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# The Impact of the Clean Air Act on Particulate Matter in the 1970s

Maureen Cropper, Nicholas Muller, Yongjoon Park, and Victoria Perez-Zetune

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## About the Authors

**Maureen Cropper** is a professor of economics at the University of Maryland, a senior fellow at Resources for the Future, a member of the Board of Directors of the National Bureau of Economic Research, and a member of the National Academy of Sciences. A former lead economist at the World Bank, Cropper has made major contributions to environmental policy through her research, teaching, and public service. Her research has focused on valuing environmental amenities, estimating consumer preferences for health and longevity improvements, and the tradeoffs implicit in environmental regulations. Previously, at the World Bank, her work focused on improving policy choices in developing countries through studies of deforestation, road safety, urban slums, and health valuation.

**Nicholas Muller** is the Lester and Judith Lave Professor of Economics, Engineering, and Public Policy at Carnegie Mellon University and works at the intersection of environmental policy and economics. His interdisciplinary research projects focus on estimating individual discount rates and risk preferences using historical pricing data, comparing air pollution and climate damages from electric vehicles to conventional vehicles, estimating air pollution damage from energy production, measuring the impact of transporting freight in the United State on air pollution and climate, and analyzing the inequality in market and augmented measures of income.

**Yongjoon Park** is an assistant professor of the Resource Economics Department at the University of Massachusetts Amherst. His research interests include industrial organization and environmental economics.

**Victoria Perez-Zetune** is a researcher at Westat Insight, where she supports several projects for the US Department of Agriculture's Food and Nutrition Service and the US Department of Labor. Victoria completed a PhD in economics at the University of Maryland, where she studied on a National Science Foundation Graduate Research Fellowship. As a doctoral student, she worked as a research assistant on projects related to childhood poverty and family formation and interned at the Congressional Budget Office.

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# Abstract

We examine whether counties designated as out of attainment with the National Ambient Air Quality Standards (NAAQS) under the 1970 CAA experienced larger reductions in total suspended particulates (TSP) during the 1970s than attainment counties. We answer this question using the official designation of nonattainment status which, between 1972 and 1978, was by Air Quality Control Region. Data from balanced panels of TSP monitors in operation 1969–1978 and 1971–1978 are used to examine the impact of nonattainment status on TSP. We also examine that impact using the definition in the literature, which designates a county as out of attainment if any of its monitors violated the NAAQS.

On average, using the official designation, TSP fell by more than  $9 \mu\text{g}/\text{m}^3$  more in nonattainment than attainment counties, controlling for county and year fixed effects, county population, employment, and per capita income. The average treatment effect is  $10.2 \mu\text{g}/\text{m}^3$  and  $9.1 \mu\text{g}/\text{m}^3$  using the 1969 and 1971 panels, respectively. Using the definition of nonattainment in the literature yields similar, albeit slightly smaller, average treatment effects:  $6.0 \mu\text{g}/\text{m}^3$  and  $7.7 \mu\text{g}/\text{m}^3$  using the 1969–1978 and 1971–1978 panels, respectively.

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# 1. Introduction

Retrospective analyses of the first decade of the 1970 Clean Air Act (CAA) have linked reductions in particulate matter (PM) to human health (Chay et al. 2003; Chay and Greenstone 2003), human capital (Isen et al. 2017), and changes in housing prices (Chay and Greenstone 2005). These studies all use nonattainment status under the CAA to instrument for changes in PM, arguing that it constituted an exogenous source of regulation imposed by the federal government. In these papers, nonattainment status is measured at the county level, using monitor readings to determine whether a county violated the National Ambient Air Quality Standards (NAAQS) for total suspended particulates (TSP).

We examine the definition of nonattainment status used in this literature and contrast it with EPA's actual designation, which was implemented by Air Quality Control Region (AQCR) rather than county. Our goal is to see how nonattainment status, measured by AQCR, affected TSP readings during the 1970s. Did TSP decline faster in nonattainment than attainment areas, when attainment is measured using the official designation? How do the magnitudes of these effects compare with results obtained using nonattainment status as measured in the literature?

Ours is not the first paper to contrast the official designation of nonattainment status in the 1970s and the definition used in the literature. Murphy (2016, 2017) points out this difference in his dissertation and examines the implications of the official designation for the use of regression discontinuity designs in the literature (e.g., Chay and Greenstone 2005). We extend his results by comparing the impact of the two definitions on the rate of TSP decline in nonattainment versus attainment counties in the 1970s.

We begin by describing the official designation of nonattainment status by AQCR in 1972 and then map it to counties. We contrast the AQCR definition with Greenstone's definition of nonattainment status in 1972 (Greenstone, personal communication, November 15, 2020). The papers cited in the first paragraph all use Greenstone's definition for the early 1970s. Using each definition, we compare nonattainment and attainment counties by population, employment, per capita income, and population density.

To examine the effect of nonattainment status on TSP, we must focus on counties with TSP monitors. We have comprehensive data on all TSP monitors in operation in the United States from 1969 to 1980 obtained from a Freedom of Information Act Request.<sup>1</sup> We select two sets of counties with a balanced panel of monitors: 226 for 1969–1978 and 413 for 1971–1978. We focus on counties with the same set of monitors operating each year due to evidence reported by Murphy (2016), which we corroborate, that newly introduced monitors averaged lower TSP readings than existing monitors. We estimate

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<sup>1</sup> We thank Karen Clay for sharing this dataset with us.

difference-in-differences models to examine the effect of nonattainment status in 1972 on annual average TSP in 1969 (1971) through 1978.

We find that AQCR nonattainment status resulted in a statistically significant and slightly greater average reduction in TSP than the traditional designation. Specifically, 1969–1978 TSP fell by approximately  $10.2 \mu\text{g}/\text{m}^3$  more in AQCR nonattainment versus attainment counties. The difference, using the definition in the literature, is approximately  $6.0 \mu\text{g}/\text{m}^3$ . Using the 1971 panel, TSP fell by approximately  $9.1 \mu\text{g}/\text{m}^3$  more between 1971 and 1978 in AQCR nonattainment versus attainment counties. The difference using the county-level definition in the literature is approximately  $7.7 \mu\text{g}/\text{m}^3$ .

## 2. Nonattainment Status Under the 1970 CAA

The 1970 CAA required EPA to establish NAAQS for common (or “criteria”) air pollutants and for states to draft implementation plans to describe how they would come into compliance with these standards (USEPA 1973). In 1971, EPA issued NAAQS for PM, carbon dioxide, nitrogen dioxide, sulfur dioxide, hydrocarbons, and photochemical oxidants (USEPA 1971). The agency also defined 247 AQCRs, spanning the continental United States, Alaska and Hawaii, the Virgin Islands, and Guam (USEPA 1972a). AQCRs are groups of contiguous counties in the same airshed.

In May 1972, each AQCR was determined to be in or out of attainment with each of the criteria pollutants (USEPA 1972b). Attainment status was determined based on 1971 monitor readings; however, TSP monitors operated in only 765 counties in 1971. Air quality modeling was also used to determine attainment status. Figure 1 shows the boundaries of the AQCRs in the continental United States and their attainment status for TSP. When AQCRs are mapped to counties, 2,035 counties were designated as nonattainment and 1,028 as attainment. A county could be in attainment but designated as nonattainment because it was located in a nonattainment AQCR.

The definition that the literature follows is Greenstone (Chay et al. 2003; Greenstone 2020), who categorized attainment status in 1972 based on monitoring readings in each county in 1971. A county that violated the annual average TSP standard or the 24-hour standard in 1971 was designated as nonattainment in 1972. By this definition, 288 counties were nonattainment in 1972.

States were required to submit plans to achieve the NAAQS by May of 1975 (USEPA 1973).<sup>2</sup> In 1976, attainment status by AQCR was reassigned (USEPA 1976). For TSP, 1,392 and 1,671 counties were declared in and out of attainment, respectively. Based on 1975 monitoring readings, 271 counties were out of attainment in 1976. EPA’s

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<sup>2</sup> Some of the 247 AQCRs cross state boundaries; counting AQCRs in individual states separately yields 313.



assignment of attainment by AQCR ended in 1978; attainment status since then is assigned by county (USEPA 1978).

## 3. The Impact of Attainment Status on TSP

### 3.1. Counties Used in the Analysis

To examine the impact of attainment status on TSP levels, we must restrict the analysis to counties with TSP monitors. In 1969, only 490 counties had at least one monitor;<sup>3</sup> 349 counties had at least one each year for 1969–1978, although not necessarily the same set of monitors each year. Two hundred and twenty-six counties had a balanced panel of monitors for 1969–1978 (they had at least one monitor that operated each year). If we begin the analysis in 1971, 413 counties have a balanced panel for 1971–1978.

Our analysis focuses on a balanced panel of monitors because TSP readings from monitors added (removed) during this period are, on average, lower (higher) than readings at monitors continuously in operation. This is illustrated by Figures 2 and 3, which show monitors added and retired during the period of our analysis in the 1969 and 1971 panels of counties. The graph on the left side of each figure shows the cumulative number of monitors added and retired, by year. The graph on the right side shows average TSP, by year and class of monitor. Average TSP for newly introduced monitors (the dashed green lines) lies below average TSP based on monitors continuously in operation (the red lines) in most years. The converse is true for monitors to be retired next year (the dashed blue lines). Figures 2 and 3 suggest the possibility of strategic placement of monitors to reduce TSP readings, a point noted by Murphy (2016), which is consistent with findings by Grainger et al. (2019).

The number of attainment counties in the 1969 and 1971 panels is much smaller when the official definition is used. Tables 1 and 2 list the number of counties by attainment status using the AQCR and Greenstone definitions in the 1969 and 1971 panels. Under the AQCR definition, only 33 out of 226 (14.6 percent) are in attainment in the 1969 panel; only 80 out of 413 (19.4 percent) are in attainment in the 1971 panel. In contrast, the definition used by the literature considers over half of counties in attainment. Using the Greenstone definition, 135 (59.7 percent) in the 1969 panel and 266 (64.4 percent) in the 1971 panel are in attainment. Figures A.1 and A.2 in the appendix show the locations of the counties in each panel, by attainment status.

How do attainment and nonattainment counties differ? We obtain county-level population and earnings statistics from the US Bureau of Economic Analysis (USBEA,

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<sup>3</sup> Counties with at least one TSP monitor were 565 in 1970, 765 in 1971, and 1,059 in 1972.

n.d.-a). All monetary values are converted to 1974 dollars using the personal consumption expenditure index (USBEA, n.d.-b). By either definition, nonattainment counties on average are more populous, are more densely populated, contain more workers, and have higher per capita incomes. Tables 3 and 4, which present summary statistics for the 1969 and 1971 panels by attainment status, using both definitions, illustrate this point. For this reason, we control for population, employment, and per capita income in the next models.

Average annual TSP readings are falling for both attainment and nonattainment counties in the 1969 and 1971 panels using both definitions, as shown in Figure 4. For both panels, average TSP levels are higher for both nonattainment and attainment counties using the Greenstone definition. This is to be expected: as noted, counties in nonattainment AQCRs need not have TSP levels that violate the NAAQS, which will lower the average TSP level for nonattainment counties under the AQCR definition. That TSP levels are higher for attainment counties under the Greenstone definition is because approximately 75 percent of these are officially designated as nonattainment.

### 3.2. Difference-in-Difference Models

Following the literature, we treat nonattainment status as exogenous and examine its effect on annual average TSP at the county and monitor levels using each definition. In county-level models, the dependent variable is the arithmetic average of TSP readings across all monitors in the balanced panel in each county in each year. We also present models in which the dependent variable is TSP measured at the monitor level in each county in each year. Specifically, we estimate Equations (1) and (2)

$$TSP_{ct} = \beta_1 After_t \times NA_c + X_{ct}\Gamma + \delta_c + \gamma_t + \epsilon_{ct} \quad (1)$$

$$TSP_{mt} = \beta_1 After_t \times NA_c + X_{ct}\Gamma + \delta_m + \gamma_t + \epsilon_{mt} \quad (2)$$

where  $After_t = 1$  if  $t > 1972$ ,  $NA_c = 1$  if county  $c$  is out of attainment in 1972,  $X_{ct} = (population_{ct}, employment_{ct}, per\ capita\ income_{ct})$ , and  $\delta_c$  ( $\delta_m$ ) and  $\gamma_t$  are county (monitor) and year fixed effects. We estimate Equations (1) and (2) using all years in each panel and, as a sensitivity analysis, (a) omitting 1972 and (b) omitting 1977–1978.

At the county level, the reduction in TSP associated with nonattainment status is greater under the AQCR designation rather than the definition used in the literature, although 95 percent confidence intervals for the two definitions overlap. Tables 5 and 6 display results at the county level for the 1969 and 1971 panels using both definitions. Under the AQCR definition, annual average TSP declined by approximately  $10.2 \mu\text{g}/\text{m}^3$  more in nonattainment than attainment counties for 1969–1978 and  $9.1 \mu\text{g}/\text{m}^3$  more for 1971–1978. The corresponding results are  $6.0 \mu\text{g}/\text{m}^3$  and  $7.7 \mu\text{g}/\text{m}^3$  using the traditional definition. Omitting 1977–78 from each panel reduces the size of the reductions in absolute magnitude, suggesting that 1972 nonattainment status continued to affect TSP through 1978.

Results at the monitor level (Tables 7 and 8) are similar. Point estimates of average treatment effects for the 1969–1978 and 1971–1978 periods are generally within 10 percent of those in Tables 5 and 6. Although Auffhammer et al. (2009) find significant impacts of nonattainment status for PM10 for 1990–2005 at the monitor but not at the county level, they do not use a balanced panel of monitors. It is not surprising that our results are statistically significant at both the monitor and county levels and quantitatively similar because we use a balanced panel.

## 4. Conclusions

This paper has two goals. The first is to examine whether counties designated as out of attainment with the NAAQS under the 1970 CAA experienced larger reductions in TSP during the 1970s than attainment counties. We ask this question using the official designation of nonattainment status; for 1972–1978, this was by AQCR. We answer this question by identifying AQCRs by attainment status and mapping AQCRs into counties. The second goal is to compare the effect of nonattainment status on TSP levels during the 1970s using two definitions: from AQCR and from the literature (which follows Greenstone by designating a county as nonattainment if any of its monitors violated the NAAQS).

The answer to the first question is that, using balanced panels of TSP monitors in operation from 1969–78 and 1971–78, TSP, on average, fell by more than 9  $\mu\text{g}/\text{m}^3$  more in nonattainment counties. This result holds at both the county and monitor levels, controlling for county (or monitor) and year fixed effects, county population, employment, and per capita income. The average treatment effect is 10.2  $\mu\text{g}/\text{m}^3$  using the 1969 panel and 9.1  $\mu\text{g}/\text{m}^3$  using the 1971 panel.

The answer to the second question is that the definition of nonattainment in the literature yields similar, albeit slightly smaller, average treatment effects: 6.0  $\mu\text{g}/\text{m}^3$  using the 1969–1978 panel and 7.7  $\mu\text{g}/\text{m}^3$  using the 1971–1978 panel. We find this result reassuring.

The question that remains unanswered is what measure of nonattainment status guided policies to control TSP in the early years of the CAA. Counties classified as nonattainment in the literature are clearly in violation of the NAAQS. Whether counties not in violation of the NAAQS but located in nonattainment AQCRs felt similar pressure to reduce emissions is unknown. Answering the question will require examining state implementation plans.

## 5. References

Auffhammer, M., A.M. Bento, and S.E. Lowe. 2009. Measuring the Effects of the Clean Air Act Amendments on Ambient PM<sub>10</sub> Concentrations: The Critical Importance of a Spatially Disaggregated Analysis. *Journal of Environmental Economics and Management* 58(1): 15–26.

Chay, K., C. Dobkin, and M. Greenstone. 2003. The Clean Air Act of 1970 and Adult Mortality. *Journal of Risk and Uncertainty* 27(3): 279–300.

Chay, K. Y., and M. Greenstone. 2003. *Air Quality, Infant Mortality, and the Clean Air Act of 1970*. National Bureau of Economic Research Working Paper 10053.

———. 2005. Does Air Quality Matter? Evidence from the Housing Market. *Journal of Political Economy* 113(2): 376–424.

Grainger, C., A. Schreiber, and W. Chang. 2019. *Do Regulators Strategically Avoid Pollution Hotspots When Siting Monitors? Evidence from Remote Sensing of Air Pollution*. Working Paper. Wisconsin: Department of Economics, University of Wisconsin–Madison.

Isen, Adam, Maya Rossin-Slater, and W. Reed Walker. 2017. Every Breath You Take—Every Dollar You’ll Make: The Long-Term Consequences of the Clean Air Act of 1970. *Journal of Political Economy* 125(3): 848–902.

Murphy, Joshua D. 2016. The Benefits of Reducing Particulate Pollution: Re-examining Evidence from the Clean Air Act. *Mimeo*, May 6, 2016.

Murphy, Joshua D. 2017. The Costs, Benefits and Efficiency of Air Quality Regulations. Ph.D. dissertation, University of Toronto.

[https://tspace.library.utoronto.ca/bitstream/1807/80811/3/Murphy\\_Joshua\\_201711\\_PhD\\_thesis.pdf](https://tspace.library.utoronto.ca/bitstream/1807/80811/3/Murphy_Joshua_201711_PhD_thesis.pdf)

USBEA (US Bureau of Economic Analysis), n.d.-a. Economic Profile by County, 1969–2020. [Dataset]. <https://apps.bea.gov/regional/downloadzip.cfm>, (accessed February 23, 2022).

———, n.d.-b. Personal Consumption Expenditures [PCE]. <https://fred.stlouisfed.org/series/PCE> (accessed June 29, 2022).

USEPA (US Environmental Protection Agency). 1971. National Ambient Air Quality Standards. *Federal Register* 37(67) Part 2: 10842–10906.

———.1972a. *Federal Air Quality Control Regions*. PB229-701.

———. 1972b. Air Programs—Approval and Promulgation of Implementation Plans. *Federal Register* 37(105), Part 3: 6680–6701.

———. 1973. *State Air Pollution Implementation Plan Progress Report, January 1, 1973 to June 30, 1973*. EPA450/2-73-005.

———. 1976. *State Air Pollution Implementation Plan Progress Report, January 1, 1976 to June 30, 1976*. EPA450/2-76-026.

———. 1978. National Ambient Air Quality Standards. *Federal Register* 43(43), Part 3: 8962–9059.

## 6. Tables and Figures

**Table 1. Nonattainment Status, Counties with Balanced Monitors, 1969–1975**

Greenstone 1972 nonattainment status			
AQCR 1972 status	Attainment	Nonattainment	Total
Attainment	33	0	33
Nonattainment	102	91	193
Total	135	91	226

**Table 2. Nonattainment Status, Counties with Balanced Monitors, 1971–1978**

Greenstone 1972 nonattainment status			
AQCR 1972 status	Attainment	Nonattainment	Total
Attainment	74	6	80
Nonattainment	192	141	333
Total	266	147	413

**Table 3. Summary Statistics by Attainment Status, Counties with Balanced Monitors, 1969–1978**

NA Status	Variable	Attainment Counties			Nonattainment Counties		
		N	Mean	SD	N	Mean	SD
AQCR	Population (1,000s)	330	185	307	1,900	359	698
	Population density (people per square mile)	330	189	296	1,900	851	1,840
	Employment (1,000s)	330	90	154	1,900	179	362
	Per capita income (1974 dollars)	330	5,277	1,022	1,900	5,601	919
	PM2.5 readings from balanced monitors ( $\mu\text{g}/\text{m}^3$ )	330	52	20	1,900	77	29
Greenstone	Population (1,000s)	1,330	220	301	900	500	945
	Population density (people per square mile)	1,330	441	879	900	1,214	2,414
	Employment (1,000s)	1,330	103	150	900	259	490
	Per capita income (1974 dollars)	1,330	5,439	944	900	5,722	914
	PM2.5 readings from balanced monitors ( $\mu\text{g}/\text{m}^3$ )	1,330	60	21	900	92	30

Statistics are based on annual values of variables in counties with balanced monitors, 1969–1978.

**Table 4. Summary Statistics by Attainment Status, Counties with Balanced Monitors, 1971–1978**

NA Status	Variable	Attainment Counties			Nonattainment Counties		
		N	Mean	SD	N	Mean	SD
AQCR	Population (1,000s)	616	135	239	2,560	295	601
	Population density (people per square mile)	616	345	1,683	2,560	1,073	4,263
	Employment (1,000s)	616	66	127	2,560	147	327
	Per capita income (1974 dollars)	616	5,265	1,120	2,560	5,433	998
	PM2.5 readings from balanced monitors ( $\mu\text{g}/\text{m}^3$ )	616	58	22	2,560	74	27
Greenstone	Population (1,000s)	2,040	173	271	1,136	429	826
	Population density (people per square mile)	2,040	487	1,659	1,136	1,732	6,066
	Employment (1,000s)	2,040	80	129	1,136	224	458
	Per capita income (1974 dollars)	2,040	5,315	1,039	1,136	5,553	981
	PM2.5 readings from balanced monitors ( $\mu\text{g}/\text{m}^3$ )	2,040	60	18	1,136	90	29

Statistics are based on annual values of variables in counties with balanced monitors, 1971–1978.

**Table 5. County-Level Difference-in-Differences Regressions, Counties with Balanced Monitors, 1969–1978**

	AQCR Nonattainment			Greenstone Nonattainment		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>NA x After 1972</b>	-10.154 ***	-10.630 ***	-8.672 ***	-5.988 ***	-6.538 ***	-4.113 *
	(1.907)	(2.064)	(1.738)	(2.302)	(2.432)	(2.352)
<b>N</b>	2,230	2007	1,784	2,230	2007	1,784
<b>Years excluded?</b>	No	1972	1977–1978	No	1972	1977–1978
<b>R2</b>	0.782	0.777	0.798	0.781	0.776	0.797

\*\*\* p < 0.01; \*\* p < 0.05; \* p < 0.1.

In all models, the dependent variable is annual county-level average TSP. County-level population, per capita income, and employment are controlled for, together with time and county-level fixed effects. Three counties were dropped due to missing economics data. Standard errors are clustered at the county level.



**Table 6. County-Level Differences-in-Differences Regressions, Counties with Balanced Monitors, 1971–1978**

	AQCR Nonattainment			Greenstone Nonattainment		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>NA x After 1972</b>	-9.060 ***	-9.890 ***	-7.954 ***	-7.694 ***	-8.982 ***	-5.254 **
	(1.904)	(2.014)	(1.812)	(2.258)	(2.357)	(2.295)
<b>N</b>	3,176	2,779	2,382	3,176	2,779	2,382
<b>Years excluded?</b>	No	1972	1977–1978	No	1972	1977–1978
<b>R2</b>	0.787	0.784	0.816	0.787	0.785	0.815

\*\*\* p < 0.01; \*\* p < 0.05; \* p < 0.1.

In all models, the dependent variable is annual county-level average TSP. County-level population, per capita income, and employment are controlled for, together with time and county-level fixed effects. Sixteen counties were dropped due to missing economics data. Standard errors are clustered at the county level.

**Table 7. County-Level Differences-in-Differences Regressions, Counties with Balanced Monitors, 1971–1978**

	AQCR Nonattainment			Greenstone Nonattainment		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>NA x After 1972</b>	-9.356 ***	-11.610 ***	-8.244 ***	-5.371 ***	-6.274 ***	-4.188 **
	(2.088)	(2.254)	(1.757)	(1.892)	(2.236)	(1.945)
<b>N</b>	4,540	4,086	3,632	4,540	4,086	3,632
<b>Years excluded?</b>	No	1972	1977–1978	No	1972	1977–1978
<b>R2</b>	0.826	0.822	0.838	0.826	0.822	0.838

\*\*\* p < 0.01; \*\* p < 0.05; \* p < 0.1.

In all models, the dependent variable is annual monitor-level average TSP. County-level population, per capita income, and employment are controlled for, together with time and monitor-level fixed effects. Three counties were dropped due to missing economics data. Standard errors are clustered at the county level.

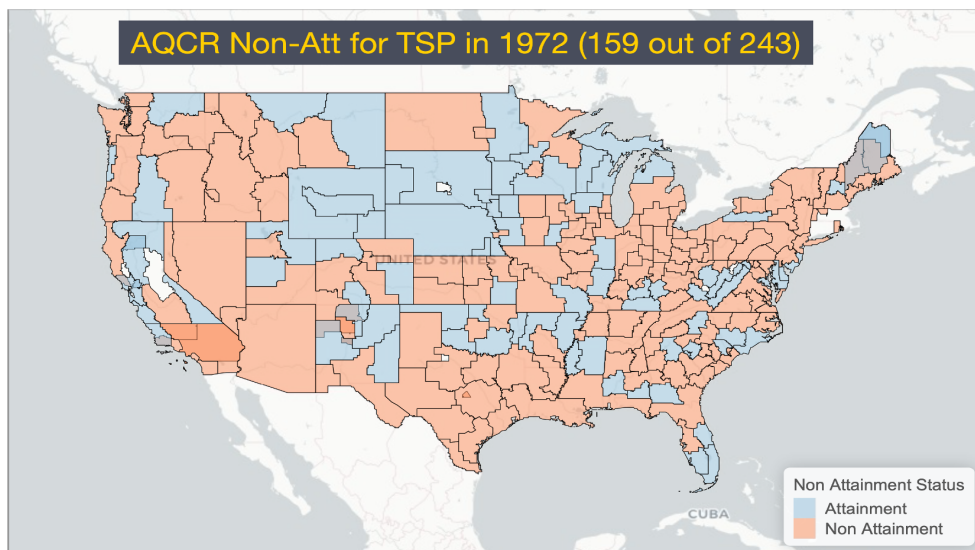
**Table 8. County-Level Differences-in-Differences Regressions, Counties with Balanced Monitors, 1971–1978**

	AQCR Nonattainment			Greenstone Nonattainment		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>NA x After 1972</b>	-8.632 ***	-11.661 ***	-7.683 ***	-7.338 ***	-7.944 ***	-5.550 ***
	(1.587)	(1.916)	(1.432)	(1.379)	(1.717)	(1.291)
<b>N</b>	7,624	6,671	5,718	7,624	6,671	5,718
<b>Years excluded?</b>	No	1972	1977–1978	No	1972	1977–1978
<b>R2</b>	-8.632 ***	-11.661 ***	-7.683 ***	-7.338 ***	-7.944 ***	-5.550 ***

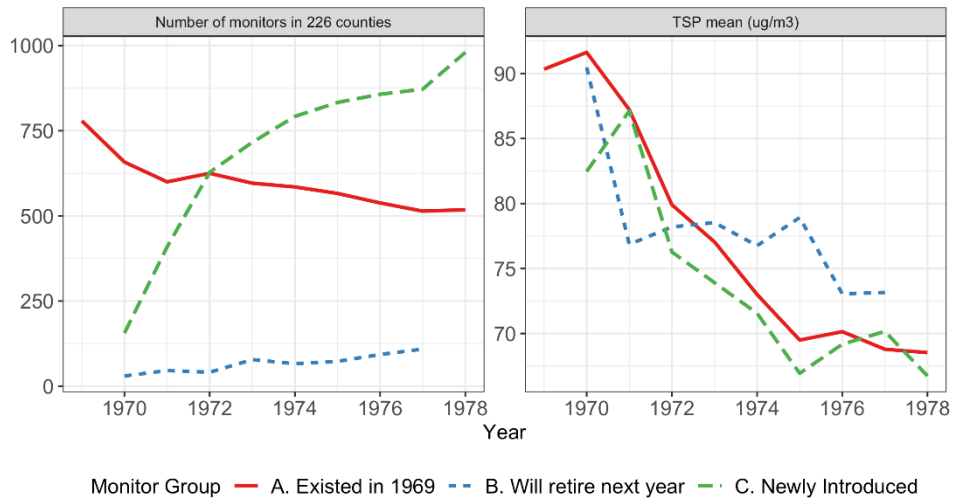
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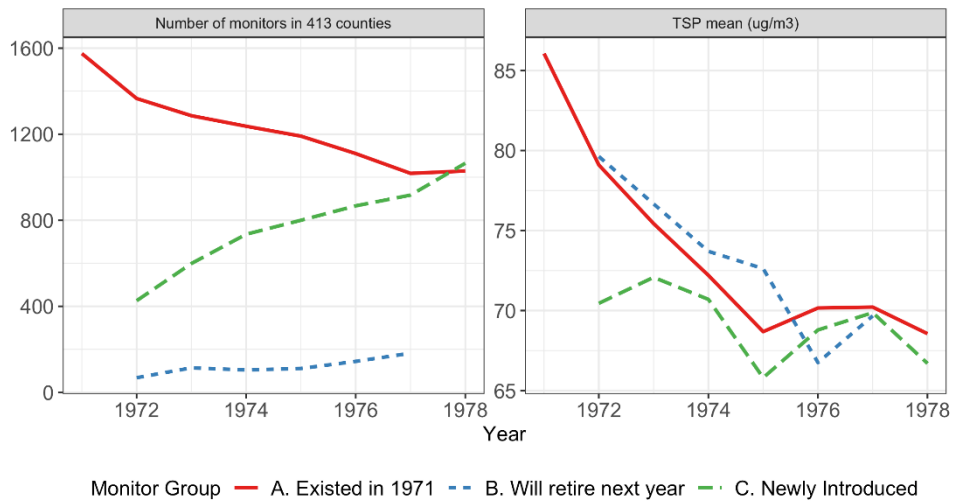
**Figure 1. Map of Air Quality Control Regions by TSP Attainment Status in 1972**



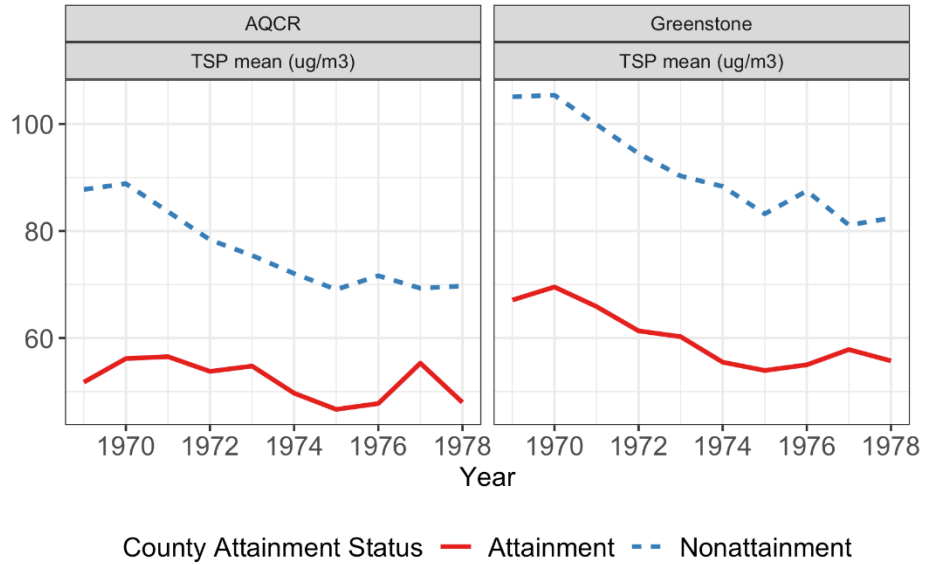
**Figure 2. Average TSP by Monitor Entry/Exit Type, Counties with Balanced Monitors, 1969–1978**



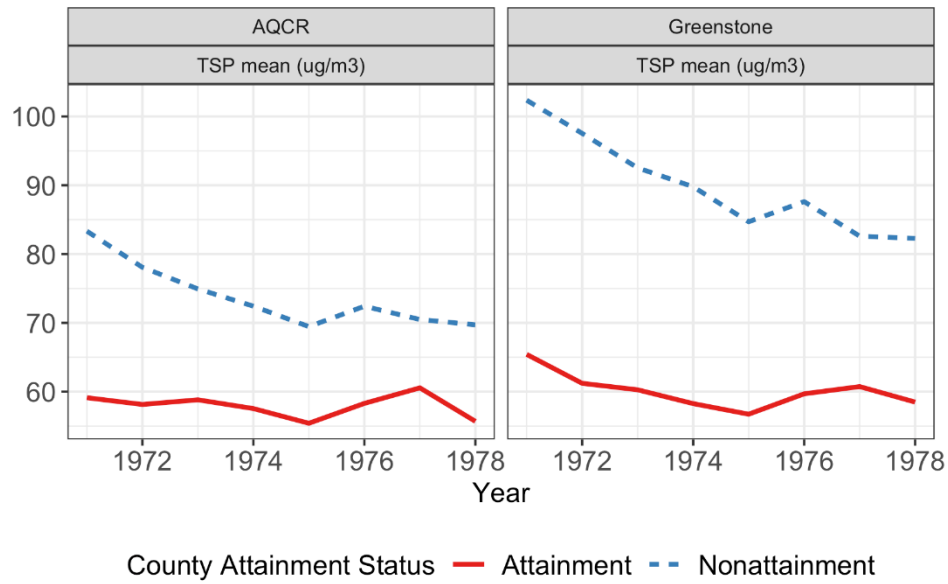
**Figure 3. Average TSP by Monitor Entry/Exit Type, Counties with Balanced Monitors, 1971–1978**



**Figure 4. Average TSP by Attainment Status, Counties with Balanced Monitors, 1969–1978**

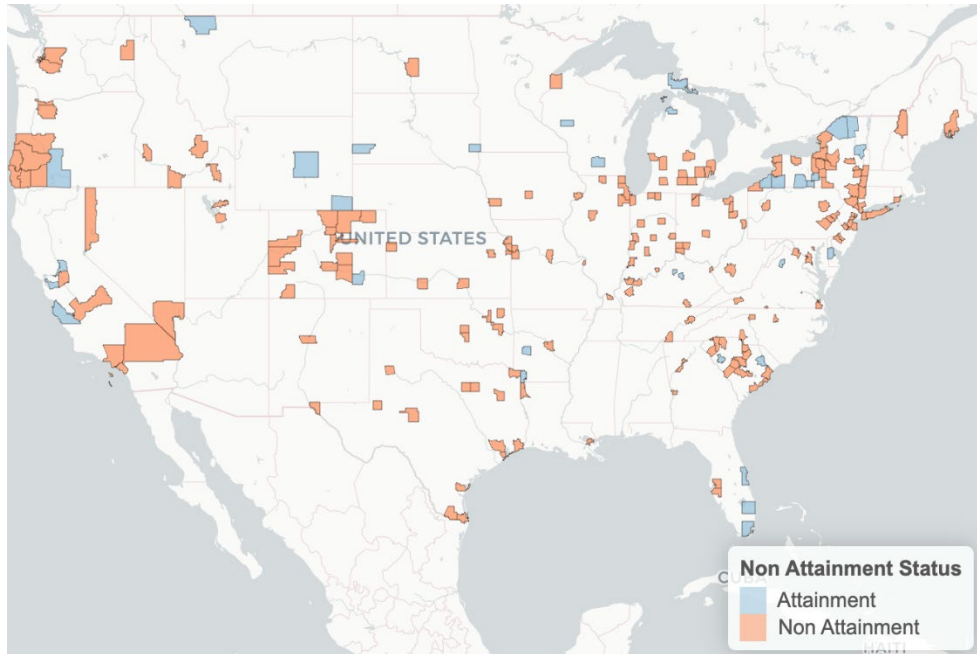


**Figure 5. Average TSP by Attainment Status, Counties with Balanced Monitors, 1971–1978**



## 7. Appendix

**Figure 6. Map of Counties with Balanced Monitors, 1969–1978, by Air Quality Control Region Attainment Status**



**Figure 7. Map of Counties with Balanced Monitors, 1971–1978, by Air Quality Control Region Attainment Status**

