Appendices (for online publication only)

A. Data

In this online appendix, we describe in more detail the various data sources that we use for our analysis.

A.1. EIA forms 767, 860, and 923

The EIA 767 is an annual survey that electric power producers that operate a generator that is greater than 10 megawatts (MW) in nameplate capacity must complete. The EIA 767 contains information on various facility, boiler, and generator level characteristics, e.g., fuel usage, waste production. Most important for our analysis, the EIA 767 provides several measures that detail the abatement technology installed at the facility or boiler level. First, the EIA 767 contains information on the amount of abatement expenditures by each facility. EIA separates the information into expenditures on several abatement items, e.g., ash collection, yearly water pollution abatement. Because our interests lie in how states implement the CAA, the amount of spending on new air pollution abatement capital is our measure of interest within the EIA 767. This value represents the total facility level expenditures on new air pollution abatement capital equipment. As a specific example, if a facility installs $10,000 worth of new air pollution abatement equipment in year one, the EIA 767 reflects this expenditure for that year. If the same facility did not install any new air pollution abatement technology in year two, then this measure takes a value of $0, even if the facility expended resources on other forms of abatement, including the operation of the technology installed in year one.

The EIA 767 also contains information on the specific type of air pollution abatement technology installed at each boiler. The EIA 767 tracks abatement technology presence for the control of two pollutants consistently over time: SO2 and NOx. The EIA 767 also tracks air pollution abatement equipment for the control of mercury and PM emissions. We do not focus our discussion on the control of these pollutants for the following reasons. First, mercury is not a criteria air pollutant and the NAAQS therefore do not control mercury emissions. Thus, there is no RACT determination for mercury emission control, which is the basis of our analysis. For PM emissions, the EIA 767 (and other EIA forms) does not track emission control technology consistently during our sample period. Additionally, there is very little within-boiler variation in the presence of PM abatement technology at boilers in our sample. Nearly all electric utility boilers have some form of PM control [flue-gas precipitators (FGP)] because PM emissions are the most damaging to human health and the environment (Muller and Mendelsohn 2009; Fann et al. 2012), so allowable emission limits are low. When examining specific air pollution abatement technology adoption, our interests lie exclusively in SO2 and NOx abatement technology. For SO2 abatement, EIA tracks only one type of add-on technology: FGD. FGD equipment is the primary type of technological add-on for the control of SO2 emissions. There exist other ways to control SO2 emissions, e.g., the use of low-sulfur (subbituminous) coal, but none are technological add-ons. Thus, RACT for SO2 is the installation of an FGD. For this reason, we examine FGD adoption as a placebo test (we discuss this examination in greater detail in the main text). For abatement technology type, EIA records the data at the boiler, rather than the facility, level. We measure SO2 abatement using a dummy that indicates whether a given boiler has FGD technology installed in each year. For NOx abatement, the EIA 767 provides a qualitative measure that describes the nature of the abatement technology installed at each boiler. There exist several types of technological NOx abatement strategies, e.g., LNB, SCR; EPA considers many of these technologies as RACT under the CAA. We measure NOx abatement using a dummy that indicates whether a given boiler has the most effective abatement technology installed in each year. We define most effective as the use of SCR/SNCR equipment because these technologies have a much higher NOx elimination rate than other types of NOx abatement technologies, e.g., LNB, OFA (Xiong et al. 2016); these technologies are also considerably more expensive than the other options. (EPA also considers SCR/SNCR technology as the most effective means of NOx abatement. In its National Enforcement Initiative to reduce air pollution from the largest sources, EPA considers as "controlled" those boilers with SCR/SNCR technology installed, but not LNB/OFA technology.)

In 2005, EIA discontinued the 767 form. We supplement data from this form with data from the EIA 860 and EIA 923 to complete our panel; these EIA forms collect many of the same items as the original EIA 767. For our purposes, we are concerned with the new air pollution abatement technology capital expenditures and SO2 and NOx abatement technology type measures. We collect the latter from the EIA 860, which is an annual survey completed by electric power producers that are over one MW in nameplate capacity. EIA primarily uses this form to document generator level characteristics of each electric utility, including environmental protection efforts. Thus, we complement data on the use of FGD and SCR/SNCR at each boiler from the EIA 767 with the same information gathered from the EIA 860. We gather from the EIA 923 the new capital expenditures for air pollution abatement at the facility level. The EIA 923 collects data both monthly and annually on electricity generation and expenditures; we use the annual survey. The EIA 923 includes information on measures such as fuel consumption, fuel costs, and some environmental protection data. The new air pollution abatement capital expenditure measure from this form is identical to that from the EIA 767. In addition to our outcome variables, we also gather information on the age of each electric utility boiler from the EIA 767 and EIA 860 and historical NSR permit information for each boiler from the EIA 923.

A.2. Other data sources

For nonattainment data, we use the EPA Green Book (2020). The Green Book contains data on county level nonattainment status for the six criteria air pollutants designated by the NAAQS (which we list in the main text). We gather county level population data from the US Census Bureau's Topologically Integrated Geographic Encoding and Referencing database. Finally, we gather county level unemployment rates from the Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics program.

A.3. Statistical summaries

We first discuss the outcome measures. As shown in Table 1 of the main text, descriptive statistics are similar for the gubernatorial and state legislative samples. Therefore, for tractability, we focus on the gubernatorial sample in this data description. New air pollution abatement capital expenditures at all facilities are considerable during our sample period. The average facility purchases over $10 million worth of new air pollution abatement equipment each year, which represents new air pollution abatement capital expenditures for all boilers at each facility. The average facility in our sample consists of 2.5 boilers, so average spending per boiler is roughly $4 million. This unconditional mean is reasonable because new capital expenditures for the control of air emissions are considerable. For example, EPA (2015) estimates FGD installation at electric utility boilers between 100 and 500 MW in capacity to cost between $75 and $236 million (2007$). Because the range of new air pollution abatement capital expenditures is so wide, we also examine as a robustness check an outcome measure of years where this measure is positive. Regardless of nonattainment designation, almost 50% of facility-year observations have positive spending on new air pollution abatement technology. For boiler level outcomes, 31% and 37% of boilers have SCR/SNCR and FGD equipment installed, respectively. (We do not tabulate these values in Table 1 of the main text.)

Table 1 of the main text also includes summary statistics for other analysis measures. Roughly 27% of facility-year observations are in areas that EPA designates as nonattainment for any of the six criteria air pollutants. For boiler-years, 27% are in areas designated as nonattainment for NOx affected pollutants and 19% are in areas designated as nonattainment for SO2 affected pollutants. Additionally, 58% of facility- and boiler-years are located in states with a Republican governor.

Next, Online Appendix Table A1 presents sample summary statistics by gubernatorial affiliation. Electric utilities in states controlled by a Democratic governor have a higher average amount of new air pollution abatement capital expenditures and instances of positive abatement spending. Online Appendix Table A1 also shows that, for each sample, there are more observations designated as nonattainment for Democratic governor-controlled states than for those controlled by a Republican governor. Online Appendix Table A3 shows the analogous information by state lower house majority.

Online Appendix Table A2 presents sample summary statistics by gubernatorial affiliation and nonattainment designation. This table provides summary statistics for the outcomes when firm managers determine the level of abatement (attainment) and when the governor and their administration (or legislative body) determine the level of abatement through SIPs (nonattainment). First, the averages for all outcomes are larger in nonattainment areas than in attainment areas, for both parties of gubernatorial control. These summaries are unsurprising because the CAA mandates abatement technology requirements in nonattainment areas. Second, the average outcomes in attainment areas are generally larger in Democratic governor-controlled states. Online Appendix Table A4 presents the analogous information by state lower house majority and nonattainment designation. For this sample, we note similar descriptive statistics to those presented for the gubernatorial analysis.

B. Theory

EPA designed the NAAQS to improve ambient air quality, but to allow flexibility in how states satisfy air quality standards. In this online appendix, we examine how a governor's political ideology affects federally required emission reductions at stationary sources.[1] Our objective is to identify how gubernatorial preferences influence air pollution abatement strategies necessary to reach federal standards. We model two principled actors, a state administration with ideology-based preferences and a profit maximizing firm. The state administration's actions occur through the state environmental protection agencies but are constrained by EPA guidelines. Our

[1] We focus our theoretical analysis on the governor and their administration. As discussed in the main text, the lower house of the state legislature may also play a role in how states administer the NAAQS. The theoretical framework incorporates this alternative framing below.

overarching examination looks at how political preferences lead governors to implement different air pollution abatement strategies.

B.1. Emissions, emission standards, and federal mandates

We begin with a representative firm whose production creates air emissions. Firm *i*'s output creates emissions, e_i, according to $e_i = [e - F(\boldsymbol{x}_i)]q_i$, where e represents baseline emissions from production, q_i represents output, and $F(\boldsymbol{x}_i)$ represents net emission reductions from firm *i*'s air pollution abatement technologies, $\boldsymbol{x}_i$. Air pollution abatement technology takes the form $\boldsymbol{x}_i = (x_{i1}, \ldots, x_{iJ})$, with $x_{ij} \in \{0,1\}$, where a value of one represents the use of technology *j* at firm *i*. We assume that the effectiveness of each air pollution abatement technology is independent of other installed air pollution abatement technologies and can be represented additively, i.e., $F(\boldsymbol{x}_i) = f(x_{i1}) + \ldots + f(x_{iJ})$, where $f(x_{ij})$ represents technology *j*'s effectiveness (when $x_{ij} = 1$) with $f(x_{ij}) < f(x_{ik})$, whenever $j < k$.

For brevity, we focus on the installation costs of any air pollution abatement technology. We assume that price and output are exogenous to electric utilities due to grid management (Fowlie 2010).[2] Thus, the firm's revenue is exogenously determined, which allows us to represent the firm's problem as:

$$\max_{\boldsymbol{x}_i} \pi_i = TR_i - C(\boldsymbol{x}_i) \qquad \text{(A1)}$$

where TR_i represents total revenue for firm i and $C(\boldsymbol{x}_i)$ represents the costs of installing air pollution abatement technology $\boldsymbol{x}_i$, i.e., $C(\boldsymbol{x}_i) = c(x_{i1}) + \ldots + c(x_{iJ})$, where $c(x_{ij})$ represents the cost of air pollution abatement technology *j*. We limit our analysis to the catalog of cost effective abatement options, consistent with RACT requirements. Under these conditions, we expect that $c(x_{ij}) < c(x_{ik})$ whenever $j > k$.[3]

The degree of federal regulatory oversight that firms face is contingent on ambient air quality, denoted by e_R. Air pollution monitors measure ambient air quality as a pollutant concentration (e.g., parts per million, micrograms per square meter), which is a function of emissions, geography/topography, and meteorological conditions.

As outlined by the NAAQS, the degree of regulatory oversight depends on an area's nonattainment status, which is determined by:

$$\begin{bmatrix} \sum_{i=1}^{N} \phi e_i + \sum_{m=1}^{M} a_m < e_R & \text{if in an attainment area} \\ \sum_{i=1}^{N} \phi e_i + \sum_{m=1}^{M} a_m \geq e_R & \text{if in an non-attainment area} \end{bmatrix} \qquad \text{(A2)}$$

where *N* represents the number of stationary emission sources, *M* represents the number of non-

[2] For electric utilities in regulated electricity markets, price is generally determined by a public service commission; electric utilities also must maintain grid integrity. For electric utilities in deregulated markets, firms face competition from other providers and energy sources.

[3] Note that firms do not voluntarily install any air pollution abatement technology but are subject to inspection and oversight.

stationary emission sources, a_m represents emissions from non-stationary source m,[4] and ϕ represents a scaler converting emissions into pollutant concentrations based on local conditions.[5] Since decisions made by the firm or local regulators do not affect non-stationary emission sources, we omit these emissions from the remainder of our analysis.

Next, nonattainment designation requires that states construct and submit to EPA a nonattainment SIP. Each SIP requires emission monitoring, additional oversight of polluting facilities, and the demonstration that future abatement yields emission reductions. More important, each SIP must include air pollution abatement strategies sufficient to reach federal standards. The state administration must therefore choose which air pollution abatement technology to install at each stationary emission source. Let $\boldsymbol{Y} = (\boldsymbol{y_1}, \dots, \boldsymbol{y_N})$ denote a state administration's air pollution abatement strategy to address emissions at N firms within a designated area, where $\boldsymbol{y_i} = (y_{i1}, \dots, y_{iJ}) \in \{0,1\}$ represents additional air pollution abatement technology adoption by firm $\boldsymbol{i}$. The adoption of any SIP required air pollution abatement technology is more than currently employed abatement strategies, or, analytically, if $y_{ij} = 0$ then $y_{ij} = x_{ij}$, if $y_{ij} = 1$ then $y_{ij} = x_{ij}$. To meet ambient air quality standards, a SIP must sufficiently reduce emissions, or more explicitly, $\sum_{i=1}^{N} [e - F(\boldsymbol{x_i}) - F(\boldsymbol{y_i})]\, q_i < e_R$.

EPA also requires that any SIP sufficiently decrease emissions to account for non-stationary variations in ambient air concentrations. Therefore, satisfactory emission reductions need additional reductions beyond the minimum required, to ensure that areas avoid entry back into nonattainment. State administrations with environmental concerns can also require further emission reductions beyond those that EPA outlines. Let B represent a state's political leaders' willingness to increase (private) expenditures to obtain greater environmental quality. We assume that a greater preference for environmental quality is associated with a quadratic reduction in emissions (B^2). For a governor with willingness B, an approved SIP takes the form:

$$\sum_{i=1}^{N} [e - F(x_i)]\, q_i - B^2 \ll e_R. \tag{A3a}$$

From the state administration's perspective, a nonattainment designation mandates the selection of an emission reduction target (B^2) and an air pollution abatement strategy $[\boldsymbol{Y} = (\boldsymbol{y_1}, \dots, \boldsymbol{y_N})]$ such that:

$$\sum_{i=1}^{N} [F(\boldsymbol{y}_i)]\, q_i > B^2. \tag{A3b}$$

B.2. State government: Governor objective

Next, we model the decisionmaking process of the state's political leaders. In the economics literature, the government's objective takes many forms, resulting in the weighting of multiple goals. Generally, these forms include some form of social welfare and some objectives of interest groups (Aidt 1998; Schopf and Voss 2019). We assume that partisan ideology influences the structure of a governor's utility function, which we represent as multidimensional due to the

[4] As mentioned, the largest air emission source in each county is typically automobiles (Auffhammer et al. 2011). Emissions from outside each county also contribute to local ambient air quality. For brevity, we omit these emissions from the model. The introduction of extraneous pollution has the same effects as an increase in non-stationary emissions, i.e., there are few regulatory actions available to reduce these types of emissions.

[5] This includes geography, meteorological conditions, etc. Note, reducing emissions improves (i.e., decreases) pollutant concentrations, ceteris paribus.

political objectives possible (Santolini 2009). We also examine how different environmental valuations lead to equivalent outcomes.[6] The utility of a governor with ideology $\tau \in [0,1)$ with perceived (marginal) environmental damages $\gamma \in \mathbb{R}^{+}$ (i.e., a greater value of γ implies a greater social cost from pollution) is represented by:

$$G_{\tau,\gamma} = \tau U(\boldsymbol{Y},\gamma) + (1-\tau)\Pi(\boldsymbol{Y}) \quad \text{(A4a)}$$

where $U(\boldsymbol{Y},\gamma)$ represents environmental benefits.[7] Environmental benefits take the form $U(\boldsymbol{Y},\gamma) = W - \gamma\sum_{i=1}^{N}[e - F(x_i) - F(y_i)]q_i$, where W represents the absence of harmful pollutants. $\Pi(\boldsymbol{Y})$ represents aggregate profits from local stationary sources with production that creates emissions,[8] i.e., $\Pi(\boldsymbol{Y}) = \sum_{i=1}^{N}[TR_i - C(y_i)]$. Finally, a higher τ represents a governor's preference for lower environmental damages relative to aggregate profits, which highlights the tradeoff that governors face between lowering emissions and increasing aggregate profits.[9]

In the absence of EPA oversight from nonattainment, the governor's problem becomes:[10]

$$\max_{y} G_{\tau,\gamma} = \tau(W - \gamma\sum_{i=1}^{N}[e - F(\boldsymbol{x}_i) - F(y_i)]q_i) + (1-\tau)\sum_{i=1}^{N}[TR_i - C(y_i)]. \quad \text{(A4b)}$$

From (A4b) we find the ideal air pollution abatement technology based a governor's political ideology. After optimizing, we find that a governor with ideology τ prefers air pollution abatement technology according to:[11]

$$\frac{\tau}{(1-\tau)}\gamma = \frac{C'}{q_i F'}\,. \quad \text{(A4c)}$$

Equation (A4c) represents the governor's benefit-cost threshold for abatement technology. A governor only recommends the installation of air pollution abatement technology until the ratio of marginal costs to marginal environmental benefits surpasses their preference for lower emissions relative to profits, or equivalently, $\frac{MB}{MC} = \frac{1-\tau}{\tau}$. Therefore, the governor's preferences influence the benefit-cost threshold. Or equivalently,

[6] Governors may have similar objective functions or partisan ideologies but have different beliefs on the benefits of clean air. Different perceived health benefits, or equivalently, environmental damages estimates (in our case), are represented with different values for γ. Conceptually, lower perceived health benefits *($\gamma\downarrow$)* or greater preference for aggregate profits *($\tau\downarrow$)* lead to equivalent outcomes; see remark 1.

[7] RACT requires that air pollution abatement technology adoption is affordable, so we assume that all firms remain profitable and continue to operate. As such, we expect that any air pollution abatement strategy has little to no impact on production, leaving consumer surplus unaffected.

[8] Our focus is on capital expenditures. Therefore, we omit the cost of previously installed air pollution abatement technology. Alternatively, we could have $c(y_i)$ represent the present discounted cost of operating air pollution abatement technology y_i and reach the same conclusion.

[9] Our use of ideology as a measure of a governor's policy preference mirrors the "government position" calculations of Ceron et al. (2019). However, our interest is in environmental policy implementation. We therefore replace "ProState" with health and environmental benefits.

[10] For computational ease, we assume that the catalog of available air pollution abatement technologies is continuous in terms of effectiveness and cost, where $\frac{\partial F(y_i)}{\partial y_i}=F'>0$ and $\frac{\partial C(x_i)}{\partial x_i}=C'>0$, with $F'' < 0$ and $C'' > 0$.

[11] If governors share the same objective function (i.e., $\tau = \bar{\tau}$), then the benefit-cost threshold is a function of the governor's perceived environmental damage (γ)

Remark A1. *As a governor's preference for environmental benefits increases ($\tau \uparrow$), or the perceived environmental damages increase ($\gamma\uparrow$), the cost effectiveness threshold for installing air pollution abatement technology decreases* $\left(\frac{C'}{q_i F'} \uparrow\right)$.

The benefit-cost threshold decreases with a governor's preference for environmental benefits,[12] so a "greener" governor mandates the installation of air pollution abatement technology with a higher per-unit cost.[13] For the remainder of our analysis, we assume that a governor's benefit-cost threshold is driven by ideology (τ) but acknowledge that using different (marginal) environmental damages (γ) has an equivalent effect.

The governor's preference is noteworthy due to the implications for environmental regulation. In the absence of federal oversight, a governor's ideology leads to different environmental outcomes. For example, let τ take two values, r and d, representing two types of governors, with $r, d \in [0,1)$ and $d > r$. Using equation (A4c), we obtain $\frac{d}{1-d} > \frac{r}{1-r}$, and therefore expect that a governor with weight d prefers the installation of more effective air pollution abatement technology.[14]

Importantly, the governor's preference influences environmental appointments, e.g., environmental protection agency officials, PUCs. Equation (A4c) implies that for any governor, with an area in nonattainment, there exists some i, such that $y_i > 0$. Once in nonattainment, governors and their appointees select air pollution abatement technology. Note that without a SIP, governors and state agencies cannot force firms to adopt air pollution abatement technology. Therefore, for all i, $y_i = 0$ in attainment areas, regardless of the value of τ. The absence of a SIP has further implications for expenditures on air pollution abatement technology. Specifically:

Proposition A1. *In attainment areas, a governor's political preferences do not influence stationary emission source expenditures on air pollution abatement technology. However, in nonattainment areas, the governor's political preferences influence stationary emission source expenditures.*

Governor preferences, realized through direct action and political appointments, influence the preferred air pollution abatement technologies. However, state legislatures must approve gubernatorial appointments. State legislatures controlled by the same political party are likely to mirror the governor's preferences, while state legislatures controlled by an opposing party can restrict gubernatorial appointments. If a state government is divided, then gubernatorial appointments require mitigation.

Suppose state legislatures[15] and governors have ideology preference τ_L and τ_g,

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[12] The two extreme thresholds, $\frac{\partial G}{\partial y} = q_i \gamma F_y$ and $\frac{\partial G}{\partial y} = -C_y$, are synonymous with installing the most effective air pollution abatement technology regardless of cost (which occurs when τ approaches one) and not installing any air pollution abatement technology regardless of effectiveness ($\tau = 0$).

[13] "Greener" could imply larger values for τ or γ.

[14] In the US, Democrats are generally considered more environmentally friendly than Republicans (e.g., Cragg et al. 2013). Obviously, this statement suggests that a Democratic governor's ideology leads to a larger reduction in air pollution than republican governors. Therefore, our model provides a plausible reason for the empirical results of Beland and Boucher (2015).

[15] The legislature's preference is taken as an aggregate preference based on composition.

respectively. Candidates whose ideological preference[16] falls within a range (δ) of each branch's ideological preference are approved, but we assume each branch's range for approval does not include the other party's ideal candidate, i.e., WLOG, if $\tau_g > \tau_L$, then $\tau_g - \delta > \tau_L$.[17] Therefore, each branch approves candidate (C) if $|\tau_C - \tau_i| \leq \delta$, with $i \in L, g$. A governor's objective is to select candidates such that $\tau_L \pm \delta = \tau_C$, i.e., governors nominate candidates according to: $\underset{\tau_C}{Min} \left|\tau_g - \tau_C\right| \ s.t. \ \tau_C \in \{\tau_L + \delta, \tau_g - \delta\}$. Since the governor selects candidates, the environmental preferences of any candidate skew in favor of the governor, which implies:

Proposition A2: *In nonattainment areas with a divided state legislature, the governor's political preferences and appointees are restrained by the state legislature, thereby influencing air pollution abatement expenditures at stationary emission sources.*

This proposition suggests that in divided state governments, air pollution abatement technology expenditures at stationary emission sources will skew towards, but not match, the governor's preference.

B.3. Policy implementation

SIP requirements for nonattainment areas provide governors with considerable discretion to address emission reductions. To satisfy NAAQS requirements, SIPs must sufficiently reduce emissions; see (A3b). The governor's environmental preference affects stationary emission sources and air pollution abatement technology adoption. As the governor's environmental preference increases,[18] the effectiveness of adopted air pollution abatement technology must increase to satisfy the SIP. However, regulatory statute prevents over-burdening stationary emission sources with expensive air pollution abatement technology. As part of RACT requirements, installed air pollution abatement technology must be affordable for each firm,[19] i.e., $TR_i - C(\boldsymbol{y}_i) > 0$. Incorporating these requirements into equation (A4b), the governor's problem becomes:

$$\max_{Y,B,\lambda,\eta} G_\tau = \tau\left(W - \gamma \sum_{i=1}^{N}[e - F(x_i) - F(y_i)]q_i\right) + (1-\tau)\sum_{i=1}^{N}[TR_i - C(y_i)] - \lambda\left(\sum_{i=1}^{N}[F(y_i)]q_i - B^2\right) - \eta\left(TR_i - C(y_i)\right) \quad \text{(A5)}$$

where λ and η represent Karush-Kuhn-Tucker (KKT) multipliers. (We provide the associated KKT conditions in Online Appendix B.4.) Several properties emerge. First, any governor unconcerned with aggregate profit or the difference between ambient air quality and the relevant NAAQS makes decisions based solely on the benefits and costs of any air pollution abatement technology. This scenario mirrors the governor's preference in the absence of federal oversight in

[16] A candidate's preference may be unknown. However, candidates are generally selected due to their alignment with an administration. Furthermore, cabinet positions generally serve at the pleasure of the governor.
[17] We assume deviation from the ideal preference is uniform across branches. If the range of appropriate candidates overlaps with each branch, then the governor selects candidates matching their preference.
[18] For the remainder of our analysis, we assume that environmental decisions are based on the governor's partisan preference, which may be somewhat restrained if the state's government is divided.
[19] As mentioned, we omit the input costs associated with each air pollution abatement technology. Importantly, for NOx abatement technology, the installation costs are correlated with input costs and effectiveness.

attainment areas. Second, governors with a strong preference for environmental benefits obtain greater utility from emission reductions beyond the federal standard. Finally, stationary emission source profits increase a governor's utility, but also provide the governor with latitude to require (as part of a SIP) better air pollution abatement technology.

We assume a functional form for air pollution abatement technology for cost and effectiveness, where air pollution abatement technology effectiveness takes the form $F(y) = \theta \ln y$ and air pollution abatement costs take the form $C(y) = \rho y^2$. θ scales the effectiveness of air pollution abatement technology and ρ scales the costs. The FOCs from (A5) show that the optimal air pollution abatement technology satisfies $\tau C_y - C_y + \tau q_i \gamma F_y = 0$. We then obtain:

$$2\tau y\rho - 2y\rho + \frac{\tau q_i \gamma \theta}{y} = 0, \tag{A6a}$$

which gives the optimal air pollution abatement technology based off the governor's preferences as:

$$y_\tau^* = \frac{\sqrt{2q_i \tau\theta\rho\gamma(1-\tau)}}{2\rho(1-\tau)}. \tag{A6b}$$

From (A6a) and (A6b), we obtain several comparative statics. The benefit-cost threshold of the governor's preferred abatement technology increases with abatement effectiveness θ, environmental damages γ, and firm output q_i.[20] Next, we wish to identify how the governor's partisan ideology influences the adoption of air pollution abatement technology. Using (A6b), we obtain a representative governor's preferred air pollution abatement technology based on their partisan affiliation. For governors of type r and d, this gives:

$$y_r^* = \frac{\sqrt{2q_i r\theta\rho\gamma(1-r)}}{2\rho(1-r)}; \quad y_d^* = \frac{\sqrt{2dq_i\theta\rho\gamma(1-d)}}{2\rho(1-d)}. \tag{A7a}$$

From these outcomes we obtain two important results. First, we calculate air pollution abatement technology expenditures corresponding to each partisan affiliation, which yields:

$$C(y_r^*) = \frac{1}{2}\gamma q_i \theta \frac{r}{1-r}; \quad C(y_d^*) = \frac{1}{2}\gamma q_i \theta \frac{d}{1-d}. \tag{A7b}$$

Comparing expenditures gives:

$$C(y_d^*) - C(y_r^*) = \frac{1}{2} q_i \theta\gamma \frac{d-r}{(1-d)(1-r)} \tag{A8a}$$

Collectively, $C(y_d^*) > C(y_r^*)$, or equivalently:

Proposition A3. *In nonattainment areas, governors of type d (relative to type r) require stationary emission sources to expend more on air pollution abatement technology, ceteris paribus.*

For governors of type d, the additional expenses imposed on polluting firms are worthwhile

[20] We provide comparative static calculations below.

due to the environmental improvements that they provide. Because of cost constraints imposed by RACT, firms maintain non-negative profits. If firms are profitable, a governor's willingness to impose greater expenses on firms impacts the effectiveness of installed air pollution abatement technology.

Next, we compare each type of the governor's preferred air pollution abatement technology, which provides the following:

$$y_d^* - y_r^* = \frac{\sqrt{2dq_i\theta\beta\gamma(1-d)}}{2\beta(1-d)} - \frac{\sqrt{2q_i r\theta\beta\gamma(1-r)}}{2\beta(1-r)}, \tag{A8b}$$

which shows that $y_d^* - y_r^* > 0$, or equivalently:

Proposition A4. *In nonattainment areas, governors of type d (relative to type r) require stationary emission sources to install more effective air pollution abatement technology, ceteris paribus.*

This result has implications for federal regulations that state administrations implement and enforce. We find that air pollution abatement technology decisions differ across state administrations according to:

$$\underbrace{y_d^* - y_r^*}_{\text{Change in techology standard}} = \underbrace{\left(\sqrt{\frac{d}{1-d}} - \sqrt{\frac{r}{1-r}}\right)}_{\text{Political ideology}} \underbrace{\sqrt{\frac{q_i\theta\gamma}{2\rho}}}_{\text{Production}} . \tag{A9}$$

We therefore expect air pollution abatement technology adoption in nonattainment areas to differ from that of attainment areas according to the governor's partisan affiliation.

B.4. Governor's FOC

In this online appendix, we examine the governor's multidimensional problem and examine the associated KKT conditions. Evaluating these conditions allows us to identify which constraints are binding, thereby allowing us to identify which variables influence the governor's standard for installed air pollution abatement technology.

Under SIP guidelines, the governor's problem becomes:

$$\max_{\boldsymbol{Y},B,\lambda,\eta} G_\tau = \tau(W - \gamma \sum_{i=1}^{N}\left[e - F(\mathbf{x}_i) - F(\mathbf{y}_i)\right]q_i) + (1-\tau)\sum_{i=1}^{N}\left[TR_i - C(\mathbf{y}_i)\right] - \lambda(\sum_{i=1}^{N}\left[F(\mathbf{y}_i)\right]q_i - B^2) - \eta(TR_i - C(\mathbf{y}_i)), \tag{A10}$$

which yields the following KKT conditions:

$$\frac{\partial G_\tau}{\partial y_i} = C'\eta - C' + C'\tau - F'q_i\lambda + F'\tau q_i\gamma$$
$$\frac{\partial G_\tau}{\partial \lambda} = B^2 - q_i F\left(y_i\right)$$
$$\frac{\partial G_\tau}{\partial B} = 2B\lambda$$

$\frac{\partial G_\tau}{\partial \eta} = C(x_i) - TR_i$.

Examining the possible scenarios from the KKT conditions yields the five following cases:

1) $B = 0$, then $F(\boldsymbol{y}_i)q_i = 0$, which can't happen since $\sum_{i=1}^{N}\left[e - F(\mathbf{x}_i)\right]q_i + \sum_{m=1}^{M}\tau_m - B^2 \le e_R$

2) $B > 0$, $\lambda = 0$, and $\eta = 0$, then $F(\boldsymbol{y}_i)\, q_i = B^2 > 0$ and $C'(1-\tau) = F'\tau q_i \gamma$, which implies that $\frac{\tau\gamma}{1-\tau} = \frac{C'}{F' q_i}$. Therefore, a governor unconcerned with having a "buffer" against the ambient air quality standard or aggregate profits makes the air pollution abatement technology adoption decision based off effectiveness and cost. This outcome matches the governor's preference in the absence of direct federal oversight.

3) $B > 0$, $\lambda > 0$, and $\eta = 0$, then $F(\boldsymbol{y}_i)\, q_i = B^2 > 0$ and $F' q_i(\tau\gamma - \lambda) = C'(1-\tau)$, which implies that $\frac{\tau\gamma - \lambda}{1-\tau} = \frac{C'}{F' q_i}$. This result requires that $\tau\gamma - \lambda > 0$, or equivalently, $\tau > \frac{\lambda}{\gamma}$. Therefore, requiring greater emission cuts beyond the federal standard increases the governor's utility through reduced environmental damages.

4) $B > 0$, $\lambda = 0$, and $\eta > 0$, then $F(\boldsymbol{y}_i)\, q_i = B^2 > 0$ and $\tau\gamma q_i F' = (1-\tau-\eta)C'$, which implies that $\frac{\tau\gamma}{1-\tau-\eta} = \frac{C'}{F' q_i}$. This result requires that $1-\tau-\eta > 0$, or equivalently, $\tau < 1-\eta$.

Therefore, greater firm profits increase the governor's utility through reduced environmental damages.

5) $B > 0$, $\lambda > 0$, and $\eta > 0$, then $F(\boldsymbol{y}_i)\, q_i = B^2 > 0$ and $(\tau\gamma - \lambda) q_i F' = (1-\tau-\eta)C'$ $\tau\gamma q_i F' = (1-\tau-\eta)C'$, which implies that $\frac{\tau\gamma - \lambda}{1-\tau-\eta} = \frac{C'}{F' q_i}$. This result requires that $\tau\gamma - \lambda > 0$ and $1-\tau-\eta > 0$. This outcome matches the results from cases 3) and 4): greater emission cuts and lower aggregate emissions increase the governor's utility.

B.5. Governor's comparative statics

Finally, we provide the comparative statics based on the governor's problem that we provide in equation (A5). Examining the governor's problem once an area enters nonattainment yields the following:

$$\frac{\partial y_\tau^*}{\partial \beta} = -\frac{\tau q_i \theta \gamma}{\beta\sqrt{2\tau q_i \theta \beta \gamma (1-\tau)}} < 0$$

$$\frac{\partial y_\tau^*}{\partial \theta} = \frac{\tau q_i \gamma}{\sqrt{2\tau q_i \theta \beta \gamma (1-\tau)}} > 0$$

$$\frac{\partial y_\tau^*}{\partial \gamma} = \frac{\tau q_i \theta}{\sqrt{2\tau q_i \theta \beta \gamma (1-\tau)}} > 0$$

$$\frac{\partial y_{\tau}^{*}}{\partial q_{i}} = \frac{\tau\theta\gamma}{\sqrt{2\tau q_{i}\theta\beta\gamma(1-\tau)}} > 0$$

From these comparative statics, we observe the factors that influence the governor's preferred air pollution abatement technology. Specifically, as air pollution abatement technology costs increase, the governor selects a lower standard for the required air pollution abatement technology. However, as air pollution abatement effectiveness, emission damages, and firm production increase, the governor's standard also increases.

C. Supplementary analysis for gubernatorial sample

In this online appendix, we perform several additional analyses of the gubernatorial sample. Here, we examine our RD specification using event studies in time, perform RD validity tests, examine the variation in our regression measures, perform power calculations, assess the coverage of electric utility emissions in our analysis sample, and provide additional sensitivity analyses.

C.1. Event studies in time

We lend support to the validity of our results by examining the trends in our outcomes in states where Democrats and Republicans won prior to the close election. In the spirit of Grembi et al. (2016), we estimate event-time-varying RD treatment effects. In a way analogous to difference-in-difference event studies, we define the "event" as a close Republican win (the year of the election). In this online appendix, we present event studies for new air pollution abatement capital expenditures and the probability of SCR/SNCR technology with county fixed effects (Online Appendix Figure A2) and the probability of FGD technology with state and county fixed effects (Online Appendix Figure A3). [Event studies for new air pollution abatement capital expenditures and the probability of SCR/SNCR technology with state fixed effects are in the main text.] For each outcome, we show event study graphs for electric utilities in attainment areas and for electric utilities in nonattainment areas. Importantly, we do not find evidence of significant differential pre-event trends for any of these outcomes of interest, as their coefficient magnitudes are statistically insignificant and close to zero. The post-treatment effects that we estimate from these specifications also qualitatively match those of the RD results presented in our primary analysis, providing further evidence of the validity of our estimation results.

In addition to these RD event studies, we present dynamic difference-in-differences plots analogous to those discussed above (Online Appendix Figures A7-A12). As before, we do not find evidence of significant differential pre-event trends for any of our outcomes of interest.

C.2. RD validity tests

First, we estimate the RD specifications (equations (1) and (2) of the main text) on placebo outcomes. An assumption of local linear RD is that potential outcomes are smooth through the RD threshold. While it is not possible to test potential outcomes, finding discontinuities in observable outcomes could suggest that other unobservable factors change in states that experience close Republican wins versus states that experience close Democratic wins. As recommended by de la Cuesta and Imai (2016) and Skovron and Titiunik (2015), we estimate separate local linear regressions for each baseline covariate.[21]

We re-estimate equations (1) and (2) for the baseline covariates of boiler age, county unemployment, and county population. We conduct placebo tests at the facility level and at the boiler level.[22] Online Appendix Table A6 shows results for these placebo outcomes using equation (1) and Online Appendix Table A7 shows results for the differential effects that we estimate using equation (2). Online Appendix Table A6 shows no statistically significant effects of Republican governor on any placebo outcome (neither in plant level nor boiler level data). More importantly for the hypotheses of interest to this study, we find little evidence of differential effects in placebo outcomes in Online Appendix Table A7.[23] In addition to our baseline covariates, we test for discontinuities in several other variables including: new air pollution abatement capital expenditures in the four years prior to the governor taking power (facility level only), NOx abatement technology installation in the four years prior to the governor taking power (boiler level only), the year of the election, partisan control of the lower state house, partisan control of the state senate, and partisan majority of the federal delegation of US senators and representatives. We re-estimate equations (1) and (2) on these outcomes, using both facility level and boiler level data. As shown in Online Appendix Tables A8-A11, we do not find any significant discontinuities in any of these placebo outcomes.

Finally, we examine the density function of the forcing variable (vote margin). In the context of close elections, we aim to test for a discontinuous change in the number of close elections won by a Republican candidate versus a Democratic candidate. A discontinuity in the density of vote margin may signify that political parties influence close elections, which could cast doubt on our identification strategy. We examine the density of vote margin at the state-year level, which is the level of treatment in this application. We test for discontinuities in vote margin density for the overall sample (Online Appendix Figure A13, Panel A), attainment areas (Online Appendix Figure A13, Panel B), and nonattainment areas (Online Appendix Figure A13, Panel C). In each case, we fail to reject the null hypothesis of no manipulation in the density of vote margin.

C.3. Variation in regression measures

Here, we discuss the temporal and cross-sectional variation in the outcomes for our gubernatorial sample. Table 1 of the main text indicates much variation in both new air pollution abatement capital expenditures and the presence of SCR/SNCR technology across our sample; coefficients of variation for these measures across the entire sample are 3.08 and 1.51, respectively. Online Appendix Tables A1 and A2 present evidence that this temporal and cross-sectional variation is even more pronounced for the outcomes by gubernatorial affiliation and nonattainment designation subsample. We examine variation in the dependent variables in two additional ways. First, we estimate the variation that is unexplained by entity, i.e., facility or boiler, and year fixed effects. Across entities, 96% of the variation in new air pollution abatement capital expenditures and 28% of the variation in SCR/SNCR adoption is unexplained by entity and year fixed effects. Second, we explore the within-entity variation in the outcomes. We calculate the standard deviation of each

[21] We use the optimal bandwidths from our two main dependent variables of interest.

[22] The facility level analysis is relevant for new air pollution abatement capital expenditures and the boiler level analysis is relevant for the NOx abatement technology of SCR/SNCR. We use overall nonattainment status for the plant level analysis and PM, ozone, and NO2 nonattainment for the boiler level analysis.

[23] The differential effect is significant at the 10% level for one outcome at the boiler level of analysis (age). However, this is not significant at conventional levels once applying corrections for multiple hypothesis testing.

entity's new air pollution abatement capital expenditures and SCR/SNCR adoption over the sample period. We then generate summary statistics for these measures. The entity specific standard deviations have a mean and standard deviation of 16,553 and 20,768 for new air pollution abatement capital expenditures and a mean and standard deviation of 0.160 and 0.214 for SCR/SNCR adoption. These values reveal coefficients of variation of 1.25 and 1.34, respectively, which suggest much within-entity variation in the outcomes. As before, these measures of variation are amplified when examining our subsamples of interest.

C.4. Power calculations

In this online appendix, we present power analyses for our RD design. Cattaneo et al. (2019) develop the rdpow command (Stata) to assess the statistical power of the RD design for a given hypothesized RD treatment effect. For both the facility level sample and the boiler level sample, we present graphs of the power functions. For consistency with the RD design of the main text, we use a uniform kernel, the same optimal bandwidths as described in the main text, and cluster standard errors at the state level. We follow the same approach that we use to produce Figures 1 and 2 of the main text. As one example, we regress arcsinh transformed real new air pollution abatement capital expenditures on year fixed effects, state fixed effects, number of boilers, and indicators for coal fuel and nonattainment status. We then use the residuals as the outcome variable in the rdpow command. Because we use conventional RD inference in our analysis, we set the bias to zero.

Online Appendix Figure A14 shows the power function for new air pollution abatement capital expenditures and Online Appendix Figure A15 shows the power function for SCR/SNCR technology. As seen in the figures, our RD design has substantial power to detect treatment effects in the ranges that we find in our RD estimations, even for the subsamples of nonattainment/attainment areas.

C.5. Percentage of electric utility emissions in the analysis samples

Because we examine only a balanced panel of electric utilities and boilers, it is possible that our benefit and cost analysis (section 7 of the main text) omits emissions from this sector during our sample period, which would bias our estimates toward zero, i.e., we would be more likely to show null effects of air pollution abatement technology on ambient air quality. To assess this concern, we examine the proportion of electricity generating capacity and emissions in 2017 that our sample contains. For nonattainment areas, our sample contains 65% of all electricity generating capacity produced by natural gas and coal fired boilers. For emissions, our sample contains 81% and 76% of SO2 and NOx emissions in this sector, respectively. These percentages and the fact that the electric utility sector is the highest stationary emission source of SO2 and NOx emissions (EPA 2017) suggest that our analysis provides credible estimates for the effects of air pollution abatement technology on ambient air quality.

C.6. Additional sensitivity analysis

In our analysis sample, roughly half of all observations have $0 in new air pollution abatement capital expenditures. We therefore re-estimate equations (1) and (2), replacing the outcome with a dummy that indicates any positive capital expenditures. In this way, we estimate the change in the probability of installing any new air pollution abatement capital. Columns 1 and 2 of Online Appendix Table A12 show results for the estimation of equation (1) and columns 3 and 4 of Online Appendix Table A12 show results for the estimation of equation (2). In Online Appendix Table A12, there is no significant effect of a Republican governor on the overall probability of positive new air pollution abatement capital expenditures. However, we do see a statistically significant and large differential effect on facilities in nonattainment areas. Relative to a facility in an attainment area, a Republican governor leads to a 36-percentage point decrease in the probability of positive new air pollution abatement capital expenditures, as compared to the counterfactual of a Democratic governor.

Next, Online Appendix Tables A13-A15 present estimation results for alternative bandwidths and Online Appendix Tables A16-A18 show estimation results when we lag nonattainment status or limit the estimation samples to states where the governor's party has been in power for one or more years. In Online Appendix Tables A19-A21, we collapse our data to the county level and estimate regressions on county level averages, where we use weights on county level population and county level electrical generation capacity. In Online Appendix Tables A22-A23, we exclude the smallest generators from the sample. Online Appendix Table A22 shows results for new air pollution capital expenditures and Online Appendix Table A23 shows results for probability of SCR/SNCR technology. In Online Appendix Figures A19-A24, we conduct a leave-one-out analysis where we estimate our main specifications successively leaving out one state at a time. In general, qualitative results hold across these sensitivity checks. The magnitudes of the point estimates sometimes increase or decrease relative to their baseline levels, and we lose some precision in the estimates in a few of the checks. However, the general pattern of results holds; relative to a Democratic governor, a Republican governor differentially decreases spending on new air pollution abatement capital and reduces the probability of installing the most effective NOx abatement technology in nonattainment areas.

D. Supplementary analysis for state legislative sample

In this online appendix, we perform several additional analyses for the state legislative sample. Here, we examine our multidimensional RD specification using event studies in time, perform multidimensional RD validity tests, examine the variation in our regression measures, perform power calculations, and provide additional sensitivity analyses.

D.1. Event studies in time

Like the gubernatorial analysis, we lend support to the validity of our multidimensional RD results by examining the trends in our outcomes in states where Democrats and Republicans won the majority prior to the close state legislative election. Here, we present analogous figures, where the "event" is the year of the election of a close Republican majority to the lower state house; we present these graphs in Online Appendix Figures A4-A6. Like the gubernatorial analysis, we do not find evidence of significant differential pre-event trends for any of the outcomes of interest, as their coefficient magnitudes are statistically insignificant and close to zero. These event studies again present further evidence of the validity of our estimation results.

D.2. Multidimensional RD validity tests

We conduct the same placebo tests on baseline covariates for the multidimensional RD (state legislative sample) as described in Online Appendix C.2. for the gubernatorial sample. As seen in Online Appendix Tables A24 and A25, we find no statistically significant effects of a Republican majority on our placebo outcomes. Likewise, we find no evidence of a discontinuous density in the running variable in Panels A-C of Online Appendix Figure A16.

D.3. Variation in regression measures

Here, we discuss the temporal and cross-sectional variation in the outcomes for our state legislative sample. We proceed analogously to Online Appendix C.3. Table 1 of the main text shows that the state legislative sample is descriptively like the gubernatorial sample. Coefficients of variation across the entire state legislative sample are 3.02 (new air pollution abatement capital expenditures) and 1.53 (presence of SCR/SNCR technology). Also, Online Appendix Tables A3 and A4 for the state legislative sample resemble their counterparts from the gubernatorial sample (Online Appendix Tables A1 and A2). Across entities, 95% of the variation in new air pollution abatement capital expenditures and 28% of the variation in SCR/SNCR adoption is unexplained by entity and year fixed effects. Regarding within-entity variation in the outcomes, the entity specific standard deviations have a mean and standard deviation of 16,923 and 21,053 for new air pollution abatement capital expenditures and a mean and standard deviation of 0.159 and 0.214 for SCR/SNCR adoption. These values reveal coefficients of variation of 1.24 and 1.35, respectively, which are nearly identical to their counterparts from Online Appendix C.3.

D.4. Power calculations

We produce power functions for our multidimensional RD on the state legislative sample using procedures analogous to those described in Online Appendix C.4. Online Appendix Figures A17 and A18 collectively show that we have sufficient power to detect treatment effects across our outcomes and subsamples.

D.5. Additional sensitivity analysis

Finally, we discuss the results for additional sensitivity analyses of the state legislative sample. Online Appendix Table A26 shows results when we estimate as our outcome a dummy that indicates positive new air pollution abatement capital expenditures. Coefficients are not statistically significant at conventional levels, but point estimates suggest that a Republican majority differentially decreases the probability of new air pollution abatement capital expenditures in nonattainment areas relative to attainment areas.

Online Appendix Tables A27-A29 present multidimensional RD results from alternative bandwidths. Online Appendix Tables A30-A32 show results when we lag nonattainment status or limit the sample to states where the governor’s party has been in power for one or more years. Finally, Online Appendix Tables A33-A35 tabulate results when we aggregate our analysis to the county level and weight based on county population or electricity generation capacity. In general, qualitative results hold across the various robustness checks.

E. Effect of air pollution control policies other than the NAAQS on technological adoption

In the US, electric utilities are the largest stationary emission sources of several harmful air pollutants (EPA 2017). As such, in addition to the NAAQS, electric utilities are subject to other air pollution control policies. We examine in this appendix how these other policies affect the interpretation of our results.

First, we turn to the literature to consider the likelihood that electric utilities in our sample install capital intensive abatement technology because of air pollution control policies other than the NAAQS. As mentioned in the main text, the more recent air pollution control policies have moved from a command and control approach to market-based solutions. These policies therefore do not mandate abatement technology adoption like the NAAQS, but instead provide an incentive structure where regulated facilities can abate emissions in any way they choose. Nearly all policies that control air pollution from the electric utility sector over the past 20 years use a tradable permit system, where individual electric utilities can choose to abate or purchase emission allowances on the open market. Tradable permit systems therefore allow regulated facilities flexibility in meeting emission targets, which encourages the use of low-cost abatement options (Linn 2008). There exists evidence that electric utilities make slight technological modifications, rather than installing add-on abatement technology, because of tradable permit policies. In its analysis of the NOx Budget Program (NBP), EPA (2004) finds that regulated facilities invest in technologies with short (e.g., one-year) pay-back periods. SCR/SNCR (and FGD) systems have much longer periods of use, lasting between 15 and 25 years, so the NBP likely does not drive most SCR/SNCR installation in our sample. Similarly, Linn (2008) finds that electric utilities subject to the requirements of the NBP make low-cost abatement technology modifications rather than installing expensive add-on technology. However, Fowlie (2010) finds that several coal fired electric utilities chose to comply with the NBP by installing SCR technology, particularly publicly owned electric utilities located in regulated electricity markets. Within our sample, only six boilers at three coal fired power plants subject to both NBP and nonattainment requirements installed new SCR technology between 2001 and 2004 (the years that overlap ours and Fowlie's (2010) sample). It is therefore possible that these electric utility managers made the decision to install the SCR to comply with the NBP, rather than being mandated to install the technology by a nonattainment SIP (we do note, however, that it is possible that the SCR installation is the result of the nonattainment SIP). We empirically assess whether these and other electric utility boilers subject to the requirements of both the NAAQS and other air pollution control policies affect our primary estimation results. We discuss this analysis and its results below.

Second, we again turn to the literature, now to examine the emission allowance and abatement costs of electric utilities regulated under tradable permit policies in the US that aim to curb NOx and SO2 emissions. Like before, the purpose of this exercise is to determine the likelihood that electric utilities in our sample install the most effective forms of NOx and SO2 abatement technology because of regulatory requirements outside of those of the NAAQS. As part of emission trading policies, economic theory suggests that profit maximizing facilities will abate to the point where their marginal abatement costs equal the price of an additional emission allowance. Normatively, the marginal costs of abatement technology should be less than or equal to the price of an emission allowance for electric utilities to comply with emission trading policies by installing the technology. Several studies examine the costs of emission allowances and pollution abatement for these policies. First, Carlson et al. (2000) find that the least cost abatement option under the Acid Rain Program (ARP) is fuel switching and that the marginal cost of FGD installation is prohibitively larger than both fuel switching and the purchase of emission allowances. Importantly, these cost differences are so large that the authors assume that no boilers comply with the ARP by installing FGD technology. Second, Chan et al. (2018) also examine the ARP and produce similar conclusions: the cost to abate one ton of SO2 emissions via FGD is much more expensive than purchasing an emission allowance to emit an additional ton of SO2 on the ARP's allowance market. Other studies look at NOx abatement policies. Fowlie and Muller (2019) identify the allowance price in the NBP market of roughly $4,500 per ton (the average price during the period prior to the NBP compliance deadline). Compared to the marginal abatement cost of SCR/SNCR of $5,000-$6,500 (EPA 2015), electric utility managers would minimize costs in abatement as part of the program by purchasing emission allowances rather than installing capital intensive abatement technology. And finally, Fowlie et al. (2012) identify Regional Clean Air Incentives Market (RECLAIM) allowance prices between $2,000 and $3,000 per ton of NOx during our sample period, well below the marginal abatement costs of the most effective NOx abatement technology.

Finally, and perhaps most telling, we empirically examine how the presence of other NOx and SO2 emission control policies affect our primary estimation results. We re-estimate our primary regression specifications (equations (1) and (2) from the main text) that examine abatement technology adoption as the outcome (SCR/SNCR for NOx emissions and FGD for SO2 emissions) with the following changes in analysis sample and specification. First, we eliminate from the analysis sample all boilers that at any point during our sample period install the most effective NOx abatement technology while regulated under both the NAAQS (via nonattainment designation) and the NBP. For the remaining boilers in this analysis sample, add-on abatement technology adoption is the result only of a nonattainment SIP, not as a way to comply with another regulation. Columns 1 and 2 of Online Appendix Table A36 present results for this estimation, which are nearly identical to those of our primary specification. Second, we control for the NBP by including in our specifications a dummy that indicates if the boiler is regulated under the NBP each year. Columns 3 and 4 of Online Appendix Table A36 show that the inclusion of this control does not meaningfully alter our primary estimation results. We also examine if there is differential implementation of the NBP depending on the partisan affiliation of the governor. Here, we do not expect differential effects like with the NAAQS because the NBP does not mandate abatement technology adoption in a setting where there is regulatory discretion, i.e., state political leaders have no say in abatement choices under these policies. Instead, the NBP provides an incentive structure for regulated facilities to cost effectively decrease NOx emissions in any way. Therefore, these policies serve as placebos for our primary specifications. Column 5 of Online Appendix Table A36 presents estimation results for this specification. The interaction coefficient, which is statistically insignificant and close to zero, confirms that there is no differential effect of gubernatorial political affiliation under the NBP on SCR/SNCR adoption. Finally, columns 6-8 of Online Appendix Table A36 present results for similar specifications to those whose results we present in columns 3-5. However, here we incorporate NOx emission control policies in addition to the NBP. These specifications include a "NOx control policy" dummy that indicates if boilers are regulated under the Clean Air Interstate Rule, the SIP NOx Program, or RECLAIM. The results in columns 6 and 7 of Online Appendix Table A36 show that the inclusion of this policy dummy does not meaningfully change our primary estimation results. And column 8 results are like those in column 5, confirming our expectation that there is no differential effect of gubernatorial political affiliation under the non-NAAQS policies on SCR/SNCR adoption.

For SO2 abatement technology and emission control policies, we perform exercises analogous to those above, with several key differences. First, we eliminate from the analysis sample all boilers that at any point during our sample period install an FGD system while regulated under both the NAAQS (via nonattainment designation) and the ARP. Columns 1 and 2 of Online Appendix Table A37 present results from this estimation, which are nearly identical to those of our primary specification. Second, we control for the ARP by including in our specifications a dummy that indicates if the boiler is regulated under the ARP each year. Columns 3 and 4 of Online Appendix Table A37 show that the inclusion of this control does not meaningfully change our primary estimation results. We also examine if there is differential implementation of the ARP depending on the partisan affiliation of the governor. For the same reasons as above, we do not expect a differential effect in this setting. Column 5 of Online Appendix Table A37 presents estimation results for this specification and confirms that there is no differential effect. Finally, columns 6-8 of Online Appendix Table A37 present results while incorporating an "SO2 control policy" dummy that indicates if boilers are regulated under the Clean Air Interstate Rule, the Mercury and Air Toxics Program, or RECLAIM. The results in columns 6 and 7 show that the inclusion of this policy dummy does not meaningfully change our primary estimation results. And column 8 results are qualitatively like those that we present in column 5.

Collectively, we show that the adoption of capital intensive air pollution abatement technology in our setting is most likely a result of the NAAQS and nonattainment designation, rather than some other air pollution control policy. Further, our primary analysis examines an air pollution control policy (NAAQS) where there is regulatory discretion, which is not the case for the other policies, so the differential effect that we identify is unique to our setting (which we empirically show). The existence of additional air pollution control policies that regulate electric utilities during our sample period therefore does not affect our primary estimation results or their interpretation.

F. External validity

In this online appendix, we assess the empirical results of our primary analysis away from the RD cutoff using a difference-in-differences estimator. Angrist and Rokkanen (2015) develop a method to identify effects away from the RD cutoff. This approach depends on a conditional independence assumption where potential outcomes are assumed to be independent of the running variable within a specified window. In their approach, one runs separate regressions on both sides of the threshold, where the dependent variable is the same as that from the RD specifications and the key independent variable is the running variable (vote margin and Euclidean distance in our application). After adding a suitable control set of covariates, one interprets a small and insignificant relationship between the running variables and the outcome as evidence of conditional independence. Hainmueller et al. (2015) apply this method to a close election setting and conclude that they can estimate the effects of incumbency in windows as large as 15 percentage points. In their application, they find estimated effects that are like the RD estimates from narrower windows.

Here, we implement this approach to estimate the ATE away from the threshold for both the gubernatorial elections and the state legislative elections. For clarity, we focus here on the gubernatorial RD and note the multidimensional state legislative analysis is analogous. For our control set, we use all the covariates from our RD specifications [e.g., nonattainment status, fuel controls, age of boilers, county population, state fixed effects, year fixed effects, number of boilers (facility level analysis), and lagged NOx abatement technology (boiler level analysis)] and add controls for lagged vote margin (previous gubernatorial election), percentage Republican of US House delegations, percentage Republican of US Senate delegations, annual state level productive capacity of coal, and annual state level production of natural gas. We then start with vote margins of 40 and decrease the window by five percentage points until we find a window where vote margin is small and statistically insignificant on both sides of the threshold. For the boiler level analysis (NOx abatement technology), we find evidence to support the conditional independence assumption for a window as wide as 25 percentage points (on both sides of the threshold). For the facility level analysis (new air pollution abatement capital expenditures), vote margin is statistically significant when we use windows larger than 15 percentage points. So, we use a window of 15 (on both sides of the threshold) for the facility level analysis.

We then estimate difference-in-differences specifications within the above windows. The specifications take equation (1), remove RD controls, and add the variables from the above discussed control set. Online Appendix Table A38 shows results for nonattainment and attainment areas for the gubernatorial analysis. Online Appendix Table A39 presents results for the analogous state legislative analysis. We also present RD estimates for each subsample, using the optimal bandwidths from the manuscript. As seen in Online Appendix Tables A38 and A39, qualitative results hold when estimating the ATE on wider bandwidths. Coefficient point estimates sometimes differ in magnitude, but confidence intervals overlap. Therefore, across all outcomes, we find no evidence that the ATE is statistically different from the RD design LATE.

G. Political contributions from the electric utility sector

In this online appendix, we examine whether political contributions or lobbying affect the interpretation of our primary estimation results. We obtain data on political contributions from two sources, Bonica (2016) and Bonica (2017). Bonica (2016) contains records on over 130 million contributions made to political candidates in local, state, and federal elections from 1979 to 2014. Bonica (2017) identifies political contributors from corporate directors and executives of Fortune 500 firms who were serving in July 2012. Within Bonica (2017), there exist records on total amount contributed to Democrats, total amount contributed to Republicans, and sector/industry of the contributor. The unit of analysis is Bonica (2017) is an individual at a Fortune 500 company.

We first test for differences in the percentage of contributions to Republicans (in any election) for directors/executives of electric utilities versus directors/executives in other sectors. Table A40 shows results for two comparison groups. Comparing electric utility directors/executives with directors/executives from all non-electric utilities, we see that there is no significant difference in the percentage of contributions to Republicans. In a second comparison group, we exclude executives/directors from services and the financial sector. Environmental policies are least likely to affect these two sectors because they have little or no manufacturing. Again, we find no significant differences in the percentage of contributions going to Republicans from electric utilities versus non-electric utilities (excluding services and financial sectors). We also conduct a parallel analysis of contributor ideologies using the Bonica (2016) DIME CFscore. The CFscore is a common-space campaign finance score that measures the ideal point ideology of contributors. Among the Fortune 500 directors/executives, the CFscore ranges from -1.74 (most liberal contributor) to 2.39 (most conservative contributor). As shown in Online Appendix Table A40, we do not find any significant differences in the average ideology as measured by the CFscore for executives/directors from electric utilities versus those from non-electric utilities.

A subset of the records in Bonica (2016) are contributions to gubernatorial candidates; we match these contribution records with information about directors and executives from Bonica (2017). This matching results in 14,176 gubernatorial election contribution records where we can identify the political party (Democrat or Republican) and state of the candidate. At the contributor level, we have data on 165 electric utility executives and 1,993 executives from other sectors that contributed to at least one gubernatorial campaign. Multiple contributions from the same individual are not independent events so we test for differences in partisan composition of gubernatorial contributions in a simple linear regression framework. Using the contributions data, we estimate a linear probability model. We estimate the following equation with OLS:

$$Republican\ Contribution_{ij} = \alpha + \beta * utility_i + \varepsilon_{ij}, \quad \text{(A11)}$$

where the dichotomous outcome, $Republican\ Contribution_{ij}$, equals one for a contribution to a Republican gubernatorial candidate from individual *i* on occasion j and zero for a contribution to a Democratic gubernatorial candidate, $utility_i$ is an indicator for the contributor *i* being an executive/director at an electric utility, and ε_{ij} is the error term. We cluster standard errors at the individual (contributor) level. We show in Online Appendix Table A41 that there is no significant difference in the probability of an electric utility director/executive contributing to a Republican gubernatorial candidate, as compared to a non-electric utility director/executive.

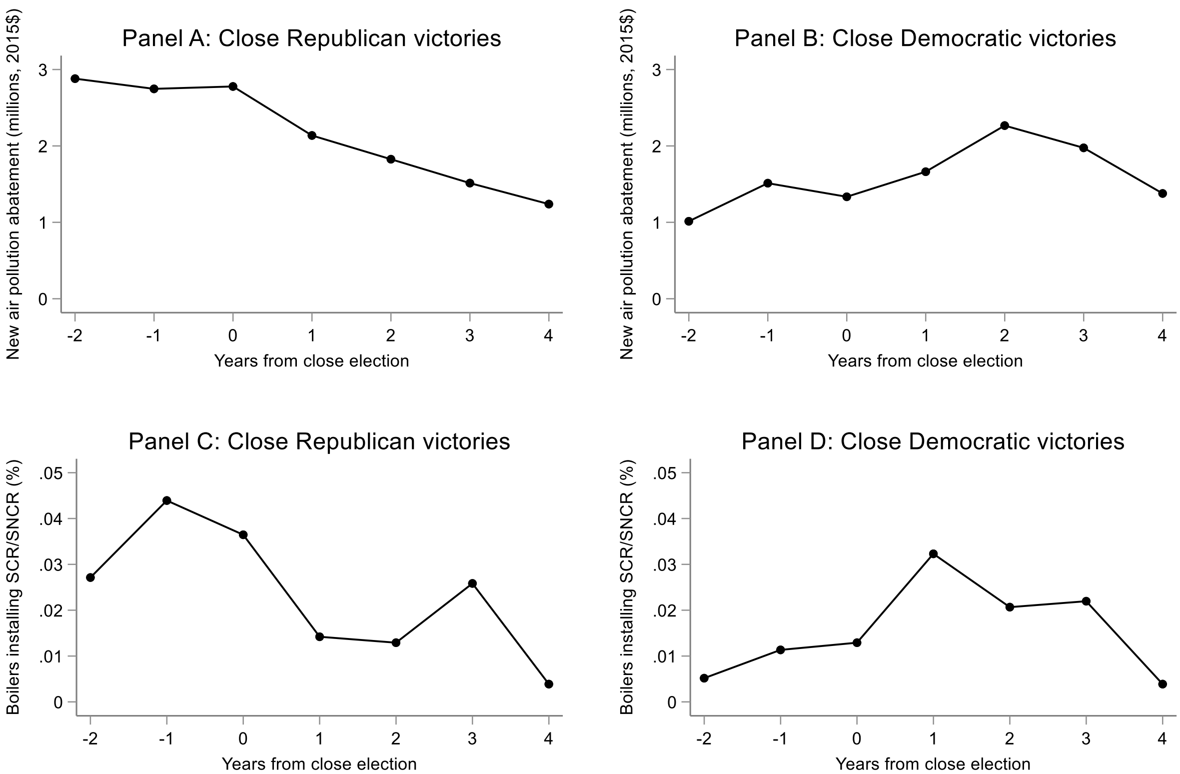
We also sum the total contributions to Republican and Democratic gubernatorial candidates to the individual (contributor) level and test for differences in the percentage of dollars contributed to Republican candidates for electric utility executives/directors versus non-electric utility executives/directors. We estimate the analogous model to equation (A11), replacing the dichotomous outcome in equation (A11) with a continuous percentage ranging from zero to one. We report robust standard errors to correct for heteroskedasticity. Lastly, we estimate the same model on the individual level data, replacing the outcome variable with the DIME CFscore of the contributor. This exercise tests for differences in the political ideologies of contributors to gubernatorial candidates. Across all specifications and samples, we find only one case in which there is a significant difference at the 10% level; this occurs when we drop services and financial sectors from the comparison group. In this sample, executives/directors at electric utilities contribute 5.8% less of their total contributions to Republican governors as compared to non-electric utility executives/directors. Collectively, these analyses therefore show that electric utility executives/directors descriptively look nearly identical to their non-electric utility counterparts, both in partisan contribution behavior and in ideology.

Finally, we test for a discontinuous change in the proportion of contributions from electric utility executives/directors relative to other industries and for a discontinuous change in the dollar amount of contributions from electric utility executives/directors, for close Republican gubernatorial wins versus close Democratic wins. We collapse the 14,176 gubernatorial contribution records to the state-election cycle level. We then match the state-election cycle level observations with historical gubernatorial election outcomes and estimate RD specifications analogous to those in equations (1) and (2) of the main text. Online Appendix Table A42 shows results for the Calonico et al (2019) optimal bandwidths and for the bandwidths used for our gubernatorial samples in the main text (9.697 and 9.191). In columns 1-3, we do not find any significant effect of a Republican win on the proportion of contributions from electric utility directors/executives. Likewise, we do not find any significant effect of a Republican win on the dollar amount of contributions from electric utility directors/executives in columns 4-6

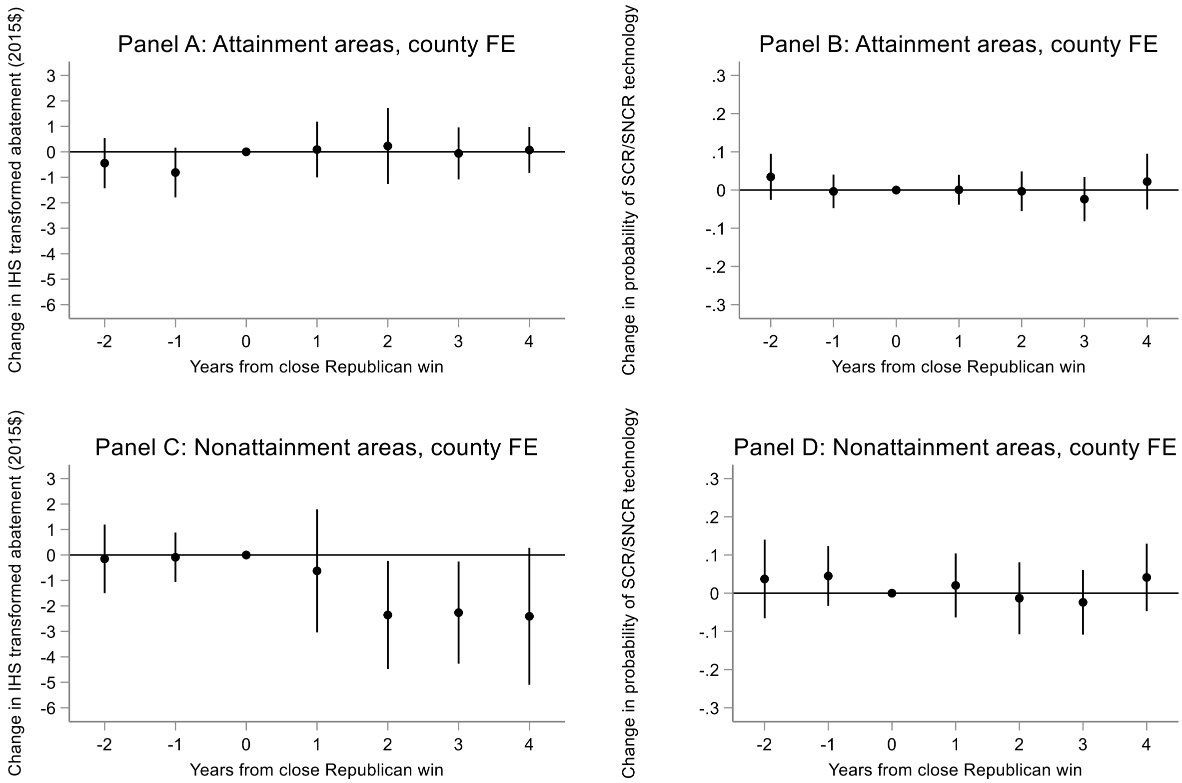
H. Heterogeneity by nonattainment designation

In this final online appendix, we estimate our baseline specifications using the nonattainment status of each individual criteria air pollutant, rather than pooling the measures. We present estimation results for these specifications in Online Appendix Tables A46-A51. In both the gubernatorial and state legislative samples, the effects of close elections on new air pollution abatement capital expenditures appear strongest for PM and CO nonattainment. For the gubernatorial sample, the effects on SCR/SNCR and FGD technology installation are qualitatively like the baseline results across the various contributing criteria pollutants. For the state legislative sample, the results on SCR/SNCR technology are more mixed; the effect is like the baseline result for ozone nonattainment, but there is a small, positive, and insignificant differential effect of a close Republican majority for PM nonattainment.

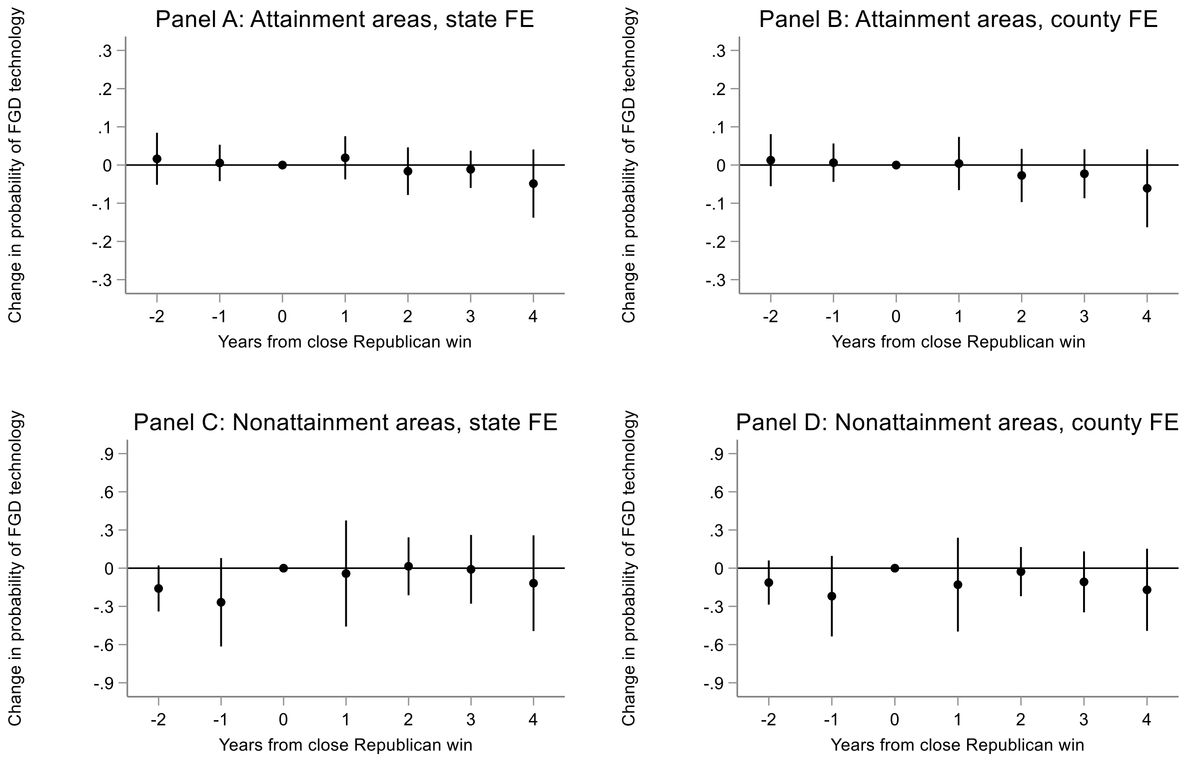
I. Supplemental figures



Appendix Figure A1. Data trends for new air pollution abatement capital expenditures and proportion of boilers installing SCR/SNCR technology, nonattainment areas.
Notes: This figure presents aggregate new air pollution abatement capital expenditures (Panels A and B) and the proportion of boilers that install SCR/SNCR technology (Panels C and D) for electric utilities located in nonattainment areas for the years leading up to and after each close election.

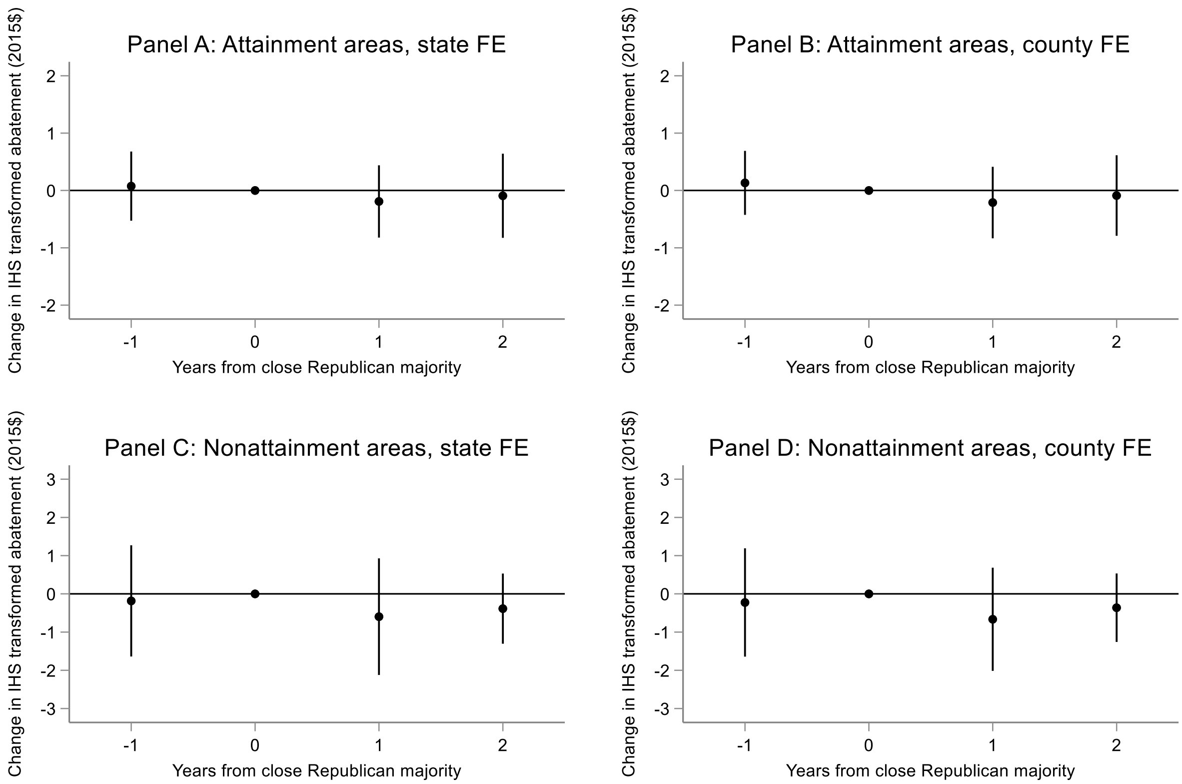


Appendix Figure A2. RD event studies for new air pollution abatement capital expenditures and probability of SCR/SNCR technology, gubernatorial elections.
Notes: This figure presents point estimates from the estimation of an event study of a close Republican gubernatorial win on new air pollution abatement capital expenditures (Panels A and C) and a dummy indicating the presence of the most effective NOx abatement technology (SCR/SNCR) [Panels B and D]. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include county and year fixed effects and the appropriate controls from the full specifications of equations (1) and (2).



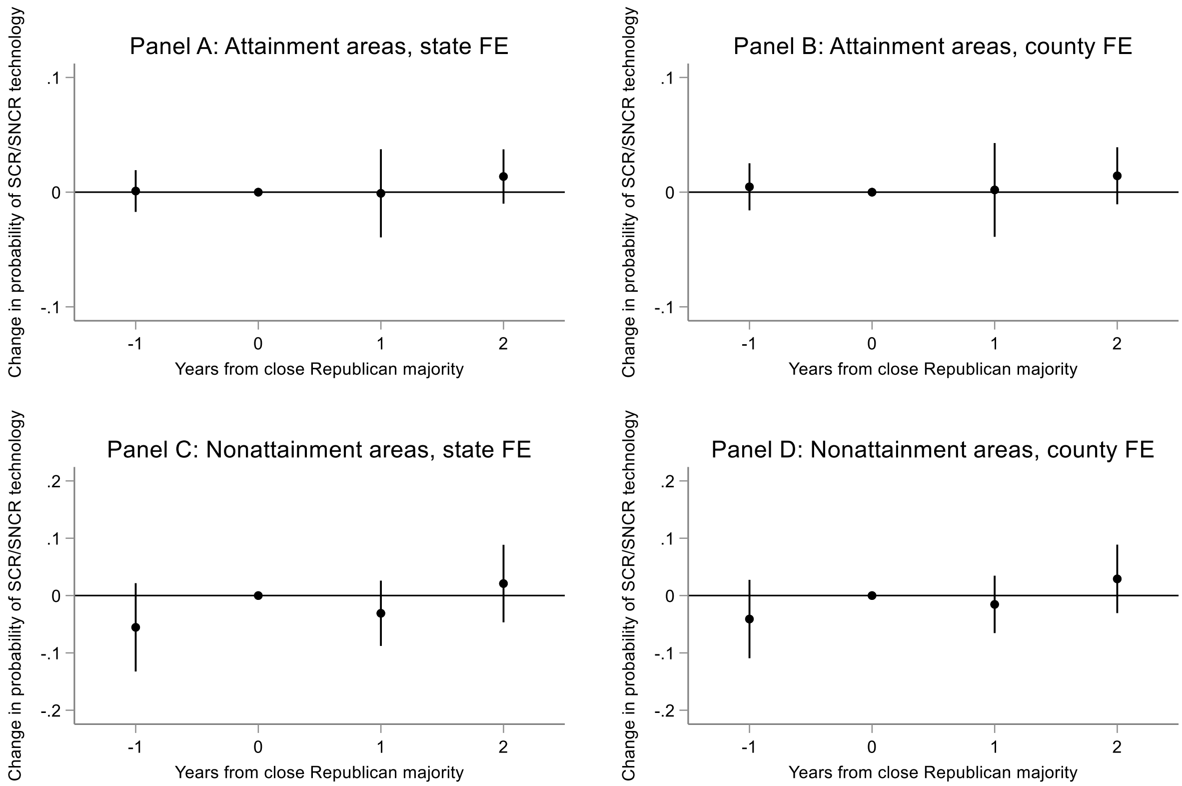
Appendix Figure A3. RD event studies for probability of FGD technology, gubernatorial elections.

Notes: This figure presents the point estimates from the estimation of a placebo event study of a close Republican gubernatorial win on a dummy indicating the presence of FGD technology, at the boiler level. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the one-year lag of FGD technology, boiler age, and county population as controls.



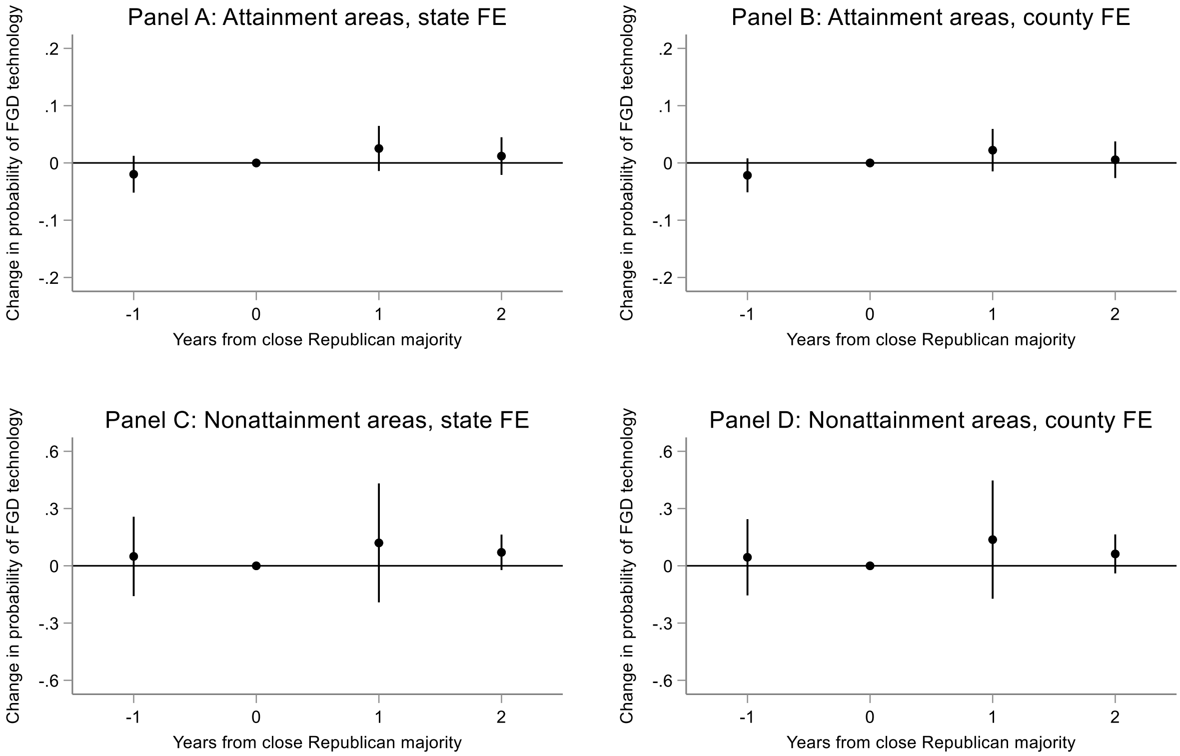
Appendix Figure A4. RD event studies for new air pollution abatement capital expenditures, state legislature elections.

Notes: This figure presents the point estimates from the estimation of an event study of a close Republican majority win in the state legislature election on new air pollution abatement capital expenditures, at the facility level. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. All dependent variables are arcsinh transformed and normalized to 2015$. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the number of boilers, percent of boilers burning coal, plant age, and county population as controls.



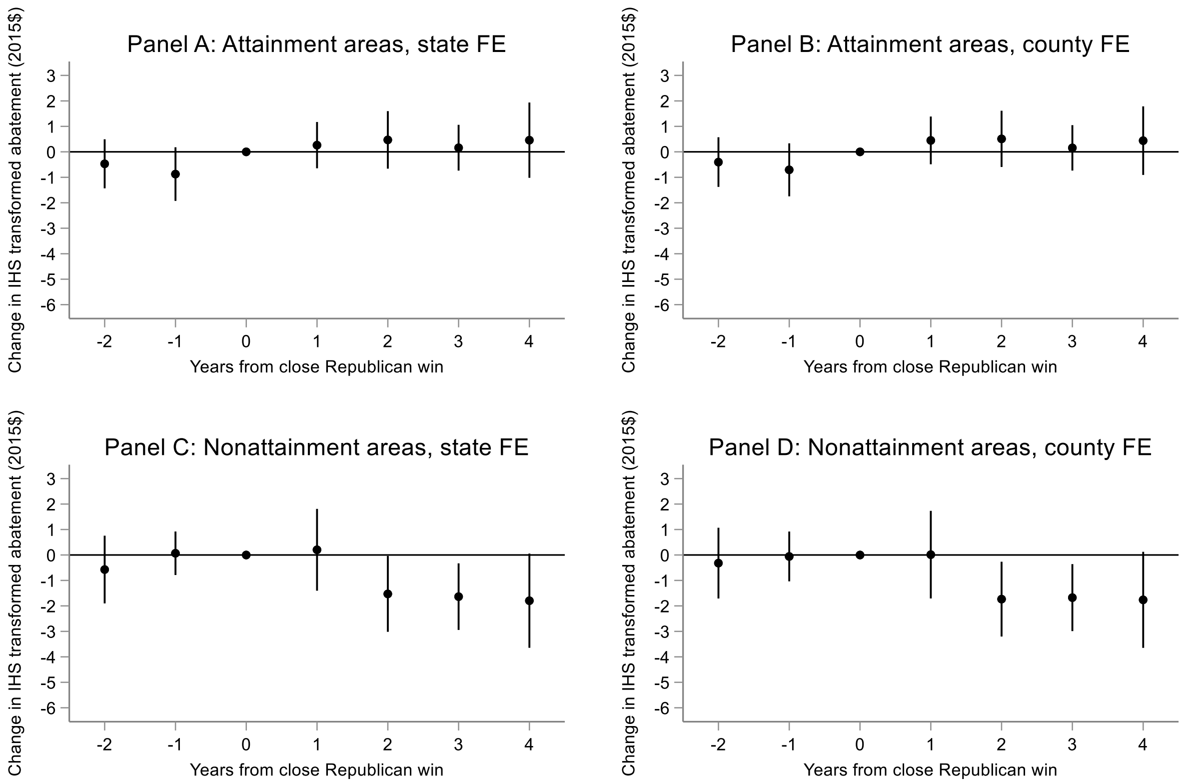
Appendix Figure A5. RD event studies for probability of SCR/SNCR technology, state legislature elections.

Notes: This figure presents the point estimates from the estimation of an event study of a close Republican majority win in the state legislature election on a dummy indicating the presence of the most effective NOx abatement technology (SCR/SNCR), at the boiler level. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the one-year lag of SCR/SNCR technology, coal fuel, boiler age, and county population as controls.



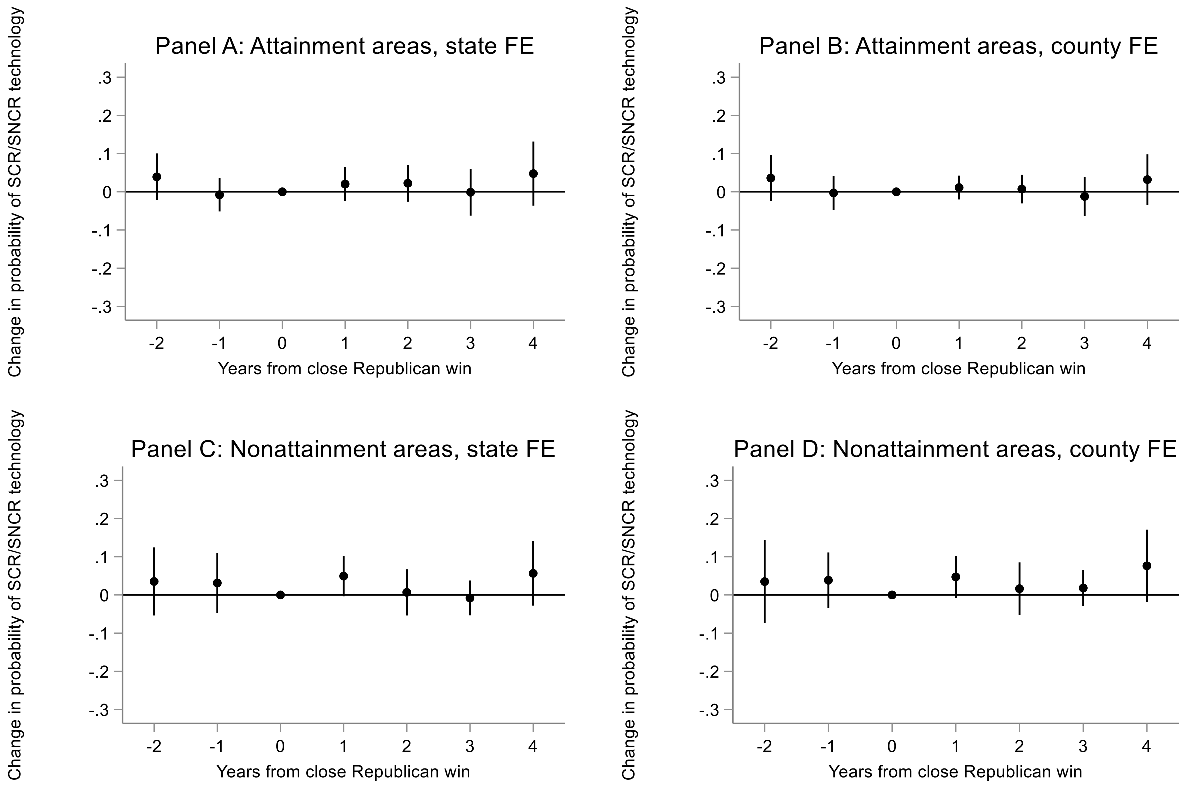
Appendix Figure A6. RD event studies for probability of FGD technology, state legislature elections.

Notes: This figure presents the point estimates from the estimation of a placebo event study of a close Republican majority win in the state legislature election on a dummy indicating the presence of FGD technology, at the boiler level. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the one-year lag of FGD technology, boiler age, and county population as controls.



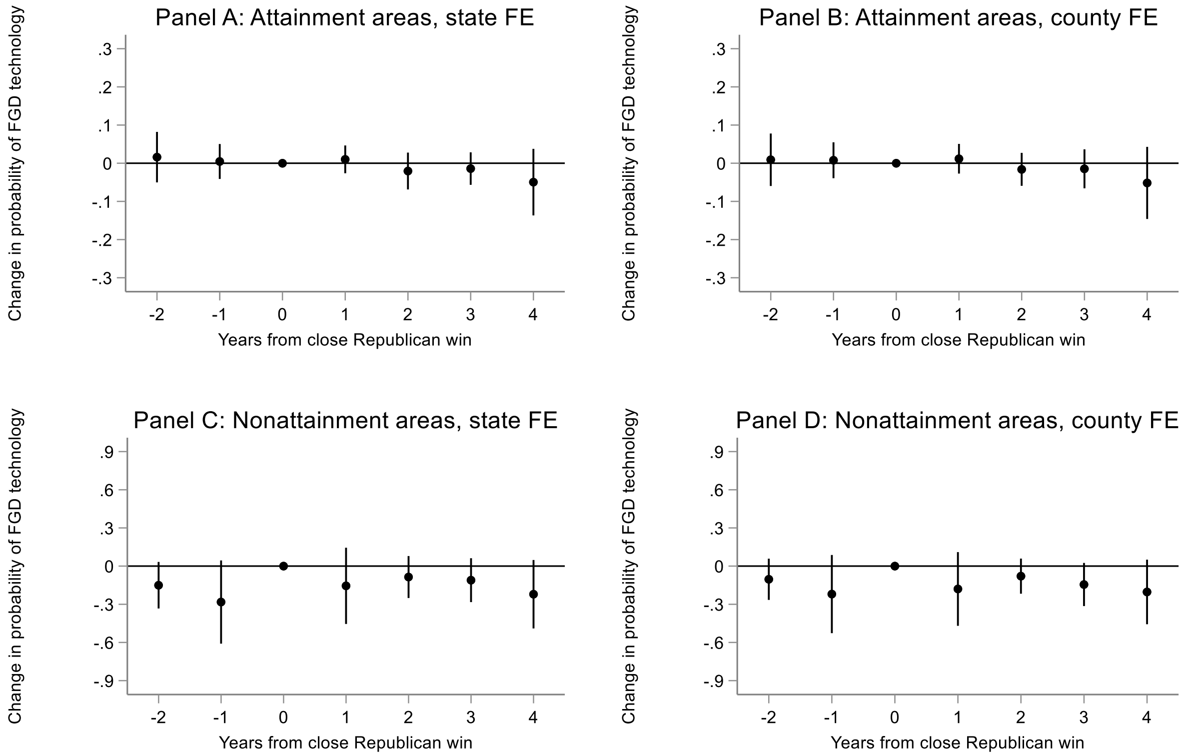
Appendix Figure A7. Dynamic DID event studies for new air pollution abatement capital expenditures, gubernatorial elections.

Notes: This figure presents the point estimates from the estimation of a dynamic DID event study of a close Republican gubernatorial win on new air pollution abatement capital expenditures, at the facility level, within the bandwidth of the RD analysis. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the number of boilers, percent of boilers burning coal, plant age, and county population as controls.



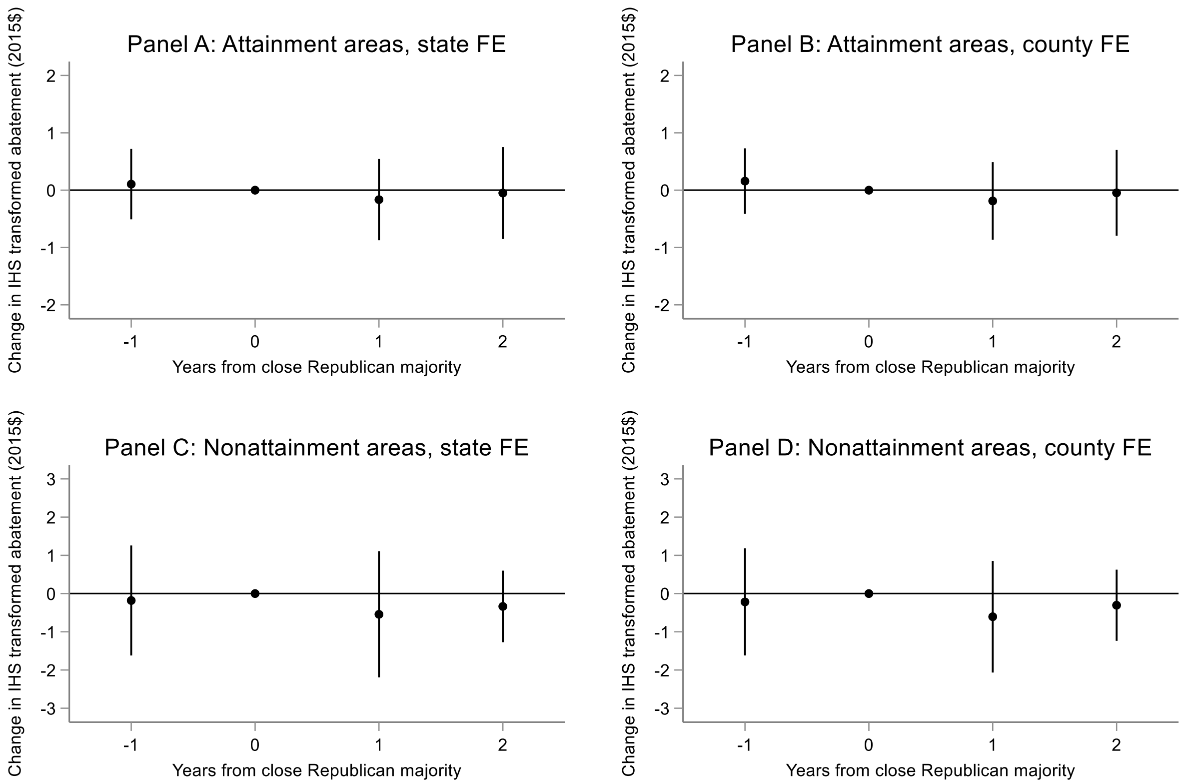
Appendix Figure A8. Dynamic DID event studies for probability of SCR/SNCR technology, gubernatorial elections.

Notes: This figure presents the point estimates from the estimation of a dynamic DID event study of a close Republican gubernatorial win on a dummy indicating the presence of the most effective NOx abatement technology (SCR/SNCR), at the boiler level, within the bandwidth of the RD analysis. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the one-year lag of SCR/SNCR technology, coal fuel, boiler age, and county population as controls.



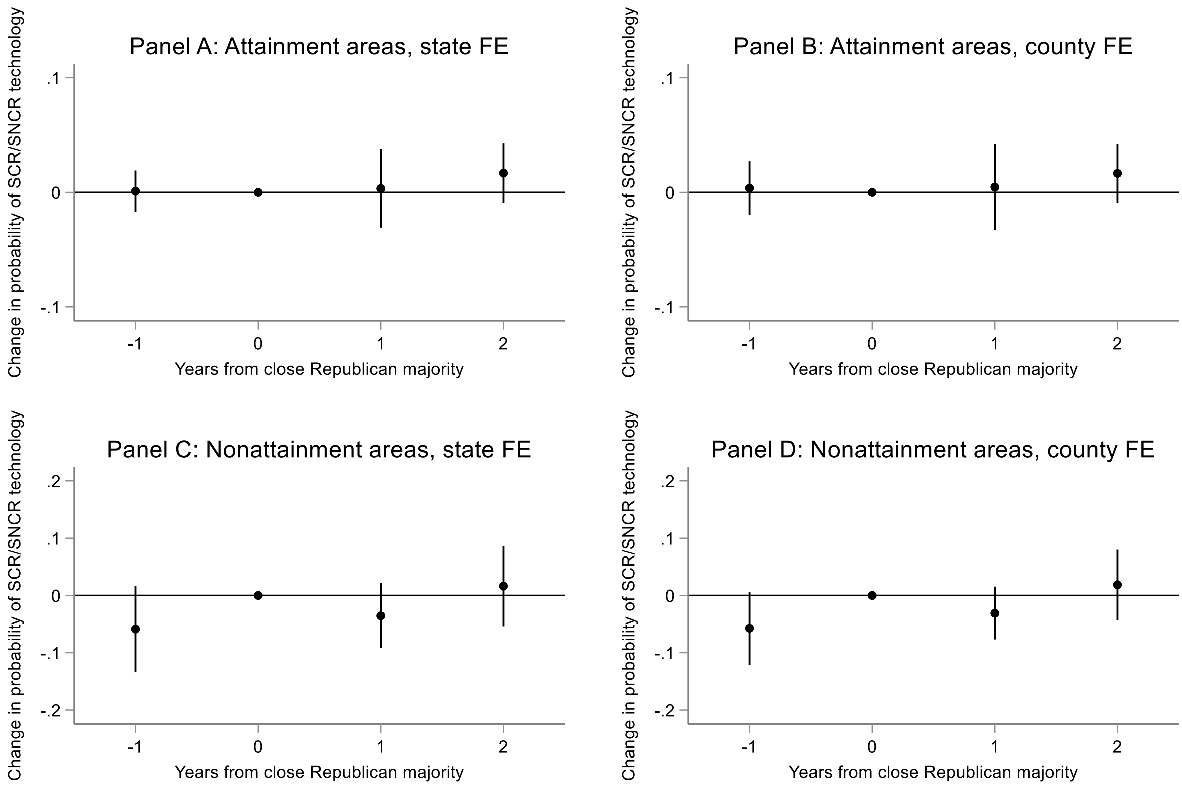
Appendix Figure A9. Dynamic DID event studies for probability of FGD technology, gubernatorial elections.

Notes: This figure presents the point estimates from the estimation of a dynamic DID event study of a close Republican gubernatorial win on a dummy indicating the presence of FGD technology, at the boiler level, within the bandwidth of the RD analysis. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the one-year lag of FGD technology, boiler age, and county population as controls.



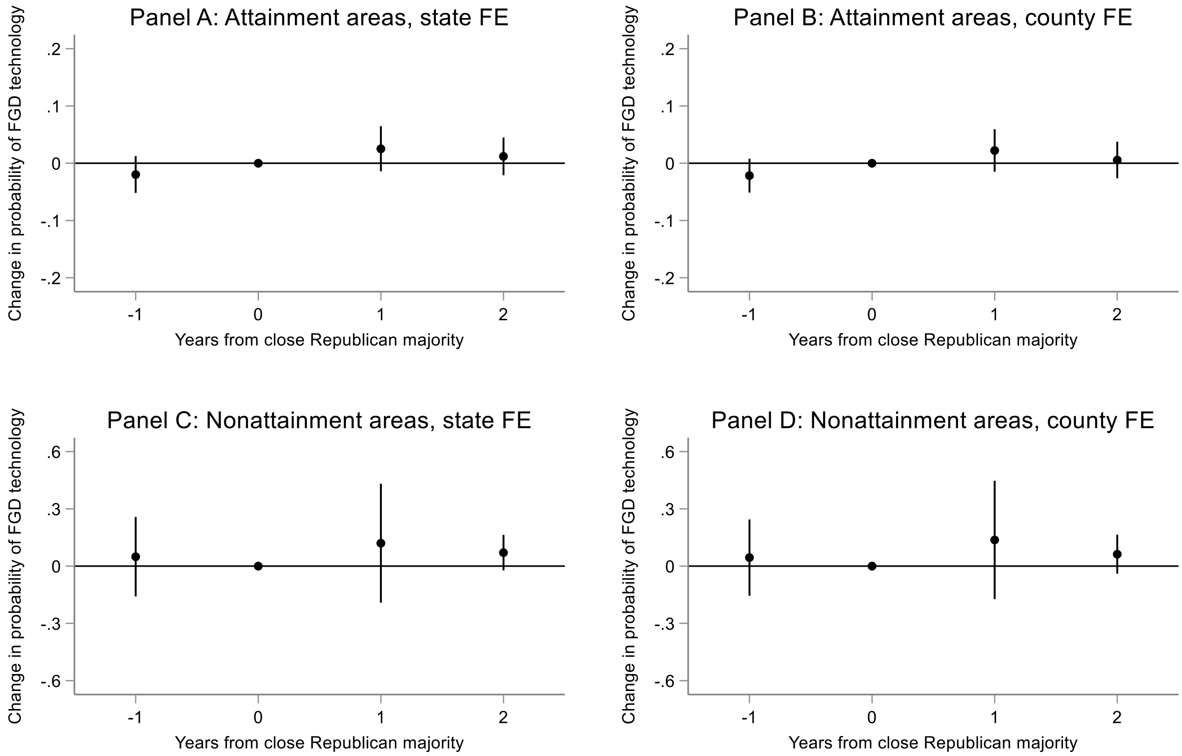
Appendix Figure A10. Dynamic DID event studies for new air pollution abatement capital expenditures, state legislature elections.

Notes: This figure presents the point estimates from the estimation of a dynamic DID event study of a close Republican majority win in the state legislature election on new air pollution abatement capital expenditures, at the facility level, for the bandwidth of the RD analysis. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. All dependent variables are arcsinh transformed and normalized to 2015$. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the number of boilers, percent of boilers burning coal, plant age, and county population as controls.



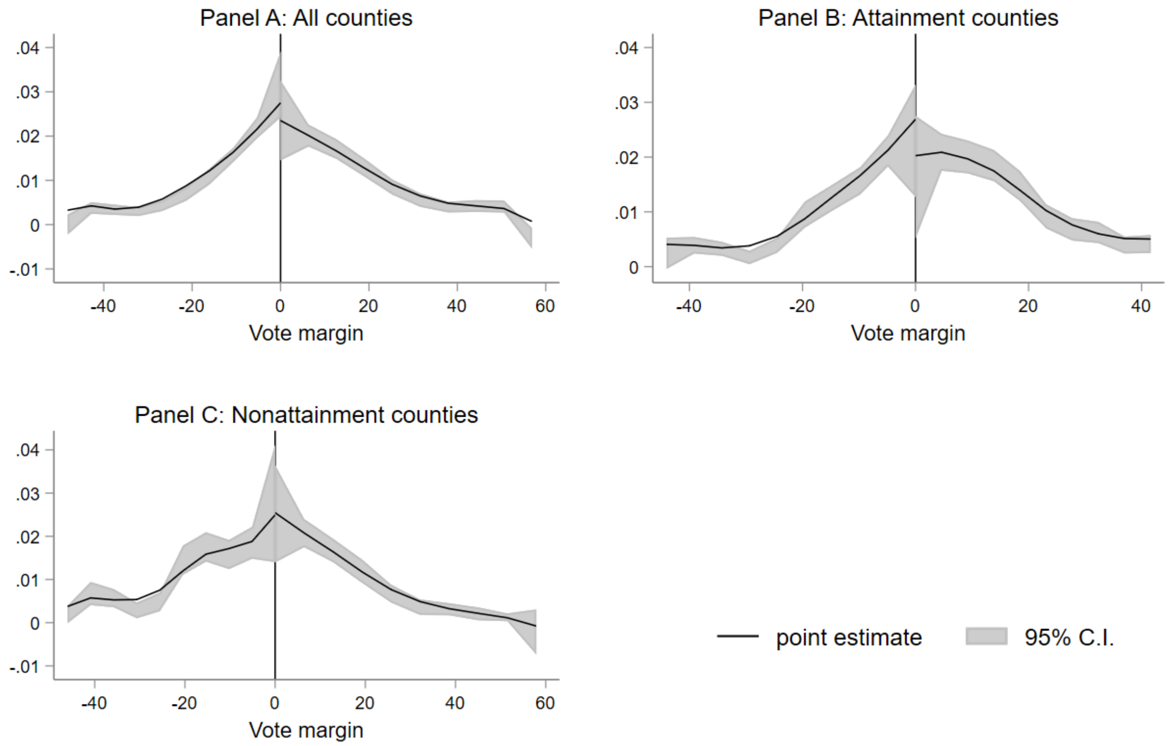
Appendix Figure A11. Dynamic DID event studies for probability of SCR/SNCR technology, state legislature elections.

Notes: This figure presents the point estimates from the estimation of a dynamic DID event study of a close Republican majority win in the state legislature election on a dummy indicating the presence of the most effective NOx abatement technology (SCR/SNCR), at the boiler level, within the bandwidth of the RD analysis. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the one-year lag of SCR/SNCR technology, coal fuel, boiler age, and county population as controls.



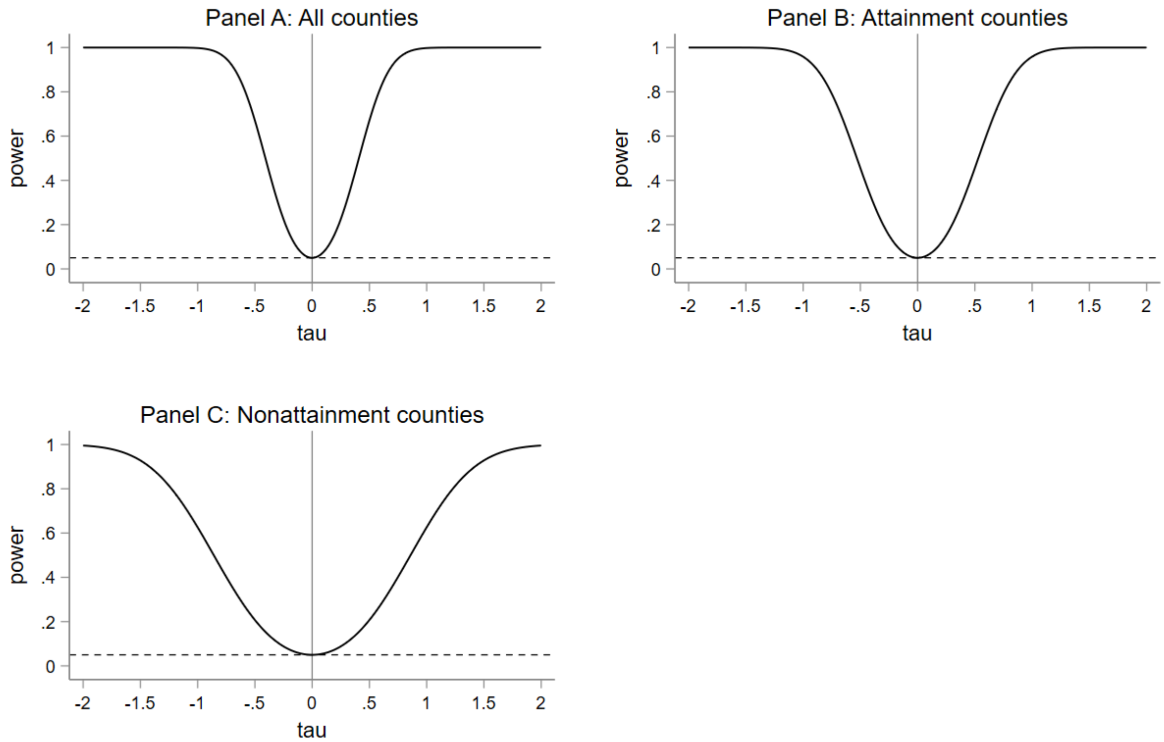
Appendix Figure A12. Dynamic DID event studies for probability of FGD technology, state legislature elections.

Notes: This figure presents the point estimates from the estimation of a placebo dynamic DID event study of a close Republican majority win in the state legislature election on a dummy indicating the presence of FGD technology, at the boiler level, within the bandwidth of the RD analysis. Standard errors are clustered at the state level and produce 95% confidence intervals, which are included. Panels A and B present event studies for electric utilities located in attainment areas. Panels C and D present event studies for electric utilities located in nonattainment areas. All estimations include the one-year lag of FGD technology, boiler age, and county population as controls.



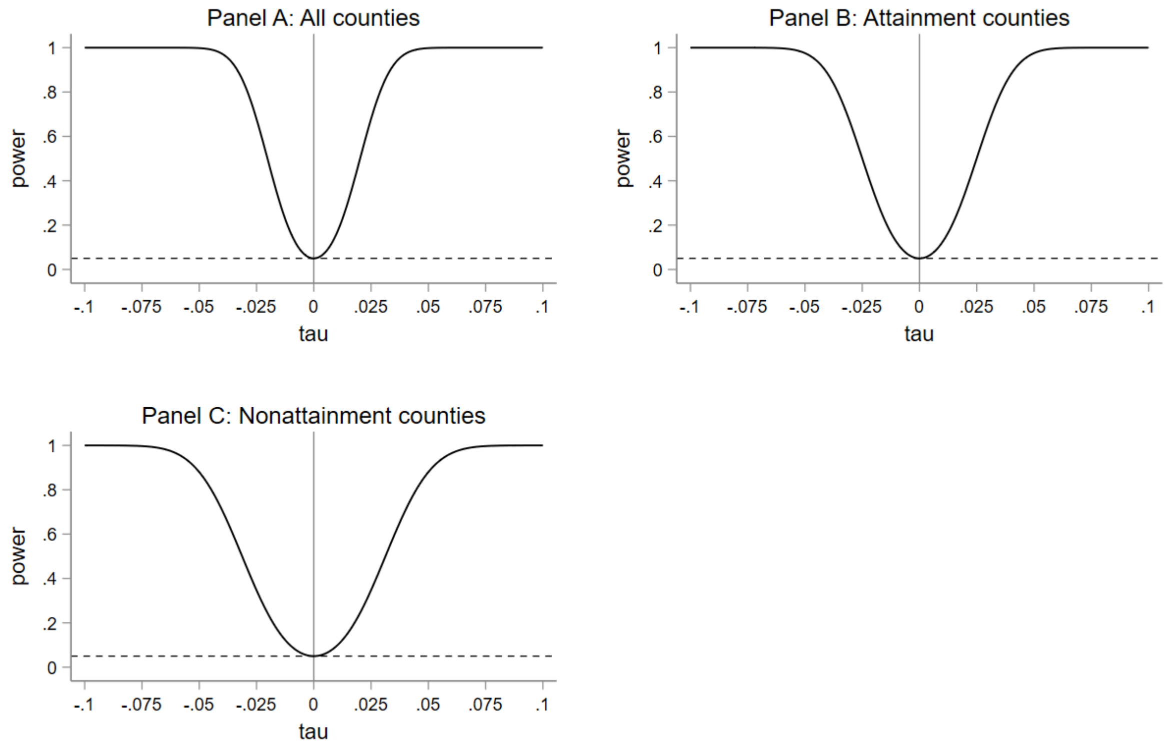
Appendix Figure A13. RD density plots, gubernatorial elections

Notes: These graphs show density plots for state-year election outcomes. Negative vote margins indicate Democratic victories and positive vote margins indicate Republican victories. Panel A includes all observations, Panel B includes observations for electric utilities in attainment areas, and Panel C includes observations for electric utilities in nonattainment areas. We use the default options of the rddensity command in Stata (Cattaneo et al. 2018).

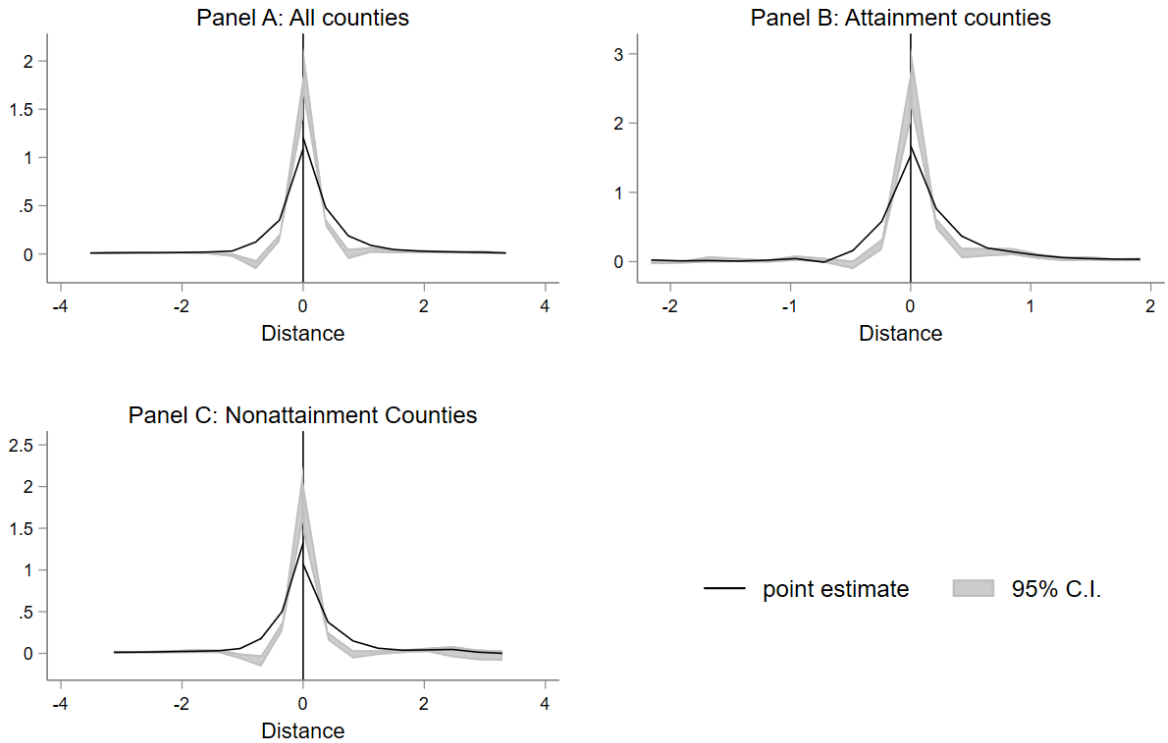


Appendix Figure A14. RD power functions for new air pollution abatement capital spending, gubernatorial elections.

Notes: These graphs show power functions of our RD design for hypothesized RD treatment effects ranging from zero to two. The dependent variables are residuals from regressions of arcsinh transformed real new air pollution abatement capital expenditures on year fixed effects, state fixed effects, and indicators for coal fuel and nonattainment status (panel A). Panel A includes all facilities, Panel B includes facilities in attainment areas, and Panel C includes facilities in nonattainment areas. These power functions use uniform kernels and cluster standard errors at the state level. Significance level = 0.05.

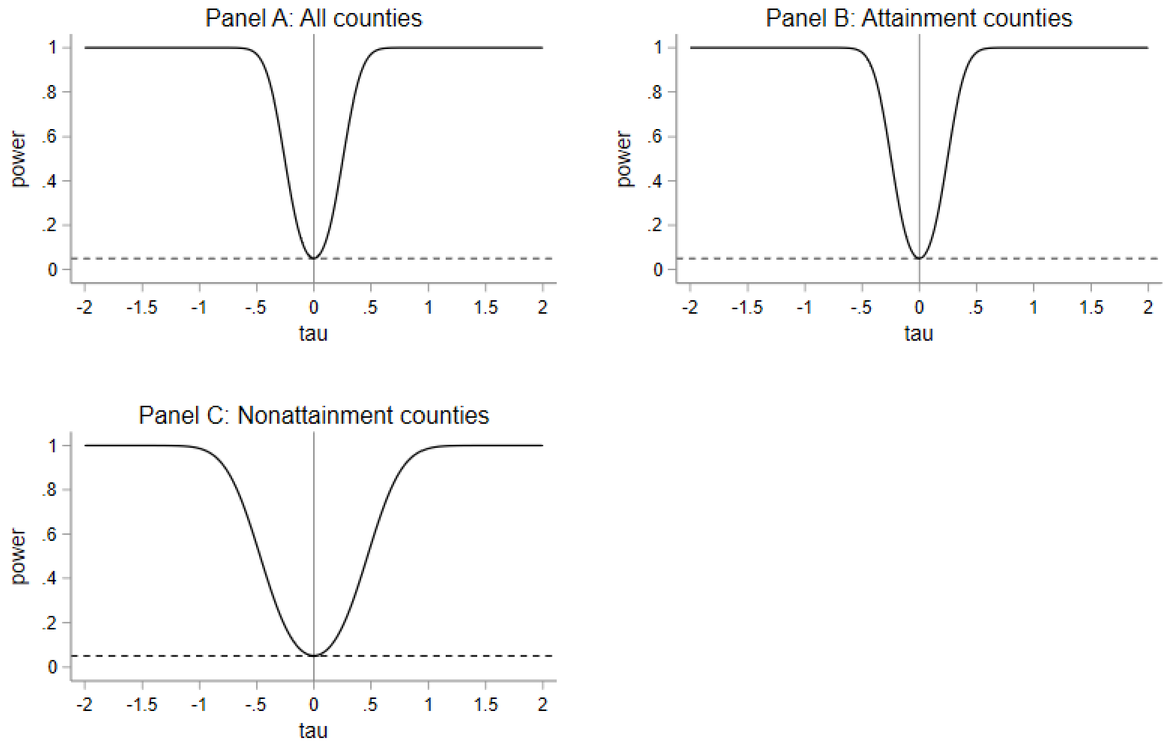


Appendix Figure A15. RD power functions for SCR/SNCR technology, gubernatorial elections. *Notes*: These graphs show power functions of our RD design for hypothesized RD treatment effects ranging from zero to 0.1. The dependent variables are residuals from regressions of linear probability models where an indicator for installed SCR/SNCR technology is regressed on year fixed effects, state fixed effects, the one-year lagged value of the dependent variable, and indicators for coal fuel and nonattainment status (panel A). Panel A includes all boilers, Panel B includes boilers in attainment areas, and Panel C includes boilers in nonattainment areas. These power functions use uniform kernels and cluster standard errors at the state level. Significance level = 0.05.



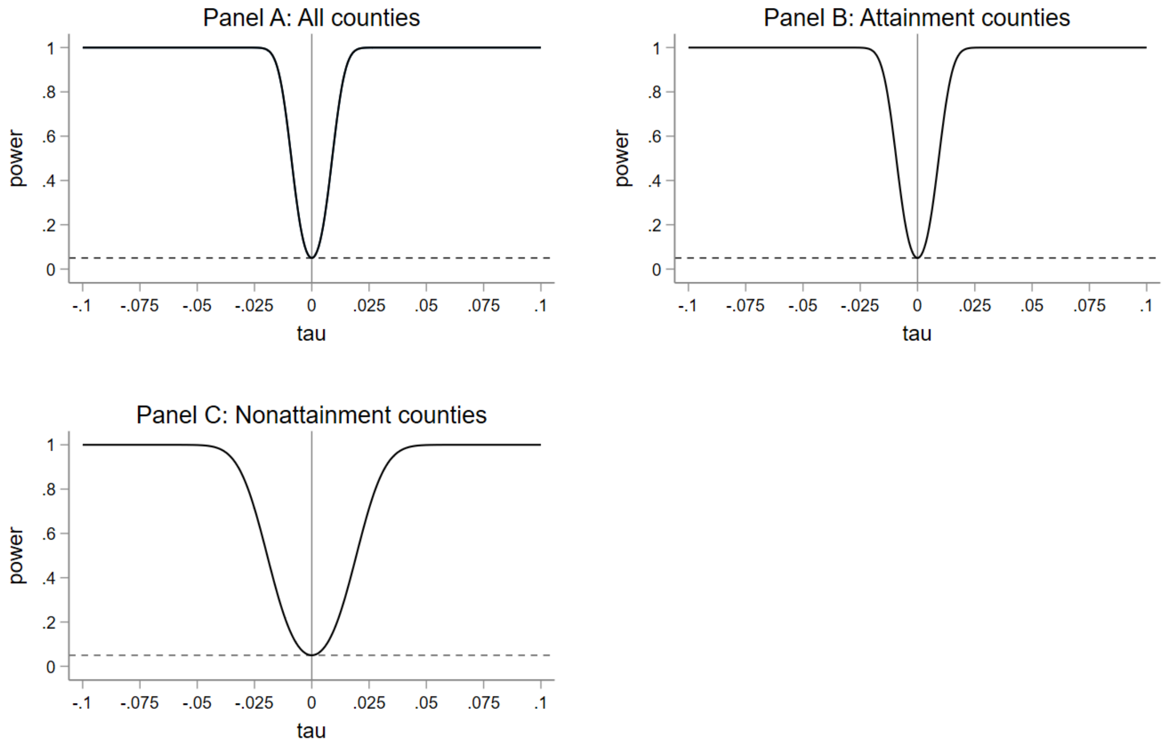
Appendix Figure A16. Multidimensional RD density plots

Notes: These graphs show density plots for state-year election outcomes. Negative distance measures indicate Democratic majorities and positive distance measures indicate Republican majorities. Panel A includes all observations, Panel B includes observations for facilities in attainment areas, and Panel C includes observations for facilities in nonattainment areas. We use the default options of the rddensity command in Stata (Cattaneo et al. 2018).



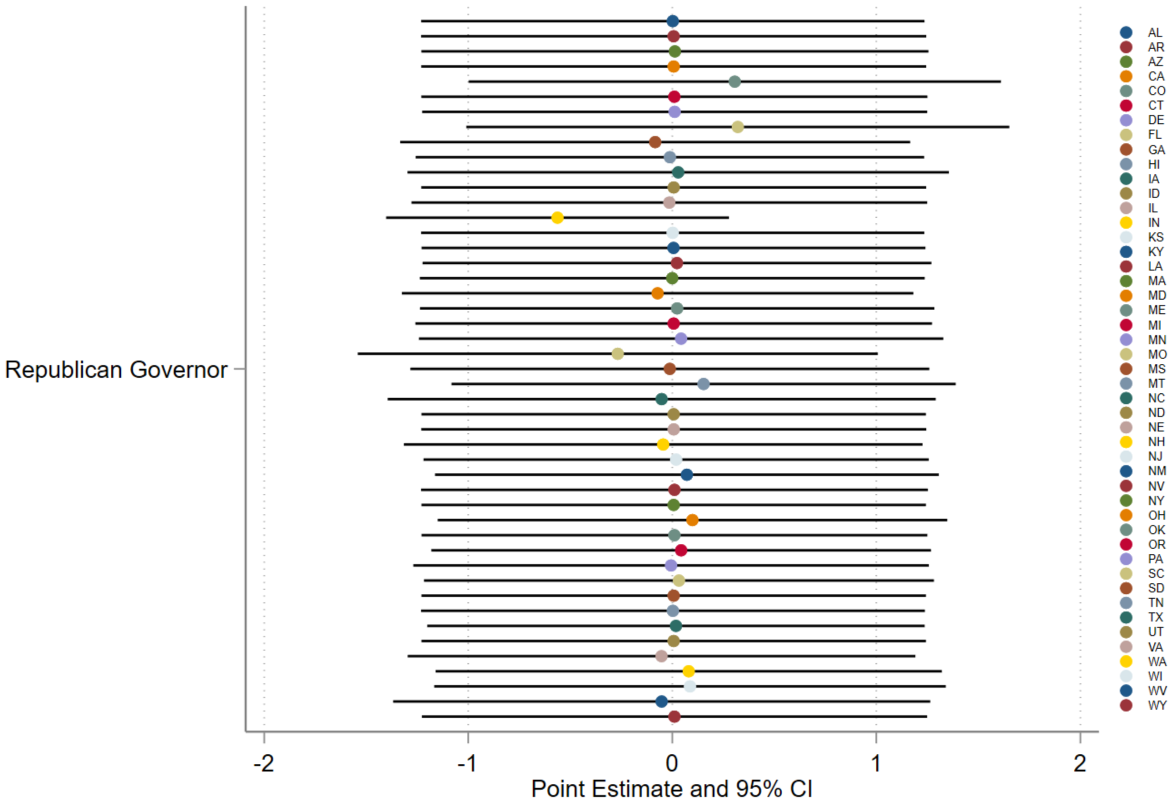
Appendix Figure A17. Multidimensional RD power functions for new air pollution abatement capital spending, state legislature elections

Notes: These graphs show power functions of our multidimensional RD design for hypothesized RD treatment effects ranging from zero to two. The dependent variables are residuals from regressions of arcsinh transformed real new air pollution abatement capital expenditures on year fixed effects, state fixed effects, and indicators for coal fuel and nonattainment status (panel A). Panel A includes all facilities, Panel B includes facilities in attainment areas, and Panel C includes facilities in nonattainment areas. These power functions use uniform kernels and cluster standard errors at the state level. Significance level = 0.05.



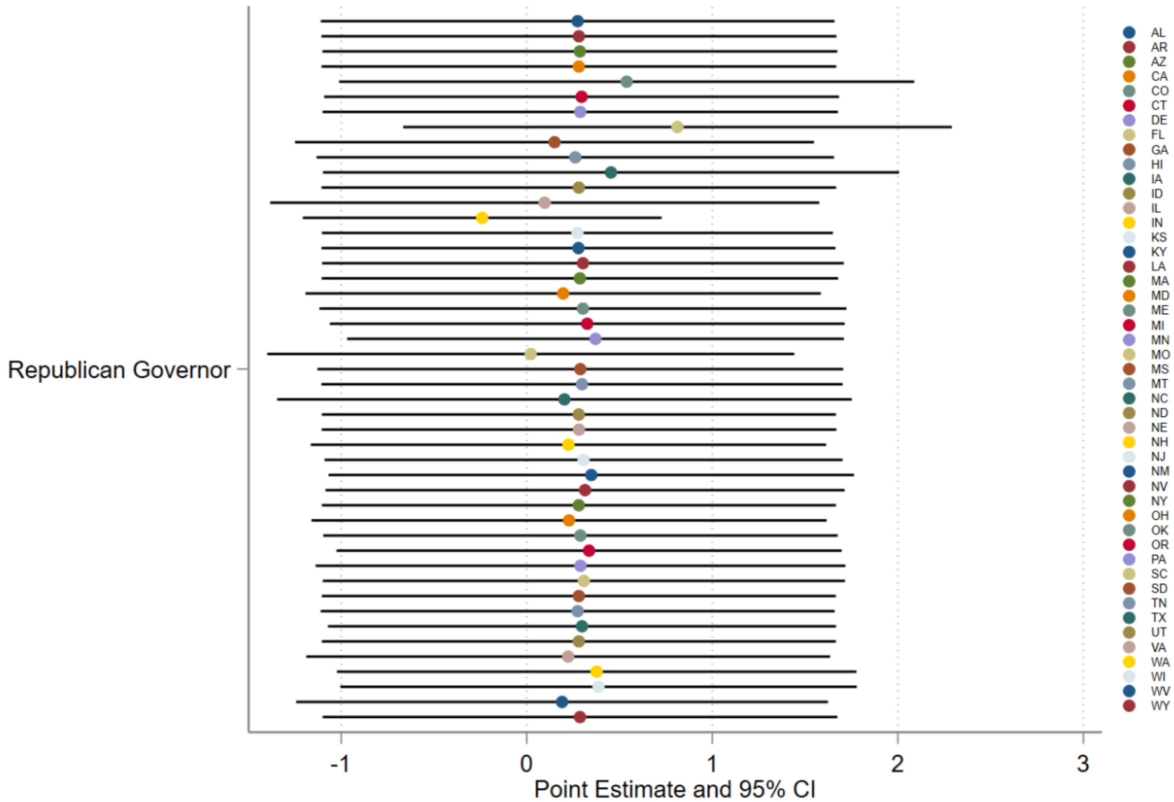
Appendix Figure A18. Multidimensional RD power functions for SCR/SNCR technology, state legislature elections.

Notes: These graphs show power functions of our multidimensional RD design for hypothesized RD treatment effects ranging from zero to 0.1. The dependent variables are residuals from regressions of linear probability models where an indicator for installed SCR/SNCR technology is regressed on year fixed effects, state fixed effects, the one-year lagged value of the dependent variable, and indicators for coal fuel and non-attainment status (panel A). Panel A includes all boilers, Panel B includes boilers in attainment areas, and Panel C includes boilers in nonattainment areas. These power functions use uniform kernels and cluster standard errors at the state level. Significance level = 0.05.



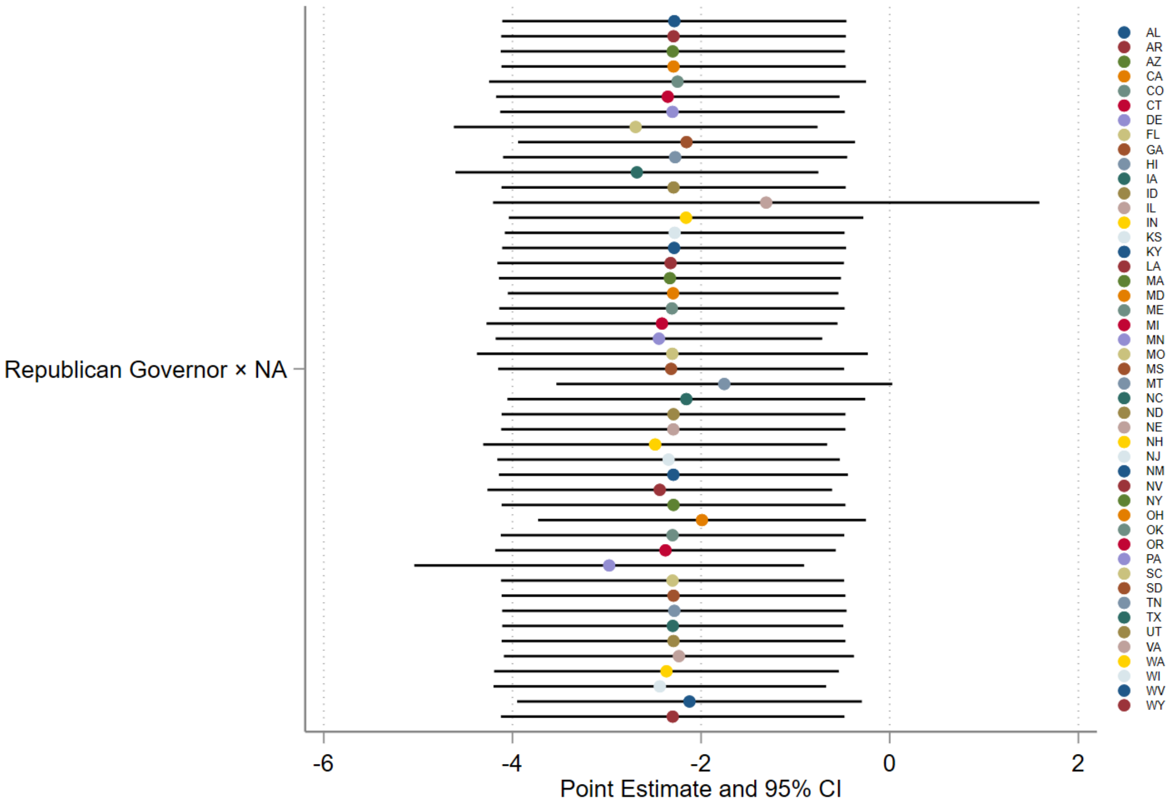
Appendix Figure A19. Leave-one-out analysis for Table 2, equation (1). Effect of a Republican governor on new air pollution abatement capital expenditures.

Notes: This figure presents RD point estimates and 95% confidence intervals corresponding to column 1 of Table 2, where we successively leave out one state at a time from the sample. The dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. The number of boilers and percent of boilers burning coal are included as controls in each estimation.



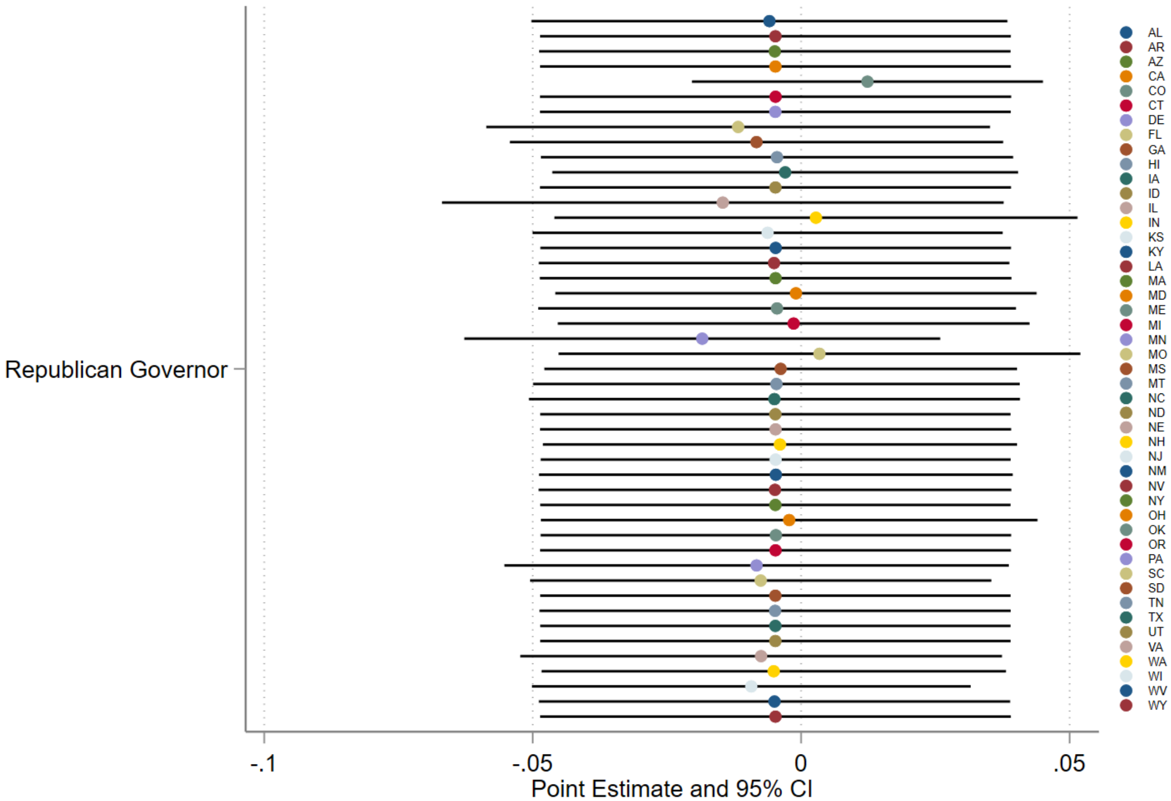
Appendix Figure A20. Leave-one-out analysis for Table 2, equation (2). Effect of a Republican governor on new air pollution abatement capital expenditures in an attainment area.

Notes: This figure presents RD point estimates and 95% confidence intervals corresponding to the first row of column 3 of Table 2, where we successively leave out one state at a time from the sample. The dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. The number of boilers and percent of boilers burning coal are included as controls in each estimation.



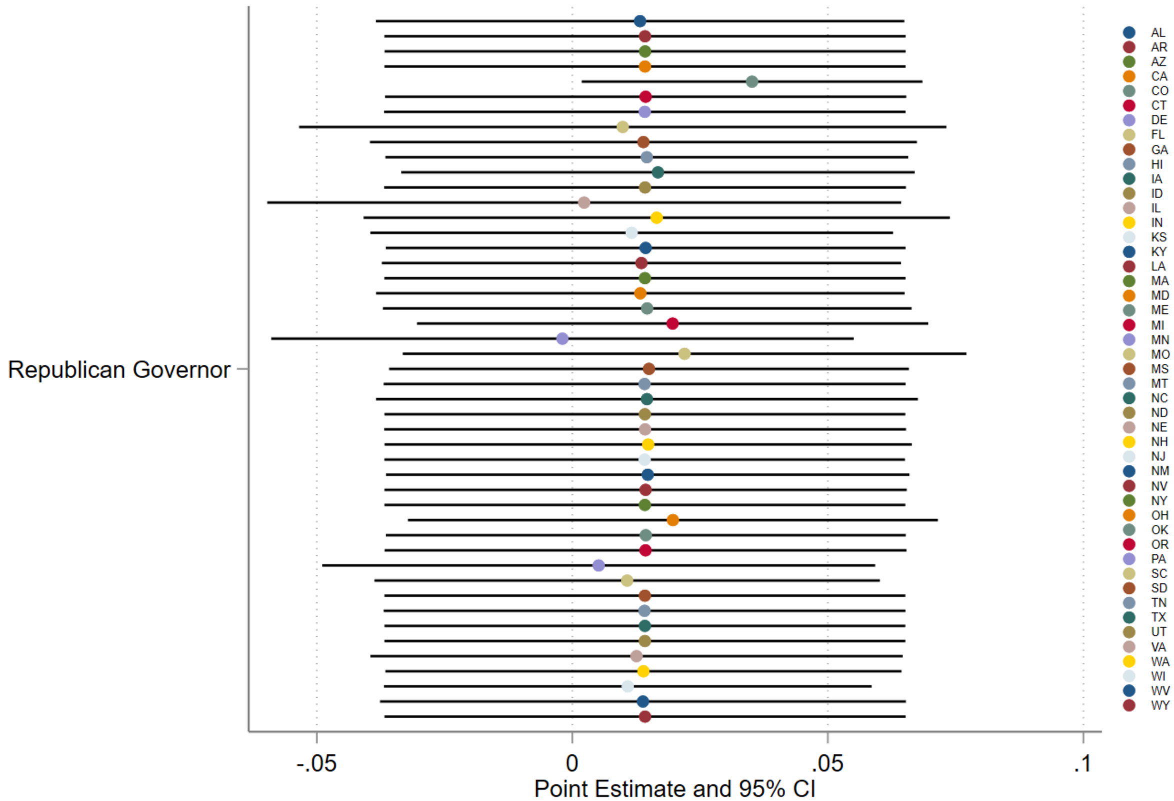
Appendix Figure A21. Leave-one-out analysis for Table 2, equation (2). Differential effect of a Republican governor on new air pollution abatement capital expenditures in a nonattainment area.

Notes: This figure presents RD point estimates and 95% confidence intervals corresponding to the third row of column 3 of Table 2 (Republican governor × NA), where we successively leave out one state at a time from the sample. The dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. The number of boilers and percent of boilers burning coal are included as controls in each estimation.



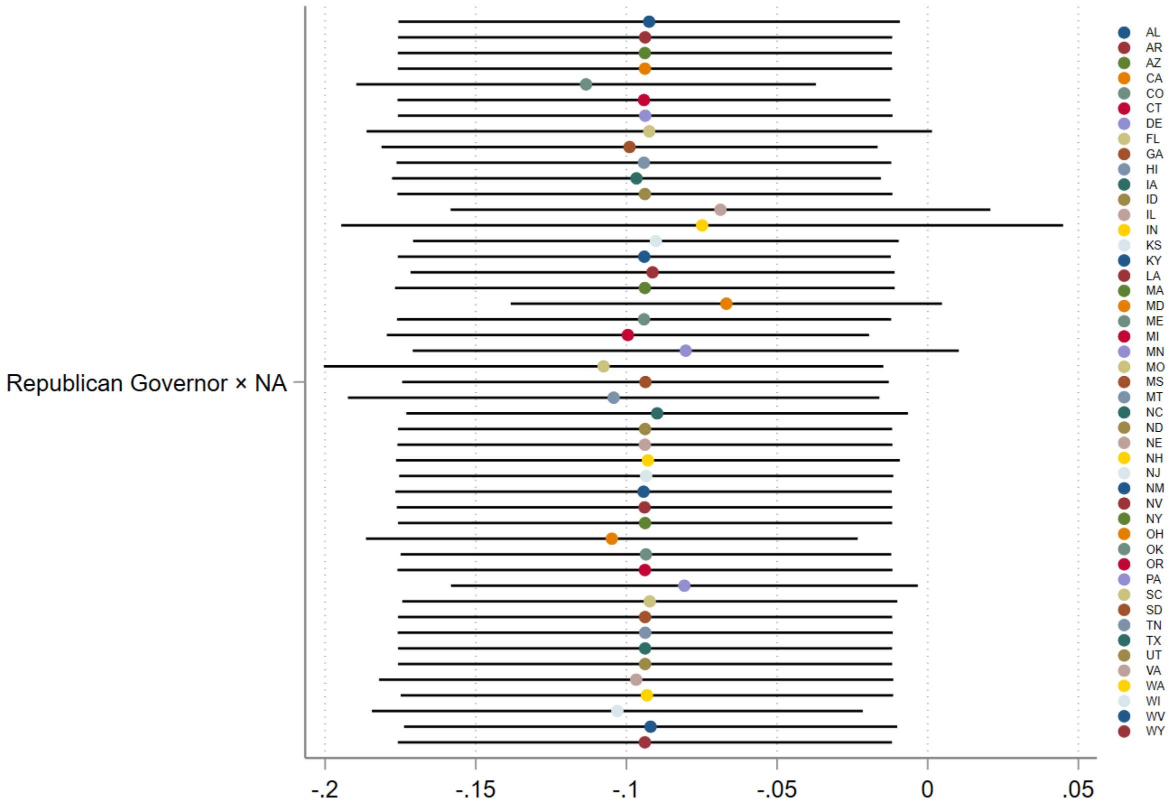
Appendix Figure A22. Leave-one-out analysis for Table 3, equation (1). Effect of a Republican governor on probability of SCR/SNCR technology.

Notes: This figure presents RD point estimates and 95% confidence intervals corresponding to column 1 of Table 3, where we successively leave out one state at a time from the sample. The dependent variable is an indicator for SCR/SNCR technology. Indicators for the one-year lag of SCR/SNCR technology and coal fuel are included as controls in each estimation.



Appendix Figure A23. Leave-one-out analysis for Table 3, equation (2). Effect of a Republican governor on probability of SCR/SNCR technology in an attainment area.

Notes: This figure presents RD point estimates and 95% confidence intervals corresponding to the first row of column 3 of Table 3, where we successively leave out one state at a time from the sample. The dependent variable is an indicator for SCR/SNCR technology. Indicators for the one-year lag of SCR/SNCR technology and coal fuel are included as controls in each estimation.



Appendix Figure A24. Leave-one-out analysis for Table 3, equation (2). Differential effect of a Republican governor on probability of SCR/SNCR technology in a nonattainment area.

Notes: This figure presents RD point estimates and 95% confidence intervals corresponding to the third row of column 3 of Table 3 (Republican governor × NA), where we successively leave out one state at a time from the sample. The dependent variable is an indicator for SCR/SNCR technology. Indicators for the one-year lag of SCR/SNCR technology and coal fuel are included as controls in each estimation.

J. Supplemental tables

Online Appendix Table A1. Sample summary statistics by gubernatorial affiliation

	Republican		Democrat	
Variable	Mean	SD	Mean	SD
Panel A. Facility level sample				
New air pollution abatement capital expenditures (000s) [2015$]	8,872	28,187	10,405	30,828
Positive abatement spending	0.501	0.500	0.529	0.499
Boilers	2.296	1.401	2.316	1.538
Nonattainment (any pollutant)	0.235	0.424	0.323	0.468
Average boiler age (years)	36.04	11.90	35.75	12.12
County level unemployment rate	6.227	2.387	6.645	2.625
Population (10,000s)	38.62	102.61	58.42	178.7
Panel B. Boiler level sample				
SCR/SNCR technology	0.282	0.450	0.342	0.475
FGD technology	0.387	0.487	0.349	0.477
Coal fired boiler	0.685	0.465	0.796	0.403
Nonattainment (NOx affected pollutants)	0.258	0.438	0.316	0.465
Nonattainment (SO2 affected pollutants)	0.180	0.384	0.221	0.415
Age (years)	37.99	12.92	36.90	13.26
County level unemployment rate	6.303	2.308	6.678	2.513
Population (10,000s)	41.61	114.5	69.55	210.0

Notes: Summary statistics are at the facility-year (Panel A) and boiler-year (Panel B) level and for the observations of the final analysis sample (from all margins of victory). The Republican columns present statistics for states controlled by a Republican governor and the Democrat columns present statistics for states controlled by a Democratic governor. In Panel B, SCR/SNCR technology and FGD technology represent the presence of the most effective abatement technology for NOx and SO2 emissions, respectively, at each boiler in each year. Nonattainment for NOx affected pollutants represents electric utilities located in PM, ozone, and NO2 nonattainment areas. And nonattainment for SO2 affected pollutants represents electric utilities located in PM and SO2 nonattainment areas.

Online Appendix Table A2. Sample summary statistics by gubernatorial affiliation and nonattainment status

	Republican		Democrat	
	Attainment	NA	Attainment	NA
Variable	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Panel A. Facility level sample				
New air pollution abatement capital expenditures (000s) [2015$]	8,621	9,686	10,024	11,202
	(27,490)	(30,347)	(28,754)	(34,786)
Positive abatement spending	0.502	0.499	0.556	0.473
	(0.500)	(0.500)	(0.497)	(0.500)
Boilers	2.129	2.839	2.302	2.343
	(1.200)	(1.812)	(1.593)	(1.416)
Average boiler age (years)	34.90	39.76	33.54	40.39
	(11.51)	(12.41)	(11.85)	(11.35)
County level unemployment rate	6.117	6.581	6.526	6.893
	(2.279)	(2.681)	(2.380)	(3.059)
Population (10,000s)	18.02	105.3	12.32	154.5
	(34.15)	(187.2)	(19.47)	(290.1)
Panel B. Boiler level sample: NOx affected nonattainment				
SCR/SNCR technology	0.236	0.416	0.286	0.465
	(0.425)	(0.493)	(0.452)	(0.499)
Coal fired boiler	0.745	0.513	0.878	0.617
	(0.436)	(0.500)	(0.327)	(0.486)
Age (years)	36.79	41.42	34.96	41.09
	(12.80)	(12.65)	(13.60)	(11.42)
County level unemployment rate	6.141	6.768	6.524	7.011
	(2.216)	(2.497)	(2.319)	(2.859)
Population (000s)	19.03	106.3	12.17	193.4
	(34.73)	(204.0)	(17.46)	(340.9)
Panel C. Boiler level sample: SO2 affected nonattainment				
FGD technology	0.558	0.602	0.432	0.468
	(0.497)	(0.490)	(0.495)	(0.499)
Age (years)	34.86	43.36	34.74	41.14
	(12.16)	(12.55)	(13.03)	(9.54)
County level unemployment rate	6.109	7.137	6.585	7.476
	(2.256)	(2.406)	(2.388)	(2.784)
Population (10,000s)	16.12	21.84	12.88	26.83
	(28.25)	(35.86)	(18.75)	(35.65)

Notes: Summary statistics are at the facility-year (Panel A) and boiler-year (Panels B and C) level and for the observations of the final analysis sample (from all margins of victory). The Republican columns present statistics for states controlled by a Republican governor and the Democrat columns present statistics for states controlled by a Democratic governor. The NA columns represent electric utility location in areas in nonattainment for NOx affected pollutants (PM, ozone, and NO2) [Panel B] and SO2 affected pollutants (PM and SO2) [Panel C]. In Panels B and C, SCR/SNCR technology and FGD technology represent the presence of most effective abatement technology for NOx and SO2 emissions, respectively, at each boiler in each year.

Online Appendix Table A3. Sample summary statistics by lower house majority

	Republican		Democrat	
Variable	Mean	SD	Mean	SD
Panel A. Facility level sample				
New air pollution abatement capital expenditures (000s) [2015$]	9,917	29,989	9,951	30,019
Positive abatement spending	0.539	0.499	0.494	0.500
Boilers	2.393	1.485	2.299	1.627
Nonattainment (any pollutant)	0.214	0.410	0.354	0.478
Average boiler age (years)	35.86	11.76	35.98	11.74
County level unemployment rate	6.16	2.13	6.80	2.74
Population (10,000s)	27.61	52.94	67.99	187.97
Panel B. Boiler level sample				
SCR/SNCR technology	0.292	0.455	0.313	0.464
FGD technology	0.435	0.496	0.282	0.450
Coal fired boiler	0.760	0.427	0.711	0.453
Nonattainment (NOx affected pollutants)	0.231	0.422	0.353	0.478
Nonattainment (SO2 affected pollutants)	0.160	0.366	0.249	0.432
Age (years)	37.83	12.93	37.24	13.06
County level unemployment rate	6.30	2.14	6.83	2.62
Population (10,000s)	26.47	47.22	80.40	221.16

Notes: Summary statistics are at the facility-year (Panel A) and boiler-year (Panel B) level and for the observations of the final analysis sample (from all margins of victory). The Republican columns present statistics for states with lower houses controlled by a Republican majority and the Democrat columns present statistics for states with lower houses controlled by a Democratic majority. In Panel B, SCR/SNCR technology and FGD technology represent the presence of the most effective abatement technology for NOx and SO2 emissions, respectively, at each boiler in each year. Nonattainment for NOx affected pollutants represents electric utilities located in PM, ozone, and NO2 nonattainment areas. And nonattainment for SO2 affected pollutants represents electric utilities located in PM and SO2 nonattainment areas.

Online Appendix Table A4. Sample summary statistics by lower house majority and nonattainment status

	Republican		Democrat	
	Attainment	NA	Attainment	NA
Variable	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Panel A. Facility level sample				
New air pollution abatement capital expenditures (000s) [2015$]	9,933	11,845	10,053	9,765
	(29,032)	(33,231)	(28,253)	(33,016)
Positive abatement spending	0.534	0.558	0.529	0.431
	(0.499)	(0.497)	(0.499)	(0.496)
Boilers	2.22	3.05	2.28	2.34
	(1.28)	(1.94)	(1.70)	(1.48)
Average boiler age (years)	34.87	39.50	33.62	40.28
	(11.64)	(11.48)	(11.27)	(11.37)
County level unemployment rate	6.07	6.48	6.69	7.01
	(2.14)	(2.03)	(2.48)	(3.15)
Population (10,000s)	19.19	58.58	12.49	169.08
	(35.25)	(85.63)	(22.53)	(288.12)
Panel B. Boiler level sample: NOx affected nonattainment				
SCR/SNCR technology	0.262	0.389	0.255	0.419
	(0.440)	(0.488)	(0.436)	(0.494)
Coal fired boiler	0.794	0.648	0.844	0.467
	(0.405)	(0.478)	(0.363)	(0.499)
Age (years)	36.58	41.99	35.37	40.66
	(13.06)	(11.56)	(13.24)	(12.01)
County level unemployment rate	6.17	6.74	6.66	7.13
	(2.14)	(2.07)	(2.40)	(2.96)
Population (000s)	19.82	48.56	12.21	205.29
	(35.22)	(69.89)	(20.81)	(337.10)
Panel C. Boiler level sample: SO2 affected nonattainment				
FGD technology	0.567	0.600	0.394	0.405
	(0.496)	(0.490)	(0.489)	(0.491)
Age (years)	34.73	43.46	35.55	41.65
	(12.43)	(11.90)	(13.18)	(9.81)
County level unemployment rate	6.21	7.23	6.64	7.90
	(2.17)	(2.20)	(2.31)	(3.07)
Population (10,000s)	16.92	19.77	12.25	28.88
	(28.86)	(35.56)	(18.32)	(36.14)

Notes: Summary statistics are at the facility-year (Panel A) and boiler-year (Panels B and C) level and for the observations of the final analysis sample (from all margins of victory). The Republican columns present statistics for states with lower houses controlled by a Republican majority and the Democrat columns present statistics for states with lower houses controlled by a Democratic majority. The NA columns represent electric utility location in areas in nonattainment for NOx affected pollutants (PM, ozone, and NO2) [Panel B] and SO2 affected pollutants (PM and SO2) [Panel C]. In Panels B and C, SCR/SNCR technology and FGD technology represent the presence of most effective abatement technology for NOx and SO2 emissions, respectively, at each boiler in each year.

Online Appendix Table A5. Gubernatorial election counts

Variable	Count	%
Panel A. All gubernatorial elections		
All new elections	206	100
Democratic governor elected	97	47.1
Republican governor elected	109	52.9
Panel B. All gubernatorial elections, by margin of victory		
All new elections, 5% margin of victory	51	
All new elections, 10% margin of victory	93	
All new elections, 15% margin of victory	127	
All new elections, 20% margin of victory	151	
Panel C. Close gubernatorial elections		
All new elections	92	
Democratic governor elected	51	55.4
Republican governor elected	41	44.6
Dt|Dt-1	31	33.7
Dt|Rt-1	18	19.6
Rt|Dt-1	22	23.9
Rt|Rt-1	18	19.6

Notes: This table provides information about gubernatorial elections during our sample period. Panel A describes all gubernatorial elections with Republican or Democrat winners. Panel B shows the number of elections within various margins of victory. Panel C shows the balance of close gubernatorial election winners within the optimal bandwidth.

Online Appendix Table A6: Gubernatorial RD results for placebo outcomes

Variable	(1) Unemployment	(2) Population	(3) Age	(4) Unemployment	(5) Population	(6) Age
Republican governor	0.204	1.145	0.134	0.0554	2.655	0.471
	(0.236)	(2.380)	(0.223)	(0.256)	(1.665)	(0.414)
State FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Level	Facility	Facility	Facility	Boiler	Boiler	Boiler
Bandwidth	9.697	9.697	9.697	9.191	9.191	9.191
Clusters	42	42	42	41	41	41
Observations	2,012	2,015	2,020	4,116	4,122	4,132

Notes: Each column represents a separate RD specification of equation (1) for the placebo outcomes of unemployment, population, and age. Columns 1-3 use facility level data and columns 4-6 used boiler level data. All specifications include controls for nonattainment status and coal fuel usage. Columns 1-3 also control for the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Online Appendix Table A7: Gubernatorial RD results for placebo outcomes, differential effects by nonattainment status

Variable	(1) Unemployment	(2) Population	(3) Age	(4) Unemployment	(5) Population	(6) Age
Republican governor	0.276	-2.989	-0.420	0.0335	1.978	-0.318
	(0.278)	(1.970)	(0.588)	(0.310)	(1.487)	(0.610)
Republican governor × NA	-0.179	11.71	3.871	0.360	-2.596	4.402*
	(0.365)	(11.71)	(2.321)	(0.405)	(5.058)	(2.425)
State FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Level	Facility	Facility	Facility	Boiler	Boiler	Boiler
Bandwidth	9.697	9.697	9.697	9.191	9.191	9.191
Clusters	42	42	43	41	41	42
Observations	2,011	2,014	2,019	4,115	4,121	4,131

Notes: Each column represents a separate RD specification of equation (2) for the placebo outcomes of unemployment, population, and age. Columns 1-3 use facility level data and columns 4-6 used boiler level data. All specifications include controls for nonattainment status and coal fuel usage. Columns 1-3 also control for the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A8: Gubernatorial RD results for additional placebo outcomes, facility level analysis

Variable	(1) 4 years prior	(2) Year election	(3) Lower house maj. Rep.	(4) State senate maj. Rep.	(5) Fed delegation (maj. Rep.)
Rep. Governor	-0.354	0.282	0.197	0.0137	0.0986
	(0.850)	(0.393)	(0.206)	(0.176)	(0.206)
State FE	X	X	X	X	X
Year FE	X	X	X	X	X
Bandwidth	9.697	9.697	9.697	9.697	9.697
Clusters	40	43	42	42	43
Observations	1,524	2,020	2,010	2,010	2,020

Notes: Each column represents a separate RD specification of equation (1) for the outcome of arcsinh transformed real new air pollution abatement capital expenditures in the four years prior to the governor taking power, the year of the election, partisan control of the lower state house, partisan control of the state senate, and Republican majority of the federal delegation of US senators and representatives. All columns use facility level data. All specifications include controls for nonattainment status, coal fuel usage, and the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A9: Gubernatorial RD results for additional placebo outcomes, differential effects by nonattainment status, facility level analysis

Variable	(1) 4 years prior	(2) Year election	(3) Lower house maj. Rep	(4) State senate maj. Rep	(5) Fed delegation (maj. Rep.)
Republican Governor	0.202	0.279	0.153	0.0441	0.124
	(0.874)	(0.441)	(0.202)	(0.199)	(0.214)
Republican Gov. × NA	-0.335	-0.0461	0.185	-0.125	-0.151
	(0.986)	(0.341)	(0.129)	(0.169)	(0.169)
State FE	X	X	X	X	X
Year FE	X	X	X	X	X
Bandwidth	9.697	9.697	9.697	9.697	9.697
Clusters	40	43	42	42	43
Observations	1,524	2,019	2,009	2,009	2,019

Notes: Each column represents a separate RD specification of equation (2) for the outcome of arcsinh transformed real new air pollution abatement capital expenditures in the four years prior to the governor taking power, the year of the election, partisan control of the lower state house, partisan control of the state senate, and Republican majority of the federal delegation of US senators and representatives. All columns use facility level data. All specifications include controls for nonattainment status, coal fuel usage, and the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A10: Gubernatorial RD results for additional placebo outcomes, boiler level analysis

Variable	(1) 4 years prior	(2) Year election	(3) Lower state house (maj. Rep.)	(4) State senate (maj. Rep.)	(5) Fed delegation (maj. Rep.)
Republican Governor	0.0260	0.0877	0.233	-0.00841	0.0502
	(0.0466)	(0.401)	(0.196)	(0.181)	(0.219)
State FE	X	X	X	X	X
Year FE	X	X	X	X	X
Bandwidth	9.191	9.191	9.191	9.191	9.191
Clusters	39	42	41	41	42
Observations	3,078	4,132	4,112	4,112	4,132

Notes: Each column represents a separate RD specification of equation (1) for the outcome of SCR/SNCR technology installation in the four years prior to the governor taking power, the year of the election, partisan control of the lower state house, partisan control of the state senate, and Republican majority of the federal delegation of US senators and representatives. All columns use boiler level data. All specifications include controls for nonattainment status, coal fuel, and the one-year lag of SCR/SNCR technology. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A11: Gubernatorial RD results for additional placebo outcomes, differential effects by nonattainment status, boiler level analysis

Variable	(1) 4 years prior	(2) Year election	(3) Lower state house (maj. Rep.)	(4) State senate (maj. Rep.)	(5) Fed delegation (maj. Rep.)
Republican Governor	0.0419	0.0461	0.148	0.00408	-0.0240
	(0.0518)	(0.455)	(0.194)	(0.197)	(0.216)
Republican Governor × NA	0.0796	-0.192	0.221	-0.0536	0.273
	(0.153)	(0.393)	(0.160)	(0.136)	(0.178)
State FE	X	X	X	X	X
Year FE	X	X	X	X	X
Bandwidth	9.191	9.191	9.191	9.191	9.191
Clusters	39	42	41	41	42
Observations	3,078	4,131	4,111	4,111	4,131

Notes: Each column represents a separate RD specification of equation (2) for the outcome of SCR/SNCR technology installation in the four years prior to the governor taking power, the year of the election, partisan control of the lower state house, partisan control of the state senate, and Republican majority of the federal delegation of US senators and representatives. All columns use boiler level data. All specifications include controls for nonattainment status, coal fuel, and the one-year lag of SCR/SNCR technology. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A12: Baseline gubernatorial RD results, probability of positive new air pollution abatement capital expenditures

Variable	(1)	(2)	(3)	(4)
Republican governor	0.0518	0.0475	0.0913	0.0899
	(0.0453)	(0.0451)	(0.0546)	(0.0543)
Republican governor × NA			-0.359***	-0.380***
			(0.105)	(0.114)
State FE	X	X	X	X
Year FE	X	X	X	X
Additional controls		X		X
Bandwidth	7.774	7.774	7.774	7.774
Clusters	38	37	38	37
Observations	1,524	1,519	1,523	1,518

Notes: Columns 1 and 2 [3 and 4] represent separate RD specification of equation (1) [(2)], where the dependent variable is an indicator for positive new air pollution abatement capital expenditures. The number of boilers and percent of boilers burning coal are included as controls in each column. Additional controls include plant age and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A13: Gubernatorial RD alternative bandwidths, new air pollution abatement capital expenditures

	(1)	(2)	(3)	(4)
Republican governor	0.388	0.285	0.642	0.396
	(0.746)	(0.674)	(0.829)	(0.916)
Republican governor × NA	-1.931**	-2.168**	-3.858***	-4.710***
	(0.899)	(0.893)	(1.181)	(1.645)
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	12	10	8	6
Clusters	43	42	38	35
Observations	2,355	2,047	1,590	1,265

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. Controls in each specification include the number of boilers, percent of boilers burning coal, plant age, and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A14: Gubernatorial RD alternative bandwidths, SCR/SNCR technology

	(1)	(2)	(3)	(4)
Republican governor	0.00359	0.00984	0.0118	-0.0211
	(0.0272)	(0.0240)	(0.0264)	(0.0343)
Republican governor × NA	-0.0624	-0.0756**	-0.0857**	-0.0103
	(0.0401)	(0.0371)	(0.0382)	(0.0680)
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	12	10	8	6
Clusters	43	42	38	35
Observations	5,421	4,688	3,710	3,008

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for SCR/SNCR technology. Controls in each specification include boiler age, county population, and indicators for the one-year lag of SCR/SNCR technology and coal fuel. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A15: Gubernatorial RD alternative bandwidths, FGD placebo

	(1)	(2)	(3)	(4)
Republican governor	-0.0262	-0.0155	-0.0112	-0.0251
	(0.0205)	(0.0239)	(0.0245)	(0.0472)
Republican governor × NA	0.0412	0.0652	0.0474	0.0803
	(0.0485)	(0.0415)	(0.0495)	(0.0837)
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	12	10	8	6
Clusters	40	39	36	33
Observations	4,561	3,908	3,240	2,644

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for FGD technology. Indicators for the one-year lag of FGD technology, boiler age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A16: Gubernatorial RD sensitivity checks, new air pollution abatement capital expenditures

	(1)	(2)	(3)	(4)
Republican governor	0.183	0.262	0.556	0.780
	(0.668)	(0.643)	(0.830)	(0.919)
Republican governor × NA	-1.935**	-2.093**	-3.078***	-2.984**
	(0.887)	(0.978)	(1.010)	(1.212)
Specification	1-year NA lag	2-year NA lag	Party in power at least 1 year	Party in power at least 2 years
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	9.697	9.697	9.697	9.697
Clusters	42	42	42	41
Observations	2,012	2,015	1,708	1,449

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. Controls in each specification include the number of boilers, percent of boilers burning coal, plant age, and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A17: Gubernatorial RD sensitivity checks, SCR/SNCR technology

	(1)	(2)	(3)	(4)
Republican governor	0.0326	0.0125	0.0111	-0.000869
	(0.0275)	(0.0266)	(0.0316)	(0.0342)
Republican governor × NA	-0.115**	-0.0971**	-0.124**	-0.132**
	(0.0464)	(0.0399)	(0.0530)	(0.0631)
Specification	1-year NA lag	2-year NA lag	Party in power at least 1 year	Party in power at least 2 years
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	9.191	9.191	9.191	9.191
Clusters	41	41	41	40
Observations	4,087	4,089	3,379	2,800

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for SCR/SNCR technology. Controls in each specification include boiler age, county population, and indicators for the one-year lag of SCR/SNCR technology and coal fuel. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A18: Gubernatorial RD sensitivity checks, FGD placebo

	(1)	(2)	(3)	(4)
Republican governor	-0.0108	-0.00679	-0.0183	-0.0333
	(0.0248)	(0.0253)	(0.0273)	(0.0317)
Republican governor × NA	0.0481	0.0899	0.0267	0.0763
	(0.0532)	(0.0638)	(0.0617)	(0.0722)
Specification	1-year NA lag	2-year NA lag	Party in power at least 1 year	Party in power at least 2 years
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	8.073	8.073	8.073	8.073
Clusters	36	36	36	36
Observations	3,259	3,259	2,727	2,307

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for FGD technology. Indicators for the one-year lag of FGD technology, boiler age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A19: Gubernatorial RD results, new air pollution abatement capital expenditures, county level analysis

Variable	(1)	(2)	(3)	(4)
Republican governor	0.110	0.0925	0.574	0.466
	(0.690)	(0.594)	(0.854)	(0.787)
Republican governor × NA			-3.576***	-2.298**
			(1.130)	(0.969)
State FE	X	X	X	X
Year FE	X	X	X	X
Weights	Population	Capacity	Population	Capacity
Clusters	38	42	38	42
Bandwidth	8.122	10.249	8.122	10.249
Observations	1,474	1,928	1,474	1,928

Notes: Columns 1 and 2 [3 and 4] represent separate RD specifications of equation (1) [(2)], where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. The number of boilers, percent of boilers burning coal, plant age, and county population are included as controls in each column. Columns 1 and 3 weight by population and Columns 2 and 4 weight by capacity. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A20: Gubernatorial RD results, SCR/SNCR technology, county level analysis

Variable	(1)	(2)	(3)	(4)
Republican governor	-0.00930	-0.0209	0.00551	-0.00321
	(0.0294)	(0.0267)	(0.0358)	(0.0310)
Republican governor × NA			-0.102*	-0.0865*
			(0.0546)	(0.0447)
State FE	X	X	X	X
Year FE	X	X	X	X
Weights	Population	Capacity	Population	Capacity
Bandwidth	7.771	7.845	7.771	7.845
Clusters	37	37	37	37
Observations	1,385	1,403	1,385	1,403

Notes: Columns 1 and 2 [3 and 4] represent separate RD specifications of equation (1) [(2)], where the dependent variable is an indicator for SCR/SNCR technology. Indicators for the one-year lag of SCR/SNCR technology, coal fuel, boiler age, and county population are included as controls in each column. Columns 1 and 3 weight by population and Columns 2 and 4 weight by capacity. Robust standard errors in parentheses are clustered at the state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Online Appendix Table A21: Gubernatorial RD results, FGD placebo, county level analysis

Variable	(1)	(2)	(3)	(4)
Republican governor	-0.0173	0.0120	-0.0165	-0.0163
	(0.0380)	(0.0430)	(0.0449)	(0.0431)
Republican governor × NA			0.0433	0.0716
			(0.0595)	(0.0829)
State FE	X	X	X	X
Year FE	X	X	X	X
Weights	Population	Capacity	Population	Capacity
Bandwidth	6.667	6.044	6.667	6.044
Clusters	34	33	34	33
Observations	1,050	1,022	1,050	1,022

Notes: Columns 1 and 2 [3 and 4] represent separate RD specifications of equation (1) [(2)], where the dependent variable is an indicator for FGD technology. Indicators for the one-year lag of FGD technology, boiler age, and county population are included as controls in each column. Columns 1 and 3 weight by population and Columns 2 and 4 weight by capacity. Robust standard errors in parentheses are clustered at the state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Online Appendix Table A22: Gubernatorial RD results, new air pollution capital expenditures, excluding smallest generators

Variable	(1)	(2)	(3)	(4)
Republican governor	0.0393	0.403	0.161	0.500
	(0.692)	(0.797)	(0.633)	(0.708)
Republican governor × NA		-2.605***		-2.509***
		(0.887)		(0.873)
State FE	X	X	X	X
Year FE	X	X	X	X
MW cutoff	125.22	125.22	50	50
Bandwidth	9.697	9.697	9.697	9.697
Clusters	40	40	40	40
Observations	1,833	1,832	1,961	1,960

Notes: Columns 1 and 3 [2 and 4] represent separate RD specifications of equation (1) [(2)], where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. The number of boilers and percent of boilers burning coal are included as controls in each column. Columns 1 and 2 exclude facilities below the 10^{th} percentile and columns 3 and 4 exclude facilities below 50 MW. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A23: Gubernatorial RD results, SCR/SNCR technology, excluding smallest generators

Variable	(1)	(2)	(3)	(4)
Republican governor	-0.00461	0.0156	-0.00615	0.0155
	(0.0242)	(0.0275)	(0.0249)	(0.0292)
Republican governor × NA		-0.0914**		-0.0909*
		(0.0436)		0.0455)
State FE	X	X	X	X
Year FE	X	X	X	X
MW cutoff	37.22	37.22	50	50
Bandwidth	9.191	9.191	9.191	9.191
Clusters	40	40	40	40
Observations	3,645	3,644	3,528	3,527

Notes: Columns 1 and 3 [2 and 4] represent separate RD specifications of equation (1) [(2)], where the dependent variable is an indicator for SCR/SNCR technology. Indicators for the one-year lag of SCR/SNCR technology and coal fuel are included as controls in each column. Columns 1 and 2 exclude boilers below the 10^{th} percentile and columns 3 and 4 exclude boilers below 50 MW. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A24: Multidimensional RD results for placebo outcomes

Variable	(1) Unemployment	(2) Population	(3) Age	(4) Unemployment	(5) Population	(6) Age
Republican majority	-0.125	2.708	0.0726	-0.188	2.920	0.185
	(0.253)	(1.968)	(0.0969)	(0.232)	(1.885)	(0.125)
State FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Level	Facility	Facility	Facility	Boiler	Boiler	Boiler
Bandwidth	0.540	0.540	0.540	0.609	0.609	0.609
Clusters	33	33	33	33	33	33
Observations	3,271	3,271	3,271	7,988	7,988	7,988

Notes: Each column represents a separate RD specification of equation (1) for the placebo outcomes of unemployment, population, and age. Columns 1-3 use facility level data and columns 4-6 used boiler level data. All specifications include controls for nonattainment status and coal fuel usage. Columns 1-3 also control for the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A25: Multidimensional RD results for placebo outcomes, differential effects by nonattainment status

Variable	(1) Unemployment	(2) Population	(3) Age	(4) Unemployment	(5) Population	(6) Age
Republican governor	-0.0992	2.348*	-0.0924	-0.193	1.981**	-0.112
	(0.255)	(1.258)	(0.320)	(0.216)	(0.910)	(0.477)
Republican governor × NA	-0.184	0.747	0.866	-0.0880	-0.825	0.856
	(0.190)	(1.723)	(0.913)	(0.196)	(1.816)	(1.146)
State FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Level	Facility	Facility	Facility	Boiler	Boiler	Boiler
Bandwidth	0.540	0.540	0.540	0.609	0.609	0.609
Clusters	33	33	33	33	33	33
Observations	3,271	3,271	3,271	7,988	7,988	7,988

Notes: Each column represents a separate RD specification of equation (2) for the placebo outcomes of unemployment, population, and age. Columns 1-3 use facility level data and columns 4-6 used boiler level data. All specifications include controls for nonattainment status and coal fuel usage. Columns 1-3 also control for the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A26: Baseline multidimensional RD results, probability of positive new air pollution abatement capital expenditures

Variable	(1)	(2)	(3)	(4)
Republican majority	0.00766	0.00762	0.0205	0.0210
	(0.0292)	(0.0288)	(0.0318)	(0.0319)
Republican majority × NA			-0.0695	-0.0738
			(0.0520)	(0.0520)
State FE	X	X	X	X
Year FE	X	X	X	X
Additional controls		X		X
Bandwidth	0.682	0.682	0.682	0.682
Clusters	33	33	33	33
Observations	3,463	3,463	3,463	3,463

Notes: Columns 1 and 2 [3 and 4] represent separate RD specification of equation (1) [(2)], where the dependent variable is an indicator for positive new air pollution abatement capital expenditures. The number of boilers and percent of boilers burning coal are included as controls in each column. Additional controls include plant age and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A27: Multidimensional RD alternative bandwidths, new air pollution abatement capital expenditures

	(1)	(2)	(3)	(4)
Republican majority	0.114	0.116	0.176	0.0516
	(0.250)	(0.254)	(0.266)	(0.241)
Republican majority × NA	-0.820**	-0.832**	-0.917**	-0.972**
	(0.372)	(0.371)	(0.359)	(0.452)
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	1.2	1	0.8	0.4
Clusters	34	34	34	32
Observations	3,813	3,787	3,603	3,075

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. Controls in each specification include the number of boilers, percent of boilers burning coal, plant age, and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A28: Multidimensional RD alternative bandwidths, SCR/SNCR technology

	(1)	(2)	(3)	(4)
Republican majority	-0.0115	-0.00968	-0.0108	-0.0145*
	(0.00841)	(0.00814)	(0.00839)	(0.00806)
Republican majority × NA	-0.0536**	-0.0558**	-0.0525**	-0.0357
	(0.0244)	(0.0243)	(0.0252)	(0.0286)
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	1.2	1	0.8	0.4
Clusters	34	34	34	32
Observations	8,979	8,927	8,463	7,239

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for SCR/SNCR technology. Controls in each specification include boiler age, county population, and indicators for the one-year lag of SCR/SNCR technology and coal fuel. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A29: Multidimensional RD alternative bandwidths, FGD placebo

	(1)	(2)	(3)	(4)
Republican majority	-0.0122	-0.0119	-0.0126	-0.00745
	(0.0173)	(0.0173)	(0.0176)	(0.0181)
Republican majority × NA	0.0662	0.0658	0.0686	0.0771
	(0.0485)	(0.0485)	(0.0505)	(0.0631)
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	1.2	1	0.8	0.4
Clusters	33	33	33	31
Observations	6,808	6,777	6,418	5,587

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for FGD technology. Indicators for the one-year lag of FGD technology are included as controls in each column. Additional controls include boiler age and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A30: Multidimensional RD sensitivity checks, new air pollution abatement capital expenditures

	(1)	(2)	(3)
Republican majority	0.0978	0.0380	0.0228
	(0.280)	(0.288)	(0.303)
Republican majority × NA	-0.991*	-0.717	-1.286**
	(0.523)	(0.580)	(0.585)
Specification	1-Year NA Lag	2-Year NA Lag	Party in power at least 1 year
State FE	X	X	X
Year FE	X	X	X
Bandwidth	0.54	0.54	0.54
Clusters	33	33	33
Observations	3,271	3,271	2,925

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. Controls in each specification include the number of boilers, percent of boilers burning coal, plant age, and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A31: Multidimensional RD sensitivity checks, SCR/SNCR technology

	(1)	(2)	(3)
Republican majority	-0.0136*	-0.0117	-0.0107
	(0.00794)	(0.00821)	(0.0101)
Republican majority × NA	-0.0459**	-0.0494**	-0.0410
	(0.0209)	(0.0224)	(0.0338)
Specification	1-year NA lag	2-year NA lag	Party in power at least 1 year
State FE	X	X	X
Year FE	X	X	X
Bandwidth	0.609	0.609	0.609
Clusters	33	33	33
Observations	7,904	7,904	7,077

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for SCR/SNCR technology. Controls in each specification include boiler age, county population, and indicators for the one-year lag of SCR/SNCR technology and coal fuel. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A32: Multidimensional RD sensitivity checks, FGD placebo

	(1)	(2)	(3)
Republican majority	-0.0137	-0.0131	-0.0111
	(0.0160)	(0.0160)	(0.0213)
Republican majority × NA	0.0589	0.0405	0.0964
	(0.0411)	(0.0386)	(0.0730)
Specification	1-year NA lag	2-year NA lag	Party in power at least 1 year
State FE	X	X	X
Year FE	X	X	X
Bandwidth	0.858	0.858	0.858
Clusters	33	33	33
Observations	6,562	6,562	5,906

Notes: Each column represents a separate RD specification of equation (2), where the dependent variable is an indicator for FGD technology. Indicators for the one-year lag of FGD technology are included as controls in each column. Additional controls include boiler age and county population. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A33: Multidimensional RD results,
new air pollution abatement capital expenditures, county level analysis

Variable	(1)	(2)	(3)	(4)
Republican governor	-0.0761	0.000561	0.210	0.270
	(0.292)	(0.280)	(0.309)	(0.273)
Republican governor × NA			-1.141***	-1.071**
			(0.362)	(0.452)
State FE	X	X	X	X
Year FE	X	X	X	X
Weights	Population	Capacity	Population	Capacity
Bandwidth	0.806	0.565	0.806	0.565
Clusters	34	33	34	33
Observations	3,185	2,899	3,185	2,899

Notes: Columns 1 and 2 [3 and 4] represent separate multidimensional RD specifications of equation (1) [(2)], where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. All regressions are at the county level. The number of boilers, percent of boilers burning coal, plant age, and county population are included as controls in each column. Columns 1 and 3 weight by population and Columns 2 and 4 weight by capacity. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A34: Multidimensional RD results, SCR/SNCR technology, county level analysis

Variable	(1)	(2)	(4)	(5)
Republican governor	-0.0186**	-0.0222**	-0.0143	-0.0116
	(0.00846)	(0.00938)	(0.00933)	(0.00969)
Republican governor × NA			-0.0249	-0.0459*
			(0.0196)	(0.0267)
State FE	X	X	X	X
Year FE	X	X	X	X
Weights	Population	Capacity	Population	Capacity
Bandwidth	0.694	0.741	0.694	0.741
Clusters	33	34	33	34
Observations	3,040	3,114	3,040	3,114

Notes: Columns 1 and 2 [3 and 4] represent separate multidimensional RD specifications of equation (1) [(2)], where the dependent variable is an indicator for SCR/SNCR technology. All regressions are at the county level. Indicators for the one-year lag of SCR/SNCR technology, coal fuel, boiler age, and county population are included as controls in each column. Columns 1 and 3 weight by population and Columns 2 and 4 weight by capacity. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A35: Multidimensional RD results for FGD placebo, county level analysis

Variable	(1)	(2)	(3)	(4)
Republican governor	-0.0117	0.000404	-0.0134	-0.0166
	(0.0144)	(0.0168)	(0.0152)	(0.0182)
Republican governor × NA			0.00308	0.0685
			(0.0404)	(0.0473)
State FE	X	X	X	X
Year FE	X	X	X	X
Weights	Population	Capacity	Population	Capacity
Bandwidth	0.713	0.848	0.713	0.848
Clusters	32	33	32	33
Observations	2,412	2,516	2,412	2,516

Notes: Columns 1 and 2 [3 and 4] represent separate multidimensional RD specifications of equation (1) [(2)], where the dependent variable is an indicator for FGD technology. Indicators for the one-year lag of FGD technology, boiler age, and county population are included as controls in each column. Columns 1 and 3 weight by population and Columns 2 and 4 weight by capacity. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A36: Gubernatorial RD results for SCR/SNCR technology adoption, accounting for other NOx emission control policies

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Republican governor	-0.00403	0.0132	0.0115	0.0380	-0.00145	0.0117	0.0381	-0.0128
	(0.0219)	(0.0260)	(0.0247)	(0.0288)	(0.0287)	(0.0247)	(0.0289)	(0.0350)
Republican governor × NA		-0.0838**		-0.112**			-0.111**	
		(0.0410)		(0.0494)			(0.0503)	
Republican governor × NBP					-0.0257			
					(0.153)			
Republican governor × NOx control policy dummy								0.0266
								(0.0417)
State FE	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X
NBP control			X	X	X	X	X	X
Other regulatory controls						X	X	X
Bandwidth	9.191	9.191	9.191	9.191	9.191	9.191	9.191	9.191
Clusters	41	41	39	39	39	39	39	39
Observations	4,013	4,012	3,386	3,385	3,386	3,386	3,385	3,384

Notes: All columns represent separate RD specifications of equation (2), where the dependent variable is an indicator for SCR/SNCR technology. The analysis sample or specification changes presented in this table are as follows: columns 1 and 2 eliminate from the analysis sample those boilers that are subject to both the NAAQS and the NBP; columns 3-5 include a dummy indicating that the boiler is regulated as part of the NOx Budget program in that year; columns 6-8 include a "policy dummy" that indicates if the boiler is regulated as part of some NOx emission control program, which include the Clean Air Interstate NOx program, the SIP NOx program, or the RECLAIM program, in that year. Indicators for the one-year lag of SCR/SNCR technology, coal fuel, boiler age, and county population are included as controls in all specifications. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A37: Gubernatorial RD results FGD technology adoption, accounting for other SO2 emission control policies

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Republican governor	-0.0319	-0.0297	0.0123	-0.00320	0.0702	-0.00707	-0.00410	-0.0157
	(0.0206)	(0.0228)	(0.0284)	(0.0258)	(0.0497)	(0.0213)	(0.0255)	(0.0386)
Republican governor × NA		-0.00548		-0.0550			0.0531	
		(0.0329)		(0.0502)			(0.0476)	
Republican governor × ARP					-0.0438			
					(0.0586)			
Republican governor × SO2 control policy dummy								-0.0699
								(0.0736)
State FE	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X
ARP control			X	X	X	X	X	X
Other regulatory controls						X	X	X
Bandwidth	8.073	8.073	8.073	8.073	8.073	8.073	8.073	8.073
Clusters	36	36	37	37	37	38	37	37
Observations	2,861	2,860	3,096	3,096	3,096	3,730	3,096	3,095

Notes: All columns represent separate RD specifications of equation (2), where the dependent variable is an indicator for FGD technology. The analysis sample or specification changes presented in this table are as follows: columns 1 and 2 eliminate from the analysis sample those boilers that are subject to both the NAAQS and the ARP; columns 3-5 include a dummy indicating that the boiler is regulated as part of the ARP in that year; columns 6-8 include a “policy dummy” that indicates if the boiler is regulated as part of some SO2 emission control program, which include the Clean Air Interstate SO2 program, the Mercury and Air Toxics program, or the RECLAIM program, in that year. An indicator for the one-year lag of FGD technology, boiler age, and county population are included as controls in all specifications. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A38: Gubernatorial effects in less competitive states and at the threshold

Panel A: New air pollution abatement capital expenditures				
	(1)	(2)	(3)	(4)
	DID	RD	DID	RD
Republican governor	-0.670**	-2.524**	0.0809	0.278
	(0.262)	(1.014)	(0.259)	(0.724)
State FE	X	X	X	X
Year FE	X	X	X	X
Sample	Nonattainment	Nonattainment	Attainment	Attainment
Bandwidth	15	9.697	15	9.697
Panel B: SCR/SNCR technology				
	(5)	(6)	(7)	(8)
	DID	RD	DID	RD
Republican governor	-0.025*	-0.0618**	0.0163	0.0116
	(0.0132)	(0.0247)	(0.0103)	(0.0261)
State FE	X	X	X	X
Year FE	X	X	X	X
Sample	Nonattainment	Nonattainment	Attainment	Attainment
Bandwidth	25	9.191	25	9.191

Notes: Columns 2, 4, 6, and 8 represent separate RD specifications of equation (1) on the subsamples of electric utilities in attainment or nonattainment areas. Columns 1, 3, 5, and 7 represent separate DID specifications as described in Online Appendix F, also on subsamples of electric utilities in attainment or nonattainment areas. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A39: State legislative effects in less competitive states and at the threshold

Panel A: New air pollution abatement capital expenditures				
	(1)	(2)	(3)	(4)
	DID	RD	DID	RD
Republican majority	-0.501	-0.900*	-0.139	0.0890
	(0.498)	(0.531)	(0.268)	(0.253)
State FE	X	X	X	X
Year FE	X	X	X	X
Sample	Nonattainment	Nonattainment	Attainment	Attainment
Bandwidth	(all)	0.54	(all)	0.54
Panel B: SCR/SNCR technology				
	(5)	(6)	(7)	(8)
	DID	RD	DID	RD
Republican majority	-0.0515**	-0.0525**	-0.0172	-0.0114
	(0.0216)	(0.0219)	(0.0110)	(0.00865)
State FE	X	X	X	X
Year FE	X	X	X	X
Sample	Nonattainment	Nonattainment	Attainment	Attainment
Bandwidth	(all)	0.609	(all)	0.609

Notes: Columns 2, 4, 6, and 8 represent separate RD specifications of equation (1) on the subsamples of electric utilities in attainment or nonattainment areas. Columns 1, 3, 5, and 7 represent separate DID specifications as described in Online Appendix F, also on subsamples of electric utilities in attainment or nonattainment areas. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A40: Political contributions and ideology of directors/executives at electric utilities vs. non-electric utilities

		Comparison 1 (All Non-elec. utilities)		Comparison 2 (Excluding fin./services)	
	Elec. Utilities	Non-elec. utilities	Difference	Non-elec. utilities	Difference
Percentage contributions to Republicans					
Mean	0.5698	0.5750	0.0052	0.6000	0.0302
(SE)	(0.0197)	(0.006)	(0.0206)	(0.0076)	(0.0212)
Observations	323	3,925	4,248	2,446	2,769
Dime CFscore					
Mean	0.1472	0.1107	-0.0365	0.156	0.0088
(SE)	(0.0387)	(0.0114)	(0.0403)	(0.0145)	(0.0413)
Observations	327	3,999	4,326	2,492	2,819

Notes: This table presents means of political contributions and ideology (measured by the Dime CFscore) for executives at electric utilities and for executives at non-electric utilities. Comparison 1 includes all non-electric utility executives and comparison 2 includes all non-electric utility executives except for those in the financial and service sectors. Online Appendix G describes the data used in this table. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A41: Estimation results for gubernatorial contributions

Variable	(1) Republican contribution	(2) Republican contribution	(3) % dollars to Republicans	(4) % dollars to Republicans	(5) Dime CFscore	(6) Dime CFscore
Electric utility	-0.0146	-0.0325	-0.0365	-0.0581*	0.0282	-0.00803
	(0.0381)	(0.0389)	(0.0324)	(0.0330)	(0.0541)	(0.0553)
Constant	0.581***	0.599***	0.598***	0.620***	0.169***	0.206***
	(0.0119)	(0.0143)	(0.00945)	(0.0114)	(0.0155)	(0.0191)
Exclude financial and services		X		X		X
Individuals	2,158	1,481	2,158	1,481	2,124	1,455
Observations	13,410	9,232	2,158	1,481	2,124	1,455

Notes: Columns 1 and 2 represent separate specifications of equation (A11) for the dichotomous outcome of a contribution to a Republican gubernatorial candidate. We cluster standard errors at the individual (contributor) level for columns 1 and 2. Columns 3 and 4 report results for the analogous model to equation (A11), replacing the dichotomous outcome in equation (A11) with a continuous percentage ranging from zero to one. Columns 5 and 6 show results from the same model, replacing the outcome variable with the Dime CFscore of the contributor and using individual level data. We report robust standard errors to correct for heteroskedasticity in columns 3-6. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A42: RD Results for gubernatorial contributions

	(1)	(2)	(3)	(4)	(5)	(6)
	% Contributions from electric utilities			$ Contributed from electric utilities		
Republican governor	-0.00392	-0.0183	-0.0219	5,063	196.2	-2,764
	(0.033)	(0.0284)	(0.0318)	(4,594)	(5,385)	(4,939)
State FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Bandwidth	8.816	9.697	9.191	10.871	9.697	9.191
Clusters	30	34	32	35	34	32
Observations	102	120	110	132	120	110

Notes: Each column represents a separate RD specification of equation (1) for the outcomes of the percentage of contributions from electric utility executives/directors relative to other industries (columns 1-3) and the amount of contributions from electric utility executives/directors (columns 4-6). Observations are at the state-election cycle level, as described in Online Appendix G. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A43: Gubernatorial RD results for electric utility retirements

Variable	(1)	(2)	(3)	(4)
	Boiler level		Plant level	
Republican governor	-0.000816	-0.00102	0.00183	0.0106
	(0.00266)	(0.00275)	(0.0139)	(0.0170)
NA	-0.00174		0.00188	
	(0.00127)		(0.0198)	
Republican governor × NA		0.00114		-0.0325
		(0.00174)		(0.0511)
State FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	9.191	9.191	9.697	9.697
Clusters	42	42	43	43
Observations	7,806	7,806	3,374	3,374

Notes: Columns 1 and 3 [2 and 4] represent separate RD specifications of equation (1) [(2)]. For the boiler level sample, the dependent variable is a dummy indicating boiler retirement. For the plant level sample, the dependent variable is the proportion of retired boilers at that plant. NA represents nonattainment for any criteria pollutant. Controls for coal fuel, boiler age, and county population (boiler level) and number of boilers, percent of boilers burning coal, plant age, and county population (plant level) and are included in all regressions. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A44: Gubernatorial RD results, county fixed effects

	(1) IHS abatement spending	(2) IHS abatement spending	(3) SCR/SNCR technology	(4) SCR/SNCR technology
Republican governor	0.00384	0.265	-0.00503	0.00305
	(0.600)	(0.629)	(0.0243)	(0.0243)
Republican governor × NA		-1.376		-0.0443
		(0.948)		(0.0457)
NA	0.116	1.422*	-0.0248	0.0301
	(0.304)	(0.832)	(0.0340)	(0.0453)
County FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	9.697	9.697	9.191	9.191
Clusters	42	42	41	41
Observations	2,011	2,011	4,086	4,086

Notes: Columns 1 and 3 [2 and 4] represent separate RD specifications of equation (1) [(2)] for the outcomes of arcsinh transformed real new air pollution abatement capital expenditures and SCR/SNCR technology. Columns 1 and 2 use facility level data and columns 3 and 4 use boiler level data. All specifications include controls for nonattainment status and coal fuel usage. Columns 1 and 2 also control for the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A45: State legislative multidimensional RD results, county fixed effects

	(1) IHS abatement spending	(2) IHS abatement spending	(3) SCR/SNCR technology	(4) SCR/SNCR technology
Republican majority	-0.136	0.0646	-0.0248**	-0.00758
	(0.267)	(0.259)	(0.0120)	(0.0113)
Republican majority × NA		-0.818*		-0.0504**
		(0.419)		(0.0200)
NA	-0.158	0.227	0.0142	0.0545**
	(0.289)	(0.482)	(0.0215)	(0.0233)
County FE	X	X	X	X
Year FE	X	X	X	X
Bandwidth	0.54	0.54	0.609	0.609
Clusters	33	33	33	33
Observations	3,271	3,271	7,904	7,904

Notes: Columns 1 and 3 [2 and 4] represent separate multidimensional RD specifications of equation (1) [(2)] for the outcomes of arcsinh transformed real new air pollution abatement capital expenditures and SCR/SNCR technology. Columns 1 and 2 use facility level data and columns 3 and 4 use boiler level data. All specifications include controls for nonattainment status and coal fuel usage. Columns 1 and 2 also control for the number of boilers. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A46: Baseline gubernatorial RD results for new air pollution abatement expenditures, heterogeneity by nonattainment designation

Variable	(1)	(2)	(3)	(4)	(5)
Republican governor	-0.0724	-0.366	-0.287	-0.222	-0.243
	(0.603)	(0.651)	(0.567)	(0.571)	(0.584)
Republican governor × PM NA	-2.044*				
	(1.163)				
Republican governor × O3 NA		0.730			
		(1.254)			
Republican governor × SO2 NA			0.279		
			(1.310)		
Republican governor × CO NA				-3.997*	
				(2.286)	
Republican governor × Pb NA					1.242
					(1.604)
State FE	X	X	X	X	X
Year FE	X	X	X	X	X
Bandwidth	9.697	9.697	9.697	9.697	9.697
Clusters	42	42	42	42	42
Observations	2,014	2,014	2,014	2,014	2,014

Notes: Columns 1 through 5 represent separate baseline RD specifications of equation (2), where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. Nonattainment designations are split into their component parts, rather than pooled, for nonattainment designations that require the installation of RACT for each respective pollutant. The number of boilers, percent of boilers burning coal, plant age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A47: Baseline gubernatorial RD results for SCR/SNCR technology, heterogeneity by nonattainment designation

Variable	(1)	(2)
Republican governor	0.00243	0.00347
	(0.0225)	(0.0212)
Republican governor × PM NA	-0.0539	
	(0.0518)	
Republican governor × O3 NA		-0.0499
		(0.0351)
State FE	X	X
Year FE	X	X
Bandwidth	9.191	9.191
Clusters	41	41
Observations	4,088	4,088

Notes: Columns 1 and 2 represent separate baseline RD specifications of equation (2), where the dependent variable is an indicator for SCR/SNCR technology. Nonattainment designations are split into their component parts, rather than pooled, for nonattainment designations that require the installation of NOx RACT. We do not examine NO2 nonattainment, because all areas in the US had reached attainment with these standards by the beginning of our sample period. Indicators for the one-year lag of SCR/SNCR technology, boiler age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A48: Baseline gubernatorial RD results for FGD placebo, heterogeneity by nonattainment designation

Variable	(1)	(2)
Republican governor	-0.00494	-0.00178
	(0.0239)	(0.0252)
Republican governor × PM NA	0.0782	
	(0.0703)	
Republican governor × SO2 NA		0.0146
		(0.0659)
State FE	X	X
Year FE	X	X
Bandwidth	8.073	8.073
Clusters	36	36
Observations	3,259	3,259

Notes: Columns 1 and 2 represent separate baseline RD specifications of equation (2), where the dependent variable is an indicator for FGD technology. Nonattainment designations are split into their component parts, rather than pooled, for nonattainment designations that require the installation of SO2 RACT. Indicators for the one-year lag of FGD technology, boiler age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A49: Multidimensional RD results for new air pollution abatement expenditures, heterogeneity by nonattainment designation

Variable	(1)	(2)	(3)	(4)	(5)
Republican majority	-0.00935	-0.0342	-0.185	-0.132	-0.168
	(0.272)	(0.259)	(0.265)	(0.261)	(0.270)
Republican majority × PM NA	-0.858*				
	(0.436)				
Republican majority × O3 NA		-0.698			
		(0.632)			
Republican majority × SO2 NA			1.722		
			(1.280)		
Republican majority × CO NA				-1.803*	
				(0.902)	
Republican majority × Pb NA					2.778
					(1.979)
State FE	X	X	X	X	X
Year FE	X	X	X	X	X
Bandwidth	0.54	0.54	0.54	0.54	0.54
Clusters	33	33	33	33	33
Observations	3,271	3,271	3,271	3,271	3,271

Notes: Columns 1 through 5 represent separate baseline RD specifications of equation (2), where the dependent variable is arcsinh transformed real new air pollution abatement capital expenditures. Nonattainment designations are split into their component parts, rather than pooled, for nonattainment designations that require the installation of RACT for each respective pollutant. The number of boilers, percent of boilers burning coal, plant age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A50: Multidimensional RD results for SCR/SNCR technology, heterogeneity by nonattainment designation

Variable	(1)	(2)
Republican majority	-0.0246**	-0.0170*
	(0.00957)	(0.00889)
Republican majority × PM NA	0.00845	
	(0.0223)	
Republican majority × O3 NA		-0.0349
		(0.0248)
State FE	X	X
Year FE	X	X
Bandwidth	0.609	0.609
Clusters	33	33
Observations	7,904	7,904

Notes: Columns 1 and 2 represent separate baseline RD specifications of equation (2), where the dependent variable is an indicator for SCR/SNCR technology. Nonattainment designations are split into their component parts, rather than pooled, for nonattainment designations that require the installation of NOx RACT. We do not examine NO2 nonattainment, because all areas in the US had reached attainment with these standards by the beginning of our sample period. Indicators for the one-year lag of SCR/SNCR technology, boiler age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table A51: Multidimensional RD results for FGD placebo, heterogeneity by nonattainment designation

Variable	(1)	(2)
Republican majority	-0.00994	0.000388
	(0.0166)	(0.0151)
Republican majority × PM NA	0.0631	
	(0.0461)	
Republican majority × SO2 NA		0.0104
		(0.0559)
State FE	X	X
Year FE	X	X
Bandwidth	0.858	0.858
Clusters	33	33
Observations	6,562	6,562

Notes: Columns 1 and 2 represent separate baseline RD specifications of equation (2), where the dependent variable is an indicator for FGD technology. Nonattainment designations are split into their component parts, rather than pooled, for nonattainment designations that require the installation of SO2 RACT. Indicators for the one-year lag of FGD technology, boiler age, and county population are included as controls in each column. Robust standard errors in parentheses are clustered at the state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Online Appendix Table A52: Benefits and costs of NOx abatement from SCR/SNCR

		Discount rate			
Tech. life (years)		1%	3%	5%	7%
	Annualized cost differential (2015$)	12,748,249	13,437,045	14,142,926	14,865,344
5	Annualized benefit differential (2015$)	17,743,704	17,743,704	17,743,704	17,743,704
	Benefit/Cost ratio	1.39	1.32	1.25	1.19
	Annualized cost differential (2015$)	7,129,397	7,780,923	8,467,443	9,187,458
10	Annualized benefit differential (2015$)	17,743,704	17,743,704	17,743,704	17,743,704
	Benefit/Cost ratio	2.49	2.28	2.10	1.93
	Annualized cost differential (2015$)	5,257,991	5,909,202	6,612,593	7,365,016
15	Annualized benefit differential (2015$)	17,743,704	17,743,704	17,743,704	17,743,704
	Benefit/Cost ratio	3.37	3.00	2.68	2.41
	Annualized cost differential (2015$)	4,323,445	4,983,471	5,712,096	6,503,560
20	Annualized benefit differential (2015$)	17,743,704	17,743,704	17,743,704	17,743,704
	Benefit/Cost ratio	4.10	3.56	3.11	2.73
	Annualized cost differential (2015$)	3,763,641	4,436,012	5,192,476	6,023,525
25	Annualized benefit differential (2015$)	17,743,704	17,743,704	17,743,704	17,743,704
	Benefit/Cost ratio	4.71	4.00	3.42	2.95
	Annualized cost differential (2015$)	3,391,207	4,077,563	4,862,417	5,731,327
30	Annualized benefit differential (2015$)	17,743,704	17,743,704	17,743,704	17,743,704
	Benefit/Cost ratio	5.23	4.35	3.65	3.10

Online Appendix Table 53: Effect of air pollution abatement on ambient air quality (additional AQS parameters)

Variable	(1) CO 8-hr max	(2) SO2 24-hr max	(3) SO2 1-hr 99th percentile	(4) PM 24-hr 98th percentile	(5) PM 24-hr 98th percentile	(6) NO2 1-hr 99th percentile	(7) NO2 1-hr 99th percentile
Cumulative air pollution abatement	0.0341	-3.041	-9.073**	-0.190		-0.610	
capital expenditures	(0.0566)	(1.876)	(3.934)	(0.322)		(0.584)	
SCR/SNCR technology					-0.0524		0.0768
					(0.278)		(0.315)
County FE	X	X	X	X	X	X	X
State-by-year FE	X	X	X	X	X	X	X
Observations	453	781	781	1,001	917	505	464

Notes: Each column presents regression results from a separate specification of equation (4). SCR/SNCR technology represents the presence of the most effective abatement technology for NO_X emissions at each boiler in each year. County level unemployment rate and population are included as controls in each specification. Robust standard errors in parentheses are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

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