	−0.37	−0.27	−0.31	−0.29
Conservation Foundation			1.00	0.65	0.67	0.46	0.67
FREE Index				1.00	0.58	0.35	0.63
Green Index					1.00	0.89	0.72
Southern Studies						1.00	0.62
League of Conservation							1.00

Table 4
An Application:
Foreign Direct Investment to U.S. States
As a Function of Abatement Costs
1977 − 1994

	Mean (std. dev.) (1)	Pooled OLS Manufacturing (2)	Pooled OLS Chemicals[a] (3)	Dynamic Panel Data Model (GMM -- First Differences) Manufacturing (4)	Dynamic Panel Data Model (GMM -- First Differences) Chemicals[a] (5)
Industry-adjusted index of abatement costs: *S**		500* (237)	267 (186)	2.4 (92.6)	−338* (100)
Lagged FDI				0.90* (0.02)	0.89* (0.03)
Market proximity	6631 (8220)	0.207* (0.019)	0.098* (0.015)	0.104* (0.018)	0.041* (0.014)
Population (1000s)	4940 (5134)	0.175* (0.033)	−0.016 (0.023)	−0.043 (0.051)	−0.003 (0.054)
Unemployment rate	6.61 (2.09)	122* (43)	86.0* (29.1)	−67.5* (15.7)	−56.6* (14.0)
Unionization rate	16.6 (6.7)	−108* (20)	−84.6* (13.9)	32.7 (21.4)	59.8* (20.0)
Wages	9.10 (2.24)	179* (87)	32.9 (66.7)	−135.7 (76.7)	5.8 (60.1)
Road mileage (1000s)	80.5 (48.4)	12.3* (2.6)	10.8* (1.8)	−0.37 (6.25)	−4.20 (5.48)
Land prices (per acre)	887 (775)	0.52* (0.12)	0.62* (0.10)	0.21* (0.10)	0.26* (0.08)
Energy prices	5.51 (1.70)	−288* (56)	−144* (41)	54.6* (27.7)	58.1* (24.4)
Tax effort	96.1* (16.1)	−31.0* (5.9)	−11.4* (4.1)	18.4* (4.9)	16.6* (4.6)
Year		166* (41)	32.4 (33.4)		
Constant		−11602* (3072)	−1525 (2516)	60.4 (25.9)	12.2 (21.5)
No. observations	816	811	563	761	496
No. censored		5	109	7	272
R^2		0.70	0.47	0.10	0.15

Source: Keller and Levinson (1999). The dependent variable is property, plant and equipment investment by foreign-owned manufacturers, from the BEA.

Standard errors in parentheses.

1987 is dropped because no PACE data were collected that year.

* Statistically significant at 5 percent.

[a] The chemical industry investment data are only available 1977-1991.

Data Appendix

Pollution Abatement Costs and Expenditures (PACE) Data

PACE data come from U.S. Department of Commerce, Bureau of the Census. The data are published in Current Industrial Reports: Pollution Abatement Costs and Expenditures, MA-200, various years. The variable of interest from this source was the Pollution Abatement Gross Annual Cost (GAC) total across all media types. Starting in 1977, Census collected data only for establishments with 20 or more employees. Although PACE data were collected from all establishments for the years 1973-1979, in order to lessen the administrative burden on small businesses, they were dropped from the survey, starting in 1980. The PACE Survey was not collected in 1987. There are some censored observations for the state totals, and in those cases values were interpolated.

Gross State Product data:

All gross state product data were acquired via the Regional Economic Information System CD, 1969-1994 published by the US Department of Commerce, Bureau of Economic Analysis, Regional Economic Measurement Division.

League of Conservation Voters Index

This index is the unweighted average of the House and Senate environmental voting records. Each record is the average voting record for each member of the state's delegation. Thus, for states with more House members than Senate members, the Senate votes are weighted more heavily (and vice versa). The bills that are used to construct the index have been chosen by the LCV. See http://www.lcv.org. For the Senate votes, the years 1977-78, 1979-80, 1983-4, 1985-86, and 1987-88 each had only one scorecard. Therefore, the voting records for these years were entered separately for each year. For the House votes, the years 1987-88 had only one scorecard. Here also the same value was entered for both years. Also, the House had a scorecard for 1985 and for 1985-86. The information from the 1985 scorecard was used to disaggregate the 1985-86 scorecard by a weighted average.

Property, Plant and Equipment Investment by Foreign-Owned Manufacturers

Bureau of Economic Analysis (BEA), Department of Commerce. *Foreign Direct Investment in the U.S.*

Appendix Table 1: Industry-Adjusted Index of State Environmental Compliance Costs

State	1977	1978	1979	1980	1981	1982	1983	1984	1985
Alabama	1.36	1.26	1.28	1.19	1.26	1.30	1.94	1.12	1.08
Arizona	2.59	2.43	1.70	1.33	1.47	1.12	0.89	1.72	1.64
Arkansas	1.14	1.17	1.19	1.24	1.13	1.16	1.08	1.21	1.30
California	0.93	0.96	0.83	0.83	0.75	0.67	0.79	0.82	0.90
Colorado	1.06	0.96	0.77	0.83	0.88	0.61	0.64	0.58	0.72
Connecticut	0.49	0.55	0.60	0.60	0.59	0.51	0.58	0.63	0.63
Delaware	1.16	1.47	1.56	1.53	1.61	1.35	1.20	1.17	1.33
Florida	1.70	1.55	1.35	1.24	1.15	1.35	1.19	1.17	1.22
Georgia	0.92	0.83	0.77	0.80	0.81	0.87	0.89	0.90	0.86
Idaho	1.59	1.64	1.92	1.93	1.98	2.29	2.11	2.02	1.63
Illinois	0.82	0.76	0.86	0.83	0.83	0.85	0.93	0.96	0.97
Indiana	1.15	1.14	1.15	1.28	1.30	1.44	1.28	1.18	1.16
Iowa	1.00	1.02	1.00	1.01	1.05	0.94	0.93	1.18	1.04
Kansas	0.68	0.64	1.30	0.72	0.68	0.69	0.62	0.84	0.65
Kentucky	0.88	1.05	0.98	0.98	0.99	0.87	1.06	1.10	0.95
Louisiana	1.26	1.27	1.52	1.34	1.62	1.59	1.79	1.92	1.97
Maine	1.28	1.43	1.39	1.44	1.54	1.68	1.68	1.66	1.46
Maryland	1.08	1.23	1.25	1.24	1.10	1.06	1.11	1.17	1.25
Massachusetts	0.59	0.58	0.61	0.54	0.58	0.48	0.77	0.67	0.63
Michigan	0.98	0.96	1.02	1.11	1.12	1.05	1.00	1.11	1.04
Minnesota	0.58	0.61	0.66	0.69	0.61	0.65	0.70	0.64	0.59
Mississippi	1.72	1.85	1.54	1.56	1.18	1.35	1.52	1.64	1.52
Missouri	0.73	0.82	0.71	0.78	0.77	0.71	0.79	0.74	0.77
Montana	1.19	1.23	1.36	1.35	1.53	1.85	1.69	1.69	1.85
Nebraska	0.76	0.80	0.75	0.77	0.82	0.65	0.81	1.16	1.13
Nevada	0.42	0.59	0.58	0.61	0.57	0.62	0.61	0.86	0.69
New Hampshire	1.05	0.90	0.73	0.64	0.60	0.64	0.61	0.55	0.60
New Jersey	0.95	0.80	0.93	0.99	0.79	0.81	0.84	0.77	0.72
New Mexico	2.46	2.49	2.12	2.11	1.70	1.15	1.27	1.15	1.32
New York	0.71	0.71	0.79	0.78	0.80	0.83	0.73	0.65	0.66
North Carolina	0.95	0.80	0.81	0.81	0.78	0.93	0.84	0.86	0.81
North Dakota	0.77	0.69	0.53	0.47	0.40	0.36	0.48	0.79	0.84
Ohio	0.79	0.82	0.82	0.78	0.80	0.79	0.71	0.72	0.74
Oklahoma	0.77	0.68	0.63	0.69	0.48	0.65	0.78	0.51	0.43
Oregon	1.33	1.33	1.32	1.16	1.15	1.39	1.45	1.19	1.09
Pennsylvania	0.93	0.95	0.87	0.92	0.98	1.02	0.93	0.75	0.97
Rhode Island	0.47	0.48	0.37	0.35	0.39	0.36	0.43	0.52	0.66
South Carolina	1.12	1.05	1.07	0.78	0.83	0.91	0.83	0.92	0.97
South Dakota	0.39	0.60	0.58	0.65	0.64	0.79	0.56	0.68	0.64
Tennessee	1.14	1.03	1.05	1.02	1.00	0.97	1.05	1.30	1.31
Texas	1.29	1.34	1.29	1.42	1.40	1.51	1.37	1.59	1.53
Utah	0.80	0.98	0.93	1.04	0.96	0.89	0.82	0.77	0.75
Vermont	0.65	0.61	0.57	0.54	0.57	0.66	0.67	0.66	1.11
Virginia	0.99	0.99	0.93	0.90	0.93	0.95	1.05	1.08	1.04
Washington	1.54	1.41	1.37	1.28	1.47	1.42	1.71	1.54	1.65
West Virginia	1.65	1.87	1.94	1.83	2.04	1.82	1.25	1.09	1.02
Wisconsin	0.88	0.86	0.81	0.84	0.83	0.88	0.93	0.92	0.92
Wyoming	0.38	0.38	0.37	0.36	0.35	0.23	0.34	0.29	1.10

(continued)

Appendix Table 1 (continued)

State	1986	1988	1989	1990	1991	1992	1993	1994
Alabama	1.01	0.90	1.01	1.04	1.18	1.07	1.13	1.12
Arizona	1.29	1.46	1.06	1.11	1.02	1.02	0.87	0.86
Arkansas	1.21	1.13	1.26	1.05	1.07	1.22	1.21	1.20
California	1.03	1.00	1.01	1.11	1.00	0.90	0.86	0.96
Colorado	0.91	0.72	1.87	2.42	2.07	0.64	0.60	0.82
Connecticut	0.62	0.76	0.92	0.92	0.80	0.67	0.68	0.80
Delaware	1.35	1.58	1.44	1.00	1.10	1.05	1.08	1.12
Florida	1.19	1.18	1.19	1.04	0.92	1.00	0.97	1.10
Georgia	0.84	0.88	1.18	1.05	1.05	0.85	0.93	0.96
Idaho	1.92	1.43	1.16	1.25	0.94	1.44	1.41	1.54
Illinois	0.96	0.95	0.96	1.02	0.95	1.02	0.97	0.89
Indiana	1.08	1.13	1.04	0.97	1.02	1.01	1.02	0.99
Iowa	0.91	0.88	0.91	0.77	0.78	0.91	0.89	1.05
Kansas	0.75	0.62	0.85	0.90	0.79	0.67	0.81	0.77
Kentucky	0.92	0.93	1.05	1.02	1.07	0.97	0.99	1.01
Louisiana	1.75	1.32	1.21	1.17	1.18	1.56	1.56	1.57
Maine	1.48	1.34	1.61	1.45	1.79	1.71	1.64	1.69
Maryland	1.25	1.32	1.10	1.04	1.19	1.17	1.25	1.03
Massachusetts	0.65	0.75	0.83	0.76	0.75	0.75	0.75	0.78
Michigan	0.94	1.07	0.99	0.99	0.96	0.97	0.95	0.88
Minnesota	0.58	0.60	0.67	0.63	0.71	0.68	0.84	0.84
Mississippi	1.42	1.29	1.16	1.32	1.37	1.62	1.60	1.39
Missouri	0.87	0.80	0.94	0.95	0.71	0.73	0.84	0.71
Montana	1.58	1.93	1.88	1.67	1.56	0.76	0.63	1.65
Nebraska	0.94	0.97	0.63	0.64	0.65	0.95	0.84	0.85
Nevada	0.68	0.93	0.63	0.48	0.60	0.72	0.60	0.45
New Hampshire	0.73	0.70	0.90	0.87	0.81	0.69	0.78	0.97
New Jersey	0.73	0.82	0.86	0.86	0.87	0.85	0.69	0.61
New Mexico	0.97	2.49	1.67	1.77	1.09	1.50	1.64	1.05
New York	0.80	0.84	0.84	0.80	0.85	0.82	0.84	0.71
North Carolina	0.77	0.76	0.78	0.77	0.73	0.88	0.81	0.81
North Dakota	0.88	1.09	0.51	0.68	0.74	1.74	1.55	0.64
Ohio	0.81	0.94	0.91	0.89	0.86	0.84	0.82	0.95
Oklahoma	0.54	0.59	0.49	0.49	0.44	0.55	0.57	0.60
Oregon	1.12	1.38	0.96	1.07	1.25	1.14	1.14	1.21
Pennsylvania	0.96	0.96	0.98	0.97	0.80	0.81	0.78	0.86
Rhode Island	0.69	1.59	1.40	1.20	0.73	0.68	0.62	1.24
South Carolina	0.97	1.02	1.15	1.16	1.08	0.99	1.08	0.98
South Dakota	0.60	0.87	0.45	0.51	0.66	1.18	0.84	0.94
Tennessee	1.28	1.19	1.01	1.10	1.05	1.06	1.08	1.11
Texas	1.44	1.17	1.11	1.12	1.38	1.53	1.69	1.52
Utah	0.96	0.76	1.08	1.05	0.84	1.18	1.16	0.88
Vermont	0.98	0.81	0.50	0.60	0.51	0.63	0.56	0.68
Virginia	0.97	1.03	0.88	0.82	0.78	0.98	1.01	0.96
Washington	1.18	1.21	1.10	1.08	1.41	1.32	1.31	1.34
West Virginia	1.20	1.03	1.31	1.40	2.32	1.89	1.78	1.38
Wisconsin	0.91	0.90	0.93	0.88	0.85	0.89	0.93	0.94
Wyoming	1.25	1.72	0.75	0.92	0.77	1.37	1.00	0.69

Appendix Table 2: Non-Adjusted Index of State Environmental Compliance Costs

State	1977	1978	1979	1980	1981	1982	1983	1984	1985
Alabama	0.0211	0.0205	0.0219	0.0215	0.0225	0.0208	0.0333	0.0193	0.0208
Arizona	0.0237	0.0222	0.0177	0.0145	0.0166	0.0113	0.0101	0.0160	0.0177
Arkansas	0.0125	0.0135	0.0150	0.0168	0.0153	0.0145	0.0148	0.0163	0.0177
California	0.0104	0.0106	0.0098	0.0107	0.0101	0.0090	0.0106	0.0112	0.0123
Colorado	0.0100	0.0092	0.0079	0.0088	0.0093	0.0056	0.0067	0.0063	0.0081
Connecticut	0.0041	0.0050	0.0060	0.0064	0.0063	0.0051	0.0069	0.0065	0.0069
Delaware	0.0252	0.0344	0.0386	0.0418	0.0420	0.0362	0.0319	0.0316	0.0377
Florida	0.0164	0.0157	0.0145	0.0137	0.0126	0.0131	0.0132	0.0129	0.0138
Georgia	0.0099	0.0101	0.0099	0.0110	0.0109	0.0104	0.0113	0.0120	0.0121
Idaho	0.0152	0.0153	0.0196	0.0222	0.0232	0.0218	0.0201	0.0209	0.0180
Illinois	0.0099	0.0095	0.0115	0.0116	0.0109	0.0109	0.0132	0.0129	0.0136
Indiana	0.0144	0.0155	0.0173	0.0211	0.0216	0.0225	0.0225	0.0200	0.0212
Iowa	0.0083	0.0091	0.0095	0.0098	0.0100	0.0087	0.0102	0.0123	0.0121
Kansas	0.0086	0.0088	0.0179	0.0110	0.0102	0.0089	0.0105	0.0107	0.0102
Kentucky	0.0092	0.0109	0.0114	0.0125	0.0127	0.0110	0.0152	0.0164	0.0142
Louisiana	0.0408	0.0424	0.0465	0.0471	0.0576	0.0568	0.0616	0.0677	0.0682
Maine	0.0163	0.0199	0.0197	0.0207	0.0217	0.0204	0.0227	0.0228	0.0220
Maryland	0.0141	0.0173	0.0193	0.0204	0.0186	0.0166	0.0183	0.0184	0.0190
Massachusetts	0.0044	0.0045	0.0051	0.0046	0.0050	0.0038	0.0072	0.0064	0.0061
Michigan	0.0086	0.0090	0.0107	0.0133	0.0127	0.0106	0.0111	0.0121	0.0120
Minnesota	0.0065	0.0069	0.0078	0.0084	0.0076	0.0077	0.0094	0.0091	0.0089
Mississippi	0.0179	0.0202	0.0180	0.0202	0.0157	0.0171	0.0207	0.0230	0.0224
Missouri	0.0070	0.0083	0.0081	0.0099	0.0097	0.0081	0.0101	0.0085	0.0097
Montana	0.0221	0.0216	0.0247	0.0297	0.0375	0.0476	0.0396	0.0425	0.0454
Nebraska	0.0058	0.0067	0.0069	0.0075	0.0080	0.0057	0.0081	0.0114	0.0122
Nevada	0.0047	0.0057	0.0061	0.0069	0.0070	0.0071	0.0069	0.0094	0.0083
New Hampshire	0.0077	0.0063	0.0057	0.0053	0.0050	0.0050	0.0059	0.0049	0.0058
New Jersey	0.0141	0.0132	0.0155	0.0174	0.0138	0.0142	0.0154	0.0133	0.0136
New Mexico	0.0413	0.0433	0.0392	0.0418	0.0380	0.0264	0.0284	0.0317	0.0313
New York	0.0067	0.0070	0.0081	0.0083	0.0085	0.0082	0.0083	0.0072	0.0078
North Carolina	0.0074	0.0065	0.0072	0.0078	0.0075	0.0083	0.0084	0.0087	0.0089
North Dakota	0.0083	0.0076	0.0061	0.0060	0.0052	0.0046	0.0066	0.0117	0.0122
Ohio	0.0101	0.0108	0.0119	0.0127	0.0136	0.0129	0.0132	0.0119	0.0132
Oklahoma	0.0115	0.0088	0.0088	0.0105	0.0078	0.0115	0.0140	0.0094	0.0095
Oregon	0.0117	0.0115	0.0128	0.0128	0.0134	0.0141	0.0157	0.0130	0.0129
Pennsylvania	0.0150	0.0155	0.0150	0.0167	0.0177	0.0169	0.0181	0.0151	0.0179
Rhode Island	0.0037	0.0039	0.0035	0.0035	0.0038	0.0032	0.0044	0.0051	0.0069
South Carolina	0.0128	0.0128	0.0143	0.0114	0.0120	0.0129	0.0125	0.0142	0.0160
South Dakota	0.0030	0.0037	0.0040	0.0046	0.0048	0.0053	0.0047	0.0053	0.0058
Tennessee	0.0148	0.0141	0.0152	0.0156	0.0147	0.0135	0.0155	0.0171	0.0188
Texas	0.0282	0.0287	0.0265	0.0306	0.0294	0.0312	0.0337	0.0355	0.0341
Utah	0.0117	0.0149	0.0145	0.0168	0.0161	0.0135	0.0131	0.0120	0.0124
Vermont	0.0047	0.0044	0.0045	0.0044	0.0046	0.0051	0.0063	0.0060	0.0109
Virginia	0.0097	0.0106	0.0107	0.0109	0.0111	0.0105	0.0122	0.0123	0.0125
Washington	0.0177	0.0166	0.0178	0.0190	0.0221	0.0188	0.0230	0.0224	0.0229
West Virginia	0.0370	0.0446	0.0487	0.0478	0.0536	0.0473	0.0347	0.0310	0.0325
Wisconsin	0.0080	0.0084	0.0086	0.0094	0.0093	0.0094	0.0113	0.0107	0.0117
Wyoming	0.0174	0.0161	0.0124	0.0144	0.0141	0.0100	0.0137	0.0120	0.0375

(continued)

Appendix Table 2 (continued)

State	1986	1988	1989	1990	1991	1992	1993	1994
Alabama	0.0192	0.0161	0.0191	0.0217	0.0250	0.0228	0.0232	0.0239
Arizona	0.0143	0.0156	0.0122	0.0134	0.0121	0.0126	0.0105	0.0105
Arkansas	0.0161	0.0169	0.0196	0.0172	0.0179	0.0205	0.0203	0.0201
California	0.0128	0.0131	0.0139	0.0160	0.0151	0.0134	0.0125	0.0139
Colorado	0.0102	0.0077	0.0218	0.0294	0.0262	0.0077	0.0073	0.0091
Connecticut	0.0072	0.0090	0.0121	0.0128	0.0111	0.0090	0.0090	0.0102
Delaware	0.0391	0.0392	0.0375	0.0292	0.0322	0.0304	0.0290	0.0294
Florida	0.0143	0.0145	0.0151	0.0138	0.0124	0.0128	0.0120	0.0135
Georgia	0.0119	0.0128	0.0180	0.0167	0.0167	0.0135	0.0142	0.0145
Idaho	0.0217	0.0161	0.0131	0.0152	0.0128	0.0185	0.0161	0.0174
Illinois	0.0144	0.0140	0.0147	0.0162	0.0153	0.0168	0.0154	0.0140
Indiana	0.0208	0.0191	0.0204	0.0195	0.0208	0.0202	0.0186	0.0176
Iowa	0.0115	0.0103	0.0114	0.0100	0.0109	0.0120	0.0114	0.0134
Kansas	0.0108	0.0101	0.0136	0.0153	0.0143	0.0109	0.0122	0.0119
Kentucky	0.0144	0.0146	0.0170	0.0184	0.0191	0.0177	0.0162	0.0169
Louisiana	0.0649	0.0430	0.0423	0.0461	0.0518	0.0606	0.0589	0.0580
Maine	0.0230	0.0206	0.0262	0.0263	0.0316	0.0309	0.0293	0.0288
Maryland	0.0192	0.0205	0.0178	0.0174	0.0196	0.0198	0.0209	0.0168
Massachusetts	0.0069	0.0073	0.0090	0.0087	0.0088	0.0089	0.0087	0.0091
Michigan	0.0113	0.0134	0.0133	0.0145	0.0145	0.0144	0.0132	0.0110
Minnesota	0.0091	0.0080	0.0095	0.0098	0.0119	0.0114	0.0122	0.0119
Mississippi	0.0216	0.0198	0.0194	0.0241	0.0253	0.0285	0.0260	0.0226
Missouri	0.0114	0.0110	0.0138	0.0155	0.0114	0.0118	0.0125	0.0104
Montana	0.0339	0.0334	0.0358	0.0373	0.0451	0.0217	0.0168	0.0448
Nebraska	0.0109	0.0110	0.0075	0.0078	0.0083	0.0116	0.0100	0.0101
Nevada	0.0081	0.0109	0.0084	0.0062	0.0073	0.0083	0.0064	0.0049
New Hampshire	0.0073	0.0070	0.0096	0.0100	0.0094	0.0080	0.0087	0.0105
New Jersey	0.0150	0.0153	0.0175	0.0192	0.0193	0.0195	0.0174	0.0155
New Mexico	0.0273	0.0424	0.0300	0.0337	0.0155	0.0193	0.0188	0.0112
New York	0.0096	0.0089	0.0100	0.0097	0.0105	0.0103	0.0102	0.0085
North Carolina	0.0085	0.0087	0.0095	0.0099	0.0096	0.0115	0.0105	0.0112
North Dakota	0.0131	0.0154	0.0074	0.0099	0.0108	0.0243	0.0207	0.0087
Ohio	0.0136	0.0155	0.0157	0.0173	0.0166	0.0158	0.0146	0.0165
Oklahoma	0.0114	0.0100	0.0090	0.0087	0.0108	0.0112	0.0108	0.0122
Oregon	0.0136	0.0170	0.0124	0.0146	0.0183	0.0148	0.0131	0.0142
Pennsylvania	0.0180	0.0168	0.0177	0.0185	0.0174	0.0175	0.0159	0.0178
Rhode Island	0.0076	0.0152	0.0149	0.0147	0.0081	0.0074	0.0068	0.0146
South Carolina	0.0164	0.0161	0.0206	0.0218	0.0205	0.0198	0.0202	0.0181
South Dakota	0.0056	0.0080	0.0043	0.0049	0.0066	0.0105	0.0063	0.0079
Tennessee	0.0184	0.0174	0.0162	0.0186	0.0184	0.0175	0.0172	0.0173
Texas	0.0346	0.0260	0.0264	0.0296	0.0346	0.0343	0.0331	0.0317
Utah	0.0133	0.0126	0.0199	0.0207	0.0182	0.0246	0.0251	0.0191
Vermont	0.0099	0.0084	0.0060	0.0070	0.0063	0.0077	0.0064	0.0079
Virginia	0.0119	0.0128	0.0117	0.0116	0.0113	0.0136	0.0136	0.0130
Washington	0.0188	0.0183	0.0175	0.0192	0.0210	0.0194	0.0186	0.0203
West Virginia	0.0348	0.0272	0.0363	0.0416	0.0697	0.0577	0.0517	0.0401
Wisconsin	0.0120	0.0114	0.0125	0.0124	0.0126	0.0130	0.0133	0.0131
Wyoming	0.0396	0.0595	0.0265	0.0310	0.0310	0.0489	0.0331	0.0235

Figure 1. S* for four states

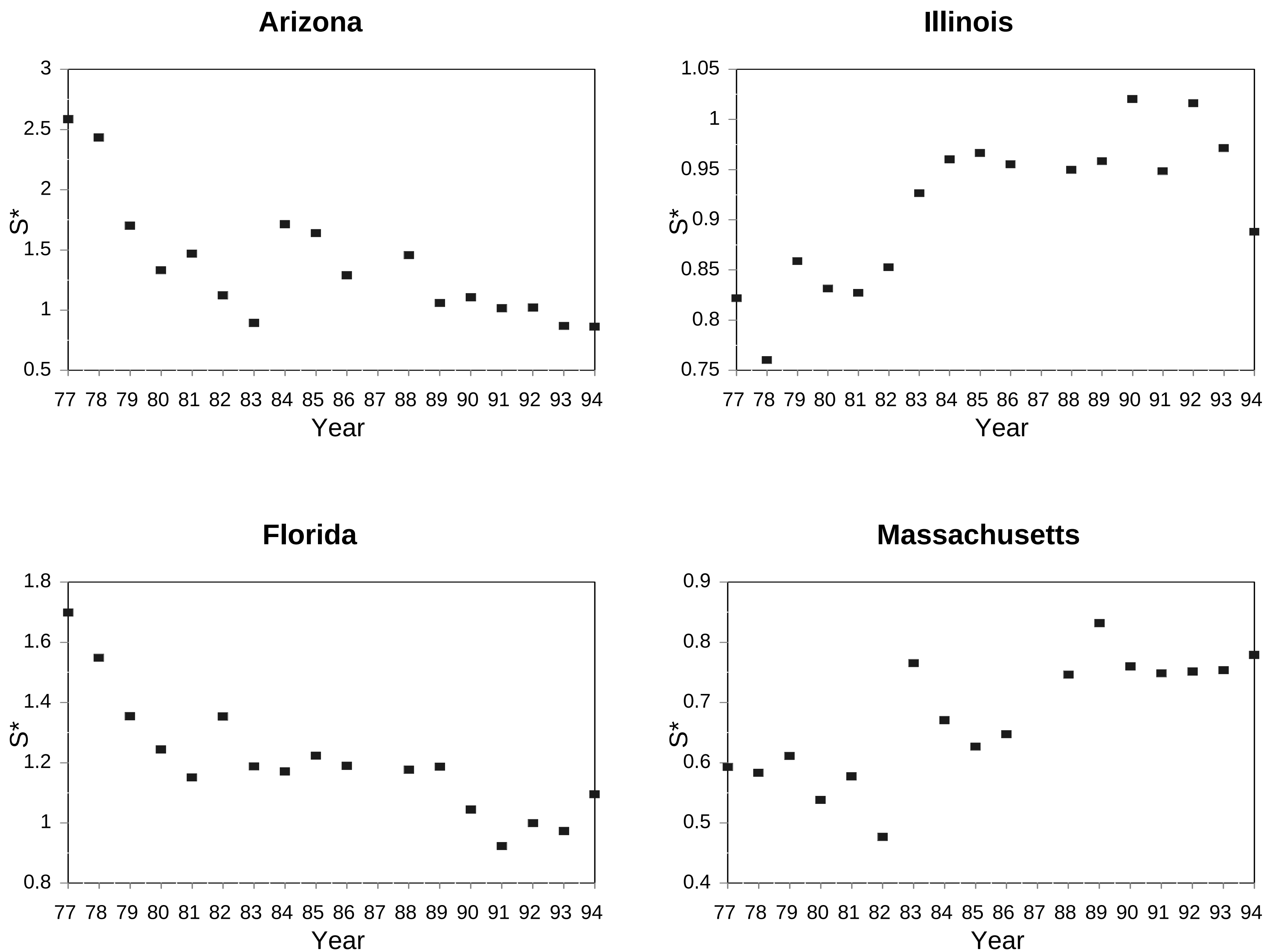

Figure 2: Coefficients of Variation

Unadjusted & industry-adjusted indices