The Demand, Supply, and Market Responses of Corporate ESG Actions: Evidence from a Nationwide Experiment in China*

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In a nationwide field experiment involving all Chinese listed companies, we created demand for ESG actions by randomly conveying ESG rating concerns to company management teams via public online platforms. We find that many companies actively addressed these concerns by supplying detailed ESG strategies and actions. High-productivity and low-transparency companies were more likely to respond to such demand for actions. Moreover, companies that received ESG concerns improved their ESG performances over time and published more ESG reports after the experiment. In the long run, stock price responded positively to E and S inquiries while negatively to G inquiries. This divergence can be attributed to investors interpreting E and S inquiries as positive signals and G inquiries as negative signals, demonstrated through their platform interactions. Overall, the results show that companies' ESG actions are mainly value-driven, rather than values-driven. Corporate ESG actions can be rationalized by a simple signaling model, where companies utilize costly ESG actions (similar to advertisements) to signal their quality under information asymmetry.

Keywords: Environmental, Social, and Governance (ESG), Corporate Social Responsibility (CSR), Randomized Controlled Trials (RCT), Shareholder Engagement, Information Asymmetry

JEL: C93, D82, G14, G34, M14

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I. Introduction

Public demand has long been a powerful force in shaping corporate behavior. From the consumer rights movements of the 1960s to the shareholder activism of the 1980s, shifts in public sentiment have repeatedly demanded firms adopt new standards of accountability and transparency. In recent decades, this dynamic has intensified with the rise of Environmental, Social, and Governance (ESG) practices, which have become a critical benchmark for evaluating corporate performance (Eccles et al., 2014). Yet, public demand is neither uniform nor static. It varies significantly across regions and over time, reflecting divergent societal values, cultural norms, and economic conditions (Dyck et al., 2019). Adding to this complexity, firms face heterogeneous investor preferences, requiring them to balance the demands of ESG-conscious investors against those prioritizing short-term financial returns (Ilhan et al., 2023). This dynamic and fragmented landscape makes it challenging for firms to determine the optimal level of ESG investment amidst often conflicting public expectations.

Firms adopt diverse strategies to navigate these pressures, reflecting a tension between profit maximization and broader societal considerations. Some firms opt for minimal compliance, adhering only to regulatory requirements or addressing reputational risks. This approach aligns with Milton Friedman's classical view that the sole obligation of a firm is to maximize shareholder value (Friedman, 1970). In contrast, other firms pursue ambitious ESG initiatives, going beyond compliance to address societal expectations and signal their commitment to sustainability. These actions broadly resonate with the stakeholder theory (Freeman, 1984), which advocates for balancing the interests of all stakeholders to achieve sustainable value creation. The choice between these strategies carries significant market implications. While proactive ESG initiatives often attract socially conscious investors (Bolton & Kacperczyk, 2021; Dhaliwal et al., 2011; Gibbons, 2024), their impact on market valuation remains mixed (Friede et al., 2015; Gillan et al., 2021; Margolis et al., 2007). The interplay between firm strategies and market outcomes underscores the broader economic and social consequences of corporate ESG actions, raising critical questions about their drivers and implications.

In this context, this paper examines how firms respond to the public demand for better ESG performance and the market responses to their divergent strategies. Specifically, we ask the following questions Do firms maintain business-as-usual practices, largely ignoring the growing demand for ESG, or do they actively invest in ESG initiatives? What

are the fundamental drivers behind these ESG actions, and what are their market implications? These questions are central to understanding firm behavior, yet they pose significant empirical challenges. A key difficulty lies in the fact that both the supply of and demand for corporate ESG actions are shaped by numerous unobservable factors, and firms' strategic behaviors often obscure their true motivations. Additionally, the limited availability of public communication channels hinders researchers' ability to accurately measure public ESG demand for specific firms, let alone trace the full impact-generating process of their actions.

We address these challenges through a nationwide field experiment involving all listed firms in China. Specifically, we raise ESG-related concerns to randomly selected listed firms through two online platforms that allow retail investors to communicate directly with corporate management teams. The two platforms are established by the Shenzhen Stock Exchange and the Shanghai Stock Exchange to enhance accountability and transparency, and all the Chinese listed companies are required by the Chinese government to respond to investors' inquiries on the platforms. Given that ESG is still a relatively new concept in China, this unique environment allows us to create exogenous public demand on these platforms, observe the firms' responses, and analyze the subsequent market implications.

We then follow the full impact-generating process and investigate whether and how demand translates into supply and equilibrium responses. This process includes firms' online responses, offline actions, spillover effects, and ultimate market impacts. We observe that many firms actively address our concerns by supplying detailed ESG information and outlining future strategies. These firms are more likely to mention such ESG information under other topics, release ESG reports, and promote their ESG commitments during onsite visits following our experiment. However, not all ESG investments translate into market value. Investors perceive environmental and social dimensions positively, while governance information is often treated as a warning sign, resulting in divergent stock price trajectories. Despite the costless nature of our demand shifter, our experiment generates a notable move toward a more ESG-friendly market state.

To further understand the underlying motives for ESG actions, we develop a simple conceptual model based on the classical Spence (1973) signaling framework. We incorporate ESG as an image-enhancing signal that aligns with profit-maximization goals. Firms adopt costly ESG actions as second-best strategies to reveal their quality under information asymmetry. Consistent with the theory predictions, we find that firms with

higher productivity, greater information barriers, and more ESG-conscious investors are more likely to rely on ESG signals. These firms also reap the largest market benefits from their signaling behaviors in equilibrium.

This paper contributes to the literature in four ways. First, we provide the first experimental evidence of ESG supply-demand dynamics in a real-world setting. Existing studies on ESG are predominantly observational, relying on natural experiments to infer firms' responses to regulatory or investor demands (Chen et al., 2018; Flammer et al., 2021; Kahn et al., 2023). Establishing causal relationships using observational data is challenging due to unobservable social changes that affect both the demand and supply sides. Among the few experimental designs, Bartling et al. (2024) explore the role of public discourse in pro-social market behaviors in a lab setting. Burbano (2016), Hedblom et al. (2019), and Colonnelli et al. (2023) focus solely on firms' internal decisions during the hiring process. Our experiment is the first to systematically examine firms' interactions with external stakeholders and to follow the full impact-generating process. Moreover, our study encompasses all listed companies in China, revealing general equilibrium effects that transcend industrial or administrative boundaries.

Second, we mathematically formulate and empirically test the signaling motive behind corporate ESG actions. This framework reconciles the competing goals of profit maximization and social responsibility, suggesting that firms can "do well by doing good" under the market failure of information asymmetry (Eichholtz et al., 2010; Waddock & Smith, 2000). Importantly, not all firms benefit equally from ESG initiatives: those facing higher information barriers in financial markets and possessing comparative advantages in signaling cost have the strongest incentives to invest in ESG causes. We validate our theoretical predictions using experimental data and rule out competing values-driven hypotheses in the context of Chinese listed firms.

Third, we provide concrete evidence of the differentiated investor perceptions of the E, S, and G dimensions of ESG. Several studies, such as Heath et al. (2023) and He et al. (2023), have argued for separating G issues from ESG due to their distinctive features and regulatory frameworks, but empirical support for this argument has been limited. Our experiment demonstrates that investors exhibit asymmetric interpretations of E, S, and G issues—responding positively to E and S, but negatively to G. Consequently, these three dimensions have divergent stock market implications despite similar corporate inputs. Our

findings contribute to ongoing public debates over the definitions and interpretations of ESG, potentially inspiring more nuanced regulatory approaches in the future.

Lastly, we create a leading example of how individuals can be empowered to promote pro-social corporate actions. Institutional investors are widely recognized for their significant influence on corporate decisions, whereas retail investors, often "diffused shareholders," typically have limited control or impacts (Dyck et al., 2019; Kim et al., 2019; Shleifer & Vishny, 1986). Our field experiment shows that effective use of public communication channels can exert strong enforcement pressures on firms, leading to widespread impacts including responses, disclosures, and advertising. Retail investors' voices not only serve as demand signals but also provide valuable information for firms to update their potential market payoffs.

The rest of this paper is structured as follows. Section II describes our research settings. Section III provides an overview of the experimental design. Section IV introduces the data, presents balance tests, and outlines our empirical strategy. Section V reports the experimental results. Section VI builds a conceptual framework to explain firms' ESG motivations, with predictions tested in Section VII. Finally, Section VIII concludes.

II. Research Settings

II.1 Online Q&A Platforms

In this study, we make use of two unique online Q&A platforms in China. Unlike developed economies, China has over two hundred million retail investors in its stock market. Retail investors hold 36% of the free-float market value of the A-share companies and account for 82% of the trading volume (Quan, 2022; Xun et al., 2022). To streamline the communication between retail investors and A-share companies, the Shenzhen Stock Exchange and the Shanghai Stock Exchange set up official online Q&A platforms in 2010 and 2013, respectively (see Figure A1). Each A-share firm has its own dedicated community on the platforms and is required to appoint a high-level employee, typically a board secretary, to ensure the accuracy of responses. Whenever a question is posted online, both the manager and the investors who follow the company will receive an alert, the latter of which would also get a follow-up when the company posts a reply. The platforms prohibit any dissemination of significant new information but are dedicated to explaining prior disclosures in a publicly accessible manner.

As an indispensable channel of first-hand information, the two platforms have attracted great interest from retail investors. As of 2023, over 450,000 questions are posted on these two platforms annually, equivalent to more than 9,000 questions per week. Almost all (>98%) non-financial A-share firms have joined the platforms, and the overall reply rate is above 85%. Depending on the firm's efficiency, the response time can range from a few hours to more than a month, but the average response time is just over a week (9 days). Overall, the two platforms play an integral role in bridging businesses and people. Executives now have direct access to public opinion and can swiftly respond to individual concerns as a result of this new information channel.

Several studies have attempted to evaluate the effectiveness of these online platforms. Lee and Zhong (2022) finds that interactive platforms help reduce investors' difficulties in processing public information, increase market liquidity, and improve price informativeness. In terms of motivating corporate actions, Y. Jiang et al. (2022) finds that a higher degree of interaction improves corporate TFP, and Li et al. (2023) notes that the green concerns of minority shareholders can significantly encourage firms to conduct green innovation. Meanwhile, investors benefit from voicing out their requests, as the number of dividend-related questions is positively associated with future dividend payouts (Lin et al., 2023). These studies provide some preliminary understanding of the power of individual voices. Nevertheless, their results are likely biased by omitted variables and self-selection problems using only the observational data. By randomizing treatment and control groups, we will be able to identify causal relationships free of the aforementioned biases. To the best of our knowledge, Wong et al. (2023) is the only study that applies experimental design to online platforms, which finds that retail investors' demand for disclosing the identities of major customers and suppliers enhanced the transparency of Chinese firms. Our research significantly distinguishes from theirs in terms of firm-specific input data, mechanism identification, and the ability to track the full impact-generating process. As the first ESG-related social experiment in China, we aim to systematically document the demand-supply dynamics of this ever-growing issue and generate social influence far beyond the scope of these platforms.

II.2 Stock Forums and Social Media

A parallel design to raising questions on Q&A platforms is forwarding the interactions to stock forums and social media. The former draws attention primarily from the management team, while the latter spreads more widely among retail investors and

ordinary individuals. The interplay between these platforms enables us to identify the role of diffused stakeholders in influencing corporate decisions. We consider three platforms when forwarding the messages: Guba, Xueqiu, and Weibo. The first two are stock forums, where retail investors exchange ideas and share their investment strategies. Guba (Guba.EastMoney.com, as shown on the left panel of Figure A2) is one of the most active sets of stock message boards in the world and the most influential one in China (Li & Zhang, 2023). Due to its popularity, it has been employed to proxy public attention (L. Jiang et al., 2022), investor communications (Jiang et al., 2019), and crowd criticisms (Ang et al., 2021) in many studies. Xueqiu (xueqiu.com, as shown on the right panel of Figure A2) is another popular and representative financial community in China. It houses professional knowledge exchanges and stock advice that are welcomed by relatively inexperienced investors. A few studies have applied sentiment analyses to Xueqiu posts to investigate their implications on the stock market yield and volatility (An et al., 2018; Tham, 2015). The last platform, Weibo, is the counterpart of *X* (Twitter) in China (see Figure A3). As one of the most powerful social media in China, Weibo features 500-600 million active users and over 38 thousand verified media accounts (Weibo, 2020). It is found to play a vital role in shaping public opinions (Nip & Fu, 2016; Zheng et al., 2019) and coordinating collective actions (Qin et al., 2021; Yang & Calhoun, 2007). Although ESG-related posts only account for a small proportion on Weibo, the possibility of mentioning (@) specific companies and tagging (#) relevant keywords could engage a wide audience, including consumers, suppliers, activists, and community members. We hope some of our forwarded messages could increase public awareness and trigger discussions beyond the confines of social media.

III. Experimental Design

III.1 Overview

We conduct a nationwide randomized controlled trial (RCT), an experimental evaluation method that enables the identification of causal effects of programs with a high level of confidence, to examine the research question. An RCT randomly assigns subjects (individuals, households, schools, or firms) into either a treatment group (that is offered the program) or a control group (that is not allowed to receive the program during the evaluation period). Since the policy application is fully randomized, subjects in the two groups should, in theory, have similar observable and unobservable characteristics *ex-ante*,

and any changes in their behavior and outcomes *ex-post* can be attributed to the treatment. Based on its undisputable advantage of reducing selection bias and confounding factors, RCT has been viewed as a "gold standard" in causal inference (Banerjee et al., 2016).

The structure of our experiment is summarized in Figure 1. We use block randomization based on the market value to create four treatment arms: T1, where firms receive information only about their overall ESG ratings from multiple sources; and T2-T4, where firms receive ESG ratings along with specific concerns about their environmental, social, or governance performance, respectively. All messages are intentionally crafted with a negative tone to motivate further efforts (sample questions can be found in Appendix A)[1]. To enhance credibility and relevance, we include comparative advantages within the industry and recent ESG-related media coverage in all messages.

In addition to the main treatment arms, we establish two crosscut arms to examine the effect of investors' preferences toward ESG on firm behavior. In C1A, we only engage with firm management teams on the Q&A platforms. In C1B, we further share our interactions with firms on two investor forums (Guba and Xueqiu) and social media (Weibo). For the forwarded messages, we maintain a neutral tone to evoke authentic investor reactions without biasing their sentiments. We then analyze the sentiments of investors' comments on our posts and examine whether these sentiments influence firms' responses on Q&A platforms and affect market valuation accordingly.

III.2 Implementation

Our experiment started on December 4, 2023 and concluded on April 1, 2024. We recruited a team of 20 research assistants and divided them into three groups. The first group was responsible for drafting and sending ESG inquiries on Q&A platforms. Each assistant managed two to three accounts to avoid concentrating ESG questions within a small number of accounts. Their duties included consulting the latest ESG ratings of listed firms from our database, phrasing the questions using various rhetorical skills, and sending

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[1] It is important to note that we do not condition our treatment arms based on ESG ratings or E/S/G sub-ratings. In other words, firms from different treatment arms are balanced *ex ante*, with no statistical difference in their ESG performance. To maintain the negative tone of our experimental messages, we selectively choose a few well-known agencies that give the treated firms a low rating. This approach is feasible due to the low correlation in ESG ratings across different agencies, a phenomenon well documented by Berg et al. (2022).

the questions to firm management teams according to a prespecified schedule. The second group handled quality control. They reviewed all messages the day before they were sent to the firms and identified potential issues. This group played a key role in ensuring consistency in the information and tone of our messages across research assistants and treated firms. The third group forwarded 40% of our messages to investor forums and social media, contributing to the C1B crosscut arm. They took forwarding actions within a week after the original post on the Q&A platforms and tailored the messages depending on whether the firms had provided any replies. They also added two to three comments using different accounts to keep the posts active after two to three days.

The sample of our analysis consists of 4,852 non-financial A-share companies that received at least one question on either platform in 2023. Companies that ranked first in ESG performance within each industry were excluded to avoid untruthful complaints about their lack of ambition. At the baseline, we collected a rich set of data on firms' ESG performance before the experiment. For each A-share company available on the platforms, we recorded its ESG ratings, E/S/G sub-ratings, historical ESG reports, and negative news coverage related to its ESG performance. This baseline data was incorporated into the questions we posted on the platforms as evidence of our concerns. During the RCT, we continuously monitored platform dynamics, including companies' responses, follow-up questions by other investors, and spillovers of ESG content to other non-ESG questions. We also tracked companies' offline behaviors, such as the publication of ESG/CSR reports, changes in ESG ratings across agencies, mentions of ESG during institutional investor investigations, and negative media reports. To explore market impacts, we collected daily A-share data and used event studies to quantify stock price effects. The data collection period spanned from July 1, 2023 to June 30, 2024.

The timeline of our experiment is illustrated in Figure A4. For the treatment arms, we raised 5,908 questions covering 2,945 firms on the Q&A platforms (see Panel A). We initially spread out the questions evenly across weekdays, but the actual posting days varied due to censorship delays by platform administrators. Additionally, because censorship took a long time given the large volume of questions, we decided to halve the posting frequency two weeks after the start of our experiment. These contingencies are unlikely to bias our causal estimates, as censorship decisions are primarily aimed at checking for question duplication and are independent of firm characteristics. For the crosscut arm C1B, we forwarded 2,359 questions linked with 1,180 firms to each of the three platforms (Guba,

Xueqiu, and Weibo) (see Panel B). The time interval between the original post and the forwarded post was randomized between one to seven days, regardless of whether firms had provided a response. Unfortunately, post deletion after other users' complaints was common on stock forums, resulting in incomplete web scraped results in our analysis. Given that this missing data likely drives down the coefficient estimates, our results provide a lower bound of the effect of investors' feedback.

Our experiment has led to non-negligible attention and interaction on both the Q&A platforms and forwarded platforms. By the end of our data collection period (June 30, 2024), we had received 4,992 responses from listed firms, resulting in a response rate of 84.5%. The median reply time was four days, and 24.88% of the questions were answered within a day. Responses varied in length, with the median being 123 Chinese characters (equivalent to a brief paragraph), and the full range spanning from 5 to 1,086 characters. Section V.1 delves further into the response patterns of firms across the various treatment arms. Regarding investor interactions, 42.97% of firms in the C1B group received investor comments. The number of comments per firm ranged from one to 13, with a median of two comments. The comment length had a median of 14 Chinese characters (one short sentence) and a large standard deviation of 45 characters. In Sections V.3 and V.4, we explore whether these individual comments have any impact on firms' behaviors and market responses.

III.3 Ethical Considerations

Prior to designing this experiment, we have carefully considered its ethical implications. First, the Shenzhen Stock Exchange and Shanghai Stock Exchange explicitly encourage investors to post questions on their online Q&A platforms. There are, on average, over 9,000 questions per week, and our experiment adds <5% of questions to the ongoing discussions. Second, the Chinese government has been advocating for full coverage of ESG disclosure for central enterprises (SASAC, 2024). Our efforts to motivate firms to disclose more ESG information are consistent with the Chinese government's policy direction. Third, we consulted with several institutional investors and active users of online platforms and were not advised of any repercussions of ESG-related posts. Finally, although we did not collect data from any individual people, we obtained ethics approval from the Human Research Ethics Committee at the University of Hong Kong.

IV. Data and Empirical Specifications

IV.1 Data

Data in this study comes from four main sources: financial terminals, company websites, ESG data vendors, and web scraping. This section briefly discusses the variables we obtain from various sources.

Firm characteristics: We collect a comprehensive set of characteristics for China's A-share firms using data from the China Securities Market and Accounting Research (CSMAR) Database, the Wind Financial Terminal, and the Choice Financial Terminal. Basic information includes firms' location, industry, age, number of employees, and market value. Additionally, we collect four sets of variables to measure firm productivity, transparency, leader traits, and cultural factors. For productivity, we use two standardized measures: return on assets (ROA) and return on equity (ROE). We also gather data to calculate value-added-based and revenue-based total factor productivity (TFP), such as fixed assets, depreciation, operating revenue, and operating costs. For transparency, we use 16 measures from highly cited papers, including equity structure, product diversification, and the ratio of independent board members. For leader traits, we refer to the CSMAR director database to obtain information on the Chairman, Vice-Chairman, CEO, and Vice-CEOs of each company, who are equivalent to the "C-Suite" executives in American firms (Fisman & Wang, 2015). For cultural factors, we combine locations of firms' headquarters and leaders' hometowns with city-level data provided by Chen et al. (2020) and Chen et al. (2022).

Online interactions: We regularly monitor and scrape data from the Q&A platforms, stock forums, and social media (Weibo) included in the experiment. We collect data on firms' responses from the Q&A platforms, including their reply rate, response time, response length, and sentiment towards our questions and other questions on the platforms. We also document the spillovers of our RCT by counting mentions of ESG keywords in questions outside our RCT and on other topics. From stock forums and social media, we collect investors' reactions by scraping all comments and follow-up discussions related to our posts. This comprehensive dataset allows us to gain a complete understanding of both the supply and demand sides of ESG issues in China.

Quarterly ESG ratings: ESG ratings serve as a crucial outcome variable, reflecting how firms perform across various ESG dimensions. We compile these ratings on a

quarterly basis from financial terminals, using data from both domestic and foreign agencies. The domestic agencies include Syntao, Wind, CSIndex, Sino-Securities Index, and RKS. The foreign agencies include MSCI, Refinitiv, FTSE, Bloomberg, and S&P Global. Wherever available, we also gather E/S/G sub-ratings and specific ESG indicator values. These ratings and sub-ratings were referenced in the questions we posed to firms during our experiment. Following the conclusion of our RCT, we obtained access to the iFind Terminal and collected historical ESG data from additional agencies such as QuantData and Hithink RoyalFlush. These new sources allow us to investigate whether firms enhance their ESG performance in a neutral manner, as captured by the agencies not initially covered in the experiment.

ESG-related offline actions: In addition to ESG ratings, we examine three dimensions of firms' ESG offline actions: the release and quality of their ESG reports, news coverage of their ESG performance, and mentions of ESG during institutional investor investigations (such as site visits and interviews). For the first two dimensions, we collaborate with a data vendor called YoujiVest to scrape the websites of listed firms and mainstream media regularly. This allows us to obtain all historical ESG reports in PDF format and use OCR techniques to access their contents and construct quality measures. Additionally, we create a daily measure of negative media coverage for each listed company in the ESG domain, using keywords related to regulation violations and supply chain issues. For institutional investor investigations, we use the CSMAR database, which records the date, target firm, institution name, participants, and transcript of each investigation. We distinguish firms' responses from institutional investors' questions in the transcripts using GPT and identify mentions of ESG using a comprehensive set of relevant keywords.

IV.2 Balance Tests

We conducted a series of balance tests prior to the experiment, as presented in Appendix Tables A1 and A2. The firm-level statistics include basic information (such as market value, age, and number of employees), offline actions (such as ESG reports, mentions of ESG during institutional investor investigations, and ESG ratings), productivity measures (such as ROA, ROE, and TFP), transparency indices (including summary index, internal management index, external relationship index, and market research index), leader traits, and cultural factors. The t-statistics and p-values from the group-wise T-tests are shown in parentheses. For most variables, p-values are rarely smaller than 0.05, indicating that we cannot reject the null hypothesis that the treatment and

control groups are statistically identical. We also conduct F-tests of joint significance and find no significant differences across groups. Therefore, firm-level characteristics are balanced across experimental arms, confirming that the randomization was well executed.

IV.3 Summary Statistics

Table 1 provides an overview of the characteristics of the Shenzhen and Shanghai Q&A platforms over the 11 months leading up to our experiment. Each platform contributes approximately 50% of the firms in our study, totaling 4,852 firms that received at least one question in 2023. On average, firms on the Shenzhen platform received 105 questions during this period, with the number of questions ranging from one to 1,270. While firms on the Shanghai platform received fewer questions on average, the maximum number of questions per firm reached 3,587.

Prior to the experiment, there were almost no ESG-specific questions (defined narrowly as those containing the keyword "ESG" rather than just one aspect of E/S/G), accounting for less than 1% of the total questions. The average reply rate on both platforms was over 80%, with response times typically ranging from one to two weeks. The average length of responses was around 100 Chinese characters, equivalent to a short paragraph. Notably, there is no text limit on firms' responses; the longest responses on either platform exceeded 500 words, with significant variation across questions.

Overall, the summary statistics confirm the characteristics of the platforms highlighted in previous sections. First, firms place great importance on these platforms, providing high-quality responses within a relatively short time frame. Second, investors are highly active, posing 3,000 to 5,000 questions per week. Third, there was limited public interest in ESG topics prior to our experiment, as evidenced by the minimal number of investor queries on ESG. Therefore, these platforms offer an excellent setting to examine firms' supply-side responses to new public demand.

IV.4 Empirical Specifications

This section outlines the specifications used in our analysis. Given that we collect data from a variety of sources, the data structure and corresponding regressions differ on a case-by-case basis. Here, we provide a brief overview of the primary methodologies, emphasizing the rationale behind our tests and the justifications for our causal estimates.

We start with firms' online responses, using the following regression model:

$$Y_{ijrt} = \beta_0 + \beta_1 \times \text{treat}_r + \gamma X_r + \mu_i + \theta_{jt} + \varepsilon_{ijrt} \quad (1)$$

where i, j, r, and t represent firm, industry, question, and day, respectively. Y_{ijrt} captures the quality measures of firms' responses (e.g., length, number of ESG keywords, and sentiment) to questions on the Q&A platforms. $treat_r = 1$ if the question is part of our RCT. X_r includes question-level controls, such as question length and sentiment. μ_i represents firm-level fixed effects, controlling for time-invariant characteristics of each listed firm. θ_{jt} are industry-day fixed effects, accounting for time-varying events at the industry level, such as news shocks and industrial policies. ε_{ijrst} is the error term. Standard errors are clustered at the firm level.

The main coefficient of interest, β_1, captures the difference in response quality between our RCT questions and other similar questions to firms within the same industry on the same day. A positive β_1 suggests that firms provide higher-quality responses to our ESG questions compared to similar questions from other investors.

To investigate the causal impacts of our experiment on firm-level actions and market responses, we implement a difference-in-differences (DiD) design:

$$Y_{ijt} = \beta_0 + \beta_1 \times \text{treat}_i \times \text{post}_t + \mu_i + \theta_{jt} + \varepsilon_{ijt} \quad (2)$$

or

$$Y_{it} = \beta_0 + \beta_1 \times \text{treat}_i \times \text{post}_t + \mu_i + \varphi_t + \varepsilon_{it} \quad (3)$$

where i, j, and t represent firm, industry, and time, respectively. Y_{ijt} or Y_{it} are firms' outcome measures (such as release or quality of ESG reports, question or answer spillovers, question sentiments, and stock price, each defined in subsequent sections). $treat_i = 1$ if the firm belongs to one of the RCT treatment arms. $post_t = 1$ after the experiment commences. μ_i are firm-level fixed effects, controlling for time-invariant characteristics of each listed firm. θ_{jt} are industry-day fixed effects, controlling for time-varying industry-level events. φ_t are quarter-level or year-level fixed effects, controlling for time-varying factors such as economic growth and stock market sentiments common to all the listed firms. ε_{ijst} is the error term. Standard errors are clustered at the firm level. Depending on the data structure, t may refer to day, quarter, or year. When data is at the day level (t refers to day), we use Equation (2) to incorporate firm-level and industry-day-level fixed

effects. Otherwise, we implement Equation (3), replacing industry-day-level fixed effects with quarter-level or year-level fixed effects to allow for higher statistical power.

The main coefficient of interest is β_1, which measures the difference in outcomes between treated firms and control firms after our experiment. Since the treatment status is randomly assigned regardless of any firm-level characteristics, we can interpret β_1 as the causal impact of our RCT on the outcome variable.

To further analyze the evolution of the treatment effects over time, we use an event study approach on the same set of outcomes as in the DiD design and run the following regressions:

$$Y_{ijt} = \sum_{\tau=a,\tau\neq-1}^{b}(\alpha_\tau \times treat_i \times \mathbb{1}[t=\tau]) + \mu_i + \theta_{jt} + \varepsilon_{ijt} \quad (4)$$

or

$$Y_{it} = \sum_{\tau=a,\tau\neq-1}^{b}(\alpha_\tau \times treat_i \times \mathbb{1}[t=\tau]) + \mu_i + \varphi_t + \varepsilon_{it} \quad (5)$$

where i, j, and t represent firm, industry, and time, respectively. The only differences from Equations (2) and (3) are $\mathbb{1}[t=\tau]$, which is an indicator function that equals one when t falls in a time interval $\tau \in [a,b]$ around our experiment. We omit period $\tau=-1$ as the reference group. The coefficients of interest are a set of α_τ's, which measure the treatment effects of our experiment in each period. We expect α_τ $(\tau<0)$ to be close to zero based on the randomization design and will test this parallel trend assumption for causal interpretation. Changes of α_τ $(\tau\geq 0)$ indicate the evolution of the causal effects of our experiment on the outcomes of interest.

Lastly, we investigate the heterogeneity of our treatment effect across groups using the following regressions:

$$Y_{ijrst} = \beta_0 + \sum_{s=1}^{k}(\beta_{1s} \times \text{treat}_r \times Q_s) + \gamma X_r + \mu_i + \theta_{jt} + \rho_{st} + \varepsilon_{ijrst} \quad (6)$$

or

$$Y_{ijst} = \beta_0 + \sum_{s=1}^{k}(\beta_{1s} \times \text{treat}_i \times \text{post}_t \times Q_s) + \mu_i + \theta_{jt} + \rho_{st} + \varepsilon_{ijst} \quad (7)$$

or

$$Y_{ijst} = \beta_0 + \sum_{s=1}^{k}\sum_{\tau=a,\tau\neq-1}^{b}(\alpha_{\tau s} \times \text{treat}_i \times \mathbb{1}[t=\tau] \times Q_s) + \mu_i + \theta_{jt} + \rho_{st} + \varepsilon_{ijst} \quad (8)$$

which are revisions of Equations (1), (2), and (4) to incorporate group-wise estimates. Notably, we do not separate groups for quarterly or yearly data due to a lack of statistical power. In Equations (6), (7), and (8), Q_s refers to a dummy variable that equals one if firm i belongs to a group $s \in [1, k]$, and ρ_{st} refers to group-day fixed effects to control for time-varying common shocks within each group. For treatment and crosscut arms, group refer to T1/T2/T3/T4 or C1A/C1B, and we omit ρ_{st} in (7) and (8) as they would absorb the variation of interest. For productivity, transparency, leader traits, and cultural factors, groups correspond to the quartile a variable falls into prior to our experiment, thus $k = 4$.

The main variables of interest are β_{1s} and $\alpha_{\tau s}$. They measure the treatment effects of our experiment on a specific group $s \in [1, k]$. The difference in estimates across s values help us identify the relative importance of treatment arms and the potential motivations behind firms' ESG responses and actions.

V. Experimental Results

V.1 Firms' Online Responses

We begin by examining the responses we received directly from China's listed companies. Table 2 presents firms' responses across treatment groups. In T1 (ESG Messages), firms are asked about their overall ESG performance in a general manner, while T2-T4 (E/S/G Messages) further inquire about their performance in specific E/S/G dimensions. The control group comprises questions of similar length and sentiment but lies outside of our experiment. Overall, generic ESG messages do not elicit significantly higher-quality responses from firms, as indicated by comparable response length and sentiment in Columns 1-2. When firms are asked about specific dimensions of E/S/G, their responses tend to be notably longer and more positive, particularly in terms of E and S messages, where responses are 34.14% and 28.18% longer than the control mean, and 25.52% and 23.87% more positive. The last four columns represent the word counts dedicated to E/S/G aspects and ESG in general. These findings indicate that firms have a clear understanding of ESG and can provide specific responses related to targeted ESG aspects, as evidenced by the significantly higher number of relevant words in the treatment groups (T2-T4). Notably, T2, which focuses on environmental concerns, features the highest number of ESG words. It suggests that firms exhibit a stronger comprehension of environmental issues than other ESG aspects.

In addition to responses to our RCT questions, we monitor whether firms incorporate their ESG information into responses to other investors' queries. Given the rarity of ESG-related questions prior to our RCT, firms' responses to our questions are likely new information on the platforms. If firms recognize the value of such information, they may choose to disseminate it widely in response to other questions. Panel A of Figure 2 illustrates this answer spillover phenomenon, where firms proactively introduce ESG information into their responses, potentially aiming to enhance their reputation. Using an event study design, Panel B of Figure 2 demonstrates that firms in the treated group begin mentioning ESG more frequently than the control group, and this trend persists even after several months. While statistical significance for individual periods is not detected due to limited observations, the DiD estimate is significantly positive at the 5% level. These findings indicate that treated firms are inclined to share ESG information once the topic is introduced on the platforms.

It is important to highlight the strong correlation between firms' online responses and offline actions. In Figure A6, we plot firms' average ESG ratings from various rating agencies against two measures of their responses: length and sentiment. Both panels indicate a close alignment between firms' ESG ratings and the quality of their responses on the platforms. This alignment is unsurprising given that the platforms are overseen by official stock exchanges, and board secretaries are responsible for ensuring information accuracy. Consequently, the positive response effects identified in this section extend beyond mere "ESG-washing" to genuine efforts, which will be further examined in the subsequent section.

V.2 Firms' Offline Behaviors

Do firms translate their high-quality online responses into concrete ESG actions? In this section, we address this question by examining various types of offline behaviors. We begin with ESG ratings, which are likely the most direct targets for firms since we reference these ratings in our questions. Next, we analyze the release and quality of ESG reports, which require significant effort to compile. We then track the frequency of ESG mentions during institutional investor investigations, viewing this as an investment in corporate advertising of ESG topics. Lastly, we present suggestive evidence regarding the media's ESG coverage for treated versus control groups.

Figure 3 shows the event study plots from major ESG rating agencies in China. We exclude foreign agencies due to their limited coverage and lack of adjustments for Chinese

firms. Panels A and B feature two widely cited rating agencies in our experiment. The likelihood of a specific agency being referenced in our messages is negatively correlated with rating outcomes, creating a selection-on-observables design based solely on rating results. To obtain causal estimates of our RCT's effect, we incorporate propensity score matching (PSM) into the event study. Here, the propensity to be treated (i.e., a message citing a specific agency) is predicted using the ESG rating from the same agency before our experiment. Panels C and D show data from two uncited agencies, whose information became available only after our experiment concluded. For these agencies, we apply a standard event study approach to identify causal effects.

Across all panels in Figure 3, we observe a positive trend in ESG ratings for treated firms compared to their control counterparts. The effect does not appear immediately after the experiment, as it takes time for rating agencies to process new ESG information and adjust their ratings. Figure A9 demonstrates that the timing of these positive effects aligns well with each rating agency's adjustment schedule. Importantly, the improvement in ratings is unlikely to be driven by collusion between firms and rating agencies, as agencies in Panels C and D were never cited. Instead, the consistent trend across agencies suggests that firms are enhancing their visible ESG efforts, which are detected by agencies using diverse methodologies.

A crucial source of information for ESG ratings is the ESG/CSR reports. In Column 1 of Table 3, we investigate whether treated firms are more likely to release ESG reports following the public demand created by our experiment. On top of the prevailing regulatory pressure on ESG disclosure, we observe a significantly positive DiD estimate of 2.6% for treated firms, which represents almost 10% of the control mean. This suggests that treated firms are significantly more likely to release an ESG report a few months after the public demand is initiated.

Columns 2-5 of Table 3 further reveal that these newly released ESG reports maintain a quality comparable to existing reports. Firms do not appear to be flooding the market with low-quality reports just for the sake of improving their ratings.

In Column 6 of Table 3, we perform a textual analysis of the transcripts from institutional investor investigations to examine whether firms increase their efforts in ESG advertising during communications with other investors. The analysis shows that the likelihood of ESG being mentioned during investigations rises by 1.3% after the experiment, nearly matching the control mean. This increase is primarily driven by

proactive mentions by the firms themselves, rather than inquiries from institutional investors, as detailed in Appendix X.

Finally, we provide suggestive evidence on the trend of negative media reports on ESG issues for treated versus control firms. Figure 4 presents the event study plots. Given the rarity of firm-specific ESG-related media reports, we lack the statistical power to detect significant effects. However, for the two most frequent topic categories—regulation violations and supply chain issues—we observe a slight downward trend for treated firms. The most notable declines occur four months after the start of our experiment, coinciding with the period when companies typically publish annual reports and are under media scrutiny. Overall, the trend in media reports aligns with our findings from other offline actions, indicating that firms under public ESG pressure are inclined to undertake substantial efforts to enhance their ESG ratings.

V.3 Market Responses

Given that treated companies exhibit proactive responses and actions, it is intriguing to investigate whether these supply-side dynamics extend to the demand side, impacting market valuation. This section explores the market responses to our experiment. While we observe no aggregate market impact on treated firms in Panel A of Figure 5, Panel B reveals interesting heterogeneity across treatment arms. In the six months following our experiment, firms that received E messages experienced a significant 2.3% increase in stock price, firms that received S messages saw a slight rise in market value, while firms that received G messages faced a clear negative trend in market valuation. This heterogeneity on the supply side mirrors the findings in Table 2, which show that E and S messages elicit much higher response quality from firms, potentially enhancing their brand reputation. In contrast, firms' responses to G messages may not be strong enough to counterbalance the negative sentiment triggered by our queries, resulting in net negative effects.

To further investigate demand-side investor behavior, we compare platform dynamics before and after our experiment. Panel C of Figure 5 shows that immediately following the start of our RCT, there was a significant increase in the ratio of ESG-related questions raised by other retail investors. This pattern persisted for several months, leading to a notably positive 0.2% increase over six months. Moreover, the increase is primarily driven by the G message group, as depicted in Panel D. This suggests that investors may not be satisfied with firms' responses to our G messages, prompting them to raise more concerns afterward. These concerns may have contributed to the negative stock price trends.

Analyzing investor question sentiments more closely, we find a decline in overall sentiment for treated firms after our experiment. This pattern is mainly driven by the G message group, which experienced two waves of negative sentiment effects: one after the start of our RCT and another following the release of their annual reports. Although we lack precise interpretations for these two waves, the findings are consistent with the notion that retail investors scrutinize firms receiving G messages more closely and remain critical of their performance even after reviewing the annual reports. In sum, the findings on market responses underscore the importance of investor perception in driving corporate valuation. Retail investors in China appear more positive toward E and S discussions but view G issues as potentially value-reducing.

VI. Illustrative Model

We develop a simple model to explore the motivations behind firms' ESG actions, building on the seminal signaling framework by Spence (1973). Our central argument posits that firms undertake costly ESG actions to signal their quality under information asymmetry. We derive key propositions from this illustrative model, which will guide our heterogeneity analysis in the subsequent section.

The market consists of two sets of risk-neutral players: firms and investors. A firm's productivity (quality/type) θ is drawn from a continuous distribution $\Theta = [\underline{\theta}, \overline{\theta}]$ with a density function $f(\theta) > 0$ at all points. θ is publicly observable with a probability φ, where φ is public information and unalterable by firms. Productivity θ and transparency φ are orthogonal attributes for each firm.

Investors, who are the owners of the firms, collectively determine market value based on available information. Their beliefs follow the Bayesian rule. Among these investors, a fraction γ are ESG-conscious, incorporating firms' ESG performance in their valuation process. The remaining investors do not consider ESG as relevant to firms' market value. The investors operate in a competitive market, where each expects to earn zero profit in equilibrium.

Firms may use ESG as costly signals e to convey their inherent type θ to uninformed investors. These ESG efforts are generally not directly linked to a firm's core business operations, allowing firms to enhance their social reputation without disclosing trade secrets. For simplicity, we assume that ESG efforts do not directly enhance firm

productivity but serve solely as signals of their type. This assumption is relaxed in Appendix X.

Following Spence (1973), we make the following assumptions about the signaling cost $c(e, \theta)$:

1) $c(0, \theta) = 0$: No signaling effort implies no signaling cost.
2) $c_e(e, \theta) > 0$: Higher signaling effort results in higher signaling cost.
3) $c_{ee}(e, \theta) > 0$: The cost function is convex with respect to signaling effort.
4) $c_\theta(e, \theta) < 0$: Higher firm productivity leads to lower signaling cost.
5) $c_{e\theta}(e, \theta) < 0$: Higher firm productivity reduces the marginal signaling cost with respect to signaling effort.

The first four assumptions are standard and straightforward to justify. The last assumption suggests that the marginal cost of increasing ESG signaling effort decreases with higher firm productivity/quality. This can be supported by the fact that higher-quality firms generally have more capable personnel and resources, which enables them to achieve ESG signaling at lower additional expenditure. Without loss of generality, we assume $c(e, \theta) = c(\frac{e}{\theta})^2$ ($c > 0$) to obtain a closed-form solution.

The timeline of actions is as follows. In the first period, firms choose their ESG signaling levels e based on their own type θ and transparency φ. In the following period, there is a probability φ that θ becomes public knowledge, allowing investors to price firms based on their true type θ. Alternatively, with probability $(1 - \varphi)$, θ remains private information, and uninformed rational investors infer firms' inherent quality based on the observed ESG signals e. In the concluding period, θ is fully revealed, and firms and investors achieve their respective profits. We assume no discount between periods.

Given this setup, we can formulate the following optimal strategies for each player.

Firms' optimal strategy:

$$e(\theta, \varphi, \gamma) \in arg\max_e \varphi\theta + (1 - \varphi)[\gamma w_1(e, \varphi) + (1 - \gamma)w_2(\varphi)] - c(e, \theta) \quad (1)$$

where $w_1(e, \varphi)$ and $w_2(\varphi)$ represent the market valuation outcomes for ESG-conscious and non-ESG-conscious investors, respectively. These outcomes are weighted by their market share, which can vary among firms based on the composition of their investors.

ESG-conscious investors' optimal strategy:

$$w_1(e,\varphi) \in arg\ \max_{w} \int_{\underline{\theta}}^{\overline{\theta}} \mu_i(e,\varphi)\theta_i d\theta_i - w_1(e,\mu) \tag{2}$$

where $\mu_i(e,\varphi)$ is investors' belief that a firm is of type θ_i given the observed signal and transparency level. This belief obeys the Bayesian rule.

Non-ESG-conscious investors' optimal strategy:

$$w_2(\varphi) = \varphi\theta + (1-\varphi)\mathbb{E}[\theta] \tag{3}$$

which is not a function of ESG signaling effort e because this group of investors does not consider ESG to be value-relevant. They base their valuation decisions solely on the availability of accurate productivity information.

The optimization problems may lead to multiple types of equilibria. For real-world relevance, we only focus on separating perfect Bayesian equilibria (PBE), where $e^*(\theta,\varphi) \neq e^*(\theta',\varphi')\ \forall(\theta,\varphi) \neq (\theta',\varphi')$. In other words, we limit our attention to cases where different firms supply different levels of ESG signals to explore the drivers of their heterogeneity. To characterize firms' optimal strategy, we first write down their first-order condition:

$$(1-\varphi)\gamma w_{1e}(e,\varphi) - \frac{2ce}{\theta^2} = 0 \tag{4}$$

Claim. The optimal signal under perfect transparency $\overline{\varphi} = 1$ is always zero.

Proof. When $\overline{\varphi} = 1$, the partial derivative of firms' profit with respect to e is $-\frac{2ce}{\theta^2} < 0$. As a result, the firms' optimal strategy is to minimize their signaling efforts, i.e., $e^* = 0$.

For other firms $\theta \in [\underline{\theta}, \overline{\theta}]$ and $0 \leq \varphi < 1$, we utilize the zero-profit condition for investors ($w_1(e,\varphi) = \theta$). Therefore, equation (4) can be rewritten as:

$$w_1(e,\varphi)^2 w_{1e}(e,\varphi) = \frac{2ce}{(1-\varphi)\gamma} \tag{5}$$

Corollary. $w_{1e}(e,\varphi) > 0$: Investors' valuation of firms is positively correlated with firms' ESG signals.

Solving this simple differential equation, we obtain:

$$w_1(e,\varphi) = \left[\frac{3ce^2}{(1-\varphi)\gamma} + C\right]^{\frac{1}{3}}, where\ C\ is\ a\ constant \tag{6}$$

From equation (6), the separating PBE signaling path can be summarized as:

$$e^*(\theta, \varphi, \gamma) = \sqrt{\frac{(1-\varphi)\gamma[\theta^3 - C]}{3c}} \quad (7)$$

Propositions. In separating PBEs, firms' optimal ESG signaling $e^*(\theta, \varphi, \gamma)$ satisfies:

1) $\frac{\partial e^*}{\partial \theta} > 0$: Firms with higher productivity send more ESG signals.

2) $\frac{\partial e^*}{\partial \varphi} < 0$: Firms with lower transparency send more ESG signals.

3) $\frac{\partial e^*}{\partial \gamma} > 0$: Firms with more ESG-conscious investor bases send more ESG signals.

VII. Testing Model Predictions

Guided by the theoretical framework, this section empirically tests whether firms' ESG responses and actions align with the predictions of the signaling model. We consider both firms' online responses and offline actions as ESG signals and use them to test the three propositions. Additionally, we utilize stock price data to examine the corollary regarding market feedback to firms' ESG signaling behaviors.

VII.1 Firm Productivity and ESG Responses/Actions

We first test proposition 1: whether firms with higher productivity are more willing to send ESG signals. By assumption, firms' productivity is not directly observable. Therefore, we could only use imperfectly measured proxies to infer the relationship. In Panel A of Figure 6, we utilize four different variables: return on assets (ROA), return on equity (ROE), and two total factor productivity (TFP) measures based on firms' value added and revenue to approximate firms' inherent potential to earn profit. Notably, these four measures exhibit weak correlations, with pairwise correlation below 0.4. This indicates a lack of consensus in the market regarding firms' productivity, with each proxy capturing only a specific aspect of it.

Panel B of Figure 6 presents results from Equation (7). Consistent with Proposition 1, the findings suggest that firms with higher productivity are more willing to supply higher-quality responses to our ESG questions. This result holds across different measures of firm productivity and response quality. The effect is most pronounced in the highest-productivity group, which theoretically has the most capable personnel and abundant

resources to invest in ESG actions. In Appendix X, we demonstrate that these results are robust when using continuous versions of the firm productivity measures.

Do high-productivity firms translate their stronger ESG signals into concrete actions? In Table 4, we examine the heterogeneity of their offline ESG actions in terms of ESG ratings, publication of ESG reports, mentions of ESG during institutional investor investigations, and negative media reports. For the first three measures, higher values indicate better ESG performance, and we find that the interaction term between the DiD estimator and ROA (a productivity measure) is significantly positive in most cases. For negative media reports, lower values indicate fewer ESG scandals/incidents, and we find significantly negative interaction coefficients as predicted by the model. In summary, firms do act on their ESG commitments. High-productivity firms that send the strongest signals are observed to improve their ESG performance to the greatest extent.

VII.2 Firm Transparency and ESG Responses/Actions

We then move on to test Proposition 2, which examines the relationship between a firm's inherent transparency and its ESG signaling behavior. The literature has put forward a number of measures of firm transparency, such as ownership structure, board composition, rating divergence, and the number of external analysts (Armstrong et al., 2014; Avramov et al., 2022; Boone & White, 2015; Guedhami et al., 2009). To avoid relying on a single indicator, we collect data on a variety of measures and standardize them to construct transparency indices (see Panel A of Figure 7). The summary index is comprised of three sub-indices, including the internal management index, the external relationship index, and the market research index, each consisting of four well-documented transparency indicators. While we focus on the heterogeneity across the indices in the main text, all the indicator results are included in Figure A10.

In Panel B of Figure 7, we present the heterogeneity of firms' response quality across the four transparency indices. The results consistently show that lower-transparency firms are more eager to send high-quality ESG signals, possibly due to their lack of communication channels in the financial market. Only firms with below-median transparency supply significantly higher-quality responses to our ESG questions, whereas above-median transparency firms respond to ESG questions similarly to other types of questions on the platforms. This is consistent with Proposition 2, which suggests that higher-transparency firms do not need to engage in costly signaling, given the high market consensus on their productivity and quality.

In Table 5, we further investigate whether these less transparent firms take more ESG actions than their higher transparent counterparts. The results support our hypothesis. Columns 1-6 indicate that low-transparency firms make greater efforts to improve ESG ratings, release ESG reports, and advertise ESG during investor investigations. Columns 7-8 suggest that these firms receive fewer negative media reports on ESG-related matters. It is worth noting the weak correlation between firm transparency and productivity, with a correlation coefficient of -0.10. The heterogeneity results for transparency remain largely unchanged when we introduce productivity measures into the regressions (see Figure A11). This suggests that transparency serves as a distinct driver of firms' ESG actions, operating independently of firm productivity.

VII.3 Investor Preferences and ESG Responses/Actions

Proposition 3 suggests that firms with a more ESG-conscious investor base have greater incentives to send signals to uninformed investors. In the context of China, retail investors play a dominant role in stock trading and market fluctuations. Therefore, their preferences and beliefs about ESG are likely to influence firms' decisions to send ESG signals. In our experiment, we forwarded 40% of our questions from Q&A platforms to stock forums and social media, where retail investors actively discuss firms' stock market performance. We maintained a neutral tone and used diverse phrases to encourage genuine interactions with retail investors. We then investigated whether the sentiments expressed by retail investors towards ESG in response to our posts might trigger any reactions from the treated firms.

Unfortunately, among the 1,180 firms in the forward crosscut group, only 507 (42.97%) received any responses from retail investors. This lack of response was not only due to limited attention from retail investors but also various censorship issues on public forums, such as posting frequency limits and traffic control by administrators. Several of our posts were hidden or removed after a few days, restricting their influence and limiting potential interactions. Nevertheless, we received a total of 1,100 comments from retail investors, averaging two comments per firm. We calculated the sentiment of these comments for each firm as a proxy for the ESG consciousness of their investor base.

Since ESG is still a relatively novel concept in China, most retail investors have little knowledge of or interest in this issue. They overwhelmingly treated our questions as irrelevant to the stock market, posting negative or toxic comments (see Figure A8 for examples). A total of 61.74% of the firms exposed to investor comments received at least

one negative comment. The remaining firms received solely positive or neutral comments, which may not discourage them from sending ESG signals.

We are interested in comparing firms' signaling behavior in response to investor sentiments, conditional on forum censorship and investor attention. Therefore, we limit our regression analysis to the 507 firms exposed to investor comments, viewing them as the treated group. We compare the difference in coefficients between firms that received no negative comments and those that received at least one negative comment. Table 6 presents the regression estimates. Across three measures of firm response quality, we find that firms that did not receive any negative comments from retail investors tend to provide higher-quality and more positive answers to our ESG inquiries. This indicates that firms value retail investors' opinions and strategically adjust their signaling behavior on public communication channels, in line with Proposition 3.

VII.4 Market Responses to ESG Responses/Actions

In our signaling framework, the primary motivation for firms to engage in ESG activities is to gain positive market valuation benefits from uninformed investors. If the market is inefficient or sluggish in terms of stock prices, firms would not be incentivized to invest in any costly signals. We empirically examine this feedback using stock price data.

According to our corollary, investors' aggregate market valuation should be positively correlated with firms' signaling efforts as long as there exist ESG-conscious investors. Combining this with the three propositions we validated earlier, we expect that firms that are more productive and less transparent and those with fewer negative investor comments will enjoy positive market valuation benefits following their signaling behaviors. Table 7 supports this hypothesis. In addition to the average treatment effect term $\text{treat}_i \times \text{post}_t$, we introduce interaction terms with ROA, the transparency index, and negative comment indicators to investigate the heterogeneous treatment effects across various motivation factors. We find that the relative magnitude of market responses aligns with the extent of firms' signaling efforts. While we do not claim our explanation to be the sole one, firms' online responses, offline actions, and market reactions all appear to be consistent with the predictions of the signaling model.

VII.5 Alternative Hypotheses

Since the influential presidential address by Starks (2023), the value-versus-values debate over investor and manager motivations for ESG has gained tremendous popularity.

Our signaling framework largely aligns with value motivation, where firms invest in ESG in pursuit of profit maximization. However, a plausible alternative hypothesis suggests that firms' ESG decision-making may be driven by nonpecuniary preferences, leading them to sacrifice some profit in exchange for social well-being.

The literature has proposed several preference-based factors that could influence firms' ESG decisions, which generally fall into two categories: leader traits and locational factors. The first category includes indicators such as leaders' education, joint appointments in academia, gender, and government connections. For instance, a highly educated female leader with academic and government connections may be more inclined to conform to social norms even without explicit requirements. The second category includes cultural and customary factors that may influence firms' operations within the socio-economic environment. For example, regions influenced by historical collectivism or Confucianism may be more inclined to pursue social goals in addition to corporate profits. We empirically test these two strands of values motivations using variables well documented in the existing literature.

In Figure 8, we present the heterogeneity of firms' responses across leader and cultural factors. Panel A focuses on leader traits, while Panel B focuses on location-based cultural factors. The highlighted groups are those with the highest likelihood of investing in ESG according to values-based theories. Across all measures, we do not observe a significant trend across quartiles. In Appendix X, we also document the lack of heterogeneity in offline actions and market responses. In contrast to the significant trends observed across productivity and transparency measures, it appears that values do not explain a substantial portion of firms' motivation to engage in ESG actions.

VIII. Conclusion

This study provides a comprehensive examination of the demand-supply dynamics in corporate ESG actions within China. Utilizing a nationwide experiment conducted on online Q&A platforms established by stock exchanges, we create exogenous ESG demand shocks to firm management teams and collect a comprehensive dataset to monitor the full impact-generating process. Additionally, we formulate and empirically test a signaling model to explain the underlying motives behind firms' ESG actions.

We find that treated firms actively address ESG concerns and are willing to invest in concrete actions to meet public demand. The experiment effectively triggered voluntary information sharing about firms' ESG commitments and prompted treated firms to undertake costly measures to improve their ESG ratings, publish ESG reports, and advertise their ESG efforts. These investments garnered a positive market response: treated firms experienced fewer negative media reports, which translated into higher stock prices. Notably, investors exhibit distinct perceptions of the E, S, and G dimensions, generally viewing environmental and social actions positively while interpreting governance issues negatively. This perception is reflected in diverging stock price trends across treatment groups following the experiment.

To further understand the motivations behind firms' ESG decisions, we conceptualize their behavior through an illustrative signaling model. Consistent with model predictions, we find robust evidence that firms invest in ESG for potential market value gains, rather than being driven by values-based motivations to achieve social goals at the expense of corporate profits. This nuanced understanding of firms' motivations within the ESG framework offers valuable insights for policymakers aiming to design effective regulatory systems and incentives to encourage sustainable practices. It also provides guidance for investors seeking to align their investments with their ESG values and expectations.

Our costless information intervention sets an example of how individual voices can catalyze social change. We show that public communication channels significantly stimulate corporate ESG responses, challenging the conventional collective action problem. By expressing concerns and engaging in online discussions, individuals create a demand for greater ESG transparency and accountability, prompting companies to take proactive steps to enhance their ESG performance. Their voices also serve as an important information medium, informing firms of social preferences and potential market payoffs.

The implications of our findings extend well beyond the Chinese context. In a world where the demand for ESG practices evolves rapidly, it is essential for stakeholders—policymakers, investors, and activists—to tailor their ESG strategies to market conditions. They should allow firms to exert varying ESG endeavors based on their inherent characteristics. Moreover, each dimension of ESG requires distinct approaches to address diverse social perceptions. Adapting strategies in a thoughtful manner enables stakeholders to harness significant market forces for positive change without sacrificing profitability.

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Tables and Figures

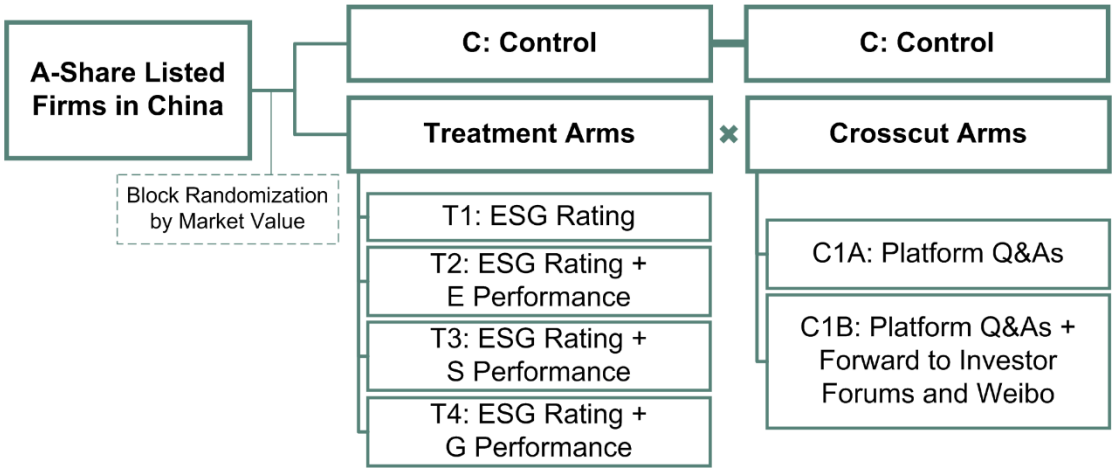


Figure 1 Experimental Design

Notes: This figure summarizes our experimental design. For all the non-financial listed firms in China with at least one active question on either Q&A platform in 2023, we apply the block randomization method to assign them evenly to the control arm or one of the treatment arms. For the treated firms, we further randomize them independently into one of the crosscut arms.

Panel A: Examples of Answer Spillovers　　Panel B: Event Study of Answer Spillovers

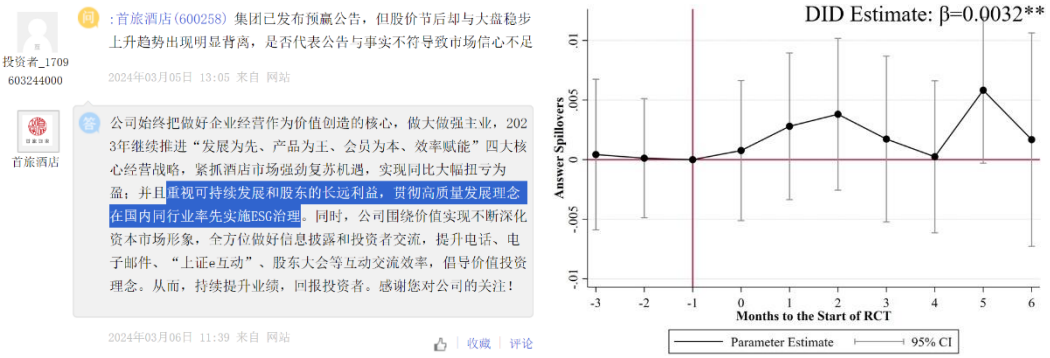
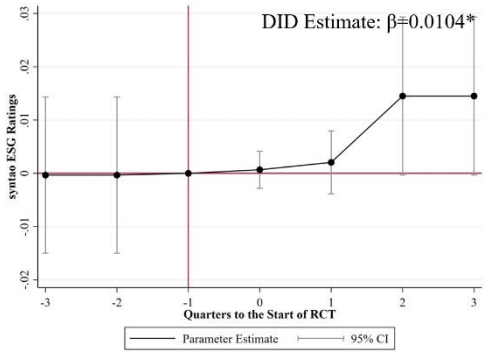


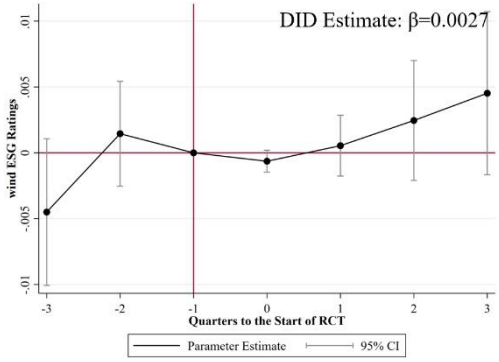
Figure 2 Firms' Answer Spillovers

Notes: This figure presents an example and the event study results of firms' answer spillovers. Panel A shows that firms may cite their ESG performance in response to questions that are not related to ESG, what we define as "answer spillovers." Panel B plots the event study estimates of answer spillovers for treated firms against control firms based on Equation (4). Dots represent regression estimates, and error bars indicate 95% confidence intervals.

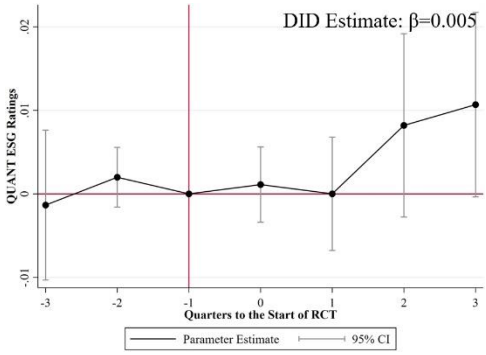
Panel A: Syntao (商道融绿)



Panel B: Wind (万得)



Panel C: QuantData (秩鼎)



Panel D: Hithink (同花顺)

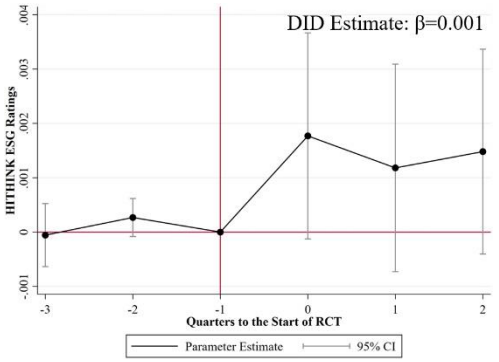
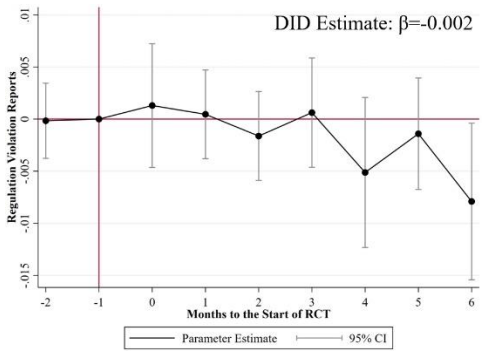


Figure 3 Event Study of ESG Ratings

Notes: This figure presents the event study results of ESG ratings around our experiment. Panel A and Panel B refer to two agencies that are widely cited in our messages to firms, for which we incorporate propensity score matching to obtain causal estimates. Panel C and Panel D refer to uncited agencies, where we use a simple event study approach based on Equation (5). Dots represent regression estimates, and error bars indicate 95% confidence intervals.

Panel A: Regulation Violations



Panel B: Supply Chain Issues

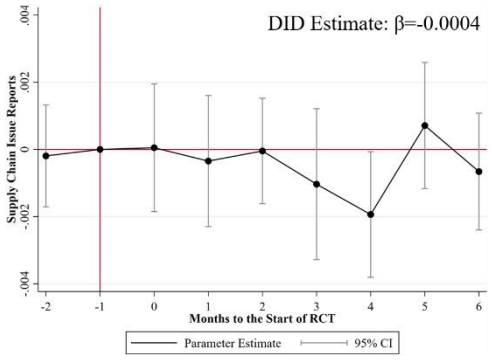
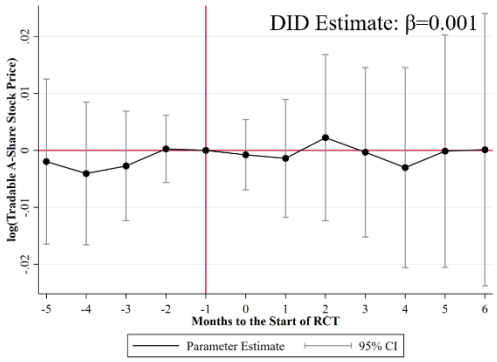


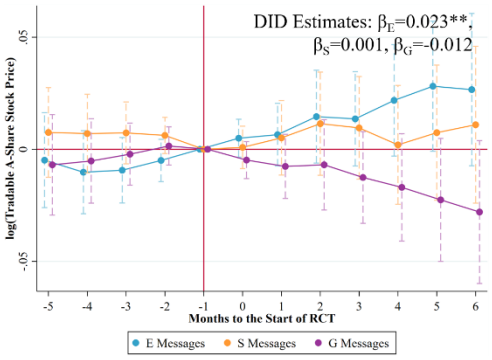
Figure 4 Event Study of Negative ESG Media Reports

Notes: This figure presents the event study results of negative ESG media reports around our experiment. Panel A and Panel B refer to the two most frequent topic categories, regulation violations and supply chain issues, respectively. All panels are based on Equation (5). Dots represent regression estimates, and error bars indicate 95% confidence intervals.

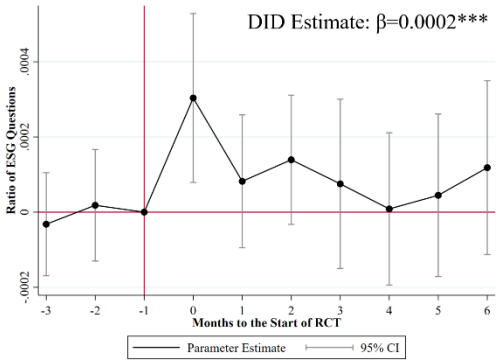
Panel A: Aggregate Market Responses



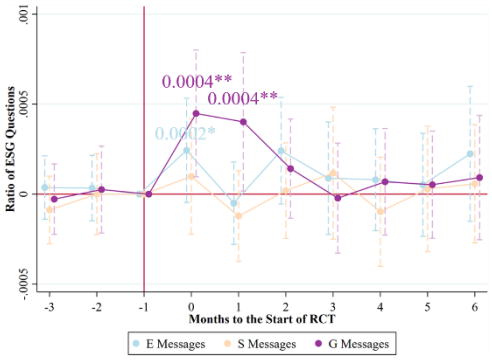
Panel B: Market Responses by Treatment



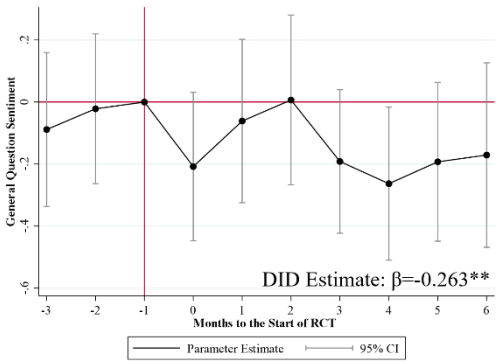
Panel C: Aggregate Question Spillovers



Panel D: Question Spillovers by Treatment



Panel E: Aggregate Question Sentiments



Panel F: Question Sentiments by Treatment

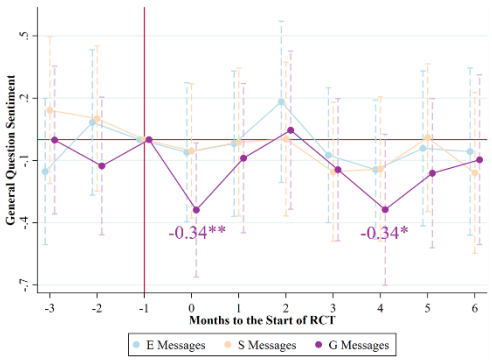


Figure 5 Event Study of Market Responses

Notes: This figure presents the event study results of the market responses to our experiment. Panel A and Panel B show the aggregate and group-wise treatment effects, while the following four panels explore the underlying mechanisms. The left panels are based on Equation (4), and the right panels are based on Equation (8). Dots represent regression estimates, and error bars indicate 95% confidence intervals.

Panel A: Correlation of Firm Productivity Measures

Panel B: Heterogeneity of Responses Across Productivity Measures

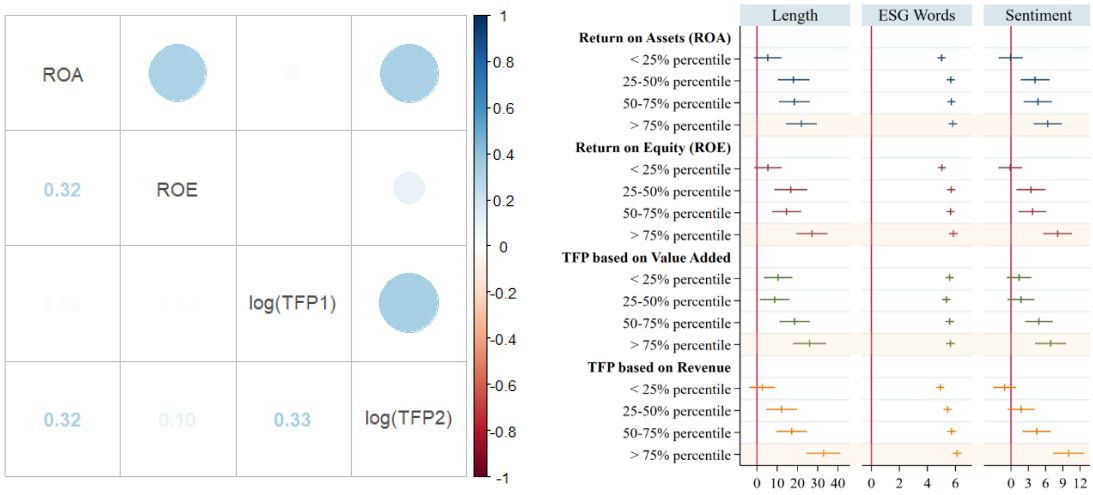


Figure 6 Firm Productivity and ESG Responses

Notes: This figure plots the correlation matrix and heterogeneity results across firms' productivity measures. In Panel A, we show that the four common productivity measures are weakly correlated, indicating the unobservability of firms' true productivity. In Panel B, we plot the heterogeneity results across the productivity measures from Equation (6). All productivity measures are continuous and divided into four quartiles. Each dot represents a regression estimate, with error bars denoting 95% confidence intervals. The highlighted quartile groups are those expected to exhibit the largest effects according to our conceptual framework.

Panel A: Construction of Firm Transparency Indices

Panel B: Heterogeneity of Responses Across Transparency Measures

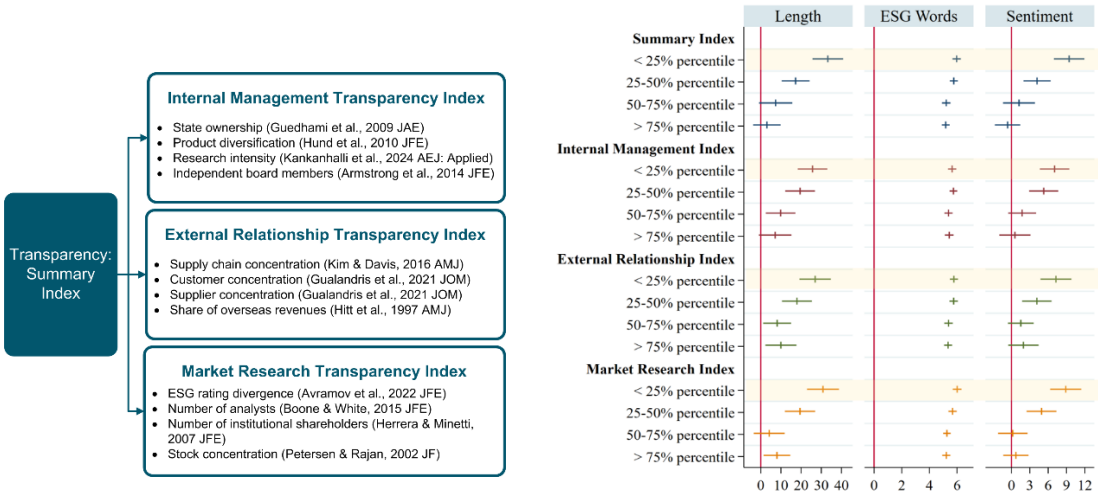


Figure 7 Firm Productivity and ESG Responses

Notes: This figure presents the construction of firms' transparency indices and heterogeneity results across transparency levels. In Panel A, we show that our transparency summary index is constructed using three indices, each comprised of four well-documented indicators. In Panel B, we plot the heterogeneity results across the summary index and the three component indices from Equation (6). All indices are continuous and divided into four quartiles. Each dot represents a regression estimate, with error bars denoting 95% confidence intervals. The highlighted quartile groups are those expected to exhibit the largest effects according to our conceptual framework.

Panel A: Leader Traits

Panel B: Cultural Factors

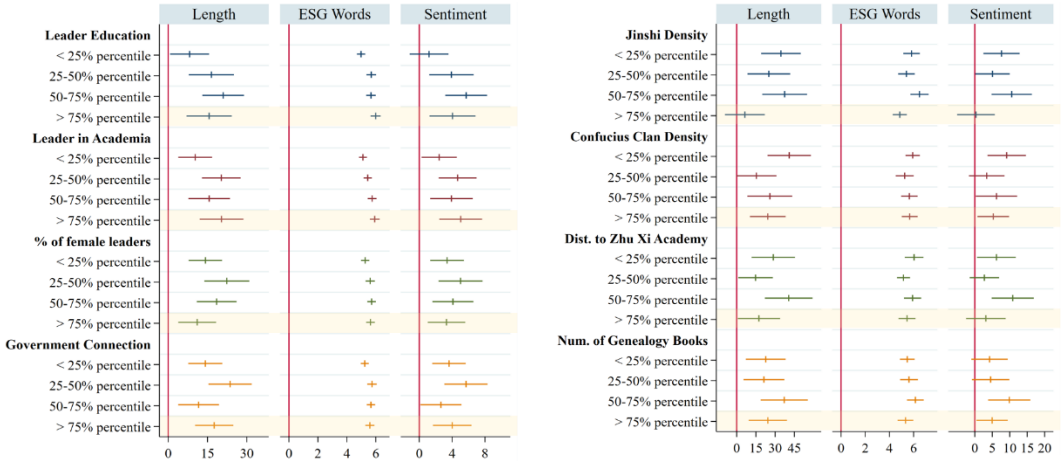


Figure 8 Heterogeneity of Responses Across Leader Traits and Cultural Factors

Notes: This figure shows the heterogeneity results for firms' online responses based on leader traits and cultural factors (values-based motivations). All indicators are continuous and divided into four quartiles. Each dot represents a regression estimate, with error bars indicating 95% confidence intervals. The highlighted quartile groups are those expected to exhibit the largest effects according to values-driven motivations.

Table 1 Summary Statistics (Jan-Nov 2023, Pre-Experiment)

Platform	Shenzhen (SZ)				Shanghai (SH)			
Statistics	Mean	Sd	Min	Max	Mean	Sd	Min	Max
Number of Firms	2753				2099			
Number of Questions Per Firm	105	109	1	1270	51	96	1	3587
Number of ESG Questions (Narrowly-Defined)	0	0	0	4	0	0	0	6
Reply Rate	93%	17%	0%	100%	82%	27%	0%	100%
Reply Time (Days)	9	16	0	281	14	18	0	210
Reply Length (Characters)	94	45	17	515	111	54	12	629

Notes: This table presents the summary statistics of the Shenzhen and Shanghai Q&A platforms prior to our experiment. With the exception of the number of firms, all statistics are calculated at the firm level. ESG questions are narrowly defined as those that explicitly mention the keywords: environmental, social, and governance (ESG) or corporate social responsibility (CSR).

Table 2 Firms' Online Responses to Different Treatments

	(1) Length	(2) Sentiment	(3) ESG Words	(4) E Words	(5) S Words	(6) G Words
ESG Messages	6.03*	1.75	5.38***	1.46***	1.18***	0.68***
	(3.34)	(1.10)	(0.14)	(0.07)	(0.04)	(0.03)
E Messages	25.95***	6.03***	6.33***	3.11***	1.02***	0.54***
	(3.68)	(1.14)	(0.18)	(0.14)	(0.04)	(0.04)
S Messages	21.42***	5.64***	5.44***	1.27***	1.64***	0.64***
	(4.23)	(1.35)	(0.14)	(0.06)	(0.06)	(0.03)
G Messages	11.04***	1.91	5.08***	1.01***	1.10***	1.12***
	(4.02)	(1.29)	(0.14)	(0.05)	(0.04)	(0.05)
Control Mean	76.01	23.63	0.18	0.09	0.00	0.09
Observations	238,385	238,385	238,385	238,385	238,385	238,385
R-Squared	0.27	0.26	0.50	0.27	0.49	0.22
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Day FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents regression estimates of firms' online responses on Q&A platforms based on Equation (6). The dependent variables include response length (measured by the number of Chinese characters), the number of ESG (and E/S/G) keywords in answers, and response sentiment. The independent variables are indicators of whether a question belongs to our treatment arms, in order to measure the average treatment effect for each arm. Control variables include question length and sentiment. All regressions include firm and industry-by-day fixed effects. Standard errors in parentheses are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3 ESG Reports and Institutional Investor Investigation Regression Results

	ESG Reports					Investigations
	(1) Release: Dummy	(2) Quality: Sentence Length	(3) Quality: Transition Words	(4) Quality: Rare Words	(5) Quality: Fog Index	(6) Mention ESG
Post * Treat	0.026**	0.001	-0.001	-0.002	-0.001	0.013**
	(0.010)	(0.001)	(0.005)	(0.002)	(0.002)	(0.006)
Control Mean	0.250	0.002	0.128	0.072	0.067	0.017
Observations	33,894	8,041	8,041	8,041	8,041	11,540
R-Squared	0.754	0.252	0.620	0.644	0.595	0.525
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports regression estimates of firms' ESG-related offline actions based on Equation (2) and (3). The dependent variables include the release of ESG reports, the quality of released ESG reports, and mentions of ESG during institutional investor investigations. The independent variable is the interaction term between post and treat dummies to measure the average treatment effect. All regressions include firm fixed effects. ESG report regressions further include year fixed effects, and investigation regressions include industry-by-day fixed effects. Standard errors in parentheses are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4 Heterogeneity of Offline Actions Across Productivity Measures

	ESG Ratings				ESG Report	Investigations	Negative Media Reports	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Syntao	Wind	QuantData	Hithink	Release Dummy	Mention ESG	Regulation Violations	Supply Chain Issues
Post * Treat	0.006	0.002	0.001	0.001	0.016	0.008	0.000	-0.000
	(0.006)	(0.002)	(0.003)	(0.001)	(0.010)	(0.007)	(0.000)	(0.000)
Post * Treat * ROA	0.120**	0.033*	0.128***	0.013*	0.351***	0.098	-0.010**	-0.003***
	(0.056)	(0.017)	(0.023)	(0.008)	(0.061)	(0.092)	(0.004)	(0.001)
Observations	32,946	32,824	32,751	28,418	33,894	11,539	1,324,596	1,324,596
R-Squared	0.815	0.756	0.863	0.923	0.754	0.525	0.055	0.025

Notes: This table reports regression estimates of offline actions across productivity measures. The dependent variables include firms' ESG ratings from cited and uncited agencies, the release of ESG reports, mentions of ESG during institutional investor investigations, and negative ESG-related media reports. The independent variables include the interaction term between post and treat dummies to measure the average treatment effect, along with an interaction term with ROA to capture heterogeneity. Based on the data structure, columns 1-4 include firm and quarter fixed effects, column 5 includes firm and year fixed effects, and columns 6-8 include firm and industry-by-day fixed effects. Standard errors in parentheses are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5 Heterogeneity of Offline Actions Across Transparency Measures

	ESG Ratings				ESG Report	Investigations	Negative Media Reports	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Syntao	Wind	QuantData	Hithink	Release Dummy	Mention ESG	Regulation Violations	Supply Chain Issues
Post * Treat	0.007	0.003	0.005	0.001	0.025**	0.013**	0.000	0.000
	(0.006)	(0.002)	(0.003)	(0.001)	(0.010)	(0.006)	(0.000)	(0.000)
Post * Treat * Transparency	-0.056***	-0.021***	0.001	-0.009***	-0.095***	-0.018	0.001*	0.001**
	(0.012)	(0.003)	(0.005)	(0.002)	(0.015)	(0.013)	(0.001)	(0.000)
Observations	32,946	32,824	32,751	28,418	33,894	11,539	1,324,596	1,324,596
R-Squared	0.815	0.756	0.863	0.923	0.755	0.525	0.055	0.025

Notes: This table reports regression estimates of offline actions across transparency measures. The dependent variables include firms' ESG ratings from cited and uncited agencies, the release of ESG reports, mentions of ESG during institutional investor investigations, and negative ESG-related media reports. The independent variables include the interaction term between post and treat dummies to measure the average treatment effect, along with an interaction term with the transparency index to capture heterogeneity. Based on the data structure, columns 1-4 include firm and quarter fixed effects, column 5 includes firm and year fixed effects, and columns 6-8 include firm and industry-by-day fixed effects. Standard errors in parentheses are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6 Heterogeneity of Response Quality Across Investor Preferences

	(1) Length	(2) ESG Words	(3) Sentiment
No Neg Comments	14.30***	5.65***	3.57***
	(3.83)	(0.14)	(1.23)
Neg Comments	9.04**	5.28***	2.10
	(4.60)	(0.19)	(1.56)
Control Mean	75.95	0.18	23.62
Observations	144,872	144,872	144,872
R-Squared	0.31	0.57	0.30
Firm FE	Yes	Yes	Yes
Industry-Day FE	Yes	Yes	Yes

Notes: This table reports regression estimates of response quality across investor preference groups. The dependent variables include firms' response length (measured by the number of Chinese characters), the number of ESG keywords in answers, and the response sentiment. The independent variables include the interaction term between post, treat, and negative comment indicators. The negative comment indicator equals one if a firm belongs to the C1B group and has received negative comments from other investors, zero if a firm belongs to the C1B group but has not received negative comments from other investors, and 99 otherwise. We only present estimates for interactions with the first two cases in this table. All regressions include firm and industry-by-day fixed effects. Standard errors in parentheses are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7 Heterogeneity of Market Responses

	Log(Tradable A-Share Stock Price)		
	(1)	(2)	(3)
Post * Treat	-0.006	0.001	0.002
	(0.008)	(0.008)	(0.009)
Post * Treat * ROA	0.263**		
	(0.104)		
Post * Treat * Transparency		-0.038***	
		(0.012)	
Post * Treat * (No Neg Comments)			0.007
			(0.011)
Post * Treat * (Neg Comments)			-0.020
			(0.013)
Observations	1,259,029	1,259,029	1,259,029
R-Squared	0.960	0.960	0.960

Notes: This table reports regression estimates of market responses across groups. The dependent variable is the log of tradable A-share stock prices. The independent variables include the interaction term between post and treat dummies to measure the average treatment effect, along with an interaction term with ROA (for column 1), transparency index (for column 2), or negative comments indicator (for column 3) to capture heterogeneity. The negative comment indicator equals one if a firm belongs to the C1B group and has received negative comments from other investors, zero if a firm belongs to the C1B group but has not received negative comments from other investors, and 99 otherwise. We only present estimates for interactions with the first two cases in the last column. All the regressions include firm and industry-by-day fixed effects. Standard errors in parentheses are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix A. Sample Messages on the Platforms

A1 Online Q&A platforms

董秘你好：我关注贵公司了好几年，但发现你们 ESG 评分总是不高，在华证、MSCI 等机构打分都在行业中下游(CC)。 想问董事会是否重视社会的 ESG 大趋势？ 是否有提高 ESG 重要性的计划？

[English Translation] Dear Board Secretary: I have been following your company for several years, but I have noticed that your ESG scores have consistently been low, with ratings from institutions like Sino-Securities Index and MSCI placing you in the lower tier of the industry (CC). I would like to ask if the board is paying attention to the growing trend of ESG in society. Are there any plans to enhance the importance of ESG?

请问公司领导怎么看待 ESG？ 我发现贵公司在商道融绿和 MSCI 的 ESG 评级都较低(CCC 和 CC)，而且和同行业领先水准相比还有进步空间。 最近正在召开联合国气候大会，公司有没有提升 ESG 雄心的计划？

[English Translation] May I ask how the company leaders view ESG? I have noticed that your company's ESG ratings from Syntao Green Finance and MSCI are relatively low (CCC and CC), and there is room for improvement compared to the leading standards in the industry. With the recent United Nations Climate Conference taking place, does the company have any plans to increase its ESG ambitions?

A2 Stock forums and social media

近期在投资者论坛看到了和公司 ESG 表现相关的问题，大家怎么看待现在 ESG 这个趋势？ ESG 有用吗？

[English Translation] Recently, I saw questions related to the firm's ESG performance at the investor forum. What does everyone think about the current trend of ESG? Is ESG useful?

有网友在互动平台问了企业 ESG 的问题，但没收到董秘回复。 关于 ESG，各位怎么看？

[English Translation] Some people asked questions about the company's ESG on the interaction platform but did not receive a response from the board secretary. What do you think about ESG?

Appendix B. Additional Tables and Figures

Panel A: Shenzhen Platform

Panel B: Shanghai Platform

Figure A1 Screenshots of Online Q&A Platforms in China (taken in January 2024)

Notes: This figure shows screenshots of the homepages of two online Q&A platforms established by the Shenzhen and Shanghai Stock Exchanges. Apart from platform statistics and announcements on the sides, the main part of the window presents the latest Q&A interactions between investors and firms. The interactions are sorted by the last update time, either by investors posting the question or firms providing an answer. All interactions are public to all users. For each question, the platform shows the target firm, its list code, the questioner ID, the interaction contents, the update time, and the number of likes. Investors are not allowed to follow up on a question other than raising a new question to the same firm.

Panel A: Guba (Guba.EastMoney.com) Panel B: Xueqiu (xueqiu.com)

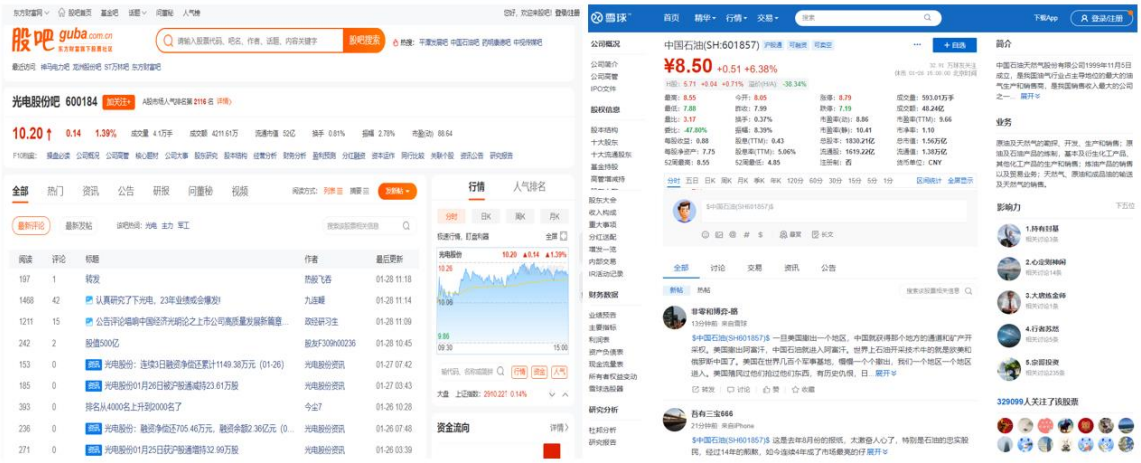


Figure A2 Screenshots of Stock Forums in China (taken in January 2024)

Notes: This figure presents screenshots of two company pages on the stock forums used in the experiment. They are arranged in a similar manner. At the top, the name and code of a listed firm are displayed, followed by recent stock return trends. The bulk of the window is dedicated to interactions between investors concerning this specific firm. For each message, the platform shows its content, original author, page views, all follow-up comments, and the latest update time. Messages can be sorted either by popularity or update time.

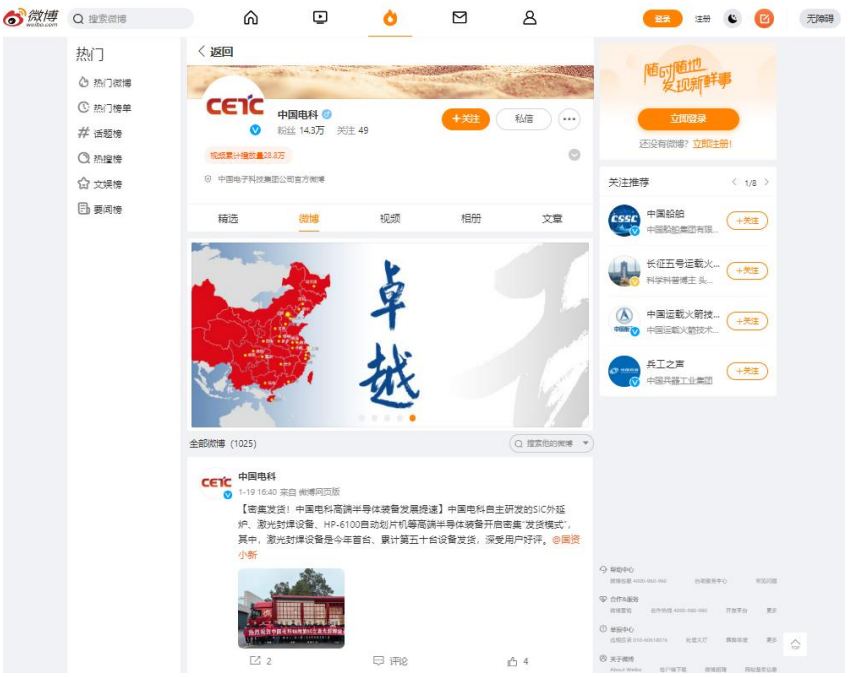
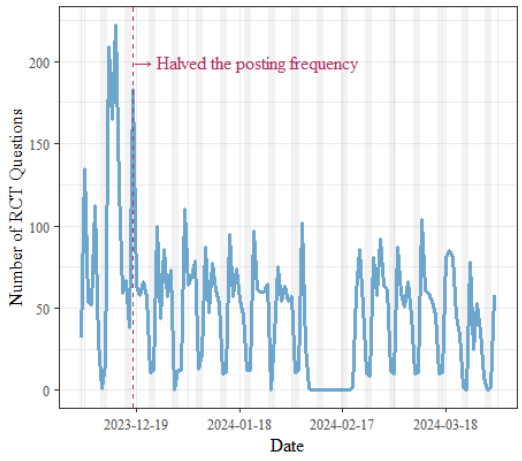


Figure A3 Screenshot of a Listed Firm's Weibo Account (taken in January 2024)

Notes: This figure is a screenshot of a listed firm's Weibo page. At the top, it displays the name, description, and number of followers of this corporate account. The blue checkmark indicates official verification by Weibo. In the middle section, it presents some highlights of this account. At the bottom, it shows the most recent interactions that this account has posted or replied to.

Panel A: RCT Questions



Panel B: Forwarded Messages

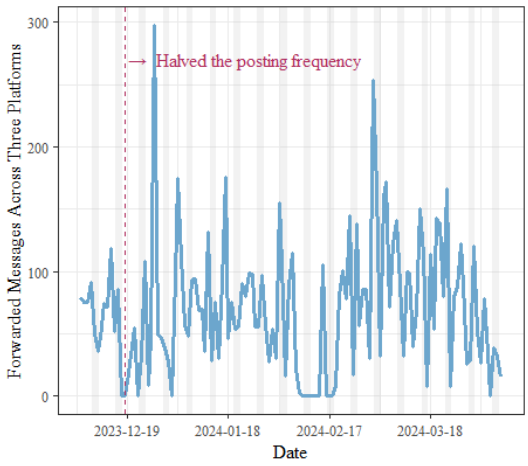


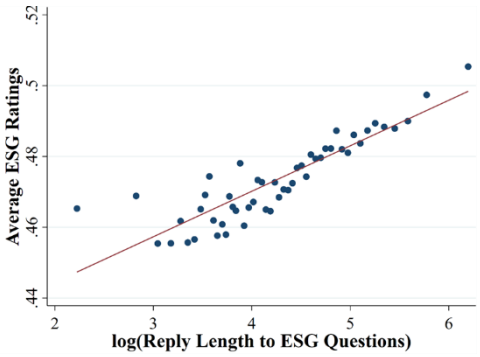
Figure A4 Frequency of RCT Questions by Day

Notes: This figure illustrates the timeline of our messages on the Q&A platform (Panel A) and the forwarded platforms (Panel B). The lines represent the number of posts approved by the platform administrators per day, and the shaded areas indicate weekends with minimal approvals. The daily fluctuations are primarily driven by censorship delays, which are independent of our experimental design. To avoid excessive delays, we halved the posting frequency two weeks into the experiment. This adjustment is unlikely to bias our results since the timing and sequence of posts were randomized before the start of the experiment.

Figure A5 Examples of Q&A Interactions in the RCT

Notes: This figure presents screenshots of three examples of our Q&A interactions with firms during the experiment. The texts in the upper regions are our questions, and the texts in the lower regions are firms' responses. Three points are worth mentioning: First, our questions are tailored to each firm's actual ESG performance by citing their rating results and identifying areas for improvement. Second, despite differing content, our questions are phrased with similar lengths and sentiments to minimize noise. Third, firms provide drastically different responses in terms of length, content, and sentiment. The two left examples show relatively shorter and more qualitative responses, while the right example includes numerous statistics and specific actions.

Panel A: Response Length and ESG Performance



Panel B: Response Sentiment and ESG Performance

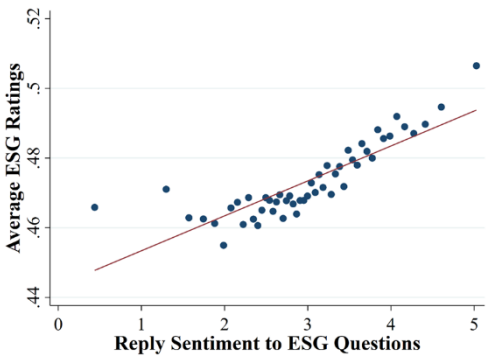


Figure A6 Correlation between Firms' Response Quality and ESG Performance

Notes: This figure consists of two binned scatterplots of the relationship between firms' response quality to ESG-related questions and their actual ESG performance. The response quality is measured by the log of reply length (number of Chinese characters) and reply sentiment derived from sentiment analysis. The actual ESG performance is measured using the average standardized ESG ratings from multiple agencies. The standardization is based on the percentile ranking of a firm according to each ESG rating agency.

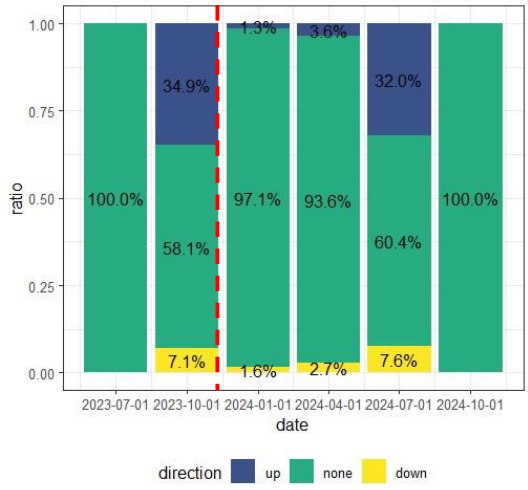
Figure A7 Examples of Question Spillovers

Notes: This figure shows two examples of investors inquiring about ESG to treated and control firms after the start of our experiment. In the first example (treated firm), the investor asks whether the firm considers the ESG performance of potential partners or alliances and if they will continue to work with those that have relatively poor ESG performance. The firm responds by emphasizing their own ESG development and expressing a desire to strengthen cooperation with partners in the industry chain that have good ESG performance. In the second example (control firm), the investor asks if other investors have expressed concern about the firm's CSR rating during the financing process. The firm replies that they have not received any CSR-related inquiries. They also highlight their commitment to environmental protection, social responsibility, and corporate governance and are actively working to improve their ESG performance.

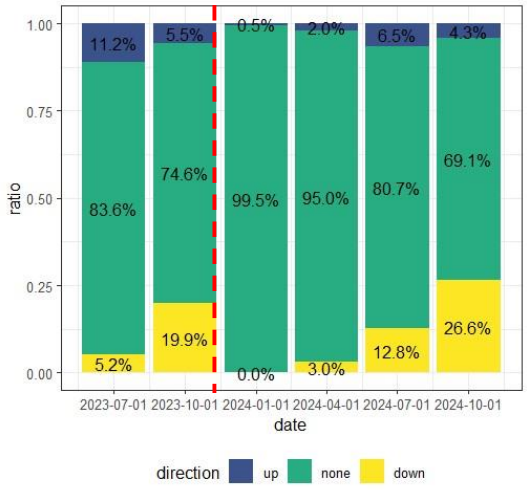
Figure A8 Examples of Negative Investor Comments

Notes: This figure shows five examples of negative investor comments toward our ESG messages on the investor forums. They can each be translated as: "These ratings are meaningless and too subjective; they are merely a tool used by Western capital to manipulate stock prices. The company does not need to pay attention to them at all." "ESG is all fluff. Managing without financial indicators is just playing games." "The company is already struggling to survive, so there is no need to focus too much on ESG. Just do the bare minimum." "ESG is completely useless; it is just about paying money to fool people." "The more you invest in these trash (ESG) ratings, the worse your profits will be!"

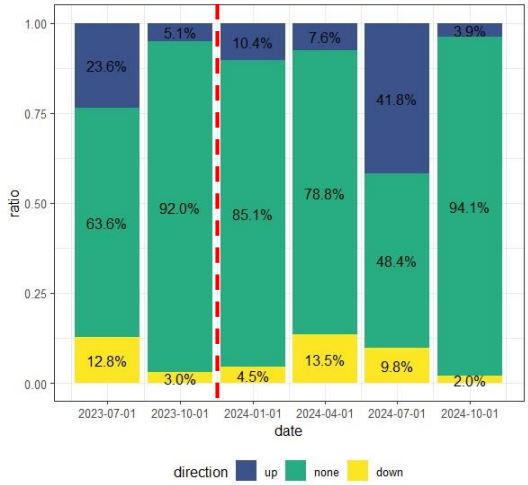
Panel A: Syntao (商道融绿)



Panel B: Wind (万得)



Panel C: QuantData (秩鼎)



Panel D: Hithink (同花顺)

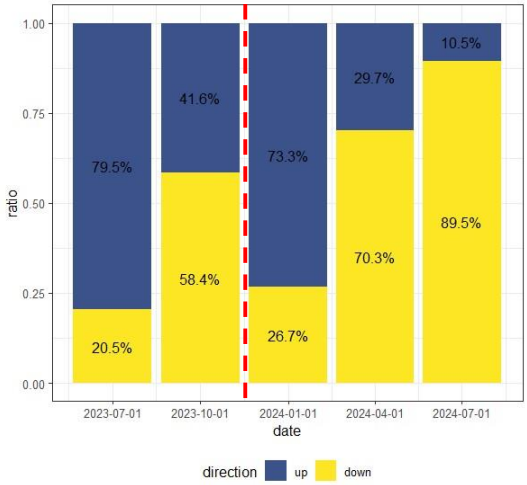
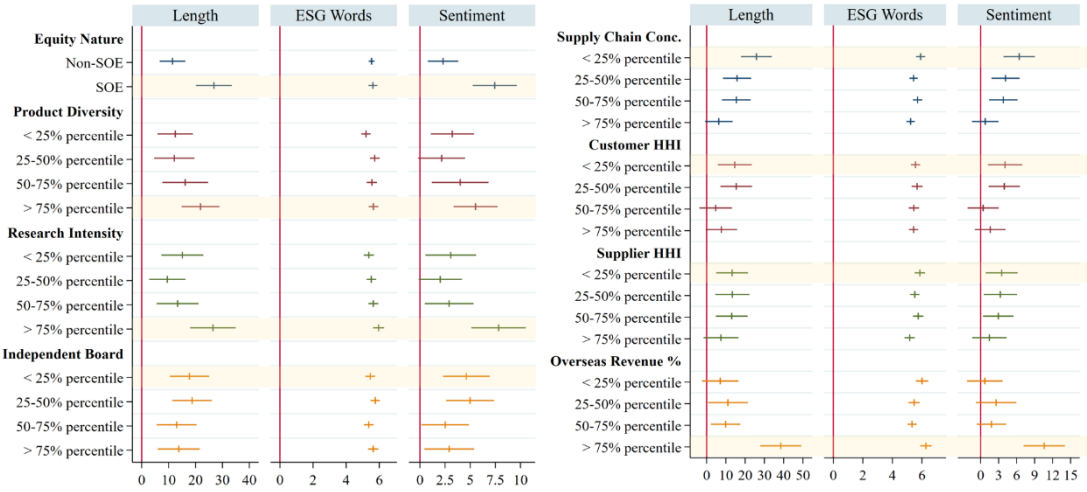


Figure A9 Update Frequency of ESG Ratings

Notes: This figure displays the update frequency of each ESG rating agency, categorized by the direction of rating adjustment (up, down, or no adjustment). The first three panels pertain to agencies with categorical ratings, while the last panel pertains to an agency with continuous ratings. The red dotted line marks the division between the pre- and post-experiment periods. The black numbers indicate the percentages of firms in our experiment that experience rating adjustments each quarter.

Panel A: Internal Management Index

Panel B: External Relationship Index



Panel C: Market Research Index

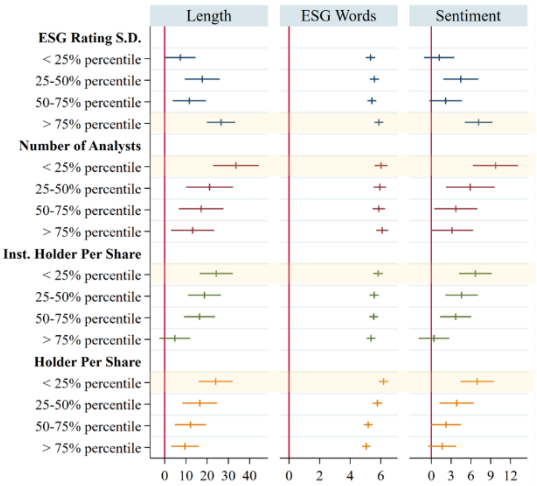


Figure A10 Heterogeneity of Responses Across Transparency Indicators

Notes: This figure presents the heterogeneity results for the indicators that make up the three transparency indices. All indicators are continuous and divided into four quartiles, except for equity nature, which is a dummy variable indicating whether a firm is a state-owned enterprise. Each dot represents a regression estimate, with error bars denoting 95% confidence intervals. The highlighted quartile groups are those expected to exhibit the largest effects according to our conceptual framework.

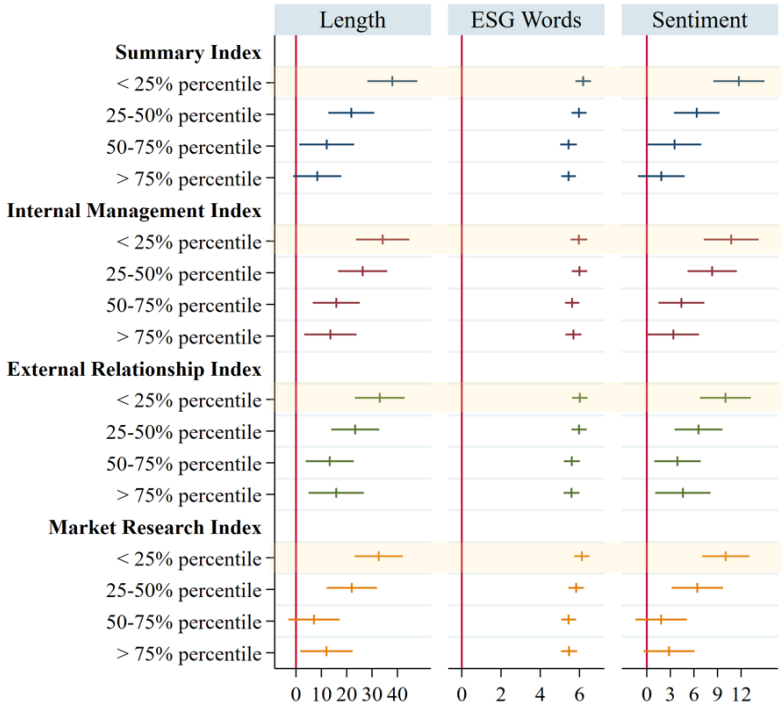


Figure A11 Robustness of Responses Heterogeneity after Controlling for ROA

Notes: This figure examines the robustness of firms' response heterogeneity across transparency levels when controlling for ROA quartiles. Building on the regressions from Panel 2 of Figure 7, we include interaction terms between experiment questions and ROA quartiles, as well as between ROA quartiles and day dummies. The figure illustrates the remaining variation captured by the interaction terms between experiment questions and transparency quartiles. Each dot represents a regression estimate, with error bars denoting 95% confidence intervals. The highlighted quartile groups are those expected to exhibit the largest effects according to our conceptual framework.

Table A1 Balance Table Across Treatment Arms

Statistics	C	T1	T2	T3	T4
Number of Firms	1900	744	736	736	736
Market Value	135	131 (t=-0.22, p=0.82)	141 (t=0.27, p=0.79)	129 (t=-0.3, p=0.76)	153 (t=0.82, p=0.41)
Age	24	23 (t=-0.85, p=0.4)	24 (t=1.19, p=0.23)	24 (t=-0.09, p=0.92)	23 (t=-1.06, p=0.29)
Employees	4747	5103 (t=0.53, p=0.59)	5177 (t=0.59, p=0.55)	5187 (t=0.59, p=0.56)	5714 (t=0.86, p=0.39)
ROA	0.03	0.02 (t=-1.03, p=0.3)	0.03 (t=0.64, p=0.52)	0.02 (t=-1.23, p=0.22)	0.03 (t=0.91, p=0.37)
Product Diversity	2.49	2.49 (t=-0.12, p=0.91)	2.47 (t=-0.45, p=0.65)	2.53 (t=0.75, p=0.45)	2.53 (t=0.84, p=0.4)
Historical ESG Reports	1.31	1.27 (t=-0.43, p=0.67)	1.44 (t=1.36, p=0.17)	1.47 (t=1.66, p=0.1)	1.37 (t=0.58, p=0.56)
ESG Report Quality	1.31	0.07 (t=-0.85, p=0.4)	0.07 (t=-0.41, p=0.68)	0.07 (t=-0.79, p=0.43)	0.08 (t=0.92, p=0.36)
Mentions of ESG during Institutional Investigations	0.02	0.02 (t=-0.61, p=0.54)	0.02 (t=-1, p=0.32)	0.02 (t=-0.68, p=0.5)	0.03 (t=0.89, p=0.37)
Average ESG Rank	0.47	0.47 (t=0.07, p=0.94)	0.48 (t=0.7, p=0.48)	0.47 (t=0.04, p=0.97)	0.47 (t=0.41, p=0.69)
Sino-Securities Index ESG Rank	0.48	0.48 (t=0.18, p=0.86)	0.48 (t=1.28, p=0.2)	0.48 (t=-0.38, p=0.7)	0.48 (t=0.32, p=0.75)
Wind ESG Rank	0.49	0.49 (t=-0.56, p=0.58)	0.49 (t=-0.2, p=0.84)	0.49 (t=-0.28, p=0.78)	0.49 (t=-0.32, p=0.75)
Syntao ESG Rank	0.61	0.61 (t=-0.13, p=0.9)	0.60 (t=-0.54, p=0.59)	0.60 (t=-0.66, p=0.51)	0.60 (t=-0.55, p=0.58)
S&P Global ESG Rank	0.27	0.29 (t=0.86, p=0.39)	0.29 (t=0.79, p=0.43)	0.28 (t=0.14, p=0.89)	0.29 (t=0.89, p=0.38)

Notes: This table presents the balance tests for the treatment arms (T1, T2, T3, and T4). The mean values for each variable for firms within each arm are shown outside the parentheses. Inside the parentheses, we provide the t-statistics and p-values from the T-tests comparing each treatment arm to the control group. Almost all p-values exceed 0.20, confirming that the randomization was well executed.

Table A2 Balance Table Across Crosscut Arms

Statistics	C	C1A	C1B
Number of Firms	1900	1180	1772
Market Value	135	143 (t=0.02, p=0.99)	135 (t=0.39, p=0.7)
Age	24	24 (t=0.04, p=0.97)	24 (t=-0.68, p=0.5)
Employees	4747	5482 (t=0.77, p=0.44)	5170 (t=0.93, p=0.35)
ROA	0.03	0.03 (t=-0.56, p=0.58)	0.03 (t=-0.01, p=0.99)
Product Diversity	2.49	2.51 (t=0.25, p=0.81)	2.50 (t=0.42, p=0.68)
Historical ESG Reports	1.31	1.40 (t=0.96, p=0.34)	1.38 (t=1.07, p=0.28)
ESG Report Quality	0.07	0.07 (t=0.11, p=0.91)	0.08 (t=-0.27, p=0.79)
Mentions of ESG during Institutional Investigations	0.02	0.01 (t=0.63, p=0.53)	0.03 (t=-1.87, p=0.06)
Average ESG Rank	0.47	0.47 (t=0.28, p=0.78)	0.47 (t=0.52, p=0.6)
Sino-Securities Index ESG Rank	0.48	0.48 (t=0.22, p=0.82)	0.48 (t=0.71, p=0.48)
Wind ESG Rank	0.49	0.49 (t=-0.69, p=0.49)	0.49 (t=-0.09, p=0.93)
Syntao ESG Rank	0.61	0.60 (t=-0.5, p=0.62)	0.61 (t=-0.75, p=0.46)
S&P Global ESG Rank	0.27	0.28 (t=1.16, p=0.25)	0.29 (t=0.38, p=0.7)

Notes: This table presents the balance tests for the crosscut arms (C1A and C1B). The mean values for each variable within each arm are shown outside the parentheses. Inside the parentheses, we provide the t-statistics and p-values from the T-tests comparing C1A and C1B to the control group. Notably, all p-values are greater than 0.20, confirming that the randomization was well executed.