Speculation and Liquidity in Stock and Corporate Bond Markets*

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Abstract

Canonical theories of trading assume that financial asset payoffs are linear in their fundamentals. This study argues that the nonlinearity of equity and corporate bond payoffs (by virtue of their issuer's solvency) has novel, important effects on their price formation. We show that informed risk-neutral speculation trades strategically in a firm's stocks and bonds on the basis of their relative sensitivity to its value, a function of its perceived probability of default. As that probability changes so does the relative intensity of informed speculation (and adverse selection), yielding differential equilibrium liquidity provision from equity and bond dealers and non-monotonic stock-bond price comovement. We find supportive evidence within a comprehensive sample of intraday U.S. stock and corporate bond trades and prices.

JEL classification: D22; G14; G34

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1 Introduction

It is commonly understood that better-informed market participants trade strategically in corporate securities (Bagehot, 1971). Accordingly, the study of strategic speculation is key to the understanding of the process of price formation in stock and corporate bond markets. The seminal work of Kyle (1985) has provided invaluable guidance to that end, by modeling the strategic interaction between monopolistic speculation and competitive dealership to explain market liquidity as the equilibrium outcome of adverse selection risk imposed by the former upon the latter. However, this framework relies on the simplifying assumption that the payoff of the traded asset is linear in its fundamentals. Stock and corporate bond payoffs are instead *nonlinear* in their common fundamentals by virtue of their issuer's solvency, and this nonlinearity importantly affects their valuation and use by firms and market participants (see, e.g., Merton, 1974). The goal of this paper is to investigate theoretically and assess empirically the effects of the nonlinearity of stock and corporate bond payoffs on their market quality.

We illustrate this relationship in a parsimonious and analytically tractable one-period model of strategic multi-asset speculation and segmented competitive dealership based on Kyle (1985) and Pasquariello and Vega (2009). In this setting, risk-neutral speculation is endowed with private information about a firm's value at liquidation and trades in its stocks and discount bonds — i.e., two assets whose payoffs depend nonlinearly on that value as in Merton (1974). Risk-neutral dealers in each market clear the corresponding aggregate order flow made of both speculative and uncorrelated noise trades — and the latter's camouflage to the former is a source of adverse selection risk and illiquidity.

This model generates numerous equilibrium implications for the time-series and cross-sectional relation between a firm's probability of default and stock and bond illiquidity and price comovement that are both intuitive yet missing from standard models of price formation in the literature. In particular, we show that risk-neutral speculation extracts rents from its private information about firm value by allocating its trades strategically across stocks and corporate bonds on the basis of their relative sensitivity to firm value, a function of the firm's perceived probability of default. As that probability declines (rises) — e.g., when firm-level leverage ceteris paribus decreases (increases) — equity payoffs are more (less) sensitive to firm value, and to private information about it, than bond payoffs. Hence, stocks attract more (less) informed speculation than corporate bonds. In turn, this relative imbalance exposes dealers to greater (lower) adverse selection risk from liquidity provision in stocks than in corporate bonds, yielding lower (greater) equilibrium market *depth* — the reciprocal of price impact — in the former than in the latter. Accordingly, we further show that the comovement of a firm's equity and bond prices is highest when there is non-trivial uncertainty about their payoffs, and low when either the bond is virtually risk-free upon continuation or the stock is nearly worthless upon recovery. Greater fundamental uncertainty exacerbates these effects, by affecting the firm's perceived probability of default and dealers' adverse selection risk in both markets.

In sum, the main novel prediction of the model is that stock and bond price formation are jointly and nontrivially related to the probability of default across firms and over time because of strategic speculation in both assets. Establishing a causal relationship between such endogenously determined equilibrium variables as illiquidity or price comovement, informed trading, and default probability is beyond the scope of this, and likely any study because of the many obvious empirical challenges of such a task. Thus, our more limited goal is to establish their correlation in the data and assess whether it resembles the one predicted by our model. To that end, we construct a comprehensive sample of intraday stock and corporate bond transactions for more than 600 U.S. firms for which both are available spanning 2010-2019. Over this period, the latter are mandatorily reported and hence unaffected by selection bias (e.g., Bessembinder et al., 2018), while neither are plagued by the distress accompanying the 2008 financial crisis or the 2020 COVID-19 pandemic (e.g., Pasquariello, 2014a; Gormsen and Koijen, 2020; Boyarchenko et al., 2021; Kargar et al., 2021). We then examine the relationship between various measures of permanent (i.e., likely informational) intraday and daily price impact of these transactions (e.g., Hasbrouck, 1991, 2007; Boehmer and Wu, 2008; Holden and Jacobsen, 2014; O'Hara and Zhou, 2019), daily stock-bond return covariation, and estimates of firm-level probability of default based on Bharath and Shumway's (2008) widely adopted implementation of the Merton (1974) debt model.

Our empirical analysis yields evidence consistent with the main predictions of our model. First, we find that stock (bond) price impact is negatively (positively) associated with firm-level default probability, even after controlling for common cross-sectional and time-series determinants of stock and bond illiquidity in the literature as well as industry, weekday, firm or time fixed effects. These estimates are not only strongly statistically significant but also economically material, e.g., implying that a one standard deviation increase in a firm's probability of default (about 14%) is accompanied by a decline in its permanent intraday stock price impact of 0.15 cents per trade in the time-series and 0.16 cents in the cross-section (versus a samplewide median of 1.3 cents) and a corresponding increase in its permanent intraday bond price impact of 6.8 and 5.9 cents (per hundred dollars of par, versus a median of 38.5 cents). Second, we show that estimated firm-level comovement between daily stock and corporate bond returns is both positive as well as low when firm-level default probability is either low or high — such as to make corporate bonds or stocks nearly insensitive to private fundamental information, respectively — and high otherwise — when both securities are information-sensitive — as postulated by our model. Neither findings can be easily reconciled by inventory considerations, whose relevance instead may always increase with default risk. Third, we seek more direct evidence in support for the model's information channel by investigating the relationship between a firm's stock and bond market depth and price covariation and each of the primitive determinants of its probability of default, namely its leverage and fundamental volatility. We find firm-level stock (bond) price impact to be negatively (positively) related to firm-level leverage ratios and positively related to firm-level estimated asset volatility, the two main inputs of firm-level distance to default in Bharath and Shumway (2008). Stock-bond return comovement is instead first increasing then decreasing in the former and only increasing in the latter. Both findings are once again consistent with our model.

Our study contributes to a rich literature on multi-asset price formation in securities and derivatives markets — one whose comprehensive survey is beyond our scope. More specifically, Back and Crotty (2015) develop a continuous-time Kyle (1985) model of corporate bond and equity trading in which speculators are endowed with a binary signal of firm value and dealership is fully integrated to investigate the return spillover effects of trading in U.S. equity and corporate bonds at the daily frequency. Relatedly, Back (1993) uses a similar setting to study price formation in integrated markets for an asset and a European call option on its liquidation payoff. Relative to these and other studies of strategic multi-asset speculation and integrated dealership in stock markets (e.g., Caballé and Krishnan, 1994; Pasquariello, 2007; Albuquerque and Vega, 2009; Pasquariello and Vega, 2015; Keller and Tseng, 2022), our focus is on segmentation in specialized market-making (e.g., Chowdhry and Nanda, 1991; Subrahmanyam, 1991a; Baruch et al., 2007; Pasquariello and Vega, 2009; Boulatov et al., 2013; Pasquariello, 2018) as a plausible reduced-form representation of the more opaque, less-than-perfectly integrated, higher-frequency cross-price formation in U.S. stock and corporate bond markets within the canonical one-period Kyle (1985) model in order to study their liquidity (Coughenour and Deli, 2002; Naik and Yadav, 2003; Coughenour and Saad, 2004; Holden et al., 2021; Sandulescu, 2021).[1]

Prior literature also postulates and finds empirical support for the notion that greater liquidity may lower a company's default risk by improving its stock price informativeness (e.g., Luo, 2005; Chen et al., 2007; Chordia et al., 2008; Brogaard et al., 2017), facilitating corporate governance by its blockholders (e.g., Maug, 1998; Admati and Pfleiderer, 2009; Edmans, 2009; Edmans and Manso, 2011; Norli et al., 2015; Nadarajah et al., 2021), or easing access to capital to serve its debt (Hanselaar et al., 2019; Nadarajah et al., 2021). As noted earlier, our novel empirical analysis investigates corporate bond and stock price formation at the highest feasible frequency and for the largest feasible cross-section of U.S. firms. The former mitigates reverse causality concerns, while the latter allows us to explicitly consider these (and other) alternative interpretations of our findings. The resulting inference is both robust to their direct assessment

[1] Other studies investigate the effects of asymmetric information on price formation in integrated markets where multiple contigent claims are traded and risk-averse investors act competitively; see, e.g., Chabakauri et al. (2021) and references therein.

and consistent with the information channel postulated by our model.

We proceed as follows. In Section 2, we construct a model of strategic trading in stocks and corporate bonds. In Section 3, we describe the data and present the empirical analysis. We conclude in Section 4. Additional details are in the Appendix.

2 Theory

We study price formation in corporate bond and stock markets in the presence of common speculation and segmented liquidity provision. To that purpose, we develop a noisy rational expectations equilibrium (REE) model of strategic, informed, one-shot multi-asset trading and competitive single-asset dealership based on Kyle (1985) and Pasquariello and Vega (2009). The model's basic setting has long been used to link asymmetric information to financial market quality (see, e.g., the literature surveyed in O'Hara, 1995; Vives, 2008; Foucault et al., 2013). We amend this framework by assuming that the liquidation values of the traded assets depend nonlinearly on common fundamentals. This representation allows us to investigate the effect of adverse selection risk on the liquidity of corporate bond-like and equity-like assets in tractable fashion. We then derive the model's equilibrium in closed-form and consider its implications for corporate bond and stock market liquidity. All proofs are in Section A of the Appendix.

2.1 The Economy

The model is a two-date ($t = 0, 1$), one-period economy in which two risky assets issued by the same firm are traded: a zero-coupon corporate bond (debt) with principal $P > 0$ and payoff D, and a stock (equity) with payoff E.[2] Following Merton (1974), both asset payoffs depend on firm

[2] Allowing for more complex securities, e.g., such as coupon, callable, or convertible bonds and/or preferred stocks, would considerably complicate the analysis without correspondingly affecting its general insights. For the sake of simplicity, we also abstract from the process leading to a firm's optimal debt-equity mix; e.g., see Frank, Goyal, and Shen (2020) for a comprehensive survey of the literature on this topic.

value v, a normally distributed random variable with mean $v_0 > 0$ and variance σ_v^2 as follows:

$$D \equiv \min(v, P), \tag{1}$$

$$E \equiv \max(v - P, 0), \tag{2}$$

such that the firm at liquidation is either solvent (if $v > P : D = P$ and $E = v - P$) or in default (if $v \leq P : D = v$ and $E = 0$), and $v = D + E$ by balance sheet identity.[3]

The above assumptions imply that debt and equity payoffs D and E are censored normally distributed random variables (e.g., Greene, 1997, pp. 959-961) with means:

$$\mathrm{E}(D) = P[1 - \Phi(P_z)] + \mathrm{E}(R)\Phi(P_z), \tag{3}$$

$$\mathrm{E}(E) = [\mathrm{E}(C) - P][1 - \Phi(P_z)], \tag{4}$$

where $E(R) \equiv \mathrm{E}(v|v \leq P) = v_0 + \sigma_v \Lambda^-(P_z)$ is the expected recovered firm value upon default (with ex ante probability $\Pr\{v \leq P\} = \Phi(P_z)$), $\mathrm{E}(C) \equiv \mathrm{E}(v|v > P) = v_0 + \sigma_v \Lambda^+(P_z)$ is the expected continuing firm value upon solvency (with ex ante probability $\Pr\{v > P\} = 1 - \Phi(P_z)$, such that $\mathrm{E}(D) + \mathrm{E}(E) = v_0$), $P_z \equiv \frac{P - v_0}{\sigma_v}$, $\Lambda^-(\cdot) \equiv -\frac{\psi(\cdot)}{\Phi(\cdot)}$, $\Lambda^+(\cdot) \equiv \frac{\psi(\cdot)}{1-\Phi(\cdot)}$, $\Phi(\cdot)$ and $\psi(\cdot)$ are the standard normal cumulative distribution function (cdf) and partial density function (pdf); variances:

$$\mathrm{var}(D) = [P - \mathrm{E}(R)]^2 \Phi(P_z)[1 - \Phi(P_z)] + \mathrm{var}(R)\Phi(P_z), \tag{5}$$

$$\mathrm{var}(E) = [\mathrm{E}(C) - P]^2 \Phi(P_z)[1 - \Phi(P_z)] + \mathrm{var}(C)[1 - \Phi(P_z)], \tag{6}$$

[3] Equivalently, Eqs. (1) and (2) imply that equityholders are residual claimants of firm value subject to limited liability. Only for tractability and consistency with Kyle (1985), we neither allow for violations of the absolute priority rule in favor of equityholders nor impose that v be left-truncated at zero. According to Bharath et al. (2010), the frequency and magnitude of those violations (e.g., due to renegotiation in the bankruptcy process; see Asquith et al., 1994; Campello et al., 2016) have experienced a significant secular decline in the United States. By definition, $D = E = 0$ when $v = 0$, as in Merton (1974, Equation (9.a)). The less likely and plausible circumstances when $D = v < 0$ but $E = 0$ may be interpreted as reflecting direct and indirect costs borne by bondholders when the firm is in severe financial distress or bankruptcy (see, e.g., Senbet and Wang, 2012; Sundaresan, 2013). In any case, in the numerical analysis that follows, we set $v_0 \gg \sigma_v$ to ensure that ex ante $\Pr\{v \leq 0\} \approx 0$ such that bondholders are also subject to limited liability, in the spirit of Merton (1974).

where $\operatorname{var}(R) \equiv \operatorname{var}(v|v \leq P) = \sigma_v^2 [1 - \Delta^- (P_z)]$ is the unconditional variance of recovered firm value upon default, $\operatorname{var}(C) \equiv \operatorname{var}(v|v > P) = \sigma_v^2 [1 - \Delta^+ (P_z)]$ is the unconditional variance of continuing firm value upon solvency, $\Delta^- (\cdot) \equiv \Lambda^- (\cdot) [\Lambda^- (\cdot) - (\cdot)]$, $\Delta^+ (\cdot) \equiv \Lambda^+ (\cdot) [\Lambda^+ (\cdot) - (\cdot)]$; and covariance:

$$\operatorname{cov}(D, E) = \{P [\mathrm{E}(R) + \mathrm{E}(C) - P] - \mathrm{E}(R) \mathrm{E}(C)\} \Phi (P_z) [1 - \Phi (P_z)] > 0. \tag{7}$$

We illustrate the properties of the traded bond and stock in the economy by plotting the firm's unconditional probability of default $\Phi (P_z)$, as well as each of the above unconditional moments of their payoffs (Eqs. (3) to (7)) in Figure 1, as a function of the bond's principal P in a numerical example where mean firm value $v_0 = 100$ (Figure 1b, solid gray line) and $\sigma_v^2 = 100$ (Figure 1c, solid gray line). Equivalent plots with respect to v_0 yield identical insights. Ceteris paribus, if the firm is ex ante unlikely to default (low P and $\Phi (P_z)$ in Figure 1a, dotted line), its zero-coupon bond is relatively risk-free ($\mathrm{E}(D) \approx P$ and $\operatorname{var}(D) \approx 0$; Figures 1b and 1c, solid lines) while its stock is close to be a residual claim against its risky value ($\mathrm{E}(E) \approx v_0 - P$ and $\operatorname{var}(E) \approx \sigma_v^2$; Figures 1b and 1c, dashed lines). Vice versa, when the firm is ex ante close to default (high P and $\Phi (P_z)$), bondholders are likely to take over the firm and realize its risky value v ($\mathrm{E}(D) \approx v_0$ and $\operatorname{var}(D) \approx \sigma_v^2$) while leaving equityholders only with limited liability protection ($\mathrm{E}(E) \approx 0$ and $\operatorname{var}(E) \approx 0$). Accordingly, in either polar case, the comovement of bond and equity payoffs is low ($\operatorname{cov}(D, E) \approx 0$; Figure 1d, dotted line). However, in those intermediate cases when there is nontrivial ex ante uncertainty about the firm's default given P ($0 < \Phi (P_z) < 1$), the expected payoffs of both its risky bond and stock depend on its residual value (upon recovery and continuation, i.e., $\mathrm{E}(R)$ and $\mathrm{E}(C)$, respectively), such that their relative riskiness is ambiguous and their covariance is higher.

Further insight into the properties of bond and stock payoffs comes from plotting the above moments of Eqs. (3) to (7) as a function of the issuing firm's fundamental uncertainty σ_v^2 in Figure 2, in correspondence with nontrivially high or low default probability in the economy of Figure 1a, i.e., either high $P = 110$ (such that $\frac{1}{2} < \Phi (P_z) < 1$) or low $P = 90$ ($0 < \Phi (P_z) < \frac{1}{2}$).

For ease of representation only, we set those high and low bond principals as equidistant from the firm's unconditional expected value ($v_0 = 100$) such that the probability mass and ensuing second moments of the payoff of debt (equity) in distress are equal to those of the payoff of equity (debt) in solvency by symmetry of the normal distribution. Accordingly, ceteris paribus, a firm issuing more (less) debt is symmetrically less (more) likely to default when fundamental uncertainty is greater (higher σ_v^2; see $\Phi(P_z)$ in Figure 2a) and extreme realizations of firm value at maturity are more likely.

At high bond principal ($P = 110 > v_0$), default probability remains nonetheless high enough to make the unconditional expected bond (equity) value $\mathrm{E}(D)$ ($\mathrm{E}(E)$) both close to v_0 (zero) and marginally declining (increasing) in fundamental uncertainty in Figure 2b, bonds increasingly riskier than stocks in Figure 2c, and their comovement higher in Figure 2d. Intuitively, in those circumstances, larger realizations of terminal firm value v (relative to its mean v_0) marginally increase shareholders' expected residual claim $\mathrm{E}(C)$ while bondholders' expected recovery value $\mathrm{E}(R)$ is close to, and capped at $v_0 = 100$ by definition. However, any smaller realization of v (relative to v_0) lowers only bondholders' senior claim on firm assets but not equityholders' junior claim, floored by zero because of limited liability. Therefore, while both bond and equity payoffs become more sensitive to shocks to firm value — yielding higher $cov(D, E)$ of Eq. (7) — bond payoff volatility $\mathrm{var}(D)$ of Eq. (5) increases more than equity payoff volatility $\mathrm{var}(E)$ of Eq. (6) as firm values becomes more uncertain.

Vice versa, when bond principal is relatively low ($P = 90 < v_0$), default probability remains low enough to make the unconditional expected equity (bond) value both close to, and floored by $v_0 - P$ (capped at P) by definition, as well as marginally increasing (decreasing) in fundamental uncertainty in Figure 2b. This is because, in those circumstances, extreme realizations of firm value affect stockholders' expected continuation value in likely solvency more than bondholders' expected recovery value at unlikely liquidation. Accordingly, stocks become increasingly riskier than bonds in Figure 2c and their covariance higher in Figure 2d.

2.2 Agents, Information, and Trading

The economy is populated by three types of risk-neutral agents: a strategic, informed trader (labeled *speculator*) in both assets, as well as non-discretionary liquidity traders and competitive market-makers (labeled MMs or *dealers*) in each asset. Trading among those agents occurs only at date $t = 1$, after which firm value v is revealed and liquidated, and bond and equity payoffs D and E are realized. All traders know the structure of the economy and the decision process leading to order flow and prices.

At date $t = 0$, there is neither information asymmetry about firm value v nor trading in the economy. Sometime between $t = 0$ and $t = 1$, the speculator receives perfect private information about v, as in Kyle (1985), hence perfectly observes the liquidation value of both the bond and the stock: $\mathrm{E}(D|v) = D$ of Eq. (1) and $\mathrm{E}(E|v) = E$ of Eq. (2).[4] At date $t = 1$, the speculator and liquidity traders simultaneously submit their bond and equity orders to the corresponding dealers before their equilibrium prices p_D and p_E have been set. The market orders of the speculator in bonds and stocks are denoted by x_D and x_E, such that her profit is given by $\pi = (D - p_D)\, x_D + (E - p_E)\, x_E$. Liquidity traders generate random, normally distributed bond and stock demands u_D and u_E, both with mean zero and variance σ_u^2. For simplicity, u_D and u_E are assumed to be independent from each other as well as from all other random variables.[5]

Competitive bond and equity dealers do not receive any information about the firm's liquidation value v, and observe only their corresponding aggregate order flow, $\omega_D = x_D + u_D$ and $\omega_E = x_E + u_E$, before setting the market-clearing bond and stock prices, $p_D = p_D(\omega_D)$ and $p_E = p_E(\omega_E)$, as in Chowdhry and Nanda (1991), Subrahmanyam (1991a), Baruch et al. (2007), Pasquariello and Vega (2009), Boulatov et al. (2013), and Pasquariello (2018). As noted in Sec-

[4] Allowing for noisy private information (e.g., as in Grossman and Stiglitz, 1980; Pasquariello, 2014a; Pasquariello, 2022) or for a discrete number of informed speculators in the model (e.g., as in Subrahmanyam, 1991b; Foster and Viswanathan, 1996; Pasquariello and Vega, 2007, 2009, 2015) would make its analysis more involved without altering its main implications.

[5] See, e.g., Pasquariello (2007); Boulatov et al. (2013); Pasquariello and Vega (2015). Back and Crotty (2015) and Pasquariello (2018) investigate the implications of correlated noise trading for equilibrium price comovement in the presence of strategic multi-asset trading and integrated or segmented dealership, respectively. As we discuss further in Section 2.3, relaxing this assumption does not materially affect our insights.

tion 1, segmentation in specialized market-making (Coughenour and Deli, 2002; Naik and Yadav, 2003; Coughenour and Saad, 2004) captures, both plausibly and parsimoniously, the relatively opaque and less-than-perfectly integrated nature of cross-price formation in U.S. corporate bond and stock markets, while considerably simplifying the theoretical analysis that follows. These considerations are especially relevant at the high frequency of our subsequent empirical investigation and in light of recent, albeit often divergent trends in their post-trade transparency (e.g., Edwards et al., 2007; O'Hara et al., 2014; Holden et al., 2021; Sandulescu, 2021). We further discuss the institutional features of those markets and their relationship with our model in Section 3.1.

2.3 Equilibrium

A Bayesian Nash equilibrium of the game of Section 2.2 at date $t = 1$ is a set of four functions, $x_D(\cdot)$, $x_E(\cdot)$, $p_D(\cdot)$, and $p_E(\cdot)$, satisfying the following conditions:

Condition 1 *Utility maximization*: $\{x_D(v), x_E(v)\} = \arg\max E(\pi|v)$;

Condition 2 *Semi-strong market efficiency*: $p_D = \mathrm{E}(D|\omega_D)$ and $p_E = \mathrm{E}(E|\omega_E)$.[6]

The bond (D) and stock (E) payoffs of Eqs. (1) and (2) are nonlinear functions of firm value (v), making the dealers' inference problem in either market intractable; see also the discussion in Section A of the Appendix. Several approaches have been proposed to approximate nonlinear REE models (e.g., Judd, 1998; Bernardo and Judd, 2000; Sims, 2001; Lombardo and Sutherland, 2007; Pasquariello, 2014b, 2022). In this paper, we follow Pasquariello (2014b, 2022) by representing dealers' conditional first moments $\mathrm{E}(D|\omega_D)$ and $\mathrm{E}(E|\omega_E)$ as linear regressions of the corresponding asset payoff on its order flow (ω_D and ω_E), whose intercept and slope coefficients

[6] Condition 2 can also be interpreted as the outcome of dealership competition in either market forcing their expected profits to zero (Kyle, 1985).

can be expressed explicitly:

$$\mathrm{E}(D|\omega_D) \approx \mathrm{E}(D) + \frac{\mathrm{cov}(D,\omega_D)}{\mathrm{var}(\omega_D)}[\omega_D - \mathrm{E}(\omega_D)], \tag{8}$$

$$\mathrm{E}(E|\omega_E) \approx \mathrm{E}(E) + \frac{\mathrm{cov}(E,\omega_E)}{\mathrm{var}(\omega_E)}[\omega_E - \mathrm{E}(\omega_E)]. \tag{9}$$

Intuitively, rational bond and equity dealers use their knowledge of the economy to form their conditional expectations of bond and stock payoffs, as they would do given limited computational ability, by first simulating a large number of its realizations and then estimating a linear relation between either asset payoff and its order flow via ordinary least squares (see, e.g., Hayashi, 2000, pp. 138-140; Pasquariello, 2014b, pp. 303-305).[7] According to Pasquariello (2014b), inference from this approach is both accurate and robust to its expansion to higher-order polynomials in numerical analysis; see also Bernardo and Judd (2000).[8] Proposition 1 describes the unique linear closed-form REE that obtains in this case.

Proposition 1 *There exists a unique linear equilibrium given by the price functions:*

$$p_D = \mathrm{E}(D) + \lambda_D \omega_D, \tag{10}$$

$$p_E = \mathrm{E}(E) + \lambda_E \omega_E, \tag{11}$$

where:

$$\lambda_D = \frac{1}{2\sigma_u}\sqrt{\mathrm{var}(D)}, \tag{12}$$

$$\lambda_E = \frac{1}{2\sigma_u}\sqrt{\mathrm{var}(E)}; \tag{13}$$

[7] Alternatively, Eqs. (8) and (9) are equivalent to assuming that bond and equity dealers are approximately Bayesian in that they consider D and E to be normally distributed, and so compute their first moments correctly after observing ω_D and ω_E, respectively (e.g., Roşu, 2019). See also the discussion in Banelli (2013).

[8] Segmentation in bond and equity dealership and uncorrelated noise trading in either asset further imply that $\mathrm{E}(v = D + E|\omega_D)$ may differ from $\mathrm{E}(v|\omega_E)$. Similarly, in a continuous-time Kyle (1985) model of integrated asset and call option dealership but less-than-perfectly correlated noise trading, Back (1993) shows that the conditional distribution of asset value given asset and call option trading may be bimodal. We further discuss this issue next.

and by the speculator's market orders:

$$x_D = \frac{1}{2\lambda_D}\left[D - \mathrm{E}(D)\right], \tag{14}$$

$$x_E = \frac{1}{2\lambda_E}\left[E - \mathrm{E}(E)\right]. \tag{15}$$

Although the equilibrium of Proposition 1 can be expressed in appealing closed forms, its explicit expressions remain analytically complicated.[9] Thus, to facilitate its interpretation, we proceed in two steps. First, in Corollary 1 we consider its limiting cases in which the firm at liquidation is deemed ex ante as either almost surely (a.s.) in default ($\Phi(P_z) = 1$ such that uncertain $D = v$ and riskless $E = 0$) or a.s. solvent ($\Phi(P_z) = 0$ such that riskless $D = P$ and uncertain $E = v - P$). To that end, we characterize expected equilibrium unsigned informed bond and equity trading volume $vol_D \equiv \mathrm{E}(|x_D|)$ and $vol_E \equiv \mathrm{E}(|x_E|)$ (e.g., Vives, 2008; Pasquariello, 2014b), since signed risk-neutral speculation in a riskless asset is indeterminate as profitless in a Kyle (1985) setting, as follows:

$$\begin{aligned}\mathrm{E}(|x_D|) = {} & \frac{\sigma_u}{\sqrt{\mathrm{var}(D)}}\Big\{P\left[1-\Phi(P_z)\right] + \left[v_0 + \sigma_v\Lambda^{\pm}\left(\mathrm{E}(D)_z, P_z\right)\right]\left[\Phi(P_z) - \Phi\left(\mathrm{E}(D)_z\right)\right] \\ & -\mathrm{E}(D)\left[1-\Phi\left(\mathrm{E}(D)_z\right)\right] - \left[v_0 + \sigma_v\Lambda^{-}\left(\mathrm{E}(D)_z\right) - \mathrm{E}(D)\right]\Phi\left(\mathrm{E}(D)_z\right)\Big\},\end{aligned} \tag{16}$$

where $\mathrm{E}(D)_z \equiv \frac{\mathrm{E}(D)-v_0}{\sigma_v}$ and $\Lambda^{\pm}(\cdot,*) \equiv \frac{\psi(\cdot)-\psi(*)}{\Phi(*)-\Phi(\cdot)}$, while

$$\begin{aligned}\mathrm{E}(|x_E|) = {} & \frac{\sigma_u}{\sqrt{\mathrm{var}(E)}}\Big\{\left[v_0 - P + \sigma_v\Lambda^{+}\left(\mathrm{E}(E)_z\right) - \mathrm{E}(E)\right]\left[1-\Phi\left(\mathrm{E}(E)_z\right)\right] \\ & -\left[v_0 - P + \sigma_v\Lambda^{\pm}\left(P_z, \mathrm{E}(E)_z\right)\right]\left[\Phi\left(\mathrm{E}(E)_z\right) - \Phi(P_z)\right] + \mathrm{E}(E)\,\Phi\left(\mathrm{E}(E)_z\right)\Big\},\end{aligned} \tag{17}$$

[9] The assumptions of bond and equity dealership segmentation and uncorrelated noise trading in Section 2.2 also raise the possibility that the law of one price may be violated in the equilibrium of Proposition 1, i.e., that, as noted earlier, $\mathrm{E}(v|\omega_D) \neq \mathrm{E}(v|\omega_E)$ such that $p_D + p_E \neq p_v$ — the price of an hypothetical asset paying firm value v at liquidation — although $D + E = v$ by balance sheet identity (see Section 2.1). As argued by Subrahmanyam (1991a) and Pasquariello and Vega (2009), these violations do not represent feasible riskless arbitrage opportunities in multi-asset economies based on Kyle (1985) such as the one in Proposition 1, since the speculator can only place market orders in bonds and stocks (i.e., x_D and x_E of Eqs. (14) and (15) are based only on expectations of p_D and p_E of Eqs. (10) and (11) in the presence of noise trading in bond and stock order flow) and their unconditional expected prices are consistent with their corresponding payoffs in equilibrium (i.e., $\mathrm{E}(p_D) = \mathrm{E}(D)$ and $\mathrm{E}(p_E) = \mathrm{E}(E)$ of Eqs. (3) and (4) such that $\mathrm{E}(p_D) + \mathrm{E}(p_E) = v_0 = \mathrm{E}(p_v)$). For further analysis of this issue, see Chowdhry and Nanda (1991) and Pasquariello (2018).

where $\mathrm{E}(E)_z \equiv \frac{\mathrm{E}(E)+P-v_0}{\sigma_v}$, by definition of absolute value and conditional probability (e.g., Siegrist, 2017, Chap. 3.10).

Corollary 1 *When the firm is ex ante either a.s. in default (with label $\Phi = 1$) or a.s. solvent (with label $\Phi = 0$) at liquidation, the equilibrium of Proposition 1 reduces to either:*

$$\lambda_D^{\Phi=1} = \frac{\sigma_v}{2\sigma_u}, \tag{18}$$

$$\lambda_E^{\Phi=1} = 0, \tag{19}$$

$$vol_D^{\Phi=1} = \sigma_u\sqrt{\frac{2}{pi}}, \tag{20}$$

$$vol_E^{\Phi=1} = 0; \tag{21}$$

or:

$$\lambda_D^{\Phi=0} = 0, \tag{22}$$

$$\lambda_E^{\Phi=0} = \frac{\sigma_v}{2\sigma_u}, \tag{23}$$

$$vol_D^{\Phi=0} = 0, \tag{24}$$

$$vol_E^{\Phi=0} = \sigma_u\sqrt{\frac{2}{pi}}. \tag{25}$$

Comfortingly, both the above limiting economies converge to trivial extensions of the classic economy in Kyle (1985); hence, their equilibrium properties and comparative statics are also intuitive and well-understood (e.g., Pasquariello and Vega, 2009). The imperfectly competitive, risk-neutral speculator trades cautiously in either bonds or stocks alone ($vol_D^{\Phi=1} < +\infty$ while $vol_E^{\Phi=1} = 0$ in Eqs. (20) and (21); or $vol_E^{\Phi=0} < +\infty$ while $vol_D^{\Phi=0} = 0$ in Eqs. (24) and (25)) to protect her private information about firm value by camouflaging among uninformed (noise) traders in the order flow ($x_D^{\Phi=1} = \frac{\sigma_u}{\sigma_v}(v - v_0)$ in $\omega_D^{\Phi=1} = x_D^{\Phi=1} + u_D$; or $x_E^{\Phi=0} = \frac{\sigma_u}{\sigma_v}(v - v_0)$ in $\omega_E^{\Phi=0} = x_E^{\Phi=0} + u_E$). Only when faced with adverse selection risk, competitive MMs set a positive price impact of order flow in equilibrium ($\lambda_D^{\Phi=1} > 0$ of Eq. (18) in $p_D^{\Phi=1} = v_0 + \lambda_D^{\Phi=1}\omega_D^{\Phi=1}$ while $p_E^{\Phi=1} = 0$; or $\lambda_E^{\Phi=0} > 0$ of Eq. (23) in $p_E^{\Phi=0} = v_0 - P + \lambda_E^{\Phi=0}\omega_E^{\Phi=0}$ while $p_D^{\Phi=0} = P$)

to offset their expected losses from trading with the speculator with their expected gains from providing depth to noise traders; thus, limiting market-clearing bond and stock prices never comove ($\mathrm{cov}\left(p_D^{\Phi=1}, p_E^{\Phi=1}\right) = \mathrm{cov}\left(p_D^{\Phi=0}, p_E^{\Phi=0}\right) = 0$). Accordingly, equilibrium liquidity is lower (higher $\lambda_D^{\Phi=1}$ or $\lambda_E^{\Phi=0}$) when firm value is more uncertain (higher σ_v^2) — since dealers' adverse selection risk is more severe — as well as when noise trading is less intense (lower σ_u^2) — since dealers require more compensation from less camouflaged speculation in the order flow.[10] Hence, equilibrium price volatility and informativeness ($\mathrm{var}\left(p_D^{\Phi=1}\right) = \frac{1}{2}\sigma_v^2$ or $\mathrm{var}\left(p_E^{\Phi=0}\right) = \frac{1}{2}\sigma_v^2$) do not depend on σ_u^2; however, unsigned informed trading volume ($vol_D^{\Phi=1}$ or $vol_E^{\Phi=0}$) depends exclusively on it, as any change in σ_v^2 reverberates exactly in equilibrium market depth ($\frac{1}{\lambda_D^{\Phi=1}}$ or $\frac{1}{\lambda_E^{\Phi=0}}$).

Second, in Corollary 2 we present some basic comparative statics of interest for equilibrium bond and stock price formation in Proposition 1 relative to the issuing firm's bond principal P, mean value v_0, and fundamental uncertainty σ_v^2 when its ex ante default probability is nontrivial (i.e., $0 < \Phi(P_z) < 1$), as well as illustrate their intuition by means of a numerical example.

Corollary 2 *When the firm is ex ante neither a.s. in default nor a.s. solvent at liquidation, equilibrium bond price impact (λ_D of Eq. (12)) and price variance ($\mathrm{var}(p_D) = \frac{1}{2}\mathrm{var}(D)$) are increasing in P and σ_v^2, and decreasing in v_0; equilibrium stock price impact (λ_E of Eq. (13)) and price variance ($\mathrm{var}(p_E) = \frac{1}{2}\mathrm{var}(E)$) are decreasing in P, and increasing in v_0 and σ_v^2; equilibrium price comovement ($\mathrm{cov}(p_D, p_E) = \frac{1}{4}\mathrm{cov}(D, E)$) is first increasing then decreasing in P (from $P < v_0$ to $P > v_0$) and v_0 (from $v_0 < P$ to $v_0 > P$), and increasing in σ_v^2.*

To that purpose, we use the baseline economy of Section 1.2, where $v_0 = 100$ and $\sigma_v^2 = 100$, and then normalize noise trading intensity $\sigma_u^2 = 100$ (e.g., as in Kyle, 1985); alternative parameter selection does not affect the ensuing insights. We start by examining equilibrium bond and stock price formation as a function of the bond's principal P in Figure 3.

Ceteris paribus, when the firm is ex ante very likely to be solvent (e.g., at low P and $\Phi(P_z) \approx 0$), its bondholders are very likely to receive a certain payoff at liquidation ($D \approx P$), while its

[10] Specifically, $\frac{\partial \frac{\sigma_v}{2\sigma_u}}{\partial \sigma_v^2} = \frac{1}{4\sigma_u\sigma_v} > 0$ and $\frac{\partial \frac{\sigma_v}{2\sigma_u}}{\partial \sigma_u^2} = -\frac{\sigma_v}{4\sqrt{\sigma_u^3}} < 0$.

stockholders' residual claim is very likely to be both risky and valuable ($E \approx v - P$). In those circumstances, equity dealers perceive nearly as extreme adverse selection risk from liquidity provision in the presence of informed speculation as if firm value itself was traded — $\mathrm{var}(E) \approx \sigma_v^2$ and expected equilibrium unsigned equity speculation $vol_E \approx vol_E^{\Phi=0}$ (Figure 3b, dashed line). Hence, they optimally respond with nearly as low market depth ($\lambda_E \approx \lambda_E^{\Phi=0}$; Figure 3a, solid gray line). Vice versa, bond dealers perceive nearly as low such adverse selection risk as if the traded bond was riskless — $\mathrm{var}(D) \approx 0$ and expected equilibrium unsigned bond speculation $vol_D \approx vol_D^{\Phi=0} = 0$ (Figure 3b, solid line). Thus, they make their liquidity provision nearly unbounded ($\lambda_D \approx \lambda_D^{\Phi=0} = 0$ of Eq. (22); Figure 3a). Accordingly, Eqs. (10) and (11) imply that stock prices are significantly more volatile than bond prices ($\mathrm{var}(p_E) \approx \mathrm{var}\left(p_E^{\Phi=0}\right) = \frac{1}{2}\sigma_v^2$ of Kyle, 1985, while $\mathrm{var}(p_D) \approx \mathrm{var}\left(p_D^{\Phi=0}\right) = 0$; Figure 3c) and barely comove ($\mathrm{cov}(p_D, p_E) \approx \mathrm{cov}\left(p_D^{\Phi=0}, p_E^{\Phi=0}\right) = 0$; Figure 3d, dotted line).[11]

As the ex ante probability of default $\Phi(P_z)$ increases (e.g., for higher P), dealers' perceived adverse selection risk and equilibrium price impact increase in the bond market but decrease in the stock market. Intuitively, the bond payoff at liquidation becomes closer to uncertain firm value v than to its riskless principal P, while equityholders are more likely to be presented with limited liability protection and less likely to receive the firm's uncertain terminal residual value $v - P$. Hence, the value of private fundamental information to the speculator increases in bonds but declines in stocks, yet so does their corresponding illiquidity. In equilibrium, the former *information* effect decisively prevails upon the latter *liquidity* effect for bonds while being marginally offset by it for stocks (higher vol_D of Eq. (16) and marginally higher vol_E of Eq. (17); Figure 3b). Accordingly, bond market volatility increases while equity market volatility declines and equilibrium price comovement increases. Informed stock trading volume is largest

[11] However, both equilibrium corporate bond and stock prices in Proposition 1 always incorporate the same constant fraction (one-half) of the speculator's corresponding private information ($var(D)$ and $var(E)$) and their volatility is always unaffected by the intensity of noise trading (σ_u^2), as in Kyle (1985). Relaxing our assumption that liquidity trading is uncorrelated across bonds and stocks in Section 2.2 ($\mathrm{cov}(u_D, u_E) = 0$) would allow for circumstances when $\mathrm{cov}(p_D, p_E)$ may be negative (i.e., for sufficiently negative $\mathrm{cov}(u_D, u_E)$ in the ensuing $\mathrm{cov}(p_D, p_E) = \frac{1}{4}\left[\mathrm{cov}(D, E) + \rho_{u_D,u_E}\sqrt{\mathrm{var}(D)}\sqrt{\mathrm{var}(E)}\right]$, where $\rho_{u_D,u_E} \equiv \frac{1}{\sigma_u^2}\mathrm{cov}(u_D, u_E)$); see also Back and Crotty (2015), Pasquariello (2018), and references therein. Equilibrium price correlation has identical properties.

when the stock's payoff is uncertain enough to attract informed speculation while stock market illiquidity is not high enough to deter it. Afterwards, risk-neutral speculation begins to migrate from the increasingly less information-sensitive stocks (despite their lower illiquidity) to the increasingly more information-sensitive bonds (despite their greater illiquidity). Nonetheless, bond price volatility remains lower and informed bond speculation remains less intense than in stocks insofar as $\Phi(P_z) < \frac{1}{2}$ (e.g., for $P < v_0$).

In this otherwise symmetric economy, bond and stock price formation are identical and their equilibrium comovement is the highest ($\text{cov}(p_D, p_E) = \frac{1}{4}\sigma_v^2\psi^2(0)$; Figure 3d) when $\Phi(P_z) = \frac{1}{2}$ (e.g., for $P = v_0$). Once default becomes more likely ($\Phi(P_z) > \frac{1}{2}$; e.g., for $P > v_0$), limited liability makes the bond's terminal payoff more uncertain than that of the stock, leading to greater adverse selection risk in the bond market than in the equity market. This liquidity effect does not suffice to direct risk-neutral speculation away from bonds into stocks, because of the declining value of private information in the equity market relative to the bond market. Informed bond trading volume is largest when liquidation is likely enough to attract informed speculation while bond market illiquidity is not so high as to deter it. When bond payoff volatility is sufficiently high and equity payoff volatility is sufficiently low, the information effect dominates the liquidity effect in stocks while being marginally dominated by it in bonds, such that informed speculation declines decisively in stocks and marginally in bonds (lower vol_E and marginally lower vol_D; Figure 3b). Accordingly, as the probability of default increases, equity and bond price formation continue to diverge, such that equity prices are more volatile than bond prices and their comovement declines.

Lastly, when the firm is ex ante very likely to default (e.g., at high P and $\Phi(P_z) \approx 1$), informed risk-neutral speculation nearly fully migrates away from the nearly worthless and riskless stock ($E \approx 0$ and $vol_E \approx vol_E^{\Phi=1} = 0$) to the risky bond ($D \approx v$ and $vol_D \approx vol_D^{\Phi=1}$; Figure 3b). Thus, as bond dealers are faced with near-highest extent of adverse selection risk ($\text{var}(D) \approx \sigma_v^2$) and equity dealers with nearly no such risk ($\text{var}(E) \approx 0$), the bond market becomes most illiquid ($\lambda_D \approx \lambda_D^{\Phi=1}$; Figure 3a) and volatile ($\text{var}(p_D) \approx \text{var}\left(p_D^{\Phi=1}\right) = \frac{1}{2}\sigma_v^2$ of Kyle, 1985; Figure 3c), the stock market is most deep ($\lambda_E \approx \lambda_E^{\Phi=1} = 0$ of Eq. (19); Figure 3a) and calm ($\mathrm{var}(p_E) \approx \mathrm{var}\left(p_E^{\Phi=1}\right) = 0$; Figure 3c), and their price formation is nearly independent ($\mathrm{cov}(p_D, p_E) \approx \mathrm{cov}\left(p_D^{\Phi=1}, p_E^{\Phi=1}\right) = 0$; Figure 3d).[12] Figure 3 further indicates that any nontrivial uncertainty about the firm's ability to pay its debt yields greater bond and equity market depth and informed trading volume than if the firm were either a.s. in default or a.s. solvent (Figures 3a and 3b). This is because in such cases the terminal payoff of the only traded security (bond or stock) would be the more uncertain firm value at liquidation, yielding greater adverse selection risk for its dealers and higher illiquidity.

We also consider equilibrium bond and stock price formation as a function of the issuing firm's fundamental uncertainty σ_v^2 in Figure 4 in correspondence with nontrivially low or high default probability in the economy of Figures 1 and 2. As discussed in Section 2.2, for simplicity only, we set low and high P as equidistant to mean firm value v_0 to ensure that equilibrium price formation for debt (equity) in distress, i.e., at $P = 110$, is equal to that of equity (debt) in solvency, i.e., at $P = 90$, by symmetry of the normal distribution.

When bond principal is relatively low, the probability of default is low yet increasing in σ_v^2, as extreme realizations of firm value are unlikely yet decreasingly so. In those circumstances, shareholders' payoff is both close to residual firm value and increasingly risky, while bondholders are decreasingly likely to receive their principal in full. Accordingly, the firm's stocks are both increasingly less liquid than its bonds (higher $\lambda_E > \lambda_D$; Figure 4a) and more volatile (higher $\mathrm{var}(p_E) > \mathrm{var}(p_D)$; Figure 4c). Intuitively, in those circumstances, private fundamental information is more valuable to strategic equity trading than to strategic bond trading; hence, equity dealers face greater adverse selection risk than bond dealers. In equilibrium, the latter information effect is strong enough to dominate the former liquidity effect on speculation in either security, yet decreasingly more so for stocks than for bonds. Thus, informed bond trading

[12] The dichotomy in equilibrium bond and stock market depth with respect to the probability of default $\Phi(P_z)$, as implied by Figures 1a and 3a, differs from the comparative statics of the extended Kyle (1985) model of dynamic, multi-asset trading of Back and Crotty (2015), where integrated bond and equity dealership yields greater commonality of adverse selection risk and liquidity provision in bond and stock price formation. See also Caballé and Krishnan (1994) and Pasquariello (2007).

volume is both decreasingly smaller and significantly more sensitive to fundamental uncertainty than informed stock trading volume (higher $vol_D < vol_E$; Figure 4b).

Vice versa, at high bond principal, default probability is both high enough yet decreasing in σ_v^2 to make bondholders' payoff both close to firm value and increasingly risky, while limited liability is increasingly likely to be invoked by equityholders. Hence, the value of private fundamental information and the ensuing adverse selection risk are greater in bonds than in stocks, making bond market depth increasingly lower than stock market depth (Figure 4a), bond prices increasingly more volatile than equity prices (Figure 4c), and equity speculation decreasingly smaller than virtually flat bond speculation (Figure 4b). In either case, however, a firm's greater fundamental uncertainty is accompanied by increasing equilibrium comovement of its bond and equity prices (higher $\mathrm{cov}(p_D, p_E)$; Figure 4d), as so is the comovement of their terminal payoffs.

3 Empirical Analysis

Our model postulates that the quality of the process of price formation in the markets for a firm's stocks and bonds is related, in a complex fashion, to that firm's default probability via a novel information channel. In particular, the model in Section 2 implies the following original, testable observations about a firm's stock and bond price formation in the presence of strategic, informed speculation in either asset.

Hypothesis 1 *A firm's stock (bond) market depth is generally decreasing (increasing) in its default probability, decreasing (increasing) in its leverage, and increasing in its volatility.*

Hypothesis 2 *A firm's stock and bond price comovement is positive, first increasing and then decreasing in its default probability and leverage, as well as increasing in its volatility.*

In this section, we assess the empirical relevance of these notions within the U.S. stock and corporate bond markets.

3.1 Sample Construction

The U.S. stock and corporate bond markets are among the largest, most efficient, and most liquid trading venues for firms and investors. Holden and Jacobsen (2014) and O'Hara and Zhou (2019) provide recent surveys of their main institutional features and properties. In our empirical analysis, we merge multiple databases of firm-level time-stamped stock and corporate bond trades, prices, as well as corresponding corporate characteristics. We describe data and sample selection in depth in Section B.1 of the Appendix.

Importantly, stock trading occurs at very high frequency (including milliseconds), while corporate bonds trade only infrequently (e.g., , Bao et al., 2011; Holden and Jacobsen, 2014; Harris, 2015). Therefore, we estimate λ_E and λ_D in Proposition 1 with four sets of proxies for stock and corporate bond price impact over two different horizons. Further details of their construction are in Section B.2 of the Appendix. The first two sets measure the permanent intraday price impact of a trade, i.e., the one likely associated with its information content (see, e.g., Boehmer and Wu, 2008 and references therein). In particular, following Holden and Jacobsen (2014) and O'Hara and Zhou (2019), we compute $\$\_PRICEIMPACT\_ID_{i,t}^{E}$ as the daily average of firm i's intraday stock price change (in dollar cents) and $\$\_PRICEIMPACT\_ID_{i,t}^{D}$ as the daily average of firm i's intraday bond price change (in cents per hundred dollars of par) per trade on day t; $\%\_PRICEIMPACT\_ID_{i,t}^{E}$ and $\%\_PRICEIMPACT\_ID_{i,t}^{D}$ are their percentage equivalents (in basis points: bps). We additionally compute two similar sets of measures of price impact over a longer, daily horizon — hence also likely informational (e.g., Hasbrouck, 1991, 2007). Specifically, $\$\_PRICEIMPACT\_D_{i,t}^{E}$ and $\$\_PRICEIMPACT\_D_{i,t}^{D}$ are firm i's dollar stock and bond price change (in cents) on day t per one percent of its daily net order flows (i.e., order imbalances as firm i's number of stock's or bond's buyer-minus-seller initiated trades scaled by their totals on day t, respectively; see, e.g., Jones et al., 1994; Chordia and Subrahmanyam, 2004; Pasquariello and Vega, 2015); $\%\_PRICEIMPACT\_D_{i,t}^{E}$ and $\%\_PRICEIMPACT\_D_{i,t}^{D}$ are their corresponding percentages (in bps). Equally important to our empirical analysis is firm-level perceived probability of default, $\Phi\left(P_z\right)$ of Section 2.1. In this study, we follow the well-established methodology of Bharath and Shumway (2008), who propose a "naïve" measure of Merton's (1974) distance to default, based on a firm's leverage ratio and approximated fundamental uncertainty, to estimate its ensuing implied default probability at the highest (daily) frequency among its inputs, $DEFPROB_{i,t}$; additional details are in Section B.2 of the Appendix.

Our final sample comprises an unbalanced panel of nearly 1.3 million firm-day observations for 614 firms and $4,256$ bonds over $2,516$ trading days between January 2010 and December 2019. Such a period is convenient for several reasons. First, it begins well after reporting of corporate bond transactions to TRACE became mandatory in January 2005, thus avoiding the potentially serious selection bias and confounding results in using TRACE since its introduction in July 2002 (e.g., Bessembinder et al., 2018). In addition, it does not encompass either the 2008 financial crisis and its immediate aftermath of significant distress in U.S. and global capital markets (e.g., Pasquariello, 2014a; Boyarchenko et al., 2021) or the 2020 COVID-19 pandemic and the accompanying financial turmoil (e.g., Gormsen and Koijen, 2020; Kargar et al., 2021).

Summary statistics are in Table 1. Our estimates of intraday and daily price impact in stock and corporate bonds are broadly consistent with those reported in previous studies (e.g., see Holden and Jacobsen, 2014; O'Hara and Zhou, 2019). For instance, median permanent intraday (daily) dollar price impact per trade (one percent of order imbalance) is 1.30 (2.94) cents for stocks and 38.5 (0.06) cents per hundred dollars of par for corporate bonds. Daily inverse depth per one percent of order imbalance is broadly similar, yet displays a larger variation. Median firm-day default probability is unsurprisingly low in our sample (e.g., a median of 0.0%) since it would otherwise limit a firm's access to borrowing in general, and to the corporate bond market in particular. However, $DEFPROB_{i,t}$ also displays nontrivial variation, both across firms and over time (e.g., a mean of 3.6% and a standard deviation of 13.8%). Its two main inputs, firm-level leverage ratios and fundamental uncertainty, exhibit similar properties, albeit to a lesser extent. Accordingly, we investigate both their time-series and cross-sectional relationship with our measures of stock and bond price impact in the analysis that follows.

3.2 Price Formation and Default Probability

We begin by testing the model's first prediction in Hypothesis 1, namely the notion that firm-level market depth in stocks and corporate bonds is related to firm-level default probability both in the cross-section and in the time-series. To that end, we estimate various versions of the following regression model:

$$LAMBDA^g_{i,t} = \alpha + \alpha_j + \alpha_d + \alpha_n + \beta^g DEFPROB_{i,t} + \gamma' X^g_{i,t} + \varepsilon_{i,t}, \tag{26}$$

where $LAMBDA^g_{i,t}$ is one of the four measures of price impact for firm i's security g (D or E) on day t, α_j are two-digit SIC-code industry fixed effects, α_d are weekday fixed effects, α_n are either firm (i) or time (q, at the quarterly frequency where $DEFPROB_{i,t}$ and its inputs display most time-series variation) fixed effects, and $X^g_{i,t}$ is a vector of controls most commonly associated with dispersion in equity illiquidity (firm size: $MKTCAP_{i,t}$; stock price: $PRC^E_{i,t}$) or corporate debt illiquidity ($MKTCAP_{i,t}$; notional principal-weighted bond price: $PRC^D_{i,t}$) in the literature (e.g., Hasbrouck, 1991, 2009; O'Hara et al., 2018). Details on the construction of all variables are in Section B.2 of the Appendix. Our model predicts that $\beta^E < 0$ and $\beta^D > 0$, i.e., that ceteris paribus, greater firm-level default probability improves adverse selection risk and liquidity provision in stocks but worsens both in corporate bonds, as equity becomes less information sensitive than debt.

We report estimates of Eq. (26) in Panels A (stocks) and B (bonds) of Table 2 for intraday and daily market depth. In all regressions, we use two-way cluster-robust standard errors at the firm and time (quarter) levels to account for heteroscedasticity as well as cross-sectional and serial correlation (e.g., Petersen, 2009). All independent variables are standardized to facilitate the comparability and economic interpretation of their corresponding coefficients of interest without affecting their statistical significance. Consistent with our model, most estimates for β^E (β^D) are negative (positive), strongly statistically significant, and economically meaningful. For instance, according to Table 2, a one standard deviation increase in $DEFPROB_{i,t}$ (14% in

Table 1) is accompanied by an average decline in firm-level permanent intraday stock price impact ($\$\_PRICEIMPACT\_ID^E_{i,t}$) of 0.15 cents per trade in the time-series (Panel A, column (III)) and 0.16 cents in the cross-section (column (IV); versus a samplewide median of 1.30 cents) and an average increase in its permanent intraday bond price impact ($\$\_PRICEIMPACT\_ID^D_{i,t}$) of 6.8 and 5.9 cents per trade, respectively (Panel B; versus a median of 38.5 cents).[13]

When scaling dollar price impact by pre-trade prices ($\%\_PRICEIMPACT\_ID^g_{i,t}$ and $\%\_PRICEIMPACT\_D^g_{i,t}$ in Table 2), model support for corporate bonds is stronger (e.g., an average daily percentage price change of $\beta^D \approx 0.12$ bps per one percent order imbalance in Panel B, versus a median of 0.06 bps in Table 1) and more homogeneous than for stocks (e.g., $\beta^E \approx -0.92$ bps only in Panel A, column (III), versus a median of 9.9 bps). This additional evidence is consistent with the observation that measures of percentage price impact imply a uniform economic impact of illiquidity across trade sizes, a more plausible assumption for corporate bonds (whose minimum trade size is high, one unit with $\$1,000$ face value; ten units in our sample) than for stocks (one share).[14]

Further support for our model comes from investigating the relationship between firm-level stock-bond price comovement and default probability, as follows:

$$\begin{aligned} EXRET^E_{i,t} \;&=\; \alpha + \alpha_j + \alpha_d + \alpha_n + \rho EXRET^D_{i,t} + \delta DEFPROB_{i,t} \\ &\quad + \rho_{DEF} EXRET^D_{i,t} \times DEFPROB_{i,t} + \gamma' X^{D,E}_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{27}$$

[13]Accordingly, Holden et al. (2021) find that Hasbrouck's (1995) firm-level information shares of corporate bonds (i.e., their percentage contributions to overall price discovery) are inversely related to firm-level credit ratings over the sample period 2011-2015. Feldhütter et al. (2016) report that quarterly averages of such daily measures of corporate bond illiquidity as round-trip costs and Amihud's (2002) return to volume ratio increase in the year prior to default (and subsequent Chapter 11 bankruptcy) for 77 (53) firms in their sample over 2002-2012.

[14]Consistently, Cziraki and Gider (2021) find that dollar profits paint a more accurate picture of insider equity speculation than percentage returns since its most informative trades tend to be small; see also Bohemer et al. (2021); Farrell et al. (2022); and references therein. More generally, Collin-Dufresne and Fos (2015) argue that conventional measures of stock price impact may not adequately capture the intensity of informed equity speculation because of its tendency to trade when markets are broadly more liquid, hence potentially biasing estimates of β^E in Eq. (26) against our model's predictions in Hypothesis 1. We consider the robustness of our inference to alternative interpretations as well as assess more direct implications of informed trading for stock and bond illiquidity within our model in Section 3.3.

where $EXRET_{i,t}^{g}$ is the daily return of firm i's security g (RET_{t}^{g}) in excess of its market ($MKTRET_{t}^{g}$), and $X_{i,t}^{D,E}$ is (a vector of control variables including) firm size. We report estimates of various specifications of Eq. (27) in Panel A of Table 3. Hypothesis 2 implies that the coefficient ρ, while positive, should be first increasing and then decreasing in $DEFPROB_{i,t}$. However, as previously noted, firm-level default probability is generally low and high default probability firm-days are relatively scarce within our sample. Accordingly, samplewide estimates of average stock-bond return comovement from Eq. (27) are positive and statistically significant (e.g., $\rho \approx 0.42$, or 42 bps of $EXRET_{i,t}^{E}$ per 100 bps of $EXRET_{i,t}^{D}$; column (II)), as well as increasing in $DEFPROB_{i,t}$ ($\rho_{DEF} \approx 0.06$). Therefore, we elicit its potential nonmonotonicity by estimating Eq. (27) within terciles ($T_m(\cdot)$) of $DEFPROB_{i,t}$ and when $DEFPROB_{i,t}$ is large ($> 90\%$), after imposing that $\delta = 0$ and $\rho_{DEF} = 0$. The ensuing coefficients ρ, plotted in Figure 5a, are consistent with Hypothesis 2. Estimates of ρ are first close to zero when default probability is also close to zero (in its tercile 1: T_1) such that only stocks are information-sensitive. Those estimates are then increasing in $DEFPROB_{i,t}$ when default probability is non-trivial (in its terciles 2 and 3: T_2 and T_3) and both stocks and bonds are information-sensitive. Lastly, estimated ρ are again close to zero once default is highly likely (in the tail subset $\overline{T}(\cdot)$ made of a sufficiently large number of firm-year observations displaying high $DEFPROB_{i,t}$, i.e., close to one: $\overline{T}$) such that only bonds are information-sensitive.

Overall, these results suggest that the relationship between the quality of price formation in U.S. stocks and corporate bonds and firm-level default probability over the sample period 2010-2019 is both non-trivial and consistent with the informational role of strategic speculation in both markets postulated by our theory.

3.3 Additional Analysis

The evidence presented in Section 3.2 provides support for the main equilibrium implication of our model, namely that informed speculation in equity and corporate bond markets is an important cross-sectional and time-series determinant of their firm-level illiquidity and price comovement, by virtue of their default-driven sensitivity to adverse selection. In this section, we consider alternative interpretations of these results, assess their robustness to reverse causality considerations, and test two additional predictions of our model uniquely resulting from the informational role of strategic speculation in both markets.

Inventory management considerations represent the literature's most popular alternative to information frictions when assessing the quality of price formation in financial markets (see, e.g., the surveys in O'Hara, 1995; Hasbrouck, 2007; Foucault et al., 2013). Intuitively, dealers' perceived inventory risk from holding a firm's bonds may increase with its default probability, as their payoffs become increasingly dependent upon that firm's uncertain fundamentals, thus hindering liquidity provision in its securities (like in Panel B of Tables 2 and 3). However, dealers' inventory risk from holding that firm's stocks may also increase, since its equity value correspondingly declines, leading to worsening stock market depth (unlike in Panel A of Table 2). In addition, those considerations shed little light on the patterns in stock-bond price comovement displayed in Table 3 and Figure 5a. Lastly, the empirical specifications of Eqs. (26) and (27) explicitly control for firm characteristics also commonly associated with inventory risk (such as price, industry, or weekday; e.g., Hendershott and Seasholes, 2007 and references therein).

Alternatively, as noted in the Introduction, recent studies suggest that the liquidity of a firm's securities may itself lower its default probability, e.g., by improving the firm's information environment (see, e.g., Luo, 2005; Chen et al., 2007; Chordia et al., 2008; Brogaard et al., 2017), its external corporate governance (see, e.g., Maug, 1998; Admati and Pfleiderer, 2009; Edmans, 2009; Edmans and Manso, 2011; Norli et al., 2015; Nadarajah et al., 2021), or its access to capital (Hanselaar et al., 2019; Nadarajah et al., 2021). While certainly important, these considerations are unlikely to be material at the highest feasible frequency (intraday and daily) of our empirical analysis of stock and bond price formation. Nonetheless, our sample also encompasses the largest feasible cross-section of U.S. firms in both markets, allowing us to explicitly assess the robustness of our inference to these and other considerations.

To that end, we expand the set of controls $X^g_{i,t}$ and $X^{D,E}_{i,t}$ in Eqs. (26) and (27), respectively, to include popular proxies in the literature for a variety of firm-level characteristics capturing stock market informativeness (stock return synchronicity: $STKSYNC_{i,t}$, Morck et al., 2000; Dasgupta et al., 2010; dispersion of analyst stock recommendations: $DISPERSION_{i,t}$, e.g., Cvitanić et al., 2006; Jegadeesh and Kim, 2009; Kim and Zapatero, 2021), access to debt markets (asset tangibility: $TANGIBILITY_{i,t}$, e.g., Almeida and Campello, 2007; Bharath et al., 2009); and intensity of financial constraints, $FINCONST_{i,t}$: Whited and Wu, 2006), distress risk (market-to-book equity: $MTB_{i,t}$, e.g., Griffin and Lemmon, 2002) or interest rate risk (notional principal-weighted bond duration: $DURATION_{i,t}$), and quality of corporate governance (*e*-index: $EINDEX_{i,t}$, Bebchuk et al., 2009). With the caveat that the heterogeneous availability of those additional covariates over our sample period limits comparisons with the baseline analysis in Section 3.2, our inference is qualitatively unaffected by their inclusion. In particular, the ensuing estimates of β^g, ρ, and ρ_{DEF}, in columns (V) to (VII) of Table 4, Panel A of Table 5, and Figure 5d, are similar to (and sometimes higher than) those in columns (II) to (IV) of Tables 2 and 3 and Figure 5a. For instance, column (VII) of Table 4 implies that average permanent intraday dollar price impact (β^g for $\$\_PRICEIMPACT\_ID^g_{i,t}$) in the cross-section of firms in our sample is 0.25 cents lower for stocks and 8.9 cents higher for corporate bonds in correspondence with a one standard deviation increase in default probability ($DEFPROB_{i,t}$), while stock-bond daily return comovement (ρ and ρ_{DEF}) in Panel A of Table 5 and Figure 5d also remains increasing in non-trivial $DEFPROB_{i,t}$ and lower otherwise — consistent with our model.

Notwithstanding these efforts, the above evidence remains only indirectly suggestive of the specific information-based linkage between a firm's stock and bond market depth and its probability of default described in Section 2 and summarized in Hypotheses 1 and 2. In fact, not only the firm's adverse selection risk is unobservable to the econometrician but also its perceived default probability is itself a function of its decisions and market conditions. In addition, the discussion in Section 2.3 suggests possible exceptions to the main thrust of Hypotheses 1 and 2. In particular, Figures 2a and 4a show that when leverage and default probability are low (e.g.,

$P = 90 < v_0$ such that $\Phi(P_z) < \frac{1}{2}$ in Figure 2a), stock price impact may be increasing (rather than decreasing) in default probability, via its relationship with fundamental uncertainty (e.g., see λ_E versus σ_v^2 in Figure 4a). Similarly, when leverage and default probability are high (e.g., $P = 110 > v_0$ such that $\Phi(P_z) > \frac{1}{2}$ in Figure 2a), bond price impact may be decreasing (rather than increasing) in default probability, again due to its dependence on fundamental uncertainty (e.g., see λ_D versus σ_v^2 in Figure 4a).

These observations motivate us to directly and separately investigate the relationship between a firm's stock and bond price impact and either its leverage or fundamental uncertainty, the two main drivers of its perceived probability of default both in our model ($P - v_0$ and σ_v^2 in $\Phi(P_z)$ of Section 2.1) and in Merton's (1974) and Bharath and Shumway's (2008) empirical characterization (quarterly leverage ratio: $LEVERAGE_{i,t}$, and daily annualized inferred volatility of firm value: $FIRMVOL_{i,t}$, in $DEFPROB_{i,t}$ of Section 3.1). The resulting estimates, in Tables 6 ($LEVERAGE_{i,t}$) and 7 ($FIRMVOL_{i,t}$) for Eq. (26) and in the corresponding Panels B and C of Table 3 and Figures 5b and 5c for Eq. (27), provide further support for our theory. In particular, the estimated relationships between both stock or bond price impact and stock-bond return comovement and default probability display the heterogeneity postulated by our model, even after controlling for the aforementioned additional firm-level covariates (in Tables 8 and 9, Panels B and C of Table 5, and Figures 5e and 5f).

For instance, firm-level daily stock price impact $\$\_PRICEIMPACT\_D^E_{i,t}$ (bond price impact $\$\_PRICEIMPACT\_D^D_{i,t}$) in columns (I) to (IV) of Table 6 is on average 1.31 cents lower (0.13 cents per hundred dollars of par higher) in correspondence with a one standard deviation increase in firm-level leverage (16% in Table 1), as adverse selection risk decreases for stocks and increases for bonds (e.g., see Figure 3a). However, both $\$\_PRICEIMPACT\_D^E_{i,t}$ and $\$\_PRICEIMPACT\_D^D_{i,t}$ in columns (I) to (IV) of Table 7 are (an average of 1.26 cents and 0.04 cents) higher in correspondence with a one standard deviation increase in firm-level fundamental uncertainty (13%), since in those circumstances adverse selection increases monotonically (Figure 4d), in line with Hypothesis 1. Accordingly, estimated daily stock-bond return covariation is first increasing and then decreasing in firm-level leverage ratios in Figure 5b (see also Panel B of Table 3), as debt becomes more information-sensitive than equity (Figure 3d), while only monotonically increasing in firm-level fundamental volatility in Figure 5c (and Panel C of Table 3), as so is their information sensitivity (Figure 4d), consistent with Hypothesis 2.[15]

Overall, the above discussion and additional analysis suggest that high-frequency, firm-level stock and bond market depth is materially, robustly, and uniquely related to both firm-level default probability and its main determinants, consistent with the information channel predicated by our model.

4 Conclusions

This study contributes to the theoretical and empirical understanding of the frictions affecting the quality of price formation in a firm's most important capital markets, those for its stocks and corporate bonds, by showing that the nonlinearity of equity and corporate bond payoffs has original, important informational effects on their liquidity and price comovement.

We first develop a tractable model of trading in corporate bond and stock markets based on Merton (1974) and Kyle (1985), in which equity and bond payoffs depend nonlinearly on common fundamentals, informed risk-neutral speculation trades strategically in both, and segmented competitive dealership clears each separately. We show that the relative intensity of speculation in either asset depends on a firm's perceived probability of default, in that its accrual makes informed trading in corporate bonds relatively more valuable than in stocks, worsening adverse selection risk and equilibrium market depth in the former and improving them in the latter. Accordingly, equilibrium stock-bond price comovement is low when either security is less information-sensitive, i.e., when the firm is perceived to be closer to either solvency or default (e.g., for either low or high firm leverage), and higher otherwise (e.g., in the presence of greater fundamental uncertainty).

[15] Figures 5c and 6c do not include the tail grouping $\overline{T}\left(FIRMVOL_{i,t}\right)$ as there is no conceptually "high" level for volatility of firm value (unlike realizations closer to one for $DEFPROB_{i,t}$ and $LEVERAGE_{i,t}$); unreported analysis including $\overline{T}\left(\cdot\right)$ for large realizations of $FIRMVOL_{i,t}$ within the sample display similar inference.

We find supportive evidence for our model within the most comprehensive feasible sample of intraday stock and corporate trades and prices between 2010 and 2019. In particular, we show that numerous measures of firm-level, permanent intraday and daily (i.e., likely information-driven) price impact in either security and their daily return comovement are non-trivially related to estimates of firm-level default probability based on Merton (1974) and Bharath and Shumway (2008) both in the cross-section and in the time-series, in a fashion that is consistent with our model's predictions and robust to several of their alternative determinants in the literature.

Our novel investigation indicates that firms' adverse selection problems may play an important joint role for the liquidity and price comovement of their bonds and stocks. We hope that this insight may stimulate future work on the commonality in equity and corporate bond market quality.

Appendix

A Proofs

Proof of Proposition 1. As standard in this class of models, we restrict our attention to linear REEs of the game between competitive dealership in each and strategic speculation in both (e.g., see Kyle, 1985; Pasquariello and Vega, 2009; Pasquariello, 2018). Thus, the proof is by construction in three steps. In the first step, we conjecture general linear functions for bond and equity pricing and speculation. In the second step, we solve for the parameters of these functions satisfying the equilibrium Conditions 1 and 2 in Section 2.3. In the third step, we verify that these parameters and functions represent a REE. We begin by noting that the speculator's risk neutrality, segmentation between bond and equity dealers in Section 2.2, and Conditions 1 and 2 imply that $x_D(v) = \arg\max \mathrm{E}[x_D(D - p_D)|v] = \arg\max x_D\{D - \mathrm{E}[\mathrm{E}(D|\omega_D)|v]\}$ and $x_E(v) = \arg\max \mathrm{E}[x_E(E - p_E)|v] = \arg\max x_E\{E - \mathrm{E}[\mathrm{E}(E|\omega_E)|v]\}$, i.e., that optimal informed trading and clearing in either market are separated from the other. Accordingly, we conjecture that, in equilibrium, $p_D = A_{0,D} + A_{1,D}\omega_D$ and $x_D = B_{0,D} + B_{1,D}D$ in the bond market and $p_E = A_{0,E} + A_{1,E}\omega_E$ and $x_E = B_{0,E} + B_{1,E}E$ in the stock market. From these conjectures and the definitions of ω_D and ω_E in Section 2.2, it then ensues that:

$$\mathrm{E}(p_D|v) = A_{0,D} + A_{1,D}x_D, \quad \text{(A-1)}$$
$$\mathrm{E}(p_E|v) = A_{0,E} + A_{1,E}x_E. \quad \text{(A-2)}$$

Using Eqs. (A-1) and (A-2), the first order conditions for the maximization of the speculator's above-stated expected profit in the bond and stock markets with respect to x_D and x_E are given by:

$$D - A_{0,D} - 2A_{1,D}B_{0,D} - 2A_{1,D}B_{1,D} = 0, \quad \text{(A-3)}$$
$$E - A_{0,E} - 2A_{1,E}B_{0,E} - 2A_{1,E}B_{1,E} = 0. \quad \text{(A-4)}$$

Eqs. (A-3) and (A-4) are both true iff:

$$A_{0,D} = -2A_{1,D}B_{0,D}, \quad \text{(A-5)}$$
$$1 = 2A_{1,D}B_{1,D}, \quad \text{(A-6)}$$
$$A_{0,E} = -2A_{1,E}B_{0,E}, \quad \text{(A-7)}$$
$$1 = 2A_{1,E}B_{1,E}, \quad \text{(A-8)}$$

while the corresponding second order conditions $-2A_{1,D} < 0$ and $-2A_{1,E} < 0$ are jointly satisfied iff $A_{1,D} > 0$ and $A_{1,E} > 0$. We next describe the dealers' bond and stock market clearing. According to Condition 2 in Section 2.3 (semi-strong market efficiency), $p_D = \mathrm{E}(D|\omega_D)$ and $p_D = \mathrm{E}(D|\omega_D)$. Eqs. (1) and (2) and the law of total expectation imply that:

$$\mathrm{E}(D|\omega_D) = P\Pr\{v > P|\omega_D\} + \mathrm{E}(R|\omega_D)\Pr\{v \leq P|\omega_D\}, \quad \text{(A-9)}$$
$$\mathrm{E}(E|\omega_E) = [\mathrm{E}(C|\omega_E) - P]\Pr\{v > P|\omega_E\}, \quad \text{(A-10)}$$

where $\mathrm{E}(R|\omega_D) \equiv \mathrm{E}(v|v \leq P, \omega_D)$ and $\mathrm{E}(C|\omega_E) \equiv \mathrm{E}(v|v > P, \omega_E)$. As noted in Section 2.3, the distributional assumptions in Sections 2.1 and 2.2 make Eqs. (A-9) and (A-10) intractable in our setting. Hence, we assume bond and stock dealers' inference to stem from linear regressions of asset payoffs on the corresponding aggregate order flow, as in Pasquariello (2014b, 2022). Specifically, the aforementioned conjectures lead to:

$$
\begin{aligned}
\mathrm{E}(\omega_D) &= B_{0,D} + B_{1,D}\mathrm{E}(D), && \text{(A-11)}\\
\mathrm{E}(\omega_E) &= B_{0,E} + B_{1,E}\mathrm{E}(E), && \text{(A-12)}\\
\mathrm{var}(\omega_D) &= B_{1,D}^2\mathrm{var}(D) + \sigma_u^2, && \text{(A-13)}\\
\mathrm{var}(\omega_E) &= B_{1,E}^2\mathrm{var}(E) + \sigma_u^2, && \text{(A-14)}\\
\mathrm{cov}(D, \omega_D) &= B_{1,D}\mathrm{var}(D), && \text{(A-15)}\\
\mathrm{cov}(E, \omega_E) &= B_{1,E}\mathrm{var}(E). && \text{(A-16)}
\end{aligned}
$$

Substituting the expressions for the unconditional moments of Eqs. (A-11) and (A-16) in Eqs. (8) and (9) then yields the following approximately linear conditional first moments $\mathrm{E}(D|\omega_D)$ and $\mathrm{E}(E|\omega_E)$:

$$
\begin{aligned}
\mathrm{E}(D|\omega_D) &\approx \mathrm{E}(D) + \frac{B_{1,D}\mathrm{var}(D)}{B_{1,D}^2\mathrm{var}(D) + \sigma_u^2}\left[\omega_D - B_{0,D} - B_{1,D}\mathrm{E}(D)\right], && \text{(A-17)}\\
\mathrm{E}(E|\omega_E) &\approx \mathrm{E}(E) + \frac{B_{1,E}\mathrm{var}(E)}{B_{1,E}^2\mathrm{var}(E) + \sigma_u^2}\left[\omega_E - B_{0,E} - B_{1,E}\mathrm{E}(E)\right]. && \text{(A-18)}
\end{aligned}
$$

Therefore, our prior conjectures for p_D and p_E are both correct iff:

$$
\begin{aligned}
A_{0,D} &= \mathrm{E}(D) - A_{1,D}B_{0,D} - A_{1,D}B_{1,D}\mathrm{E}(D), && \text{(A-19)}\\
A_{1,D} &= \frac{B_{1,D}\mathrm{var}(D)}{B_{1,D}^2\mathrm{var}(D) + \sigma_u^2}, && \text{(A-20)}\\
A_{0,E} &= \mathrm{E}(E) - A_{1,E}B_{0,E} - A_{1,E}B_{1,E}\mathrm{E}(E) && \text{(A-21)}\\
A_{1,E} &= \frac{B_{1,E}\mathrm{var}(E)}{B_{1,E}^2\mathrm{var}(E) + \sigma_u^2}. && \text{(A-22)}
\end{aligned}
$$

The coefficients $A_{0,D}$, $A_{0,E}$, $A_{1,D}$, $A_{1,E}$, $B_{0,D}$, $B_{0,E}$, $B_{1,D}$, and $B_{1,E}$ must uniquely solve the system made of Eqs. (A-5) to (A-8) and (A-19) to (A-22) to represent a unique linear Bayesian Nash equilibrium of the economy of Sections 2.1 and 2.2. Rewriting Eqs. (A-5) to (A-8) with respect to $A_{1,D}B_{0,D}$, $A_{1,E}B_{0,E}$, $A_{1,D}B_{1,D}$, and $A_{1,E}B_{1,E}$, respectively, and plugging the resulting expressions for $A_{1,D}B_{0,D} = -\frac{1}{2}A_{0,D}$ and $A_{1,D}B_{1,D} = \frac{1}{2}$ into Eq. (A-19) and those for $A_{1,E}B_{0,E} = -\frac{1}{2}A_{0,E}$ and $A_{1,E}B_{1,E} = \frac{1}{2}$ into Eq. (A-21) yields $A_{0,D} = \mathrm{E}(D)$ and $A_{0,E} = \mathrm{E}(E)$. Rewriting Eqs. (A-6) and (A-8) with respect to $A_{1,D}$ and $A_{1,E}$, and equating the resulting expressions $A_{1,D} = \frac{1}{2B_{1,D}}$ and $A_{1,E} = \frac{1}{2B_{1,E}}$ to Eqs. (A-20) and (A-22) yields:

$$
\begin{aligned}
B_{1,D}^2\mathrm{var}(D) + \sigma_u^2 &= 2B_{1,D}^2\mathrm{var}(D), && \text{(A-23)}\\
B_{1,E}^2\mathrm{var}(E) + \sigma_u^2 &= 2B_{1,E}^2\mathrm{var}(E). && \text{(A-24)}
\end{aligned}
$$

Subject to the aforementioned first and second order conditions, Eqs. (A-23) and (A-24) are jointly satisfied iff $B_{1,D} = \frac{\sigma_u}{\sqrt{\text{var}(D)}} > 0$ and $B_{1,E} = \frac{\sigma_u}{\sqrt{\text{var}(E)}} > 0$. Replacing $B_{1,D}$, and $B_{1,E}$ in Eqs. (A-6) and (A-8) with these expressions, and solving for $A_{1,D}$ and $A_{1,E}$ yields $A_{1,D} = \frac{\sqrt{\text{var}(D)}}{2\sigma_u} > 0$ and $A_{1,E} = \frac{\sqrt{\text{var}(E)}}{2\sigma_u} > 0$. Lastly, by substituting $A_{0,D} = \text{E}(D)$ and $A_{0,E} = \text{E}(E)$ into Eqs. (A-23) and (A-24), and rewriting the resulting expressions with respect to $B_{0,D}$ and $B_{0,E}$ we obtain $B_{0,D} = -B_{1,D}\text{E}(D) = -\frac{\sigma_u}{\sqrt{\text{var}(D)}}\text{E}(D)$ and $B_{0,E} = -B_{1,E}\text{E}(E) = -\frac{\sigma_u}{\sqrt{\text{var}(E)}}\text{E}(E)$. Substitution of the resulting expressions for all equilibrium coefficients into the aforementioned linear conjectures for x_D, x_E, p_D, and p_E then yields the equilibrium of Proposition 1. ■

Proof of Corollary 1. As noted in Section 2.3, we consider the limiting cases when the firm is ex ante either a.s. in default ($\Phi(P_z) = 1$) at liquidation (such that a.s. $D = v$ and $E = 0$; labeled as $\Phi = 1$) or a.s. solvent ($\Phi(P_z) = 0$) at liquidation (such that a.s. $D = P$ and $E = v - P$; labeled as $\Phi = 0$). In either case, the corresponding equilibrium for each security is characterized by Theorem 1 in Kyle (1985); see also the accompanying discussion in Section 2.3. The distributional and parametric assumptions in Section 2.1 imply that, ceteris paribus, default can occur a.s. iff $P \in (0, +\infty)$ is infinitely large, $v_0 \in (0, +\infty)$ is infinitely small (and $P \gg \sigma_v$), or σ_v^2 is infinitely small (and $P > v_0$); vice versa, solvency can occur a.s. iff P is infinitely small (and $v_0 \gg \sigma_v$), v_0 is infinitely large, or σ_v^2 is infinitely small (and $P < v_0$). Convergence of the equilibrium of Proposition 1 to either limiting equilibrium of Corollary 1 then ensues from the straightforward yet tedious application of limiting properties of the standard normal distribution under those conditions (e.g., Greene, 1997; Baricz, 2008; Pinelis, 2019); details are available on request from the authors. ■

Proof of Corollary 2. When the firm is ex ante neither a.s. in default nor a.s. solvent ($0 < \Phi(P_z) < 1$) at liquidation, it is straightforward yet tedious to prove that $\frac{\partial \text{var}(D)}{\partial P} > 0$ and $\frac{\partial \text{var}(E)}{\partial P} < 0$ for any $P \in (0, +\infty)$, while $\frac{\partial \text{cov}(D,E)}{\partial P} > 0$ for any $P \in (0, v_0)$, $\frac{\partial \text{cov}(D,E)}{\partial P} = 0$ for $P = v_0$, and $\frac{\partial \text{cov}(D,E)}{\partial P} < 0$ for any $P \in (v_0, +\infty)$; $\frac{\partial \text{var}(D)}{\partial v_0} < 0$ and $\frac{\partial \text{var}(E)}{\partial v_0} > 0$ for any $v_0 \in (0, +\infty)$, while $\frac{\partial \text{cov}(D,E)}{\partial v_0} > 0$ for any $v_0 \in (0, P)$; $\frac{\partial \text{cov}(D,E)}{\partial v_0} = 0$ for $v_0 = P$, and $\frac{\partial \text{cov}(D,E)}{\partial v_0} < 0$ for any $v_0 \in (P, +\infty)$; $\frac{\partial \text{var}(D)}{\partial \sigma_v^2} > 0$, $\frac{\partial \text{var}(E)}{\partial \sigma_v^2} > 0$, and $\frac{\partial \text{cov}(D,E)}{\partial \sigma_v^2} > 0$ for any $\sigma_v^2 \in (0, +\infty)$; details are available on request from the authors. The statement then follows from applying these comparative statics to the equilibrium expressions for λ_D and λ_E in Proposition 1 and the trivially ensuing ones for $\text{var}(p_D)$, $\text{var}(p_E)$, and $\text{cov}(p_D, p_E)$ in Corollary 2. ■

B Sample Construction and Variable Definition

In this section, we describe our data sources, sample construction, as well as the construction of the variables of interest in the order in which they are introduced in the analysis.

B.1 Data and Sample Selection

The data for stocks and corporate bonds of the issuing firms are obtained by merging several different databases. The sample comprises the largest feasible set of U.S. corporate bonds satisfying the selection criteria commonly employed in the literature, for which there exist stocks, corporate bonds, and firm-level characteristics.

We obtain transaction prices and trading volume data, as well as an indicator of whether each trade were customer- or dealer-initiated, together with trade direction (buy or sell), from the Financial Industry Regulatory Authority (FINRA) Trade Reporting and Compliance Engine (TRACE) enhanced database.[16] Corporate bond issue characteristics, such as bond type, issue and maturity date, the offering amount, the amount outstanding, the coupon rate, come from the Mergent FISD database. We also use the WRDS Bond Returns database, in order to perform the link with equity issues for every firm through the CRSP database. We apply standard filters commonly used in the literature (see, e.g., Dick-Nielsen, 2014; Bai et al., 2019; Dick-Nielsen and Rossi, 2019; Sandulescu, 2021). In addition, since our study focuses on high-frequency measures of price impact, we restrict our analysis to bonds that trade at least 10 days within a given month (e.g., Bao et al., 2011).

Equity data for the issuing firms containing price, shares outstanding, and industry classification are obtained from CRSP, whereas firm-level fundamentals are from Compustat, analyst recommendations from the IBES database, corporate governance variables from Institutional Shareholder Services (ISS), and market returns from the WRDS Factors database. We use the Trade and Quote Millisecond Daily Product (DTAQ) database to compute high-frequency measures of price impact for equity, following Holden and Jacobsen (2014).

Our final sample consists of 614 firms and $4,256$ bonds over $2,516$ trading days between January 2010 and December 2019. Additional details on sample construction are available from the authors on request.

B.2 Variable Definition

$\_PRICEIMPACT\_ID$^{\mathbf{E}}_{\mathbf{i,t}}$ $= \frac{1}{K}\sum_{k=1}^{K} \$\_\lambda^E_{k,i,t}$: The daily average of firm i's intraday stock price change per trade on day t, expressed in dollar cents, where

$$\$\_\lambda^E_{k,i,t} = 2 \times 100 \times D_{k,i,t} \times \left(M_{k+5,i,t} - M_{k,i,t}\right), \tag{B-1}$$

D_k is the direction of trade k (+1 for a buy; -1 for a sell) based on the Lee and Ready (1991) algorithm, M_k is the prevailing quote midpoint for trade k, and M_{k+5} is the prevailing quote midpoint five minutes after trade k, as in Holden and Jacobsen (2014, Equation (7); see also Hendershott and Madhavan, 2015). Trade and quote millisecond data are from DTAQ.

%_PRICEIMPACT_ID$^{\mathbf{E}}_{\mathbf{i,t}}$ $= \frac{1}{K}\sum_{k=1}^{K} \%\_\lambda^E_{k,i,t}$: The daily average of firm i's intraday percentage stock price change per trade on day t, expressed in basis points (bps), where

$$\%\_\lambda^E_{k,i,t} = 2 \times D_{k,i,t} \times 10,000 \times \ln\left(M_{k+5,i,t}/M_{k,i,t}\right), \tag{B-2}$$

as in Holden and Jacobsen (2014).

[16] Size-reporting of trades in TRACE is capped at \$1 million for high-yield and unrated bonds and at \$5 million for investment-grade bonds; see Hollifield et al. (2020) for an in-depth analysis of this cap and of its (limited) impact on price discovery in corporate bond markets.

$\$_$PRICEIMPACT_ID$^{\mathbf{D}}_{\mathbf{i,t}}$ $= \frac{1}{K}\sum_{k=1}^{K} \$\_\lambda^{D}_{k,i,t}$: The daily average of firm i's intraday corporate bond price changes per trade on day t, expressed in dollar cents per hundred dollars of par, where

$$\$\_\lambda^{D}_{k,i,t} = 2 \times 100 \times (Price_{k,i,t} - Benchmark_{k-1,i,t}) \times D_{k,i,t}, \tag{B-3}$$

where $Price_k$ is the price of a customer-initiated trade k, either a buy or sell, $Benchmark_{k-1}$ is the transaction price of the last trade in the interdealer market prior to trade k, and D_k is the direction of trade k (+1 for a buy; −1 for a sell), as in O'Hara and Zhou (2019). Bond transaction data are from TRACE Enhanced. When a firm has multiple bonds trading on day t, we aggregate their intraday price impact estimates at the firm level by value-weighting these individual daily averages by those bonds' corresponding notional principal outstanding, from Mergent FISD.

%_PRICEIMPACT_ID$^{\mathbf{D}}_{\mathbf{i,t}}$ $= \frac{1}{K}\sum_{k=1}^{K} \%\_\lambda^{D}_{k,i,t}$: The daily average of firm i's intraday percentage corporate bond price changes per trade on day t, expressed in basis points (bps), where

$$\%\_\lambda^{D}_{k,i,t} = 2 \times 10{,}000 \times \ln\left(Price_{k,i,t}/Benchmark_{k,i,t}\right) \times D_{k,i,t}, \tag{B-4}$$

as in O'Hara and Zhou (2019, Equation (1)). When a firm has multiple bonds trading on day t, we aggregate their intraday percent price impact estimates at the firm level by value-weighting these individual daily averages by those bonds' corresponding notional principal outstanding, from Mergent FISD.

PRC$^{\mathbf{E}}_{\mathbf{i,t}}$: Firm i's closing stock price on day t, from CRSP.

$\$_$PRICEIMPACT_D$^{\mathbf{E}}_{\mathbf{i,t}}$: Firm i's daily stock price change per one percent of its daily net order flow (i.e., order imbalance) on day t, expressed in dollar cents,

$$\$\_PRICEIMPACT\_D^{E}_{i,t} = 2 \times 100 \times \left(PRC^{E}_{i,t} - PRC^{E}_{i,t-1}\right) / \left(OIB^{E}_{i,t} \times 100\right), \tag{B-5}$$

where $OIB^{E}_{t} = \left(B^{E}_{t} - S^{E}_{t}\right) / \left(B^{E}_{t} + S^{E}_{t}\right)$, B^{E}_{t} = number of stock buys on day t, and S^{E}_{t} = number of stock sales on day t, from DTAQ.

%_PRICEIMPACT_D$^{\mathbf{E}}_{\mathbf{i,t}}$: Firm i's daily percentage stock price change per one percent of its daily net order flow on day t, expressed in bps,

$$\%\_PRICEIMPACT\_D^{E}_{i,t} = 2 \times 10{,}000 \times \ln\left(PRC^{E}_{i,t}/PRC^{E}_{i,t-1}\right) / \left(OIB^{E}_{i,t} \times 100\right). \tag{B-6}$$

$\$_$PRICEIMPACT_D$^{\mathbf{D}}_{\mathbf{i,t}}$: Firm i's daily corporate bond price change per one percent of its daily net order flow on day t, expressed in dollar cents per hundred dollars of par,

$$\$\_PRICEIMPACT\_D^{D}_{i,t} = 2 \times 100 \times \left(P^{D}_{i,t} - P^{D}_{i,t-1}\right) / \left(OIB^{D}_{i,t} \times 100\right), \tag{B-7}$$

where P^{D}_{t} is that bond's last price on day t, $OIB^{D}_{t} = \left(B^{D}_{t} - S^{D}_{t}\right) / \left(B^{D}_{t} + S^{D}_{t}\right)$, B^{D}_{t} = number of bond buys on day t, and S^{D}_{t} = number of bond sales on day t, from TRACE Enhanced. When a firm has multiple bonds trading on day t, we aggregate their daily price impact estimates at the firm level by value-weighting these estimates by those bonds' corresponding notional principal outstanding, from Mergent FISD.

%_PRICEIMPACT_D$^{\mathbf{D}}_{\mathbf{i,t}}$: Firm i's daily percentage corporate bond price change per one percent of its daily net order flow on day t, expressed in bps,

$$\%\_PRICEIMPACT\_D^D_{i,t} = 2 \times 10,000 \times \ln\left(P^D_{i,t}/P^D_{i,t-1}\right) / \left(OIB^D_{i,t} \times 100\right). \quad \text{(B-8)}$$

When a firm has multiple bonds trading on day t, we aggregate their daily percent price impact estimates at the firm level by value-weighting these estimates by those bonds' corresponding notional principal outstanding, from Mergent FISD.

MKTCAP$_{\mathbf{i,t}}$: Market capitalization of firm i on day t, computed as the product of its closing stock price $PRC^E_{i,t}$ and its corresponding number of shares outstanding, from CRSP.

DEBT$_{\mathbf{i,t}}$: Face value of debt of firm i on day t, computed at the quarterly frequency as in Bharath and Shumway (2008, Equation (8)) as debt in current liabilities plus one-half of long-term debt, both from Compustat.

LEVERAGE$_{\mathbf{i,t}}$ $= \frac{DEBT_{i,t}}{MKTCAP_{i,t}+DEBT_{i,t}}$: The leverage ratio of firm i on day t, as in Bharath and Shumway (2008, Equation (10)).

ERET$_{\mathbf{i,t}}$: The naïve expected return on firm i's assets on day t, computed as in Bharath and Shumway (2008, Equation (11)) as the firm's simple stock return over the previous year from its corresponding closing stock prices $PRC^E_{i,t}$.

STOCKVOL$_{\mathbf{i,t}}$: Firm i's stock volatility on day t, computed as in Bharath and Shumway (2008) as the rolling annualized percent standard deviation of the firm's daily simple stock returns over the previous year from its corresponding closing stock prices $PRC^E_{i,t}$.

FIRMVOL$_{\mathbf{i,t}}$: Firm i's naïve fundamental volatility on day t, computed as in Bharath and Shumway (2008, Equation (10)) as

$$\begin{aligned} FIRMVOL_{i,t} &= (1 - LEVERAGE_{i,t}) \times STOCKVOL_{i,t} \\ &\quad + LEVERAGE_{i,t} \times (0.05 + 0.25 \times STOCKVOL_{i,t}). \end{aligned} \quad \text{(B-9)}$$

DEFPROB$_{\mathbf{i,t}}$ $= \Phi\left(-NA\ddot{I}VE\_DD_{i,t}\right)$: Firm i's naïve probability of default on day t, computed as the standard normal cdf of $DD_{i,t}$, the naïve distance to default of Bharath and Shumway (2008, Equation (12)),

$$NA\ddot{I}VE\_DD_{i,t} = \frac{\ln\left(1/LEVERAGE_{i,t}\right) + \left(ERET_{i,t} - 0.5 \times FIRMVOL^2_{i,t}\right) \times T}{FIRMVOL_{i,t} \times \sqrt{T}}, \quad \text{(B-10)}$$

where $T = 1$ is a forecasting horizon of one year.

RET$^{\mathbf{E}}_{\mathbf{i,t}}$: Daily stock return of firm i on day t, from CRSP.

$\mathbf{MKTRET^E_t}$: Daily stock market return on day t, computed as the value-weighted average of all daily stock returns in our sample on that day, $RET^E_{i,t}$.

$\mathbf{EXRET^E_{i,t}}$ $= RET^E_{i,t} - MKTRET^E_t$: Daily stock return of firm i on day t, in excess of its market.

$\mathbf{PRC^D_{i,t}}$: Firm i's last corporate bond price on day t, from TRACE Enhanced. For firms having multiple bonds outstanding on day t, we aggregate their prices at the firm level by value-weighting these prices by those bonds' corresponding notional principal outstanding, from Mergent FISD.

$\mathbf{RET^D_{i,t}}$ $= \left(PRC^D_{i,t}/PRC^D_{i,t-1}\right) - 1$: Daily corporate bond return of firm i on day t. For firms having multiple bonds outstanding on day t, we aggregate their returns at the firm level by value-weighting these returns by those bonds' corresponding notional principal outstanding, from Mergent FISD.

$\mathbf{MKTRET^D_t}$: Daily corporate bond market return on day t, computed as the weighted average of all daily bond returns in our sample on that day, $RET^D_{i,t}$, with weights given by these bonds' principal notional outstanding, from Mergent FISD.

$\mathbf{EXRET^D_{i,t}}$ $= RET^D_{i,t} - MKTRET^D_t$: Daily corporate bond return of firm i on day t, in excess of its market.

$\mathbf{STKSYNC_{i,t}}$: Stock return synchronicity for firm i on day t, computed at the monthly frequency following Morck et al. (2000) as $\ln\left[R^2/\left(1-R^2\right)\right]$, where R^2 is the coefficient of determination from regressing daily stock returns in excess of the risk-free rate from WRDS Factors, $RET^E_{i,t} - RF_t$, on the value-weighted stock market return within a month from CRSP, $VWRETD_t$.

$\mathbf{DISPERSION_{i,t}}$: Dispersion of analyst stock recommendations for firm i on day t, computed from I/B/E/S Recommendations at the monthly frequency following Cvitanić et al. (2006) as the standard deviation of analysts' trade recommendation scores: 1 (Strong Buy), 2 (Buy), 3 (Hold), 4 (Underperform), and 5 (Sell).

$\mathbf{TANGIBILITY_{i,t}}$: Asset tangibility of firm i on day t, computed from Compustat at the quarterly frequency following Almeida and Campello (2007) as

$$\begin{aligned} TANGIBILITY_{i,t} &= (0.715 \times RECTQ_{i,t} + 0.547 \times INVTQ_{i,t} \\ &\quad +0.535 \times CSTKQ_{i,t} + CHEQ_{i,t})\,/TA_{i,t}, \end{aligned} \tag{B-11}$$

where $RECTQ$ denotes receivables, $INVTQ$ is inventory, $CSTKQ$ is common stock, $CHEQ$ are cash equivalents, and TA are total assets.

$\mathbf{FINCONST_{i,t}}$: A proxy for the intensity of financial constraints of firm i on day t, computed from Compustat at the quarterly frequency following Whited and Wu (2006) as

$$\begin{aligned} FINCONST_{i,t} &= -0.091 \times CFA_{i,t} - 0.062 \times DIVPOS_{i,t} + 0.021 \times TLTD_{i,t} \\ &\quad -0.044 \times LNTA_{i,t} + 0.102 \times ISG - 0.035 \times SG, \end{aligned} \tag{B-12}$$

where CFA is the ratio between a firm's cash flows and its TA, $DIVPOS$ is an indicator variable equal to one if that firm pays cash dividends and zero otherwise, $TLTD$ is the ratio between long-term debt and TA, $LNTA = \ln(TA)$, ISG is the average sales growth rate within that firm's three-digit SIC industry, and SG is that firm's sales growth rate.

$\mathbf{MTB_{i,t}}$: Market-to-book ratio of firm i on day t, computed at the quarterly frequency as the ratio between the firm's market capitalization $MKTCAP_{i,t}$ and its book value of equity, from Compustat.

$\mathbf{DURATION_{i,t}}$: Duration of firm i's corporate bond on day t, available from Mergent FISD at the monthly frequency. For firms having multiple bonds outstanding on day t, we aggregate their duration at the firm level by value-weighting these durations by those bonds' corresponding notional principal outstanding, also from Mergent FISD.

$\mathbf{EINDEX_{i,t}}$: Firm i's corporate governance e-index of Bebchuk et al. (2009), computed from Institutional Shareholder Services (ISS) at the annual frequency as the sum of firm-level scores (one or zero) capturing the intensity of managerial entrenchment along each of the following six dimensions: *i) Staggered board*: A board in which directors are divided into separate classes (typically three) with each class being elected to overlapping terms; *ii) Limitation on amending bylaws*: A provision limiting shareholders' ability through majority vote to amend the corporate bylaws; *iii) Limitation on amending the charter*: A provision limiting shareholders' ability through majority vote to amend the corporate charter; *iv) Supermajority to approve a merger*: A requirement that requires more than a majority of shareholders to approve a merger; *v) Golden parachute*: A severance agreement that provides benefits to management or board members in the event of firing, demotion, or resignation following a change in control; and *vi) Poison pill*: A shareholder right that is triggered in the event of an unauthorized change in control that typically renders the target company financially unattractive or dilutes the voting power of the acquirer. We exclude firms with dual-share structure.

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Table 1. Summary Statistics

This table reports summary statistics for variables of interest defined in Section B.2 of the Appendix: Dollar (in cents, i.e., multiplied by 100) or percent (in basis points: bps, i.e., multiplied by 10,000), permanent intraday ($_PRICEIMPACT_ID^g or %_PRICEIMPACT_ID^g, per trade) or daily ($_PRICEIMPACT_D^g or $_PRICEIMPACT_D^g, per one percent order imbalance) price impact for stocks (g = E; Panel A) or corporate bonds (g = D, per hundred dollars of par; Panel B), as well as firm-level default probability (DEFPROB), leverage ratio (LEVERAGE), and fundamental volatility (FIRMVOL; in percentage, i.e., multiplied by 100; Panel C). N is the corresponding number of available firm-day observations in our sample over 2010-2019.

	Mean	Median	Stdev	N
	Panel A: Stocks			
$_PRICEIMPACT_ID^E	2.15	1.30	2.57	1,260,772
%_PRICEIMPACT_ID^E	5.89	3.63	7.10	1,260,772
$_PRICEIMPACT_D^E	7.86	2.94	146.6	1,260,190
%_PRICEIMPACT_D^E	13.7	9.91	305.3	1,260,190
	Panel B: Corporate Bonds			
$_PRICEIMPACT_ID^D	62.8	38.5	84.8	373,665
%_PRICEIMPACT_ID^D	62.2	37.3	86.0	373,665
$_PRICEIMPACT_D^D	0.50	0.06	9.86	373,643
%_PRICEIMPACT_D^D	0.50	0.06	9.72	373,643
	Panel C: Firm Characteristics			
DEFPROB	3.36	0.00	13.8	1,269,067
LEVERAGE	21.3	15.9	15.9	1,269,067
FIRMVOL	28.9	26.3	12.7	1,269,067

Table 2. Stock and Bond Price Impact and Default Probability: Baseline Analysis

This table reports estimates for the relationship between each measure of dollar (in cents, i.e., multiplied by 100) or percent (in basis points: bps, i.e., multiplied by 10,000), permanent intraday ($\$\_PRICEIMPACT\_ID^g$ or $\%\_PRICEIMPACT\_ID^g$, per trade) or daily ($\$\_PRICEIMPACT\_D^g$ or $\$\_PRICEIMPACT\_D^g$, per one percent order imbalance) price impact and firm-level default probability (DEFPROB) for stocks (g = E; Panel A) or corporate bonds (g = D; Panel B), from various specifications of the firm-day panel regressions of Eq. (26). Specification I includes no additional covariates; specification II includes two-digit SIC-code industry fixed effects (FEs), weekday FEs, as well as baseline controls in $X^g_{i,t}$ (firm size: MKTCAP; and either stock price: PRC^E, or notional principal-weighted bond price: PRC^D) to specification I; specification III adds firm FEs to specification II; specification IV adds time (quarterly) FEs to specification II. All independent variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; R^2_a is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	$_PRICEIMPACT_ID				%_PRICEIMPACT_ID			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
DEFPROB	-0.242***	-0.155***	-0.146***	-0.163***	3.48***	3.04***	2.12***	3.12***
	[0.026]	[0.035]	[0.020]	[0.036]	[0.196]	[0.185]	[0.154]	[0.179]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.88%	37.17%	67.25%	37.81%	23.92%	32.59%	62.56%	33.66%
N	1,260,772	1,260,770	1,260,770	1,260,770	1,260,772	1,260,770	1,260,770	1,260,770
	Panel B: Corporate Bonds							
	I	II	III	IV	I	II	III	IV
DEFPROB	10.1***	7.65***	6.82***	5.93***	15.7***	9.33***	8.47***	7.38***
	[1.81]	[1.41]	[1.45]	[1.14]	[2.60]	[1.65]	[1.71]	[1.31]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Day of Week FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	1.60%	5.03%	12.08%	9.02%	3.75%	8.19%	14.98%	12.24%
N	365,383	365,383	365,383	365,383	365,383	365,383	365,383	365,383

Table 2. (*Continued*)

	$_PRICEIMPACT_D				%_PRICEIMPACT_D			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
DEFPROB	-1.48***	-0.395	-0.469***	-0.154	0.843	0.243	-0.917*	0.850
	[0.159]	[0.249]	[0.137]	[0.272]	[0.535]	[0.567]	[0.600]	[0.536]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.01%	0.67%	0.89%	0.71%	0.00%	0.02%	0.06%	0.07%
N	1,260,190	1,260,188	1,260,188	1,260,188	1,260,190	1,260,188	1,260,188	1,260,188
	Panel B: Corporate Bonds							
	I	II	III	IV	I	II	III	IV
DEFPROB	0.128***	0.100***	0.113***	0.085***	0.157***	0.109***	0.125***	0.093***
	[0.027]	[0.025]	[0.029]	[0.025]	[0.031]	[0.026]	[0.029]	[0.026]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.02%	0.04%	0.07%	0.07%	0.03%	0.06%	0.10%	0.09%
N	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361

Table 3. Stock and Bond Return Comovement: Baseline Analysis

This table reports estimates for the relationship between firm-level daily excess stock returns (EXRET^{E}) and both the corresponding excess corporate bond returns (EXRET^{D}) as well as its interaction with such firm-level characteristics (CH) as default probability (DEFPROB; Panel A), leverage ratio (LEVERAGE; Panel B), or fundamental volatility (FIRMVOL; Panel C), from various specifications of the firm-day panel regressions of Eq. (27). Specification I includes no additional covariates; specification II includes two-digit SIC-code industry fixed effects (FEs), day-of-week FEs, as well as baseline controls in $X_{i,t}^{D,E}$ (firm size: MKTCAP) to specification I; specification III adds firm FEs to specification II; specification IV adds time (quarterly) FEs to specification II. All CH variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; R_{a}^2 is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	Panel A: CH = DEFPROB				Panel B: CH = LEVERAGE				Panel C: CH = FIRMVOL			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
EXRET^{D}	0.416***	0.416***	0.413***	0.325***	0.363***	0.363***	0.361***	0.363***	0.435***	0.434***	0.431***	0.433***
	[0.046]	[0.046]	[0.046]	[0.046]	[0.041]	[0.041]	[0.041]	[0.040]	[0.040]	[0.040]	[0.040]	[0.040]
CH	-0.0004***	-0.0004***	-0.0006***	-0.0005***	-0.0003***	-0.0003***	-0.0011***	-0.0003***	0.0002***	0.0005***	0.0007***	0.0005***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
CH×EXRET^{D}	0.064***	0.064***	0.064***	0.064***	0.141***	0.140***	0.139***	0.140***	0.174***	0.174***	0.173***	0.173***
	[0.013]	[0.013]	[0.013]	[0.013]	[0.026]	[0.026]	[0.026]	[0.026]	[0.031]	[0.030]	[0.031]	[0.031]
Controls		Y	Y	Y		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y				Y	
Time FE				Y				Y				Y
R_{a}^2	3.43%	3.45%	3.53%	3.50%	3.52%	3.54%	3.65%	3.58%	3.59%	3.63%	3.89%	3.66%
N	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361

Table 4. Stock and Bond Price Impact and Default Probability: Robustness Analysis

This table reports estimates for the relationship between each measure of dollar (in cents, i.e., multiplied by 100) or percent (in basis points: bps, i.e., multiplied by 10,000), permanent intraday ($\$\_PRICEIMPACT\_ID^g$ or $\%\_PRICEIMPACT\_ID^g$, per trade) or daily ($\$\_PRICEIMPACT\_D^g$ or $\$\_PRICEIMPACT\_D^g$, per one percent order imbalance) price impact and firm-level default probability (DEFPROB) for stocks (g = E; Panel A) or corporate bonds (g = D; Panel B), from various amended specifications of the firm-day panel regressions of Eq. (26). Specification V includes includes two-digit SIC-code industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP; and either stock price: PRC^E, or notional principal-weighted bond price: PRC^D) as well as additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or notional principal-weighted bond duration: DURATION; and governance: EINDEX) in $X^g_{i,t}$; specification VI adds firm FEs to specification V; specification VII adds time (quarterly) FEs to specification V. All independent variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; R^2_a is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	$_PRICEIMPACT_ID			%_PRICEIMPACT_ID		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
DEFPROB	-0.227***	-0.142***	-0.246***	2.05***	1.74***	2.07***
	[0.046]	[0.028]	[0.046]	[0.153]	[0.176]	[0.145]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Weekday FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	40.40%	66.83%	41.19%	42.01%	58.56%	43.29%
N	860,411	860,411	860,411	860,411	860,411	860,411
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
DEFPROB	10.7***	9.47***	8.90***	12.2***	11.0***	10.2***
	[1.78]	[1.88]	[1.45]	[2.13]	[2.27]	[1.74]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Day of Week FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	15.08%	19.19%	18.40%	16.04%	20.23%	19.48%
N	287,459	287,459	287,459	287,459	287,459	287,459

Table 4. (*Continued*)

	$_PRICEIMPACT_D			%_PRICEIMPACT_D		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
DEFPROB	0.041	-0.182	0.275	0.879	0.154	1.45*
	[0.338]	[0.260]	[0.368]	[0.910]	[0.962]	[0.888]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Weekday FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	0.78%	1.01%	0.81%	0.03%	0.07%	0.07%
N	860,424	860,424	860,424	860,424	860,424	860,424
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
DEFPROB	0.095***	0.096***	0.085***	0.107	0.146	0.095
	[0.035]	[0.036]	[0.034]	[0.037]	[0.045]	[0.035]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Day of Week FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	0.08%	0.05%	0.07%	0.06%	0.08%	0.08%
N	287,444	287,444	287,444	287,444	287,444	287,444

Table 5. Stock and Bond Return Comovement: Robustness Analysis

This table reports estimates for the relationship between firm-level daily excess stock returns ($\mathrm{EXRET}^{\mathrm{E}}$) and both the corresponding excess corporate bond returns ($\mathrm{EXRET}^{\mathrm{D}}$) as well as its interaction with such firm-level characteristics (CH) as firm-level default probability (DEFPROB; Panel A), leverage ratio (LEVERAGE; Panel B), or fundamental volatility (FIRMVOL; Panel C), from various amended specifications of the firm-day panel regressions of Eq. (27). Specification V includes two-digit SIC-code industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP; and either stock price: $\mathrm{PRC}^{\mathrm{E}}$, or notional principal-weighted bond price: $\mathrm{PRC}^{\mathrm{D}}$) as well as additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or notional principal-weighted bond duration: DURATION; and governance: EINDEX) in $X_{i,t}^{D,E}$; specification VI adds firm FEs to specification II; specification VII adds time (quarterly) FEs to specification V. All CH variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; $\mathrm{R}_{\mathrm{a}}^2$ is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	Panel A: CH = DEFPROB			Panel B: CH = LEVERAGE			Panel C: CH = FIRMVOL		
	V	VI	VII	V	VI	VII	V	VI	VII
$\mathrm{EXRET}^{\mathrm{D}}$	0.339***	0.338***	0.339***	0.312***	0.311***	0.313***	0.434***	0.431***	0.433***
	[0.042]	[0.042]	[0.042]	[0.036]	[0.036]	[0.036]	[0.040]	[0.040]	[0.040]
CH	-0.0005***	-0.0006***	-0.0006***	-0.0006***	-0.0012***	-0.0006***	0.0005***	0.0007***	0.0005***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$\mathrm{CH}\times\mathrm{EXRET}^{\mathrm{D}}$	0.064***	0.088***	0.088***	0.175***	0.174***	0.174***	0.174***	0.173***	0.173***
	[0.013]	[0.016]	[0.016]	[0.030]	[0.030]	[0.030]	[0.030]	[0.031]	[0.031]
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Weekday FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y			Y	
Time FE			Y			Y			Y
$\mathrm{R}_{\mathrm{a}}^2$	2.36%	2.38%	2.41%	2.43%	2.47%	2.46%	3.63%	3.89%	3.66%
N	272,891	272,891	272,891	272,891	272,891	272,891	365,361	365,361	365,361

Table 6. Stock and Bond Price Impact and Leverage: Baseline Analysis

This table reports estimates for the relationship between each measure of dollar (in cents, i.e., multiplied by 100) or percent (in basis points: bps, i.e., multiplied by 10,000), permanent intraday ($\$\_PRICEIMPACT\_ID^g$ or $\%\_PRICEIMPACT\_ID^g$, per trade) or daily ($\$\_PRICEIMPACT\_D^g$ or $\$\_PRICEIMPACT\_D^g$, per one percent order imbalance) price impact and firm-level leverage ratio (LEVERAGE) for stocks (g = E; Panel A) or corporate bonds (g = D; Panel B), from various specifications of the firm-day panel regressions of Eq. (26). Specification I includes no additional covariates; specification II includes two-digit SIC-code industry fixed effects (FEs), weekday FEs, as well as baseline controls in $X^g_{i,t}$ (firm size: MKTCAP; and either stock price: PRC^E, or notional principal-weighted bond price: PRC^D) to specification I; specification III adds firm FEs to specification II; specification IV adds time (quarterly) FEs to specification II. All independent variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; R^2_a is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	$_PRICEIMPACT_ID				%_PRICEIMPACT_ID			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
LEVERAGE	-0.384***	-0.224***	-0.387***	-0.224***	3.64***	3.54***	3.55***	3.63***
	[0.069]	[0.086]	[0.055]	[0.089]	[0.259]	[0.267]	[0.274]	[0.264]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	2.23%	37.41%	67.60%	38.01%	26.21%	34.55%	62.74%	35.82%
N	1,260,772	1,260,770	1,260,770	1,260,770	1,260,772	1,260,770	1,260,770	1,260,770
	Panel B: Corporate Bonds							
	I	II	III	IV	I	II	III	IV
LEVERAGE	10.3***	6.04***	7.13***	4.83***	14.3***	6.93***	8.59***	5.55***
	[1.85]	[1.51]	[2.70]	[1.38]	[2.43]	[1.55]	[2.83]	[1.38]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Day of Week FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	1.49%	4.71%	11.83%	8.84%	2.77%	7.65%	14.59%	11.93%
N	365,383	365,383	365,383	365,383	365,383	365,383	365,383	365,383

Table 6. (*Continued*)

	$_PRICEIMPACT_D				%_PRICEIMPACT_D			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
LEVERAGE	-3.35***	-0.540	-1.16***	-0.178	1.29***	1.26**	-0.951	2.06***
	[0.529]	[0.484]	[0.327]	[0.513]	[0.453]	[0.579]	[1.06]	[0.561]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.05%	0.67%	0.89%	0.72%	0.00%	0.02%	0.06%	0.07%
N	1,260,190	1,260,188	1,260,188	1,260,188	1,260,190	1,260,188	1,260,188	1,260,188
	Panel B: Corporate Bonds							
	I	II	III	IV	I	II	III	IV
LEVERAGE	0.115***	0.108***	0.201***	0.103***	0.136***	0.113***	0.217***	0.106***
	[0.026]	[0.025]	[0.060]	[0.025]	[0.029]	[0.025]	[0.061]	[0.025]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.01%	0.04%	0.07%	0.07%	0.02%	0.06%	0.09%	0.09%
N	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361

Table 7. Stock and Bond Price Impact and Fundamental Volatility: Baseline Analysis

This table reports estimates for the relationship between each measure of dollar (in cents, i.e., multiplied by 100) or percent (in basis points: bps, i.e., multiplied by 10,000), permanent intraday ($\$\_PRICEIMPACT\_ID^g$ or $\%\_PRICEIMPACT\_ID^g$, per trade) or daily ($\$\_PRICEIMPACT\_D^g$ or $\$\_PRICEIMPACT\_D^g$, per one percent order imbalance) price impact and volatility of firm value (FIRMVOL) for stocks (g = E; Panel A) or corporate bonds (g = D; Panel B), from various specifications of the firm-day panel regressions of Eq. (26). Specification I includes no additional covariates; specification II includes two-digit SIC-code industry fixed effects (FEs), weekday FEs, as well as baseline controls in $X^g_{i,t}$ (firm size: MKTCAP; and either stock price: PRC^E, or notional principal-weighted bond price: PRC^D) to specification I; specification III adds firm FEs to specification II; specification IV adds time (quarterly) FEs to specification II. All independent variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; R^2_a is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	$_PRICEIMPACT_ID				%_PRICEIMPACT_ID			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
FIRMVOL	-0.096*	0.020	-0.066*	0.072	2.55***	1.99***	0.507***	2.14***
	[0.056]	[0.049]	[0.039]	[0.050]	[0.205]	[0.199]	[0.093]	[0.217]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.14%	36.85%	67.07%	37.51%	12.89%	21.94%	56.77%	22.90%
N	1,260,772	1,260,770	1,260,770	1,260,770	1,260,772	1,260,770	1,260,770	1,260,770
	Panel B: Corporate Bonds							
	I	II	III	IV	I	II	III	IV
FIRMVOL	9.54***	7.20***	5.75***	4.45***	12.2***	7.33***	5.86***	4.34***
	[1.76]	[1.33]	[1.35]	[1.09]	[2.25]	[1.37]	[1.37]	[1.09]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Day of Week FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	1.13%	4.86%	11.91%	8.82%	1.81%	7.73%	14.63%	11.84%
N	365,383	365,383	365,383	365,383	365,383	365,383	365,383	365,383

Table 7. (*Continued*)

	$_PRICEIMPACT_D				%_PRICEIMPACT_D			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
FIRMVOL	0.336	1.95***	0.971***	1.80***	5.21***	4.63***	3.97***	3.84***
	[0.493]	[0.464]	[0.274]	[0.468]	[0.631]	[0.591]	[0.627]	[0.450]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.00%	0.68%	0.89%	0.72%	0.03%	0.04%	0.07%	0.08%
N	1,260,190	1,260,188	1,260,188	1,260,188	1,260,190	1,260,188	1,260,188	1,260,188
	Panel B: Corporate Bonds							
	I	II	III	IV	I	II	III	IV
FIRMVOL	0.092***	0.038	0.016	0.027	0.110***	0.044**	0.023	0.031
	[0.022]	[0.023]	[0.028]	[0.025]	[0.026]	[0.023]	[0.028]	[0.024]
Controls		Y	Y	Y		Y	Y	Y
Industry FE		Y	Y	Y		Y	Y	Y
Weekday FE		Y	Y	Y		Y	Y	Y
Firm FE			Y				Y	
Time FE				Y				Y
R^2_a	0.01%	0.04%	0.07%	0.06%	0.01%	0.05%	0.09%	0.08%
N	365,361	365,361	365,361	365,361	365,361	365,361	365,361	365,361

Table 8. Stock and Bond Price Impact and Leverage: Robustness Analysis

This table reports estimates for the relationship between each measure of dollar (in cents, i.e., multiplied by 100) or percent (in basis points: bps, i.e., multiplied by 10,000), permanent intraday ($\$\_PRICEIMPACT\_ID^{g}$ or $\%\_PRICEIMPACT\_ID^{g}$, per trade) or daily ($\$\_PRICEIMPACT\_D^{g}$ or $\$\_PRICEIMPACT\_D^{g}$, per one percent order imbalance) price impact and firm-level leverage ratio (LEVERAGE) for stocks (g = E; Panel A) or corporate bonds (g = D; Panel B) from various amended specifications of the firm-day panel regressions of Eq. (26). Specification V includes two-digit SIC-code industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP; and either stock price: PRC^{E}, or notional principal-weighted bond price: PRC^{D}) as well as additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or notional principal-weighted bond duration: DURATION; and governance: EINDEX) in $X^{g}_{i,t}$; specification VI adds firm FEs to specification V; specification VII adds time (quarterly) FEs to specification V. All independent variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; R^2_a is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	$_PRICEIMPACT_ID			%_PRICEIMPACT_ID		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
LEVERAGE	-0.343***	-0.473***	-0.356***	2.01***	2.34***	2.04***
	[0.110]	[0.084]	[0.113]	[0.166]	[0.251]	[0.164]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Weekday FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	40.84%	67.23%	41.63%	42.03%	57.74%	43.52%
N	860,411	860,411	860,411	860,411	860,411	860,411
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
LEVERAGE	8.53***	11.9***	7.31***	9.41***	13.2***	8.07***
	[1.57]	[2.80]	[1.32]	[1.70]	[3.06]	[1.41]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Day of Week FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	14.60%	18.95%	18.11%	15.38%	19.87%	19.06%
N	287,459	287,459	287,459	287,459	287,459	287,459

Table 8. (*Continued*)

	$_PRICEIMPACT_D			%_PRICEIMPACT_D		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
LEVERAGE	0.443	-1.18**	0.797	1.95***	0.034	2.69***
	[0.634]	[0.575]	[0.663]	[0.632]	[1.30]	[0.854]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Weekday FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	0.78%	1.01%	0.81%	0.04%	0.07%	0.07%
N	860,424	860,424	860,424	860,424	860,424	860,424
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
LEVERAGE	0.134***	0.221***	0.135***	0.139***	0.238***	0.139***
	[0.036]	[0.079]	[0.036]	[0.036]	[0.079]	[0.035]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Day of Week FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	0.05%	0.07%	0.08%	0.06%	0.07%	0.09%
N	287,444	287,444	287,444	287,444	287,444	287,444

Table 9. Stock and Bond Price Impact and Fundamental Volatility: Robustness Analysis

This table reports estimates for the relationship between each measure of dollar (in cents, i.e., multiplied by 100) or percent (in basis points: bps, i.e., multiplied by 10,000), permanent intraday ($\$\_PRICEIMPACT\_ID^g$ or $\%\_PRICEIMPACT\_ID^g$, per trade) or daily ($\$\_PRICEIMPACT\_D^g$ or $\$\_PRICEIMPACT\_D^g$, per one percent order imbalance) price impact and volatility of firm value (FIRMVOL) for stocks (g = E; Panel A) or corporate bonds (g = D; Panel B), from various amended specifications of the firm-day panel regressions of Eq. (26). Specification V includes two-digit SIC-code industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP; and either stock price: PRC^E, or notional principal-weighted bond price: PRC^D) as well as additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or notional principal-weighted bond duration: DURATION; and governance: EINDEX) in $X^g_{i,t}$; specification VI adds firm FEs to specification V; specification VII adds time (quarterly) FEs to specification V. All independent variables are standardized. N is the number of available firm-day observations in our sample over 2010-2019; R^2_a is the adjusted coefficient of determination; robust standard errors (in square brackets) are adjusted for two-way clustering at the firm and time (quarter) level in FE regressions. *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	$_PRICEIMPACT_ID			%_PRICEIMPACT_ID		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
FIRMVOL	-0.143**	-0.112**	-0.105	0.637***	0.369***	0.624***
	[0.067]	[0.047]	[0.069]	[0.099]	[0.078]	[0.106]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Weekday FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	40.23%	66.80%	40.90%	32.98%	53.30%	34.24%
N	860,411	860,411	860,411	860,411	860,411	860,411
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
FIRMVOL	5.61***	5.71***	2.95**	5.90***	6.02***	3.07***
	[1.50]	[1.42]	[1.17]	[1.58]	[1.44]	[1.22]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Day of Week FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	14.41%	18.89%	17.86%	15.11%	19.77%	18.75%
N	287,459	287,459	287,459	287,459	287,459	287,459

Table 9. (*Continued*)

	$_PRICEIMPACT_D			%_PRICEIMPACT_D		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
FIRMVOL	2.03***	0.893*	2.09***	4.21***	3.09***	3.70***
	[0.525]	[0.463]	[0.518]	[0.882]	[0.873]	[0.730]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Weekday FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	0.79%	1.01%	0.82%	0.04%	0.07%	0.08%
N	860,424	860,424	860,424	860,424	860,424	860,424
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
FIRMVOL	0.022	-0.014	0.016	0.025	-0.010	0.019
	[0.025]	[0.027]	[0.028]	[0.025]	[0.027]	[0.028]
Controls	Y	Y	Y	Y	Y	Y
Controls+	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Day of Week FE	Y	Y	Y	Y	Y	Y
Firm FE		Y			Y	
Time FE			Y			Y
R^2_a	0.05%	0.06%	0.07%	0.05%	0.07%	0.08%
N	287,444	287,444	287,444	287,444	287,444	287,444

Figure 1. Bond and Equity Payoffs: Unconditional Moments versus Bond Principal

This figure plots the unconditional probability of default $\Phi(P_z)$ in Figure 1a (in percentage, dotted line), the mean and variance of the bond (D, solid line) and equity (E, dashed line) payoffs, as defined in Section 2.1 — $\mathrm{E}(D)$ and $\mathrm{E}(E)$ of Eqs. (3) and (4) in Figure 1b; $var(D)$ and $var(E)$ of Eqs. (5) and (6) in Figure 1c — as well as their covariance — $\mathrm{cov}(D, E)$ of Eq. (7) in Figure 1d (dotted line) — as a function of the bond's principal P when $v_0 = 100$ (Figure 1b, solid gray line) and $\sigma_v^2 = 100$ (Figure 1c, solid gray line).

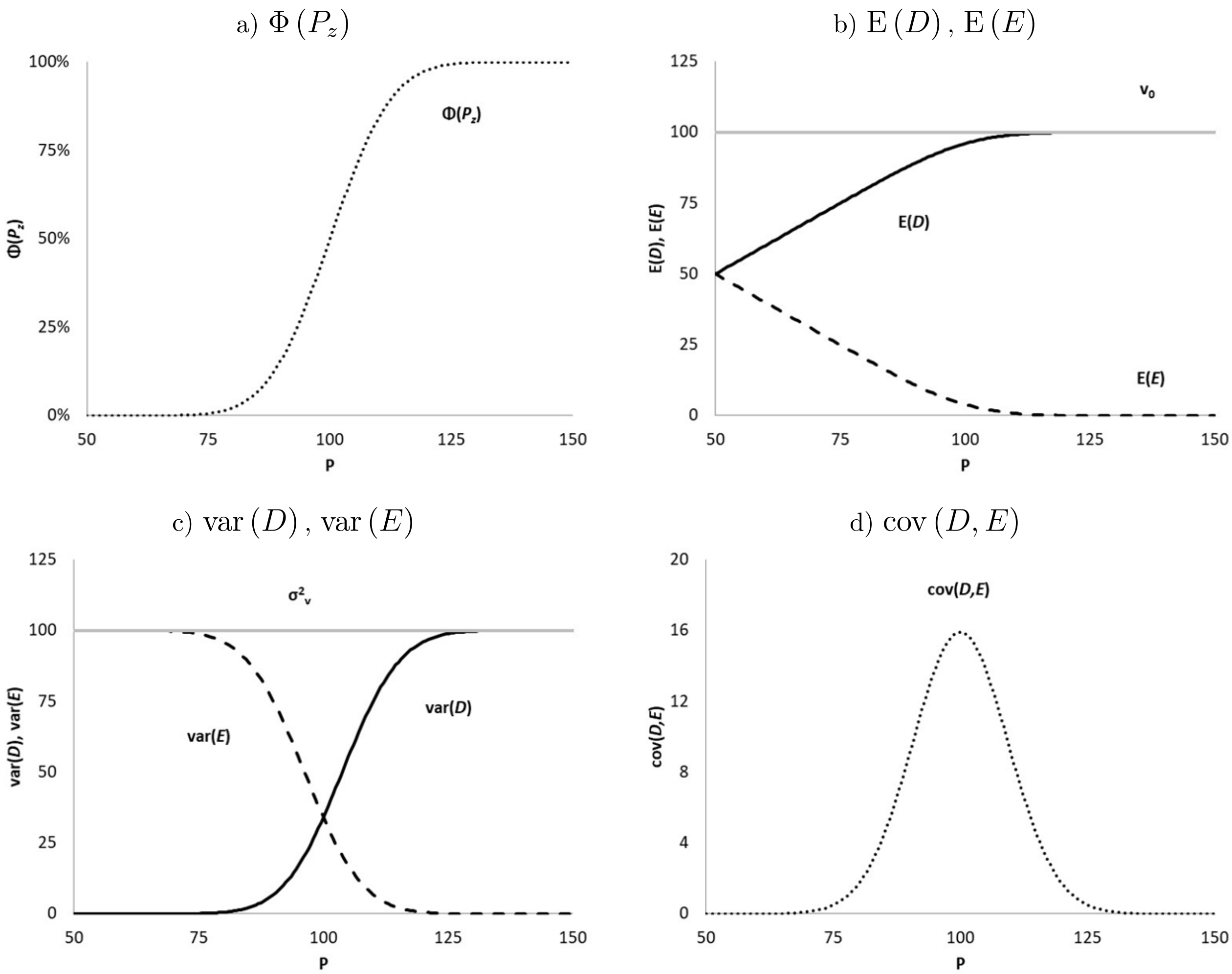


Figure 2. Bond and Equity Payoffs: Unconditional Moments versus Fundamental Volatility

This figure plots the unconditional probability of default $\Phi(P_z)$ in Figure 2a (in percentage, dotted line), the mean and variance of the bond (D, solid line) and equity (E, dashed line) payoffs, as defined in Section 2.1 — $\mathrm{E}(D)$ and $\mathrm{E}(E)$ of Eqs. (3) and (4) in Figure 2b; $\mathrm{var}(D)$ and $\mathrm{var}(E)$ of Eqs. (5) and (6) in Figure 2c — as well as their covariance — $\mathrm{cov}(D, E)$ of Eq. (7) in Figure 2d (dotted line) — as a function of the firm's fundamental volatility σ_v^2 when $v_0 = 100$ (Figure 2b, solid gray line) and either $P = 110$ or $P = 90$.

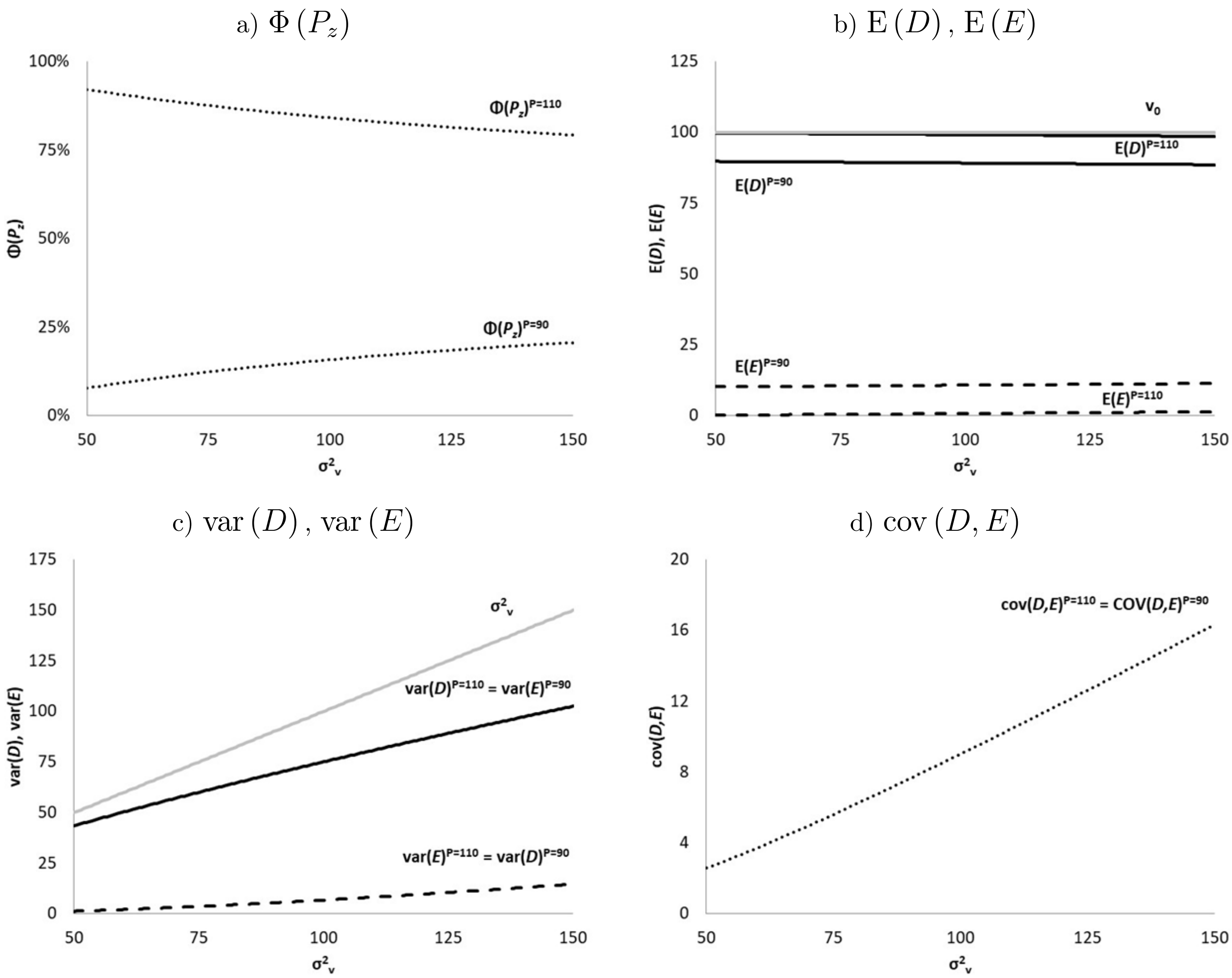
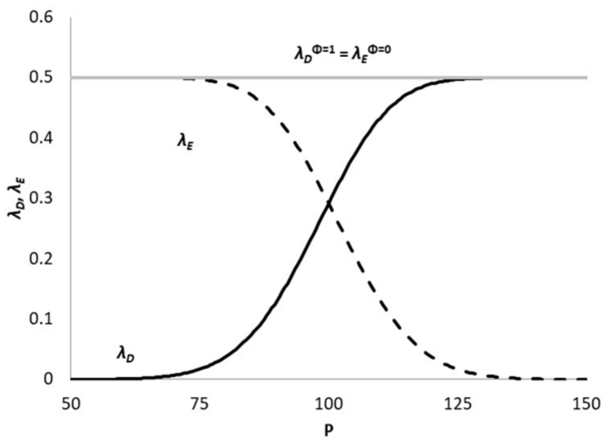


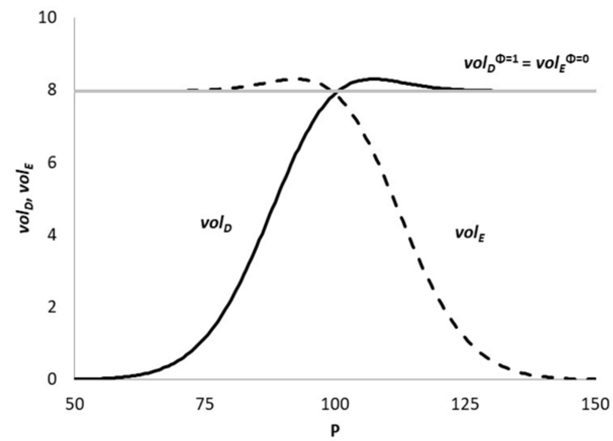
Figure 3. Bond and Equity Equilibrium versus Bond Principal

This figure plots bond (D, solid line) and equity (E, dashed line) equilibrium outcomes of Proposition 1 when the firm's default probability is nontrivial (i.e., $0 < \Phi(P_z) < 1$), as well as when the firm is either a.s. in default or a.s. solvent ($\Phi = 1$ or $\Phi = 0$; Corollary 1; solid gray line) — price impact λ_D and λ_E of Eqs. (12) and (13), and $\lambda_D^{\Phi=1} = \lambda_E^{\Phi=0} = \frac{\sigma_v}{2\sigma_u}$ in Figure 3a (while $\lambda_D^{\Phi=0} = \lambda_E^{\Phi=1} = 0$); informed trading volume vol_D and vol_E of Eqs. (16) and (17), and $vol_D^{\Phi=1} = vol_E^{\Phi=0} = \sigma_u \sqrt{\frac{2}{pi}}$ in Figure 3b (while $vol_D^{\Phi=0} = vol_E^{\Phi=1} = 0$); price variance $\text{var}(p_D) = \frac{1}{2}\text{var}(D)$ of Eq. (5) and $\text{var}(p_E) = \frac{1}{2}\text{var}(E)$ of Eq. (6), and $\text{var}\left(p_D^{\Phi=1}\right) = \text{var}\left(p_E^{\Phi=0}\right) = \frac{\sigma_v^2}{2}$ in Figure 3c (while $\text{var}\left(p_D^{\Phi=0}\right) = \text{var}\left(p_E^{\Phi=1}\right) = 0$); and price covariance $\text{cov}(p_D, p_E) = \frac{1}{4}\text{cov}(D, E)$ of Eq. (7) in Figure 3d (dotted line; while $\text{cov}\left(p_D^{\Phi=0}, p_E^{\Phi=0}\right) = \text{cov}\left(p_D^{\Phi=1}, p_E^{\Phi=1}\right) = 0$) — as a function of the bond's principal P when $v_0 = 100$, $\sigma_v^2 = 100$, and $\sigma_u^2 = 100$.

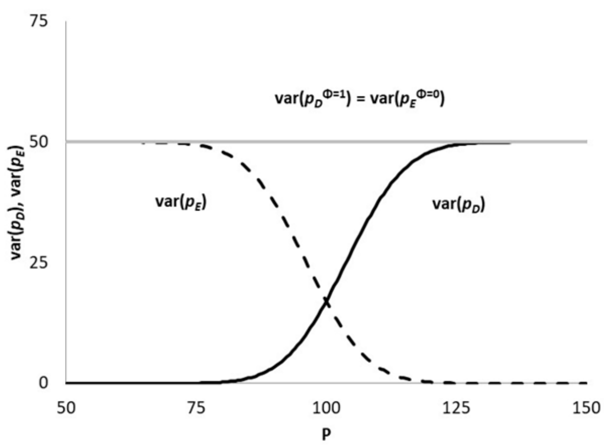
a) λ_D, λ_E



b) vol_D, vol_E



c) $\text{var}(p_D)$, $\text{var}(p_E)$



d) $\text{cov}(p_D, p_E)$

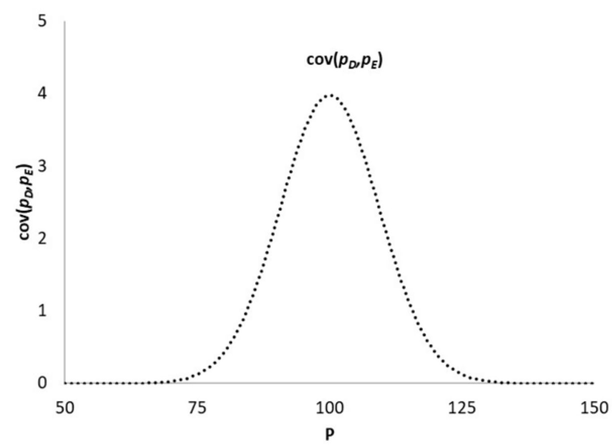


Figure 4. Bond and Equity Equilibrium versus Fundamental Volatility

This figure plots bond (D, solid line) and equity (E, dashed line) equilibrium outcomes of Proposition 1 when the firm's default probability is nontrivial (i.e., $0 < \Phi(P_z) < 1$), as well as when the firm is either a.s. in default or a.s. solvent ($\Phi = 1$ or $\Phi = 0$; Corollary 1; solid gray line) — price impact λ_D and λ_E of Eqs. (12) and (13), and $\lambda_D^{\Phi=1} = \lambda_E^{\Phi=0} = \frac{\sigma_v}{2\sigma_u}$ in Figure 4a (while $\lambda_D^{\Phi=0} = \lambda_E^{\Phi=1} = 0$); informed trading volume vol_D and vol_E of Eqs. (16) and (17), and $vol_D^{\Phi=1} = vol_E^{\Phi=0} = \sigma_u\sqrt{\frac{2}{pi}}$ in Figure 4b (while $vol_D^{\Phi=0} = vol_E^{\Phi=1} = 0$); price variance $\mathrm{var}(p_D) = \frac{1}{2}\mathrm{var}(D)$ of Eq. (5) and $\mathrm{var}(p_E) = \frac{1}{2}\mathrm{var}(E)$ of Eq. (6), and $\mathrm{var}\left(p_D^{\Phi=1}\right) = \mathrm{var}\left(p_E^{\Phi=0}\right) = \frac{\sigma_v^2}{2}$ in Figure 4c (while $\mathrm{var}\left(p_D^{\Phi=0}\right) = \mathrm{var}\left(p_E^{\Phi=1}\right) = 0$); and price covariance $\mathrm{cov}(p_D, p_E) = \frac{1}{4}\mathrm{cov}(D, E)$ of Eq. (7) in Figure 4d (dotted line; while $\mathrm{cov}\left(p_D^{\Phi=0}, p_E^{\Phi=0}\right) = \mathrm{cov}\left(p_D^{\Phi=1}, p_E^{\Phi=1}\right) = 0$) — as a function of the firm's fundamental volatility σ_v^2 when $v_0 = 100$ (Figure 1b, solid gray line), $\sigma_u^2 = 100$, and either $P = 110$ or $P = 90$.

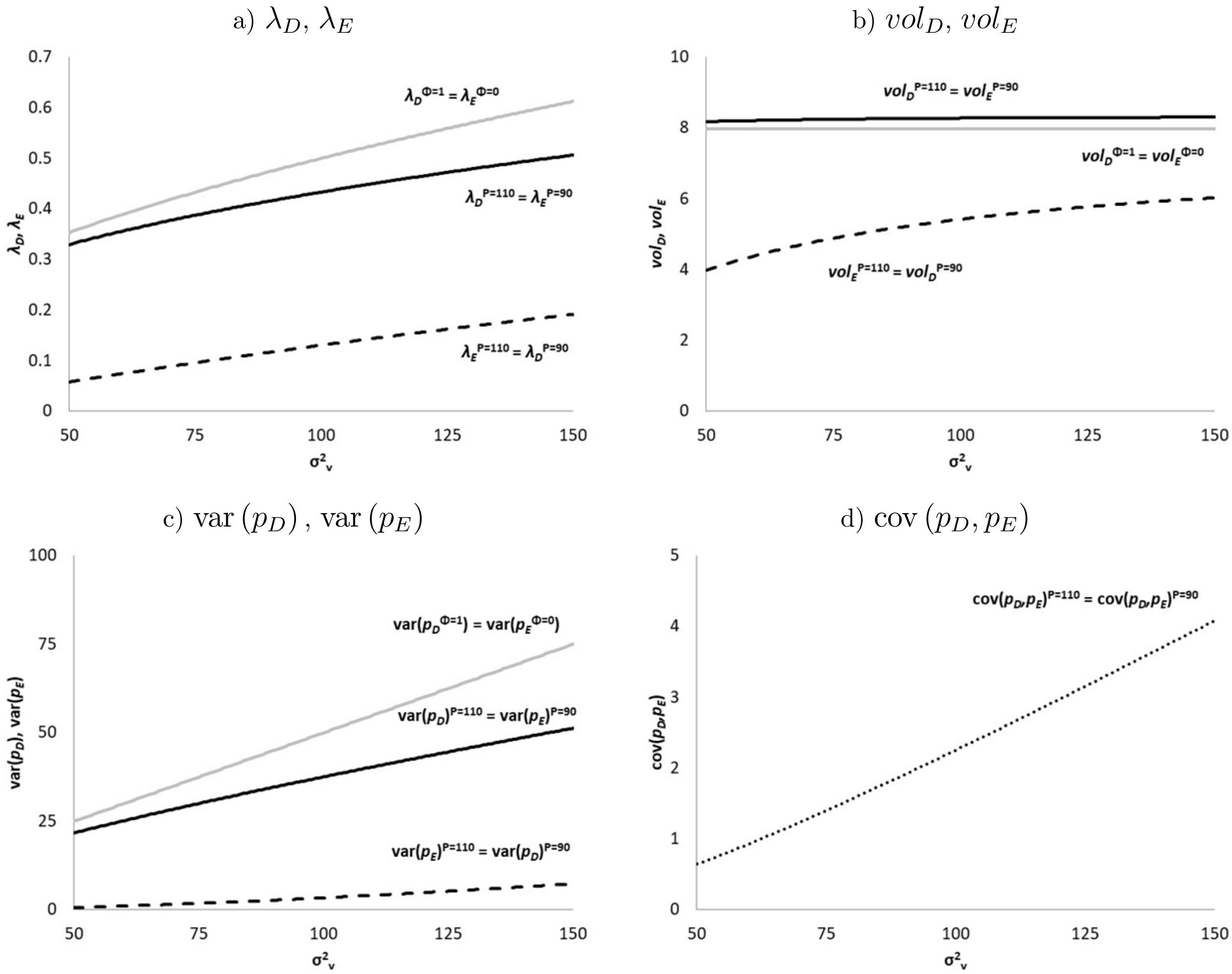


Figure 5. Stock-Bond Comovement: Tercile Analysis

This figure plots estimates of stock-bond comovement ρ from various specifications of Eq. (27) within terciles (T_1, T_2, and T_3) of firm-level default probability (DEFPROB; Figures 5a, 5d), leverage ratio (LEVERAGE; Figures 5b, 5e; as well as when either is large, $\overline{T}$), or volatility of firm value (FIRMVOL; Figure 5c, 5f) after imposing that $\delta = 0$ and $\rho_{DEF} = 0$. In Figures 5a to 5c (Baseline), specification I includes no additional covariates; specification II includes two-digit SIC-code industry fixed effects (FEs), day-of-week FEs, as well as baseline controls in $X_{i,t}^{D,E}$ (firm size: MKTCAP) to specification I; specification III adds firm FEs to specification II; specification IV adds time (quarterly) FEs to specification II. In Figures 5d to 5f (Robustness), specification V includes additional controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or notional principal-weighted bond duration: DURATION; and governance: EINDEX) to specification II; specification VI adds firm FEs to specification V; specification VII adds time (quarterly) FEs to specification V.