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HOW RULES AND COMPLIANCE IMPACT ORGANIZATIONAL OUTCOMES: EVIDENCE FROM DELEGATION IN ENVIRONMENTAL REGULATION

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ABSTRACT

Formal rules within organizations are pervasive, but may be interpreted and implemented differently by actors within the organization, impacting organizational outcomes. We consider a delegation reform that changed formal rules within the environmental regulator in an Indian state, by giving decision rights to junior officers over certain types of application. Using novel data on firms' environmental permit applications and internal communications within the regulator, we study how the delegation of formal authority affects its actual allocation, the consequences for applicant firms, and the circumstances that lead senior officers to withhold this authority. The change in decision rights led to greater approval rates for applicant firms. However, only two thirds of applications that should have been delegated according to the rules were actually delegated. We show that senior officers chose to retain decision rights over more difficult applications, namely, applications with higher pollution potential. Furthermore, baseline disagreement with more subordinates' recommendations reduces delegation post-reform, and officers facing a higher backlog of applications are more likely to delegate. These results are consistent with a framework where the allocation of decision rights is determined by a knowledge hierarchy and where different senior officers face varying costs of delegation at different times.

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1 Introduction

Formal rules within organizations are pervasive, but may be interpreted and complied with differently by actors within the organization, impacting organizational outcomes (Evans and Silbey, 2022; Schein, 2010). Related to these differences between formal rules and their potentially uneven implementation is the distinction between *de jure* vs. *de facto* implementation of regulations, which has been of longstanding interest since it impacts the efficacy and welfare consequences of regulations. Quantifying the dispersion in regulatory implementation by regulators and linking this dispersion to organizational outcomes is empirically challenging, since it requires data on regulators' actions, exogenous variation in rules, and consequences on regulated agents.

In this paper, we combine new data and a natural experiment in order to estimate the impacts of formal rules regarding an important aspect of organizational structure – the allocation of decision rights. We estimate how the delegation of formal authority affects its actual allocation, the consequences of this delegation, and the circumstances that lead senior officers in the organization to withhold this authority. While there is a rich theoretical literature on how problems within organizations should be escalated, delegated, and solved (Bolton and Dewatripont, 1994; Dessein and Santos, 2006; Garicano, 2000), there is limited empirical evidence on these questions.

The data we use comprise the universe of all environmental permit applications in one state in India covering the period from the start of 2018 to the first quarter of 2020. Most firms, except in sectors that are completely non-polluting, are required to obtain these permits. These data contain both detailed information on the application as well as internal communications within the environmental regulator. Our data consist of more than 64,000 firms' applications, and half a million emails involving individual regulators and applicant firms. Moreover, each application is a well-defined task or problem with observable characteristics (e.g. size, sector, pollution potential and pollution emitted by the applicant firm) and a clear outcome (whether the application was accepted). There are also clear rules on who has the *de jure* authority to decide whether to grant the permit. A unique feature of the data is that we observe both the links in communication (i.e. who communicated with whom) as well as the content of communication.

We combine these novel data with a natural experiment that changed the allocation of authority to make decisions on certain types of application. In July 2019, junior officers working within the regulatory agency were given the *de jure* authority to approve or reject certain types of application from industries that had relatively low pollution potential. In particular, applications are assigned a color code denoting their pollution potential, comprising Red (high pollution potential), Orange (intermediate) and Green (low), which are largely a function of their industry. Delegation gave junior officers decision rights over Green applications, rights that had previously resided with senior officers.

Our analysis proceeds in two parts. The first part estimates the impact of delegation on regulated firms. We use event study and differences in differences (DID) approaches that compare applications in industries for which junior officers gained *de jure* decision rights to those for which they did not, before and after the reform. First, we show that the delegation reform has a strong first stage, in that it did increase delegation on average. That is, the probability that a junior officer decided on an application in a Green industry increased. In raw summary statistics, Green applications went from an approximately 3% chance of being decided by a junior officer to a 66% chance. Our DID estimates suggest a similar magnitude of 54.1 percentage points. However, we also show that delegation was only imperfectly followed; applications in Green industries became 27.8 percentage points more likely to be decided by an officer *above* the officer with closing authority, i.e. above the junior officer. Thus, the probability of noncompliance with the rules, or divergence between *de jure* and *de facto* allocation of authority, increases.

The reform had meaningful impacts on the outcomes of applicant firms. Applications from Green industries became close to 3 percentage points more likely to be approved, 9 percentage points when considering treatment on the treated effects. We also show that the increase in acceptance is driven largely by more pollution-intensive firms within these Green industries. Prior to the reform, we find no evidence that applications from Green industries had differential trends in their acceptance rates over time in either the high-pollution or low-pollution samples. This pattern indicates that senior officers would have preferred a different composition of firm acceptances, which is reflected by acceptance patterns after the reform.

The second part of the analysis studies the determinants of non compliance with the rule (non-delegation). We first test whether incomplete delegation is the result of junior officers ceding their authority to the senior officer, or the senior officer withholding the authority mandated by the delegation reform. Since we observe communication across officers, we can identify whether an officer who did not decide an application was still included in the flow of communication. We find that the vast majority of lack of delegation, over 80%, is senior officers bypassing the junior officer and retaining authority in decision-making.

To understand the incomplete delegation that we observe, we use a parsimonious model in which the senior officer chooses whether or not to delegate. She is tasked with approving or denying applications, some of which may not be compliant with regulations. She will delegate only if the costs of wrongfully approving a non-compliant application are low relative to the junior officer's propensity to effectively scrutinize the application. This model identifies several conditions that make delegation more likely. If the senior faces lower costs of a wrongful approval, or if a junior officer faces higher costs of a wrongful approval, delegation becomes more likely. If the senior faces higher costs of scrutinizing an application, or if the junior faces lower scrutinizing costs, delegation again becomes more likely. Similarly, if the senior is less effective at detecting non-compliant applications, or the junior is more effective, it increases the likelihood of delegation.

We identify empirical proxies for several of these model parameters, and test for heterogeneous responses to the delegation reform that are consistent with this framework. First, we use greater pollution potential as a proxy for higher costs to the senior of wrongful approval. We show that applications with higher pollution potential are delegated less than others after the reform, consistent with the framework. Second, we use the data on communication to proxy for the senior officer's effectiveness. The approval process includes senior officers, junior officers (who received authority to decide Green applications), and subordinate officers who process these applications and conduct compliance checks. Subordinate officers frequently make recommendations regarding approving applications. Using pre-reform data, we measure officers' propensities to overturn subordinate officers' approval recommendations before the reform. This measures agreement with the subordinate, and is a proxy for senior officers' efficacy (since it requires pointing out mistakes that the subordinate has missed). Senior officers who are more effective by this proxy respond less to the reform in terms of delegation i.e. baseline agreement with subordinate officers predicts greater delegation. Thirdly, we proxy for the senior's costs of effort using the number of applications received in the past 120 days. If the senior's workload rises in this way, delegation is more likely, consistent with a higher cost of effort.

In sum, the results paint a picture of delegation impacting applicant firm outcomes, and delegation decisions by senior officers being driven by caution regarding the ability of junior officers to process difficult applications. These results are thus consistent with seniors endogenously (and heterogeneously, depending on baseline characteristics and time-varying bandwidth) creating a knowledge hierarchy in partial noncompliance with rules (Garicano, 2000), in which problems of greater complexity are resolved higher in the organizational hierarchy.

We conduct several tests to show the robustness of our main results, some of which we mention here. We show that our results are not driven by changes in the observable characteristics of applications, nor by industries in which firms can potentially change their production scale to reduce their regulatory burden (i.e. industries where regulatory scrutiny is a function of reported firm size). Furthermore, applications that may have been strategically delayed to take advantage of the reform also do not drive our results. Third, results are robust to several alternative specification and estimation choices, and to limiting the sample to sub-groups of Green and other applications that are most similar to each other in their observable characteristics. Fourth, controlling for measures of the likelihood of spillovers from Green to other applications yields similar results, as does restricting our comparisons of Green applications to other applications from other geographic regions, for which such spillovers would be much less likely. Fifth, these results also cannot be explained by changes in staffing levels. Finally, we provide evidence against an alternative interpretation of the decision to delegate grounded in corruption. Delegation is no less likely for applications that represent large capital investments and so may be vulnerable to bribes. Nor is delegation less likely in districts with greater levels of political corruption.

The paper relates to several literatures. First, we contribute to the growing literature on communication and problem solving within organizations. A substantial portion of this literature is theoretical, and studies how communication as well as the costs of specialization by agents in an organization determine how problems should be transferred within the organizational hierarchy and solved (Bolton and Dewatripont, 1994; Garicano, 2000). We conduct empirical tests of how agents communicate, and how problems are delegated and solved. Our results regarding senior officers retaining authority over higher-stakes applications are consistent with the knowledge hierarchies model by Garicano (2000). In this model, problems that are easier to solve are dealt with in the lower levels of the organization, with more difficult problems being escalated to higher levels, creating a hierarchy organized by the capacity to solve problems of varying difficulty. In our setting, senior officers retain difficult problems and delegate easier ones, resulting in a similar pattern between problem difficulty and rank of the person resolving it.

There is also recent and growing empirical work on communication within organizations. Sandvik et al. (2020) find that incentivizing sales agents to increase communication with each other improves productivity of workers who were encouraged to seek advice from their peer agent, and Espinosa and Stanton (2022) find that training workers changes their communication patterns with managers, freeing up managerial time. Battiston, Blanes i Vidal and Kirchmaier (2021) study face to face communication in a police organization in the UK, and find that it increases productivity for workers who receive help, but causes negative productivity externalities for workers who provide this help.

Impink, Prat and Sadun (2020) find that email communication patterns within firms are impacted by CEO turnover, which first decreases and then increases communication. Our paper studies how organizational reform that alters the allocation of authority in the organization impacts communication and organizational outcomes, and uses the content of the communication to identify mechanisms of why compliance with this organizational reform is partial.

Secondly, the paper relates to empirical work on the allocation of authority within organizations. Following Aghion and Tirole (1997), there is a rich theoretical literature on the causes and consequences of delegation (see Bolton and Dewatripont (2013) for a review), and more recent empirical work focuses on identifying the impact of the allocation of decision rights on organizational outcomes. Aghion et al. (2021) find that firm decentralization predicts survival during the Great Recession, consistent with managers having better information about local economic conditions. Bandiera et al. (2021) conduct a field experiment with procurement agents in Pakistan, and find that giving procurement agents more authority lowers procurement prices without affecting quality. Kala (2023) studies a natural experiment that gave the managers of well-performing state-owned enterprises in India more autonomy over strategic decisions (like capital expansion and labor restructuring), and finds that autonomy increased value added but not productivity. This paper finds that regulatory delegation has meaningful impacts on firm outcomes by changing their probability of getting a permit, and tests predictions of a framework of organizational problem-solving that is consistent with the partial implementation of delegation by the senior officers. Thus, the agency problem is quite different in this setting, since the senior officer is trading off the effort to resolve an application herself vs. the possibility that the junior officer may not resolve it satisfactorily. Consequently, whether delegation leads to positive outcomes for the organization is also different. Indeed, we find that junior officers are more likely to accept applications with greater pollution intensity. We also examine when authority is granted and when it is withheld, showing that both the type of application and the type of officer determine whether an application is delegated or not.

Related work has also focused on the drivers of delegation in the private sector, including the importance of local information (Aghion and Tirole, 1997), the importance of coordination (Dessein, Lo and Minami, 2022; McElheran, 2014), incentives and agent ability (Lo et al., 2016), trust (Bloom, Sadun and Van Reenen, 2012), the presence of information and communication technologies (Bloom et al., 2014), product market competition Meagher and Wait (2014), and how valuable the input is (Alfaro et al., 2023). This paper focuses on what determines whether public sector officials retain authority despite *de* *jure* delegation, finding that more difficult applications are less likely to be delegated and more cautious officers are less likely to delegate.

More broadly, our paper is related to the literature on the impacts of environmental regulation on firms. Prior work has studied how the introduction of new environmental regulation impacts firm productivity (Fan et al., 2019; Greenstone, List and Syverson, 2012; Harrison et al., 2015; He, Wang and Zhang, 2020), while this paper focuses on how organizational reform in the environmental regulator impacts firms' outcomes.[1] While our focus is on a single reform in one state, our results have implications for a much broader set of contexts. In the UK, for example, any firm that produces pollutants that have the potential to do harm requires an environmental permit from the Environment Agency, a regulator that employs more than 10,000 persons.[2] Under the single-medium approach in the United States, firms are often obligated to seek permits from separate agencies for each medium (e.g. air, water) they pollute (Tanaka et al., 2022). In China, polluting firms must contend with several large and hierarchical agencies, including city and county governments, the economic and trade commission of a given province, and the environmental protection department (He, Wang and Zhang, 2020). More generally, all economic regulations entail the creation of a bureaucracy and the allocation of decision rights within that bureaucracy.

2 Context

2.1 Environmental Regulation in India

India's system of environmental regulation is based on two key laws – the Water (Prevention and Control of Pollution) Act of 1974, and the Air (Prevention and Control of Pollution) Act of 1981 (Ghosh, 2019). These acts led to the establishment of the main agencies that regulate pollution in India, the national-level Central Pollution Control Board and the various state-level Pollution Control Boards. These boards are in charge of implementing various environmental regulations imposed on firms.

Our focus is on the State Pollution Control Board in the state of Kerala. Kerala is an economically important state in India, with a population of over 33 million people

[1] In related work, Duflo et al. (2018) show that environmental regulators in India target inspections towards more polluting plants, and that these targeted inspections are more likely to identify serious violations relative to randomly targeted inspections. We find that senior officers also exercise discretion when deciding whether to delegate, retaining more difficult applications.

[2] https://www.gov.uk/guidance/check-if-you-need-an-environmental-permit, https://www.gov.uk/government/organisations/environment-agency/about.

(Population Census, 2011) and the 11th highest state-level GDP (Reserve Bank of India, 2019). The Pollution Control Board of the state has a broad remit of functions. It sets standards, investigates polluting firms, conducts research, and holds training programmes. The Central Pollution Control Board, by contrast, operates in coordination with the state-level boards, to which it provides assistance (Bhat, 2010; Ghosh, 2019; Paranjape, 2013).[3] Critical for our study is the State Pollution Control Board's role in regulating polluting firms. In this capacity, it conducts inspections, gathers information, and is tasked with evaluating applications from firms to set up or expand operations that have the potential to pollute air or water, or release hazardous waste. All firms, except for those in a small number of non-polluting sectors, are required to apply for and receive approval from the State Pollution Control Board. New activities require a permit called Consent To Establish (CTE), while both new activities and renewals require one called Consent to Operate (CTO). We refer to these as new permits and renewals for the remainder of the paper, respectively. We observe both types of application in our data. After approval, the Pollution Control Board is responsible for conducting routine inspections, and is able to revoke the firm's approval if the firm is found in violation of environmental regulations (Bhat, 2010; Ghosh, 2019; Paranjape, 2013).[4] Applications are made by an official authorized by the firm.

Depending on the pollution potential of a given industry, all firms in that industry are assigned a color code – Green, Orange, or Red – that determines their regulatory burden. Red firms are the most polluting, and Green firms are the least polluting. The pollution score is a numeric index of their pollution potential that varies between 21 and 100, and regulatory measure of pollution potential based on the expected air and water pollution levels in a given industry.[5] This score is determined by the regulator, and not the firm. This score varies by industry, and not across firms within an industry.[6] The delegation

[3]The powers and responsibilities of the Central and State Pollution Control Boards, as well as their regional and district offices, are outlined in several official circulars, including PCB/T4/115/97 dated 01/03/2017 and PCB/E1/11550/2016 (2) dated 02/11/2016.

[4]These procedures are also described in guidance provided to firms through the websites of the Pollution Control Boards, including "Procedure for Obtaining a CTE/CTO(A/W)/HWM/BMW through OCMMS," at `https://pbocmms.nic.in/OCMMS-0.1/knowledgeBaseMaster/viewDocument?docName=OCMMS2&docType=pdf`, and "Standard Operating Procedure for Consent Management," at `https://krocmms.nic.in/KSPCB/SPCB_DOCUMENTS/sop/SOPKeralaStatePollutionControlBoard.PDF`.

[5]Firms with scores of 20 or below are classified as "White." For White firms, participation in the Online Consent Management & Monitoring System from which we obtain our data is not mandatory, and we do not use the small number of applications we observe in these industries (approximately 7% of the sample).

[6]Some industries are defined by size; for example, building projects receive different pollution scores and color classifications depending on whether they are greater or less than 20,000 square meters. Such applications comprise about 13.5% of the data. We discard these size-based industries in robustness checks, and show that the results do not change with this exclusion.

reform applied to applications in Green industries.

We summarize the differences in regulatory burden across color codes using information from several Indian states in Table 1 though note these vary somewhat by state. Red firms pay higher fees, must be inspected at a higher frequency, and must seek a renewal of their permit sooner. They are also required to supply more documentation. An inspection by the State Pollution Control Board is likely at the initial application stage, particularly for Red and Orange firms. Red firms also face siting restrictions that Orange and Green firms do not. They cannot, for instance, locate in Ecologically Fragile or Protected Areas (HSPCB, 2017). Location in these areas is a rare occurrence for any firm.

2.2 Organizational Hierarchy in the Regulatory Agency and Pre-Reform Workflow

There are several ranks of officer within the state's Pollution Control Board.[7] Six appear as senders and receivers of the communications in our data. At the top of the bureaucratic hierarchy is the position of Chairman, followed by the position of Member Secretary. Below these officers are the Chief Environmental Engineers. At most points in time, between four and eight officers sign emails with this title.

Below these three ranks are the three ranks of engineers that are central to this study. The first and most senior rank of these is that of the Environmental Engineer (EE), who is the usual first recipient for any application (approximately 98.5% of occurrences). There is usually one EE at a time for each of the fourteen districts of Kerala, and one additional EE for the industrial area of Eloor, which is treated as a district by the Pollution Control Board. We refer to the EE as the "senior" officer. Below her is the Assistant Environmental Engineer (AEE), to whom *de jure* authority over Green applications was given under the delegation reform. There are generally one or two AEEs in each district at a time, though occasionally there are others.[8] We refer to the AEE as the "junior" officer. Below him and at the bottom of the relevant organizational hierarchy is the Assistant Engineer, or "AE." The AE is tasked with carrying out duties such as site inspections as directed by the AEE or EE.[9] We refer to the AE as the "subordinate" officer. Applicant firms and the record room also appear as senders and receivers in the communications data. Because the terms EE, AEE, and AE, are all similar and do not make the organizational hierarchy

[7]Our discussion here is based on the recruitment rules specified in Regn. No. KERBIL/2012/45073 dated 05/09/2012 with RNI.

[8]In roughly 65% of instances within district-quarter pairs, each district houses either one or two AEEs.

[9]During a site inspection, officers visit a proposed site that a firm wants to locate. For renewals, they visit the location where the firm is already operating and ensure all regulations are being followed.

evident, we will show preference for our own labels of senior officer, junior officer, and subordinate officer throughout.[10]

When an application is made by a firm, the senior officer is supposed to check if the application is incomplete or if it is missing any required documentation. Before the delegation reform in July 2019, it was therefore generally the case that the senior officer would either return the application to the firm if it was incomplete (around 2.7% of time) or forward it to the subordinate officer for further processing (around 97.1% of time). The subordinate officer did not have any decision rights. He would, however, be responsible for conducting more detailed due diligence on the application, such as checking whether regulations regarding zoning laws such as the firm's distance from a school were followed, and would be the one to conduct any inspection.

Before the delegation reform, the communication patterns we see within the regulator include large amounts of communication between the senior and subordinate officers.[11] On the basis of any inspection and recommendations of the subordinate and junior officers, the senior officer would have the authority to approve the application or not. For instance, suppose a junior officer conducts a review of the application. If the application meets all requirements, he prepares a draft and passes it on to the subordinate for further review, along with his recommendation. The subordinate then conducts a review, and if he agrees with the junior officer, he forwards it to the senior along with a recommendation to approve the application. In cases where the senior agrees with the subordinate, the application will be approved. Otherwise, the senior officer overrules the subordinate and cites a reason, such as missing documentation, incorrect fees, or lack of pollution measurements. In 22% of pre-delegation period applications, senior officers overrules subordinates at least once.

2.3 Delegation Reform

In July 2019, the authority to decide Green applications was delegated from the senior officer to the junior officer.[12] The goal of the reform was to reduce red tape, and to "streamline the flow of applications" for firms. That is, it was intended to make processing faster. Under the delegation reform, the Pollution Control Board's *de jure* workflow rules for Green applications are as follows. After the reform, the senior officer was still supposed to be

[10] We adopt the pronoun conventions of the literature on principal-agent models, referring to the senior officer as "she" and the junior and subordinate officers as "he" throughout, regardless of the actual identities of the individuals in these roles.

[11] See section 3.1.1 for a detailed discussion.

[12] See circular PCB/HO/EE4/Delegation of Powers/2019 dated 04/07/2019.

the first officer to review the file, and this practice continued in the data (approximately 99% of the time). They would assign applications to the junior officer for processing. The junior officer is tasked with contacting firms for clarifications, corrections, and additional documentation. If an application is resubmitted due to incompleteness, it is received by the senior officer but is then to be assigned to the junior officer immediately. The junior officer has decision rights over approving and rejecting these applications. The official policy document includes a directive against bypassing junior officers and states: "Environmental Engineers shall assign the work of Assistant Engineers only through Assistant Environmental Engineer."[13]

If there is a complaint or court case relating to the application, it becomes the responsibility of the senior officer. This responsibility is also explicitly stated in the policy document that announced the delegation reform: "All activities, action on complaint, court case on the disposed application shall be dealt with by the Environmental Engineer/Head of Office."[14] We observe this responsibility in court cases that arise from these applications. For example, the senior officer in Kottayam District represented the Pollution Control Board in court during a case in 2020, during which the manager of a tyre retreading unit sought to quash an order from the Pollution Control Board ordering the firm to cease operations between 6:00PM and 6:00 AM.[15] We have identified several other cases that came before the Kerala High Court or the National Green Tribunal in which the senior officer was present.[16] Some of these cases involve firms that have already received a permit from the Pollution Control Board.[17] This obligation is one potential cost of a poorly considered decision, and helps explain why senior officers may be hesitant to delegate applications that are more higher risk.

The delegation reform, availability of data on individual applications, and the communication records provide us with a unique natural experiment to examine how a change in *de jure* decision rights affects processes and communication within an organization, and how these changes shape outcomes for regulated firms. Furthermore, there is a clear distinction between the applications to which the reform applied (Green) and those to which it did not (Orange, Red), as well as a well-defined start date (July 2019).

[13] See Office circular No. PCB/HO/EE4/Delegation of Powers/2019 dated 24 July 2019

[14] See Office circular No. PCB/HO/EE4/Delegation of Powers/2019 dated 24 July 2019

[15] W.P.(C)No.9857 OF 2020(F).

[16] See, for example, NGT/CKS/Judg/28-03-2012/15:30, WP(C).No.17315 OF 2017(L), or WP(C).No.3923 OF 2020(M).

[17] See, for example, WP(C).No.32958 OF 2018(S), WP(C).No. 27794 of 2013 (Y), or WP(C).No.8197 OF 2020(Y).

3 Data

3.1 Applications for Environmental Permits and Communication

Our primary data source is the universe of environmental permit applications and associated communication from Kerala's Consent Management & Monitoring System. These data should, by law, contain all firms that applied for permission to begin or renew an environmental permit in Kerala during the time period we consider. These data allow us to see successful, unsuccessful, and pending applications. While we have data on all applications since 2016, we focus on applications from January 2018 (the start of the calendar year prior to the delegation reform, to reduce the possibility of other confounding policy changes) until March 2020 (the start of the coronavirus pandemic).

Throughout this time period, more than 68,000 applications were submitted, leading to the exchange of nearly half a million emails involving approximately 350 distinct officers. Each officer typically handles a median of 166 applications. Lastly, during this duration, approximately 95.5% of the officers remain in the same rank without receiving promotions. The application contains information about the applicant firm (such as sector, color code and number of employees) and attached documents that verify this information such as the firm's location, date of submission, industry, number of workers, the anticipated capital investment for the activity that is the subject of the application, the fee paid, and the time between submission and final decision. It also contains information on the levels of pollution the firm expects to emit, which are most consistently available for wastewater discharge.[18] Note that this firm-level measure of pollution is distinct from the industry-level pollution score (discussed further in Section 3.2).[19] In instances where the color classification depends on measures of firm size or production scale (around 13.5% of the sample), it is possible that firms may strategically misreport some of these variables to obtain a lower level of regulatory burden. We will show robustness to excluding all applications in such size-based industries.

The data we use contain information on communication between regulatory officers and between these officers and applicant firms. These records are linked to each appli-

[18]In the application data, firms are asked to provide information about different aspects of pollution. Data is available for both air emissions and water discharge; however, the variable that is consistently reported across various industries and time periods is the amount of effluent discharge.

[19]Industry definitions used to decide whether an industry is affected by the delegation reform are unique to pollution regulation in India, and comprise more than 250 categories such as "engineering and fabrication units (dry process without any heat treatment / metal surface finishing operations / painting)" or "poultry, hatchery and piggery." These are based both on the product produced and the method used to produce it, since both are relevant to the industry's pollution potential. Other regulations (such as size-based labor regulation or sector based tax regulation) do not perfectly covary with these categories.

cation and allow us not only to identify each officer to which the application was passed and in what order, but also the content of communication at each step. That is, for every "note" attached to the file, effectively an email, we have the sender's name and job title, receiver's name and job title, time stamp, and complete text of the email. The text of the emails allows us to measure whether a topic such as inspection has been mentioned. While most emails are in English, some are in Malayalam.[20] Even when the email content is in Malayalam, the email subject, sender's name and rank, recipient's name and rank, as well as the application's status remain in English. However, email text is important for measures such as inspection. In such instances, we utilize the Malayalam equivalent of the search term to identify corresponding actions and activities.

How do these data compare to other Indian firm datasets in terms of number of firms covered and what data is collected for each firm? In comparison to other datasets on firms in India, such as the Annual Survey of Industries (ASI) or data from the Ministry of Corporate Affairs, these applications data cover many more firms. We have more than 50,000 unique firm names (for both new permits and renewals) in our sample that covers only the years 2018-2020 in the state of Kerala, of which 9,150 firms applying for a new permit. In contrast, in 2018 and 2019, about 7,500 businesses registered with the Ministry of Corporate Affairs in Kerala across all sectors (including White sectors, which do not need a permit), a significantly lower number. The number of new firms recorded in the ASI is even smaller; only 40 ASI firms in Kerala list an initial production year of 2017 or later. Thus, these data have a much larger coverage than other datasets. Moreover, key outcomes such as whether an application is delegated, or the patterns of communication within the regulatory agency, are available only in our data.

3.1.1 Descriptive Evidence Prior to the Reform

Pre-Reform Workflow: In Figure A1, we show the pre-reform workflow. Each figure uses the thickness of the line drawn to represent the volume of emails sent between each sender rank and each receiver rank for the first ten emails on an application (we restrict these graphs to the first ten emails for clarity – 75% of applications generate ten emails or fewer. We show these flows separately for Green and Non-Green (Orange and Red) applications, both in the pre-reform period. Further, we collapse positions that rank above the senior officer, such as Chairman and Member Secretary (MS) into a single "Above" category (i.e. above the senior officer). We also collapse the firm, help desk, and record room into a single "Other" category, though almost all messages to and from this category

[20] About 8% of the emails contain a Malyalam word, and approximately 16% of the applications include an email with at least one Malyalam word.

are messages to and from firms.

For example, the left panel represents Green applications in the pre-reform period. From email 1 to email 2, there is a wide bar from "Senior" to "Subordinate." This bar demonstrates that the bulk of Green applications arrive first on the desk of the senior officer, who sends the first email. This email forwards the application to the subordinate, who becomes the sender of the second email. Between emails 2 and 3 on the same panel, there are three wide bars connecting "Subordinate" to "Senior," "Subordinate," and "Other." This pattern reflects the three most common initial actions taken by a subordinate who has been forwarded a Green application – contacting the senior officer, contacting another subordinate officer, or contacting the firm.

The left panel of Figure A1 shows that the typical workflow on Green applications in the pre-reform period excluded junior officers. A typical application starts with the senior officer and is forwarded immediately to the subordinate. The resulting flow of communication typically passes back and forth between the subordinate, the senior, and the firm. Replies from the firm are sent to the senior officer directly, not to the subordinate. In almost all cases, the officer who closes the file is the senior, as can be seen by the diagonal lines leading from "Senior" to "Closed" from the fourth email onwards. Lines connecting any other rank of officer to "Closed" are very thin, representing how rare this outcome is (we discuss this further in the next section). The right panel represents communication flows for Orange and Red applications in the pre-reform period. There are few apparent differences with the communication flow for pre-reform Green applications.

Pre-Reform Effort vs. Decision Rights: In this section, we use the content of communication in the permit applications to provide descriptive evidence of who in the regulatory hierarchy works on, as well as decides on, applications. The communication data includes information on which officer decided an application, and which officers received the application and took some other action without deciding the outcome.

In Figure 1, we show the number of applications in the pre-reform period that were received and decided by each rank of officer. We count any officer who sends or receives an email on an application as having handled it, while we record the officer who closes the application as having decided it.[21] Many officers can handle an application, but only one can close it. Ranks are arranged hierarchically from left to right. The record room is largely outside the organizational hierarchy, is only rarely consulted, and is only consulted for a small number of applications.

[21]To evaluate this measure, we read all the text in a random sample of 150 applications stratified by before and after the reform – in all instances, the officer who closed the application was the one who decided it, indicating that this is the correct measure of identifying the officer who decided on the application.

The results show that subordinate officers were present on nearly 12,000 applications (around 27.1%), but had nearly no decision rights, deciding around 2% of the total applications. This pattern implies that common tasks are not completed at the bottom of the hierarchy without decision rights being exercised higher up. Junior officers are, in the pre-reform period, less likely than senior officers to be included on an application and less likely to decide on them. Senior officers are not only included on the bulk of applications, they also retain the decision rights over most applications. On the right, we have aggregated the positions of Member Secretary, Chairman, and Chief Environmental Engineer as "above." Officers with these ranks are consulted on few applications, and they rarely decide on them. Given how rarely individuals above the rank of senior officer appear, decision rights are essentially concentrated in the middle of the hierarchy in the hands of the senior officer. This pattern helps motivate our conceptual framework in Section 6.1. We note, however, that in addition to permit evaluation and approval, these officers have other tasks as part of their job description, such as preparation of reports and dealing with public complaints, that do not appear in our data.

3.2 Industry-Level Pollution Score

We measure industry-level pollution scores from instructions issued to the state-level Pollution Control Boards by the national-level Central Pollution Control Board.[22] Because these instructions do not mention all industries, particularly new industries that had not been considered before 2016, this variable is missing for some applications.[23] While, according to regulation, firms with pollution scores of 21-40 should be classified as "Green," firms with scores 41-59 should be Orange, and firms with scores of 60 and above should be "Red" (CPCB, 2016), this classification is not adhered to perfectly in the data.[24]

[22]Central Pollution Control Board No. B-29012/ESS(CPA)/2015-16. March 7, 2016.

[23]In our main sample of applications where industry information is available, we were unable to attribute pollution potential to nearly 20% of them. We do not use this variable in the main results, and show that heterogeneity results using it are robust to imputation of this score. The probability that this information is missing is not different for industries impacted by the delegation reform post-reform. We omit this result for brevity, but it is available upon request.

[24]There are several potential explanations for this. To start, some applications could be potentially misclassified, leading to a pollution category different from the one indicated in the official documents. Additionally, as some industries undergo re-classification, applications stemming from the same industry could potentially fall under different pollution categories. Furthermore, several applications had industry type labels that were not entirely precise; some had minor variations, while in other cases, we only had textual descriptions. We assigned these applications industry type based on textual content provided in the respective field. This cleaning process is imperfect and could contribute to variations in the treatment of the same industry types.

3.3 Main Outcome Variables and Treatment Definition

The outcome measures we use include several related measures of delegation. The first is an indicator for whether the junior officer is the final officer who decides on, and hence closes, the application (described in the previous section). In these applications, the junior officer sends the last email with either one of the following accompanying actions: 'close after approval' or 'close after refusal.' The second outcome is, similarly, an indicator for whether an officer with a higher rank than the junior officer closes the application. The third is an indicator variable that takes the value 1 if an officer who outranks the individual with closing authority closes the application, and 0 otherwise. This is our measure of rule noncompliance, or *de facto* treatment of applications (which deviates from the *de jure* allocation of authority). In the case of Green applications, both for new permits and renewals, closing authority prior to the delegation reform was with the head of the district office – the senior officer. After the delegation reform, this authority passed to the junior officer. For Orange and Red applications, authority would be with the senior officer, and in rare instances more senior officers such as member secretary, or chairman, depending on capital intensity.[25] This authority was not changed by the delegation reform.

We also consider regulatory outcomes of the applicant firms. The first such outcome measures whether the application was accepted, which is the most important outcome for the firm, since it requires the permit to operate legally. Secondly, we measure regulatory scrutiny with a binary variable that takes the value 1 if a unit undergoes a field inspection from the Pollution Control Board. Although direct access to inspection data is not available, officers do make references to inspections in the emails. Thus, our approach involves searching for specific indicators such as the phrase "conducted site inspection" within the communication data to determine whether an inspection was indeed carried out.[26] The third outcome measures time in the regulatory process, for which we use the inverse hyperbolic sine of the winsorized time to decision in days.[27] An application's color code (and therefore treatment status, since Green industries are treated and the others are not) is observed directly in the application. We describe other variables that we use to test for mechanisms and in robustness checks below as we introduce them.

[25]Closing authority is a complex function of application color, scale, type, and industry, as outlined in Circular PCB/T4/115/97 dated 01/03/2017.

[26]The inspection variable is generated based on a specific set of terms and phrases in both English and Malayalam. For the exact phrases employed, please refer to Appendix B.5.

[27]We winsorize at 1% and take a concave transformation because of the presence of outliers that take a very long time to be decided. The raw time to decision has a kurtosis of more than 17, while the winsorized inverse hyperbolic sine has a kurtosis less than 3.5. The inverse hyperbolic sine accounts for a small number of zeroes in the time to decision – roughly 2%.

3.4 Summary Statistics

Table 2 presents summary statistics using data prior to the reform. Slightly more than half of all applications are in the Green category, and these generate almost exactly 50% of all emails. Prior to the 2019 reform, about 94% of applications were decided above the junior officer, and some 2% were decided by the junior officer – these are consistent with Figure 1. Prior to the delegation reform, almost no applications, about 0.7%, were decided above the rank that had decision rights for that application. That is, the rule regarding the rank of the officer with decision rights was mostly respected. Almost 40% of applications are resubmitted during the application process. Each application generates about 9 emails on average, takes a bit more than 40 days to decide, and about 93% are accepted.

4 Empirical Strategy

Our empirical strategy employs differences in differences (DID) and event study approaches. In order to estimate the impact of the reform on delegation and firm outcomes, we estimate the following event-study specification:

$$y_{aidq} = \sum_{q} \beta_q Green_i \times \psi_q + \delta_i + \mu_d + \eta_q + \delta_i \times q + \epsilon_{aidq}. \tag{1}$$

In equation (1), y_{aidq} is outcome y for application a from a firm in industry i and in district d, submitted in year $\times$ quarter q. $Green_i$ is an indicator for whether the regulatory category for industry i is Green, an industry-level measure of whether the application is from one of the industries that was affected by the reform. β_q are separate coefficients by quarter, and ψ_q are year $\times$ quarter fixed effects. The omitted category here is Q2 of 2019, which is the final quarter in which junior officers did not have the authority to decide on Green applications. Our main estimating equation also includes fixed effects for industry, δ_i, for districts, μ_d, and for year $\times$ quarter, η_q.[28] $\delta_i \times q$ are industry-specific linear time trends. We cluster standard errors by industry in our baseline estimation. We also report estimates of analogous DID specifications in which we replace the $\sum_q \beta_q Green_i$ term from (1) with $\beta Green_i \times Post_q$, where $Post_q$ is an indicator for all quarters after Q2 of 2019.

In (1), we exploit variation in how the difference in outcomes between Green and non-Green applications changes over time after the delegation reform. These changes are

[28]We observe the industry information within the submitted applications directly and compare this information with the industrial classification provided in the "Revised Categorization of Industries" by the Pollution Control Board. Districts include the fourteen districts of Kerala and the industrial area of Eloor, which is treated separately in the applications. Quarter is defined based on the date of submission, which we also observe directly.

net of prior differences that may already vary by industry and district, and are based on comparisons of applications with different regulatory color codes submitted in the same year $\times$ quarter. We add additional controls in our robustness exercises. Although the existence of repeated firm names suggests that some firms do appear more than once in these data, this is uncommon (76% of applications come from firms that solely file one application during this time).

Our identifying assumptions, then, are that trends in delegation and firm outcomes across color categories were parallel in the quarters leading up to July 2019, that they would have remained parallel were it not for the delegation reform, and that there are no omitted variables that vary across industries and over time that correlate both with whether an application is in a Green industry in the post period and with the outcomes we study. For omitted variables of this type to bias our results, they must not be absorbed by the flexible time trends that are accounted for by the year $\times$ quarter fixed effects or the industry-specific time trends. We will interpret small and insignificant coefficients for β_q terms prior to Q2 of 2019 as evidence in favor of the parallel trends assumption. In addition, if these omitted variables lead to changes in the composition of Green or non-Green applications, these compositional effects will only bias our results if they are not accounted for by the industry and district fixed effects that we include. To allay these concerns, we show below that we find no evidence of changes in application characteristics due to the reform (Table A1 and Figure A2), that selective timing of submissions affects the results (Table A2 and A3), nor that the number of Green applications increased after the reform (Table A3 and Figure A4).

We present several additional robustness checks in Section 5.3 and in the Appendix. Our event study specification will address possible violations of the parallel trends assumption, as will adding alternative sets of fixed effects discussed in Section 5.3. Furthermore, we will show that our results are not driven by changes in the volume of communication nor by changes in the number of regulatory officers over time. We will also show that our results are similar when limiting the sample to the most observably similar Green and non-Green applications, alternative approaches to estimation, concerns regarding possible spillovers, and alternative approaches to clustering standard errors.

5 Results

5.1 Effects on Delegation

Tables 3 and 4 report the main DID effects on delegation and firm outcomes. The corresponding event studies are in Figure 2. Column (1) of Table 3 shows that, after the reform, a Green application became 54.2 percentage points (p.p.) more likely to be decided by a junior officer. This result is consistent with patterns in the raw data; while there was implementation of the delegation reform, the delegation rate on Green applications did not jump from 3% to 100%, but instead rose to 66%. Therefore, the reform did lead to a large increase in the allocation of authority to junior officers. At the same time, we note that the reform led to incomplete delegation, whereby a third of applications were not delegated in accordance with the new rules. We devote Section 6 to identifying possible mechanisms driving this incomplete delegation.

Symmetric with the large but incomplete effects we find on delegation, Column (2) of Table 3 shows that Green applications were 53.3 p.p. less likely to decided by an officer outranking the junior officer after the delegation reform. Column (3) makes the incomplete delegation clear – after the reform, Green applications became 30 p.p. more likely to be decided by an officer above the one with *de jure* closing authority, an outcome that, as Table 2 shows, was very rare prior to the delegation reform.

The event study results for these outcomes in Figure 2 show a clear and sharp increase after the reform, and are estimated with considerable precision: the 95% confidence intervals range from 51.2 p.p. to 57.0 p.p. for whether the application was decided by a junior officer, from -54.5 p.p. to -48.3 p.p. for whether the application was decided above the junior officer (almost always by the senior officer rather than someone outranking the senior officer), and from 26.1 p.p. to 30.8 p.p. for whether it was decided by an officer outranking the officer with *de jure* authority to decide it. The event studies also make it clear that the results are stable across the three quarters after the reform. In the next section, we estimate how the allocation of authority to decide Green applications impacts the firms who are applying to the regulatory authority for a permit.

5.2 Effects on Firms

5.2.1 Average Effects on Firms

The fact that the allocation of authority has shifted in the organization may have implications for firm outcomes. This could happen if for instance, junior officers' ability to screen applications differs from the senior officers' ability. These include impacts on regulatory burden such as the occurrence of an inspection as well as the final decision, i.e. whether the firm gets to enter the market at all. Furthermore, since the stated goal of the reform was to streamline the application process, processing times may have changed.

In Table 4 and Figure 2, we present results for the primary firm outcomes in the data. The most relevant outcome from the point of view of applying firms is whether their application is accepted. We report this outcome in column (1). The probability that a Green application is accepted increases after the delegation reform, by 3 p.p., about 3% relative to the mean acceptance rate. This is an important change for firms, since denial of a permit implies a costly and uncertain re-application process or the inability to operate legally altogether. We also estimate the fixed effects equivalent of (1), replacing $Green_i \times Post_q$ with a dummy for whether an application was decided by the junior officer, and taking $Green_i \times Post_q$ as an instrument for whether an application was decided by the junior officer. This treatment on the treated specification suggests delegation raised the probability of acceptance substantially, by 9.5 p.p., or about 10% of the mean.

Two other measures of particular importance to firms are the probability of an inspection and the length of time taken to decide on an application. We find no evidence in column (2) that the probability of inspection as measured by any reference to its occurrence within an email changed for Green applications relative to others after the delegation reform. The event study in Figure A5 does, however, give us reason to interpret this result with caution, as the parallel trends assumption may be violated for this outcome. While Figure A5 does provide some suggestive evidence that the time to decision rose for Green applications after the reform, column (6) of Table 4 shows this to be insignificant at conventional levels and small relative to the baseline mean. Thus, the reform did not achieve its goal of increasing processing speed, but did impact firms on the most significant margin, which is the probability of acceptance, which was not, at least explicitly, cited as a goal of the reform.

This result raises the question of whether this increase in acceptance is driven by any particular type of firm. We use environmental quality, proxied by application-level pollution intensity as a measure of decision quality in the next section, and test which types of firms juniors were more likely to allow to enter post-reform.

5.2.2 Impact on Decision Quality: Which Type of Firms are More Likely to be Approved?

In section 5.2.1, we show that the probability of acceptance for Green applications increases after the reform. The welfare implications of this effect depend on the decision's quality – for instance, if the policy allows more firms to enter without compromising environmental quality, it would presumably be welfare-increasing. We measure this welfare-relevant outcome using water pollution per worker, measured as the kiloliters per day of effluent per worker that the firm generates. We use data on wastewater discharge and the total number of employees to calculate water pollution per worker. Using this outcome, we test whether applications with higher costs to the environment per job created had a greater chance of being approved.

In Figure 3, we study how the probability of acceptance varies with pollution per worker. The above median group represents applications that report higher pollution per worker as compared to the pre-reform industry median. Prior to the reform, when senior officers were in charge of decision-making, we find no evidence that applications from Green industries had differential trends in their acceptance rates over time in either the high-pollution or low-pollution samples. This result provides us with an indication of seniors' preferred composition of acceptance of different types of firms. However, after the reform, when junior officers were more likely to be in charge, applications with higher pollution levels became more likely to be accepted, with no change for applications with lower pollution levels.

In Table 5, Column 1, we present corresponding DID estimates and find that applications with above median pollution have 4.3 p.p. higher probability of acceptance. Indeed, the coefficient on $Green \times Post$ indicates that the entire increase in the probability of acceptance is from higher-pollution firms, with no change for less polluting firms. In Column 2, we show that results are similar if we use an even higher threshold for pollution per worker i.e. for applications that are above the 75th percentile of pollution per worker within an industry. Lastly, in Column 3, we show that these findings persist when considering total wastewater discharge instead of discharge per worker. These results suggest the increase in likelihood of approval for Green applications induced by the delegation reform can be attributed to the relatively higher acceptance of projects with more adverse environmental consequences.

5.3 Robustness of Delegation Reform Impacts

Before discussing the mechanisms underlying incomplete delegation, in this section, we discuss the robustness of the results above. We begin by presenting robustness checks for the main effects of delegation. We then show robustness checks for the results showing that more polluting firms are more likely to be accepted after the reform.

If the composition of applications submitted changed in response to the delegation reform, the impact on the probability of acceptance could be due to selection of firms applying for a permit after the reform. We address these concerns about selection effects in several ways. First, in Table A1, we show that observable firm characteristics do not in fact respond to treatment. The firm characteristics that we consider are capital (in 00,000 rupees), land area (in acres), and labor (number of employees).[29] We show that the reported levels of capital, labor, and land for Green applications do not change relative to other applications after the delegation reform. The corresponding event study is reported in Figure A2, and the results are similar to those in Table A1. Furthermore, we check whether the environmental quality of applicants changes after the reform, which would impact the interpretation of results from Table 5 and Figure 3. We rule this out by showing that Green firms applying for permits after the delegation reform do not report different levels of pollution per worker (Table A4, Columns 1-5, and Figure A6). Finally, in Table A5 and Figure A7, we further address selection by showing that our results are similar if we discard industries in which size-based rules affect an industry's color classification.

In Table A1 and Figure A2, we also consider three additional outcomes that shed light on whether other aspects of the regulatory process changed after the delegation reform. The first measure we consider is the inverse hyperbolic sine of the fees charged for the permit, which is a function of capital investment. There is no evidence that the fee charged to Green applications changed. This result implies two things. First, this finding is consistent with the results showing that capital investment did not change on average after the reform, since capital investment is used to calculate these fees within an industry. Second, this result indicates that the processes around fees were not impacted by the reform.

The second measure we consider is whether the application was resubmitted, usually because the officer asked for additional documents in the application. Figure A2 again shows no evidence of a change in the probability of resubmission. This result suggests that Green applications were not subject to additional scrutiny regarding documentation. Third, we show that there is no evidence that the total number of emails rose on Green applications after the delegation reform. The corresponding fixed effects coefficient is -0.034, which is small relative to the baseline mean in Table 2 and not statistically significant.

A different identification challenge would arise if firms selectively delayed submitting applications until after the delegation reform, in order to increase the chance a junior officer reviewed the file. To test that our results are not driven by strategic timing of applications, we show in Table A2 and Figure A3 that our results are largely unchanged discarding applications submitted 30 days before or after July 1, 2019. Treating the num-

[29] In all three cases, winsorizing is at 1% and we use the inverse hyperbolic sine to account for zeroes and the fact that all three underlying measures are highly skewed.

ber of applications in an industry × quarter × district cell as an outcome variable and re-estimating Equation (1) at the industry × quarter × district level, we find no evidence that the number of Green applications received changed relative to other applications after the beginning of the delegation reform (see Table A3 and Figure A4).

Next, we show that our results are robust to alternative specifications. To show that our results are not driven by differential trends by pollution potential, we control for the interaction of the pollution score with a dummy variable denoting post-reform periods in Table A6 and Figure A8. Results are consistent with the main specification. We also report results using several alternative sets of fixed effects. First, in Table A7 and Figure A9, we replace the district and industry fixed effects with district × industry fixed effects. Results are very similar to the baseline. Second, we report a more parsimonious specification that includes only district and quarter fixed effects in Table A8 and Figure A10. Results are again similar to the main results.

We also show that our results are not driven by the comparison of Green applications to a control group that is dissimilar. We remove Red applications from the sample in Table A9 and Figure A11, showing the results are largely unchanged. Discarding all applications with pollution scores of 55 or greater in Table A10 and Figure A12 gives similar results. The same is true if we discard all applications with pollution scores of 25 or lower, this time trimming the least-polluting Green applications, in Table A11 and Figure A13. In Table A12 and Figure A14 we show that clustering by pollution score instead of industry does not impact the significance of our results.[30]

Although only Green applications were affected directly by the delegation reform, it is possible that the increased demands on junior officers and reduced demands on senior officers led to violations of the stable unit treatment value assumption, or SUTVA. First, the fact that discarding applications with the higher pollution scores (greater than 55) does not change our main results indicates that senior officers do not seem to have reallocated effort to high pollution potential applications. To further address this, because SUTVA violations are likely to be greatest in districts that initially had a large share of Green applications, we include the triple interaction of *Green*, *Post*, and *Pre-Reform Percentage of Green Applications*, as well as all double interactions, in Table A13 and Figure A15. While the triple interaction is significant for our delegation outcomes, the magnitude is small and the coefficient on $Green \times Post$ is unchanged. As an alternative check, we create a set of district fixed effects that take the value of 1 if the application is Green and in the same

[30]Due to the unavailability of pollution scores for all industries, we can only estimate this specification for a subset of applications. This limitation accounts for the variations in the magnitudes of the coefficients though they are consistent with the main results.

district, or if it is submitted in any other district and is not Green. This exercise restricts identification to comparison of Green applications from one district to Orange and Red applications from other districts, from which spillovers are unlikely to occur unless an application is escalated to the regional office. Results, in Table A14 and Figure A16, are similar to the main results.

In Figure A17, we show that the unique number of names of junior officers that appear on the files does not increase in the post period. This is consistent with the main results being driven by changes in the allocation of authority, not simply the hiring of new staff. Next, we consider whether missing data impact the main results. In our main sample, nearly 17% of applications do not have any information on industry. For this reason, we are unable to use these applications in our analysis. In Table A15, Column 1, we show that the pattern of industry reporting remains unaltered across color categories after the delegation reform. Within the same table (and in Figure A18), we also present our main results after including observations where industry information is missing, assigning them all the same generic industry – "missing" – for this analysis. The results are the same as our main results. It also shows that the probability an industry is missing is not different for Green industries post-reform.[31] For some industries, we do not have information on their respective pollution scores, which we utilize in our heterogeneity analysis. Table A16 and Figure A19 show that replacing the missing value with the median value of the pollution score within the corresponding color category does not lead to any change in our results.

In the Appendix, we also present robustness checks for the results presented in Table 5. First, as mentioned previously in this section, we rule out the possibility that firms applying for permits after the reform report different levels of pollution (Table A4, Columns 1-5, and Figure A6). Second, we show that this result is not driven by limited availability of pollution data, as the probability of reporting does not change for Green applications after the reform (Table A4, Column 6). Since we do not observe the number of workers for all firms, we show that the magnitude of the effect does not change much if we use imputed values for the number of workers (Table A17, Columns 2-3, and Figure A20).[32] Lastly, in Table A17, Columns 4-6, and Figure A20, we show that results are not driven by splitting data at the median. Green applications with pollution per worker above the 75th percentile are also more likely to be accepted after the reform. The coefficients are

[31] We also confirm that the probability of other important information missing on an application, such as pollution score or number of workers, is not different for Green industries post-reform. These are omitted for brevity, but available upon request.

[32] We impute the number of workers using data on capital investment and land area, while also controlling for industry, district, and firm type.

statistically significant and have similar magnitudes.

6 Mechanisms Underlying the Decision to Delegate

In the previous section, we showed that, although on average the delegation reform led to decision-making authority being allocated to the junior officer, the senior officer still exercises decision-making authority for a significant portion of applications. Furthermore, juniors are more likely to accept firms with worse environmental quality outcomes after the reform. In this section, we provide evidence that, first, applications that are not delegated are due to senior officers withholding decision-making power from junior officers by bypassing them in these decisions, rather than junior officers ceding their authority back to the senior officer. Second, we show evidence that this lack of delegation is driven by caution on the part of the senior officers after the reform. Senior officers retain applications with greater pollution potential. We also construct measures of a senior officer's effectiveness based on willingness to disagree with subordinates' approval recommendations and on past inspection propensity. We show that more effective officers by these measures are less likely to delegate. We outline our conceptual framework and empirically test predictions from our model. Then, we provide empirical evidence against an alternative interpretation based on corruption.

6.1 Conceptual Framework

Here, we outline a conceptual framework based on a simple model that we present in detail in Appendix B. The model comprises a senior and a junior, in which the senior (S) chooses to handle an application herself or delegate it to a junior (J). For either the senior or junior officer, handling an application consists of two steps. First, she (the senior) or he (the junior) can decide whether or not to exert costly effort scrutinizing whether the application is "bad." A bad application in our context would be one that does not comply with regulations, for example violating siting restrictions such as proximity to a school, or engaging in violations not apparent from the application itself but that could be discovered after an inspection. Second, if the deciding officer does not uncover that the application is "bad," he or she approves it. This second step is a simplification, but reflects the institutional role of the regulatory authority, which is to ensure that firms submit required documentation and are in compliance with the rules (for instance, around zoning and keeping pollution below permitted thresholds).

"Bad" applications are a proportion b of all applications, and there is a cost X to the senior if one is accepted. For the junior, this cost is Z. We interpret these costs as outcomes such as negative press, complaints, loss of reputation, and reduced future possibilities of promotion. If the senior exerts effort scrutinizing an application at a cost of c, she will discover it is bad with probability p. We interpret c broadly as a mix of effort costs and opportunity costs. p, similarly, reflects factors such as ability, contextual knowledge, the performance of the subordinate officers tasked with inspections, and the quality of the relationship the senior has with these subordinate officers. If the senior delegates, the cost of effort scrutinizing an application for the junior is k and the discovery probability is q.

Solving this simple model by backwards induction, we show that whether an application is delegated will depend on the parameters b, X, Z, c, p, k, and q. All else equal, the senior will prefer to delegate applications with higher Z and lower X – applications for which the costs of mistakenly accepting a bad application are high for the junior and low for the senior. The senior will also prefer to delegate applications with lower k and higher q – those for which the junior has a low cost of effort and a high probability of detecting bad applications. By contrast, the senior will prefer to delegate those for which her own effort costs are higher and her own detection probabilities are lower – those with higher c and lower p.

The prevalence of bad applications, b, plays a more ambiguous role. If the junior's costs of effort are high and his discovery probability is low, then a greater prevalence of bad applications will make the senior more wary of delegation, as he knows the junior will not exert effort detecting these applications. By contrast, if the junior's costs of effort are low and his discovery probability is high, an increased prevalence of bad applications can induce the junior to exert effort for applications he would not have scrutinized previously. This can increase delegation.

Below, we will focus on empirical proxies for three of the main parameters. First, we treat pollution score as a proxy for costs of a wrongful approval to the senior (X). As a measure of seniors with a higher probability of detecting bad applications (higher p), we will use the rate at which the senior overruled subordinate's recommendation to approve an application in the pre-reform period. Furthermore, we will use the time-varying workload of the senior officer as a measure of the senior's effort costs c. We will additionally use a senior-subordinate pair's propensity to inspect applications during the pre-reform period as an alternative proxy for higher levels of p.

6.2 Results: Lack of Delegation Due to Senior Withholding Authority or Junior Ceding It?

As shown in Section 5.1, while delegation is followed on average, it is incomplete in that roughly one third of applications are not delegated. This raises the question of whether the lack of delegation is due to senior officers choosing not to delegate to junior officers, or junior officers yielding their decision rights to the senior officers. This distinction helps us understand the mechanisms underpinning the lack of delegation. If junior officers are included on the communication chain for an application but the final decision is made by a senior officer, it could reflect juniors seeking the advice or approval of seniors, or it could be consistent with senior officers consulting juniors and approving their recommendations. Failure to include juniors on the communication chain altogether, by contrast, suggests that failure to delegate is the choice of the senior officer, a decision not made in conjunction with the junior officer.

To test between these possibilities, we split the binary variable that indicates if the application was decided at a level above the officer with closing authority into two outcomes. The first is an indicator variable for whether the application is decided by an officer above the officer with closing authority, but the junior is included on at least one email in the application. The second is whether the application is decided by an officer above the officer with closing authority and the junior is excluded from all emails in the application. We show results using these variables in Table 6 and Figure 4. The probability that an application is decided above the officer with decision rights and the junior officer is bypassed increases by nearly 23 p.p. On the other hand, the probability that an application is decided above the officer with decision rights and the junior officer is not bypassed increases by only 7 p.p.. These results indicate that bypassing junior officers by senior officers explains a much larger proportion, about 80%, of the lack of delegation. Incomplete delegation, then, is largely a decision made by senior officers to withhold authority from the junior officers, and not an outcome of consultation between junior and senior officers or the junior officer ceding their authority.

6.3 Testing Model Implications in the Data

In this section, we test the main implications of the model, which posits that application and officer characteristics both determine whether the senior chooses to delegate.

6.3.1 Applications with higher X (costs of wrongful approval to the senior) are less likely to be delegated

Because the pollution score on an application is an industry-specific measure of how much environmental damage an applicant may potentially cause, we treat this as a proxy for X. In Figure A21, we present two stylized facts consistent with our interpretation that senior officers treat applications with greater pollution potential as having worse consequences (X) if they are wrongfully approved. Each panel is a binscatter plot showing the mean of a given variable for each level of the discrete pollution score that we observe. First, the effort expended scrutinizing an application as measured by the number of emails attached to the application is rising in pollution score. Second, applications with higher pollution scores are more likely to be inspected. Both patterns suggest that applications with higher pollution scores involve more effort.

In Column 1 of Table 7, we present heterogeneous effects by pollution score, with the corresponding event study presented in Figure 5 (Panel (a)). We define the above median pollution score within each color code. In line with the model, we find Green applications with relatively higher pollution scores are less likely to be delegated by 13.5 percentage points after the reform, which is a substantial proportion of the lack of delegation (25 percent). Results from the event study similarly show the differences in post-reform delegation between high and low pollution scores, with greater delegation for lower scores.

6.3.2 Senior officers with high p (detection probabilities) delegate less

In order to measure whether a senior officer has a higher detection probability p, we measure disagreement between seniors and subordinates in the pre-reform period in cases where the subordinate officer had recommended an application be approved. In particular, we code this disagreement at the level of the senior-subordinate pair. We use senior-subordinate pairs in this estimation because there is heterogeneity in subordinate officer quality, and this allows us to use senior officer fixed effects in the estimation as an additional robustness check. We have about 120 senior-subordinate pairs which we use in the estimation.

We begin by using the texts of emails sent by subordinates in the pre-reform period in order to identify cases in which the subordinate had recommended an application be approved. Based on a reading of several hundred emails, we identify a large number of regular expressions that we use to identify these approval recommendations in the full sample.[33] Next, we pinpoint cases where the senior disagreed with this recommenda-

[33] For the list of regular expressions used, please refer to Appendix B.5.

tion. We identify disagreement if, after the subordinate's recommendation for approval, the application is not approved in the next three emails or the application is resubmitted, closed after refusal, returned to the applicant, or if the firm is given a "show cause" notification, i.e. a request for more information. Because of the linguistic subtlety of this exercise, we cannot use the Malayalam-language emails for this coding and so lose some of the sample (around 16% of the applications).

In Column 2 of Table 7, we present heterogeneous effects by disagreement, with the corresponding event study presented in Figure 5 (Panel (b)). We define disagreement at the senior-subordinate pair level. As the model predicts, we find Green applications with relatively higher disagreement are less likely to be delegated by 8.7 percentage points after the reform, a large fraction relative to mean delegation. Results from the event study similarly show a pattern of lower delegation by more effective senior officers. In Table A18, we show that the results are very similar if we use only within-senior variation. In Column 1, we add the interaction of senior officer fixed effects with a "Post" dummy, while in Column 2, we add the interaction of these senior officer fixed effects with quarter fixed effects. The results are consistent with the main effects.

We also consider an alternative measure of the detection probability p of each senior-subordinate pair of officers, which is whether they conduct inspections for applications that should, according to the rules, be inspected before approval. We use written inspection protocols to create measures of the expected inspection probability of each application.[34] These pre-existing rules are a function of the industry-level color code and capital investment.[35] In the pre-reform time period, nearly 31.5% of applications underwent a site inspection, with the percentage for Green applications being approximately 21.7%. We compare this predicted inspection probability with actual inspection to classify each application by whether it is "under-inspected." An application that is not inspected despite a predicted inspection probability of 50% or higher is "under-inspected." We expect

[34]As explained in footnote 26, we measure inspections by identifying strings within the email text that indicate the occurrence of an inspection, such as "inspection took place" or "inspection was conducted." These particular strings were derived from a manual review of several hundred randomly selected applications. A complete list of these phrases is available in Appendix C.

[35]Officers are required to inspect certain firms that submit applications for a permit (see circular PCB/HO/Circular-01/30/2017/C on KPCB website). The guidelines for inspection state clear rules that depend on the following characteristics: a) permit type, b) whether the application is for a new permit or for a renewal, c) pollution category (red/orange/green) and d) capital investment (i.e. whether the total capital investment is under 1 million Indian rupees). We use these four variables to predict inspection probability. We compute these predicted probabilities for all the applications and then assess under-inspection by comparing these predicted probabilities with our inspection measure. Lastly, we calculate the average occurrence of under-inspection for all the pairs of subordinate and senior officers using only data from Orange and Red applications. We excluded Green applications in the last step because the model predicts that none of the Green applications should be under inspection during the pre-reform period.

that officers that are more likely to "under-inspect" are less effective, and have a lower probability of detecting a bad application (p). In our model, these officers are more likely to delegate.[36]

The results are presented in Table A19. In line with our model predictions, we find that seniors with in senior-subordinate pairs who are more likely to under-inspect pre-reform are also more likely to delegate. Teams who under-inspect Red applications are 10.9 p.p. more likely to delegate post-reform, and those who under-inspect Orange and Red applications are 5.3 p.p. more likely to delegate.

6.3.3 Officers with higher c (cost of effort) delegate more

We estimate senior officers' current bandwidth using data on application submission dates. We calculate the number of applications that have reached a senior officer's desk within the previous 120 days. The 120 day threshold is relevant because the rules stipulate that all applications must be processed within this time frame.[37] A large number of pending applications would increase the marginal cost of effort for the senior officer (c) which, according to the model, would lead to more delegation. We present results in Figure 6 and Column 3 of Table 7. In line with the model, we find that officers that have an above-median level of applications in the past 120 days delegate more. Officers with lower bandwidth are 8.4 p.p. more likely to delegate after the reform.

6.3.4 Alternative Mechanism: Corruption

A possible alternative explanation of our results would be grounded in corruption – namely, if a senior officer were extracting rents from her position, she would be less willing to relinquish this source of additional income to the junior, and hence be less willing to delegate. We begin by noting that a corruption explanation is not consistent *per se* with the fact that pre-baseline overruling the subordinate's recommendations for approval predicts lower delegation, nor with the fact that lower bandwidth times are times of greater delegation.

We further present two additional pieces of evidence that are contrary to this interpretation of our results. First, we show that delegation is not lower for capital-intensive applications, i.e. those for which there should be the greatest rents to extract. In Table

[36]An alternative interpretation, that under-inspection measures greater cost of effort (c), gives the same prediction.

[37]This information can be found in the Standard Operating Procedure Document available on the Kerala Pollution Control Board's website at the following URL `https://krocmms.nic.in/KSPCB/SPCB_DOCUMENTS/SOP_Final.pdf`

8 and Figure 7, Panel (a), we show results of estimating Equation (1) while splitting the sample at the within-color median of capital investment. The event study shows that there is no difference in delegation for the high capital investment and low capital investment sub-samples. Regression results are presented in Column 1 of Table 8, and show that, if anything, applications with greater capital investment were *more* likely to be delegated – the point estimate shows applications from firms with above-median capital are 3 p.p. more likely to be delegated but the coefficient is not statistically significantly different from zero. This finding is inconsistent with an explanation based on corruption, but is consistent with the conceptual framework. Greater capital intensity is likely to increase the inspection costs c and k of both the senior and junior officers, because the rules stipulating whether a firm needs to be inspected are partially a function of capital investment. These rising costs lead to offsetting effects on delegation that could be positive on balance.

Second, we split the sample by the prevalence of corruption in a district, measured as the number of political candidates per capita with declared criminal cases. We obtain the number of political candidates in each district with declared criminal cases according to National Election Watch's Myneta database.[38] These data are recorded for four election cycles – 2006, 2011, 2016 and 2021. We sum over the number of cases in these elections to obtain a total count for each district. Across the districts in the data, the number of cases recorded varies from 85 to 668, with a mean of 318.

To convert these numbers into per capita rates, we divide the number of cases by the population of the district recorded in the 2011 census. This measure of corruption cases per 100,000 persons varies from 4.2 in Malappuram to 26.3 in Pathanamthitta, with a mean of 14.2. Since Eloor is treated as a district by the Pollution Control Board, but not by the census, we match it to the rate of corruption cases in Ernakulam, the district that contains it. For interpretability, we convert this per capita measure to a standard N(0,1) variable that we call "cases."

Since this measure is defined at the district level, we make the split by the state-level median. Results are presented in Column 2 of Table 8, with the corresponding event study shown in Figure 7. These estimates show no evidence of either greater or lesser delegation in more corrupt districts, in either the event study or the regression results.

[38] `https://myneta.info/`. Myneta is an open data platform run by the Association for Democratic Reforms (ADR). Founded in 1999, the ADR engaged in public interest litigation that resulted in the Supreme Court mandate that, from 2003, all election candidates were to file affidavits with the Election Commission that contain information on the criminal cases against them.

6.3.5 Joint Test of Heterogeneity in the Decision to Delegate

In Table 9, we presents results from a specification that includes all interactions of heterogeneity variables from Section 6.3 (and corresponding double interactions and controls), to test whether each of these explanations has separate explanatory power for the delegation decision. The first two columns show that all the heterogeneous effects presented in this section are of the same sign as well as similar magnitude in this omnibus specification. The coefficient on pollution score is, however, now only significant at conventional levels in some specifications. In Column 3, we additionally control for heterogeneous effects by capital investment and the result is similar. In the last column, we add controls for heterogeneous effects by district-level corruption cases, and find similar results as in the other specifications.

As an additional robustness check, we report p-values adjusted for multiple hypotheses testing for both Tables 7 and 9 in Table A20. For each table, we report four sets of p-values. The first is a set of bootstrap-based unadjusted p-values. The second is adjusted p-values based on Theorem 3.1 in List, Shaikh and Xu (2019). The third is the classic Bonferroni adjustment. The fourth is from Holm (1979). Any unadjusted result that was significant at the 5% level previously remains significant at the 5% level after adjustment.[39]

7 Conclusion

Our findings show that the allocation of authority to junior officers regarding granting of environmental permits has important implications for whether firms are allowed to enter the market. Moreover, we find that this authority is retained by senior officers for riskier applications, and by officers with greater propensities for overruling subordinates' approval recommendations. This endogenously creates a knowledge hierarchy that allocate decision rights to junior officers in partial non-compliance with the rules. Our specific context is important, with decision rights having impacted outcomes for over 50,000 firms during our study time period alone.

More broadly, our results shed light on how agents within organizations interpret rules, delegate or withhold power, and solve problems, determining organizational outcomes and efficacy. These results can help us understand differences in *de jure* vs. *de facto* implementation of rules and regulations, as well as the mechanisms underlying the differences between them.

[39]We use the $mhtreg$ package provided by Barsbai et al. (2020).

While the data we use are very detailed, they do not allow us to test whether, in the long term, senior officers teach junior officers how to handle applications, increasing delegation in the long run. Furthermore, the nature of the data we use makes it difficult to track the same firm over time, and data limitations prevent us from examining whether the marginal firm that is approved by the junior officer has differential productivity. These, as well as questions related to understanding whether similar differences in the implementation of rules have differential productivity implications for private sector organizations, remain interesting issues for future research.

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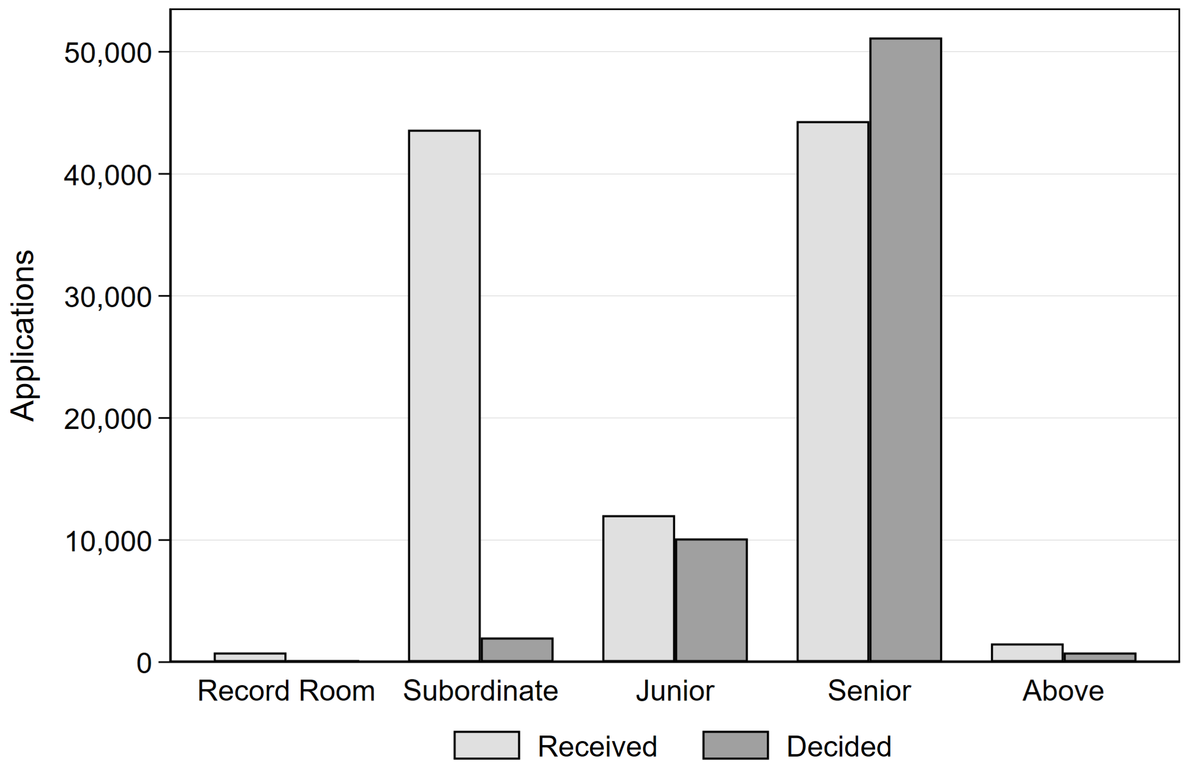
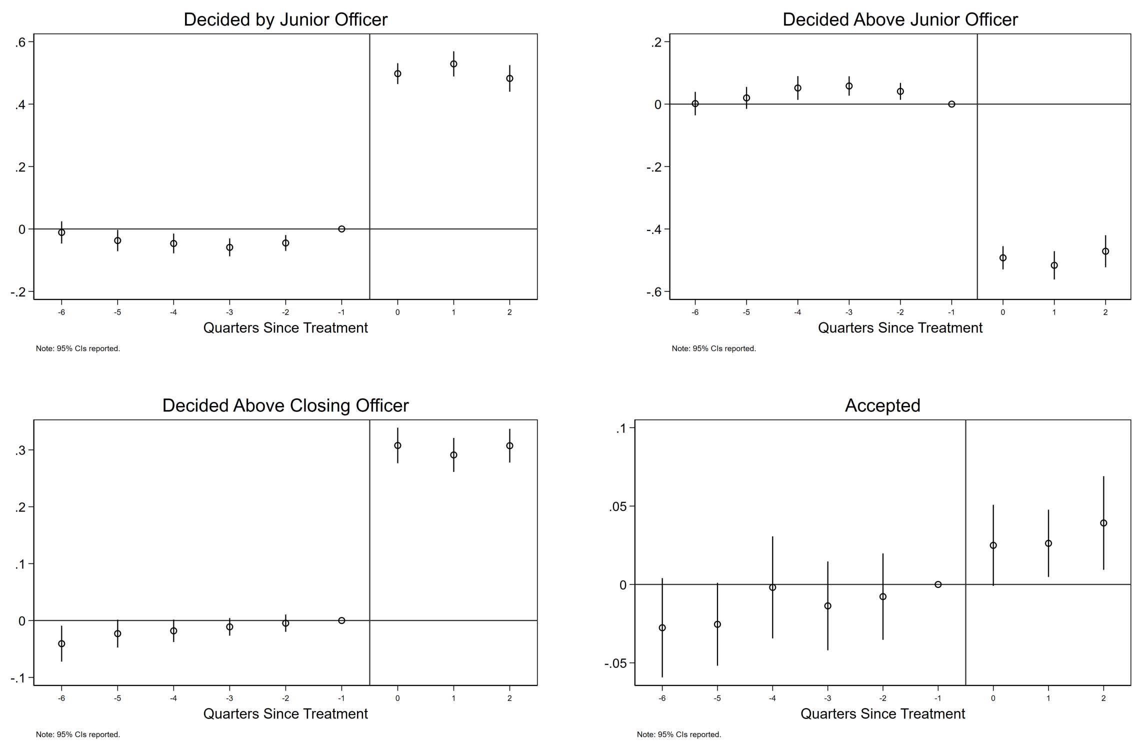
Figure 1: Number of Applications Handled and Closed by Each Rank



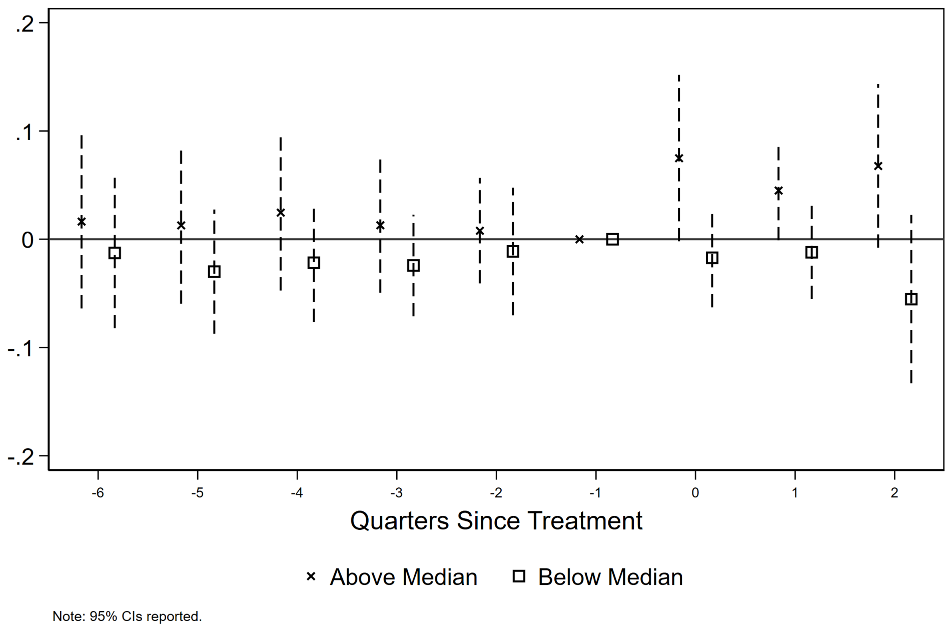
Notes: This figure uses data from the pre-reform period and plots number of applications received and decided by each rank. Subordinate is "Assistant Engineer," Junior is "Assistant Environmental Engineer," and Senior is "Environmental Engineer." The "Above" category includes officers who hold higher ranks than "Environmental Engineer," such as "Chairman," "Chief Environmental Engineer," and "Member Secretary."

Figure 2: Event Studies – Impact on Decision Rights and Acceptance Probability



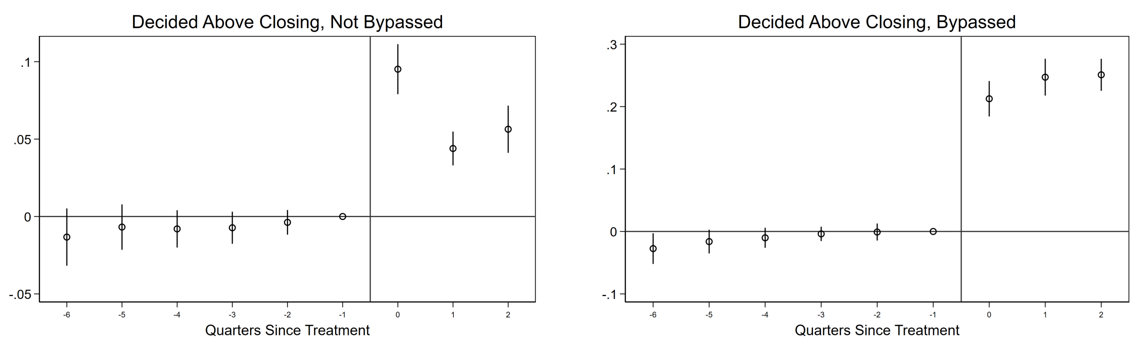
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. All the variables presented in this figure are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry. See Section 5 for details.

Figure 3: Decision Quality: Heterogeneity by Pollution



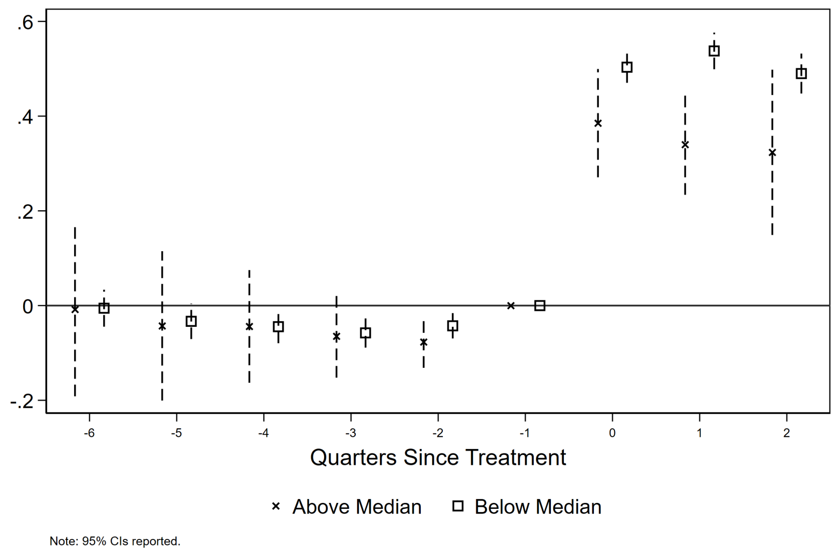
Notes: This figure presents coefficient estimates and 95% confidence intervals of equation (1) with acceptance as the outcome variable. The specification includes a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. "Above Median" is equal to 1 for those applications where pollution per worker is above the pre-reform industry median, and zero otherwise. See Section 5 for details.

Figure 4: Event Studies: Whether Junior Officer Bypassed

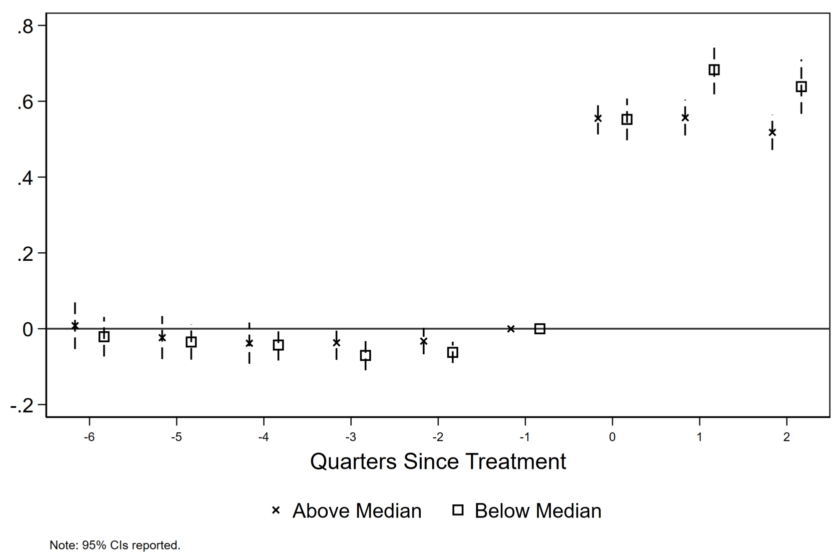


Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. "Junior" refers to the "Assistant Environmental Engineer" position. In this context, "bypass" refers to the situation where the junior officer is absent from the entire email chain. See Section 6 for details.

Figure 5: Event Studies: Heterogeneity by Application Type



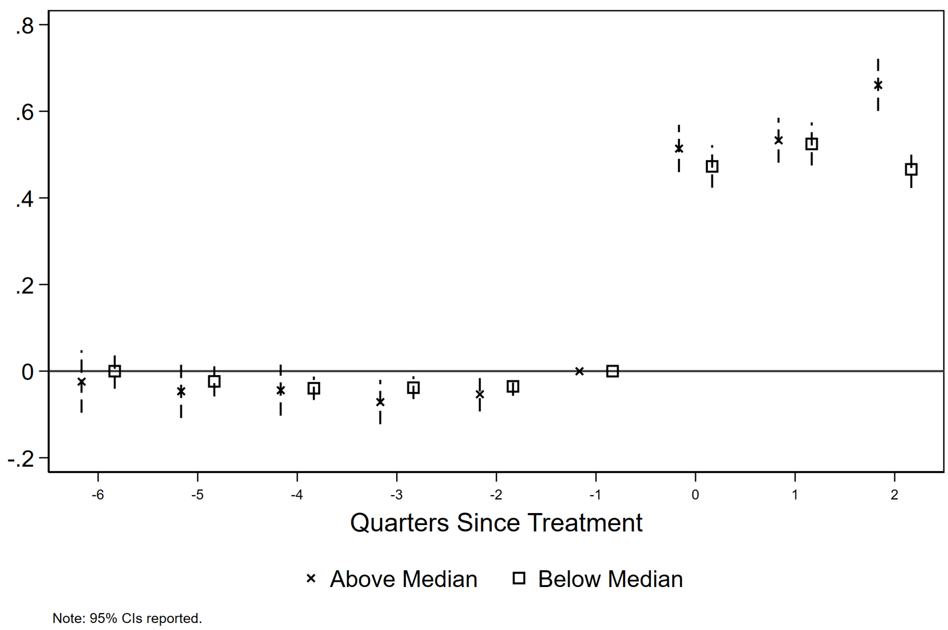
(a) Heterogeneity by Pollution Score



(b) Heterogeneity by Disagreement

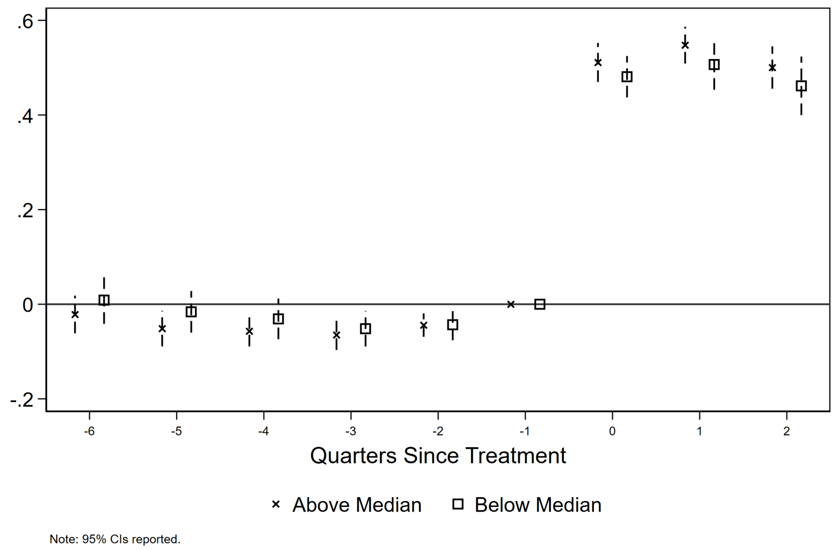
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. The outcome variable is whether the application was decided by a junior officer. 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. See Section 6 for details.

Figure 6: Event Studies: Heterogeneity by Bandwidth

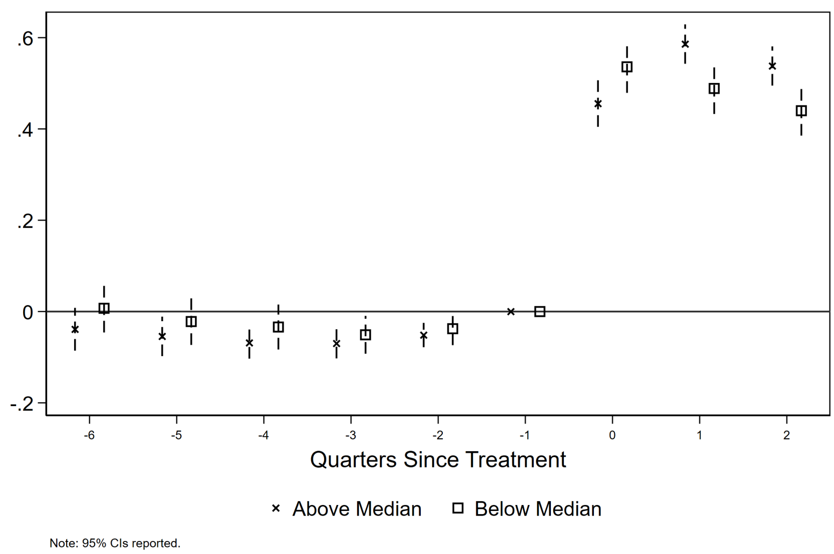


Notes: The figure presents coefficient estimates and 95% confidence intervals of equation (1). The outcome variable is whether the application was decided by a junior officer. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, 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. "Above Median" is equal to 1 if these applications are above the overall median, and zero otherwise. We also utilize data from before 2018 to calculate these measures for the initial quarters in our sample. See Section 6 for details.

Figure 7: Event Studies: Corruption as an Alternative Mechanism



(a) Heterogeneity by Capital Investment



(b) Heterogeneity by Corruption Cases

Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals from equation (1). The outcome variable is whether the application was decided by a junior officer. 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. See Section 6 for details.

Table 1: Expected Regulatory Burden by Pollution Category

	Red	*Orange*	*Green*
Usual Processing Time	30-45 days	30 days	30 days
Inspection Frequency	6 months	1 year	2 years
Location Restriction	Not Permitted in Ecologically Fragile / Protected Area	No industry-wide restriction	No industry-wide restriction
Maximum CTO Validity	5 years	10 years	15 years
Number of Documents required	13-24	12	12
Permit Fee	INR 900-2,400,000	INR 600-1,800,000	INR 600-1,200,000

Notes: The information on processing time and number of documents required is taken from the Tamil Nadu Pollution Control Board's website. Location restrictions were mentioned in a press release listed by the Press Information Bureau. The fee structure is from the Punjab Pollution Control Board's website and Inspection Frequency is from the Central Pollution Control Board's 2019 Inspection Policy document. The information on CTO validity is taken from the Kerala Pollution Control Board's website.

Table 2: 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	0.239	0.426	0	1	35569
Winsorized IHS Time to Decision	4.151	1.423	0	6.99	35673
Decided Above Closing, Not Bypassed	0.00366	0.0604	0	1	34965
Decided Above Closing, Bypassed	0.00157	0.0396	0	1	34965
Submission Quarter	22.30	1.730	20	25	35723
Number of Emails	8.709	6.044	1	130	35723
IHS of Fee Paid	5.560	5.020	0	19.8	35722
Resubmitted	0.373	0.484	0	1	35723
Winsorized IHS Capital	2.954	1.638	0.73	9.21	35723
Winsorized IHS Labor	1.910	1.006	0.88	5.63	23487
Winsorized IHS Land	0.479	0.684	0.00100	3.42	32427
$\mathbb{1}\{$Industry Type has a Split$\}$	0.128	0.335	0	1	35723
Industry Total Pollution Score	35.16	15.13	25	95	28588

Notes: Summary statistics are for the pre-reform period. In Panel A, all variables are based on the application data, except for 'Decided by Junior Officer,' 'Decided Above Junior Officer,' 'Decided Above Closing Officer,' and 'Inspected,' which are extracted from the Note History data. Additionally, 'Pollution Score' and 'Whether Industry has a split' are industry-level variables determined by matching the industry information provided in the application with the Pollution Control Board's industry listing.

Table 3: Impact of *de jure* Allocation of Authority on *de facto* Decision Rights

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing
Green × Post	0.542***	-0.533***	0.300***
	(0.015)	(0.017)	(0.013)
Observations	53026	53026	52118
Pre-Delegation Mean	0.023	0.947	0.005

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table 4: Impact on Firms' Regulatory Burden and Outcomes

	(1) Accepted	(2) Inspected	(3) Winsorized IHS Time to Decison
Green × Post	0.029***	-0.010	0.001
	(0.009)	(0.027)	(0.069)
Observations	52910	52897	52960
Pre-Delegation Mean	0.947	0.239	4.150

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. The "Inspected" dummy variable is set to 1 when the email text explicitly indicates that an inspection occurred. Time to decision represents the number of days between the application submission date and the final decision date. We winsorize this variable at 1%.

Table 5: Heterogeneity by Pollution Per Worker

	Accepted		
	(1)	(2)	(3)
Green × Post × Above Median	0.043*		0.029*
	(0.024)		(0.016)
Green × Post	0.004	0.014	0.011
	(0.016)	(0.014)	(0.014)
Post × Above Median	-0.023		-0.025**
	(0.019)		(0.012)
Green × Above Median	-0.008		-0.019*
	(0.009)		(0.010)
Above Median	-0.001		0.006
	(0.007)		(0.007)
Green × Post × Above 75th Percentile		0.049**	
		(0.024)	
Post × Above 75th Percentile		-0.033**	
		(0.015)	
Green × Above 75th Percentile		-0.006	
		(0.014)	
Above 75th Percentile		0.006	
		(0.010)	
Observations	12581	12581	19134
Pre-Delegation Mean	0.959	0.959	0.947
Pollution Measure	Pollution per Worker	Pollution per Worker	Total Discharge

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. This table presents coefficient estimates of equation (1) with acceptance as the outcome variable. In Column (1) and (3) "Above Median" is equal to 1 for those applications where pollution measure is above the pre-reform industry median, and zero otherwise. In Column (2), "Above 75th Percentile" is equal to 1 for those application where pollution measure is above the 75th percentile of an industry, and zero otherwise. In Column (1) and (2), Pollution refers to total waste water discharge. The variation in the number of observations between the first two columns and the last column is because of missing data in the "number of workers" variable. See Section 5 for details.

Table 6: Delegation: Bypassing Junior Officers

	(1) Decided Above Closing Not Bypassed	(2) Decided Above Closing Bypassed
Green × Post	0.070***	0.230***
	(0.006)	(0.012)
Observations	52118	52118
Pre-Delegation Mean	0.004	0.002

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. "Junior" refers to the "Assistant Environmental Engineer" position. In this context, "bypass" refers to the situation where the junior officer is absent from the entire email chain. See Section 6 for details.

Table 7: Heterogeneity by Application and Officer Characteristics

	Decided by Junior		
	(1)	(2)	(3)
Green × Post × Heterogeneity Measure	-0.135***	-0.087***	0.084***
	(0.030)	(0.016)	(0.022)
Green × Post	0.570***	0.663***	0.509***
	(0.017)	(0.018)	(0.018)
Post × Heterogeneity Measure	0.019	0.031***	0.019*
	(0.014)	(0.006)	(0.011)
Green × Heterogeneity Measure	0.124***	0.026***	0.019***
	(0.035)	(0.005)	(0.006)
Heterogeneity Measure	-0.055*	0.003	-0.053***
	(0.031)	(0.005)	(0.008)
Observations	41447	44554	53026
Pre-Delegation Mean	0.021	0.024	0.023
Heterogeneity Measure	Pollution Score	Disagreement	Submissions

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. The outcome variable is whether the application was decided by a junior officer. In Column (1), "Heterogeneity Measure" is "Above Median Pollution Score" where "Above Median" means industries whose pollution score exceeds the median score within their respective categories. In Column (2), "Heterogeneity Measure" is a dummy variable that equals 1 for senior-subordinate pairs with above-median levels of disagreement in the pre-reform period. In Column (3), we use the number of submissions as a heterogeneity measure. 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. "Above Median Submission" is equal to 1 if these applications are above the overall median, and zero otherwise. We also utilize data from before 2018 to calculate these measures for the initial quarters in our sample. See Section 6 for details.

Table 8: Heterogeneity: Corruption as an Alternative Mechanism

	Decided by Junior	
	(1)	(2)
Green × Post × Heterogeneity Measure	0.029	0.001
	(0.021)	(0.019)
Green × Post	0.528***	0.541***
	(0.021)	(0.020)
Post × Heterogeneity Measure	-0.009	0.023**
	(0.009)	(0.010)
Green × Heterogeneity Measure	-0.000	-0.037***
	(0.007)	(0.009)
Heterogeneity Measure	-0.005	
	(0.005)	
Observations	53026	53026
Pre-Delegation Mean	0.023	0.023
Heterogeneity Measure	Capital Investment	Corruption Cases

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. In Column (1), "Above Median Capital Investment" is equal to 1 for applications with total capital investments exceeding the median within their respective categories. In Column (2), "Above Median Corruption Cases" is equal to 1 for districts that had more cases of political candidates per capita with declared criminal cases than the overall median.

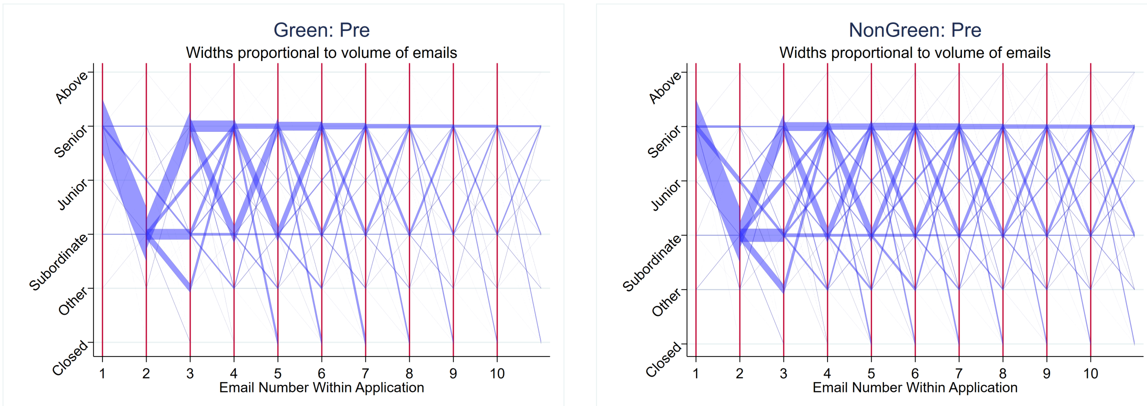
Table 9: Heterogeneity by Application and Officer Characteristics – Combined Specification

	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

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. "Pollution Score" is a dummy for an above-median pollution score, equal to 1 for industries whose pollution score exceeds the median score within their respective categories. "Disagreement" is determined by comparing subordinates' recommendations to approve an application with seniors' decision to not approve an application. The disagreement measure is then averaged over the pre-reform period for each senior-subordinate pair. The measure in this table is in a binary form and equal to 1 if the average is above the overall median. "Submissions" is equal to 1 if these applications are above the overall median, and zero otherwise. In Column (3), we include interaction with "Above Median Capital Investment" which is equal to 1 for applications with total capital investments exceeding the median within their respective categories. In Column (4), we also include interactions with "Above Median Corruption Cases" which is equal to 1 for districts that had more cases of political candidates per capita with declared criminal cases than the overall median.

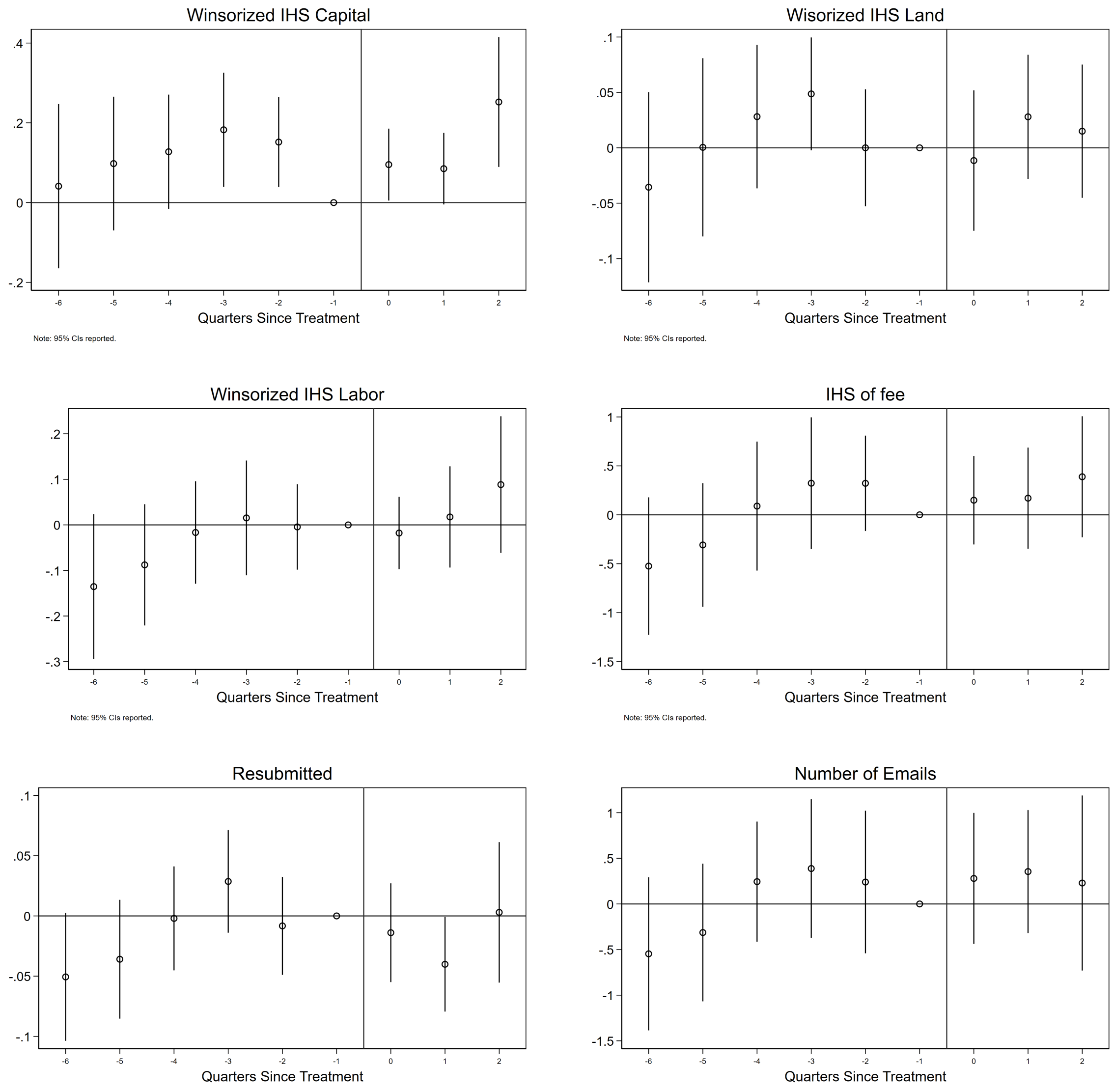
A Appendix Figures and Tables

Figure A1: Pre-reform flow of communication



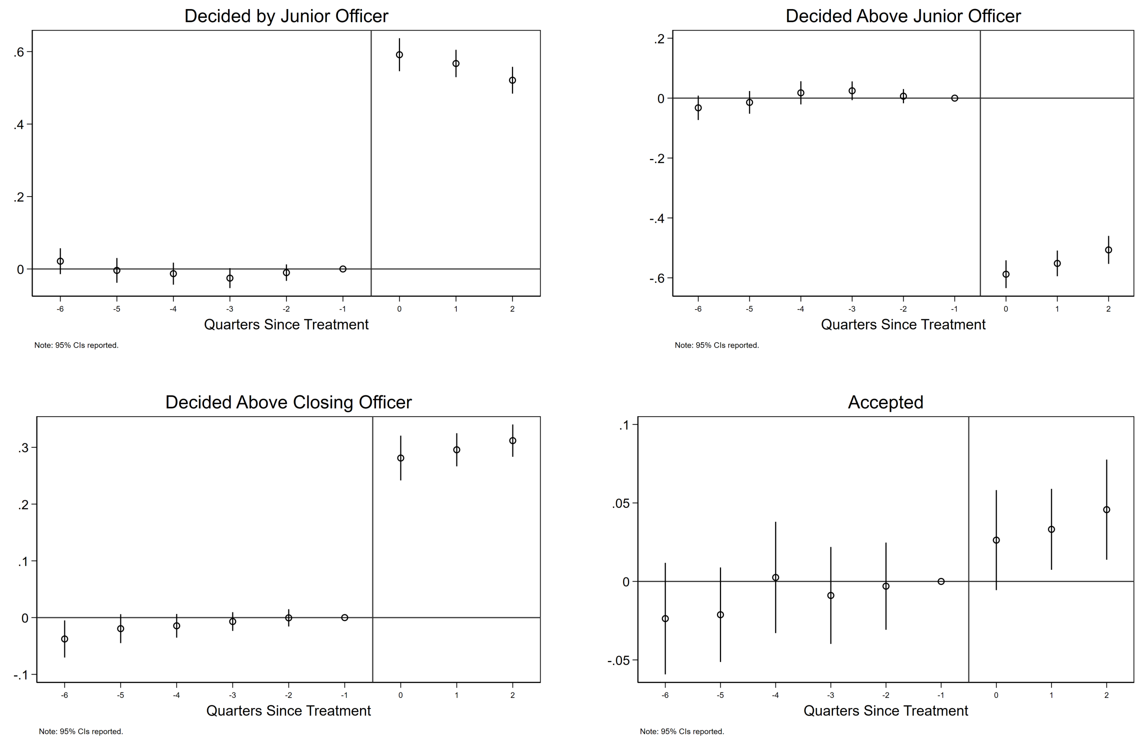
Notes: In each figure, the y axis represents an officer rank, or whether the application is closed. The x axis represents the number of an email on an application. The width of a line is probational to the number of emails. See section 3.1.1 for details. Subordinate is "Assistant Engineer," Junior is "Assistant Environmental Engineer," and Senior is "Environmental Engineer." The "Above" category includes officers who hold higher ranks than "Environmental Engineer," such as "Chairman," "Chief Environmental Engineer," and "Member Secretary." On the y-axis we have Sender/Receiver.

Figure A2: Robustness: Application characteristics



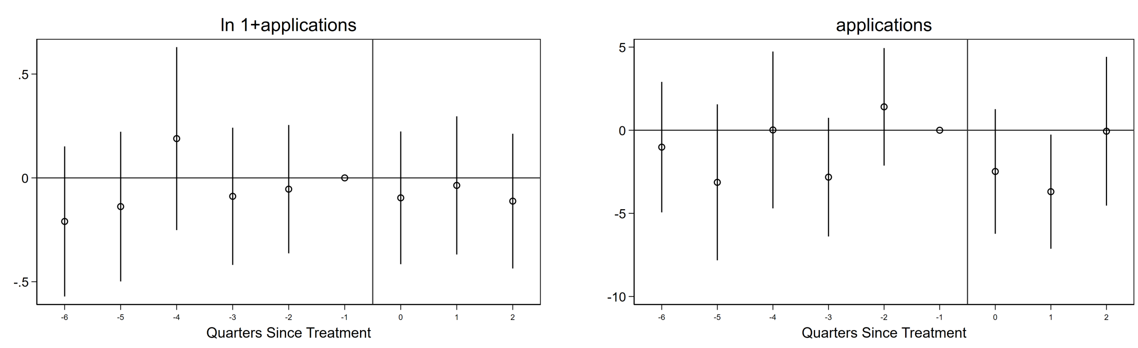
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. We winsorize capital investment, land area, and number of workers at 1%. Apart from “Resubmitted” and “Number of Emails,” all other variables were taken from the application data. The variable “Resubmitted” is a dummy variable and takes the value of 1 if a firm resubmits the application using the same application ID.

Figure A3: Robustness: Drop applications within 30 days of policy



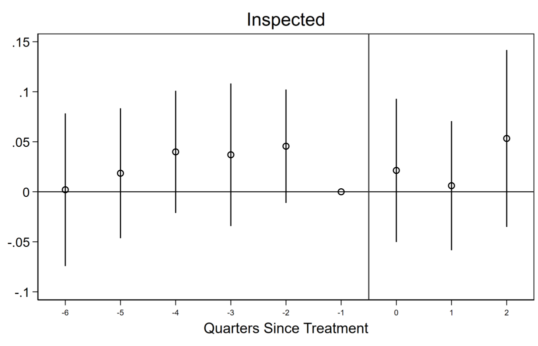
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. See Section 5.3 for details. Applications submitted within 30 days of July 1, 2019, have been discarded. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

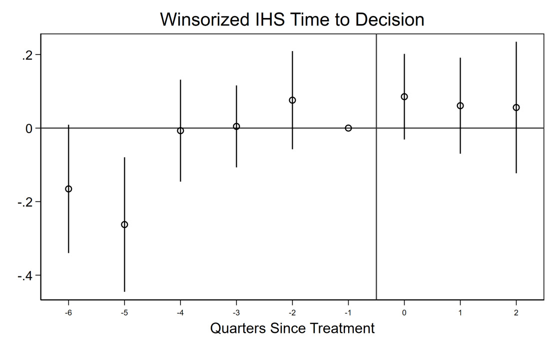
Figure A4: Robustness: Number of Green Applications



Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. Outcome variables are given in sub-figure titles. We aggregate the data at the district-industry-quarter level and count the number of Green applications.

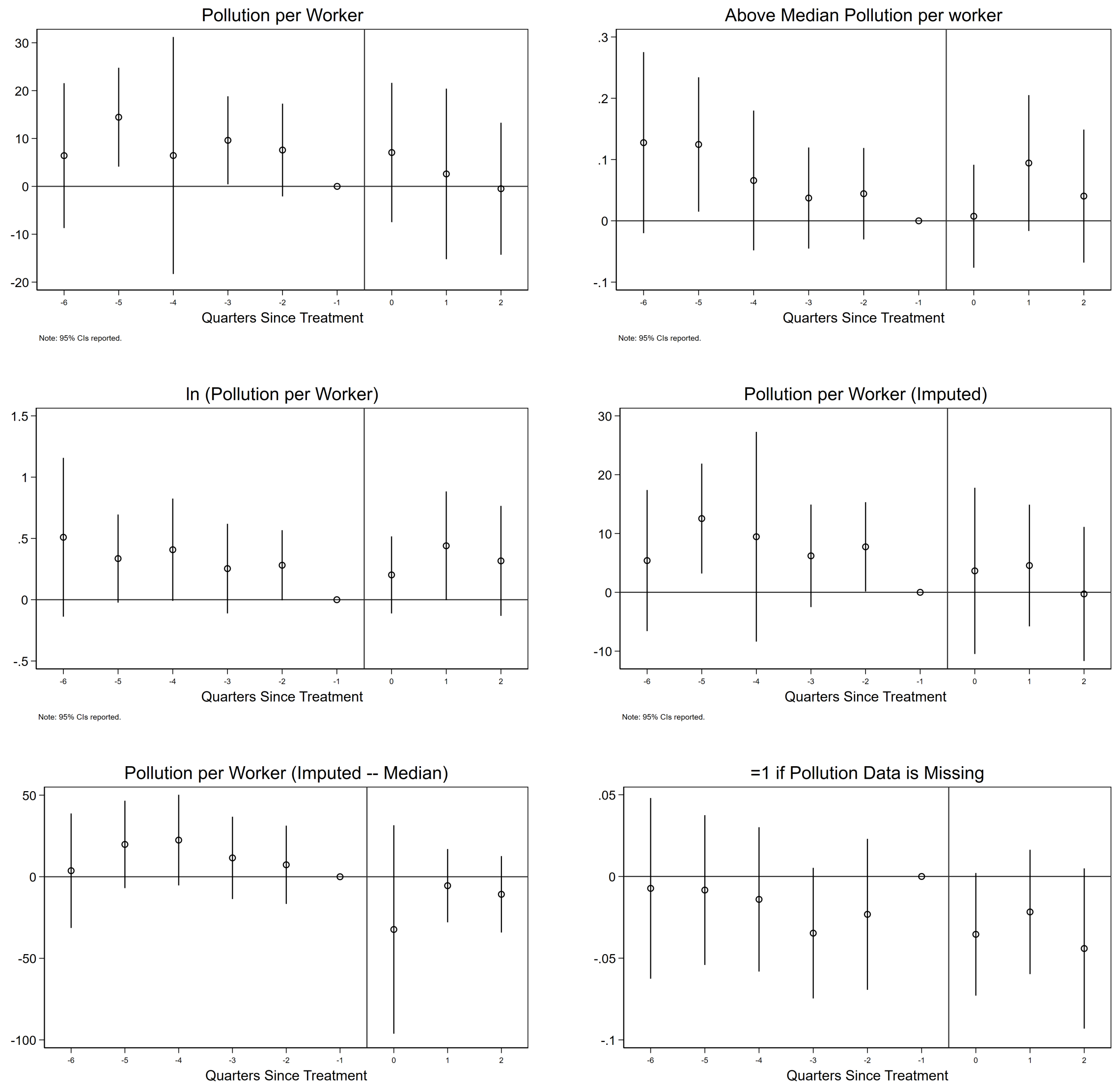
Figure A5: Event Studies – Impact on Firm's Regulatory Burden





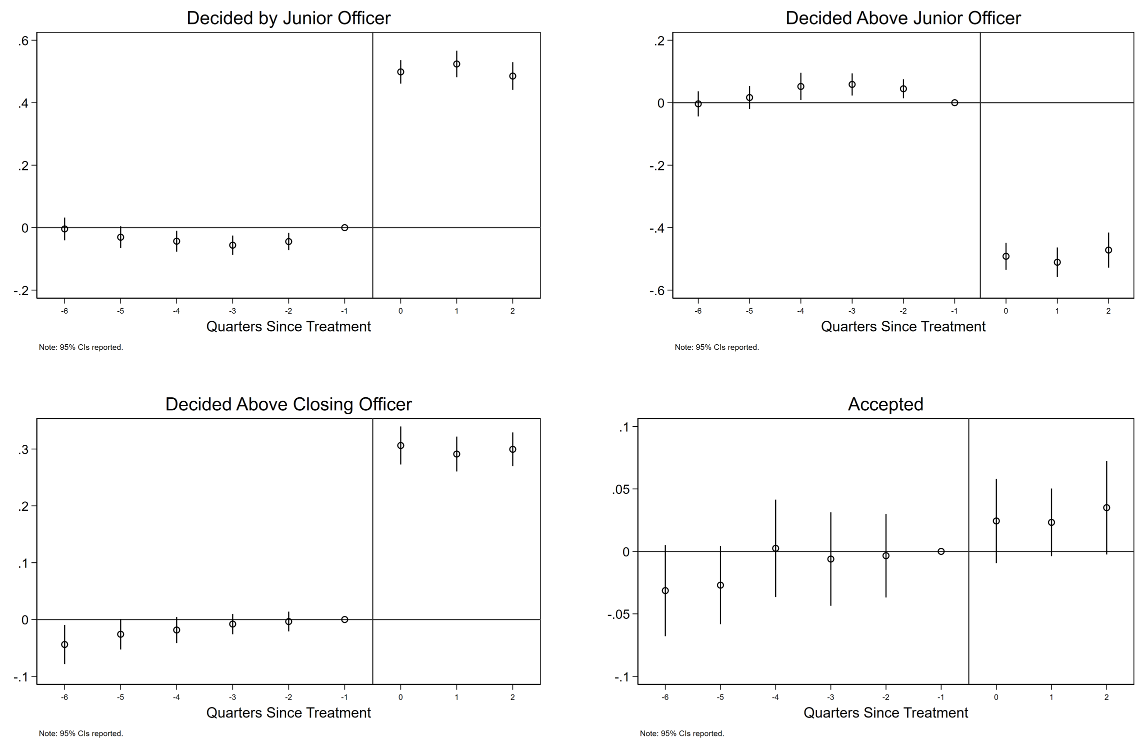
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of Equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. The "Inspected" dummy variable is set to 1 when the email text explicitly indicates that an inspection occurred. Time to decision represents the number of days between the application submission date and the final decision date. We winsorize this variable at 1%. See Section 5 for details.

Figure A6: Robustness: Type of Firm Applying for Permit Does not Change – Pollution Outcomes



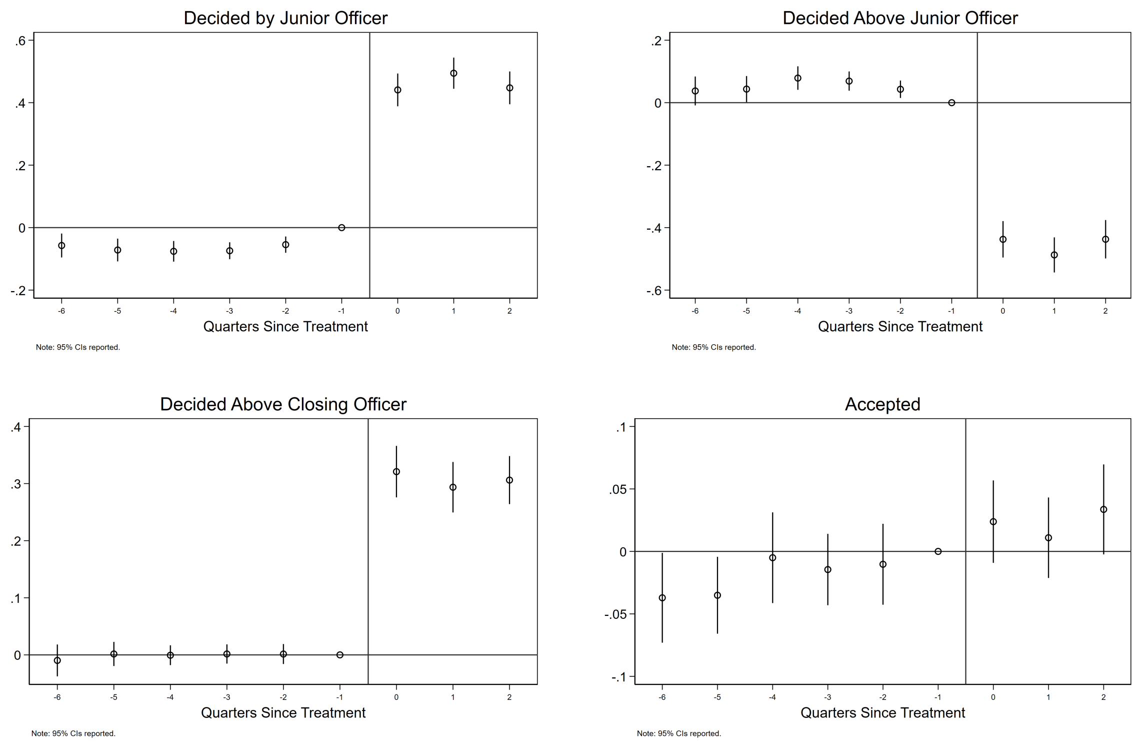
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. Pollution refers to total waste water discharge. In sub figure "Pollution per Worker (Imputed)," we estimate the number of workers for applications with missing data by employing a predictive model that utilizes information regarding capital investment and total land area. In sub figure "Pollution per Worker (Imputed – Median)," we fill in missing values by assigning them the median value of wastewater discharge within their respective industries during the pre-reform period.

Figure A7: Robustness: Restrict sample: No size-based definitions



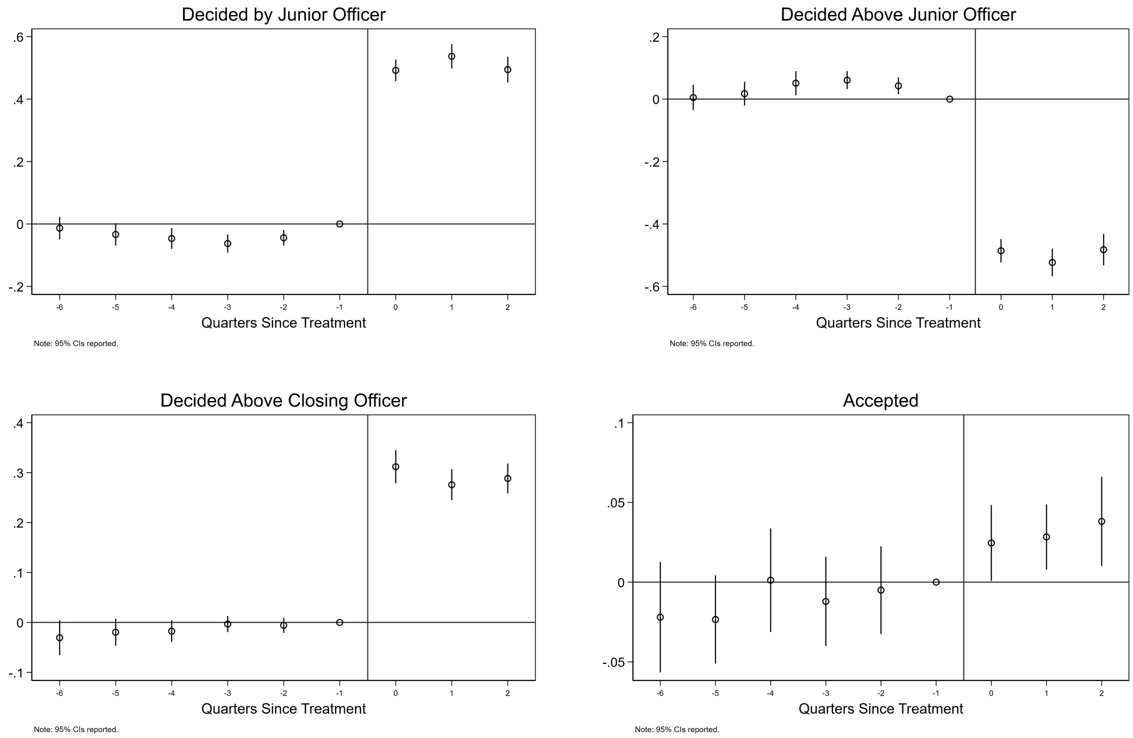
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. See Section 5.3 for details. Industries with size-based definitions have been excluded. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A8: Robustness: Control for Pollution Score × Post



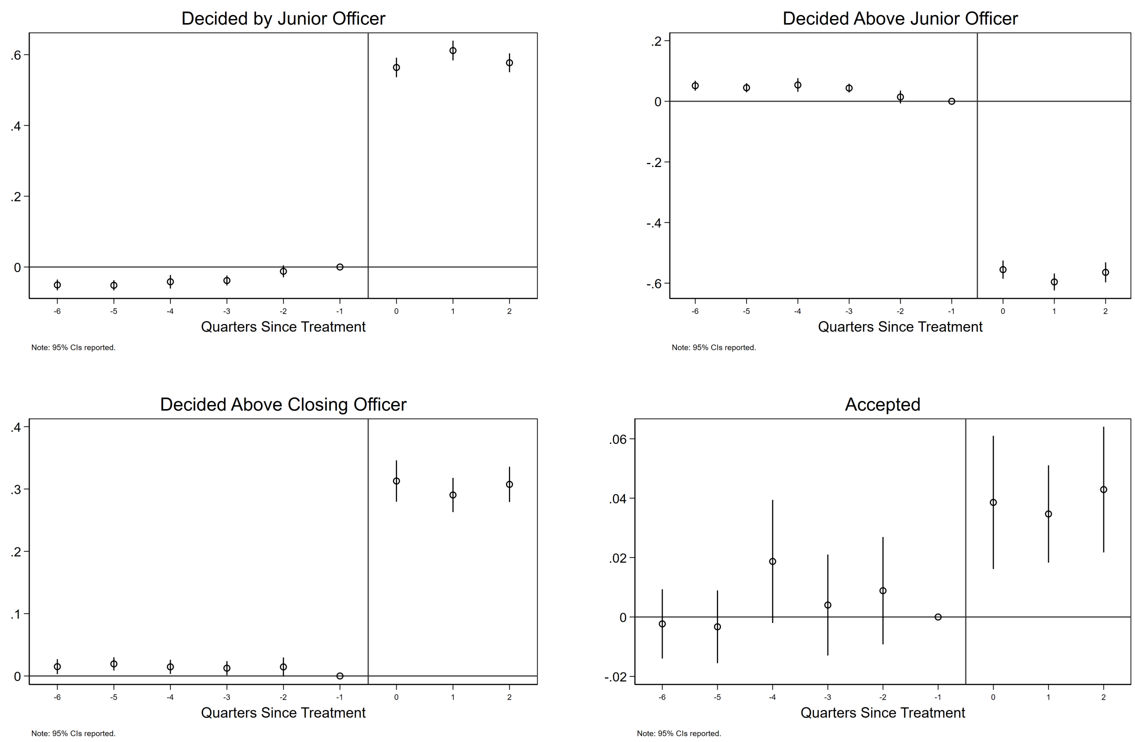
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects and additionally Pollution Score × Post has been added as a control. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A9: Robustness: Industry by District Fixed Effects



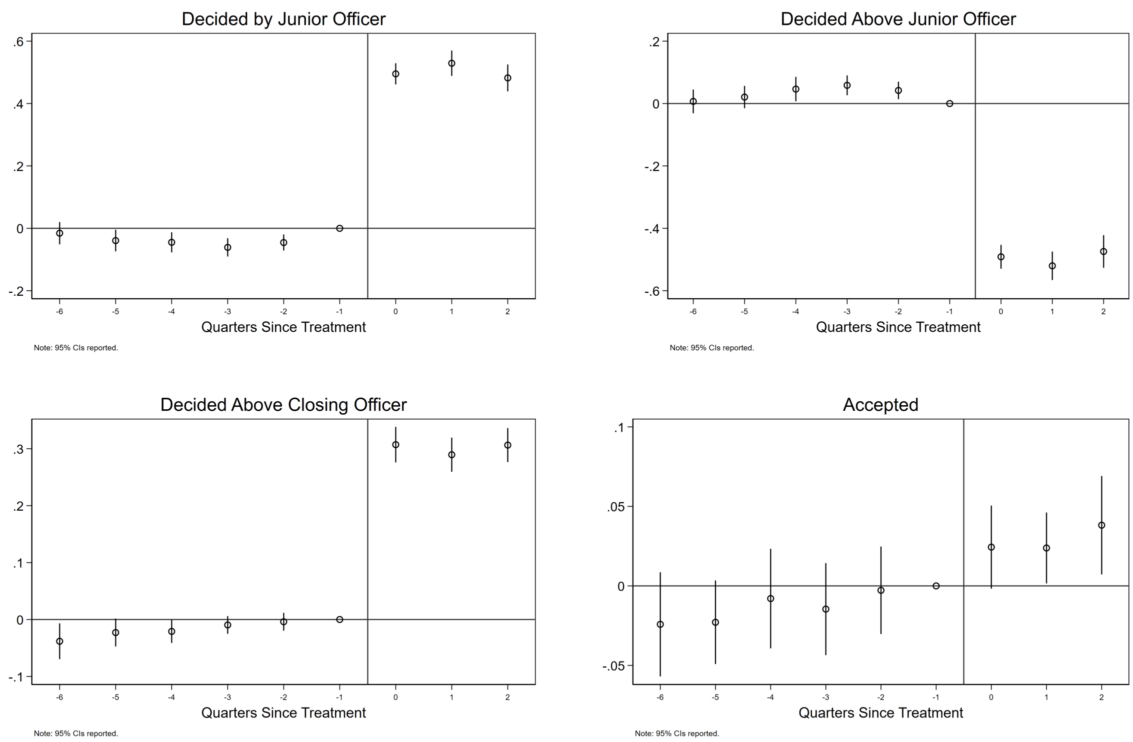
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. The estimating equation has been modified to include a constant, industry by district fixed effects, industry time trends, quarter fixed effects, and category code fixed effects. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A10: Robustness: Industry and Quarter Fixed Effects



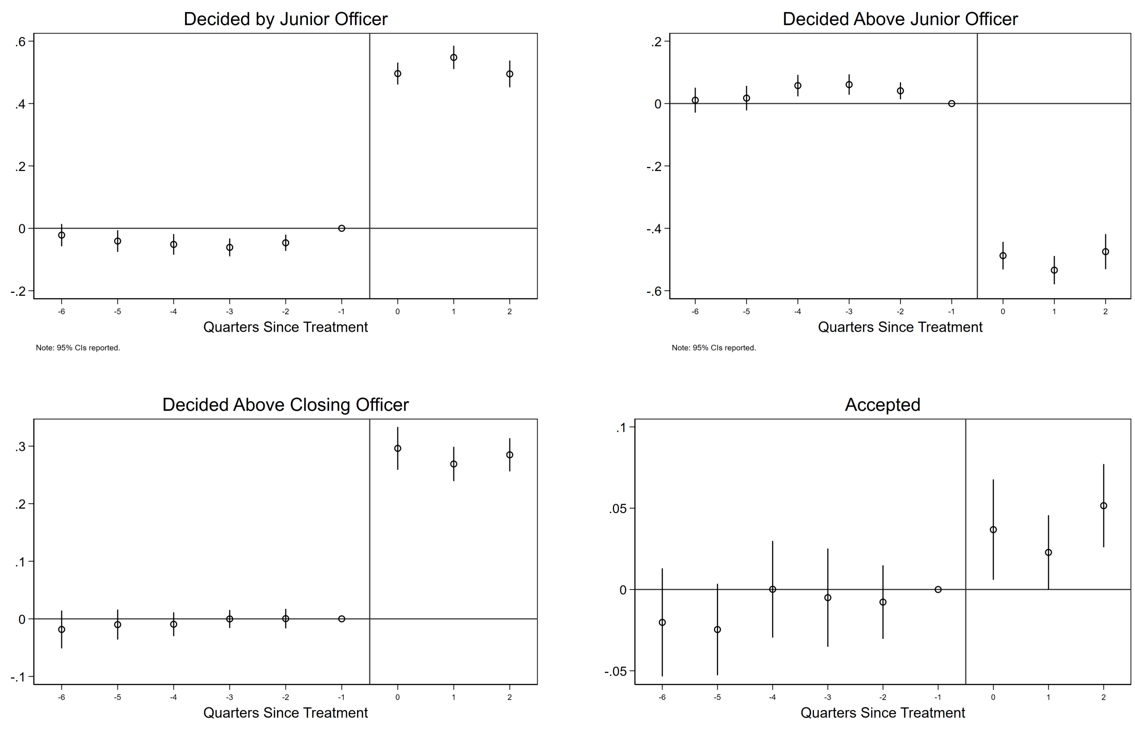
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. The estimating equation has been modified to include a constant, industry fixed effects, and quarter fixed effects. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A11: Robustness: Drop Red Applications



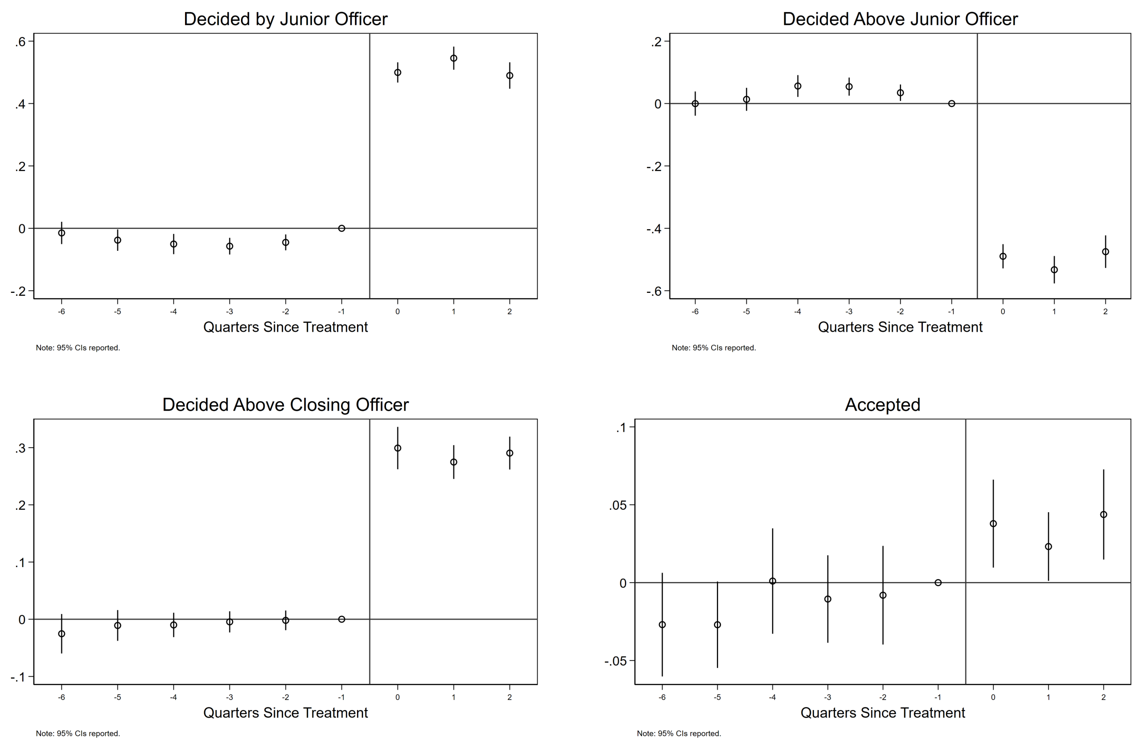
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. Red applications have been discarded. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A12: Robustness: Restrict Sample: Pollution Score < 55



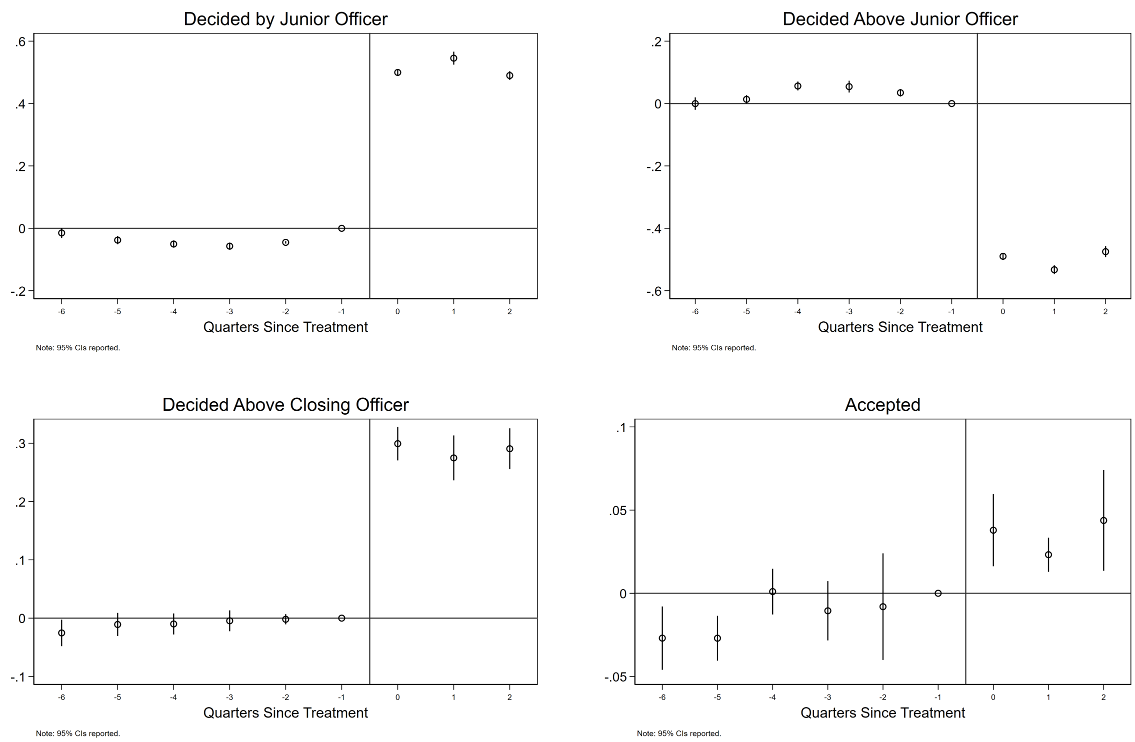
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. Sample restricted to applications with pollution Score < 55. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A13: Robustness: Restrict Sample: Pollution Score > 25



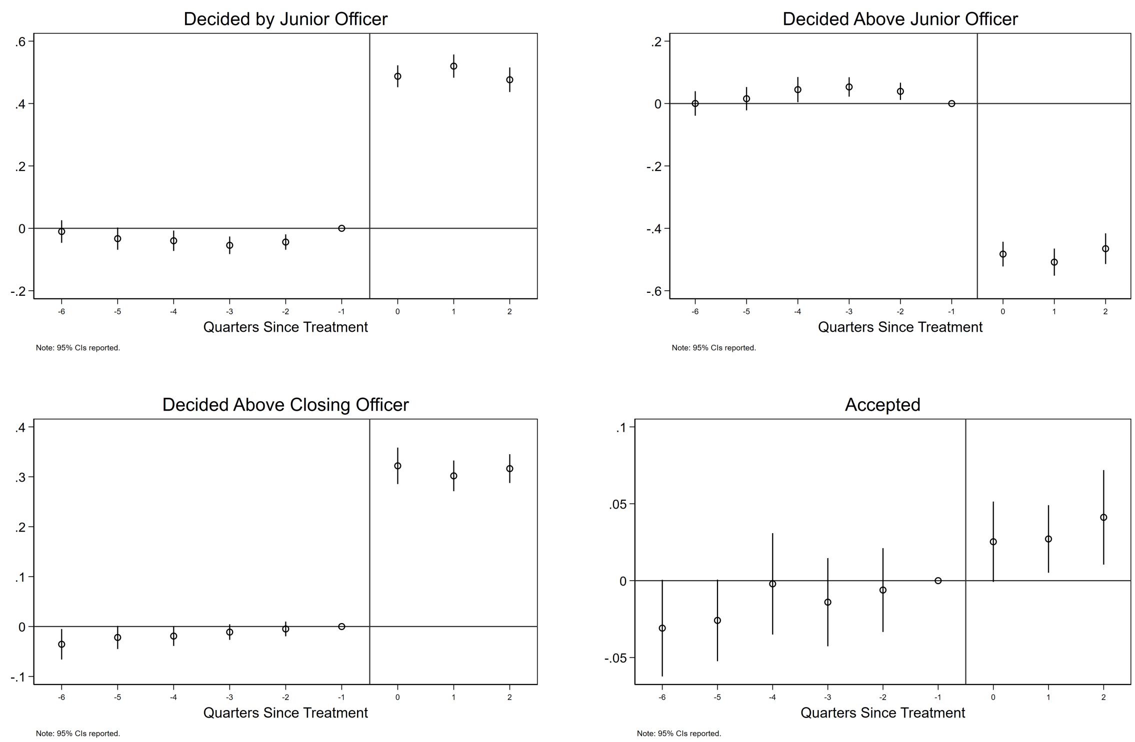
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. Sample restricted to applications with pollution Score > 25. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A14: Robustness: Cluster by Pollution Score



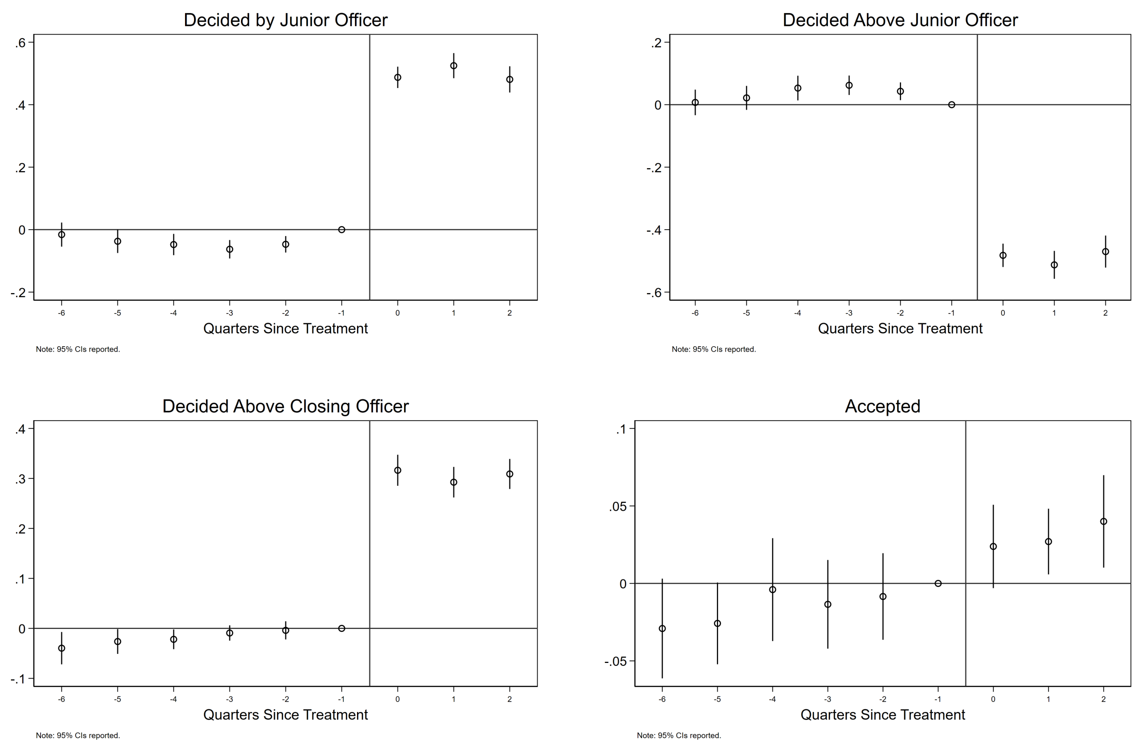
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. The specification has been modified, with clustering by pollution score. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A15: Robustness: Interact with percent Green by District in Pre Period



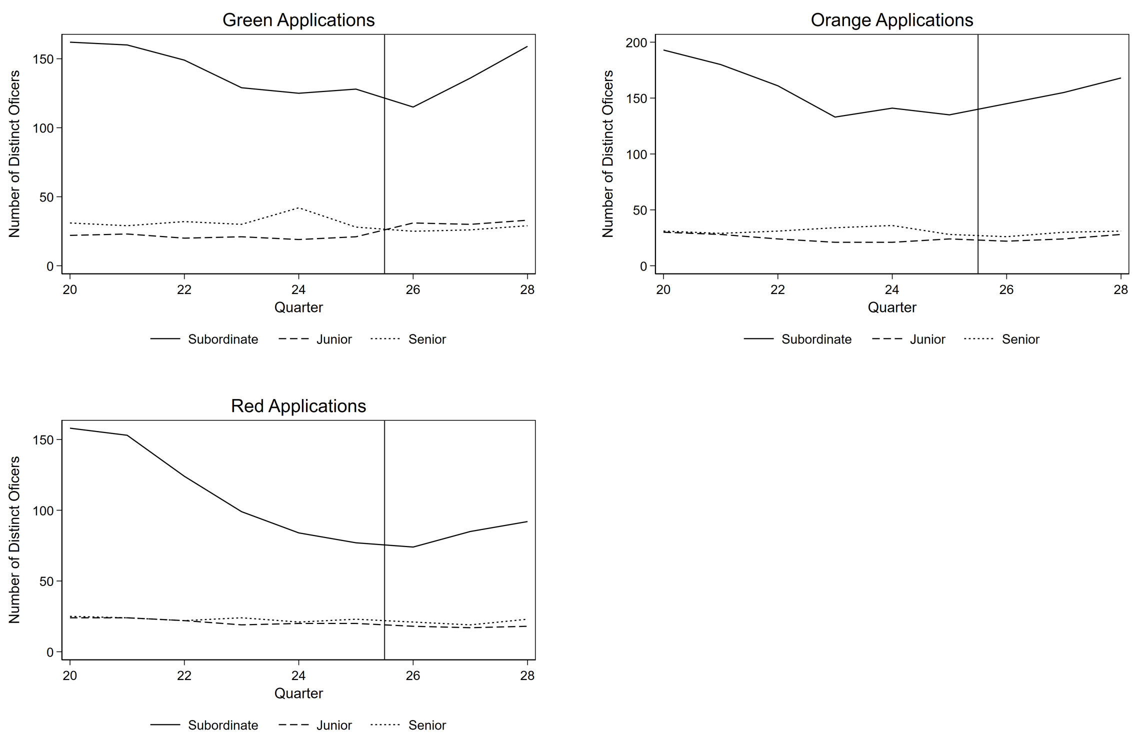
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. We include all the double and triple interactions with percent Green application in the pre-period. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A16: Robustness: District × Green $\bigcup$ Any Other District × Not Green Fixed Effects



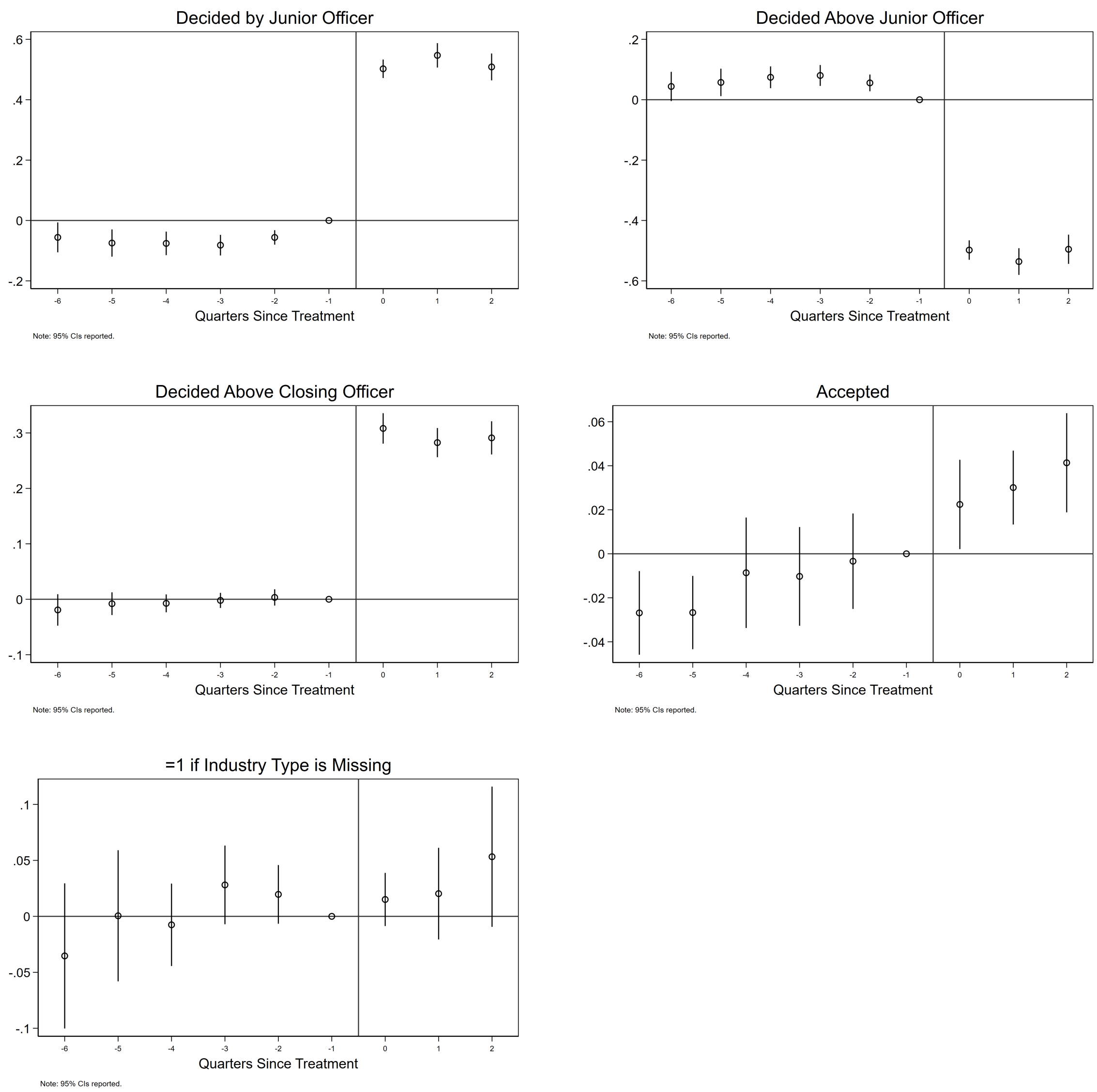
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Outcome variables are given in sub-figure titles. See Section 5.3 for details. In addition, all specifications control for district × Green $\bigcup$ any other district × not Green fixed effects. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A17: Number of Junior Officers



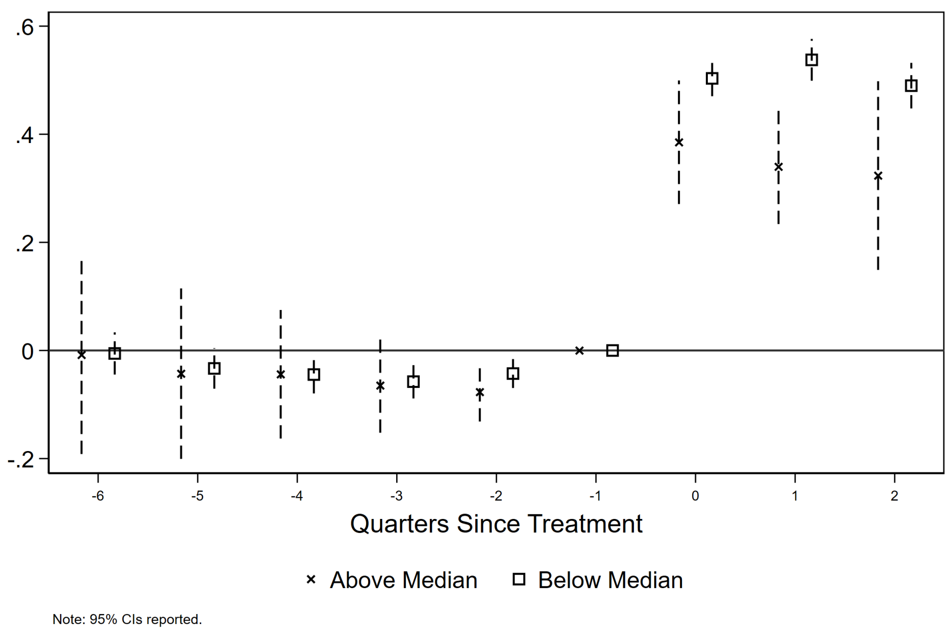
Notes: These figures show the unique number of officer names appearing by rank, quarter, and industry color.

Figure A18: Robustness: Missing Industry Information.



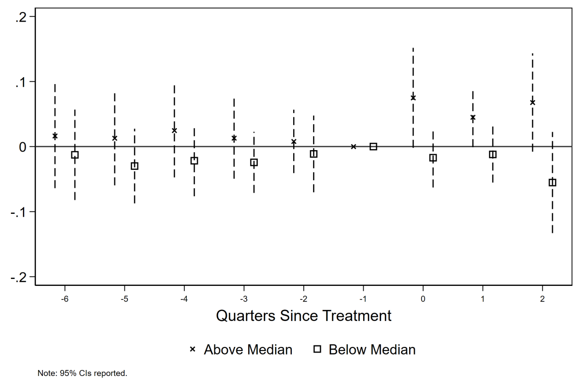
Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). Apart from the specification used for the last sub-figures, all other specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. See Section 5.3 for details. Apart from the specification used for the last sub-figures, in all other specifications, we replace missing industry information with generic industry. The specification used for the last sub-figure only include district, quarter, and category code fixed effects. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Figure A19: Robustness: Missing Pollution Score is Replaced with Median Score

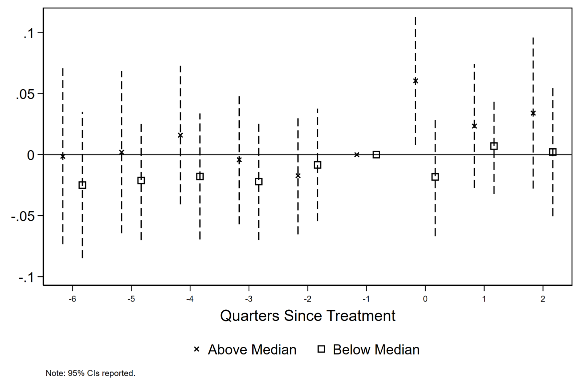


Notes: The figure presents coefficient estimates and 95% confidence intervals of equation (1). The outcome variable is whether the application was decided by a junior officer. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. "Above Median" signifies industries whose pollution score exceeds the median score within their respective categories. See Section 5 for details.

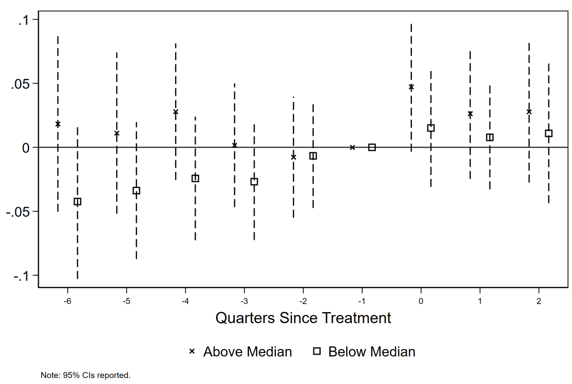
Figure A20: Robustness: Alternative Measures of Decision Quality – Pollution per Worker



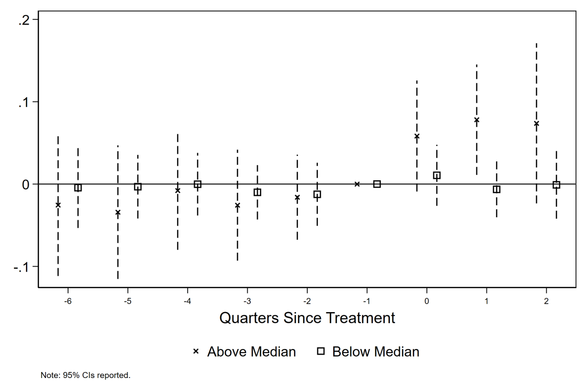
(a) Above Median



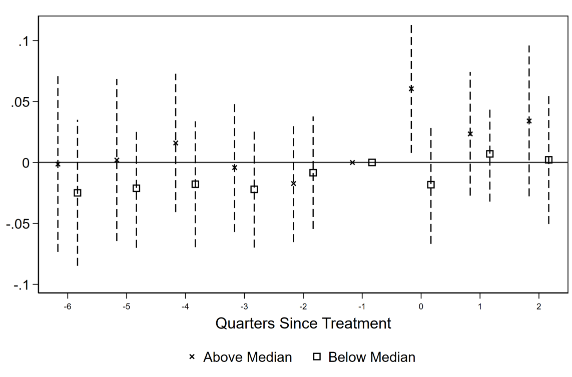
(b) Above Median – Imputed



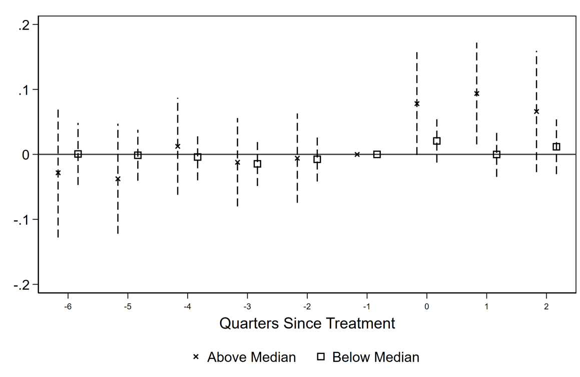
(c) Above Median – Imputed (Median)



(d) Above 75th Percentile



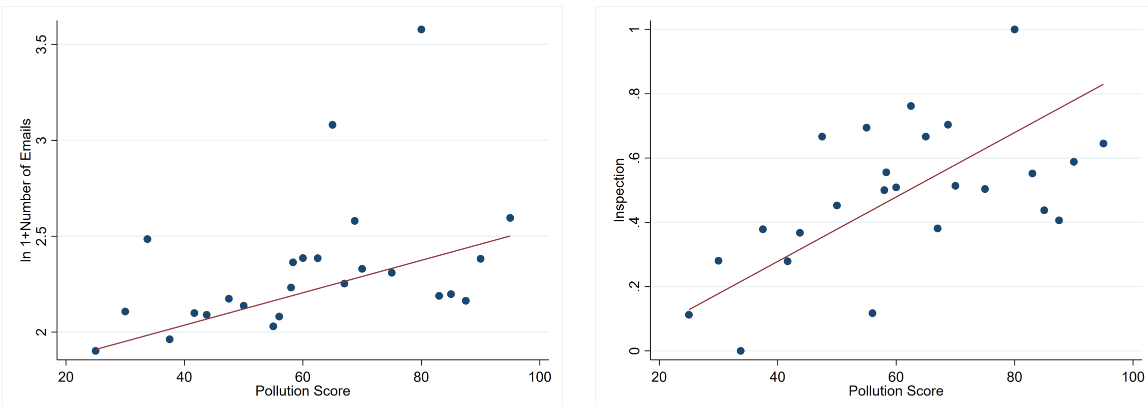
(e) Above 75th Percentile – Imputed



(f) Above 75th Percentile – Imputed (Median)

Notes: Each sub-figure presents coefficient estimates and 95% confidence intervals of equation (1). All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Outcome variables are given in sub-figure titles. The above median and and above 75th percentile refers to above median and above 75th percentile of pollution per worker. In sub figures with label "Imputed," we estimate the number of workers for applications with missing data by employing a predictive model that utilizes information regarding capital investment and total land area. In sub figure with label "Imputed (Median)," we fill in missing values by assigning them the median value of wastewater discharge within their respective industries during the pre-reform period.

Figure A21: Effort by Pollution Score



Notes: Each sub-figure shows a binned scatterplot and line of best fit representing the correlation between the application-level measure of effort on the y axis and the industry-level pollution score. The "Inspected" dummy variable is set to 1 when the email text explicitly indicates that an inspection occurred.

Table A1: Robustness: Firm Characteristics Do Not Change

	(1) Wisorized IHS Capital	(2) Wisorized IHS Labor	(3) Wisorized IHS Land	(4) IHS of Fee	(5) Resubmitted	(6) Number of Emails
Green × Post	0.010	-0.001	-0.012	-0.126	-0.033*	-0.034
	(0.041)	(0.031)	(0.023)	(0.190)	(0.018)	(0.246)
Observations	53112	34432	48431	53111	53112	53112
Pre-Delegation Mean	2.953	1.909	0.479	5.560	0.373	8.708

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. We winsorize capital investment, land area, and number of workers at 1%. Apart from "Resubmitted" and "Number of Emails," all other variables were taken from the application data. The variable "Resubmitted" is a dummy variable and takes the value of 1 if a firm resubmits the application using the same application ID.

Table A2: Robustness: Drop applications within 30 days of policy

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.582***	-0.572***	0.290***	0.032***
	(0.017)	(0.019)	(0.014)	(0.010)
Observations	49335	49335	48494	49226
Pre-Delegation Mean	0.018	0.952	0.005	0.947

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A3: Robustness: Number of Green Applications

	(1) Number of Applications	(2) ln (1+ Applications)
Green $\times$ Post	-0.382	-0.018
	(0.666)	(0.051)
Observations	8684	8684
Pre-Delegation Mean	6.195	1.403

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. In both Columns, we aggregate the data at the district-industry-quarter level and count the number of Green applications.

Table A4: Robustness: Type of Firms Applying for Permit Does not Change After the Delegation – Pollution Outcomes

	(1) Pollution per Worker	(2) Above Median	(3) ln Pollution per Worker	(4) Pollution per Worker (Imputed - Predicted)	(5) Pollution per Worker (Imputed - Median)	(6) $\mathbb{1}\{\text{Pollution Data is Missing}\}$
Green × Post	-0.954	0.037	0.191	-0.957	-24.454	-0.014
	(5.531)	(0.034)	(0.133)	(3.892)	(15.128)	(0.017)
Observations	12622	12622	12622	18664	18666	53112
Pre-Delegation Mean	11.157	0.544	-2.075	12.374	21.477	0.638

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. Pollution refers to total waste water discharge. In Column (4), we estimate the number of workers for applications with missing data by employing a predictive model that utilizes information regarding capital investment and total land area. In Column (5), we fill in missing values by assigning them the median value of wastewater discharge within their respective industries during the pre-reform period.

Table A5: Robustness: Restrict sample: No size-based definitions

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.541***	-0.533***	0.298***	0.024**
	(0.016)	(0.018)	(0.013)	(0.011)
Observations	45886	45886	45165	45814
Pre-Delegation Mean	0.024	0.947	0.004	0.952

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A6: Robustness: Control for Pollution Score × Post

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.512***	-0.497***	0.306***	0.034**
	(0.021)	(0.022)	(0.020)	(0.013)
Pollution Score × Post	-0.002**	0.002**	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	41447	41447	40762	41365
Pre-Delegation Mean	0.021	0.951	0.006	0.951

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. Pollution Score interacted with Post is included as a further control. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A7: Robustness: Industry by District Fixed Effects

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.545***	-0.536***	0.292***	0.029***
	(0.016)	(0.018)	(0.014)	(0.009)
Observations	52504	52504	51598	52393
Pre-Delegation Mean	0.023	0.947	0.005	0.947

***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry by district fixed effects, industry time trends, quarter fixed effects, and category code fixed effects. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry. Standard errors clustered by industry in parentheses.

Table A8: Robustness: Industry and Quarter Fixed Effects

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.611***	-0.600***	0.293***	0.036***
	(0.012)	(0.014)	(0.013)	(0.007)
Observations	53026	53026	52118	52910
Pre-Delegation Mean	0.023	0.947	0.005	0.947

***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, and quarter fixed effects. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry. Standard errors clustered by industry in parentheses.

Table A9: Robustness: Drop Red Applications

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.540***	-0.533***	0.299***	0.028***
	(0.015)	(0.017)	(0.013)	(0.009)
Observations	50937	50937	50163	50834
Pre-Delegation Mean	0.024	0.947	0.004	0.949

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. Red applications are excluded from the sample. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A10: Robustness: Restrict Sample: Pollution Score < 55

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.300***	-0.344***	0.523***	0.024
	(0.095)	(0.092)	(0.105)	(0.055)
Observations	2704	2704	2603	2694
Pre-Delegation Mean	0.007	0.953	0.033	0.914

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A11: Robustness: Restrict Sample: Pollution Score > 25

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.551***	-0.538***	0.286***	0.034***
	(0.015)	(0.018)	(0.014)	(0.010)
Observations	41447	41447	40762	41365
Pre-Delegation Mean	0.021	0.951	0.006	0.951

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Industries with pollution score greater than 25 have been excluded. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A12: Robustness: Cluster by Pollution Score

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.551***	-0.538***	0.286***	0.034***
	(0.005)	(0.003)	(0.016)	(0.006)
Observations	41447	41447	40762	41365

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by pollution score in parentheses. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A13: Robustness: Interact with percent Green by District in Pre Period

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.530***	-0.522***	0.311***	0.030***
	(0.015)	(0.017)	(0.014)	(0.009)
Green × Post × Pre Pct. Green	0.045***	-0.040***	-0.076***	0.011
	(0.010)	(0.011)	(0.011)	(0.007)
Observations	53026	53026	52118	52910
Pre-Delegation Mean	0.023	0.947	0.005	0.947

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. In addition, all specifications control for the interaction of Green, Post, and percentage of Green applications by district in the pre-reform period. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A14: Robustness: District × Green ⋃ Any Other District × Not Green Fixed Effects

	(1) Decided by Junior	(2) Decided Above Junior	(3) Decided Above Closing	(4) Accepted
Green × Post	0.537***	-0.528***	0.304***	0.030***
	(0.015)	(0.017)	(0.014)	(0.009)
Observations	53026	53026	52118	52910
Pre-Delegation Mean	0.023	0.947	0.005	0.947

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. In addition, all specifications control for district × Green ⋃ any other district × not Green fixed effects. All the outcome variables presented in this table are binary. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A15: Robustness: Missing Industry Information

	Application-level Outcomes				
	(1) =1 if Industry Type is Missing	(2) Decided by Junior	(3) Decided Above Junior	(4) Decided Above Closing	(5) Accepted
Green × Post	0.031	0.565***	-0.556***	0.294***	0.033***
	(0.021)	(0.019)	(0.019)	(0.010)	(0.006)
Observations	64366	64236	64236	63096	64091
Pre-Delegation Mean	0.194	0.022	0.945	0.007	0.944

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Apart from Column (1), all other specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. The specification used in Column (1) only include district, quarter, and category code fixed effects. All the outcome variables presented in this table are binary. Apart from Column (1), in all other specifications, we replace missing industry information with generic industry. "Junior" refers to the "Assistant Environmental Engineer" position, while "Above Junior" encompasses all positions higher than the "Assistant Environmental Engineer." "Above Closing Officer" is a function of application color, scale, type, and industry.

Table A16: Robustness: Missing Pollution Score Replaced with Median Score

	(1) Decided Above Junior
Green × Post × Above Median	-0.123***
	(0.030)
Green × Post	0.555***
	(0.016)
Post × Above Median	0.020
	(0.013)
Green × Above Median	0.093***
	(0.033)
Above Median	-0.039
	(0.031)
Observations	53026
Pre-Delegation Mean	0.023

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. The outcome variable is whether the application was decided by a junior officer. In Column (1), "Above Median" means industries whose pollution score exceeds the median score within their respective categories. In this specification, we assign median pollution score to those industries for which score is missing.

Table A17: Robustness: Alternative Measures of Decision Quality

	Accepted					
	(1)	(2)	(3)	(4)	(5)	(6)
Green × Post × Above Median	0.043*	0.032	0.036*			
	(0.024)	(0.020)	(0.019)			
Green × Post × Above 75th Percentile				0.049**	0.049**	0.042*
				(0.024)	(0.020)	(0.022)
Observations	12581	18574	18577	12581	18574	18577
Pre-Delegation Mean	0.959	0.947	0.947	0.959	0.947	0.947
Imputed Missing Worker Data Imputed	No	Yes	Yes	No	Yes	Yes
Imputation Method	N/A	Prediction	Median	N/A	Prediction	Median

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. Pollution refers to total waste water discharge. In Columns (2) and (5), we estimate the number of workers for applications with missing data by employing a predictive model that utilizes information regarding capital investment and total land area. In Columns (3) and (6), we fill in missing values by assigning them the median value of wastewater discharge within their respective industries during the pre-reform period.

Table A18: Robustness: Disagreement With Senior Officer with Alternative Fixed Effects

	(1) Decided Above Junior	(2) Decided Above Junior
Green × Post × Above Median	-0.095***	-0.090***
	(0.016)	(0.016)
Green × Post	0.648***	0.652***
	(0.016)	(0.017)
Post × Above Median	0.067***	0.064***
	(0.019)	(0.018)
Green × Above Median	0.021***	0.019***
	(0.005)	(0.005)
Above Median	-0.005	-0.006
	(0.004)	(0.004)
Observations	44554	44551
Pre-Delegation Mean	0.024	0.024
Senior × Post FE	Yes	No
Senior × Quarter FE	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. 'Disagreement' equals 1 for senior-subordinate pairs with high rates of disagreement during the pre-reform period. See Section 6 for details.

Table A19: Heterogeneity by Officer Type: Inspection Behaviour

	Decided by Junior		
	(1)	(2)	(3)
Green × Under Inspection (Red) × Post	0.109***		
	(0.014)		
Green × Under Inspection (Orange) × Post		0.000	
		(0.025)	
Green × Under Inspection × Post (Orange/Red)			0.053**
			(0.021)
Observations	48878	50591	50606
R^2	0.645	0.620	0.621
Pre-Delegation Mean	0.022	0.022	0.022

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. All specifications include a constant, industry fixed effects, industry time trends, district fixed effects, quarter fixed effects, and category code fixed effects. Standard errors clustered by industry in parentheses. The under inspection is determined by comparing predicted inspection with actual inspection. The inspection prediction relies on the utilization of specific variables as dictated by inspection protocols including: a) permit type, b) whether the application pertains to a new permit or renewal, c) pollution category (red/orange/green), and d) capital investment (i.e., whether the total capital investment falls below 1 million Indian rupees). The under inspection measure is then averaged over the pre-reform period for each senior-subordinate pair. The measures in this table are in the binary form and are equal to 1 if the average is above the overall median.

Table A20: p Values Corrected for Multiple Comparisons: Heterogeneity by Application and Officer Characteristics

	Bootstrap	List, Shaikh and Xu (2019)	Bonferroni	Holm (1979)
Table 7				
Column (1): Green × Post × Pollution Score	.01	.01	.03	.02
Column (2): Green × Post × Disagreement	.01	.01	.03	.01
Column (3): Green × Post × Submissions	.01	.01	.03	.03
Table 9				
Column (1): Green × Post × Pollution Score	.01	.01	.04	.01
Column (2): Green × Post × Pollution Score	.01	.01	.04	.04
Column (3): Green × Post × Pollution Score	.01	.01	.04	.02
Column (4): Green × Post × Pollution Score	.01	.01	.04	.03
Column (1): Green × Post × Disagreement	.01	.01	.04	.03
Column (2): Green × Post × Disagreement	.01	.01	.04	.02
Column (3): Green × Post × Disagreement	.01	.01	.04	.01
Column (4): Green × Post × Disagreement	.01	.01	.04	.04

Notes: This table presents p-values corrected for multiple comparisons for results equivalent to those in Tables 7 and 9. See Section 6 for details.

B Model

B.1 Setup

We base our conceptual framework in Section 6.1 on a simple model with two players – a senior officer and a junior officer. The senior (S) receives an application. She can deal with it herself, or she can delegate it to the junior (J). An application can be of two types, good and bad. The probability an application is bad is b. This probability is known by both the senior and junior.

If the senior does not delegate, and so retains the application (action R), she can choose to exert effort (action E) scrutinizing the application. Her cost of effort is c. If she does not exert effort (action N), she will approve the application. If she approves a bad application, its quality will be revealed and she will pay a cost X. While we assume that a bad application approved by the senior has no cost to the junior, this will have no impact on the outcome. If the senior exerts effort, there is a probability p that she will detect that a bad application is bad, and so reject it.

While we model the choice to approve an application that has not been shown to be bad as automatic, this is consistent with the expected return to accepting a good application being positive in the absence of other information. For example, this could take the form of a positive return ρ to accepting good applications such that $\rho > c$. It could also be a cost of rejecting good applications κ such that $\kappa > bX$. Either would be consistent with the general interpretation that it is the job of the regulator to approve good applications and reject bad ones, rather than simply rejecting all applications in order to avoid wrongful approvals.

If the senior delegates (action D), the junior can choose to exert effort scrutinizing the application (action e) or not (action n). The junior's cost of effort is k. If the junior exerts effort, there is a probability q that he will detect that a bad application is bad, and so reject it. Otherwise, he will approve it. As with the senior, this automatic choice can be understood as consistent with a positive expected return to approving an application in the absence of other information, following the imperatives of the regulator.

If the junior accepts a bad application, he will pay a cost Z and the senior will pay a cost of X. We make the assumption that the senior pays the same cost of a wrongful approval whether the application is approved by the junior or by herself. Letting there be a different cost to the senior of a decision made by the junior (say, X') would add complexity without changing the key qualitative predictions of the model.

B.2 Payoffs

We assume both the senior and junior are risk neutral. Their payoffs, then, are simply the sum of effort costs and, conditional on an action taken, the possible costs of a wrongful approval.

The senior's expected payoff (π) from not delegating (R) and from and not exerting effort (N) is given by:

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

The senior's expected payoff from not delegating (R) and exerting effort (E) is, by contrast:

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

If the senior delegates, her payoffs will be conditional on the actions taken by the junior. The senior's expected payoff from delegating (D) if the junior does not exert effort (n) is:

$$\begin{aligned}\pi_S^{D,n} &= (1-b) \times 0 + b \times (-X) \\ &= -bX\end{aligned}$$

Instead, if the senior delegates (D) and the junior exerts effort (e), the senior's expected payoff becomes:

$$\begin{aligned}\pi_S^{D,e} &= (1-b) \times 0 + bq \times 0 + b(1-q) \times (-X) \\ &= -b(1-q)X\end{aligned}$$

Because the junior takes no action without delegation, his payoffs without delegation are irrelevant to the model predictions. It is possible, then, to assume that junior receives a payoff of zero without delegation.

The junior's expected payoff from delegation (D) if he does not exert effort (n) is:

$$\begin{aligned}\pi_J^{D,n} &= (1-b)\times 0 + b\times(-Z)\\ &= -bZ\end{aligned}$$

Instead, the junior's expected payoff from delegation (D) if he does exert effort (e) is:

$$\begin{aligned}\pi_J^{D,e} &= (1-b)\times(-k) + bq\times(-k) + b(1-q)\times(-k-Z)\\ &= -k - bZ + bqZ\end{aligned}$$

B.3 Effort Choices

Given these payoffs, it is trivial to identify the conditions under which either the senior or the junior will exert effort. We make the simplifying assumption that, for both the senior and junior, indifference leads to inaction. First, an officer indifferent between exerting effort and not will not exert effort. Second, a senior indifferent between delegation and not will delegate. While the former assumption is innocuous, the latter does change some of the model predictions, and we will return to it when we describe the equilibrium outcomes below.

Under delegation, the junior exerts effort if his payoff is greater than from not exerting effort, i.e. if $\pi_J^{D,e} > \pi_J^{D,n}$. This condition can be rewritten as follows:

$$\begin{aligned}-k - bZ + bqZ &> -bZ\\ &\Rightarrow Z > \frac{k}{bq}\end{aligned}$$

Intuitively, if the costs to the junior of wrongly accepting a bad application are high, this strengthens his incentive to exert effort, as does a higher probability of a bad application and a higher probability of detecting a bad application conditional on effort. A high cost of effort has the opposite effect.

Without delegation, the senior exerts effort if the payoff is greater than from not exerting effort, i.e. if $\pi_S^{R,e} > \pi_S^{R,n}$. This condition can be rewritten as:

$$-c - bX + bpX > -bX$$
$$\Rightarrow X > \frac{c}{bp}$$

As with the junior, the senior's incentive to exert effort increases in the cost of a wrongful approval, in the probability of a bad application, and in the probability that effort uncovers a bad application. Higher effort costs weaken this incentive.

B.4 The choice to delegate

Again assuming a senior indifferent between delegation and not will delegate, the senior prefers no delegation and no effort by herself to delegation and no effort by the junior if this results in a greater payoff, i.e. if $\pi_S^{R,N} > \pi_S^{D,n}$. This condition can be rewritten as:

$$-bX > -bX$$

That is, the senior is always indifferent between delegating and not if neither she nor the junior will exert effort. By assumption, then, this indifference leads to delegation.

The senior prefers no delegation and no effort by herself to delegation and effort by the junior if this leads to a higher payoff, i.e. if $\pi_S^{R,N} > \pi_S^{D,e}$. This condition can be rewritten as:

$$-bX > -b(1-q)X$$
$$\Rightarrow 0 > bqX$$

In this case, it is obvious that the senior always prefers delegating if she would not exert effort but the junior would.

The senior prefers no delegation and exerting effort to delegation and no effort by the junior if $\pi_S^{R,E} > \pi_S^{D,n}$. This condition can be rewritten as:

$$-c - bX + bpX > -bX$$
$$\Rightarrow X > \frac{c}{bp}$$

That is, if the senior knows the junior will not exert effort, the senior prefers not to delegate if the senior's cost from a bad application being accepted, X, is strictly greater than $\frac{c}{bp}$, which is the same value of X above which she would choose to exert effort.

Finally, the senior prefers no delegation and exerting effort to delegation and effort by the junior if $\pi_S^{R,E} > \pi_S^{D,e}$. This can be rewritten as:

$$
\begin{aligned}
-c - bX + bpX &> -bX + bqX \\
\Rightarrow (p-q)X &> \frac{c}{b}
\end{aligned}
$$

If the senior is more effective than the junior, i.e. if $p > q$, this means that she will prefer not to delegate if $X > \frac{c}{b(p-q)}$. If $p \leq q$, she will always prefer to delegate if she knows both she and the junior would exert effort, because the junior is more likely to detect a bad application.

B.5 Equilibria

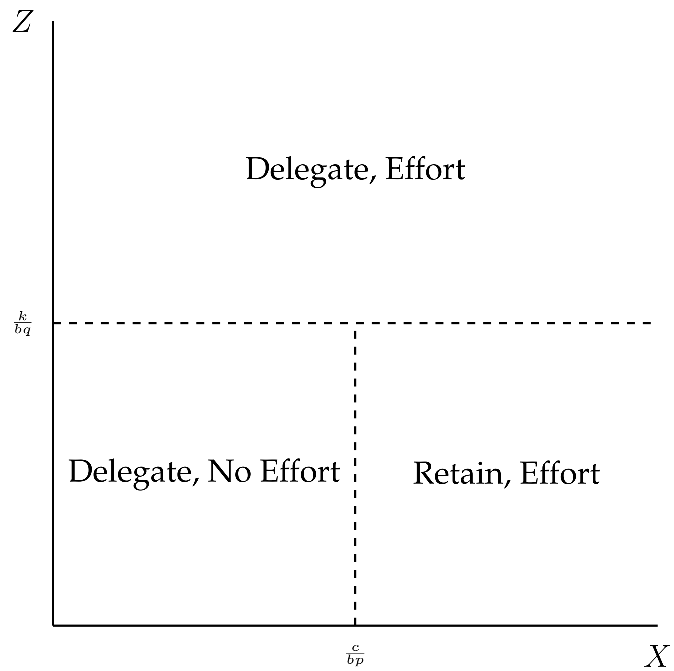
The equilibria of the model – whether the senior delegates and whether the officer who handles the file exerts effort – depend on the parameters b, X, Z, c, p, k, and q. These can be illustrated intuitively by showing these equilibria in (X, Z) space, i.e. as functions of the costs to the senior and junior of a wrongful approval. Figure A22 shows these equilibria for the case where $p \leq q$. Figure A23 shows them when $p > q$.

Consider first the case where $p \leq q$. In this case, the junior is at least as effective at detecting bad applications as is the senior. There are three possible outcomes. In the bottom-left corner of Figure A22, both X and Z are low, and so neither officer will exert effort inspecting an application that she or he is tasked with. The senior, indifferent between delegating and not, delegates.

Second, in the bottom right quadrant, X is high relative to Z, and Z is low relative to the ratio $\frac{k}{bq}$. That is, the costs to a junior of a wrongful approval are low enough compared to the relative costs from effort that he will not exert effort scrutinizing an application. The potential cost to the senior is, however, now high enough relative to her own relative costs from effort ($\frac{c}{bp}$) that she will now inspect an application she is tasked with. Knowing the junior will not exert effort, she does not delegate.

Third, in the top half of the figure, Z is high relative to $\frac{k}{bq}$. Now, the potential costs of a wrongful approval have risen for the junior when compared to his relative costs of effort. He will now scrutinize applications he is tasked with. The senior, knowing this,

Figure A22: Equilibria when $p \leq q$



delegates.

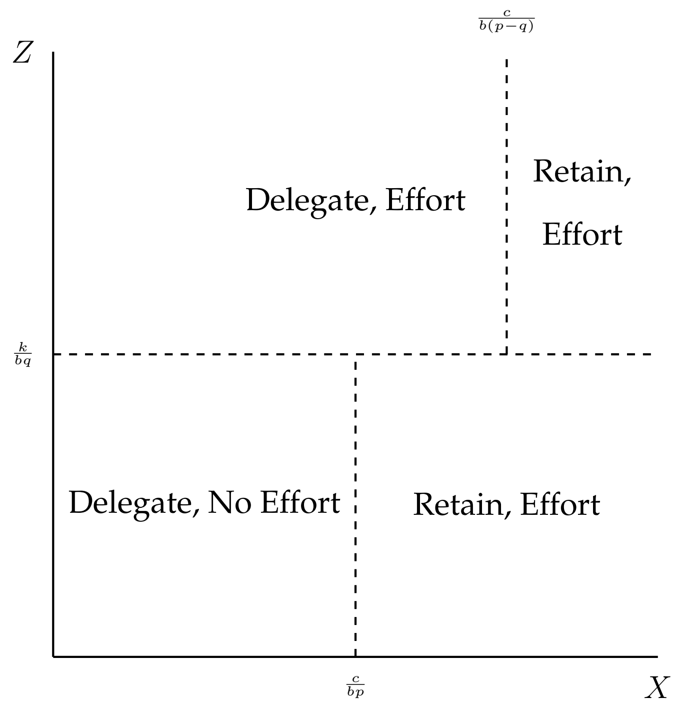
In the case where $p > q$, the senior is more effective at detecting bad applications than is the junior. This situation creates an additional possible outcome in the upper right quadrant of Figure A23. Here, although the junior will exert effort, the costs to the senior of a wrongful approval are high enough that she would exert her own, more effective effort, even though it is costly, in order to reduce the chances that a bad application is approved.

We now return two simplifying assumptions made earlier. The first is that an officer indifferent between exerting effort and not will not exert effort. This will only affect what happens precisely on the boundaries separating the regions of Figures A22 and A23, and so is innocuous.

The second is that a senior indifferent between delegating and not delegates. Were we to reverse this assumption, the bottom left quadrant of both Figures A22 and A23 would become one of "Retain, No Effort." That is, knowing that neither officer would exert effort, the senior would not delegate as the ultimate probability of a wrongful approval would not change.

The exposition of the possible outcomes in (X,Z) space in Figures A22 and A23 shows how these parameters affect delegation and effort. What of b, c, p, k, and q?

Figure A23: Equilibria when $p > q$



Increasing b, the fraction of bad applications, has ambiguous predictions. $\frac{k}{bq}$ shifts downwards and $\frac{c}{bp}$ shifts leftward, and so the boundaries of the "Delegate, No Effort" region contract. Consider the simpler case where $p \leq q$. If it was already the case that an application was delegated and inspected by the junior, this will not change. If it was previously delegated without effort, it is possible that it is now delegated and scrutinized by the junior or that it is retained and scrutinized by the senior. If it was previously retained and scrutinized by the senior, this may continue to be the case, or it may now be delegated and scrutinized by the junior. The source of this ambiguity is intuitive. A greater fraction of bad applications increases the incentive of the junior to exert effort under delegation and of the senior to retain control if the junior still will not exert effort. Depending on the starting point, either effect might dominate.

For the other parameters, the predictions are not ambiguous. If c, the senior's cost of effort, increases, both $\frac{c}{bp}$ and $\frac{c}{b(p-q)}$ shift right. This shrinks the boundaries of the "Retain, Effort" region. This is because the senior's cost of not delegating has risen.

If p, the senior's probability of detecting a bad application conditional on effort, increases, both $\frac{c}{bp}$ and $\frac{c}{b(p-q)}$ shift left. This expands the boundaries of the "Retain, Effort" region. The senior can accomplish more by not delegating.

If k, the junior's cost of effort, increases, $\frac{k}{bq}$ shifts upwards, shrinking the size of the region in which delegation occurs relative to the size of the region in which it does not. Intuitively, if the junior is less likely to scrutinize an application, the senior is less likely to delegate it.

If q, the junior's probability of detecting a bad application conditional on effort, increases, $\frac{k}{bq}$ shifts downwards, expanding the size of the region in which delegation occurs relative to the size of the region in which it does not. If $p > q$, the rightward shift in $\frac{c}{b(p-q)}$ would have the same effect. The junior can accomplish more under delegation, and is more likely to try, and so the senior is more likely to delegate.

Consider again changing the assumption that a senior indifferent between delegating and not delegates, so that instead an indifferent senior does not delegate. Now, the bottom left quadrant of both Figures A22 and A23 is an equilibrium of "Retain, No Effort." In this case, if b increases, the shift in $\frac{c}{bp}$ is now irrelevant to delegation. If $p \leq q$, $\frac{k}{bq}$ shifts downwards and the size of the region in which delegation occurs grows relative to the region in which it does not. If $p > q$, however, $\frac{c}{b(p-q)}$ also shifts leftwards, and predictions are again ambiguous.

Again under this alternative assumption about delegation under indifference, if c increases, the shift in $\frac{c}{bp}$ is now irrelevant. If $p > q$, $\frac{c}{b(p-q)}$ shifts right, increasing the size of the region in which delegation occurs relative to the region in which it does not. Again, the senior's cost of delegation has risen, but this is only relevant in cases where she would rather scrutinize an application herself than allow the junior to do so, because of her relative advantage in applying effort.

Similarly, under this alternative assumption about delegation under indifference, an increase in p would lead to an irrelevant shift in $\frac{c}{bp}$ and, if $p > q$, a relevant shift in $\frac{c}{b(p-q)}$. For the subset of cases where the senior has an incentive to exert effort even knowing the junior would do the same, a rise in the senior's effectiveness in scrutinizing applications would reduce delegation.

A rise in k under this alternative assumption about delegation under indifference would still shift $\frac{k}{bq}$ upwards, shrinking the size of the region in which delegation occurs relative to the size of the region in which it does not. A rise in q would have the same impact as before, shifting $\frac{k}{bq}$ downwards and $\frac{c}{b(p-q)}$ rightwards, increasing the size of the delegation region.

C Textual Phrases Used in Variable Definition

C.1 Identifying Subordinate Recommendations in Application

We search over the following regular expressions in emails sent by junior officers: "draft putup for approval," "draft put up for approval," "draft ce put up for approval," "draft consent put up for approval," "draft put up for the approval," "draft ce put up for the approval," "draft prepared for the approval," "draft ce prepared for the approval," "draft ce merged with site plan put up for approval," "draft cvo prepared for the approval," "draft cvo merged with site plan put up for approval," "draft consent merged with site plan put up for approval," "draft ico-r prepared and put up for approval," "draft ico put up for approval," "draft ice put up for approval," "draft ico-r put up for approval," "draft ico put up for approval," "draft ce prepared for the approval," "draft consent prepared for the approval," "draft certificate put up for approval," "ico draft put up for approval," "may be approved," "maybe approved," "draft ico-r2 put up for approval," "draft icor put up for approval," "renewal put up for approval," "draft ico r put up for approval," "ce put up for approval," "ico put up for approval," "consent put up for approval," "draft crin put up for approval," "draft put up approval," "draft for the same has been put up for approval," "draft letter in hard copy file put up for approval," "draft generated put up for approval," "file put up for approval," "may be granted," "generated put up for approval," "the same has been put up for approval," "consent prepared and put up for approval," "consent placed for approval," "put up for approval," "submitted for approval," "draft put up subject to approval," "generated put up approval," "generated for approval," "prepared for approval," "put up may please be approved," "put up subject to approval," "putup for approval," "put-up for approval," "put for approval," "subject to approval and put up," "put up of approval," "put up for approval," "u for approval," "draft for approval," "forwarded for approval," "consent for approval," "sent for approval," "attached for approval," "icor for approval," "putt up for approval," "put up approval," "draft icor for approval," "ico for approval," "put up approval," "put up for further approval," "subject to approval draft is put up," "placed for approval," "for approval pls," "attached herewith for approval," "subject to approval draft ico-r is put up," "subject to approval draft is put up," "draft put up" AND "for approval," "may be forwarded to regional office for approval," "consent can be issued," "renew may be issued," "renewal may be issued," "draft prepared may be accepted," "put up for signature and approval," "consent may be granted," "authorization may be signed," "generated put up approval," "consent may be issued," "may be issued" AND "draft put up," "consent may be signed," "generated put up approval," "consent may be renewed," "generated for approval," and "consent to operate may be approved."

C.2 Identifying Whether an Application was Inspected

In English, we search over the following phrases "inspected on," "has been inspected," "inspection was completed," "conducted site inspection," "inspected the," "was inspected," conducted inspection," "inspected. certificate," "inspected site," "inspection was conducted," "inspected the unit," "inspection conducted," "already inspected," "inspection complete," "inspection closed," "inspected by," "consent enquiry was conducted," "consent enquiry conducted," "conducted consent enquiry," "conducted enquiry on," "inspection report is attached," and "inspection report attached." We also translate these English terms into Malayalam and search for these terms in the Malayalam text.