

The Political Fallout of Air Pollution

Luna Bellani¹ Stefano Ceolotto²
Benjamin Elsner³ Nico Pestel⁴

EEA-ESEM 2023
28 August 2023

¹ University of Ulm and IZA

² ESRI

³ University College Dublin, IZA and CReAM

⁴ Maastricht University and IZA

Motivation

Poor air quality has adverse impacts on well-being

- ▶ Well-documented effects on health
- ▶ Impairment of cognitive functioning
- ▶ Trigger of **negative emotions**

⇒ **Knock-on effects on decision making**

- ▶ Fatigue
- ▶ Information processing, beliefs
- ▶ Stress, anger, anxiety, etc

Evidence: Yes! — But External Validity?



Effect of Air Pollution in the Population at Large

Effect of Air Pollution in the Population at Large



Effect of Air Pollution in the Population at Large



Voting in Parliamentary Elections

- ▶ High-stakes decision
- ▶ On the same day
- ▶ Different locations

This Paper: Effect of Air Pollution on Voting

- ▶ County level data on 65 federal/state **elections in Germany**
 - Period from 2000 to 2018, 400 counties
 - Daily measures of air pollution and weather

This Paper: Effect of Air Pollution on Voting

- ▶ County level data on 65 federal/state **elections in Germany**
 - Period from 2000 to 2018, 400 counties
 - Daily measures of air pollution and weather

- ▶ **Identification:** variation within counties across election dates
 - Capture idiosyncratic variation in air pollution
 - On election day, air pollution "happens to be higher or lower" than its normal level
 - Unconscious change in behaviour

This Paper: Effect of Air Pollution on Voting

- ▶ County level data on 65 federal/state **elections in Germany**
 - Period from 2000 to 2018, 400 counties
 - Daily measures of air pollution and weather
- ▶ **Identification:** variation within counties across election dates
 - Capture idiosyncratic variation in air pollution
 - On election day, air pollution "happens to be higher or lower" than its normal level
 - Unconscious change in behaviour
- ▶ **Main outcome:** Vote share of **incumbent parties** (status quo)
 - Increase in **risk aversion** → Incumbent support ↑
 - Increase in **bad mood** → Incumbent support ↓

Preview of Findings

Main findings

- ▶ Negative effect of air pollution on the vote share of the incumbent parties
- ▶ Corresponding increase in the vote share of established opposition parties
- ▶ Similar effects in two large-scale representative surveys

Preview of Findings

Main findings

- ▶ Negative effect of air pollution on the vote share of the incumbent parties
- ▶ Corresponding increase in the vote share of established opposition parties
- ▶ Similar effects in two large-scale representative surveys

Mechanisms

- ▶ No effect on perceptions of current state of the economy or own economic situation
- ▶ Lower approval of government and increases in negative emotions → Dissatisfaction with status quo

Contributions

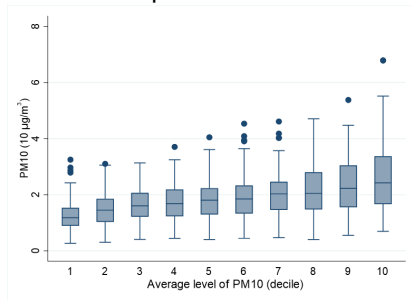
- 1. The role of incidental factors in high-stakes decisions**
 - Show that air pollution changes decision making
 - Provide evidence that effect operates via **affective emotions**
- 2. Economic and social effects of poor air quality**
 - Impacts in many domains of life (education, productivity,...)
 - Novelty is effect of air pollution on **political outcomes**
- 3. Rational voting**
 - Voters respond to irrelevant events (?) and environmental factors
 - Rainfall affects emotions *and* the cost of voting
 - Air pollution less noticeable, highlights the **role of emotions**

Descriptive Statistics

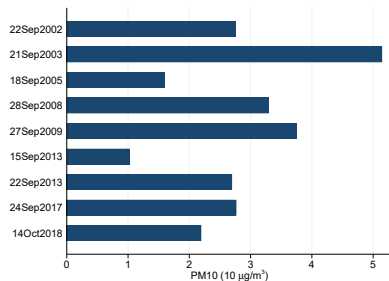
	Mean	SD(total)	SD(within)	min	max	N
Voting data						
Eligible voters	159,376	159,294	5,247	26,396	2,505,718	2,770
Valid votes	109,548	116,304	16,955	13,132	1,872,133	2,770
Turnout	0.69	0.09	0.02	0.38	0.87	2,770
Share incumbent parties	0.48	0.10	0.07	0.17	0.79	2,770
Share established opposition parties	0.42	0.12	0.07	0.13	0.82	2,770
Share other parties	0.10	0.07	0.02	0.01	0.44	2,770
Pollution data						
PM10 ($10\mu\text{g}/\text{m}^3$)	1.90	0.85	0.47	0.26	6.79	2,770
Ozone ($10\mu\text{g}/\text{m}^3$)	4.20	1.54	0.81	1.36	16.21	2,770
NO2 ($10\mu\text{g}/\text{m}^3$)	2.18	1.20	0.59	0.00	9.25	2,762
Weather data						
Temperature ($^{\circ}\text{C}$)	11.22	4.01	0.83	-7.60	21.12	2,770
Relative humidity (%)	80.02	9.12	4.45	47.40	99.58	2,770
Wind speed (m/s)	2.72	1.63	0.84	0.10	11.87	2,770
Precipitation (mm)	1.34	3.18	2.14	0.00	34.80	2,770
Demographic and economic data						
Population	214,510	228,459	10,663	34,084	3,613,495	2,770
GDP per capita	31,128	14,902	3,417	12,481	172,437	2,770
Employment rate	0.76	0.22	0.03	0.37	1.97	2,770

Variation

Overall sample



Example: Munich



Empirical Strategy

TWFE Regression

$$y_{it} = \alpha + \beta PM10_{it} + \mathbf{X}'_{it}\gamma + \delta_i + \tau_t + \varepsilon_{it}$$

- y_{it} : election outcome for county i in election date t
- $PM10_{it}$: concentration of PM10 measured on election day
- \mathbf{X}_{it} : controls for weather and demographics
- δ_i, τ_t : county and election date fixed effects
- ε_{it} : standard errors clustered at county level

Identification Assumption

$$E(\varepsilon_{it} | PM10_{it}, \mathbf{X}_{it}, \delta_i, \tau_t) = 0.$$

Variation in air pollution within counties over time should be as good as random

Challenges

- ▶ Omitted variables (local econ. shocks, weather, regional trends)
- ▶ Mail voting

Identification Assumption

$$E(\varepsilon_{it} | PM10_{it}, \mathbf{X}_{it}, \delta_i, \tau_t) = 0.$$

Variation in air pollution **within counties over time** should be as good as random

Challenges

- ▶ Omitted variables (local econ. shocks, weather, regional trends)
- ▶ Mail voting

What we do:

- ▶ Placebo tests (placebo election dates)
- ▶ IV based on **wind directions** (Deryugina et al. 2019)
- ▶ Quantify measurement error due to mail voting

Main Results – Fixed Effect Estimation

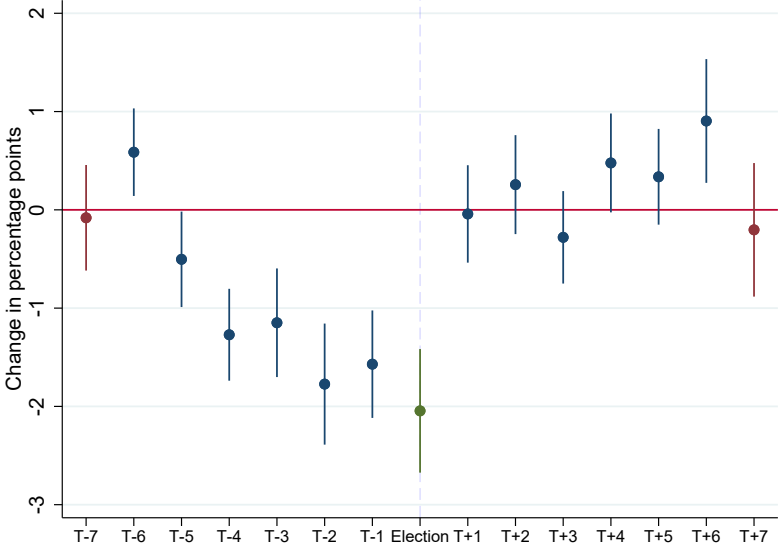
Outcome:	Vote Share of Incumbent Parties		Turnout	
	(1)	(2)	(3)	(4)
PM10 ($10\mu\text{g}/\text{m}^3$)	-0.0198*** (0.003)	-0.0205*** (0.003)	0.0012 (0.001)	0.0010 (0.001)
Mean dep. var.	0.48	0.48	0.69	0.69
R ²	0.576	0.604	0.961	0.961
N	2770	2770	2770	2770
<i>Controls</i>				
County FE	✓	✓	✓	✓
El. Date FE	✓	✓	✓	✓
Weather		✓		✓
Ozone		✓		✓
Demographics		✓		✓
El. Type FE		✓		✓
Turnout		✓		

▶ Non-linear

▶ IV Results

▶ Additional Results

Robustness – Placebo election dates



Mechanisms – Data Sources

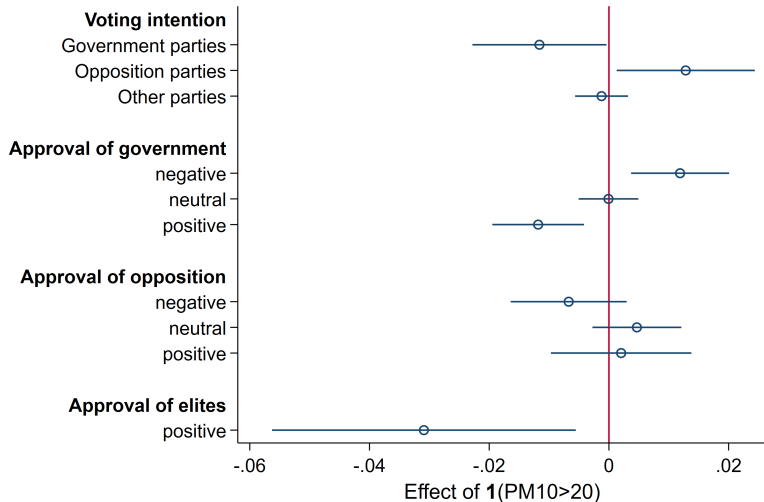
Monthly Opinion Poll

- ▶ *Politbarometer*: repeated cross-sections with week of interview and state of residence (2003–2019)
- ▶ Regular questions on **voting intention** (*Sonntagsfrage*) and **approval** of current (federal) government and opposition
- ▶ Binary indicator for $PM_{10} > 20\mu g / m^3$ in week of interview

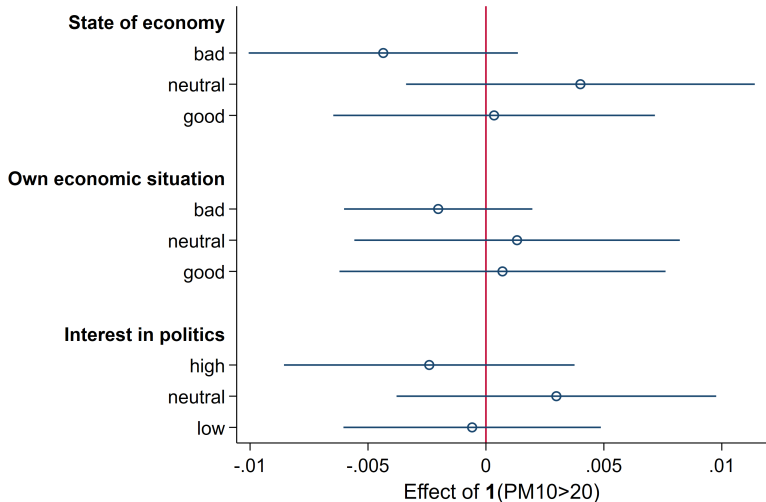
Panel Survey Data

- ▶ **Socio-Economic Panel (SOEP)**: panel survey since 1984
- ▶ Questions on **political attitudes** since mid-1980s and **affective well-being** since 2007 (2000–2019)
- ▶ Binary indicator for $PM_{10} > 20\mu g / m^3$ by county of residence over 7 days preceding the interview date

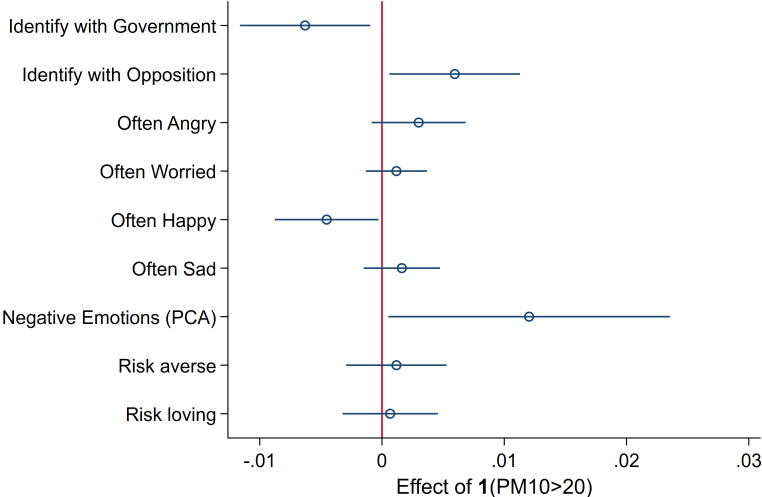
Mechanisms – Government approval (*Politbarometer*)



Mechanisms – Perceptions of economy (*Politbarometer*)



Mechanisms – Affective well-being (SOEP)



Summary & Implications

Summary

- ▶ Ambient air pollution affects decision making of **population at large** in elections, a **high-stakes real-world setting**
 - Reduction in support of government coalition
 - Increase in electoral support for opposition
- ▶ **Negative emotions** lowering **support of status quo** as a plausible psychological mechanism

Implications

- ▶ Election outcomes determine **government formation** as well as **design of policies**
- ▶ Estimates do not imply landslide shifts in voting but may still affect **government formation at the margin** in close elections

Discussion

Mood or Risk Aversion?

- ▶ Results relate to findings on effects of air pollution on crime
 - Air pollution increases violent crime
 - Aggressive/impulsive behavior and lower future orientation
- ▶ Results less consistent with result on higher risk aversion
 - Reduction in professional investors' willingness to take risks
 - Tiny marginal impact of single vote → *Paradox of Voting?*

Thank you for your attention!

www.benjaminelsner.com

@ben_elsner

Data at the County-Election Level

Elections

- ▶ Five federal and 60 state elections 2000–2018 (*Destatis*)
- ▶ Turnout and party vote shares (*second vote*)
 - Incumbent parties: part of governing coalition before election
 - Established opposition: regularly represented in *Bundestag*
 - Other parties: smaller opposition parties (incl. *AfD*)

Air pollution and weather

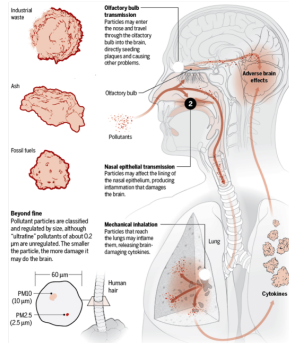
- ▶ Daily PM10 (and ozone) concentrations (*UBA*)
- ▶ Weather control variables (*DWD*)

Demographic and Economic Data

- ▶ Population, GDP per capita, employment rate (*Destatis*)

Effects of exposure to air pollution

- ▶ Inflammatory responses and oxidative stress in lungs, vascular system, heart tissues, central nervous system
- ▶ Increases occurrences of headaches and depression with knock-on effects on mental health and people's mood
- ▶ Affects brain functioning and how people process information and make judgments



Pollution exposure and voting for the status quo

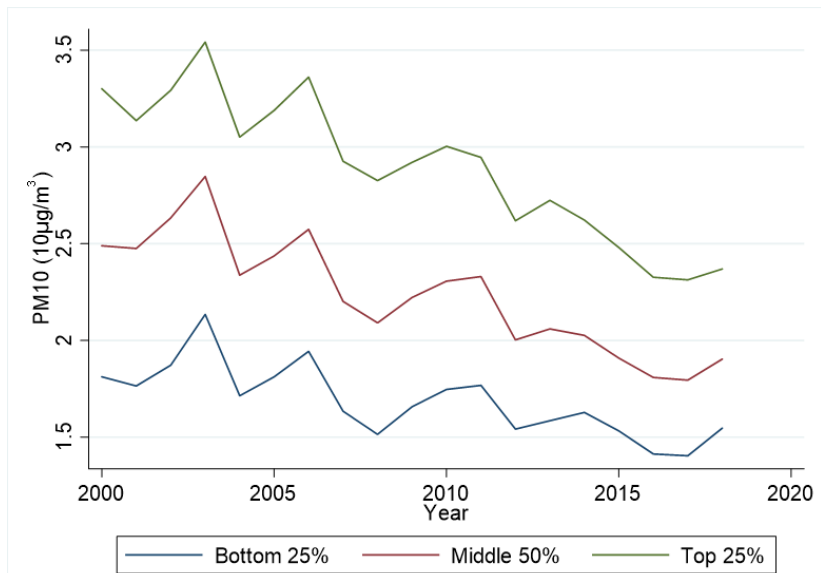
Voting for the incumbent government

- ▶ Reflects voters' happiness with current **political status quo**
 - Unhappiness decreases loss aversion, reduces status quo bias
 - Anxiety decreases reliance on political habits and heuristics
- ▶ May be indicative of voters' **risk preferences**
 - Negative emotions may impact on risk attitudes
 - Risk averse individuals more likely to vote for status quo

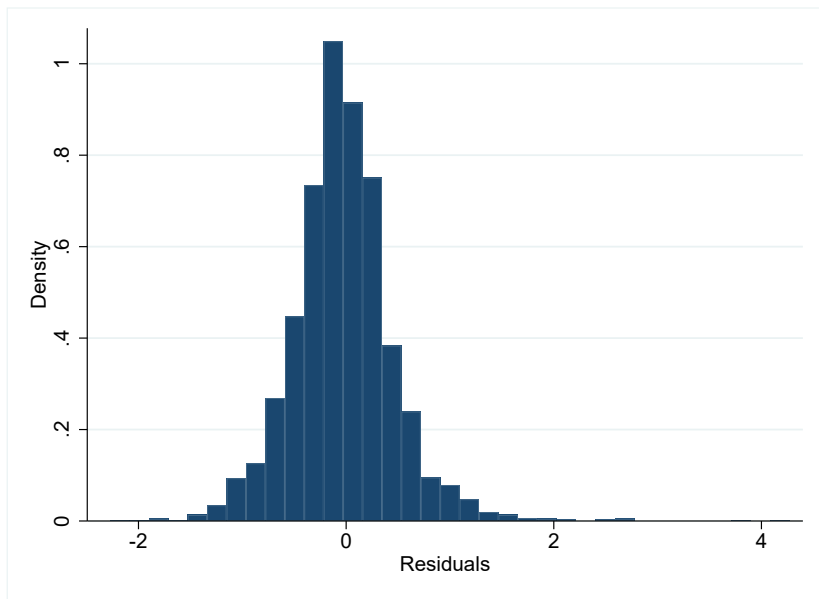
Effect of air pollution on status quo voting?

- ▶ If air pollution increases **risk aversion** → **Positive** effect
- ▶ If it mainly affects **voters' mood** → **Negative** effect

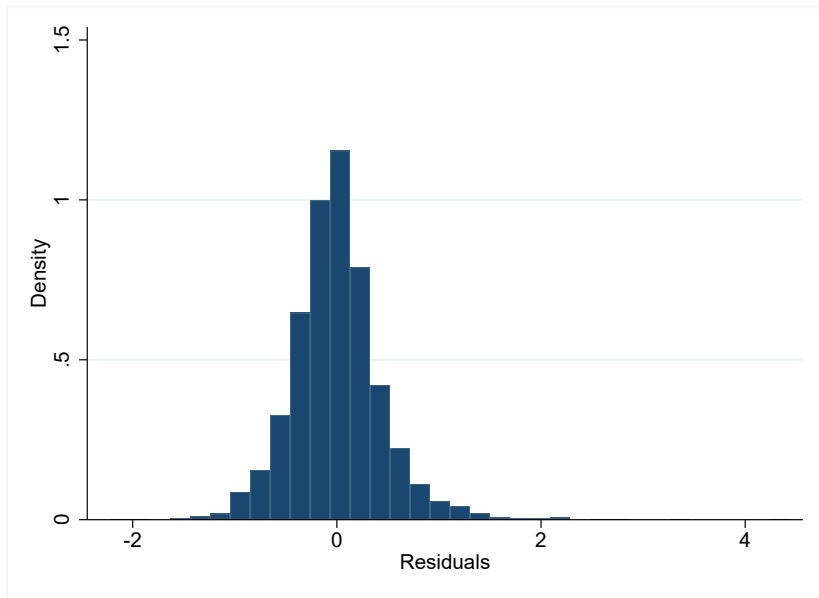
Annual Trends in PM10



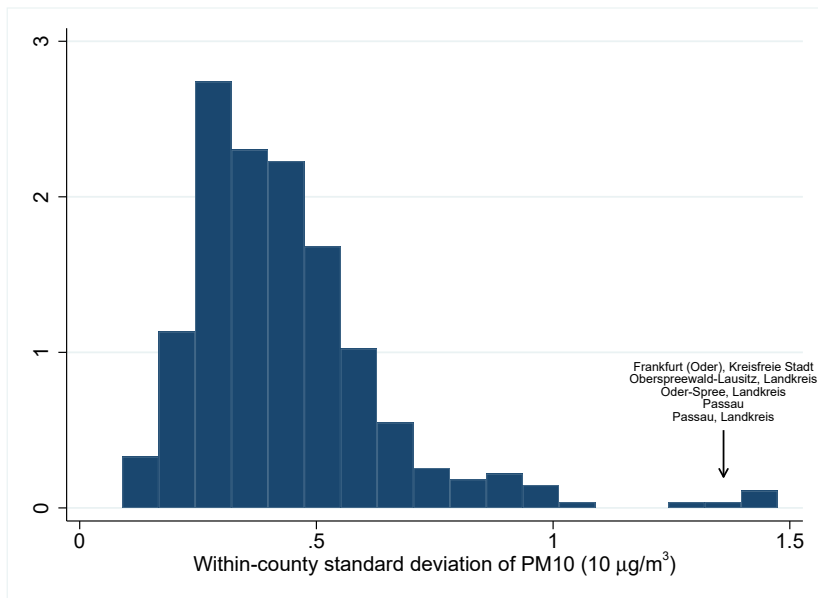
Variation in PM10 – residuals from twoway FE



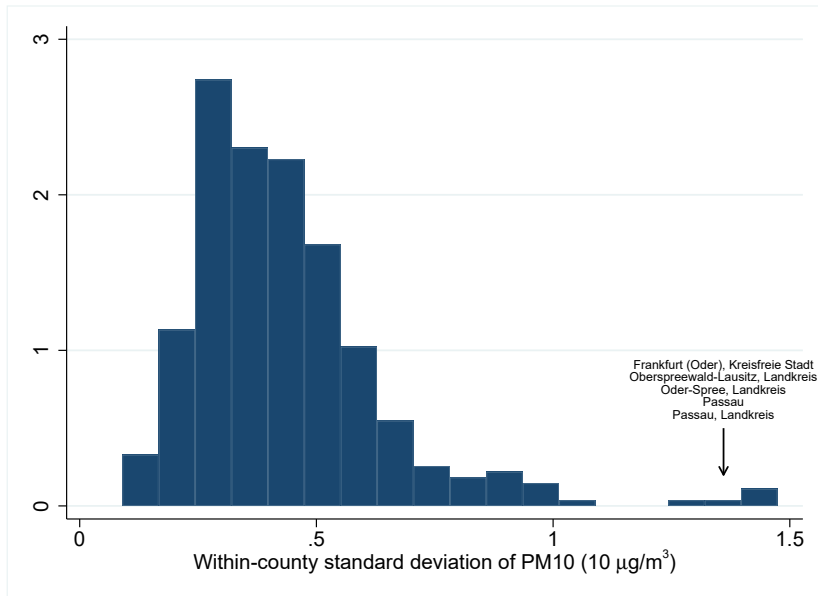
Variation in PM10 – residuals from twoway FE, with controls



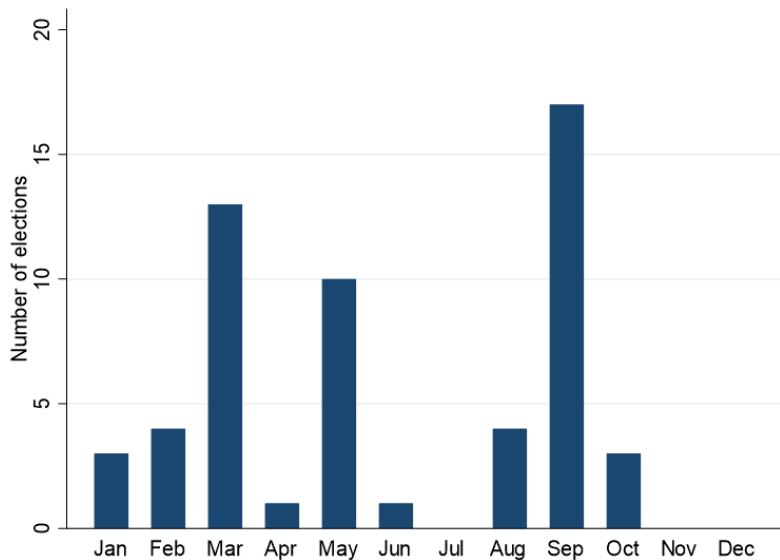
Variation in PM10



Variation in PM10



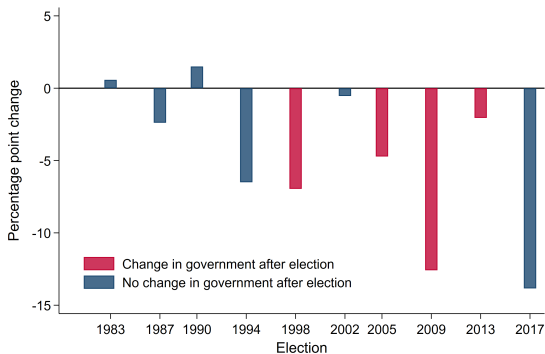
Elections by Month



How Big is the Effect?

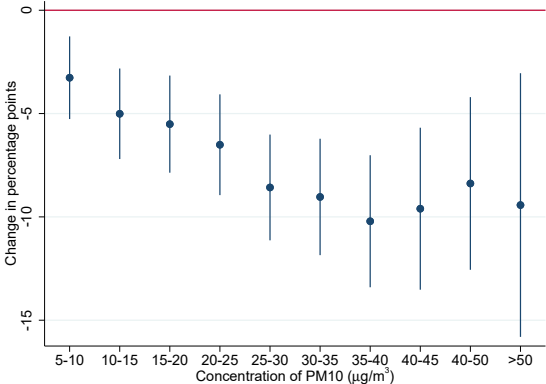
1 within SD of PM10 \Rightarrow 1 pp lower support for incumbent

Change in votes for incumbent parties, federal elections



Benchmark: the "Merkel" Election 2005 \Rightarrow incumbent lost 5 pp overall

Dose-Response Relationship



Main Results – Non-linear dose-response relationship

Outcome:	Incumbent (1)	Established Opposition (2)	Other Parties (3)	Turnout (4)
A. Without controls				
PM10 10-20 $\mu\text{g}/\text{m}^3$	-0.0154*** (0.005)	0.0209*** (0.006)	-0.0055*** (0.002)	0.0012 (0.002)
PM10 20-30 $\mu\text{g}/\text{m}^3$	-0.0343*** (0.007)	0.0478*** (0.007)	-0.0135*** (0.003)	0.0022 (0.002)
PM10 > 30 $\mu\text{g}/\text{m}^3$	-0.0509*** (0.009)	0.0721*** (0.009)	-0.0212*** (0.004)	0.0016 (0.002)
Mean dep. var.	0.48	0.42	0.10	0.69
R ²	0.575	0.684	0.893	0.961
N	2770	2770	2770	2770
<i>Controls</i>				
County FE	✓	✓	✓	✓
El. Date FE	✓	✓	✓	✓
B. With controls				
PM10 10-20 $\mu\text{g}/\text{m}^3$	-0.0198*** (0.006)	0.0266*** (0.006)	-0.0068*** (0.002)	0.0001 (0.002)
PM10 20-30 $\mu\text{g}/\text{m}^3$	-0.0365*** (0.007)	0.0503*** (0.007)	-0.0138*** (0.003)	0.0012 (0.002)
PM10 > 30 $\mu\text{g}/\text{m}^3$	-0.0546*** (0.009)	0.0768*** (0.009)	-0.0222*** (0.003)	0.0011 (0.002)
Mean dep. var.	0.48	0.42	0.10	0.69
R ²	0.603	0.704	0.901	0.961
N	2770	2770	2770	2770
<i>Controls</i>				
County FE	✓	✓	✓	✓
El. Date FE	✓	✓	✓	✓
Weather	✓	✓	✓	✓
Ozone	✓	✓	✓	✓
Demographics	✓	✓	✓	✓
El. Type FE	✓	✓	✓	✓
Turnout	✓	✓	✓	

IV Results/Robustness Checks/Additional Results

Outcome	Vote Share of Incumbent Parties (IV) (1)	Vote Share of Incumbent Parties (OLS) (2)	Vote Share of Incumbent Parties (OLS) (3)	Vote Share of Incumbent Parties (OLS) (4)
PM10 ($10\mu\text{g}/\text{m}^3$)	-0.0345*** (0.006)	-0.0185*** (0.003)	-0.0187*** (0.003)	
PM10 in Q1				0.0203*** (0.004)
PM10 in Q4				-0.0120** (0.005)
Mean dep. var.	0.48	0.48	0.48	0.48
R ²	0.076	0.601	0.605	0.600
N	2770	2770	2762	2770
Kleibergen-Paap F	51.33			
<i>Controls</i>				
County FE	✓	✓	✓	✓
El. Date FE	✓	✓	✓	✓
Weather	✓	✓	✓	✓
Temperature	linear	dummies	linear	linear
Ozone	✓	✓	✓	✓
NO2			✓	
Demographics	✓	✓	✓	✓
El. Type FE	✓	✓	✓	✓
Turnout	✓	✓	✓	✓

▶ Back to Main Results

Additional Results

Outcome	Vote Share of Established Opposition Parties (OLS) (1)	Vote Share of Other Opposition Parties (OLS) (2)	Vote Share of Greens Party (OLS) (3)	Invalid Votes (OLS) (4)
PM10 ($10\mu\text{g}/\text{m}^3$)	0.0291*** (0.004)	-0.0087*** (0.002)	-0.0007 (0.001)	-0.0002 (0.000)
Mean dep. var.	0.42	0.10	0.09	0.01
R ²	0.705	0.902	0.881	0.692
N	2770	2770	2770	2753
<i>Controls</i>				
County FE	✓	✓	✓	✓
El. Date FE	✓	✓	✓	✓
Weather	✓	✓	✓	✓
Temperature	linear	linear	linear	linear
Ozone	✓	✓	✓	✓
Demographics	✓	✓	✓	✓
El. Type FE	✓	✓	✓	✓
Turnout	✓	✓	✓	✓

[▶ Back to Main Results](#)

Permutation Tests

Outcome: Incumbent vote share

