How Rules and Compliance Impact Organizational Outcomes: Evidence from Delegation in Environmental Regulation

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Motivation

1. Formal rules within organizations are pervasive, but...
2. May be interpreted and complied with differently by actors within the organization, impacting organizational outcomes.
3. Longstanding discussion in development and public economics on *de jure* vs. *de facto* regulation (how regulators interpret/enforce rules, which rules actually get enforced).

Difficult to measure and tie into organizational/regulatory outcomes (needs data on regulators' actions, and exogenous variation in rules)

This Paper

1. Data on universe of applications for an environmental permit by firms, including internal communication within the regulatory agency

2. Each application is a well-defined task or problem, with rules on who has the authority to decide whether to grant the permit. as well as final outcome

3. Use a delegation reform that granted authority to junior officers over certain applications to estimate

   - How the (re) allocation of authority impacts firm outcomes
   - Document the incompleteness of delegation (non compliance with rules)
   - Show the importance of both the type of application and type of officer in determining whether delegation occurs

Overview of Results

- Rules regarding the allocation of decision rights respected on average, but seniors retain authority in violation of the rules about a third of the time
- Using exogenous change in *de jure* delegation, we show that allocation of authority impacts firms
  - No change in processing time or regulatory burden, but
  - Juniors more likely to accept applications, particularly more polluting ones
- Use conceptual framework + empirical heterogeneity to show determinants of rule compliance (delegation) vs. not
  - Applications with greater pollution potential less likely to be delegated (but not greater capital)
  - Seniors-subordinate pairs with more disagreement $\rightarrow$ lower delegation
  - Low bandwidth times $\rightarrow$ more delegation

  Consistent with delegation being determined by a knowledge hierarchy (Garicano, 2000), s.t. problems of greater complexity resolved higher in the organizational hierarchy, and with costs of delegation varying over time

Related Literature

Communication and Problem Solving in Organizations

- Largely theoretical: Bolton and Dewatripont (1994), Garicano (2000)
- Empirical: Espinosa and Stanton et al (2023), Impink, Prat and Sadun (2020)

How organizational reform impacts communication and outcomes, mechanisms

Determinants and impacts of decision rights

- Alfaro et al (2016), Aghion et al (2017), Bandiera et al. (2021), Bloom, Sadun and Van Reenen (2012), Dessein, Lo and Minami (2022), Kala (2023)

Different agency problem in environmental regulation, when authority is given vs. retained (in non compliance of rules)

Environmental Regulation and Firm Outcomes

- Duflo et al (2018), Greenstone, List and Syverson (2012), He, Wang and Zhang (2020)

Impact of organizational reform in the environmental regulator, *de jure* vs. *de facto* regulatory implementation

Introduction

Context and Delegation Reform

Data and Empirical Strategy

Results
- Impacts on Delegation
- Impacts of Delegation

Conceptual Framework

Results
- Heterogeneity
- Robustness

Conclusion

Environmental Permit Applications in India

1. Most firms (except in very clean sectors) need approval from the state regulatory authority to operate (Ghosh, 2019).
2. First application when firm opens, renewed periodically
3. Industries (e.g. "stone crushers") are assigned an industry-level color code by regulators based on pollution potential that determines the regulatory burden: these are red (highest regulatory burden), orange (intermediate), or green (low).
4. State pollution control boards make inquiries as applications are received, and can demand applications be resubmitted due to incompleteness (about 37% of the time pre-delegation).
5. After approval, regulator monitors firm compliance, for example through inspection.

Organizational Hierarchy in the Regulatory Agency

Six ranks, three most relevant

- Environmental Engineer (senior): usual (98.5% of the time) first recipient, in charge of allocating work and deciding a large proportion of applications
- Assistant Environmental Engineer (junior): officer receiving decion rights
- Assistant Engineer (subordinate): in charge of processing applications, checking submissions, site inspections etc.

Above senior: Chairman, Member Secretary, Chief Environmental Engineer (rarely ($< 3\%$) on applications)

Delegation Reform

- In July 2019, the decision authority for Green applications delegated from senior to the junior officers
- Objective: to "streamline the flow of applications" (reduce red tape, make processing faster)
- If junior decides an application needs to be resubmitted due to incompleteness, the revised application is received by the senior officer but then to be assigned to the junior officer immediately.
- If there is a complaint or court case relating to the application, it becomes the responsibility of the senior officer.

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Data

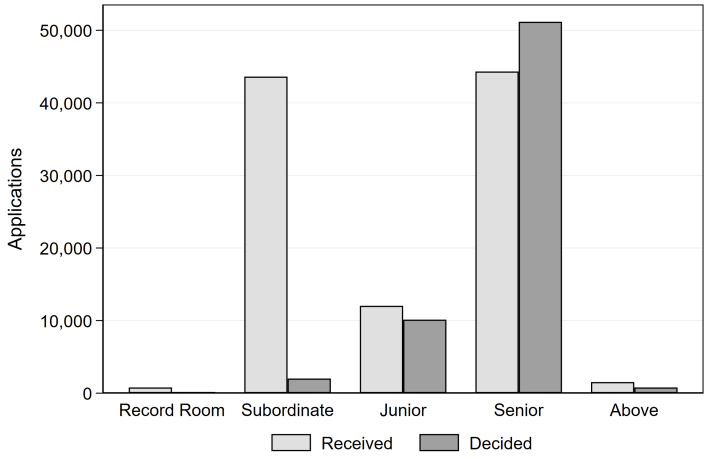
All permit applications in Kerala, (state of 34 million people) between 2018-2020

1. 14,229 new firms (50,000 firms including renewals)
   Comparison with other Indian firm datasets
   - 7,500 businesses registered with the Ministry of Corporate Affairs in Kerala (including sectors which do not need a permit)
   - Only 40 Annual Survey of Industries firms in Kerala list an initial production year of 2017 or later
2. Application details: name, industry, firm size (capital, labor), color code, pollution-score, products, whether new firm or renewal, pollution (wastewater discharge), outcomes
3. Communication: sender name, sender designation, receiver name, receiver designation, whether resubmission mandated, inspection conducted, final outcome

95.5% of the officers remain in the same rank during the time period

Number of Applications Handled and Closed by Each Rank

Subordinate officers have no decision rights but work on many tasks. "Management by exception" only followed from the middle of the hierarchy upwards.



Notes: Closed=Decided. Pre-delegation only. The "Above" category includes officers who hold higher ranks than senior.

Summary Statistics Using Pre-Reform Data

	(1) Mean	(2) SD	(3) Min	(4) Max	(5) Count
Green Category	0.616	0.486	0	1	35723
Decided by Junior Officer	0.0228	0.149	0	1	35655
Decided Above Junior Officer	0.947	0.225	0	1	35655
Decided Above Closing Officer	0.00523	0.0722	0	1	34965
Accepted	0.947	0.224	0	1	35635
Inspected	0.297	0.457	0	1	35569
Time to Decision (Days, Winsorised)	72.489	106.114	1	727	35674
Number of Emails	8.709	6.044	1	130	35723
Resubmitted	0.373	0.484	0	1	35723
Capital (00,000 INR, , Winsorised)	97.517	470.2831	.8	5000.62	35723
Number of Workers (Winsorised)	7.533	19.157	1	140	23487
1[Industry Type has a Split]	0.128	0.335	0	1	35723
Pollution Score	35.16	15.13	25	95	28588

Event Study: Application-Level Outcomes

$$y_{aidq} = \sum_q \beta_q Green_i + \delta_i + \mu_d + \eta_q + \delta_i \times q + \epsilon_{aidq}$$

- Non staggered design.
- y_{aidq} is outcome y for application a in industry i in district d, submitted in year $\times$ quarter q.
- $Green_i$ indicates whether the regulatory category for industry i is "green," i.e. industries affected by the reform.
- β_q are separate coefficients by quarter (Q2 of 2019 omitted).
- δ_i is industry fixed effects.
- μ_d is district fixed effects.
- η_q is year $\times$ quarter fixed effects.
- $\delta_i \times q$ is industry-specific linear time trends.
- We cluster standard errors by industry.

Measuring Delegation, Rule Compliance and Baseline Disagreement

- Delegation
  - Whether junior officer closed application (in random sample of 150 applications stratified pre and post reform, closing predicts decision-making 100% of the time)
- Rule noncompliance
  - Whether application decided by someone above the person with *de jure* decision rights
- Bypassing of junior officer by senior
  - Whether junior officer sent application at all
- Baseline disagreement
  - Subordinates usually make recommendations for approval ("e.g., approval may be granted"), and we observe whether seniors agree or overrule. Using 120 senior-subordinate pairs, measure above/below median disagreement.

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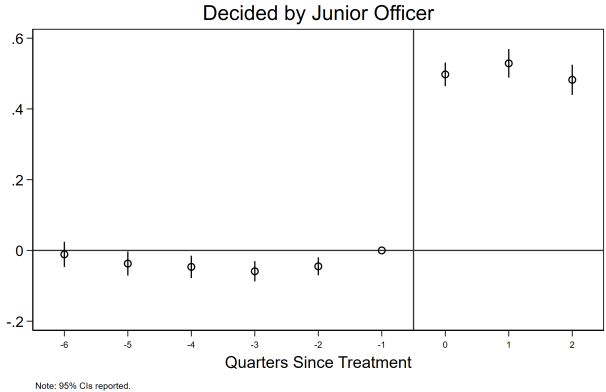
De Jure and De Facto Delegation

$$\beta = 0.542^{***}$$

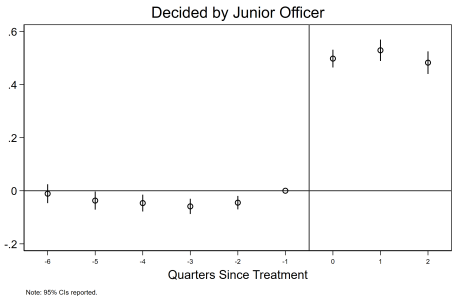


Pre Delegation Mean= 0.023

N= 53,026

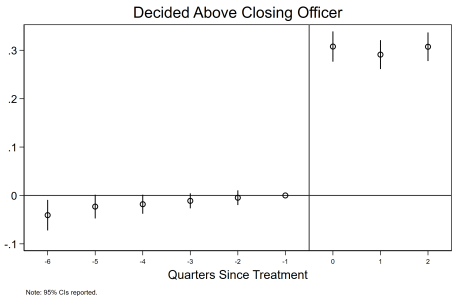
De Jure and De Facto Delegation

$\beta = 0.542^{***}$



Pre Delegation Mean= 0.023
N= 53,026

$\beta = 0.300^{***}$



Pre Delegation Mean= 0.005
N=52,118

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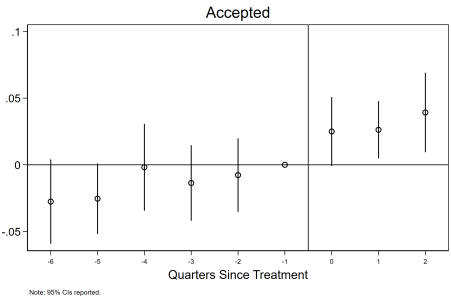
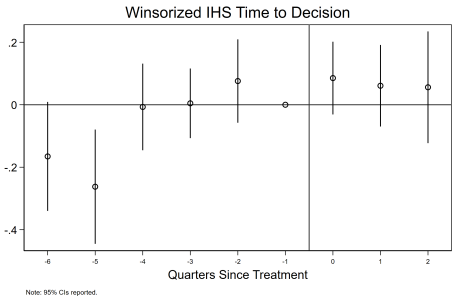
Impacts on Applicant Firms

$\beta = 0.029^{***}$



Pre Delegation Mean= 0.95
N=52,910

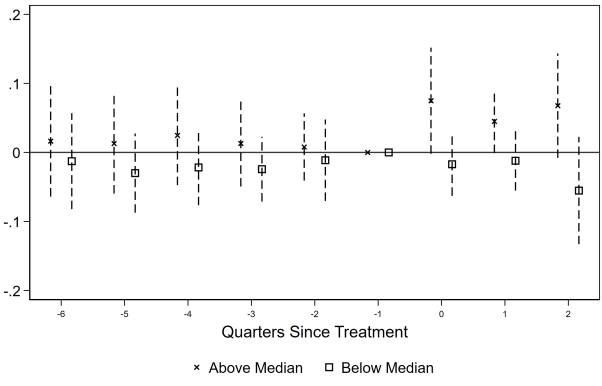
$\beta = 0.001$



Pre Delegation Mean= 4.15
N= 52,960

Impact on Firm Acceptance by Pollution Per Worker

$$\beta^{\text{Green} \times \text{Post} \times \text{Above Median}} = 0.043^{*}$$



Note: 95% CIs reported.

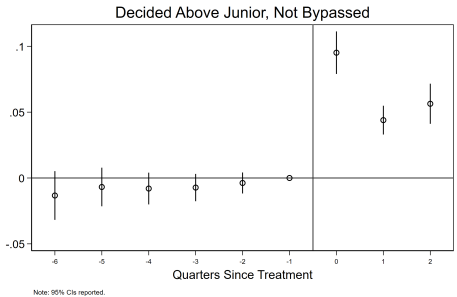
$$\beta^{\text{Green} \times \text{Post} \times \text{Above 75th percentile}} = 0.049^{**}$$

Pre Delegation Mean= 0.96

N= 12,581

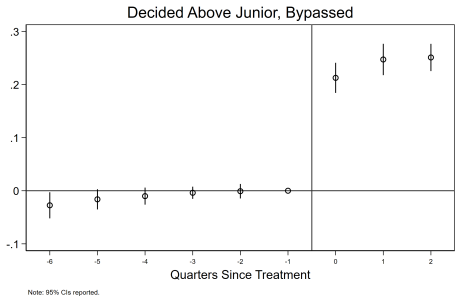
Lack of Delegation: Ceded or Witheld Decision Right?

$\beta = 0.070^{***}$



Pre Delegation Mean= 0.004
N=52,118

$\beta = 0.230^{***}$



Pre Delegation Mean= 0.006
N=52,118

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Conceptual Framework Overview

Two players, senior S and junior J (both risk-neutral), tasked with rejecting bad applications from firms (e.g. those violating site restrictions).

- A senior (S) receives an application, and is tasked with approving it or not. She can
  1. Delegate to Junior J (action J). If delegated to, Junior can
     - exert effort (action e) at cost k, or
     - not exert effort (action n)
  2. Retain (action R)
     - 2.1 and exert effort (action E) with cost c, or
     - 2.2 and not exert effort (action N)
- Bad applications are a (known to both) proportion b of all applications
- There is a cost X to the senior if a bad application is accepted. For the junior, this cost is Z
- The senior's probability of detecting a bad application is p, the junior's is q

Cutoff Regions Example

Whether delegation occurs and whether person in charge (S or J) exerts effort depends on their payoffs, which in turn are a function of b, X, Z, c, p, k, and q. The senior's expected payoff (π) from not delegating (R) and from not exerting effort (N) is given by

$$\pi_S^{R,N} = (1-b) \times 0 + b \times (-X) = -bX$$

and for not delegating (R) and exerting effort (E) is

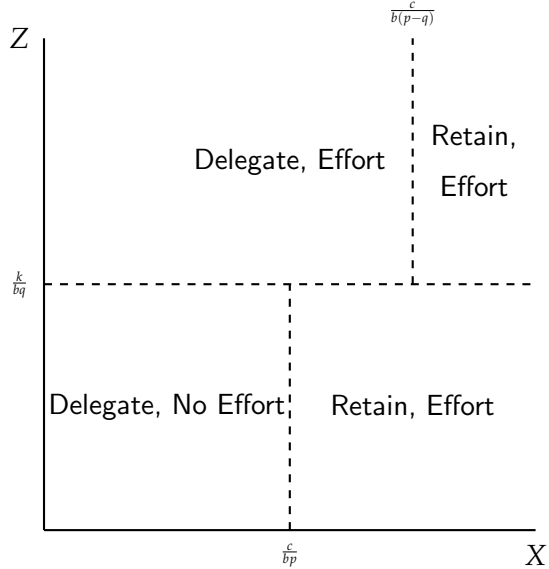
$$\pi_S^{R,E} = (1-b) \times (-c) + bp \times (-c) + b(1-p) \times (-c-X) = -c - bX + bpX$$

$\Rightarrow$ Without delegation, the senior exerts effort if the payoff is greater than from not exerting effort, i.e. if $\pi_S^{R,E} > \pi_S^{R,N}$.

$$-c - bX + bpX > -bX$$

$$\Rightarrow X > \frac{c}{bp}$$

Equilibria when $p > q$ (senior more effective than junior)



Assumption: if senior indifferent, she delegates.

Empirical Predictions and Proxies in the Data

- Applications with greater cost of wrongful approval (X) weakly less likely to be delegated: pollution score as a proxy for X
- Applications with higher senior effectiveness (p) less likely to be delegated: senior-subordinate pairs with below median disagreement
- Applications during higher cost times to senior (c) more likely to be delegated: proxied for using bandwidth (number of pending applications in the last 120 days)

Use above median as cutoff, as well as triple interactions.

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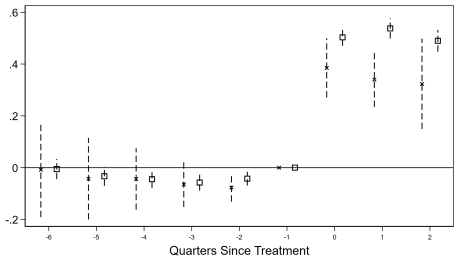
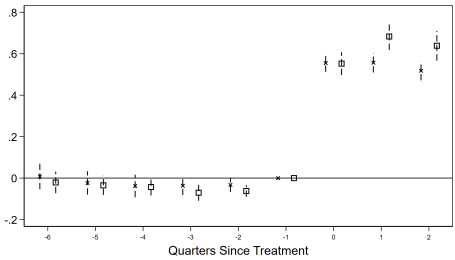
Heterogeneity in Delegation by Pollution Score and Baseline Disagreement

$\beta = -0.135^{***}$



$\beta = -0.087^{***}$



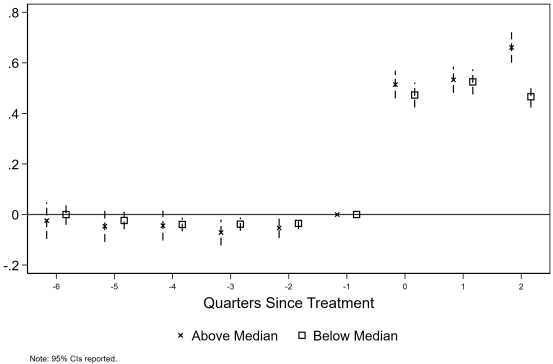
Notes: All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. In the first sub-figure "Above Median" signifies industries whose pollution score exceeds the median score within their respective categories. In the second sub-figure, "Disagreement" equals 1 for senior-subordinate pairs with high rates of disagreement during the pre-reform period.

Pre Delegation Mean= 0.02
N=41,447

Pre Delegation Mean= 0.02
N= 44,554

Results by Bandwidth

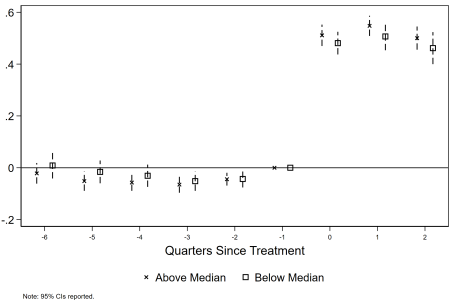
$$\beta = 0.084^{***}$$



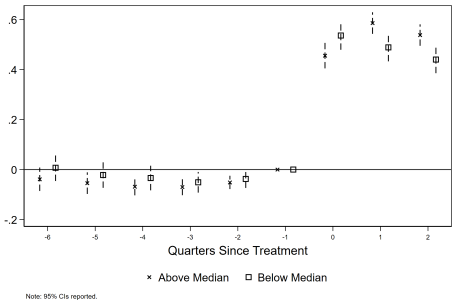
Notes: All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. We determine the count of applications that have reached a senior officer's desk in the preceding 120 days. This 120-day time frame is significant as per the rules, which require all applications to be processed within this period. The "Above Median" is equal to 1 if these applications are above the overall median, and zero otherwise.

Alternative Mechanism: Capital Investment and Corruption

$\beta = 0.029$



$\beta = 0.001$



Notes: All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. In the first sub-figure, "Above Median" equals 1 for applications with total capital investments exceeding the median within their respective categories. In the second sub-figure, "Above Median" equals 1 for districts that had more cases of political candidates per capita with declared criminal cases than the overall median.

Pre Delegation Mean= 0.02
N=53,026

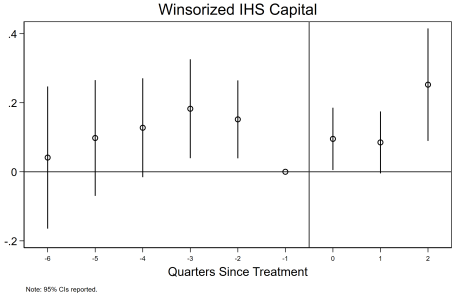
Pre Delegation Mean= 0.02
N= 53,026

Omnibus Specification

	Decided by Junior			
	(1)	(2)	(3)	(4)
Green × Post × Pollution Score	-0.061	-0.060	-0.071*	-0.072*
	(0.041)	(0.041)	(0.040)	(0.041)
Green × Post × Disagreement	-0.097***	-0.126***	-0.125***	-0.128***
	(0.018)	(0.018)	(0.017)	(0.018)
Green × Post × Submissions		0.053**	0.055**	0.051**
		(0.022)	(0.022)	(0.023)
Observations	35336	35336	35336	35336
Capital Investment	No	No	Yes	Yes
Corruption Cases	No	No	No	Yes

Type of Application (Capital/Labor) Does Not Change

$\beta = 0.010$ $\beta = -0.001$



Notes: All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects.

Similar results for fees charged, land area

Pre Delegation Mean=2.953
N=53,112

Pre Delegation Mean=1.99
N= 34,432

Other Robustness

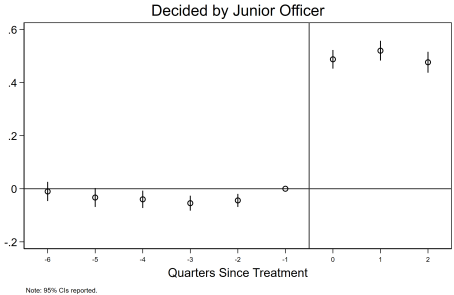
- Type of applications (Pollution) does not change ⏩ Type , ⏩ Pollution
- Number of Green applications constant ⏩ Number Green
- Industry $\times$ district fixed effects ⏩ IndustryXDistrict
- Pollution score $\times$ Post controls ⏩ Pollution Score X Post
- Drop Red applications ⏩ No Red
- No size-based industries ⏩ No Size-Based
- Drop applications within 30 days of policy ⏩ Donut
- SUTVA: Triple interaction with pre-reform percent of green applications ⏩ SUTVA

Conclusion

- The choice of rules and allocation of authority can significantly impact organizational outcomes
- We study their impact, as well as reasons for rule violations
- Seniors endogenously (and heterogeneously, depending on baseline characteristics and time-varying bandwidth) create a knowledge hierarchy in partial noncompliance with rules
- These results additionally contribute to the understanding of how regulation (de jure and de facto) impacts firms, and reasons for differences between the two

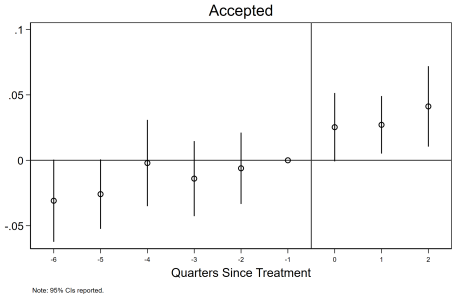
SUTVA Check: Interact with percent Green by District in Pre Period

$\beta = 0.537^{***}$



Pre Delegation Mean=0.02
N=53,026

$\beta = 0.030^{***}$



Pre Delegation Mean=0.95
N= 52,910

Notes: All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. We include all the double and triple interactions with percent green application in the pre-period.

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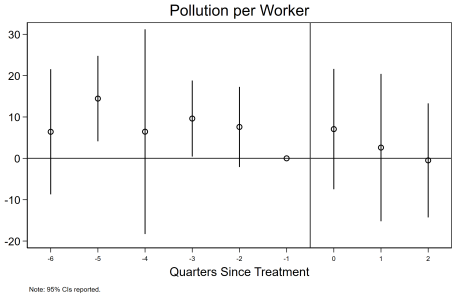
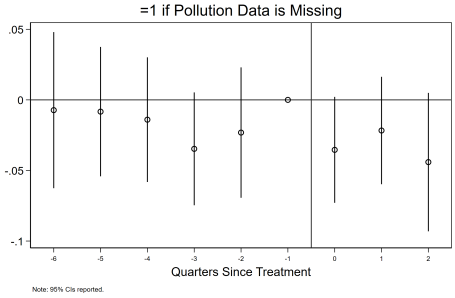
Type of Application (Environmental Outcomes) Does Not Change

$\beta = -0.954$



$\beta = -0.014$



Notes: All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects.

Pre Delegation Mean=11.65
N=12,622

Pre Delegation Mean=0.76
N=53,112

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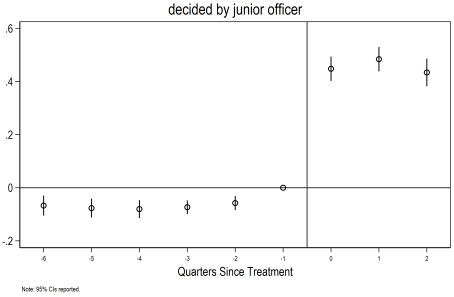
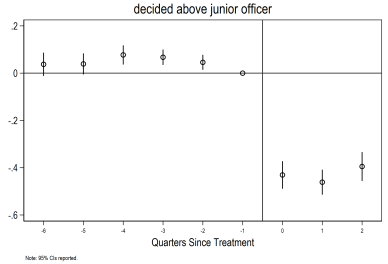
Controlling for Pollution Score × Post





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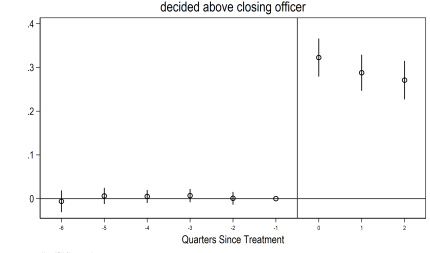
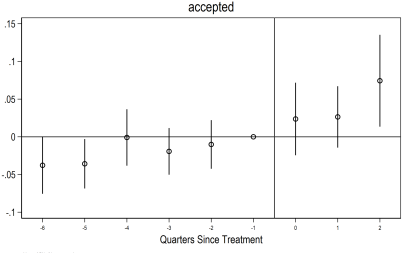
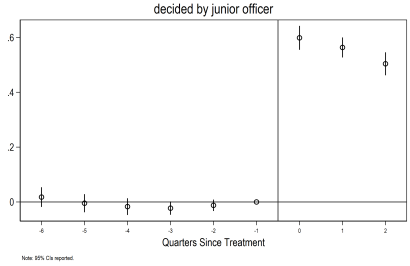
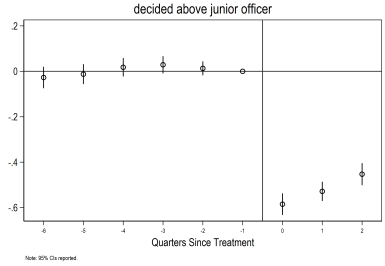




Drop applications within 30 days of policy





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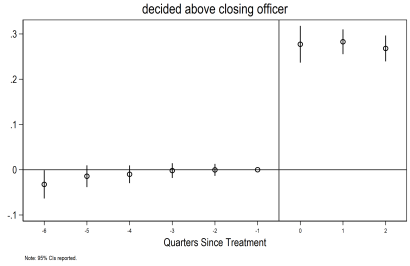
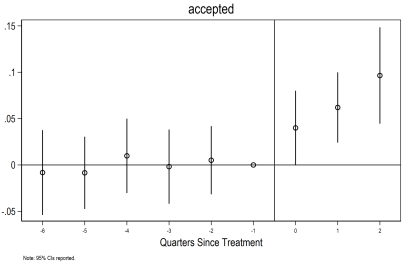
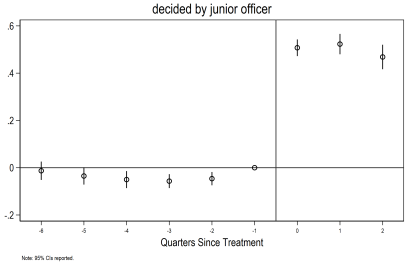
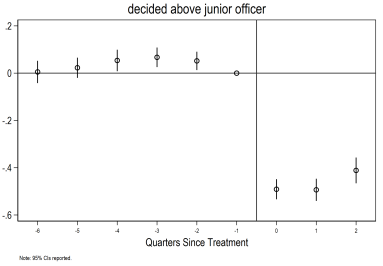




Drop Size-Based Industries





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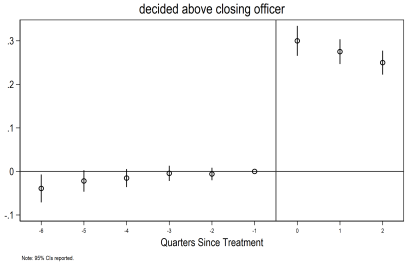
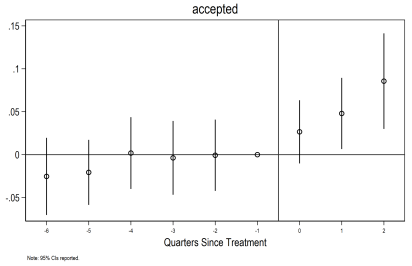
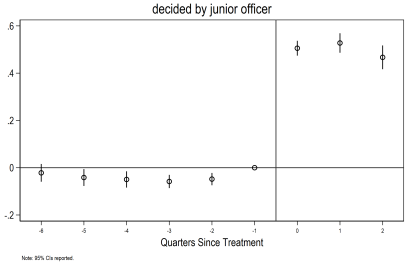
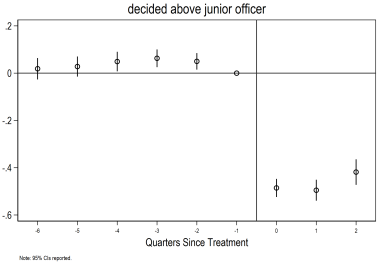




Drop Red Applications





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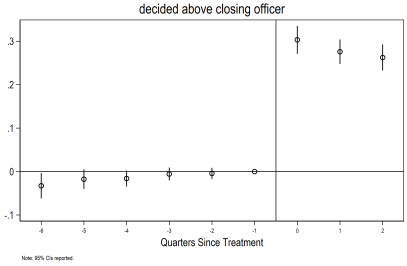
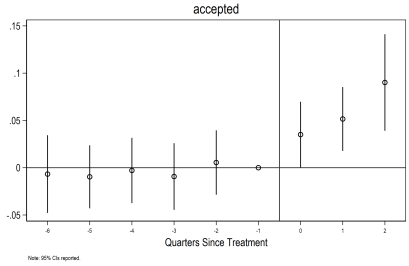
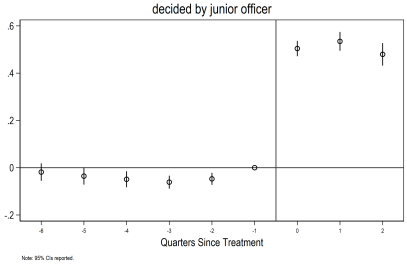
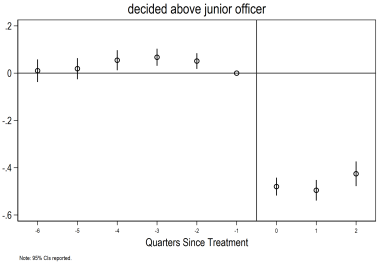




Industry by District Fixed Effects





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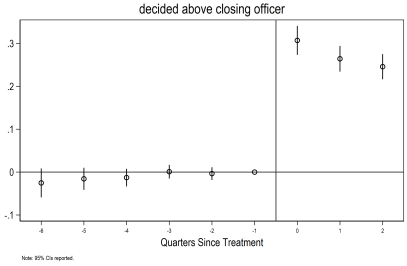
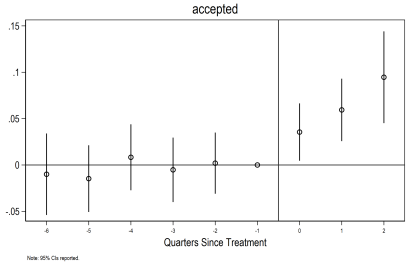
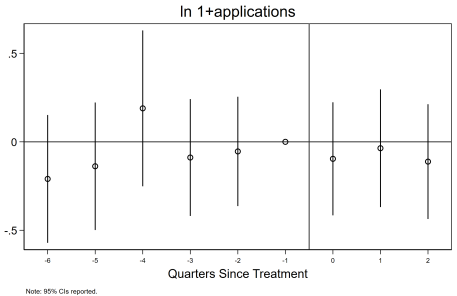
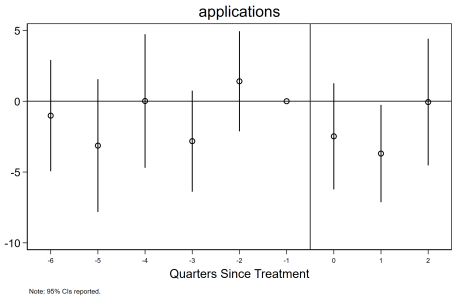




Number of Green Applications





Notes: All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects.

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