

Pollution Lowers Support for China's Regime: Quasi-Experimental Evidence from Beijing

Meir Alkon, Princeton University
Erik H. Wang, Princeton University

Using an eight-week-long original survey conducted day by day in Beijing in 2015, we leverage daily variation in air quality to estimate the causal effects of pollution on support for the Chinese regime. Our results show that pollution decreases satisfaction with both central and local governments and increases demand for oversight of government. Additionally, we time our survey to partially coincide with a period during which the government intentionally reduced air pollution, allowing us to exploit a unique instance of authoritarian environmental engineering. We show that government efforts to reduce pollution do successfully improve citizens' evaluations of the regime. To our knowledge, this article provides the first causal estimates of the challenges to popular support posed by environmental issues in a developing country and also illustrates the specific ways in which public opinion under authoritarian governance is affected by pollution.

Air pollution has been a major concern for human development since the Industrial Revolution. We present the first causal estimates of pollution's effects on political attitudes using an original survey in China. We test for two effects: (1) whether pollution lessens public satisfaction with the Chinese government and (2) whether government-led pollution reduction efforts can attenuate these negative attitudinal effects. We find that daily increases in air pollution reduce respondents' satisfaction with local and central governments and increase their demand for public oversight over government. Our results also suggest that government-led pollution control efforts may help improve respondents' assessments of the regime.¹

These findings have two important theoretical implications. First, we demonstrate that air pollution has negative public opinion consequences for the governing regime in a high-growth country. Second, by showing that government efforts at pollution reduction succeed in increasing regime popu-

larity, we provide microfoundational support for theories of information and institutions in authoritarian regimes that rest on the efficacy of autocrats' policy responses to grievances.

THEORY

In linking daily variation of pollution to political attitudes, we draw on a large body of scholarship showing the importance of recent conditions in forming retrospective evaluations. Research has shown that individuals' experience of pain is largely determined by the end of the experience (Ariely 1998). Documenting the tendency to substitute recent experience for a larger whole in a series of surveys and experiments, Healy and Lenz (2014) find further evidence of what they refer to as an end-heuristic.

These strands of behavioral research on the importance of recent events provide theoretical foundations for attitudinal variation in response to changing levels of daily air pollution. In discussing the effects of short-term variation,

Meir Alkon (malkon@princeton.edu) is a PhD candidate, Department of Politics and Woodrow Wilson School of Public and International Affairs, Princeton University, Princeton, NJ 08540. Erik H. Wang (haixiaow@princeton.edu) is a PhD candidate, Department of Politics, Princeton University, Princeton, NJ 08540.

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1. On the importance of public opinion in authoritarian regimes, empirical studies identify autocrats' efforts to collect and incorporate citizens' preferences (e.g., Meng, Pan, and Yang 2014). This body of research highlights the importance of public opinion for both autocratic survival and policy making.

by no means do we suggest that daily variation is the main, let alone the sole, way in which pollution affects public attitudes. Citizens are surely aware of pollution as a longer-term problem; short-term variation provides the analytical leverage to identify pollution's causal effects. Our design maximizes external validity by using real-world pollution variation. However, this strategy is less capable of identifying the exact psychological mechanisms underlying the effects. We sketch two likely mechanisms. For both, exogenous variation in pollution levels increases the (negative) salience of pollution to respondents. This increased salience enhances the link between air quality and evaluations of the government.

The first mechanism focuses on pollution's ties to institutions and policies in China. The regime publicly claims credit for industrial policies and economic growth. Both this rhetoric and the reality of political institutions closely connected to industrial production and market outcomes create a public link between market externalities and the regime. Daily increases in the air quality index (AQI) make pollution more salient, highlighting this link in respondents' minds. A second, complementary mechanism draws from our finding that daily pollution lowers life satisfaction (see app. table A18, available online). As pollution lowers respondents' life satisfaction, it makes them think more about the issue, highlighting the link between pollution and the government. This means that the negative effect on life satisfaction is also a likely, complementary mechanism for pollution's effects on political attitudes.

These two mechanisms contrast with "blind retrospection" (Achen and Bartels 2016), which entails holding the government responsible for acts of nature that are clearly unrelated to government policies or the political system as a whole. In fact, our mechanisms build on a rich literature linking pollution to politics. Research debates the nature of the effect linking democratic institutions to environmental quality (e.g., Bättig and Bernauer 2009). Other important studies demonstrate the relevance of globalization and national governments' decisions to join international organizations (e.g., Spilker 2013). Consistent across this large body of research is the theoretical conviction, backed by empirical evidence, that politics matter for environmental outcomes. This is the case in China, where the public has also become increasingly aware of the association between pollution and politics: the film *Under the Dome*, covering the causes and consequences of China's air pollution, has been watched over 300 million times.² Pollution is highly salient, with more than 70% of the population viewing it as

at least a moderately big problem.³ Air quality is also highly politicized as the regime's concern and actions over the issue demonstrate and as evident in widely consumed media.

RESEARCH CONTEXT AND DATA

Identifying pollution's effects on citizens' assessments of the regime is difficult because pollution in the long run is endogenous to China's institutional setting and developmental strategy (Jia 2017). For example, unobserved governance deficiencies could affect both pollution levels and citizens' regime support. We leverage daily, plausibly exogenous, within-city variation in pollution, building on the Annenberg election studies' technique of daily sampling to compile a repeated cross section (RCS) data set (Romer 2004).⁴ The novel aspect of the design is to match repeated survey samples with an exogenously changing independent variable, estimating how this variable, pollution, affects public opinion.

The data source is an online survey restricted to Beijing residents, administered on a daily basis over eight weeks from August 14 to October 9, 2015.⁵ The total *N* is 1,809, sampled over 57 days (mean daily response = 32.75, median = 32). Our dependent variables are satisfaction with local/central government, demand for more oversight over local/central government, and respondents' belief that global warming is a Western conspiracy designed to constrain China's rise (a claim made by some public, pro-regime figures).

For our purposes, an online sample has several advantages. First, general surveys that are nationally representative are usually conducted within a short time period. For most districts or cities that are sampled, we would be unable to exploit daily variation in air quality. Second, because of logistic and technological constraints, nationally representative sampling in China usually involves face-to-face interviews that could intensify potential concerns of preference falsification in answering politically sensitive questions.⁶ Third, research shows that the (digitally connected) urban middle class in China's capital forms a politically important group (Wallace 2014).

We then matched our survey data to daily measures of Beijing's air pollution, using the US Embassy's AQI.⁷ Research

2. Among the many politically charged claims made in the documentary is that politically connected state-owned industrial enterprises take advantage of the regime's developmental strategy to stymie environmental regulations.

3. For example, see <http://assets.pewresearch.org/wp-content/uploads/sites/2/2016/10/Pew-Research-Center-China-Report-FINAL-October-5-2016.pdf>.

4. Lebo and Weber (2015) offer a general discussion of RCS data in political science.

5. Summary statistics, recruitment procedures, background information, and outcome measure wording are detailed in app. sec. A1.

6. Of course, since preference falsification is not related to daily air pollution variation, it would not bias our estimation of pollution's effects.

7. We use standardized measures of raw AQI numbers as the main measure of our independent variable. Our results also remain robust with alternative measures of air pollution (see tables A19 and A20).

shows that meteorological conditions, including air pressure, wind, dew point, temperature, and precipitation, all play important roles in determining daily air quality variation (Liang et al. 2015), underpinning pollution's plausible exogeneity.⁸ Additionally, we time our survey to include a pollution control period in preparation for a military parade in Beijing, allowing us to estimate how government efforts to reduce pollution shape citizens' evaluation of the regime.

ESTIMATION STRATEGIES AND RESULTS

Our estimation framework addresses serial correlation of pollution across days by including two lagged terms of AQI that capture pollution's past dynamics.⁹ We estimate the following model, with standard errors clustered by day:

$$\text{OPINION}_i = \alpha + \beta \text{AQI}_t + \delta \text{AQI}_{t-1} + \gamma \text{AQI}_{t-2} + \eta \text{PARADE}_t + \tau \text{HOLIDAY}_t + X_i' \theta + \epsilon_i,$$

where β denotes the effect of AQI on day t on individual i 's OPINION and is therefore our main quantity of interest. We note that for β to represent a causal effect in this form, the main requirement is that no time-varying confounders jointly affect both AQI and OPINION. "PARADE" is an indicator for the preparade pollution control period plus the day of the parade itself, and "HOLIDAY" is an indicator for the national holiday (it is only during these two distinct periods that our independent variable, AQI, might be determined by factors, other than its own lagged values, that could jointly predict OPINION).¹⁰ The variables δ and γ are coefficients for lagged terms of AQI, and X_i is a vector of demographic covariates.

The model above is estimated for each of our outcome variables, and the results are summarized in table 1. The effects are fairly sizable, given that AQI (raw daily mean = 107, SD = 63) can vary by several standard deviations in a short period of time. One way to understand the substantive effects is to use our estimates to simulate the effects on political attitudes associated with moves between different categories of AQI, using raw measures of AQI, not standardized values. These widely used categories included "healthy," "moderate," "unhealthy for sensitive groups," "unhealthy," and "hazard-

ous." Our data include AQI falling within each of these levels. Moving from the middle value of the moderate category to the middle value of the unhealthy category, for example, would reduce local and central government satisfaction by .10 and increase demand for oversight of local and central governments by .13 and .10, respectively. Moving from the middle value of the moderate category to the middle value of the hazardous category would decrease local government satisfaction by .33 and central government satisfaction by .32, while increasing demand for government oversight by .43 (local government) and .32 (central government).

Another way to consider the substantive effects is to compare the effects of standardized AQI with the coefficients of standardized covariates, such as income and age. AQI's coefficient magnitude is comparable to those of income and age for local government satisfaction and is much larger than that of income for central government satisfaction. Consider state-owned enterprise (SOE) employment as another comparison, which research suggests is a predictor of authoritarian regime support (Tang, Huhe, and Zhou 2017). The magnitude of two standard deviations in AQI exceeds that for the dummy variable "SOE employment" in our model of local government satisfaction. It is worth noting that political views are often a function of many long-term determinants and thus tend to be sticky over time. That day-level variation should have any effect at all is not *ex ante* obvious.

Pollution also makes respondents more skeptical of the anti-West conspiracy theory that global warming is a hoax perpetrated by the West, especially the United States, to constrain China's rise. Supporters of China's regime use such conspiracy theories to bolster support, as they invoke a "victim mentality" among Chinese citizens, promoting a kind of Chinese nationalism that reinforces anti-West sentiments.

MEDIATION ANALYSIS OF AUTHORITARIAN ENVIRONMENTAL ENGINEERING

Can government efforts to curtail pollution improve citizens' evaluations? Actual policy responses are hard to identify. Even when a policy response occurs, endogeneity problems make disentangling the independent effect of that policy difficult. An ideal research design should therefore analyze an incident in which the regime almost "responds" to air pollution, but not in a way directly driven by citizen demands.

Our design is timed to exploit such an opportunity. Leveraging a two-week period during which the Chinese government forcefully reined in pollution in advance of a military parade on September 3, 2015, we examine whether public opinion became more favorable toward the government during these (lower-pollution) days. Intending for the parade to be a widely publicized and important event, the government

8. Appendix table A1 plots the daily volatility of pollution over time.

9. Please see app. subsection A9.4 for details of lag construction.

10. PARADE is a dummy variable taking one for the period between August 20 and September 3 and zero otherwise. HOLIDAY is a dummy variable taking one for the national day holiday week between October 1 and October 7 and zero otherwise. During these two periods (and especially the former) the government took efforts to reduce pollution, which could possibly affect public opinion as well. As we are estimating the main causal effect of pollution, we added these two dummy variables to guard against potential confounding.

Table 1. Full Sample Ordinary Least Squares Estimates with Demographic Controls

	Local Government	Central Government	Local Oversight	Central Oversight	Anti-West
AQI	−.0646* (.0347)	−.0620** (.0300)	.0841* (.0463)	.0609* (.0328)	−.0676** (.0284)
AQI lagged	.0100 (.0402)	.0142 (.0342)	−.0176 (.0538)	−.0245 (.0377)	.0130 (.0331)
AQI lagged 2	.0538 (.0347)	.0133 (.0271)	−.0076 (.0442)	−.0088 (.0288)	−.0123 (.0294)
Hukou status	−.0213 (.0989)	−.1294 (.0987)	−.0965 (.1220)	−.1053 (.1093)	.0826 (.1354)
Regime insider	−.1315** (.0607)	−.0765 (.0645)	.3628*** (.0690)	.2888*** (.0646)	.1674** (.0688)
SOE employee	−.1191** (.0592)	−.0550 (.0610)	−.0259 (.0647)	−.0351 (.0614)	−.0876 (.0661)
Education	.0101 (.0316)	−.0082 (.0312)	.0350 (.0358)	.0361 (.0296)	.0690** (.0285)
Children	.1029 (.0781)	.2797*** (.0799)	−.1199 (.1017)	−.2733** (.1162)	.2954*** (.0915)
Married	.1791** (.0840)	−.0323 (.0790)	−.2832*** (.0929)	−.1336 (.0986)	−.1775 (.1178)
Income	.0543* (.0298)	.0147 (.0282)	−.0337 (.0305)	−.0487 (.0323)	−.0310 (.0309)
Female	.1682*** (.0624)	.1207** (.0536)	−.3232*** (.0793)	−.2161*** (.0613)	−.0239 (.0604)
Communist Party member	.2947*** (.0578)	.2466*** (.0584)	−.4096*** (.0702)	−.3063*** (.0657)	−.0475 (.0701)
Parade period	.1132 (.0714)	−.0954 (.0591)	−.1562* (.0881)	−.0658 (.0808)	−.1435** (.0658)
Holiday	.2836*** (.0736)	.0941* (.0486)	−.2620*** (.0879)	−.2023*** (.0745)	−.1026 (.0816)
Age	−.0849*** (.0308)	−.0739*** (.0285)	.0533 (.0351)	.0939*** (.0309)	−.0083 (.0294)
Observations	1,747	1,744	1,738	1,739	1,740

Note. Robust standard errors clustered by day are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

worked (successfully) to lower pollution in order to ensure clear, blue skies on the day of the parade.

To rule out sentiment directly induced by the parade, we utilize causal mediation analysis (Imai, Keele, and Tingley 2010) and compute the average mediation effect of pollu-

tion reduction on attitudes. In contrast to previous models in which AQI is considered the “treatment,” in causal mediation we take the pollution control period dummy as the “treatment” with AQI as the “mediator.” We then examine how much of the effect that the pollution control period has on

public opinion is mediated through changes in pollution. We estimate three causal parameters: the total effect of the pollution control period in preparation for and during the parade; the average causal mediation effect (ACME) of pollution control (our main quantity of interest), which acts through its reduction of AQI; and the average direct effect of pollution control. Identifying the ACME entails strong assumptions, and these assumptions can be violated in observational studies. Given the plausibly exogenous daily variation in pollution, there is nothing else, other than the treatment of the parade itself, that can affect both the mediator and the outcome. This exogeneity of the mediator is an advantage for our design and a rare feature in observational studies. Despite this improvement, assumptions such as sequential ignorability might still be violated.

Our results, reported in appendix figure A10, suggest that pollution reduction indeed increases regime support. The ACME of pollution reduction is significant for outcome measures excepting demand for public oversight over central government. As a result of pollution control, respondents are more satisfied with local and central governments and demand less public oversight over local (but not central) government.

CONCLUSION

We find that pollution decreases government satisfaction and increases demand for government oversight at both local and central levels. Additionally, state-mandated pollution control may help improve citizens' regime assessment. These findings hold implications for Chinese politics: the growth-based regime survival strategy might have unintended public opinion consequences. They also point to the importance of environmental issues for public opinion in developing countries.

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