The Informativeness of Green Commitments across Bond Maturities *

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Abstract

I study how green commitments are reflected in corporate bond valuations across maturities. Using U.S. corporate bonds from 2005–2024, I find that credit spreads decline following commitments, with larger declines for short-maturity bonds than for long-maturity bonds. This maturity difference is greater among firms with higher pre-commitment carbon intensity. I also develop a signaling model in which commitments can reveal stronger operating capability and greater investment needs for future abatement. In the model, favorable operating information lowers spreads across maturities, while these investment needs can partly offset the decline for long-maturity bonds.

Keywords: Green Commitments, Corporate Bonds, Signaling, Information

JEL Codes: G12, G30, D83.

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1 Introduction

Green commitments publicly state firms' emission reduction targets and often describe how firms plan to meet them (Bauer et al., 2026). Existing evidence suggests that green commitments convey information about firms' future emissions and may reduce perceived transition risk. Firms that commit to decarbonization subsequently reduce their emissions (Bolton and Kacperczyk, 2026), and commitment announcements are associated with positive abnormal stock returns (Schnabel et al., 2026). However, firms may incur substantial investment costs to fulfill these commitments, while the financial benefits of abatement may accrue gradually through future cost savings (De Haas et al., 2025). Investors in bonds of different maturities must therefore assess what these commitments reveal about the issuer's repayment capacity over their respective horizons. I study what green commitments reveal about firms' future repayment capacity and how this information is reflected in credit spreads across maturities.

Firms weigh the expected benefits of green commitments against the costs of fulfilling them (Bolton and Kacperczyk, 2026). In my model, commitment decisions depend on operating capability, which affects cash generation from existing operations, and abatement investment costs, which determine the expenditure required for a given emissions reduction. If investors cannot fully observe these characteristics, commitment decisions may reveal information about both. The resulting reassessment of repayment prospects can affect credit spreads differently across maturities. This relates to the broader question of how bond markets price sustainability-related information. Existing studies examine corporate green bond issuance and its financial and environmental consequences (Flammer, 2021), the pricing of sustainability-linked bonds (Feldhütter et al., 2024), and the implications of green labels for security prices and the cost of capital (Feldhütter and Pedersen, 2025). Other evidence links climate regulatory risk to corporate bond ratings and yield spreads (Seltzer et al., 2026). I focus on how information revealed by firms' voluntary commitment choices is priced across debt maturities. An average spread response may conceal differences across repayment horizons. I therefore

examine overall credit spread responses and compare bonds of different maturities within the same issuer following the same commitment announcement.

To interpret these spread responses, I develop a model of how voluntary green commitments affect the repricing of outstanding debt. Managers privately observe operating capability, which affects the cost of existing operations, and abatement investment needs, which determine the expenditure needed to achieve a given additional reduction in emissions. A commitment can raise equity valuation if the information it conveys is sufficiently favorable. Managers weigh this potential gain against the reduction in expected shareholder payoffs from monitoring and reporting expenditure[1] and losses incurred if the firm fails to meet its target.[2]

Commitment can signal both stronger operating capability and greater investment needs for future abatement. Firms with stronger capability are more likely to commit when monitoring and reporting costs are sufficiently low and shortfall losses are sufficiently small. Within each capability group, I consider the benchmark where investment payments and abatement savings occur after short-term debt matures. When shortfall losses are small, firms with greater investment needs are more likely to commit. Their smaller net abatement gains imply less future shareholder value lost if monitoring and reporting payments trigger early default. When shortfall losses are large, firms face a trade-off between additional investment and losses from missing the target. Selection reverses if the resulting shareholder cost of commitment is higher for firms with greater needs than for those with lower needs.

Investors use commitment decisions to update their beliefs and forecast cash available for debt repayment. Holding investment needs fixed, favorable information about operating capability improves repayment prospects at both maturities. The effect of information about investment needs depends on payment timing. When payments and abatement savings occur after short-term debt matures, information about greater needs lowers expected net abatement gains and weakens long-term repayment prospects without directly affecting short-term repayment. With earlier payments, these needs also affect

[1]The SBTi calls for annual emissions disclosure and progress monitoring following target approval (Science Based Targets initiative, 2023a, p. 3).

[2]These losses are modeled as reductions in corporate cash flow, such as lost customer business.

short-term repayment through the firm's chosen expenditure. For the benchmark with later payments, Appendix IA.5 illustrates a numerical equilibrium in which commitments select firms with stronger operating capability and greater investment needs. In this equilibrium, the information benefit outweighs the expenditures and shortfall losses associated with commitment, so spreads fall at both maturities, with a larger decline for short-maturity bonds.

For the empirical analysis, I combine the commitment announcements identified by Bauer et al. (2026) with TRACE bond transactions and firm financial and emissions data. The announcements cover new or strengthened commitments during 2005–2023, including firms outside the Science Based Targets initiative. I document four main empirical findings. First, firms with higher prior operating profitability are more likely to commit, and commitments predict higher future profitability even after controlling for past performance. A one standard deviation increase in prior operating profitability is associated with a 0.73 percentage point higher probability of first observed commitment, about 18% of the baseline commitment rate of 3.99%. Conditional on prior profitability, its trend, and other firm characteristics, commitment predicts operating profitability 0.68 percentage points higher one year later and 0.48 percentage points higher two years later. These estimates are about 6% and 4% of mean operating profitability, respectively. Together, these findings support the model's prediction that commitments select firms with stronger operating capability and convey information about future performance beyond historical profitability.

Second, I examine how bond investors value commitments and find a decline in credit spreads relative to matched controls after the announcements. Following Seltzer et al. (2026), I match bonds of committing firms to those of firms with no recorded commitment using credit ratings, log amounts outstanding, remaining maturities, and issuers' exposure to oil prices. Over the twelve months following the commitment, the average decline is approximately 63 basis points relative to the month -12 baseline. Average declines in quarters 1–4 are 63.22, 81.17, 43.17, and 63.14 basis points. Treated bonds have an initial average spread of 161 basis points. The estimated decline is therefore about 39% of the starting spread. Using the mean of months -3 to -1 as the reference, the average

post-announcement decline is 29.11 basis points and remains statistically significant at the 1% level, indicating that part of the relative decline precedes the announcement. These results are consistent with a favorable reassessment of committing firms' repayment prospects around the announcements.

Third, following the commitment announcement, credit spreads decline more for short-maturity bonds than for long-maturity bonds of the same issuer. I rank bonds by maturity within each issuer and divide them into terciles, or use fixed maturity groups of 1–5, 5–10, and 10–30 years. The long-minus-short spread response averages 26.72 and 32.50 basis points under the two classifications, respectively. Because spreads are expressed as annual rates, equal percentage price gains can imply larger spread declines at shorter maturities. Short-maturity bonds also have larger implied percentage price gains. The difference is 1.09 percentage points under within-issuer terciles and 1.16 under fixed maturity groups. Both differences are statistically significant and correspond to approximately \$11–\$12 per \$1,000 of baseline bond value. The maturity difference therefore persists in price responses and cannot be explained solely by annualization.

Finally, the maturity difference following commitment is larger for firms with higher pre-commitment carbon intensity. Under within-issuer maturity terciles, the long-minus-short spread response is 52.21 basis points larger for high-intensity firms than for low-intensity firms. The corresponding difference is 68.63 basis points under fixed maturity groups. The model offers a possible explanation. If higher carbon intensity reflects greater investment needs, commitments may reveal smaller expected net gains from abatement. When investment payments and savings occur after short-term debt matures, this information weakens long-term repayment prospects. It partly offsets the favorable signal about operating capability, limiting the decline in long-term spreads.

The paper makes three contributions. First, I show that voluntary green commitments can convey information along two distinct dimensions, jointly signaling stronger operating capability and greater investment needs for future abatement. Firms' willingness to commit depends on the shareholder costs associated with both characteristics. Stronger operating capability can make commitment less costly. Within a given capability group, firms with greater investment needs can also face a lower

shareholder cost of commitment. If monitoring and reporting payments trigger early default, these firms forgo smaller future net abatement gains.

Second, I examine how voluntary green commitments reprice outstanding debt across maturities. Bolton and Kacperczyk (2026) study firms' commitment choices and subsequent emissions, while Bauer et al. (2026) examine stock market responses to green pledges and subsequent emissions reductions. I extend this literature to creditors by examining both overall credit spread responses and maturity differences within the same issuer and commitment announcement. This approach brings the timing of debt repayment into the analysis of how creditors value green commitments.

Finally, I contribute to research on information and corporate debt pricing (Duffie and Lando, 2001; Yu, 2005) by distinguishing the information conveyed by commitment from its effect on debt repayment. In the benchmark model, commitment entails additional costs, and the same firm is weakly less likely to repay if it commits than if it does not. The announcement may also signal stronger cash generation from the firm's existing operations. Bond prices rise when the net information benefit outweighs the repayment loss from commitment. Thus, higher bond prices need not imply that commitment itself improves repayment.

2 Related Literature

The paper relates to research on corporate climate commitments and green signaling. Bolton and Kacperczyk (2026) study commitment choices and subsequent emissions, while Bauer et al. (2026) and Schnabel et al. (2026) examine stock market responses to commitment announcements. Green bond studies emphasize commitment credibility (Flammer, 2021) and reputational incentives through media coverage (Lu, 2026). Daubanes et al. (2026) model certified green investment as a signal of project profitability. I distinguish operating capability from future abatement investment needs and examine their joint role in voluntary commitment choices.

Related asset pricing research links environmental characteristics to risk premia and cash flow expectations. Bolton and Kacperczyk (2021) and Bolton and Kacperczyk (2023)

document carbon premia in U.S. and international equity markets. Equilibrium models link green preferences and climate hedging demand to expected returns (Pástor et al., 2021) and allow ESG characteristics to inform investors about fundamentals and enter their preferences (Pedersen et al., 2021). Information and heterogeneous preferences affect price informativeness (Goldstein et al., 2026) and investor sorting and green investment (Kaniel et al., 2026). Derrien et al. (2025) document downward earnings forecast revisions following negative ESG news. I examine how repayment information conveyed by commitments affects debt values when creditors care only about financial returns.

In bond markets, related studies examine pricing differences associated with green labels (Zerbib, 2019; Larcker and Watts, 2020) and contractual sustainability targets (Feldhütter et al., 2024). Feldhütter and Pedersen (2025) show that a greenium on an individual security need not lower the issuer's overall cost of capital. Other studies relate bond pricing to environmental and social performance during a loss of trust (Amiraslani et al., 2023), climate regulatory risk (Seltzer et al., 2026), and climate hedging demand (Huynh and Xia, 2021). Duan et al. (2025) find lower subsequent returns on bonds of carbon-intensive firms, consistent with underreaction to carbon intensity's implications for cash flows and creditworthiness. My focus is the repricing of outstanding debt following firms' voluntary commitments.

Finally, the paper relates to research on information and debt pricing across maturities. Duffie and Lando (2001) show how incomplete accounting information shapes the credit spread term structure, and Yu (2005) finds that greater accounting transparency is associated with lower spreads, particularly at short maturities. Kölbel et al. (2024) examine climate risk disclosures and the CDS term structure, while D'Amico et al. (2026) estimate the greenium term structure using German sovereign twin bonds. Closely related, Schneider (2025) finds that green bond issuance lowers outstanding bond yields, especially at longer maturities. I examine voluntary emission reduction commitments that do not require green debt issuance and compare maturities within the same issuer and announcement. The model links these responses to information about operating capability and abatement investment needs, and to cash flow timing.

3 Model

I consider a continuum of firms over four dates, $t = -1, 0, 1, 2$, and study how public green commitments reprice outstanding debt across maturities. Repricing reflects information about firm characteristics and changes in cash available for repayment. At time -1, each manager privately observes (θ, k, ω) and chooses whether to commit to a given abatement target for time 2. Operating capability θ lowers the cost of existing operations; k determines a firm's investment needs for a given additional reduction in emissions; and ω measures the manager's valuation weight relative to expected shareholder payoffs.

At time 0, investors observe the commitment decision and update valuations, anticipating subsequent investment. Firms then choose abatement investment plans, whether or not they committed. The chosen abatement level is not directly observable to investors at time 0.[3]

Operating cash flow is realized at times 1 and 2, but new abatement reduces emissions expenses only at time 2. At time 1, committing firms pay monitoring and reporting costs,[4] and all firms pay scheduled investment expenditure before servicing short-term debt. A firm that cannot cover these payments defaults and ceases operations; otherwise, it carries its remaining cash forward. At time 2, surviving firms pay the remaining investment expenditure and any loss from missing their target. Retained cash and net time-2 cash flow are then available for long-term debt repayment. Figure 1 summarizes the timing.

[3]Firms may disclose past expenditures, budgets, or broad implementation plans. The SBTi encourages disclosure of capital expenditure and other financial indicators related to transition plans (Science Based Targets initiative, 2023b, p. 60). Such disclosures need not reveal the chosen abatement level because investment needs depend on private k. To isolate the commitment signal, I abstract from additional investment disclosures at time 0. The plan is fixed at that date and implemented only while the firm remains in operation.

[4]These costs include establishing monitoring and reporting procedures. The SBTi Commitment Letter calls for annual emissions disclosure and progress monitoring following target approval (Science Based Targets initiative, 2023a, p. 3). I group the incremental monitoring and reporting costs associated with commitment at time 1.

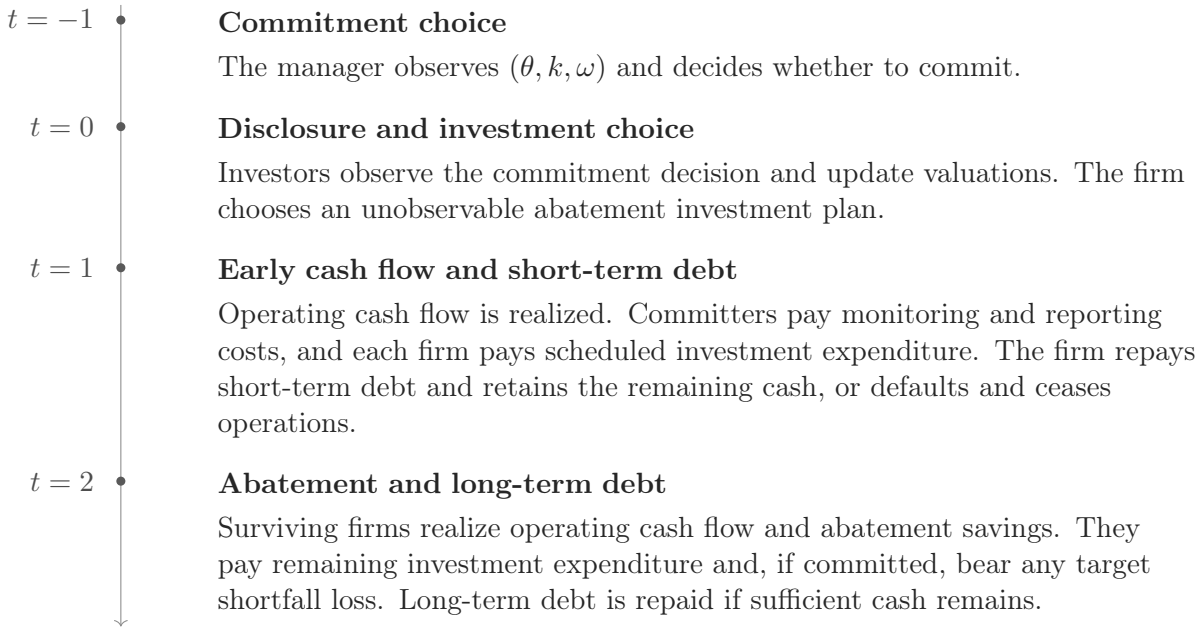


Figure 1: Model timeline.

3.1 Firms, abatement, and commitment

Let $\bar{E} > 0$ denote emissions intensity without abatement and $g \in [0, \bar{E})$ the publicly observed reduction already achieved. Emissions intensity before new investment is therefore $\bar{E} - g$. Operating capability is $\theta \in \{L, H\}$, and abatement investment needs are $k \in \{\underline{k}, \overline{k}\}$, where $0 < \underline{k} < \overline{k}$. Holding g fixed, higher k means that the same additional reduction requires more investment. This differs from operating capability: firms with similar operating capability may require minor equipment upgrades or major equipment replacement to achieve the same reduction.

Investors do not observe (θ, k, ω). Their beliefs incorporate public information available before the commitment decision, including existing abatement and financial disclosures. Historical operating profitability is informative about θ without fully revealing it.[5] Prior beliefs are

$$\Pr(\theta = H \mid g) = p, \qquad \Pr(k = \underline{k} \mid \theta = L, g) = q_L, \qquad \Pr(k = \underline{k} \mid \theta = H, g) = q_H, \quad (1)$$

[5] All probabilities and expectations are conditional on this public information. For notational simplicity, I display only g in conditioning sets.

where $p, q_L, q_H \in (0,1)$. The probability p is the prior share of firms with high operating capability, and q_θ is the share with low investment needs within capability group θ. Either value of k is possible at either capability level. Allowing $q_H \neq q_L$ permits dependence between the two characteristics without imposing its direction. All other parameters and distributions are publicly known.

Let $m = 1$ denote commitment and $m = 0$ noncommitment. Conditional on g, the target $e^{\text{tar}} \in (0, \bar{E} - g]$ is fixed and publicly known before the commitment decision. A committing firm promises to achieve this additional reduction at time 2. At time 0, every firm privately chooses $e \in [0, \bar{E} - g]$, the additional abatement its investment will deliver if it remains in operation. The public target does not constrain this choice: a committing firm may choose less abatement and bear the resulting shortfall loss. Total planned investment expenditure is

$$I(g, e; k) = k \int_0^e \psi(g, u)\, du. \tag{2}$$

The parameter k measures needs for a given abatement level; $I(g, e; k)$ is the expenditure on the chosen plan. Higher k need not raise total expenditure because the firm may choose less abatement. Marginal expenditure, $k\psi(g, e)$, increases with e, reflecting progressively more costly abatement measures.[6]

The chosen investment takes time to implement and does not reduce emissions at time 1. If the firm survives time 1, the investment delivers additional abatement e at time 2. Emissions intensities during operation are

$$\mathcal{E}_1 = \bar{E} - g, \qquad \mathcal{E}_2 = \bar{E} - g - e. \tag{3}$$

A fraction $\chi \in [0, 1]$ of investment expenditure is paid at time 1 before short-term debt service. If the firm survives time 1, it pays the remaining fraction at time 2 before long-term debt service. I first analyze the benchmark $\chi = 0$ and then allow $\chi > 0$.

[6]For each g, $\psi(g, \cdot)$ is continuously differentiable on $[0, \bar{E} - g]$, with $\psi(g, u) \geq 0$ and $\psi_u(g, u) > 0$.

A committing firm that survives time 1 incurs a cash-flow loss at time 2 if its abatement falls short of the public target. This loss is borne before long-term debt service and is specified as[7]

$$mP_\gamma(e) = m\frac{\gamma}{2}\left[(e^{\text{tar}} - e)^+\right]^2, \qquad \gamma \geq 0, \tag{4}$$

where $x^+ = \max\{x, 0\}$. The parameter γ is common across firms and governs the severity of the loss for a given shortfall.[8] The loss can capture consequences such as reduced customer business after a missed target; reputational consequences enter the model only through their effects on corporate cash flows. For $\gamma > 0$, additional abatement reduces the loss while $e < e^{\text{tar}}$. Once the target is met, the loss is zero. When $\gamma = 0$, no shortfall loss arises.

Commitment requires monitoring and reporting expenditure c_θ at time 1, before short-term debt service. It covers emissions data systems, progress monitoring, and reporting. This expenditure is separate from abatement investment, independent of k and e, and incurred even when $\gamma = 0$.

Let b_θ denote the operating cost savings of a firm of type θ at time 1. Conditional on survival, its savings at time 2 are ηb_θ, where $\eta > 0$ measures how these savings carry over to the later date. I assume

$$0 \leq b_L < b_H, \qquad 0 < c_H < c_L. \tag{5}$$

Stronger operating capability implies greater operating cost savings. The additional assumption $c_H < c_L$ assigns these firms lower monitoring and reporting expenditure.[9] The total shareholder cost of commitment is determined below.

[7] For $\gamma > 0$, the quadratic form makes the loss increase at an increasing rate with the shortfall and gives zero marginal loss at the target. The factor $1/2$ is a normalization. Related research discusses reputational costs of noncompliance with commitments (Daubanes et al., 2026).

[8] A common γ holds the loss schedule fixed across firm types to isolate differences in operating capability and investment needs. The loss depends on the chosen abatement level. In the benchmark $\chi = 0$, committing firms with the same k choose the same abatement level, so their shortfall loss is also the same conditional on survival, regardless of θ.

[9] Existing operating data and procedures may reduce the additional work needed to monitor emissions and report progress. This assumed relationship does not follow from $b_H > b_L$ alone.

3.2 Debt, cash flows, and repayment

Debt payments $D_1 > 0$ and $D_2 > 0$ are fixed before time -1 and are due at times 1 and 2, respectively. I rule out additional debt or equity financing from time -1 onward to isolate the repricing of existing debt from financing responses. Secondary-market price changes neither provide cash to the firm nor alter its contractual payments. A firm that repays D_1 carries any cash remaining after scheduled expenditure and debt service into time 2 without interest. A firm that defaults ceases operations. For simplicity, creditors receive zero recovery on any debt still outstanding at default.

Let Y_t denote baseline operating cash flow before capability savings and the expenditures below. The joint distribution of (Y_1, Y_2) is common knowledge, but realizations are unknown to managers and investors at both decision dates; no information about them arrives between commitment and investment. Conditional on public information summarized by g, (Y_1, Y_2) is independent of (θ, k), although Y_1 and Y_2 may be correlated.[10]

I hold the quantity of goods or services produced fixed and express cash flows, expenditures, and debt payments per unit of output. Let $\tau > 0$ denote the cash cost per unit of emissions, such as a charge on carbon emissions. Emissions expense is therefore $B(g) = \tau(\bar{E} - g)$ at time 1 and $B(g) - \tau e$ at time 2. Investment expenditure $I(g, e; k)$ finances the reduction in emissions, whereas τe is the resulting saving in emissions expense, realized only at time 2. Cash flows net of scheduled expenditure and before debt service are

$$X_1 = Y_1 + b_\theta - B(g) - mc_\theta - \chi I(g, e; k), \tag{6}$$

$$X_2 = Y_2 + \eta b_\theta - B(g) + \tau e - (1 - \chi) I(g, e; k) - mP_\gamma(e). \tag{7}$$

Here, X_2 applies only if the firm survives time 1 and excludes cash carried forward. If $X_1 \geq D_1$, the firm repays D_1 and retains $X_1 - D_1$ for time 2; otherwise, it defaults at time 1. Long-term debt is repaid if the firm survives time 1 and retained cash plus X_2

[10] The joint distribution is supported on $(0, \infty)^2$, with finite first moments and a continuous, strictly positive density on that support.

covers D_2. Let $\mathcal{S}_1$ and $\mathcal{S}_2$ denote the events of repayment of short-term and long-term debt, respectively:

$$\mathcal{S}_1 = \{X_1 \geq D_1\}, \qquad \mathcal{S}_2 = \{X_1 \geq D_1,\ X_1 + X_2 \geq D_1 + D_2\}. \tag{8}$$

These conditions require sufficient cash to cover both scheduled expenditures and debt payments. Long-term repayment also requires survival at time 1, so $\mathcal{S}_2 \subseteq \mathcal{S}_1$.

Even when $\chi = 0$, monitoring and reporting expenditure reduces cash available for short-term debt service. Holding the investment plan fixed, increasing χ shifts investment payments forward and lowers X_1 without changing $X_1 + X_2$. It can therefore trigger early default before abatement savings are realized, preventing repayment at both maturities.

Holding investment fixed, a larger γ increases the time-2 cash-flow loss for a committing firm with a positive shortfall. It has no direct effect on short-term repayment.

Table 1 summarizes how operating capability θ and abatement investment needs k affect repayment at each maturity in the benchmark with $\chi = 0$. These channels are based on the cash-flow expressions in equations (6) and (7) and the repayment conditions in equation (8).

Table 1: Firm characteristics and repayment channels

Characteristic	Repayment at time 1	Repayment at time 2
Operating capability θ	Operating cost savings; monitoring and reporting expenditure.	Persistent operating cost savings, survival at time 1, and retained cash.
Abatement investment needs k	No direct effect.	Investment expenditure, abatement savings, and shortfall losses.

Notes: The channels hold conditional on the commitment decision and the other type component, with $\chi = 0$. The time-2 channels for k include effects through the firm's investment choice. Monitoring and reporting expenditure and shortfall losses apply only to committing firms. When $\chi > 0$, investment payments also enter the repayment condition at time 1. The table describes cash-flow channels, not the direction of announcement price changes.

3.3 Managerial incentives

The manager values expected shareholder payoffs and current equity valuation, for example because compensation depends on the stock price.[11] The privately observed weight $\omega > 0$ has a publicly known distribution F_ω and is independent of (θ, k, Y_1, Y_2) conditional on g.[12] Managers of otherwise identical firms may therefore differ in their willingness to bear commitment costs for a valuation gain.

Expected shareholder payoffs under commitment decision m and abatement choice e are

$$W_m(\theta, k; g, e) = \mathbb{E}\big[\mathbf{1}\{X_1 \geq D_1\}(X_1 + X_2 - D_1 - D_2)^+ \mid \theta, k, g\big]. \tag{9}$$

The indicator requires survival at time 1. Shareholders receive the positive cash remaining after both debt payments and nothing following default. The expectation is over (Y_1, Y_2) conditional on type and public information.

Let $S_m(g)$ denote the equity valuation after decision m becomes public at time 0. Investors are risk neutral, and I normalize the risk-free rate to zero. When deciding whether to commit, the manager anticipates the subsequent investment choice. Taking the valuation schedule $\{S_0(g), S_1(g)\}$ as given, the sequential decisions can be represented by

$$\max_{\substack{m\in\{0,1\}\\ e\in[0,\bar{E}-g]}} \{W_m(\theta, k; g, e) + \omega S_m(g)\}. \tag{10}$$

Investors anticipate investment when forming $S_m(g)$, but do not observe the firm's chosen e at time 0. Holding m and investor beliefs fixed, a change in e therefore leaves the announcement valuation unchanged. The manager consequently chooses the abatement level to maximize expected shareholder payoffs:

$$e_m^*(\theta, k; g) \in \arg\max_{e\in[0,\bar{E}-g]} W_m(\theta, k; g, e). \tag{11}$$

[11] Stein (1989, pp. 658–659) and Daubanes et al. (2026, Section III.C, equation (2)) combine current equity values and future payoffs in managerial objectives. I use the same weighting structure; privately observed heterogeneity in the valuation weight is an additional assumption.

[12] Independence gives all firm types the same distribution of valuation weights and makes ω uninformative about baseline cash flows. The distribution F_ω has a continuous, strictly positive density on $(0, \infty)$ and a finite mean. The parameter ω affects cash flows only through the decisions it induces.

If several plans maximize expected shareholder payoffs, the firm chooses the smallest e. This publicly known rule is independent of ω. Denote the maximum by $W_m^*(\theta, k; g)$; both it and e_m^* are independent of ω conditional on type and commitment.

In the benchmark $\chi = 0$, investment expenditure is paid entirely at time 2 and does not affect survival at time 1. The manager therefore chooses e to maximize the net cash gain

$$h_m(e; k) = \tau e - I(g, e; k) - mP_\gamma(e).$$

The optimal abatement level is unique and, conditional on m, independent of θ. An interior optimum satisfies

$$\tau + m\gamma(e^{\text{tar}} - e_m^*)^+ = k\psi(g, e_m^*). \tag{12}$$

This condition equates marginal savings in emissions expense and shortfall losses with marginal investment expenditure.

When $\chi > 0$, investment payments also reduce cash available for short-term debt service. The investment choice therefore affects both survival at time 1 and net cash flow at time 2, and the optimal plan need not be unique. Appendix IA.1 establishes the existence of an optimal plan and derives the benchmark solution and its boundary conditions.

After accounting for optimal investment under each commitment decision, the manager chooses m to maximize

$$U_m(\theta, k, \omega; g) = W_m^*(\theta, k; g) + \omega S_m(g). \tag{13}$$

3.4 Bond valuation and credit spreads

Investors are risk neutral, the risk-free rate and default recovery are zero, and I abstract from liquidity and systematic risk premia, taxes, and embedded options.

Let $\mathcal{J}$ denote public information at time 0, including g, financial disclosures, and, after the announcement, m. Investors do not directly observe e, but anticipate the investment rule $e_m^*(\theta, k; g)$ when assessing repayment probabilities.

For tractability, I represent debt by zero-coupon claims. One unit of face value due at $T \in \{1, 2\}$ pays one on $\mathcal{S}_T$ and zero otherwise.[13] Let M_T denote the number of years from time 0 to repayment, with $0 < M_1 < M_2$. The labels $T = 1, 2$ identify the earlier and later repayment dates, not one- and two-year maturities.

The price per unit of face value and the continuously compounded annual credit spread are

$$V_T(\mathcal{J}) = \Pr(\mathcal{S}_T \mid \mathcal{J}), \qquad s_T(\mathcal{J}) = -\frac{1}{M_T} \log V_T(\mathcal{J}). \tag{14}$$

With a zero risk-free rate, the spread equals the annualized yield.[14]

The information channel operates through investors' updated beliefs about operating capability θ and abatement investment needs k. The cash-flow channel operates through monitoring and reporting expenditure, potential shortfall losses, and any resulting change in investment. Shortfall losses alter abatement incentives, while early monitoring and reporting expenditure can affect investment through the survival constraint when $\chi > 0$. Investors account for both channels when evaluating repayment probabilities.

4 Equilibrium and bond repricing

I first determine commitment decisions and equity valuations in a perfect Bayesian equilibrium (Fudenberg and Tirole, 1991). The key distinction is between the investment required for a given emissions reduction and the incremental shareholder cost of making a commitment. Their rankings can differ, allowing the same commitment to convey stronger operating capability and greater investment needs. I then examine how these joint updates and changes in cash flows affect bond prices across maturities.

[13] The empirical analysis uses actual coupon and principal payments to construct spreads relative to cash-flow-matched Treasury benchmarks. The zero-coupon specification provides a theoretical benchmark; its spread formula is not applied directly to coupon bonds.

[14] The assumed cash-flow distribution gives positive probability to repayment at each maturity. Thus $0 < V_T(\mathcal{J}) \leq 1$, implying finite, nonnegative spreads.

The commitment results apply to any fixed $\chi \in [0,1]$. I begin the maturity comparisons with $\chi = 0$, so monitoring and reporting expenditure is paid at time 1, while investment expenditure and abatement savings occur at time 2. I then examine how investment payments at time 1 change these comparisons.

4.1 Commitment and joint selection

For type $i = (\theta, k)$, define the shareholder cost of commitment as

$$C_i = W_0^*(i; g) - W_1^*(i; g) > 0. \tag{15}$$

The same abatement opportunities are available without commitment, allowing the firm to avoid monitoring and reporting expenditure and shortfall losses. Commitment therefore reduces optimized shareholder payoffs (Appendix IA.1). This incremental loss, C_i, differs from the investment needs governed by k. A favorable announcement response can arise from information conveyed by the decision even though commitment is costly for a given type.

Let $G = S_1(g) - S_0(g)$ denote the equity valuation gain from commitment relative to noncommitment. The manager commits if $\omega G \geq C_i$; since $C_i > 0$, no manager commits when $G \leq 0$. For a candidate gain $G > 0$, the commitment probability of type i and the overall commitment share are

$$a_i(G) = 1 - F_\omega(C_i/G), \qquad \bar{a}(G) = \sum_i \pi_i a_i(G), \tag{16}$$

where $\pi_i = \Pr(i \mid g)$. Bayes' rule gives

$$\pi_i^1(G) = \frac{\pi_i a_i(G)}{\bar{a}(G)}, \qquad \pi_i^0(G) = \frac{\pi_i[1 - a_i(G)]}{1 - \bar{a}(G)}. \tag{17}$$

Investors value equity using these posterior probabilities:

$$S_m(G; g) = \sum_i \pi_i^m(G) W_m^*(i; g), \qquad m \in \{0, 1\}. \tag{18}$$

In an equilibrium with positive commitment, the anticipated valuation gain equals the difference implied by these valuations:

$$G^* = S_1(G^*; g) - S_0(G^*; g) > 0. \tag{19}$$

The results below apply to any positive solution. Appendix IA.2 gives a sufficient existence condition.

Proposition 1 (Joint selection on θ and k)**.** *Fix $\chi \in [0,1]$ and an equilibrium with $G^* > 0$. Type i commits more frequently than type j if and only if $C_i < C_j$.*

Let $a^*_\theta = \Pr(m = 1 \mid \theta, g)$ and $p^m = \Pr(\theta = H \mid m, g)$. Then $p^1 > p$ if and only if $a^*_H > a^*_L$. A sufficient condition is

$$\max_k C_{Hk} < \min_k C_{Lk}, \tag{20}$$

which implies $0 < p^0 < p < p^1 < 1$ for any $(q_H, q_L) \in (0,1)^2$.

Within each capability group, let $q^m_\theta = \Pr(k = \underline{k} \mid \theta, m, g)$. Then

$$q^0_\theta < q_\theta < q^1_\theta \quad \Longleftrightarrow \quad C_{\theta\underline{k}} < C_{\theta\bar{k}}. \tag{21}$$

The posterior ordering reverses when the cost ordering reverses. Equal commitment costs imply $q^0_\theta = q^1_\theta = q_\theta$.

Condition (20) requires more than $c_H < c_L$, because operating cash flows also affect the shareholder loss from commitment. Holding $c_L > 0$, χ, and the other parameters fixed, there exists $\varepsilon > 0$ such that the ordering holds whenever $0 < c_H < \varepsilon$ and $0 \leq \gamma < \varepsilon$. This sufficient condition restricts both c_H and γ to a neighborhood of zero.

When $\chi = 0$ and $\gamma = 0$, lower investment needs yield weakly greater net abatement gains at a given operating capability. If monitoring and reporting payments trigger early default, low-k firms can therefore lose more continuation value, making commitment less costly at high-k firms. Thus higher k can lower C_i while raising the investment required for a fixed emissions reduction. Increasing γ can reverse this comparison when low-k

firms already meet the target without commitment, while high-k firms must invest more or bear shortfall losses. A finite reversal requires the limiting shareholder cost of meeting the target at high k to exceed the commitment cost at low k. Appendix IA.3 states the conditions and proves the result.

Commitment can therefore signal stronger operating capability together with greater investment needs for achieving the abatement target. A sufficient case combines condition (20), $C_{\theta\overline{k}} < C_{\theta\underline{k}}$ in both capability groups, and $q_H \leq q_L$. Appendix IA.2 establishes the ordering across capability groups and this case of simultaneous increases in the posterior probabilities of $\theta = H$ and $k = \overline{k}$.

4.2 Bond repricing across maturities

Let $r_T^m(i)$ denote the repayment probability of type i at maturity T, given decision m and optimal investment. Evaluate posterior probabilities at G^*, and write $\bar{a}^* = \bar{a}(G^*)$. By equation (14), the bond price per unit of face value equals its repayment probability.

Let V_T^- denote the price before the commitment decision becomes public and V_T^m the price after observing m. Subscripts identify the repayment date; superscripts 1 and 0 identify commitment and noncommitment:

$$V_T^m = \sum_i \pi_i^m r_T^m(i), \tag{22}$$

$$V_T^- = \bar{a}^* V_T^1 + (1 - \bar{a}^*) V_T^0. \tag{23}$$

The announcement responses compare the same bond after commitment with its value immediately before the announcement:

$$\Delta V_T^1 = V_T^1 - V_T^-, \qquad \Delta s_T^1 = -\frac{1}{M_T} \log\left(\frac{V_T^1}{V_T^-}\right). \tag{24}$$

Here, M_T is remaining maturity in years.[15]

[15] The model's V_T^0 conditions on observed noncommitment; it does not represent the price of a matched control firm.

Proposition 2 (Information and bond repricing)**.** *Fix $\chi = 0$ and an equilibrium with $G^* > 0$.*

(i) *For a given k and decision m, stronger operating capability θ weakly raises repayment probabilities at both maturities. For a given θ and m, short-term repayment is independent of k, while greater investment needs, represented by a higher k, weakly lower long-term repayment.*

(ii) *For each type i, commitment weakly lowers repayment probabilities: $r_T^1(i) \leq r_T^0(i)$ for $T = 1, 2$. Define $d_\theta = r_1^0(\theta) - r_1^1(\theta) \geq 0$. The short-term announcement response satisfies*

$$\Delta V_1^1 = \underbrace{(p^1 - p)\left[r_1^0(H) - r_1^0(L)\right]}_{\textit{information about capability}} - \underbrace{(1 - \bar{a}^*)\left[p^1 d_H + (1 - p^1) d_L\right]}_{\textit{monitoring and reporting costs}}. \tag{25}$$

Short-term bond prices rise, and spreads fall, if and only if the first term exceeds the second.

(iii) *Write $\bar{r}_2^0(\theta) = q_\theta r_2^0(\theta, \underline{k}) + (1 - q_\theta) r_2^0(\theta, \overline{k})$ for repayment averaged over the prior distribution of k within capability group θ. Then*

$$\begin{aligned} \Delta V_2^1 = & \underbrace{(p^1 - p)[\bar{r}_2^0(H) - \bar{r}_2^0(L)]}_{\textit{selection across capability groups}} \\ & + \underbrace{\sum_\theta \Pr(\theta \mid m = 1, g)(q_\theta^1 - q_\theta)[r_2^0(\theta, \underline{k}) - r_2^0(\theta, \overline{k})]}_{\textit{selection on } k \textit{ within groups}} \\ & - \underbrace{(1 - \bar{a}^*) \sum_i \pi_i^1 [r_2^0(i) - r_2^1(i)]}_{\textit{repayment loss from commitment}}. \end{aligned} \tag{26}$$

Long-term bond prices rise, and spreads fall, if and only if the two selection terms together exceed the repayment loss.

Appendix IA.4 proves the proposition. The first term in the long-term decomposition compares capability groups using their prior k compositions; the second captures updating about investment needs k within groups. If $q_H = q_L$, $p^1 > p$ makes the first term nonnegative, whereas $q_\theta^1 < q_\theta$ in both groups makes the second nonpositive. When

$q_H \neq q_L$, $p^1 > p$ alone does not determine the sign of the first term. The loss terms remain net of what investors already anticipated. No ordering across maturities is imposed. Table 1 summarizes the cash-flow channels.

Higher k means that the same emissions reduction requires more investment. This can reduce the net abatement gains available for long-term repayment even if the firm responds by choosing less abatement and spending less in total.

Early investment payments ($0 < \chi \leq 1$). When a fraction χ of investment expenditure is paid at time 1, k can also affect short-term repayment through $\chi I(g, e_m^*; k)$. For a given plan, earlier payment reduces cash available for short-term debt service without changing total expenditure. Greater investment needs need not lead to a larger early payment once the firm adjusts abatement, so the effect of k on early repayment has no general sign.

Spread comparisons for any χ. Let κ denote the probability of repayment at time 2 conditional on repayment at time 1. Since $\mathcal{S}_2 \subseteq \mathcal{S}_1$, its values before and after the announcement are

$$\kappa^- = \frac{V_2^-}{V_1^-}, \qquad \kappa^1 = \frac{V_2^1}{V_1^1}. \tag{27}$$

Changes in κ reflect the combined effects of type information and cash-flow changes on conditional repayment; they do not isolate information about k.

Using $V_2 = V_1\kappa$, spread responses satisfy

$$\Delta s_2^1 = \underbrace{\frac{M_1}{M_2}\Delta s_1^1}_{\text{scaled short-term response}} - \underbrace{\frac{1}{M_2}\log\left(\frac{\kappa^1}{\kappa^-}\right)}_{\text{conditional repayment update}}. \tag{28}$$

This identity holds for any $\chi \in [0, 1]$ and any sign of Δs_1^1. If κ is unchanged, nonzero spread responses have the same sign, with a smaller long-term magnitude because of annualization. An increase in κ lowers the long-term response relative to the scaled short-term response; a decrease raises it. Table 2 summarizes the possible cases.

Table 2: Long-term spread responses

	Short-term spread response		
Update in κ	Falls	Unchanged	Rises
$\kappa^1 = \kappa^-$	Falls less.	Unchanged.	Rises less.
$\kappa^1 > \kappa^-$	Falls; the relative decline depends on the update.	Falls.	May rise, remain unchanged, or fall.
$\kappa^1 < \kappa^-$	May fall, remain unchanged, or rise.	Rises.	Rises; the relative increase depends on the update.

Notes: Entries describe the long-term spread response conditional on the short-term response and the update in κ. The terms *less* and *relative* compare the magnitudes of changes at the two maturities. All cases follow from equation (28) and apply under either investment payment schedule.

A larger short-term spread decline alone therefore does not establish an adverse update about k. Appendix IA.4 derives the spread comparison and the cases in Table 2.

Percentage price responses. To distinguish repayment news from annualization, define the proportional price response $R_T^1 = V_T^1/V_T^- - 1$. Equation (27) implies

$$\frac{1 + R_2^1}{1 + R_1^1} = \frac{\kappa^1}{\kappa^-}. \tag{29}$$

Thus $R_1^1 > R_2^1$ if and only if $\kappa^1 < \kappa^-$. Both prices increase, with a larger percentage increase at the shorter maturity, if and only if

$$\Delta s_1^1 < 0, \qquad M_1 \Delta s_1^1 < \log\left(\frac{\kappa^1}{\kappa^-}\right) < 0. \tag{30}$$

Here, improved short-term repayment offsets worse repayment at time 2 conditional on survival at time 1. The condition holds for any $\chi \in [0, 1]$ and concerns the combined update in conditional repayment; it neither identifies information about k separately nor follows from joint selection alone. These identities apply to the model's zero-coupon claims; coupon bonds require pricing their individual cash flows. Appendix IA.4 provides the derivation.

4.3 Numerical results and empirical implications

Numerical results. The examples in Appendix IA.5 show that commitments can signal stronger operating capability and greater investment needs under small shortfall losses; larger losses reverse selection on k. Favorable capability information can lower spreads at both maturities, while information about higher investment needs limits the benefit for long-term debt. Annualization also contributes to the maturity difference. Tables IA4 and IA5 show that short-term bonds can experience larger percentage price increases, including when part of the investment is paid early.

Empirical implications. I use operating profitability, measured by operating income before depreciation divided by total assets (OIBDP/AT), as a proxy for θ. To examine selection on operating capability, I test whether more profitable firms are more likely to commit. To assess the information conveyed by commitment, I test whether it predicts future profitability after controlling for historical profitability, its trend, and other observed firm characteristics.

I then examine how commitment announcements reprice bonds across maturities, assessing annualization separately. I use pre-commitment carbon intensity as an observable proxy for the investment needs represented by k. Green investment is often embodied in new machinery and equipment (De Haas et al., 2025). Higher carbon intensity may reflect greater reliance on production technologies that require costly equipment replacement or process redesign to achieve a given emissions reduction. This motivates testing whether more carbon-intensive firms exhibit a larger long-minus-short spread response, as higher investment needs can offset favorable capability news for long-term repayment.

5 Data and Measurement

5.1 Data Sources and Sample Construction

I obtain corporate bond transaction data from FINRA's Trade Reporting and Compliance Engine (TRACE) and bond characteristics from the Mergent Fixed Income Securities Database (FISD). Firm accounting data come from Compustat, stock market data from the Center for Research in Security Prices (CRSP), and emissions data from S&P Global Trucost.

The sample covers January 2005 through December 2024. I retain bonds denominated in U.S. dollars and issued by U.S. firms, with fixed coupons or no coupons. Private placements and securities issued under Rule 144A are excluded. Internet Appendix IB details the bond selection criteria and transaction filters. The sample contains 2,014,880 bond-month observations for 47,044 bonds, including 1,679,044 observations with available credit spreads.

5.2 Green Commitment Announcements

I use the green commitment announcements identified by Bauer et al. (2026) from Dow Jones News coverage of U.S. firms during 2005–2023. The authors use a large language model, with human validation, to identify new plans to substantially reduce firms' future direct greenhouse gas emissions. The dataset also includes updates announcing tighter targets or new initiatives, but excludes simple reaffirmations of existing goals.

I match 4,822 distinct commitment announcements to 663 firms, representing 28.1% of the 2,357 identified firms in the corporate bond sample.[16] Panel A of Table 3 and Figure 2 show that green commitments occur in all twelve industries. Across industries, the percentage of firms that commit ranges from 11.4% to 43.8% and is not monotonic in industry carbon intensity. Over time, announcement counts rose sharply after 2019

[16] I identify firms through confirmed GVKEY links using security identifiers and historical company links. Announcements are counted once per firm and date; the first is the earliest confirmed event in the data.

and peaked at 846 in 2022, while the number of firms with a first observed commitment peaked at 96 in 2021 (Panel B of Table 3 and Figure 2). Announcements during 2020–2023 account for 56.6% of the total. Given this concentration, I assess robustness by restricting observations to calendar months through December 2019.

Commitment announcements also differ in how firms propose to reduce emissions. I use the classification of Bauer et al. (2026), which distinguishes investment, divestment, and commitments without specific implementation details. Investment refers to technologies or projects that reduce emissions; divestment refers to asset sales or exits from activities with high emissions. Among the first confirmed announcements of the 663 firms, 79.2% mention investment, 18.9% provide no specific implementation details, and 2.0% mention divestment (Panel C of Table 3). The predominance of investment-related commitments motivates the analysis of how abatement investment affects firms' repayment capacity.

5.3 Credit Spreads and Firm Characteristics

Following Gilchrist and Zakrajšek (2012), I calculate credit spreads as the difference between a corporate bond's yield to maturity and the yield on a Treasury benchmark with identical promised cash flows. I discount the coupon and principal payments using the zero-coupon curve of Gürkaynak et al. (2007) and calculate the benchmark yield from their present value. Matching payment amounts and dates avoids the bias from comparing bonds with different coupon structures solely by maturity.[17]

I use annual Compustat data on firm size, operating profitability, leverage, and cash holdings to control for issuers' financial condition (Seltzer et al., 2026). I also compare these characteristics between treated and matched control issuers before announcements. Annual emissions comprise Trucost Scope 1 emissions from firms' operations and location-based Scope 2 emissions from purchased energy. I define carbon intensity as

[17]The corporate bond yield is calculated from the last available daily volume-weighted clean price in each month plus accrued interest. The Treasury curve is dated the same day as the bond price. Both yields use semiannual compounding.

annual emissions in tonnes of CO_2 equivalent divided by Trucost revenue in USD millions for the same reporting period. Appendix A provides detailed variable definitions.

5.4 Summary Statistics and Correlations

Table 4 summarizes the sample from 2005 to 2024. I winsorize each variable at its pooled 1st and 99th percentiles and average monthly cross-sectional statistics equally across months. Panel A uses bond-month observations; Panel B counts each firm once per month. This approach limits the influence of outliers and prevents firms with more bonds from receiving greater weight in the firm-level statistics.

Credit spreads average 235.20 basis points, with an average monthly standard deviation of 217.71 basis points. Remaining maturity averages 9.94 years; its monthly 25th percentile averages 3.68 years, and its 75th percentile averages 14.58 years. Firms have average operating ROA of approximately 12%. Carbon intensity averages 377.58 tonnes of CO_2 equivalent per USD million of revenue, compared with an average monthly median of 48.94.

Table 5 reports Pearson correlations calculated within each month and averaged equally across months. In Panel A, higher rating scores indicate better credit quality (22=AAA, 1=D). Their negative correlation with spreads (-0.68) is consistent with higher borrowing costs for lower-rated issuers (Xu et al., 2025). In Panel B, higher operating ROA is weakly associated with higher leverage, a relationship that can differ within and across industries (Rajan and Zingales, 1995). Panel C shows that spreads are positively correlated with leverage (0.31) and negatively correlated with log total assets (-0.23), with weaker negative correlations for operating ROA (-0.09) and cash holdings (-0.07). Overall, lower spreads are associated with better credit quality and lower leverage.

Spreads have weak unconditional correlations with maturity (-0.01) and modified duration (-0.06). These correlations pool bonds issued by firms with different credit risks. Debt maturity can vary nonmonotonically with credit quality (Diamond, 1991), and credit spreads can rise or fall with maturity depending on firm risk (Merton, 1974).

6 Empirical Results

6.1 Commitment Selection and Future Operating Performance

Under the cost ordering in Section 4.1, firms with stronger operating capability bear a lower shareholder cost of commitment and are more likely to commit. In the model, investors do not fully observe this capability and learn about it from the commitment decision. Moreover, operating capability supports cash flow in both periods, so the information conveyed by commitment also concerns future performance.

I examine these implications using operating profitability (Barber and Lyon, 1996), measured here as operating income before depreciation scaled by year-end total assets (operating ROA). This measure provides an observable but imperfect proxy for operating capability θ.

Let $\text{Commitment}_{i,t}$ equal one if firm i announces its first recorded commitment in calendar year t, and zero otherwise. Over 2006–2023, each eligible firm contributes observations up to and including its first commitment year; subsequent observations are excluded. Firms with no recorded commitment remain eligible throughout the period, subject to the sample requirements.[18] I estimate linear probability models, with the most complete specification given by

$$\text{Commitment}_{i,t} = \alpha + \beta R_{i,t-4:t-2} + \mathbf{X}'_{i,t-4:t-2}\boldsymbol{\gamma} + \lambda_{j(i,t),t} + \varepsilon_{i,t}. \tag{31}$$

Here, $R_{i,t-4:t-2}$ is mean operating ROA over $t-4$ to $t-2$. Averaging reduces the influence of transitory fluctuations. The window ends at $t-2$ because financial statements for $t-1$ may not yet be public when commitments are announced early in year t. The vector $\mathbf{X}_{i,t-4:t-2}$ includes mean log assets, log revenue, leverage, cash holdings, and log carbon intensity, measured as $\log(1+\text{CI})$, over the same window, together with an indicator for missing carbon intensity. Continuous regressors are winsorized and standardized before estimation. Industry-by-year fixed effects, $\lambda_{j(i,t),t}$, account for common conditions within each Fama–French industry and year that may affect both profitability and commitment.

[18] Eligibility requires a bond observation in December of $t-1$ and available historical financial controls.

I retain comparisons across firms because the selection mechanism concerns persistent differences in operating capability.

Table 6 shows that higher prior ROA predicts first commitments across all specifications. In column (5), the association remains significant after controlling for firm size, prior carbon intensity, and other firm characteristics. A one standard deviation increase in prior ROA is associated with a 0.73 percentage point increase in commitment probability, about 18% of the sample annual commitment rate of 3.99%. Larger firms and firms with higher prior carbon intensity are also more likely to commit. The profitability and size findings are consistent with the descriptive evidence in Bolton and Kacperczyk (2026), who report that firms with CDP commitments are larger and have higher ROE on average.

To examine the predictive content of commitment beyond historical profitability, I relate future ROA to commitment, controlling for the level and trend of prior performance:

$$\begin{aligned} \text{ROA}_{i,t+h} = \alpha_h + \delta_h \text{Commitment}_{i,t} + \rho_h R_{i,t-4:t-2} + \kappa_h \text{Trend}_{i,t-4:t-2} \\ + \mathbf{X}'_{i,t-4:t-2}\boldsymbol{\gamma}_h + \lambda^{(h)}_{j(i,t),t} + u_{i,t+h}, \qquad h = 1, 2, 3. \end{aligned} \tag{32}$$

The dependent variable is operating ROA for the fiscal year ending in calendar year $t + h$, and $\text{Trend}_{i,t-4:t-2}$ captures its historical trend.[19] All three horizons use a common sample with t from 2006 to 2021 and ROA observed at each horizon. Table 7 shows that, conditional on historical profitability, its trend, and other firm characteristics, committing firms have operating ROA 0.68 and 0.48 percentage points higher in years $t+1$ and $t+2$, respectively, than firms that have not committed by year-end t.[20] Both estimates are significant at the 5% level; the third-year estimate is insignificant.

6.2 Average Bond Repricing around Green Commitments

Green commitments can reveal stronger repayment capacity while imposing costs that reduce cash available to creditors. The model predicts lower spreads when

[19] For each firm-year, I regress annual ROA on a constant and the calendar year of the fiscal year-end over $t-4$ to $t-2$, using at least two observations, and retain the estimated slope.

[20] These differences are about 6% and 4% of the corresponding estimation-sample mean ROA.

the favorable information conveyed by commitment outweighs these cash-flow costs (Section 4.2). I therefore first examine how outstanding debt is repriced around commitment announcements.

Adapting the matching approach of Seltzer et al. (2026), I match treated bonds to bonds issued by firms with no recorded commitment on credit rating, log principal outstanding, remaining maturity, and issuer equity oil beta, measured at month −12 relative to the first recorded commitment announcement.[21] Measuring characteristics at the start of the preannouncement window reduces the risk that they already reflect commitment preparations or investor anticipation. Matching uses one-to-one nearest-neighbor Mahalanobis distance with replacement and a caliper of one, within the same baseline calendar month. Putable bonds are excluded.

Table 8 reports 1,469 matched pairs. All four matching variables have absolute standardized mean differences below 0.04. Treated bonds nevertheless have initial spreads 22.52 basis points lower. Matching on bond characteristics does not ensure comparable issuer financial conditions, so I progressively add financial controls while keeping the matched sample fixed. I estimate the following monthly event study:

$$\begin{aligned} \text{Spread}_{bpt} = \text{BondFE}_b + \text{PairMonthFE}_{pt} \\ + \sum_{k \in \mathcal{K}} \beta_k \, \text{Treated}_{bp} \, \mathbf{1}\{\text{EventTime}_{pt} = k\} \\ + \mathbf{Controls}'_{bpt} \boldsymbol{\gamma} + \varepsilon_{bpt}, \end{aligned} \tag{33}$$

where b denotes the bond, p the matched pair, and t the calendar month. Spreads are measured in basis points, and Treated_{bp} identifies the bond issued by the committing firm. Bond fixed effects absorb persistent differences across bonds, while pair-by-month fixed effects absorb shocks common to the two bonds in each calendar month. Event time is measured relative to the announcement, with $\mathcal{K} = \{-11, \ldots, -1, 1, \ldots, 12\}$. Month −12 is the reference period, and month 0 is excluded. The coefficient β_k measures the spread change for treated bonds from month −12 to month k, net of the change for matched

[21] Seltzer et al. match on bond characteristics measured in December 2014 and use that month as the reference in their dynamic spread regression around the December 2015 Paris Agreement.

control bonds. Appendix Table IC1 assesses sensitivity to the mean of months -3 to -1 as an alternative reference, with the matched sample and regression specification held fixed. Monthly treatment coefficients allow spread responses to vary within quarters. Callable status at month -12 is interacted with each monthly indicator in $\mathcal{K}$. Columns (2)–(5) successively add the same interactions for baseline operating ROA, firm size, leverage, and cash holdings. These interactions allow spread changes to vary with initial financial conditions.

Table 9 reports quarterly averages of the coefficients on the treatment-by-event-month interactions and the average over months $+1$ to $+12$. In column (5), the reported coefficients for quarters 1 through 4 are -63.22, -81.17, -43.17, and -63.14 basis points, respectively. The coefficients for the first, second, and fourth quarters are negative and significant across all five specifications; the third-quarter coefficient is not significant in columns (3) and (4). With all controls, the average coefficient over months $+1$ to $+12$ is -62.67 basis points. The magnitude of the first-quarter estimate represents about 39% of the treated bonds' initial mean spread of 160.77 basis points. With the mean of months -3 to -1 as the reference, Appendix Table IC1 reports smaller estimated declines, indicating that part of the relative decline precedes the announcement. Under this reference, the coefficients for the first, second, and fourth quarters remain negative and significant at the 5% level. The average coefficient over months $+1$ to $+12$ is -29.11 basis points, significant at the 1% level. The pattern is consistent with a favorable reassessment of issuers' repayment prospects around commitments.

6.3 Changes in Credit Spreads across Bond Maturities

Stronger operating capability θ supports repayment at both maturities, while greater investment needs k can limit net gains available for later repayment. Section 4.2 distinguishes spread annualization from changes in later repayment prospects conditional on earlier survival. I therefore compare credit spread changes across maturities following

commitment announcements. I also examine nonannualized percentage price responses to test whether annualization alone explains the maturity difference in spreads.[22]

At month -12, I assign bonds to Short, Middle, and Long groups using two classifications. For within-issuer terciles, I rank each treated issuer's eligible bonds by remaining maturity and divide them into three groups as nearly equal in size as possible. For fixed groups, I use common intervals of $[1, 5)$, $[5, 10)$, and $[10, 30]$ years. Both classifications use 1,389 matched pairs from 220 treated and 225 distinct control firms, with 55,654 bond-pair-month observations.[23] I assign each control bond the same maturity group as the matched treated bond and keep these assignments fixed throughout the event window. Table 10 reports balance for fixed groups in Panel A and terciles in Panel B. Under terciles, treated Short bonds average 4.70 years to maturity and Long bonds average 19.78 years; all absolute standardized mean differences are below 0.10. Fixed groups retain maturity imbalances for Short and Middle bonds. Appendix Table IC2 reports two checks for both within-issuer terciles (Panel A) and fixed maturity groups (Panel B): additional maturity and duration controls in columns (1)–(4), and one-year limits on the treated-control differences in both measures in columns (5)–(8).

For each classification, I estimate

$$\begin{aligned} \text{Spread}_{bpt} = \alpha_b + \lambda_{pt} \\ + \sum_{j \in \mathcal{M}} \sum_{m \in \mathcal{R}} \beta_{jm} \, \text{Treated}_{bp} \, \mathbf{1}\{j(p) = j\} \mathbf{1}\{r(p,t) = m\} \\ + \mathbf{Z}'_{bpt} \boldsymbol{\zeta} + \varepsilon_{bpt}. \end{aligned} \tag{34}$$

Here, b, p, and t index bonds, matched pairs, and calendar months. The maturity group of the treated bond is $j(p) \in \mathcal{M} = \{\text{Short}, \text{Middle}, \text{Long}\}$, and $r(p,t)$ denotes the announcement-relative month. Bond fixed effects absorb persistent bond characteristics; bond-pair-by-calendar-month fixed effects absorb monthly movements common to matched bonds. Event coefficients cover $\mathcal{R} = \{-11, \ldots, -1, 1, \ldots, 12\}$,

[22] For zero-coupon bonds, the same proportional price increase implies a smaller annualized spread decline at a longer remaining maturity.

[23] The tercile classification requires at least three eligible bonds at month -12, excluding 80 pairs from 64 treated issuers relative to the 1,469 pairs in Table 8.

with month −12 as the reference and month 0 excluded. I report equal-weight averages by post-announcement quarter and over months +1 to +12. The controls $\mathbf{Z}_{bpt}$ interact baseline callable status with event periods. I also include baseline firm controls with coefficients that vary by maturity group and event period.[24] To estimate within-issuer maturity differences, I add issuer-by-calendar-month fixed effects.[25] A positive Long-minus-Short estimate indicates that long-maturity spreads decline less, or increase more, within the same issuer and month. I estimate these contrasts separately, so they need not equal differences between group-specific estimates.

With baseline firm controls, spreads fall by 84.65 basis points for Short bonds and 26.27 basis points for Long bonds under terciles (Table 11). The separate regression with issuer-by-month fixed effects gives a Long-minus-Short response of 26.72 basis points, significant at 1%. Under fixed groups, spreads fall by 51.22 basis points for Short bonds and 46.13 basis points for Long bonds; the within-issuer contrast is 32.50 basis points, significant at 5% (Table 12). All estimates compare treated bonds with matched controls over months +1 to +12, relative to month −12. Both classifications show a larger short-maturity decline within issuers.

If annualization alone explains the spread difference, nonannualized percentage price responses should be equal across maturities. I convert each spread change into an implied percentage price response using the baseline yield, coupons, and remaining maturity of each bond, while holding promised cash flows and the valuation date fixed, as detailed in the Appendix. I then use these price responses in the same specifications with baseline firm controls. With issuer-by-month fixed effects, the Short-minus-Long price response is 1.09 percentage points under terciles (Panel B) and 1.16 under fixed groups (Panel A), both significant at 1% (Table 13).[26] Without issuer-by-month fixed effects, I estimate differences of 1.23 percentage points under terciles and 1.27 under fixed groups, both significant at 1%. The implied percentage price response is larger for short-maturity

[24]These controls comprise operating ROA, log assets, debt/assets, cash/assets, and corresponding missing-data indicators.

[25]These fixed effects absorb issuer-wide monthly changes, including the common treatment response. Maturity contrasts remain identifiable, but separate group responses do not.

[26]These differences correspond to approximately $11–$12 per $1,000 of baseline bond value.

bonds than for long-maturity bonds following commitment announcements. Since these responses are not annualized, annualization alone cannot explain the maturity difference.

I retain baseline firm controls throughout. The larger short-maturity spread decline is robust to additional maturity and duration controls under both maturity classifications. With one-year calipers, it remains significant under within-issuer terciles and fixed groups (Internet Appendix Table IC2). The result also holds under both classifications in the pre-2020 sample (Internet Appendix Tables IC3 and IC4).

6.4 Investment Needs and Maturity Differences

In the model, greater investment needs can limit net abatement gains available for long-term repayment when investment payments and savings occur after short-term debt matures. I therefore examine whether the Long-minus-Short spread response following commitment announcements is larger for firms with higher pre-baseline emissions intensity, using intensity as a proxy for investment needs (Section 4.3). I measure intensity as Scope 1 plus location-based Scope 2 emissions per USD million of revenue. I retain matched pairs with nonmissing pre-baseline emissions intensity for the treated issuer and split these issuers at the median intensity available before month -12.[27] Panel A uses within-issuer terciles, and Panel B uses the fixed maturity groups defined above. Both bonds in each matched pair receive the intensity and maturity classifications of the treated bond.

In columns (1)–(3) of Table 14, I allow monthly treatment coefficients to vary by intensity and maturity. In column (4), I add issuer-by-month fixed effects:

$$\begin{aligned}\text{Spread}_{bpt} = \alpha_b + \lambda_{pt} + \mu_{i(b),t} \\ + \sum_{h\in\mathcal{H}} \sum_{g\in\{M,L\}} \sum_{k\in\mathcal{K}} \delta_{hgk}\, \text{Treated}_{bp}\, \mathbf{1}\{H_p = h\} \\ \times \mathbf{1}\{G_{bp} = g\}\mathbf{1}\{k_{pt} = k\} \\ + \mathbf{Z}'_{bpt}\boldsymbol{\xi} + v_{bpt},\end{aligned} \tag{35}$$

[27] I impose a six-month reporting lag to allow for delays in the availability of annual emissions data. The intensity measure used for grouping must be available before month -12 under this convention.

where b, p, and t retain their definitions in equation (34), and $i(b)$ identifies the issuer. The terms α_b, λ_{pt}, and $\mu_{i(b),t}$ denote bond, bond-pair-by-calendar-month, and issuer-by-calendar-month fixed effects. Treated_{bp} identifies the treated bond, $H_p \in \mathcal{H} = \{\text{Low}, \text{High}\}$ denotes intensity group, and $G_{bp} \in \{S, M, L\}$ denotes maturity group. Event month k_{pt} belongs to $\mathcal{K} = \{-11, \ldots, -1, 1, \ldots, 12\}$, with month -12 as the reference and month 0 excluded. Short is the omitted maturity group: δ_{hMk} measures Middle-minus-Short and δ_{hLk} measures Long-minus-Short within intensity group h, relative to month -12.

For high-intensity issuers in Panel A, the spread response is -97.98 basis points for Short bonds and -71.19 for Middle bonds, both significant at 5%. The estimate for Long bonds is -41.33 and is insignificant, as are all three estimates for low-intensity issuers. With issuer-by-month fixed effects, the Long-minus-Short response is 57.20 basis points for high-intensity issuers (significant at 1%) and 4.99 for low-intensity issuers (insignificant). The high-minus-low difference is 52.21 basis points, significant at 5%. Under fixed groups in Panel B, the Long-minus-Short response for high-intensity issuers is 53.72 basis points, significant at 1%, and the high-minus-low difference is 68.63 basis points, significant at 5%.

If higher intensity reflects greater investment needs for a given emissions reduction, the results are consistent with commitments revealing smaller expected net abatement gains at high-intensity firms. Under the benchmark timing, these smaller gains limit the improvement in long-term repayment prospects and the decline in long-term spreads.

7 Conclusion

I develop a signaling model in which voluntary green commitments can jointly signal stronger operating capability and greater investment needs for future abatement. Bond repricing reflects both what investors learn from a commitment and the effects of fulfilling it on repayment. Stronger operating capability supports repayment at both maturities. When investment payments and emissions cost savings occur after short-term

debt matures, information about greater investment needs can partly offset the benefit of favorable operating information for long-term debt.

Firms with stronger prior operating profitability are more likely to make a first commitment. Commitments also predict higher operating profitability over the following two years, conditional on prior profitability, its trend, and other firm characteristics. Credit spreads decline after first observed commitments relative to matched controls. Within the same issuer and commitment announcement, declines are significantly larger for short-maturity bonds. The long-minus-short spread response is larger among firms with higher pre-announcement carbon intensity. Implied percentage price increases are also larger for short-maturity bonds, so the maturity difference cannot be explained solely by expressing credit spreads as annual rates.

These findings suggest that creditors can respond favorably to green commitments while accounting for the investment needed to fulfill them. Different bond price responses across maturities indicate that repayment horizons matter. Disclosing the scale and timing of transition investment may help creditors assess its effects on the cash available for future debt repayment.

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Table 3: Green commitments of firms in the corporate bond sample

Panel A. Commitments and emissions by industry

Industry	All firms	Firms that commit	Announcements per firm	Share (%)	Mean annual emissions (Mt CO_2e)	Carbon intensity (t CO_2e/$m revenue)
Utilities	203	81	5.84	39.9	13.38	2,427.70
Chemicals	77	31	3.30	40.3	6.59	651.45
Energy	199	54	2.25	27.1	5.56	559.48
Other	301	77	2.23	25.6	3.51	415.37
Manufacturing	254	90	2.15	35.4	1.94	243.28
Retail	208	51	1.26	24.5	1.67	139.53
Nondurables	135	51	2.20	37.8	1.11	81.64
Durables	52	19	5.40	36.5	1.38	43.76
Finance	518	100	0.76	19.3	0.27	39.38
Health Care	118	21	0.48	17.8	0.43	37.48
Business Equipment	169	74	1.97	43.8	0.50	30.74
Telecommunication	123	14	0.78	11.4	0.59	28.34
Full sample	2,357	663	2.05	28.1	2.75	370.32

Panel B. Firms and commitment announcements by year

Year	First commitments	Share (%)	Announcements	Year	First commitments	Share (%)	Announcements
2005	21	3.17	49	2015	11	1.66	111
2006	13	1.96	52	2016	9	1.36	96
2007	28	4.22	148	2017	14	2.11	109
2008	48	7.24	177	2018	20	3.02	147
2009	56	8.45	253	2019	39	5.88	247
2010	51	7.69	222	2020	54	8.14	409
2011	22	3.32	136	2021	96	14.48	836
2012	30	4.52	138	2022	73	11.01	846
2013	18	2.71	112	2023	40	6.03	638
2014	20	3.02	96				
Total	663	100.00	4,822				

Panel C. Commitment content

Content	Firms	Share (%)
Investment mentioned	525	79.2
No implementation detail stated	125	18.9
Divestment mentioned	13	2.0
Total	663	100.0

Notes: This table summarizes green commitments and emissions during 2005–2023 for firms in the corporate bond sample. Commitment announcements are from Bauer et al. (2026) and counted once per firm and date. Panel A uses the Fama–French 12 industry classification. *Firms that commit* counts firms with at least one announcement. *Announcements per firm* divides total announcements by all firms in each industry; *Share* is the percentage of firms that commit. In Panel B, *First commitments* counts firms in the year of their earliest confirmed announcement, with shares calculated out of 663 firms. *Announcements* includes all announcements in each year. Panel C classifies firms by the content of their first confirmed announcement, with shares calculated out of 663 firms. Annual values are winsorized at the pooled 1st and 99th percentiles, then averaged first within firms and then equally across firms using available observations. Variable definitions are in Appendix A.

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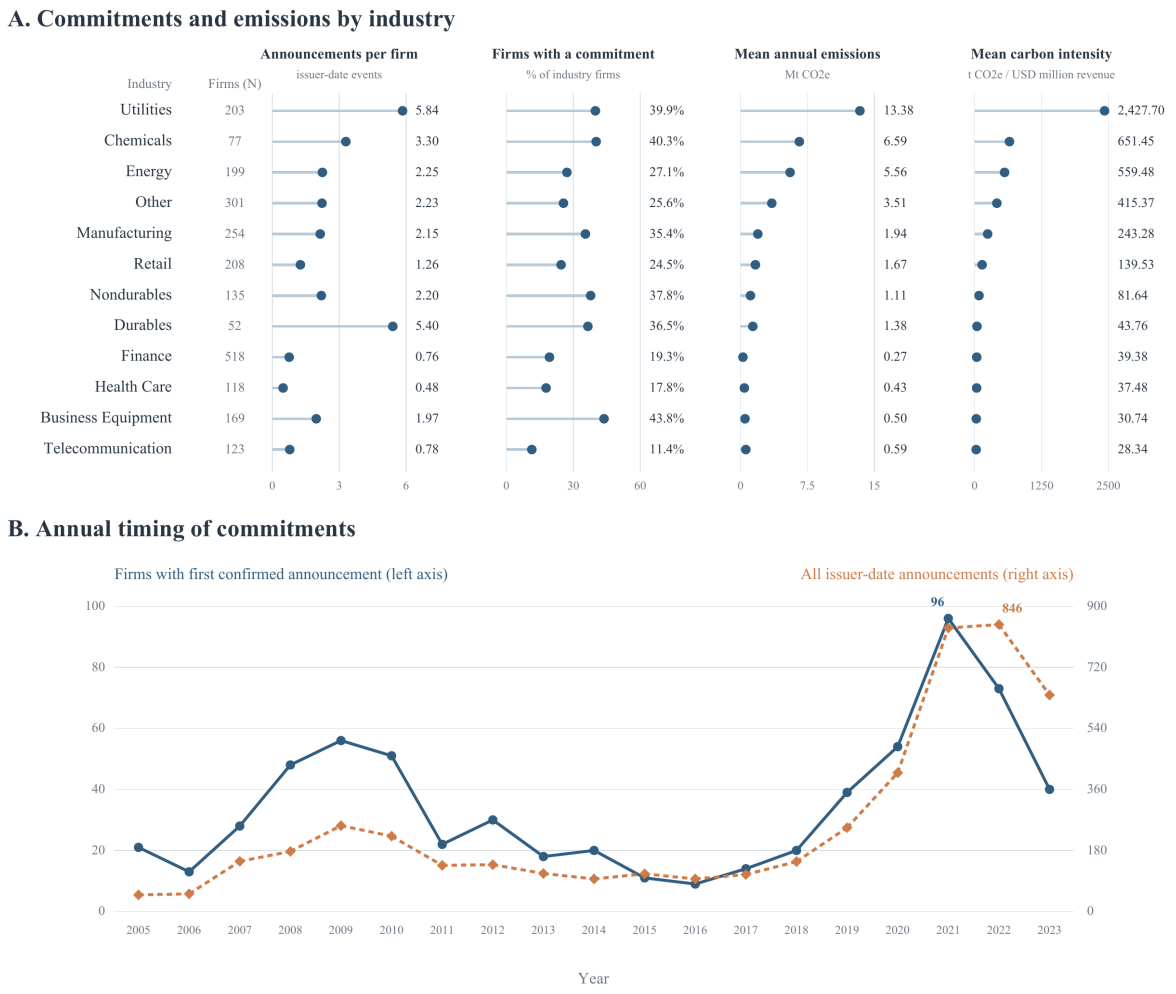


Figure 2: Green Commitments in the Bond Sample

Alt text: Panel A shows announcements per firm, commitment shares, mean annual emissions, and carbon intensity by industry, using the same data and units as Table 3. Emissions statistics cover 1,281 firms. Panel B shows firms making their first confirmed announcement (blue, left axis) and all issuer-date announcements (orange, right axis) during 2005–2023. The series total 663 firms and 4,822 announcements. First announcements peak at 96 firms in 2021; all announcements peak at 846 in 2022.

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Table 4: Summary Statistics

Variable	No. of Obs.	Mean	Median	Std. Dev.	Percentiles 1st	5th	25th	75th	95th	99th
Panel A. Bond Characteristics										
Credit spread (cash-flow matched, bp)	1,679,044	235.20	167.82	217.71	31.81	56.07	111.02	278.23	625.99	1,057.10
Credit rating (22=AAA, 1=D)	1,984,437	14.75	15.24	3.40	5.65	8.04	13.12	17.17	19.70	21.40
Time to maturity (years)	2,014,880	9.94	6.88	8.24	1.06	1.50	3.68	14.58	27.39	30.11
Modified duration (years)	1,694,809	6.64	5.69	4.15	1.01	1.40	3.22	9.68	14.36	15.60
Amount outstanding (USD million)	1,498,418	459.50	319.75	508.36	1.63	7.84	143.79	589.94	1,496.61	2,643.52
Coupon rate (%)	1,997,028	5.23	5.08	1.61	2.04	2.77	4.14	6.19	8.22	9.48
Bond age (years since issue)	2,014,771	5.23	3.87	4.84	0.07	0.36	1.84	6.86	16.71	21.53
Panel B. Firm Characteristics										
Log revenue	195,171	8.43	8.42	1.49	5.03	5.97	7.41	9.42	11.02	11.88
Log total assets	195,479	9.20	9.04	1.51	6.20	6.99	8.13	10.14	11.95	13.60
Operating ROA	184,611	0.12	0.11	0.07	-0.05	0.01	0.07	0.16	0.25	0.34
Operating cash flow/assets	195,176	0.08	0.08	0.06	-0.08	-0.0034	0.04	0.12	0.20	0.27
Debt/assets	195,388	0.35	0.33	0.20	0.02	0.06	0.21	0.46	0.71	0.96
Cash/assets	195,455	0.09	0.05	0.10	0.0004	0.0026	0.02	0.12	0.29	0.47
Scope 1 + 2 emissions (Mt CO_2e)	147,900	3.73	0.34	10.56	0.0028	0.01	0.08	1.59	21.19	61.73
Carbon intensity (t CO_2e/$m revenue)	147,900	377.58	48.94	1,013.49	1.90	2.55	17.69	174.45	2,406.25	5,528.12

Notes: The sample covers January 2005–December 2024. Panel A uses bond-month observations; Panel B counts each identified firm once per month. Variables are winsorized at their pooled 1st and 99th percentiles. Observation counts total nonmissing observations; other entries are equal-weighted averages of monthly cross-sectional statistics. Ratings use the same coding as the matching table (22=AAA, 1=D). Firm ratios are expressed as decimals. Variable definitions and sample screens are in Appendix A and Internet Appendix IB .

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Table 5: Average Cross-Sectional Correlations

Panel A. Bond Characteristics

Variable	Credit spread	Credit rating	Time to maturity	Modified duration	Amount outstanding	Coupon rate	Bond age
Credit spread (cash-flow matched, bp)	1.00						
Credit rating (22=AAA, 1=D)	−0.68	1.00					
Time to maturity (years)	−0.01	0.18	1.00				
Modified duration (years)	−0.06	0.23	0.97	1.00			
Amount outstanding (USD million)	−0.11	0.05	0.01	0.02	1.00		
Coupon rate (%)	0.46	−0.47	0.13	0.10	−0.09	1.00	
Bond age (years since issue)	0.09	−0.04	0.02	−0.01	−0.20	0.48	1.00

Panel B. Firm Characteristics

Variable	Log revenue	Log total assets	Operating ROA	Operating cash flow/assets	Debt/ assets	Cash/ assets	Scope 1 + 2 emissions	Carbon intensity
Log revenue	1.00							
Log total assets	0.78	1.00						
Operating ROA	0.13	−0.20	1.00					
Operating cash flow/assets	0.14	−0.12	0.76	1.00				
Debt/assets	−0.29	−0.32	0.12	−0.01	1.00			
Cash/assets	0.15	0.05	0.11	0.17	−0.20	1.00		
Scope 1 + 2 emissions (Mt CO_2e)	0.26	0.24	−0.03	0.00	0.01	−0.13	1.00	
Carbon intensity (t CO_2e/$m revenue)	−0.05	0.00	−0.08	−0.05	0.11	−0.18	0.68	1.00

Panel C. Credit Spreads and Firm Characteristics

Variable	Operating ROA	Debt/ assets	Cash/ assets	Log total assets
Credit spread (cash-flow matched, bp)	−0.09	0.31	−0.07	−0.23

Notes: Entries are monthly cross-sectional Pearson correlations averaged equally over January 2005–December 2024. Each pair uses available observations. Panels A and C use bond-months; Panel B uses firm-months. Variable construction and winsorization follow Table 4. Higher rating scores indicate better credit quality (22=AAA, 1=D).

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Table 6
Operating Profitability and Green Commitments

Dependent variable: First commitment in year t (0/1)					
	(1)	(2)	(3)	(4)	(5)
Operating ROA	0.82***	0.57***	0.60***	0.67***	0.73***
	(0.20)	(0.14)	(0.15)	(0.16)	(0.19)
Log assets			1.95***	1.99***	2.10***
			(0.41)	(0.44)	(0.46)
Log revenue			1.35***	1.25***	1.40***
			(0.38)	(0.38)	(0.44)
Debt/assets			−0.24	−0.26	−0.43*
			(0.22)	(0.23)	(0.23)
Cash/assets			0.15	0.11	0.22
			(0.15)	(0.15)	(0.15)
Prior log carbon intensity					1.77***
					(0.56)
Industry FE	No	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	No	No
Industry × year FE	No	No	No	Yes	Yes
Observations	10,348	10,348	10,348	10,348	10,348
Firms	1,604	1,604	1,604	1,604	1,604
R^2	0.031	0.036	0.060	0.091	0.094

Notes: This table tests whether prior operating profitability predicts first green commitments using linear probability regressions from 2006 to 2023. ROA and the controls shown in the table are averaged over $t-4$, $t-3$, and $t-2$; each average requires data for at least two of these three years. Coefficients measure changes in commitment probability in percentage points for a one standard deviation increase in the explanatory variable. Standard errors clustered by firm and year are in parentheses. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 7
First Commitments and Future Operating ROA

Dependent variable: Future operating ROA

	(1) $t+1$	(2) $t+2$	(3) $t+3$
First recorded commitment	0.68**	0.48**	0.09
	(0.33)	(0.20)	(0.22)
Prior operating ROA	4.33***	4.05***	3.76***
	(0.20)	(0.24)	(0.27)
Prior ROA trend	0.81***	0.79***	0.42*
	(0.21)	(0.23)	(0.22)
Log assets	−0.75**	−0.66**	−0.69**
	(0.27)	(0.31)	(0.30)
Log revenue	0.62**	0.48	0.45
	(0.25)	(0.28)	(0.26)
Debt/assets	0.66***	0.72***	0.81***
	(0.12)	(0.11)	(0.13)
Cash/assets	0.60***	0.64***	0.69***
	(0.13)	(0.13)	(0.13)
Prior log carbon intensity	0.15	0.22	0.16
	(0.18)	(0.18)	(0.18)
Industry × year FE	Yes	Yes	Yes
Observations	8,019	8,019	8,019
Firms	1,266	1,266	1,266
First recorded commitments	326	326	326
R^2	0.561	0.538	0.510

Notes: This table reports regressions of future operating ROA on first commitments and controls. All three horizons use a common sample with t from 2006 to 2021. Continuous controls are standardized; coefficients are in percentage points of ROA. Standard errors clustered by firm and year t are in parentheses. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 8
Bond Matching and Covariate Balance

	Treated	Control	Diff.	SMD
Matched bond pairs		1,469		
Credit rating	15.79	15.70	0.09	0.03
Log amount outstanding	5.25	5.21	0.05***	0.03
Remaining maturity (years)	11.04	11.05	−0.01	0.00
Oil beta (×100)	-2.14	-2.35	0.20	0.01
Initial credit spread (bp)	160.77	183.29	−22.52***	-0.16

Notes: Characteristics are measured at month −12. Diff. is treated minus control; stars refer to this difference. Tests cluster by treated and control firm. SMD denotes the standardized mean difference. Means and SMD retain repeated matches. Statistics use complete pairs for each characteristic. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 9
Changes in Credit Spreads around Green Commitment Announcements

	(1)	(2)	(3)	(4)	(5)
Dependent variable			Credit spread (bp)		
Treated × Quarter 1 (months +1 to +3)	−35.93***	−31.43**	−65.12***	−65.00***	−63.22***
	(13.17)	(12.44)	(18.77)	(18.72)	(18.12)
Treated × Quarter 2 (months +4 to +6)	−58.76***	−54.99***	−80.40***	−80.45***	−81.17***
	(15.64)	(14.63)	(21.86)	(21.72)	(21.74)
Treated × Quarter 3 (months +7 to +9)	−70.81***	−72.16***	−34.37	−35.27	−43.17**
	(23.28)	(24.64)	(24.75)	(24.84)	(20.52)
Treated × Quarter 4 (months +10 to +12)	−58.20***	−59.66***	−59.74***	−61.66***	−63.14***
	(16.29)	(16.25)	(18.04)	(17.82)	(17.99)
Treated × Post (months +1 to +12)	−55.92***	−54.56***	−59.91***	−60.60***	−62.67***
	(15.07)	(14.78)	(17.55)	(17.43)	(16.99)
Controls: average post-event interactions					
Operating ROA		−10.16	−7.86	−20.89*	−19.93*
		(6.76)	(9.08)	(10.70)	(10.28)
ln(Assets)			5.28	1.64	3.02
			(19.18)	(18.78)	(17.71)
Leverage				32.78**	32.30**
				(12.94)	(12.94)
Cash holdings					−6.21
					(8.43)
Callable × event-month indicators	Yes	Yes	Yes	Yes	Yes
Bond FE	Yes	Yes	Yes	Yes	Yes
Pair × month FE	Yes	Yes	Yes	Yes	Yes
Pre-event test (p-value)	0.45	0.48	0.09	0.10	0.10
Matched pairs	1,469	1,469	1,469	1,469	1,469
Observations	59,058	59,058	59,058	59,058	59,058
Within R^2	0.01	0.02	0.03	0.03	0.04

Notes: Month −12 is the reference period and month 0 is excluded. Quarterly and post-announcement rows report equal-weight averages of monthly treatment coefficients over the indicated months. The specification interacts baseline callable status and included financial controls, together with missing-data indicators, with individual event-month indicators for months −11 to −1 and +1 to +12. Callable equals one for bonds callable at month −12. Financial-control rows report average post-event interaction coefficients, in basis points per one-standard-deviation increase in the baseline variable. The pre-event test jointly tests the treatment coefficients for months −11 to −1. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 10
Bond Matching and Covariate Balance by Maturity

Panel A. Fixed maturity groups

	Short $[1, 5)$				Middle $[5, 10)$				Long $[10, 30]$			
Variable	Treated	Control	Diff.	SMD	Treated	Control	Diff.	SMD	Treated	Control	Diff.	SMD
Credit rating	15.57	15.40	0.17***	0.065	15.69	15.51	0.19***	0.067	16.43	16.47	−0.04	-0.015
Log principal outstanding	5.85	5.84	0.01	0.007	5.45	5.41	0.04**	0.024	4.53	4.45	0.07***	0.038
Remaining maturity (years)	3.60	3.85	−0.25***	-0.272	7.30	7.03	0.26***	0.159	20.54	20.66	−0.12	-0.023
Oil beta (×100)	0.72	0.45	0.27	0.017	1.26	-0.48	1.74	0.114	0.96	-0.52	1.48	0.099
Matched bond pairs		377				495				517		

Panel B. Within-issuer maturity terciles

	Short				Middle				Long			
Variable	Treated	Control	Diff.	SMD	Treated	Control	Diff.	SMD	Treated	Control	Diff.	SMD
Credit rating	15.88	15.72	0.16***	0.062	15.91	15.71	0.20**	0.076	16.02	16.11	−0.09	-0.032
Log principal outstanding	5.45	5.44	0.01	0.005	5.25	5.23	0.02	0.013	4.91	4.80	0.11	0.058
Remaining maturity (years)	4.70	4.82	−0.11*	-0.050	10.25	10.17	0.08	0.014	19.78	19.79	−0.02	-0.002
Oil beta (×100)	1.06	0.67	0.40	0.025	0.56	-0.93	1.49	0.097	-0.37	-0.76	0.39	0.025
Matched bond pairs		486				478				425		

Notes: Both panels use the same 1,389 pairs. Groups are fixed at month −12; controls inherit the treated bond's group. Diff. is treated minus control; SMD is the standardized mean difference. Tests cluster by treated and control issuer; oil beta uses unique issuer-months and issuer clustering. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 11
Credit Spread Changes around Green Commitments by Maturity: Terciles within Issuers

	Without controls for firm characteristics					With controls for firm characteristics				
	Short	Middle	Long	Middle − Short	Long − Short	Short	Middle	Long	Middle − Short	Long − Short
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Credit spread (bp)									
Treated × Quarter 1 (months +1 to +3)	−65.78***	−38.24*	7.15	7.94	17.69***	−82.66***	−87.14***	−11.34	5.96	26.31**
	(20.24)	(19.63)	(17.25)	(6.92)	(6.30)	(24.87)	(32.34)	(14.43)	(8.26)	(11.63)
Treated × Quarter 2 (months +4 to +6)	−82.13***	−68.86***	−13.80	13.25**	23.74***	−103.43***	−92.10***	−37.27*	16.51*	34.08***
	(23.67)	(21.37)	(16.63)	(6.26)	(7.90)	(30.26)	(33.49)	(18.98)	(9.06)	(11.95)
Treated × Quarter 3 (months +7 to +9)	−63.77***	−107.65**	−32.19*	8.16	23.38***	−74.56***	−5.71	−25.51	14.39	37.23***
	(20.60)	(48.96)	(17.57)	(6.01)	(7.11)	(22.66)	(54.37)	(17.23)	(9.89)	(14.06)
Treated × Quarter 4 (months +10 to +12)	−60.11***	−67.11***	−37.80*	7.52	30.54***	−77.94***	−67.16***	−30.95	−4.58	9.25
	(19.21)	(20.23)	(20.21)	(5.55)	(8.32)	(27.29)	(24.65)	(20.61)	(8.84)	(13.98)
Average: months +1 to +12	−67.95***	−70.47***	−19.16	9.22**	23.84***	−84.65***	−63.03**	−26.27*	8.07	26.72***
	(18.77)	(22.13)	(15.31)	(4.26)	(6.12)	(22.51)	(28.67)	(15.80)	(6.31)	(10.02)
Firm characteristics: average post-event interactions										
Operating ROA	–	–	–	–	–	−18.85**	−16.83	−23.33**	2.35	6.76
	–	–	–	–	–	(9.35)	(19.64)	(10.41)	(4.45)	(6.85)
Log assets	–	–	–	–	–	10.70	−13.05	4.31	3.29	2.13
	–	–	–	–	–	(9.42)	(45.87)	(15.59)	(5.74)	(6.41)
Debt/assets	–	–	–	–	–	37.25**	23.59	31.14*	−11.62**	−15.97
	–	–	–	–	–	(14.27)	(20.53)	(16.16)	(5.72)	(10.05)
Cash/assets	–	–	–	–	–	−11.61	−15.15	31.91*	0.17	7.38
	–	–	–	–	–	(7.28)	(16.46)	(18.22)	(3.66)	(6.36)
Pre-event test (p)	0.37	0.96	0.78	0.58	< 0.01	0.45	0.59	0.99	0.96	0.20
Observations	55,654	55,654	55,654	55,654	55,654	55,654	55,654	55,654	55,654	55,654
Bond pairs	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389
Treated firms	220	220	220	220	220	220	220	220	220	220
Control firms	225	225	225	225	225	225	225	225	225	225
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond pair × calendar month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer × calendar month FE	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Within R^2	0.017	0.017	0.017	0.005	0.005	0.068	0.068	0.068	0.021	0.021

Notes: Groups are within-issuer maturity terciles at month −12; controls inherit the treated bond's group. Estimation is monthly; month −12 is the reference and month 0 is excluded. Quarterly and post-announcement entries equally average monthly coefficients or contrasts. Columns (4)–(5) and (9)–(10) use separate regressions that add issuer-by-month FE. Baseline callable and firm-characteristic controls interact with event periods; firm-characteristic coefficients are per standard deviation. Pre-event tests jointly assess coefficients or contrasts for months −11 to −1. Standard errors in parentheses use the full covariance matrix and cluster by three-digit SIC industry and calendar month. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 12
Credit Spread Changes around Green Commitments by Maturity: Fixed Groups

	Without controls for firm characteristics					With controls for firm characteristics				
	Short	Middle	Long	Middle − Short	Long − Short	Short	Middle	Long	Middle − Short	Long − Short
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable						Credit spread (bp)				
Treated × Quarter 1 (months +1 to +3)	−53.65**	−46.02***	−8.63	4.90	14.60	−69.11**	−88.58***	−31.34	13.43	13.24
	(25.80)	(15.83)	(13.90)	(6.51)	(10.07)	(26.76)	(32.78)	(25.02)	(9.84)	(18.30)
Treated × Quarter 2 (months +4 to +6)	−69.96***	−82.49***	−20.85	11.50	38.57***	−65.00***	−122.25***	−54.31**	11.88	36.80**
	(22.45)	(22.01)	(15.39)	(8.17)	(12.36)	(23.80)	(38.39)	(27.04)	(8.49)	(15.97)
Treated × Quarter 3 (months +7 to +9)	−124.86*	−77.90***	−24.88	14.65	36.29***	−4.26	−92.03***	−50.61*	7.02	40.31**
	(67.48)	(18.63)	(16.84)	(9.20)	(12.71)	(42.73)	(25.21)	(30.38)	(10.80)	(20.17)
Treated × Quarter 4 (months +10 to +12)	−74.05***	−76.26***	−26.54	10.37	54.48***	−66.54**	−77.93***	−48.25*	14.10	39.63*
	(25.67)	(19.95)	(18.76)	(10.62)	(17.21)	(30.74)	(24.57)	(29.12)	(10.80)	(20.97)
Average: months +1 to +12	−80.63***	−70.66***	−20.23	10.35	35.98***	−51.22**	−95.20***	−46.13*	11.61	32.50**
	(29.41)	(16.94)	(15.12)	(7.26)	(11.06)	(22.36)	(26.98)	(26.45)	(7.55)	(15.76)
Firm characteristics: average post-event interactions										
Operating ROA	–	–	–	–	–	−41.71**	1.28	−32.36**	8.11	9.52
	–	–	–	–	–	(17.25)	(17.39)	(13.02)	(5.43)	(9.15)
Log assets	–	–	–	–	–	−70.25	31.39	15.07	−12.94**	−0.59
	–	–	–	–	–	(60.53)	(24.64)	(14.80)	(6.16)	(9.23)
Debt/assets	–	–	–	–	–	41.43**	4.92	44.27**	−24.12**	−52.86***
	–	–	–	–	–	(18.99)	(20.77)	(19.16)	(10.83)	(14.20)
Cash/assets	–	–	–	–	–	−29.52	−3.82	15.70	−5.57	0.18
	–	–	–	–	–	(21.20)	(8.81)	(11.15)	(7.20)	(12.86)
Pre-event test (p)	0.40	0.68	0.80	0.57	0.42	0.54	0.85	0.95	0.51	0.92
Observations	55,654	55,654	55,654	55,654	55,654	55,654	55,654	55,654	55,654	55,654
Bond pairs	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389
Treated firms	220	220	220	220	220	220	220	220	220	220
Control firms	225	225	225	225	225	225	225	225	225	225
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond pair × calendar month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer × calendar month FE	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Within R^2	0.018	0.018	0.018	0.010	0.010	0.082	0.082	0.082	0.039	0.039

Notes: The sample, monthly estimation, controls, and inference follow Table 11. Short, Middle, and Long denote $[1, 5)$, $[5, 10)$, and $[10, 30]$ years at month −12; controls inherit the treated bond's group. Quarterly and post-announcement entries equally average monthly coefficients or contrasts. Columns (4)–(5) and (9)–(10) use separate regressions that add issuer-by-month FE. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 13
Price Response Differences by Maturity

Panel A. Fixed maturity groups: $[1, 5)$, $[5, 10)$, *and* $[10, 30]$ *years*

	Without issuer × month FE		With issuer × month FE	
Maturity comparison	Estimate (pp)	p-value	Estimate (pp)	p-value
Short − Long	1.27***		1.16***	
	(0.47)	0.008	(0.36)	0.002
Middle − Short	−0.43		−0.38	
	(0.34)	0.208	(0.29)	0.192
Middle − Long	0.84		0.78	
	(0.57)	0.143	(0.52)	0.136

Panel B. Within-issuer maturity terciles

	Without issuer × month FE		With issuer × month FE	
Maturity comparison	Estimate (pp)	p-value	Estimate (pp)	p-value
Short − Long	1.23***		1.09***	
	(0.44)	0.006	(0.39)	0.006
Middle − Short	−0.47		−0.41	
	(0.36)	0.194	(0.31)	0.188
Middle − Long	0.76		0.68	
	(0.49)	0.123	(0.46)	0.142
Observations	55,654		55,654	
Bond pairs	1,389		1,389	
Treated firms	220		220	
Control firms	225		225	
Distinct bonds	1,952		1,952	
Bond FE	Yes		Yes	
Bond pair × month FE	Yes		Yes	
Issuer × month FE	No		Yes	
Controls for firm characteristics	Yes		Yes	
Callable controls	Yes		Yes	

Notes: Entries equally average monthly price-response contrasts over months +1 to +12, relative to month −12; month 0 is excluded. Implied nonannualized percentage price responses revalue fixed baseline cash flows using observed spread changes. The specifications differ only in issuer-by-month FE. Standard errors in parentheses use the full covariance matrix and cluster by three-digit SIC industry and calendar month; p-values use $t(133)$. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table 14
Bond Spread Responses by Pre-Baseline Emissions Intensity

	Short	Middle	Long	Long − Short
	(1)	(2)	(3)	(4)
Dependent variable	Credit spread (bp)			
Panel A. Within-issuer maturity terciles				
Low intensity	12.99	21.67	17.66	4.99
	(30.57)	(28.41)	(32.33)	(15.98)
High intensity	−97.98**	−71.19**	−41.33	57.20***
	(44.30)	(32.28)	(32.15)	(17.30)
High − Low	−110.97**	−92.86**	−58.99	52.21**
	(55.54)	(44.85)	(42.87)	(25.83)
Panel B. Fixed maturity groups: $[1,5)$, $[5,10)$, *and* $[10,30]$ *years*				
Low intensity	34.68	−17.26	37.61	−14.91
	(27.33)	(47.95)	(36.37)	(15.28)
High intensity	−121.56*	−68.42**	−36.14	53.72***
	(63.95)	(32.36)	(44.33)	(19.51)
High − Low	−156.23**	−51.16	−73.75	68.63**
	(78.59)	(52.42)	(56.75)	(27.28)
Treated firms	220	220	220	220
Distinct control firms	225	225	225	225
Matched bond pairs	1,389	1,389	1,389	1,389
Bond-pair-month observations	55,654	55,654	55,654	55,654
Bond FE	Yes	Yes	Yes	Yes
bond-pair-by-month FE	Yes	Yes	Yes	Yes
Maturity × event-period FE	Yes	Yes	Yes	Yes
Issuer × calendar month FE	No	No	No	Yes
Callable controls	Yes	Yes	Yes	Yes
Pre-baseline firm characteristics	Yes	Yes	Yes	Yes

Notes: Panel A uses within-issuer maturity terciles. Panel B uses fixed remaining-maturity intervals of $[1,5)$, $[5,10)$, and $[10,30]$ years. Both classifications are assigned at month −12 and remain fixed throughout the event window. Responses are equal-weight averages of monthly treatment coefficients over months +1 to +12, relative to month −12; month 0 is excluded. All specifications include bond and bond-pair-by-calendar-month fixed effects. The final column also includes issuer-by-calendar-month fixed effects. Standard errors are clustered by three-digit SIC industry and calendar month. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Appendix A Variable Construction

Table A1
Variable Definitions

Variable	Definition
Panel A. Bond Characteristics and Price Measures	
Credit spread (bp)	Corporate bond yield minus the yield on a Treasury benchmark with identical scheduled cash flows, constructed using the zero-coupon curve of Gürkaynak, Sack, and Wright (2007). Spreads are not option-adjusted.
Credit rating	Numerical score from 1 (D) to 22 (AAA). Higher scores indicate better credit quality throughout the analysis.
Remaining maturity (years)	Years from the bond observation date to contractual maturity.
Modified duration (years)	Modified duration based on scheduled cash flows and the yield implied by the observed dirty price.
Amount outstanding (USD million)	Outstanding principal from FISD. Matching uses its natural logarithm.
Callable	Indicator equal to one if the bond has an issuer call option.
Implied price change	Percentage change in the value of fixed baseline cash flows: $$100\left[\frac{P_{b,-12}(y_{b,-12}+\Delta s_{bt}/10^4)}{P_{b,-12}(y_{b,-12})}-1\right].$$ Here, $P_{b,-12}(y)$ values month -12 cash flows at yield y, $y_{b,-12}$ is baseline yield, and $\Delta s_{bt} = s_{bt} - s_{b,-12}$ is the spread change in basis points.
Panel B. Firm Characteristics and Emissions	
Log revenue	Natural logarithm of positive annual sales in USD millions: ln(SALE).
Log total assets	Natural logarithm of positive annual total assets in USD millions: ln(AT).
Operating ROA	Operating income before depreciation divided by year-end total assets: OIBDP/AT.
Operating cash flow/assets	Operating cash flow divided by year-end total assets: OANCF/AT.
Debt/assets	Long-term debt plus debt in current liabilities, divided by total assets: (DLTT + DLC)/AT.
Cash/assets	Cash and short-term investments divided by total assets: CHE/AT.

(continued)

Table A1
Variable Definitions, continued

Variable	Definition
Issuer oil beta	Coefficient on Brent returns in a regression of monthly issuer stock returns on CRSP value-weighted market returns and Brent returns. The 60-month window ends at month −12 and requires at least 36 observations. Brent returns use each month's last available spot price from the U.S. Energy Information Administration via FRED (DCOILBRENTEU). Matching tables report $100 \times \beta_{\text{oil}}$.
Scope 1 + 2 emissions (Mt CO_2e)	Scope 1 plus location-based Scope 2 emissions, in millions of tonnes of CO_2 equivalent. Both components must be observed.
Carbon intensity	Scope 1 plus location-based Scope 2 emissions, in tonnes of CO_2 equivalent, divided by positive Trucost revenue in USD millions for the same reporting period.

Notes: Bond characteristics are from FISD, accounting variables from Compustat, stock returns from CRSP, and emissions from Trucost. Timing, transformations, and winsorization follow the corresponding empirical specifications.

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Internet Appendix

IA Proofs and Numerical Details

IA.1 Investment and commitment costs

Fix (θ, k, g) and write $W_m(e;\chi)$ for the equity objective in equation (9). Define

$$\begin{aligned} A_\theta &= Y_1 + b_\theta - B(g) - D_1, \\ Z_\theta &= Y_1 + Y_2 + (1+\eta)b_\theta - 2B(g) - D_1 - D_2. \end{aligned} \tag{IA.1}$$

Using $h_m(e;k)$ from Section 3.3,

$$W_m(e;\chi) = \mathbb{E}\big[\mathbf{1}\{A_\theta \geq mc_\theta + \chi I(g,e;k)\}(Z_\theta - mc_\theta + h_m(e;k))^+\big], \tag{IA.2}$$

where the expectation is conditional on (θ, k, g).

The survival boundary has probability zero, and an integrable function $Y_1 + Y_2 + K$ bounds the integrand over the investment interval. Dominated convergence gives continuity in e, so compactness ensures existence of a maximizer. The same argument, applied locally in parameters, and the maximum theorem give continuity of optimized payoffs, holding g, ψ, and the cash-flow distribution fixed.

When $\chi = 0$, survival is independent of e. Positive residual equity has positive probability, so W_m is strictly increasing in h_m. Moreover,

$$h_m'(e;k) = \tau - k\psi(g,e) + m\gamma(e^{\text{tar}} - e)^+$$

is strictly decreasing. The optimum is therefore unique and independent of θ, with the interior condition in equation (12) and boundary conditions

$$\begin{aligned} e_m^* = 0 &\iff \tau + m\gamma e^{\text{tar}} \leq k\psi(g,0), \\ e_m^* = \bar{E} - g &\iff \tau \geq k\psi(g, \bar{E} - g). \end{aligned}$$

When $\chi > 0$, survival also depends on e, so concavity and uniqueness need not hold. The smallest-maximizer rule selects an optimal plan independently of ω.

For any χ, let e_1^* be optimal under commitment. Choosing the same plan without commitment avoids monitoring and reporting expenditure and shortfall losses. Hence

$$C_i = W_0^* - W_1^* \geq W_0(e_1^*; \chi) - W_1(e_1^*; \chi) > 0. \tag{IA.3}$$

The inequality is strict because $c_\theta > 0$ and positive equity under commitment occurs with positive probability. Increasing γ weakly lowers W_1 at every plan and leaves W_0 unchanged, so C_i is weakly increasing in γ.

IA.2 Joint selection and equilibrium existence

In a positive equilibrium, $a_i^* = 1 - F_\omega(C_i/G^*) \in (0,1)$ is strictly decreasing in C_i. With $\bar{a}^* = \bar{a}(G^*)$ and

$$a_\theta^* = q_\theta a_{\theta\underline{k}}^* + (1 - q_\theta) a_{\theta\bar{k}}^*,$$

Bayes' rule yields

$$\begin{aligned} p^1 - p &= \frac{p(1-p)(a_H^* - a_L^*)}{\bar{a}^*}, \\ p - p^0 &= \frac{p(1-p)(a_H^* - a_L^*)}{1 - \bar{a}^*}, \end{aligned} \tag{IA.4}$$

and, within each capability group,

$$\begin{aligned} q_\theta^1 - q_\theta &= \frac{q_\theta(1-q_\theta)(a_{\theta\underline{k}}^* - a_{\theta\bar{k}}^*)}{a_\theta^*}, \\ q_\theta - q_\theta^0 &= \frac{q_\theta(1-q_\theta)(a_{\theta\underline{k}}^* - a_{\theta\bar{k}}^*)}{1 - a_\theta^*}. \end{aligned} \tag{IA.5}$$

All denominators are positive. Condition (20) makes every type with high operating capability more likely to commit than every type with low operating capability, implying $a_H^* > a_L^*$ for any $(q_H, q_L) \in (0,1)^2$. These identities prove Proposition 1, including reversed and equal cost orderings within each capability group.

For the overall distribution of k,

$$\Pr(k = \underline{k} \mid m, g) = p^m q_H^m + (1 - p^m) q_L^m. \tag{IA.6}$$

Subtracting the prior probability gives

$$\begin{aligned} &\Pr(k = \underline{k} \mid m = 1, g) - \Pr(k = \underline{k} \mid g) \\ &\quad = p^1(q_H^1 - q_H) + (1 - p^1)(q_L^1 - q_L) + (p^1 - p)(q_H - q_L). \end{aligned}$$

Thus $p^1 > p$, $q_\theta^1 < q_\theta$ for both groups, and $q_H \leq q_L$ jointly imply a higher posterior probability of firms with greater investment needs, $k = \overline{k}$. The last restriction is sufficient, not necessary.

To establish the sufficient condition for selection on operating capability, fix $c_L > 0$, χ, and the other parameters. At $c_H = \gamma = 0$, $C_{Hk} = 0$ whereas $C_{Lk} > 0$. Continuity from Internet Appendix IA.1 gives an $\varepsilon > 0$ such that condition (20) holds for every $0 < c_H < \varepsilon$ and $0 \leq \gamma < \varepsilon$.

The two orderings of commitment costs can coexist. Set $\chi = 0$, impose the target inequality in equation (IA.7), and suppose $D_1 + B(g) > b_H$. Internet Appendix IA.3 then gives $C_{\theta\overline{k}} < C_{\theta\underline{k}}$ in both groups at $\gamma = 0$. Choose $c_H > 0$ small enough to obtain condition (20). Fixing this c_H, continuity preserves both strict orderings for sufficiently small $\gamma \geq 0$.

Finally, let $\Phi(G) = S_1(G; g) - S_0(G; g)$. This function is continuous for $G > 0$ and bounded above by $\max_i W_1^*(i; g)$. If $\Phi(G_0) > G_0$ for some $G_0 > 0$, then $\Phi(G) - G$ changes sign between G_0 and sufficiently large G. The intermediate value theorem gives a positive equilibrium. This existence condition is separate from the cost orderings above.

IA.3 Reversal of selection on investment needs

Fix (θ, g) and $\chi = 0$, and write $C_{\theta k}(\gamma)$. Suppose

$$\underline{k}\psi(g, e^{\text{tar}}) \leq \tau < \overline{k}\psi(g, e^{\text{tar}}), \qquad D_1 + B(g) + c_\theta > b_\theta. \tag{IA.7}$$

The first condition implies $e_0^*(\theta, \underline{k}; g) \geq e^{\text{tar}} > e_0^*(\theta, \overline{k}; g)$: low-$k$ firms meet the target without commitment, but high-k firms do not. The second gives positive probability to states in which monitoring and reporting expenditure triggers default at time 1.

Let $v_0(k) = \max_e h_0(e; k)$. The target condition implies $v_0(\underline{k}) > v_0(\overline{k})$. At $\gamma = 0$, $C_{\theta k}(0) = L_\theta(v_0(k))$, where

$$L_\theta(v) = \mathbb{E}\Big[\mathbf{1}\{A_\theta \geq 0\}(Z_\theta + v)^+ \\ - \mathbf{1}\{A_\theta \geq c_\theta\}(Z_\theta - c_\theta + v)^+\Big].$$

The integrand is nondecreasing in v. States with $0 \leq A_\theta < c_\theta$ and sufficiently high Y_2 have positive probability and make the loss strictly increasing. Hence

$$C_{\theta\overline{k}}(0) < C_{\theta\underline{k}}(0).$$

Greater investment needs can therefore coincide with a smaller shareholder loss from commitment. The low-k optimum already meets the target, so $C_{\theta\underline{k}}(\gamma) = C_{\theta\underline{k}}(0)$ for all γ. For high k, let e_γ maximize $h_1(e; \overline{k})$ and let v_γ be the maximum. The derivative at the target is negative, so $e_\gamma < e^{\text{tar}}$ for every finite γ. For $\gamma_2 > \gamma_1$,

$$v_{\gamma_1} \geq v_{\gamma_2} + \frac{\gamma_2 - \gamma_1}{2}(e^{\text{tar}} - e_{\gamma_2})^2 > v_{\gamma_2}.$$

Since expected equity is strictly increasing in this net gain, $C_{\theta\overline{k}}(\gamma)$ increases strictly and continuously.

Optimality implies $h_0(e^{\text{tar}}; \overline{k}) \leq v_\gamma \leq h_0(e_\gamma; \overline{k})$. Since h_0 is bounded on the feasible interval, the lower bound on v_γ bounds $\gamma(e^{\text{tar}} - e_\gamma)^2$. Hence $e_\gamma \to e^{\text{tar}}$, and continuity of h_0 gives $v_\gamma \to h_0(e^{\text{tar}}; \overline{k})$. Consequently,

$$\begin{aligned} C_{\theta\overline{k}}(\gamma) &\longrightarrow C_{\theta\overline{k}}^{\text{tar}} \\ &\equiv W_0^*(\theta, \overline{k}; g) - W_1(\theta, \overline{k}; g, e^{\text{tar}}). \end{aligned} \tag{IA.8}$$

The target payoff is independent of γ. A unique finite crossing $\gamma_\theta^* > 0$ exists if and only if

$$C_{\theta\bar{k}}^{\text{tar}} > C_{\theta\underline{k}}(0). \tag{IA.9}$$

At any positive equilibrium for the relevant γ, high-k firms commit more frequently below the crossing and low-k firms more frequently above it. At the crossing, commitment does not change q_θ. If the limiting cost is no greater than $C_{\theta\underline{k}}(0)$, no finite reversal occurs.

IA.4 Bond repricing and maturity comparisons

Proof of Proposition 2. With $\chi = 0$, write $v_m(k) = \max_e h_m(e;k)$, which is independent of θ by Internet Appendix IA.1. The repayment probabilities are

$$r_1^m(\theta) = \Pr(A_\theta \geq mc_\theta \mid g), \tag{IA.10}$$

$$r_2^m(\theta,k) = \Pr(A_\theta \geq mc_\theta,\ Z_\theta - mc_\theta + v_m(k) \geq 0 \mid g)\,. \tag{IA.11}$$

Short-term repayment is independent of k conditional on (θ, m). For a given positive abatement level, higher k requires more investment. Thus h_m weakly decreases at every plan, and maximization preserves this ordering for v_m and long-term repayment. At fixed (k,m), higher θ weakly raises both repayment probabilities because $b_H > b_L$ and $c_H < c_L$. This proves part (i).

Since $v_1(k) \leq v_0(k)$ and commitment adds c_θ, repayment under commitment implies repayment without commitment for the same type and cash-flow realizations. Thus $r_T^1(i) \leq r_T^0(i)$ for $T = 1, 2$.

Bayes' rule gives $\pi_i = \bar{a}^*\pi_i^1 + (1-\bar{a}^*)\pi_i^0$. Therefore, for $T = 1, 2$,

$$\begin{aligned}\Delta V_T^1 &= (1-\bar{a}^*)(V_T^1 - V_T^0)\\ &= \sum_i (\pi_i^1 - \pi_i) r_T^0(i) - (1-\bar{a}^*)\sum_i \pi_i^1 [r_T^0(i) - r_T^1(i)].\end{aligned}$$

For short-term debt, independence from k implies

$$\sum_i (\pi_i^1 - \pi_i) r_1^0(i) = (p^1 - p)[r_1^0(H) - r_1^0(L)],$$
$$\sum_i \pi_i^1 [r_1^0(i) - r_1^1(i)] = p^1 d_H + (1 - p^1) d_L.$$

These expressions give equation (25).

For long-term debt, the posterior average within capability group θ satisfies

$$\sum_k \Pr(k \mid \theta, m = 1, g) r_2^0(\theta, k)$$
$$= \bar{r}_2^0(\theta) + (q_\theta^1 - q_\theta)[r_2^0(\theta, \underline{k}) - r_2^0(\theta, \overline{k})].$$

Average over posterior capability shares and subtract the prior average $p\bar{r}_2^0(H) + (1 - p)\bar{r}_2^0(L)$. This gives the two selection terms in equation (26); the general price decomposition supplies the repayment-loss term. The split updates the capability share first and conditional k shares second. Both updates arise from the same announcement; the order only defines their accounting contributions.

Part (i) implies that each repayment difference between low and high k is nonnegative. Hence selection toward high k within both groups contributes nonpositively. If $q_H = q_L$, part (i) also gives $\bar{r}_2^0(H) \geq \bar{r}_2^0(L)$; this ordering need not hold when prior k compositions differ.

Both repayment-loss terms are nonnegative. Since $\Delta s_T^1 < 0$ if and only if $\Delta V_T^1 > 0$, prices rise and spreads fall exactly when the total information contribution exceeds the repayment loss. This proves parts (ii) and (iii).

Early investment payments ($0 < \chi \leq 1$). At the optimal plan,

$$r_1^m(i; \chi) = \Pr\Big(Y_1 \geq D_1 + B(g) - b_\theta + mc_\theta + \chi I(g, e_m^*(i; g); k) \;\Big|\; g\Big).$$

Thus k can affect early repayment through the investment payment. For a fixed plan, increasing χ raises the survival threshold but leaves $Z_\theta - mc_\theta + h_m(e;k)$ unchanged. Both repayment probabilities therefore weakly decrease. This comparison holds investment fixed; after reoptimization, the sign of the repayment effect of k cannot be inferred from its effect on expenditure at a given plan.

Spread responses for any χ. Because $\mathcal{S}_2 \subseteq \mathcal{S}_1$,

$$V_2(\mathcal{J}) = V_1(\mathcal{J}) \Pr(\mathcal{S}_2 \mid \mathcal{S}_1, \mathcal{J}) = V_1(\mathcal{J})\kappa(\mathcal{J}).$$

Hence

$$\log\left(\frac{V_2^1}{V_2^-}\right) = \log\left(\frac{V_1^1}{V_1^-}\right) + \log\left(\frac{\kappa^1}{\kappa^-}\right).$$

Substituting into equation (24) proves equation (28). Subtracting the short-term response yields

$$\Delta s_2^1 - \Delta s_1^1 = -\frac{M_2 - M_1}{M_2}\Delta s_1^1 - \frac{1}{M_2}\log\left(\frac{\kappa^1}{\kappa^-}\right). \tag{IA.12}$$

In particular,

$$\Delta s_2^1 < \Delta s_1^1 \quad \Longleftrightarrow \quad \log\left(\frac{\kappa^1}{\kappa^-}\right) > -(M_2 - M_1)\Delta s_1^1. \tag{IA.13}$$

Equality and the reverse inequality give the corresponding comparisons. When both spreads fall, this condition means a larger long-term decline; when both rise, it means a smaller long-term increase.

To derive the nine cases in Table 2, define

$$\alpha = \frac{M_1}{M_2} \in (0,1), \qquad x = \Delta s_1^1, \qquad y = \Delta s_2^1, \qquad z = \frac{1}{M_2}\log\left(\frac{\kappa^1}{\kappa^-}\right).$$

Then $y = \alpha x - z$.

1. *Unchanged conditional repayment ($z = 0$).* If $x < 0$, then $x < y < 0$, so the long-term spread falls less. If $x = 0$, then $y = 0$. If $x > 0$, then $0 < y < x$, so the long-term spread rises less.

2. *Improved conditional repayment ($z > 0$).* If $x < 0$, then $y < 0$; the long-term decline is larger than the short-term decline exactly when $z > -(1-\alpha)x$, and equal when equality holds. If $x = 0$, then $y = -z < 0$. If $x > 0$, then y is positive, zero, or negative as z is below, equal to, or above αx.

3. *Worse conditional repayment ($z < 0$).* If $x < 0$, then y is negative, zero, or positive as z is above, equal to, or below αx. If $x = 0$, then $y = -z > 0$. If $x > 0$, then $y > 0$; the long-term increase is larger than the short-term increase exactly when $-z > (1-\alpha)x$, and equal when equality holds.

These are conditional comparisons valid for every $\chi \in [0, 1]$; no sign restriction on the short-term spread response is imposed.

Percentage price comparison. Dividing V_2^1/V_2^- by V_1^1/V_1^- gives equation (29). Since prices are strictly positive, $R_1^1 > R_2^1$ is equivalent to $\kappa^1/\kappa^- < 1$. Moreover,

$$\begin{aligned}\log(1 + R_1^1) &= -M_1 \Delta s_1^1, \\ \log(1 + R_2^1) &= -M_1 \Delta s_1^1 + \log\left(\frac{\kappa^1}{\kappa^-}\right).\end{aligned}$$

Consequently, $R_1^1 > R_2^1 > 0$ holds if and only if equation (30) holds. The proof uses nested survival events and the model's zero-coupon pricing rule; it does not impose a sign on either selection channel.

IA.5 Numerical implementation and decomposition

I use $\psi(g, u) = u$, so $I(g, e; k) = ke^2/2$, and independent unit-mean exponential distributions for Y_1, Y_2, and ω. Here, k scales the investment required for a given e; total planned expenditure also depends on the chosen abatement level. Expected payoffs follow equation (IA.2). I substitute optimal investment into commitment payoffs and solve equation (19) for G^*. When multiple positive equilibria are found, I report the largest G^*. All examples use $\chi = 0$ except the early-payment sensitivity analysis in Table IA5. The examples are illustrative rather than calibrated.

Table IA1
Reference parameters

Parameter	Value	Parameter	Value
$(\bar{E}, g)$	$(0.60, 0)$	e^{tar}	0.50
τ	0.15	$(\underline{k}, \overline{k})$	$(0.25, 0.60)$
(b_L, b_H)	$(0.760, 0.788)$	(c_L, c_H)	$(0.014, 0.001)$
η	0.70	(D_1, D_2)	$(0.70, 1.10)$
(p, q_L, q_H)	$(0.40, 0.70, 0.70)$	(M_1, M_2)	$(1, 3)$ years
χ	0	γ	0.04

Joint selection. Cases A and B use the reference parameters, with $\gamma = 0$ and 0.04, respectively. Cases C and D instead set $\tau = 0.45$, $(\underline{k}, \overline{k}) = (0.75, 3)$, and $c_H = 0.007$, with $\gamma = 0.005$ and 0.04, respectively. All other parameters remain unchanged.

In cases C and D, initial emissions expenses equal 27% of mean Y_t. Investment expenditure required to meet the target equals 9.375% for firms with low k and 37.5% for firms with high k; actual investment depends on the chosen abatement level. Monitoring and reporting expenditure equals 0.7% for firms with high operating capability and 1.4% for firms with low operating capability. These changes raise both emissions savings and the investment required for a given abatement level, while reducing the advantage in monitoring and reporting expenditure associated with stronger operating capability.

Table IA2
Commitment and joint selection

Case	γ	$\bar{a}^*$ (%)	p^1 (%)	$q_L^1 - q_L$	$q_H^1 - q_H$
A	0.000	62.12	60.25	−0.30	−0.02
B	0.040	60.98	60.47	+0.65	+0.98
C	0.005	12.11	72.47	−3.13	−1.17
D	0.040	16.23	67.14	+2.02	+3.65

Notes: Cases A–B use Table IA1; cases C–D use the changes stated above. The last two columns are percentage-point changes in the share of low-k firms. Prior shares are $p = 0.40$ and $q_L = q_H = 0.70$.

Commitment selects stronger operating capability in every case. Cases A and C also select firms with greater investment needs (high k) within both capability groups, while B and D select firms with lower needs. Higher shortfall losses therefore reverse selection on k, as in Internet Appendix IA.3.

Information and annualization. Equation (26) separates price changes into selection across capability groups, selection on k within groups, and the repayment loss from commitment. I use the same three changes for the numerical allocation, but average their contributions across update orders and measure their effects on conditional repayment news in spreads:

$$\Delta s_2^1 - \Delta s_1^1 = \underbrace{-\frac{M_2 - M_1}{M_2}\Delta s_1^1}_{\text{annualization}} + \Lambda^\theta + \Lambda^k + \Lambda^r. \tag{IA.14}$$

Here, Λ^θ allocates the change in capability group shares, Λ^k the change in conditional k shares, and Λ^r the net repayment effect of commitment. Positive contributions increase the maturity difference. These terms measure changes in conditional repayment, V_2/V_1, rather than either repayment probability separately. Thus Λ^r can be negative even though commitment weakly lowers both repayment probabilities for every type.

Hold equilibrium investment choices and the repayment losses weighted by the posterior,

$$L_T = \sum_i \pi_i^1 [r_T^0(i) - r_T^1(i)]$$

fixed throughout. For intermediate shares of capability and investment types, let $\widetilde{\pi}_i$ denote the implied type probabilities and define

$$\widetilde{V}_T = \sum_i \widetilde{\pi}_i r_T^0(i) - \lambda L_T.$$

The three updates replace p by p^1, q_θ by q_θ^1, and $\lambda = \bar{a}^*$ by $\lambda = 1$. The initial and final prices are V_T^- and V_T^1. Updating capability shares first, conditional k shares second, and λ last reproduces equation (26). All intermediate prices in the reported examples satisfy $0 < \widetilde{V}_2 \leq \widetilde{V}_1 \leq 1$.

For each of the six update orders, I evaluate the successive changes in $-M_2^{-1}$ $\log(\widetilde{V}_2/\widetilde{V}_1)$ and average each channel's contribution across orders. The three contributions sum to $-M_2^{-1}\log(\kappa^1/\kappa^-)$. Because they allocate conditional repayment news in spreads, they need not equal the price components from a single update order.

Table IA3
Spread responses and contributions to their maturity difference

Case	Δs_1^1	Δs_2^1	Annualization	Across θ groups	k within groups	Repayment changes	$\Delta s_2^1 - \Delta s_1^1$
A	−33.91	−16.32	22.61	−5.05	0.05	−0.02	17.59
B	−33.93	−16.54	22.62	−5.11	−0.27	0.15	17.39
C	−12.72	−10.59	8.48	−9.36	2.89	0.11	2.13
D	1.54	−10.62	−1.02	−7.77	−4.15	0.79	−12.15

Notes: All entries are basis points. The four contribution columns sum to the last column before rounding. The three Shapley columns allocate conditional repayment news, not the total effect on either maturity. Cases match Table IA2.

In case A, the contribution of k is only 0.05 basis points, so the larger short-term decline mainly reflects annualization. In case C, information about greater investment needs offsets part of the favorable repayment news associated with selection on operating capability and increases the maturity difference by 2.89 basis points. Joint selection therefore has a material additional effect in this case.

Across 24 nearby parameter combinations, the contribution of k ranges from 0.83 to 3.99 basis points, with selection toward stronger operating capability and greater investment needs in every selected equilibrium. The grid uses $\tau \in \{0.375, 0.45\}$, $\underline{k} = \tau/0.6$, $\overline{k}/\underline{k} \in \{3, 4\}$, $c_H \in \{0.005, 0.006, 0.007\}$, and $\gamma \in \{0.001, 0.005\}$. Other parameters remain at their reference values, and each comparison uses the largest positive root found.

Selection toward high k occurs under weak shortfall losses in these examples: the maximum loss in case C is 0.0625% of mean Y_t. Raising γ to 0.04 reverses selection on k and changes its contribution to −4.15 basis points in case D. These results are conditional on the parameters and selected equilibrium.

Operating capability and percentage price responses. Table IA4 varies η while keeping all other parameters at their case-C values, including $\gamma = 0.005$. For each value of η, I solve the equilibrium again, allowing commitment costs, commitment probabilities, and posterior beliefs to adjust. As above, I report the largest positive equilibrium found. The exercise is illustrative and is not calibrated to empirical estimates.

Table IA4
Operating capability, commitment, and bond repricing

η	$\bar{a}^*$ (%)	p^1 (%)	Δs_1^1	Δs_2^1	$100R_1^1$	$100R_2^1$
0.02	5.14	84.00	−46.07	−11.14	0.4618	0.3348
0.05	5.47	83.28	−43.89	−11.19	0.4398	0.3363
0.10	6.02	82.15	−40.45	−11.26	0.4053	0.3384
0.20	7.11	80.06	−34.23	−11.34	0.3429	0.3408
0.35	8.69	77.34	−26.31	−11.32	0.2635	0.3403
0.50	10.21	75.03	−19.76	−11.14	0.1978	0.3348
0.70	12.11	72.47	−12.72	−10.59	0.1273	0.3183
1.00	14.65	69.49	−4.93	−8.92	0.0493	0.2679
1.50	17.81	66.34	2.75	−2.02	−0.0275	0.0607

Notes: Spread responses are in basis points; the last two columns are percentage price changes. All parameters other than η are those of case C. At every reported value, $p^1 > p$ and $q_\theta^1 < q_\theta$ in both capability groups. The numerical search detects two positive equilibria at each value, and the table consistently reports the larger G^*. No empirical estimates enter this exercise.

At $\eta = 0.10$, the short- and long-term percentage price increases are 0.4053% and 0.3384%, respectively. At $\eta = 0.70$, they are 0.1273% and 0.3183%. Thus the same direction of joint selection can coexist with either price ranking. Lower η reduces the direct contribution of operating capability to time-2 cash flow and also changes equilibrium selection. The table reports the combined equilibrium response rather than a partial change holding posterior beliefs fixed. It illustrates the conditional nature of equation (30), without establishing a general monotonicity result in η.

Early investment expenditure. Table IA5 additionally varies χ, the share of investment paid at time 1. I reoptimize investment and resolve the equilibrium for each parameter combination. Joint selection toward higher operating capability and greater investment needs persists in the reported cases. At $\eta = 0.10$, both prices rise and the short-term percentage increase remains larger when χ is 0.10, 0.25, or 0.50. At $\eta = 0.70$, the long-term percentage increase remains larger. These examples show that the two rankings do not require all investment expenditure to be deferred, without extending the general sign results in Proposition 2 beyond its $\chi = 0$ benchmark.

Table IA5
Early investment payments and percentage price responses

η	χ	p^1 (%)	$q_L^1 - q_L$	$q_H^1 - q_H$	$100R_1^1$	$100R_2^1$
0.10	0.00	82.15	−4.77	−1.77	0.4053	0.3384
0.10	0.10	81.61	−4.36	−1.55	0.4078	0.3431
0.10	0.25	80.97	−3.84	−1.28	0.4044	0.3475
0.10	0.50	80.19	−3.16	−0.91	0.3885	0.3505
0.70	0.00	72.47	−3.13	−1.17	0.1273	0.3183
0.70	0.10	72.13	−2.83	−1.01	0.1317	0.3212
0.70	0.25	71.74	−2.45	−0.79	0.1324	0.3235
0.70	0.50	71.29	−1.97	−0.52	0.1246	0.3236

Notes: All other parameters are those of case C. Changes in q_θ are in percentage points; the last two columns are percentage price changes. The prior capability share is $p = 0.40$. Each row reports the largest positive equilibrium found, with investment choices and posterior beliefs recomputed. The examples are not calibrated to empirical estimates.

IB Bond Sample and TRACE Data

I select bonds issued by U.S. firms and denominated in U.S. dollars, with fixed coupons or no coupons. I exclude private placements, Rule 144A securities, asset-backed securities, convertible and exchangeable bonds, structured notes, preferred securities, perpetual debt, and bonds explicitly designated as paying interest in kind. Each bond must have an unambiguous CUSIP match to an eligible FISD issue.

The data for 2005–2019 come from the WRDS Clean TRACE Enhanced file, and those for 2020–2024 from a separate TRACE extract. I reconcile corrections and reversals using available message identifiers and transaction fields, remove superseded and invalid reports, and exclude unresolved cases. These procedures are limited to the message histories available in the source extracts.

I retain reports with prices between \$5 and \$1,000 per \$100 of par value, transaction par amounts of at least \$10,000, and at least one year remaining to maturity on the transaction date. I exclude noncorporate reports, transactions flagged as when issued or locked in, and reports with special prices or disallowed sale conditions. Reports of portfolio trades, weighted average trades, and transactions at fixed offering prices are also excluded, as are records with inconsistent dates or unresolved reporting codes.

For each bond and day, I calculate the average clean price weighted by transaction par amounts, using reports available by the end of the transaction month. The monthly price is the last available daily price within that month; missing monthly prices are not carried forward. Credit spreads require usable contractual cash flows and a Treasury curve for the pricing date. Spreads are left missing on or after a recorded default and when remaining maturity exceeds 30 years. The sample contains 2,014,880 bond-month observations for 47,044 bonds during January 2005–December 2024, including 1,679,044 observations with available credit spreads.

IC Additional Tables and Robustness

Table IC1
Credit Spread Responses with Alternative Pre-event References

	(1)	(2)
Dependent variable	Credit spread (bp)	
Reference period	Month −12	Mean of −3 to −1
Treated × Quarter 1 (months +1 to +3)	−63.22***	−29.65**
	(18.12)	(13.08)
Treated × Quarter 2 (months +4 to +6)	−81.17***	−47.60***
	(21.74)	(15.26)
Treated × Quarter 3 (months +7 to +9)	−43.17**	−9.60
	(20.52)	(16.57)
Treated × Quarter 4 (months +10 to +12)	−63.14***	−29.57**
	(17.99)	(13.99)
Post-announcement average (months +1 to +12)	−62.67***	−29.11***
	(16.99)	(11.00)
Table 9, column (5) controls	Yes	Yes
Bond FE	Yes	Yes
Pair × month FE	Yes	Yes
Matched pairs	1,469	1,469
Observations	59,058	59,058

Notes: Both columns use the matched sample and estimates from column (5) of Table 9. Rows report equal-weight averages of monthly treatment coefficients over the indicated months. Column (1) uses month −12 as the reference. Column (2) subtracts the equal-weight mean of the treatment coefficients for months −3 to −1. Month 0 is excluded. Estimates are in basis points. Standard errors in parentheses use the full coefficient covariance matrix, clustered by three-digit SIC industry and calendar month. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Return to text

Table IC2
Robustness: Credit Spread Responses by Maturity

	Maturity and duration controls				One-year calipers			
	Short	Middle	Long	Long − Short	Short	Middle	Long	Long − Short
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Credit spread (bp)							
Panel A. Within-issuer maturity terciles								
Average: months +1 to +12	−86.35***	−64.14*	−21.43	25.86*	−62.24***	−86.39**	−25.64	38.71**
	(23.65)	(35.47)	(18.32)	(13.48)	(19.01)	(35.91)	(17.87)	(18.90)
Pre-event joint test (p)	0.52	0.66	1.00	0.35	0.48	0.75	1.00	0.62
Pre-event slope (bp/month)	−3.88**	−2.49	0.33	2.14*	−2.84**	−2.25	0.87	2.99
	(1.61)	(2.37)	(1.30)	(1.10)	(1.41)	(2.38)	(1.20)	(1.81)
Within R^2	0.079	0.079	0.079	0.058	0.094	0.094	0.094	0.085
Panel B. Fixed maturity groups: $[1,5)$, $[5,10)$, *and* $[10,30]$ *years*								
Average: months +1 to +12	−65.03***	−96.81***	−54.01**	44.50**	−43.90**	−93.93***	−65.74**	40.47**
	(23.44)	(28.63)	(26.15)	(20.24)	(21.20)	(29.25)	(25.65)	(18.12)
Pre-event joint test (p)	0.62	0.93	0.96	0.97	0.50	0.80	0.86	0.88
Pre-event slope (bp/month)	−2.52	−2.41	−2.92	0.67	−1.94	−1.73	−2.96	−1.16
	(1.87)	(2.37)	(2.46)	(1.45)	(1.70)	(2.18)	(2.11)	(2.04)
Within R^2	0.104	0.104	0.104	0.077	0.093	0.093	0.093	0.119
Matched pairs	1,389	1,389	1,389	1,389	795	795	795	795
Observations	55,654	55,654	55,654	55,654	32,550	32,550	32,550	32,550
Treated firms	220	220	220	220	192	192	192	192
Control firms	225	225	225	225	193	193	193	193
Pairs retained (%)	100.0	100.0	100.0	100.0	57.2	57.2	57.2	57.2
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond pair × month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer × month FE	No	No	No	Yes	No	No	No	Yes
Financial controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Missing indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline callable controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maturity/duration controls	Yes	Yes	Yes	Yes	No	No	No	No
One-year calipers	No	No	No	No	Yes	Yes	Yes	Yes

Notes: Groups are fixed at month −12; controls inherit treated bonds' groups. Responses equally average monthly coefficients or contrasts over months +1 to +12; month −12 is the reference and month 0 is excluded. Columns (1)–(4) add baseline maturity/duration quadratics and their group-by-event-period interactions; columns (5)–(8) require both baseline gaps to be within one year. Columns (4) and (8) report Long-minus-Short contrasts from regressions with issuer-by-month FE; their standard errors use the full coefficient covariance matrix. Pre-event slopes fit linear trends to monthly coefficients or contrasts over −11 to −1, anchored at zero at −12. Standard errors are clustered by three-digit SIC industry and calendar month. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table IC3
Credit Spread Changes around Green Commitments by Maturity: Within-Issuer Maturity Terciles (Pre-2020)

	Without controls for firm characteristics					With controls for firm characteristics				
	Short	Middle	Long	Middle − Short	Long − Short	Short	Middle	Long	Middle − Short	Long − Short
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Credit spread (bp)									
Treated × Quarter 1 (months +1 to +3)	−80.77***	−44.16**	10.42	8.84	17.48***	−110.53***	−97.85***	−13.68	5.26	22.65*
	(24.55)	(22.04)	(18.46)	(7.42)	(6.60)	(31.74)	(34.92)	(16.04)	(9.55)	(13.51)
Treated × Quarter 2 (months +4 to +6)	−103.69***	−79.52***	−12.11	14.50**	24.43***	−148.84***	−104.18***	−42.18*	19.07*	37.19**
	(29.21)	(24.39)	(17.79)	(6.71)	(8.29)	(40.41)	(35.75)	(21.48)	(10.36)	(14.61)
Treated × Quarter 3 (months +7 to +9)	−81.65***	−126.33**	−33.73*	7.24	21.76***	−115.22***	−0.21	−28.19	13.04	36.10***
	(25.52)	(57.82)	(18.99)	(6.13)	(6.46)	(29.34)	(65.65)	(19.79)	(10.69)	(13.29)
Treated × Quarter 4 (months +10 to +12)	−58.59***	−80.34***	−37.51*	9.52*	34.80***	−77.18***	−83.59***	−27.85	−0.96	20.27
	(19.57)	(23.77)	(21.70)	(5.56)	(8.86)	(23.45)	(27.54)	(22.79)	(8.28)	(15.47)
Treated × Post (months +1 to +12)	−81.17***	−82.59***	−18.23	10.02**	24.62***	−112.94***	−71.46**	−27.98	9.10	29.05**
	(22.78)	(25.69)	(16.36)	(4.57)	(6.44)	(28.56)	(31.29)	(17.74)	(7.12)	(11.91)
Firm characteristics: average post-event interactions										
Operating ROA	–	–	–	–	–	−24.97***	−17.64	−27.35***	2.09	5.87
	–	–	–	–	–	(9.39)	(20.95)	(10.24)	(4.66)	(7.20)
ln(Assets)	–	–	–	–	–	22.17**	−12.84	4.45	2.84	0.77
	–	–	–	–	–	(10.84)	(49.95)	(16.87)	(6.11)	(7.00)
Debt/assets	–	–	–	–	–	48.48***	23.72	32.50**	−11.64*	−15.82
	–	–	–	–	–	(16.98)	(21.84)	(16.21)	(6.00)	(10.31)
Cash/assets	–	–	–	–	–	−23.55**	−20.85	35.60*	0.88	8.43
	–	–	–	–	–	(9.37)	(21.43)	(19.51)	(3.87)	(6.85)
Pre-event test (p-value)	0.34	0.97	0.64	0.59	< 0.01	0.37	0.75	0.97	0.97	0.52
Bond-pair-month observations	47,880	47,880	47,880	47,880	47,880	47,880	47,880	47,880	47,880	47,880
Matched bond pairs	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209
Treated firms	156	156	156	156	156	156	156	156	156	156
Distinct control firms	202	202	202	202	202	202	202	202	202	202
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond pair × calendar month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer × calendar month FE	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Within R^2	0.021	0.021	0.021	0.006	0.006	0.083	0.083	0.083	0.022	0.022

Notes: Monthly regressions use observations through December 2019. Quarter and Post report equal-weight averages of monthly treatment coefficients or contrasts. Month −12 is the reference; month 0 is excluded. Groups are within-issuer maturity terciles at month −12; controls inherit treated groups. All columns include bond and pair-by-month FE; columns (4)–(5) and (9)–(10) add issuer-by-month FE. Standard errors use the full covariance matrix and cluster by three-digit SIC industry and calendar month. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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Table IC4
Credit Spread Changes around Green Commitments by Maturity: Fixed Maturity Groups (Pre-2020)

	Without controls for firm characteristics					With controls for firm characteristics				
	Short	Middle	Long	Middle − Short	Long − Short	Short	Middle	Long	Middle − Short	Long − Short
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable						Credit spread (bp)				
Treated × Quarter 1 (months +1 to +3)	−68.88**	−49.02***	−8.39	6.07	17.17	−96.31***	−97.11***	−35.81	14.59	15.90
	(32.12)	(16.93)	(15.71)	(6.88)	(11.07)	(35.84)	(35.18)	(28.70)	(11.93)	(19.94)
Treated × Quarter 2 (months +4 to +6)	−91.00***	−89.81***	−22.99	12.95	41.31***	−95.28***	−139.04***	−66.52**	13.05	40.31**
	(27.38)	(24.12)	(17.58)	(8.66)	(13.12)	(31.19)	(42.34)	(31.20)	(9.60)	(17.31)
Treated × Quarter 3 (months +7 to +9)	−165.03*	−84.62***	−29.19	14.91	37.86***	1.56	−105.71***	−64.42*	2.79	39.78*
	(86.67)	(20.71)	(19.44)	(9.80)	(13.40)	(69.73)	(28.23)	(35.58)	(11.40)	(21.11)
Treated × Quarter 4 (months +10 to +12)	−74.78***	−82.05***	−31.43	16.11	61.06***	−59.43**	−87.64***	−64.54*	24.45**	49.39**
	(26.65)	(22.12)	(21.88)	(11.06)	(18.22)	(27.39)	(27.52)	(33.82)	(10.16)	(22.51)
Treated × Post (months +1 to +12)	−99.92***	−76.37***	−23.00	12.51	39.35***	−62.36**	−107.38***	−57.82*	13.72	36.35**
	(36.52)	(18.52)	(17.34)	(7.79)	(11.90)	(30.39)	(29.27)	(30.52)	(8.61)	(17.11)
Firm characteristics: average post-event interactions										
Operating ROA	–	–	–	–	–	−45.63**	0.07	−35.97**	8.04	9.17
	–	–	–	–	–	(20.46)	(17.49)	(14.62)	(5.91)	(9.58)
ln(Assets)	–	–	–	–	–	−75.50	37.26	19.22	−13.62*	−2.76
	–	–	–	–	–	(69.17)	(25.74)	(16.35)	(7.02)	(9.86)
Debt/assets	–	–	–	–	–	47.38**	7.04	45.12**	−25.16**	−52.89***
	–	–	–	–	–	(23.05)	(21.67)	(19.15)	(11.84)	(14.82)
Cash/assets	–	–	–	–	–	−41.39*	−7.15	25.87	−4.98	2.37
	–	–	–	–	–	(24.84)	(9.03)	(16.43)	(7.34)	(13.56)
Pre-event test (p-value)	0.31	0.67	0.62	0.64	0.39	0.46	0.82	0.90	0.62	0.97
Bond-pair-month observations	47,880	47,880	47,880	47,880	47,880	47,880	47,880	47,880	47,880	47,880
Matched bond pairs	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209
Treated firms	156	156	156	156	156	156	156	156	156	156
Distinct control firms	202	202	202	202	202	202	202	202	202	202
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond pair × calendar month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer × calendar month FE	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Within R^2	0.022	0.022	0.022	0.010	0.010	0.099	0.099	0.099	0.041	0.041

Notes: Short, Middle, and Long denote $[1, 5)$, $[5, 10)$, and $[10, 30]$ years at month -12; controls inherit treated groups. The sample, monthly estimation, quarterly and Post averages, reference period, fixed effects, and standard errors follow Table IC3. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

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