Dirty Politics: Impact of Criminally Accused Politicians on Air Pollution in India

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Abstract

This study investigates the causal impact of electing leaders with criminal records on PM2.5 air pollution in India. Utilizing data from 2008-2018 across Indian constituencies and employing a Regression Discontinuity Design, the paper reveals significant correlations between such political choices and air pollution levels. These findings offer new insights into the intersection of political dynamics and environmental policy, with substantial implications for environmental governance and public health. ***JEL Classification***: D72, Q01, Q52, Q56.

Keywords: Air Pollution; Political Leadership; Environmental Economics; Regression Discontinuity Design; Development Outcomes.

In 2014, over a third of the members elected to the Indian parliament were under criminal indictment (Bagri, 2014). This fact is particularly concerning given the extensive body of literature emphasizing the significant influence of leader characteristics on economic outcomes. Recently, Prakash et al. (2019), for example, show that the aggregated economic cost of having criminal leaders in power accumulates to a roughly 2.3-percentage point lower GDP growth per year in India. Furthermore, Nanda and Pareek (2016) illustrate that districts represented by criminal politicians experience a significant reduction in total investments from private-sector firms.

Adding to the severity of these findings, Chemin (2012a) find that the negative effects are disproportionately borne by the most vulnerable sections of society, such as scheduled castes and scheduled tribes. These groups experience exacerbated welfare losses in districts with criminally indicted leaders, highlighting the intersectional nature of political leadership and socio-economic disparities.

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While the association between political leaders' characteristics and environmental policy outcomes has been extensively explored in development economics and political science context, it remains relatively scarce in environmental economics. Diaz-Serrano and Kallis (2022) highlight this gap, noting that while the impact of political parties and ideologies on environmental performance has been studied, the role of leader's personal traits, particularly in relation to climate policy and outcomes, has been overlooked. Their study, employing a simple fixed-effects regression and an event study, finds a correlation between leaders with a business background and increased CO2 emissions and reduced renewable energy capacity.

Addressing this oversight, our paper investigates the environmental impacts of electing criminally accused leaders in India. Specifically, we focus on fine particulate matter ($PM_{2.5}$) concentrations between 2008 and 2018. The analysis leverages election data retrived and enhanced from the SHRUG project (**?**). Combining this information with remote sensed satellite data (Hammer et al., 2020) created a fine grained data set that allows us to gap the bridge between environmental and development economics.

Preliminary findings reveal that the election of criminally accused leaders correlates with a decrease in nighttime lights (NTL), consistent with the hypothesis that such leadership negatively affects economic vitality, as indicated by Prakash et al. (2019). Furthermore, even after accounting for the downturn in economic activity, we observe a significant increase in $PM_{2.5}$ levels, by approximately 4 micrograms per cubic meters.

The policy implications of these findings are clear and urgent. There is a need for stringent scrutiny of political candidates' backgrounds, emphasizing the long-term societal and environmental costs of electing individuals with criminal charges. Furthermore, these insights necessitate the reinforcement of legal and ethical standards in political candidacy to safeguard economic growth and environmental integrity. The study's outcomes reinforce the call for an interdisciplinary approach in policy-making, where environmental considerations are integrated into broader socio-economic frameworks.

I. Theoretical Background

A. Model Considerations

In the upcoming chapter, we turn our attention to the theoretical models that dissect the nexus between the traits of political leaders and the policies they implement. Grasping these models is crucial—they shed light on the intricate processes through which a leader's personal attributes might steer policy decisions. Fully grasping these models is key to

unraveling the layered dynamics of political decision-making and policy execution. We will explore two distinct yet interrelated models in this discourse: the Downsian model and the citizen-candidate model. Each offers a unique lens through which to view the role of a politician's characteristics in shaping governance and policy.

The Downsian model, as conceptualized by Downs (1957), asserts that the personal characteristics of political leaders do not significantly impact policy-making. This model is anchored in two primary assumptions. Firstly, candidates firmly commit to specific policies upon election. Secondly, all candidates tailor their policies to resonate with the preferences of the median voter, aiming to maximize their vote share. As a result, when candidates converge toward similar policy stances, an individual candidate's identity becomes irrelevant to the policy outcomes. Hence, the equilibrium in this model, can be described by Equation 1, where $Policy_i$ is the policy adopted by candidate i, and ϵ is an error term.

$$Policy_i = f(\text{VoterMedianPreferences}) + \epsilon \tag{1}$$

In contrast, the citizen-candidate model, as proposed by Besley and Coate (1997) and Osborne and Slivinski (1996), expands but diverges from the Downsian approach by positing that post-election commitment from candidates is not guaranteed. This model views political candidacy as a strategic decision, driven by a cost-benefit analysis where potential benefits of enacting personal policy preferences are weighed against the associated costs. The diverse motivations of candidates imply that it's unlikely for two candidates with identical policy proposals to compete for office. Thus, a candidate's identity becomes a significant determinant of the policies they implement. This relationship is encapsulated in Equation 2.

$$Policy_i = g(\text{CandidatePreferences}_i, \text{Costs}_i, \text{Benefits}_i) + \delta \tag{2}$$

where $Policy_i$ is influenced by the candidate's personal preferences (CandidatePreferences$i$), along with the costs (Costs$i$) and benefits (Benefits_i) of running for office, and δ is the error term.

The citizen-candidate paradigm underscores the role of a politician's private information about their 'type,' which aligns with microeconomic theories of adverse selection or moral hazard. Factors such as re-election prospects, accountability, and initial entry into office are significantly influenced by these private traits.

Following the citizen-candidate paradigm, the "Agency and Self-selection" model, as

explored in political economics, adds another dimension to our understanding of political dynamics. This model, discussed in works like Brollo et al. (2013), emphasizes that a politician's decision to run for office is influenced by their individual characteristics and motivations, which include their agenda, competencies, and career aspirations.

In the context of this model, politicians possess private information about their 'type' which they utilize to make strategic decisions about entering politics and policy-making. This private information encompasses their capabilities, preferences, and objectives, and is pivotal in their decision-making process. The model then can be represented as:

$$PoliticalEntry_i = k(\text{PrivateInfo}_i, \text{CareerAspirations}_i) + \mu_i \tag{3}$$

Such a framework is particularly relevant when analyzing the behavior of criminally elected leaders. Their private motivations and career aspirations might lead them to adopt policies that serve personal interests or protect their position, potentially diverging from the broader public interest. This could manifest in different approaches to environmental regulation and air pollution control, offering an explanation for observed differences in policy outcomes between criminally elected leaders and their non-criminal counterparts.

B. Empirical Findings

Empirical studies have revealed diverse impacts of political leaders' characteristics on policy outcomes, underlining the complex nature of political influence. Prakash et al. (2019), for instance, focus on the impact of criminally accused politicians in India, using night-time lights as a proxy for economic activity. Their findings, derived from a Regression Discontinuity Design (RDD), show a significant decrease in economic growth in constituencies led by such politicians. This trend is particularly pronounced in less developed and more corrupt states.

On a broader scale, Besley et al. (2011) examine the influence of leaders' education levels on national economic growth rates. Utilizing a before-and-after analysis of leadership changes, they find that poorly-educated leaders' exits (often due to sudden death) correlate with positive economic growth, implying that successors with better education can enhance economic performance.

Parallel to economic insights, studies on educational outcomes reveal interesting patterns. Lahoti and Sahoo (2020) report that educated politicians in India positively impact education outcomes, but this effect is confined to more developed states. In contrast, there is no discernible impact in less-developed regions or in the overall sample, suggesting a

heterogeneous influence of leaders' educational backgrounds.

Gender also plays a significant role in policy outcomes. Clots-Figueras (2012) investigate the effect of electing female politicians in India on education, combining RDD with Two-Stage Least Squares (2SLS). Their results show that female politicians have a more substantial impact on education in urban areas, but not in rural settings.

Turning to environmental outcomes, Diaz-Serrano and Kallis (2022) bridge a gap in the literature by examining the correlation between leaders with a business background and climate policy. Employing fixed-effects regression and event studies, they find that such leaders are associated with higher CO2 emissions and lower renewable energy capacity, suggesting a distinct environmental impact.

Contrastingly, Beach and Jones (2016) analyze the influence of business experience in political leaders on various policy outcomes in California, using RDD. Their study reveals no significant effect of electing business-experienced leaders on city expenditures, revenues, or unemployment rates, presenting a nuanced view of leaders' professional background on policy.

Additionally, Chemin (2012b) focus on the welfare effects of criminally accused politicians in India, demonstrating a decrease in the welfare of vulnerable social groups in their constituencies.

Lastly, Jones and Olken (2005) provide a unique perspective by studying the effects of sudden and random changes in national leaders, focusing on growth and monetary policies. Their findings indicate that the death of autocratic leaders often leads to economic growth, a trend not observed in democratic countries.

II. Data

A. Data Set Generation

In our empirical analysis, we compile a dataset that integrates data on PM2.5 levels, elections, and political candidates at the constituency level spanning from 2008 to 2018.

For the PM2.5 data in our analysis, we leveraged the comprehensive dataset provided by Hammer et al. (2020), which presents global estimates and long-term trends of fine particulate matter concentrations from 1998 to 2018. This dataset incorporates satellite-based observations, combined with atmospheric transport models and ground-monitoring data, to derive high-resolution global distributions of PM2.5 levels.

For our election data, we utilized the Election Commission of India (ECI) Statistical Reports on General Elections to State Legislative Assemblies. These reports are a rich

source of essential electoral information, including constituency names and codes, candidate details with their respective vote shares, electorate size, voter turnout, candidate gender, and constituency reservation status (reserved for SCs/STs or unreserved).[1]

To assess criminal accusations, we turned to affidavits submitted by the candidates themselves, which have been meticulously collected and digitized by the Election Watch in partnership with the Association for Democratic Reforms (ADR). The ADR dataset is instrumental in providing comprehensive data on the number of criminal cases filed against each candidate, detailing the nature of the charges, categorizing the seriousness of each accusation, and disclosing the financial declarations of assets and liabilities for each candidate, as well as their educational qualifications.

B. Stylized Facts

The descriptive statistics of key variables are reported in Table 1. Our primary dependent variables, namely PM2.5 and night-time lights, are recorded annually during election periods. In the full sample, the mean concentration of PM2.5 is around 15 micrograms per cubic metres (mg/m^3) , while in the top-2 mixed sample, it is 16 mg/m^3. Negative growth on night-time lights is observed in both samples. Additionally, the average voter turnount is approximately 70 %. On average, political candidates have 12 years of education, and the representation of female candidates accounts for only about 8 %.

TABLE 1 – Summary statistics

	Full Sample					Top-2 Mixed Sample				
	N	Mean	SD	min	max	N	Mean	SD	min	max
Max $PM_{2.5}$	45122	47.6	21.8	3.89	129.7	8083	51.4	23.0	8.36	129.7
Mean $PM_{2.5}$	45122	14.6	17.1	0	63.0	8083	16.3	18.7	0	63.0
$PM_{2.5}$ growth (%)	41020	0.0026	0.025	-0.13	0.14	7769	0.0035	0.023	-0.089	0.13
NTL growth	40563	-0.0025	26.4	-1848.8	3499.2	7738	-0.086	5.41	-282.4	139.5
Voter turnout percentage - Winner	7737	71.2	12.2	0	99.7	2874	69.6	12.3	0	96.0
Voter turnout percentage - Runner-up	7726	71.3	12.1	0	99.7	2874	69.6	12.3	0	96.0
Candidate education from affidavit - Winner	7529	12.0	2.27	0	14	2801	12.0	2.25	0	14
Candidate education from affidavit - Runner-up	7252	11.9	2.36	0	14	2618	11.9	2.39	0	14
Candidate Gender (F/M/O) - Winner	7737	0.085	0.28	0	1	2874	0.081	0.27	0	1
Candidate Gender (F/M/O) - Runner-up	7715	0.088	0.28	0	1	2864	0.076	0.27	0	1

Notes: The full sample includes all candidates from various elections, without regard to the criminal status of the top two contenders. The top-2 mixed sample specifically refers to elections where the leading two candidates consist of one with criminal accusations and one without.

[1]Link to data

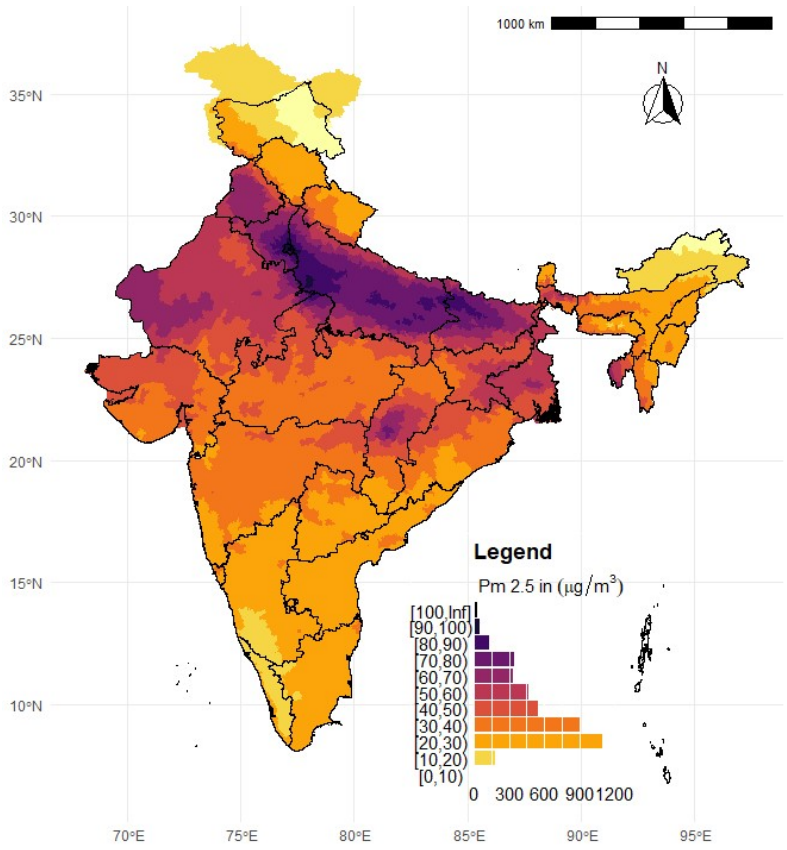

FIGURE 1 – AVERAGE ANNUAL $PM_{2.5}$ CONCENTRATION.

Notes: This map illustrates the average annual concentration of PM2.5 across India. It uses a color gradient to represent different levels of PM2.5 concentration in micrograms per cubic meter (µg/m³), with the scale ranging from yellow (lower concentrations) to dark purple (higher concentrations).

Figure 1 provides a striking visual representation of the air pollution challenge in India, with the average annual PM2.5 concentration depicted across the country. The map uses a color gradient to indicate the severity of pollution levels, with the scale ranging from yellow, denoting areas with lower concentrations, to dark purple for regions with the highest concentration of particulate matter. Notably, vast areas of India exhibit PM2.5 levels well above the World Health Organization's recommended maximum of 5 µg/m³, indicating significant air quality issues. The widespread nature of high PM2.5 concentrations across the country underscores the pressing environmental health risks faced by the population and highlights the critical need for effective air pollution management and policy intervention.

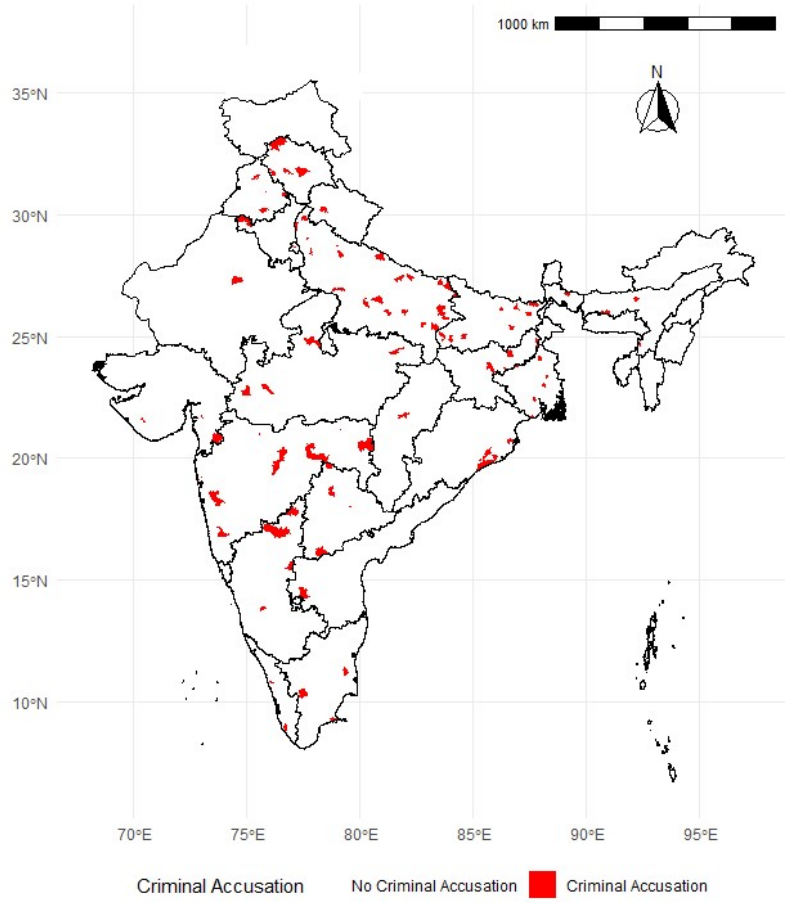

FIGURE 2 – SPATIAL DISTRIBUTION OF ELECTION WINNERS WITH CRIMINAL ACCUSATIONS.

Notes: The map depicts the geographical distribution of constituencies across India with a visual differentiation between those that have elected leaders with criminal accusations and those that have not. Red areas on the map signify constituencies where leaders with criminal accusations have been elected, whereas the non-highlighted areas represent constituencies with leaders who have no criminal accusations.

Figure 2 illustrates the widespread distribution of constituencies across India that have elected leaders with criminal accusations, highlighting that such leaders are not confined to any specific region but are instead spread throughout the country. This broad geographical spread suggests that the election of leaders with criminal backgrounds is a nationwide phenomenon, rather than being isolated to particular localities or regions. The map underscores the pervasiveness of this issue and its potential implications for policy-making and governance at a national scale. The fact that constituencies with criminally accused leaders are scattered across diverse political, social, and economic landscapes indicates that the influence of such leaders on policy outcomes could be extensive and varied, providing a substantive treatment group for our analysis.

III. Regression Discontinuity Design

A. General Approach

This study employs a Regression Discontinuity Design (RDD) to assess the causal impact of electing leaders with criminal records on PM2.5 air pollution levels in Indian constituencies. The RDD approach is chosen for its ability to exploit the discontinuity at the electoral margin, isolating the effect of the election of such leaders from other confounding variables.

The core of the RDD is centered on the assumption that constituencies electing leaders with a criminal record by a narrow margin are comparable to those where such leaders lose by a similarly narrow margin. The specification of the model central to this analysis is expressed by the following equation:

$$PM2.5_{it} = \alpha + \beta \times Criminal_i + f(VoteMargin_i) + \gamma X_{it} + \epsilon_{it} \tag{4}$$

In this equation, $PM2.5_{it}$ denotes the air pollution level measured as PM2.5 concentration in constituency i at time t. The term $Criminal_i$ is a binary indicator reflecting the presence of a criminal record for the elected leader in constituency i. The vote margin, $VoteMargin_i$, is the margin by which the leader won the election in constituency i. The function $f(VoteMargin_i)$ captures the relationship between this vote margin and PM2.5 levels, allowing for a non-linear relationship. The vector X_{it} encompasses a set of control variables that include demographic and economic attributes of constituency i at time t. The parameters α, β, and γ are to be estimated to quantify the relationships posited by the model, and ϵ_{it} captures the stochastic error term.

For the estimation process, regression lines are fitted to the data on either side of the electoral margin threshold. The parameter of primary interest, β, provides an estimate of the causal effect. It captures the discontinuity at the threshold - the jump in PM2.5 levels attributable to electing a leader with a criminal record. This methodological choice ensures a focus on the local average treatment effect at the cutoff point, which is crucial for the identification of the causal relationship under investigation.

B. Validity of the RDD

Figure 3 illustrates the McCrary density test outcome, a crucial diagnostic used to assess the manipulation of the forcing variable, which in this context is the margin of victory. The central focus is the continuity of the distribution around the cutoff point. The density

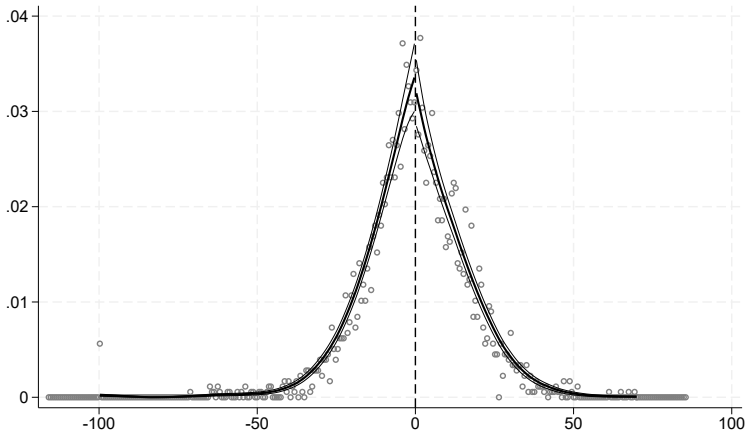

FIGURE 3 – OUTCOME OF THE MCCRARY DENSITY TEST.

Notes: The figure displays the McCrary density test result, which examines the continuity of the distribution of the forcing variable (margin of victory) around the cutoff in our RD design. The density plot centers on the cutoff point, marked by the vertical dashed line at zero, indicating the threshold between winning and losing candidates. The smoothness of the curve across this threshold suggests no evident manipulation of the margin of victory, lending credibility to the RDD's assumption of random assignment near the cutoff. This validation is essential for confirming the integrity of the RDD methodology applied in the study.

plot centers around the zero margin, which is marked by the vertical dashed line, distinguishing between winning and losing candidates. The smoothness of the curve across this threshold suggests that there is no evident manipulation of the margin of victory. This lack of discontinuity at the threshold implies that the assignment of treatment (election outcomes, in this case) is as good as random near the cutoff, lending credibility to the RDD's assumption of random assignment and thereby affirming the integrity of the methodology employed in the study.

Figure 4 presents a pre-test for the RDD analysis, displaying PM2.5 levels plotted against the margin of victory two years prior to the elections. The absence of a significant discontinuity at the zero threshold—where the margin of victory is zero—indicates that there were no pre-existing differences in air pollution levels between constituencies that would elect leaders with criminal accusations and those that would not. The continuity of PM2.5 levels across the margin of victory supports the premise that any observed effects in the post-election period can be attributed to the election outcomes rather than pre-existing trends. This pre-test is essential as it demonstrates the comparability of the groups either side of the cutoff prior to the treatment, reinforcing the study's causal inferences.

Table 2 offers essential insights into the preconditions within constituencies by performing a balance test on predetermined characteristics, providing a critical backdrop for

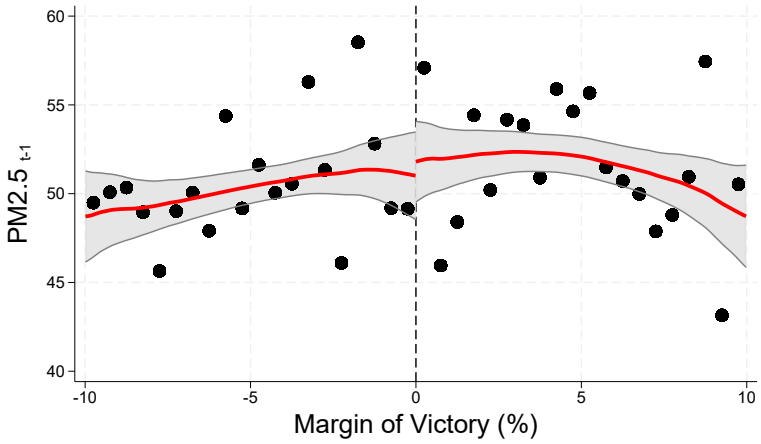

FIGURE 4 – RDD FOR PRE-ELECTION PM2.5 LEVELS.

Notes: The figure serves as a pre-test for our RDD analysis, plotting PM2.5 levels against the margin of victory two years before the election. The lack of a significant jump at the zero threshold—where the margin of victory is zero—validates the assumption that there is no pre-existing difference in air pollution levels between constituencies that will elect leaders with criminal accusations and those that will not. The continuity of the PM2.5 levels across the margin of victory supports the premise that any observed effects in the post-election period can be attributed to the election outcomes rather than pre-existing trends.

the Regression Discontinuity Design (RDD) analysis. It compares constituencies represented by individuals with and without criminal accusations, focusing on variables such as pre-Night Time Lights (NTL) growth and pre-PM2.5 levels, alongside voter turnout and candidate education. The findings are illuminating: while there are instances of statistically significant differences in the broader top 2 mixed sample, these differences dissipate and become statistically insignificant when the focus narrows to elections decided by a margin of 5% or less.

This pattern of results—where significant differences in pre-determined variables van-

TABLE 2 – Balance test on pre-determined characteristics

	Top-2 Mixed Sample			Top-2 Mixed Sample within 5% margin		
	Criminal	Non-criminal	Diff.	Criminal	Non-criminal	Diff.
Pre-NTL Growth	-0.108	0.960	-1.068**	-0.214	-0.040	-0.174
	(21.938)	(58.895)	(0.491)	(7.377)	(2.282)	(0.231)
Pre-$PM_{2.5}$	46.928	50.604	-3.676***	52.505	51.309	1.195
	(21.588)	(22.744)	(0.362)	(22.915)	(22.453)	(0.923)
Voter turnout percentage - Winner	71.642	69.541	2.101***	70.460	71.087	-0.627
	(11.991)	(12.945)	(0.354)	(11.147)	(11.560)	(0.775)
Voter turnout percentage - Runner-up	71.666	69.523	2.143***	70.499	71.086	-0.587
	(11.894)	(12.954)	(0.352)	(11.150)	(11.558)	(0.775)
Candidate education from affidavit - Winner	11.958	12.043	-0.085	11.786	11.908	-0.122
	(2.243)	(2.379)	(0.067)	(2.186)	(2.469)	(0.162)
Candidate education from affidavit - Runner-up	11.921	11.789	0.132*	11.958	11.800	0.158
	(2.354)	(2.368)	(0.074)	(2.381)	(2.381)	(0.170)

Notes: Top-2 mixed sample includes candidates with 1 criminally accused in the top 2. Columns (3) and (6) have standard errors of the difference in the means of accused and non-accused MLAs in the parentheses. Asterisks denote significance levels (*=0.10, **=0.05, ***=0.01).

ish as the sample is refined—bolsters the RDD approach's validity. It suggests that the post-election effects observed are not artifacts of pre-existing differences, but rather consequences of the criminal accusations against the candidates. The fact that these differences are not significant in closer elections adds weight to the argument that the election outcomes, rather than underlying constituency characteristics, drive the observed changes in post-election air pollution and other outcomes.

IV. Results

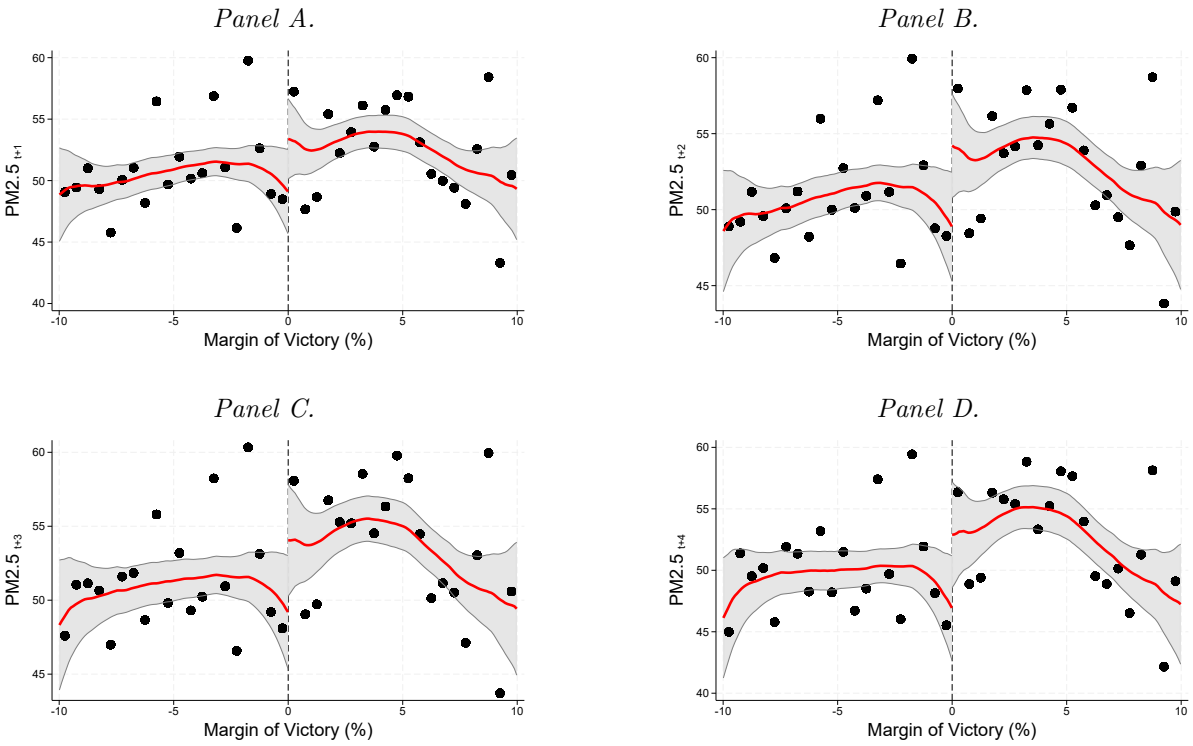

FIGURE 5 – CENTRAL RDD RESULTS: ELECTING LEADERS WITH CRIMINAL ACCUSATIONS ON PM2.5 LEVELS.

Notes: The figure presents the Regression Discontinuity Design (RDD) results, illustrating the impact of electing leaders with criminal accusations on PM2.5 air pollution levels over a span of four years. Panel A captures the immediate effect in the subsequent year after the election, while Panels B, C, and D extend the analysis to the second, third, and fourth years, respectively. Each panel displays the fitted conditional mean of PM2.5 concentrations as a function of the margin of victory, with the red line indicating the smoothed estimate and the shaded area denoting the confidence interval. The vertical dashed line at the zero margin of victory serves as the cutoff point for the RDD.

Our main findings, as illustrated in Figure 5, underscore the tangible impact of electing leaders with criminal accusations on air pollution levels, specifically PM2.5 concentration. The results are based on a rigorous Regression Discontinuity Design (RDD) methodology, examining the causal effects over a four-year period.

Panel A of Figure 5 shows the immediate impact on PM2.5 levels in the first year following the election of such leaders. It reveals a discernible pattern where constituencies that elected leaders with criminal accusations experience different PM2.5 concentrations compared to those that did not. This immediate effect is crucial as it sets the stage for understanding the short-term environmental consequences of electing potentially corrupt or criminally inclined leaders.

The subsequent panels B, C, and D extend the analysis further into the second, third, and fourth years after the election, respectively. These panels provide a broader perspective on the enduring effects of electing criminally accused leaders. Each panel presents the fitted conditional means of PM2.5 concentrations plotted against the margin of victory for elections. The red line represents the smoothed estimate of this relationship, and the grey-shaded area around it denotes the confidence interval, providing a visual representation of the statistical certainty of the estimates.

The vertical dashed line at zero on the x-axis marks the margin of victory cutoff for the RDD. This is the point that distinguishes the treatment group (constituencies electing leaders with criminal accusations) from the control group (those electing leaders without such accusations). The graphical representation shows a clear divergence on either side of this cutoff, suggesting a robust link between the election of criminally accused leaders and increased levels of PM2.5 pollution.

The consistency of the pattern across all four panels indicates that the effect of electing leaders with criminal accusations on PM2.5 air pollution levels is not a transient phenomenon but persists over time. This finding is significant as it points to the potential long-term environmental and public health implications of the political leadership's character in regions affected by such elections.

V. Robustness

Varying RD Specifications: First, we delve deeper into the stability of our RDD estimates across varying specifications. Following the guidance of Imbens and Lemieux (2008), who underscore the significance of bandwidth selection, we extend our analysis to include alternative control functions, a development highlighted in recent literature by Dell (2010), Lee and Lemieux (2010), and Meyersson (2014). More precisely, we re-estimate the RD effects for linear and quartic polynomial functions across a spectrum of bandwidth choices, including IK (h), CCT, h/2, and 2h.

Our findings reveal a consistent pattern: while the RD estimates are positive and hold statistical significance, mirroring the effects observed in our main analysis, this significance

diminishes with the adoption of broader bandwidths and higher-degree polynomials. This suggests that our results, although robust across a range of specifications, should be interpreted with consideration to the sensitivity of the RD design to these analytical choices.

Adding Covariants - While the Regression Discontinuity Design (RDD) inherently controls for confounding variables by design, the inclusion of covariates can potentially yield more precise estimations. This step aims to control for various factors that could impact the relationship between the election of criminally accused leaders and air pollution levels.

By integrating relevant demographic, economic, and environmental covariates, we aim to isolate the effect of criminally accused leaders with greater accuracy. While the RDD approach relies on the assumption that the assignment of the treatment near the threshold is as good as random, thus inherently controlling for confounders, the addition of covariates can help fine-tune our estimations. This is particularly useful for addressing any lingering concerns about unobserved variables that might correlate with both the election of such leaders and pollution levels.

Changing the Depended Variable - In addition to fine particulate matter ($PM_{2.5}$), we plan to examine the impact of electing criminally accused leaders on nitrogen dioxide (NO2) levels. NO2 is another significant air pollutant with known adverse health effects. By expanding our focus to include NO2, we can comprehensively assess whether the election of criminally accused leaders correlates with broader changes in air quality. This change will enable us to understand if the observed effects are specific to $PM_{2.5}$ or indicative of a general trend in air pollution associated with such leaders.

VI. Conclusion

In concluding this research, we've delved into the multifaceted impacts of electing criminally accused leaders on environmental quality, with a particular focus on air pollution in India. Our analysis suggests a troubling link: constituencies that elect such leaders experience a notable rise in PM2.5 pollution levels, which poses significant health risks and environmental concerns. This trend challenges the WHO guidelines, emphasizing the urgency for robust environmental policies and ethical political leadership.

The study's comprehensive approach, utilizing Regression Discontinuity Design and robustness checks, lends credibility to our results. The balance tests reinforce the assertion that the treatment effects—namely, the election of criminally charged leaders—are indeed responsible for the observed increase in pollution levels. The spatial distribution of these

leaders, widely spread across India, combined with the pervasive issue of high PM2.5 levels, paints a stark picture of the environmental challenges India faces.

Our findings have profound policy implications. They advocate for greater scrutiny in the political arena, emphasizing the necessity for candidates with clean legal records to promote sustainable development and safeguard public health. Moreover, these results highlight the intersection of governance, environmental policy, and social well-being, advocating for a holistic approach to policy-making that prioritizes environmental health as a cornerstone of economic and social progress.

Future research directions may include exploring the mechanisms through which criminally accused leaders influence environmental regulations and enforcement. Additionally, examining the long-term socio-economic impacts of such leadership on community health and economic vitality could provide further insights into the cost of compromised political integrity.

By shedding light on the repercussions of electing leaders with criminal charges, this paper contributes to the crucial discourse on the interplay between political integrity and environmental stewardship, underscoring the vital need for transparency and accountability in political candidacy to foster a cleaner, healthier future.

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Appendix

A. Data Manipulation

Here, we detail the methodology employed for processing and analyzing geographic data, with a specific focus on the integration of shapefiles and supplementary datasets. Utilizing the R programming environment, the methodology leverages the functionalities of essential libraries: `sf` for spatial data manipulation, `dplyr` for data management, and `haven` for reading and writing various data formats. The process begins with importing a shapefile, which represents geographic regions, and a Stata data file (in .dta format), containing related data elements. These files are then meticulously merged to create a coherent and comprehensive dataset for analysis.

Following the data merging, the approach focuses on identifying the maximum overlap between spatial regions (referred to as `shrid2`) and associated data (identified by `ac08_id`). This identification is conducted through a group-wise analysis, where each `shrid2` is evaluated to determine the `ac08_id` with the highest overlap, based on a predefined normative criterion (`fragment_wt_con08_norm`). Importantly, the methodology also captures additional dimensions of the data. For each `shrid2`, we record the `ac08_id` entities not constituting the maximum overlap but still present. This dual approach facilitates a nuanced understanding, emphasizing the key focus on maximal overlap while acknowledging other overlapping entities. The enriched dataset, embodying this comprehensive perspective, is subsequently visualized, providing a spatial representation of the intricate relationships within the scope of our study. This detailed process underscores our commitment to a thorough and multifaceted analysis, laying a robust foundation for further research stages.