

Speculation and Liquidity in Stock and Corporate Bond Markets*

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Abstract

Canonical studies of trading assume that asset payoffs are linear in fundamentals. We propose and test that nonlinearity of equity and corporate bond payoffs (via issuer solvency) has novel informational effects on their price formation. We show that informed risk-neutral speculation trades strategically in those securities by their relative sensitivity to firm value, a function of perceived default probability. As that probability changes so does relative speculative intensity (and adverse selection), yielding differential stock and bond liquidity and nonmonotonic 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: D43; G12; G14; G33

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1 Introduction

It is commonly understood that informed, sophisticated 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 informed trading upon market-making.¹ 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 main goal and contribution of this paper is to both investigate theoretically and assess empirically the informational 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 specialized 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 bonds — i.e., two assets whose payoffs depend nonlinearly on that value as in Merton (1974). Risk-neutral dealers in each market are assumed to use regression inference from the corresponding aggregate order flow, which comprises both speculative and uncorrelated exogenous noise trades, in order to clear it. The camouflage of speculation among uninformed trading contributes to adverse selection risk and illiquidity in either security.²

¹More broadly, the Kyle (1985) model still remains one of the most popular and empirically validated baseline representations in the literature of the effects of information asymmetry in disparate security markets (see, e.g., Hasbrouck, 2007; Foucault et al., 2013; further discussion and references are in Section 2).

²Accordingly, our analysis is not designed to investigate the well-known significant differences in average liquidity and trading intensity between stocks and corporate bonds — which extant literature attributes to significant differences in market structure, pre-trade and post-trade transparency, and security characteristics, among others (see, e.g., Bessembinder and Maxwell, 2008; Bao and Pan, 2013; Holden and Jacobsen, 2014;

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 — stemming from how their payoff nonlinearity affects the informational role of their trading activity — 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 — e.g., when the firm’s debt *ceteris paribus* decreases — equity (debt) payoffs become more (less) sensitive to firm value, and to private information about it. Hence, stocks (corporate bonds) attract more (less) informed speculation. In turn, equity (bond) dealers face greater (lower) adverse selection risk from liquidity provision, yielding lower (greater) equilibrium stock (bond) market depth — the reciprocal of price impact. The firm’s stock (bond) liquidity likewise improves (worsens) in equilibrium when its default probability rises.³ Accordingly, we further show that the comovement of a firm’s equity and debt prices is positive like at liquidation, higher when there is nontrivial uncertainty about both 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 original 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. In order to assess this prediction empirically, we construct

Harris, 2015; O’Hara and Zhou, 2021, and references therein; additional discussion is in Section 3.1). Our model abstracts from these and other frictions to concentrate on the effects of information asymmetry considerations for time-series and cross-sectional price formation in either market.

³Relatedly, Dang et al. (2015, 2018, 2020) propose that the information sensitivity of debt contracts from their intrinsic seniority of repayment makes them optimal for uninformed trading by minimizing the incentives to produce private information about their payoffs (except during crises; Frenkel, 2023), while Doh and Wang (2021) argue that competitive price-taking informed creditors may worsen liquidity provision and pricing for corporate bonds in a structural credit-risk model by selling them more aggressively when their bankruptcy risk is higher; see also the discussion in Benmelech and Bergman (2018).

a comprehensive sample of intraday stock and corporate bond transactions for more than 600 U.S. firms for which both are available spanning 2010-2019.⁴ Over this period, the latter are mandatorily reported and hence unaffected by selection bias (e.g., Bessembinder et al., 2009), while neither are plagued by the distress accompanying the 2008 financial crisis or the 2020 COVID-19 pandemic (e.g., Pasquariello, 2014a; Bessembinder et al., 2018; Gormsen and Koijen, 2020; Boyarchenko et al., 2021; Kargar et al., 2021). We then examine the relationship between commonly used measures of permanent (i.e., likely informational) intraday and daily price impact of these transactions in stock and bond markets (e.g., Hasbrouck, 1991, 2007; Boehmer and Wu, 2008; Holden and Jacobsen, 2014; O’Hara and Zhou, 2021), daily (excess-of-market) stock-bond return covariation, and estimates of firm-level perceived probability of default based on Bharath and Shumway’s (2008) widely adopted implementation of the Merton (1974) debt model.

Our empirical analysis yields original evidence consistent with the main predictions of our model. First, we find that stock (bond) permanent price impact is negatively (positively) associated with firm-level default probability, even after controlling for cross-sectional and time-series determinants of stock and bond illiquidity common 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, 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 sample-wide 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).⁵ Second, we show that estimated firm-level comovement between daily stock and corporate bond returns is positive as well as lower when firm-level default probability is either low or high (making debt or equity nearly insensitive to private fundamental information) and higher otherwise (when both

⁴Establishing 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 goal is to establish their correlation in the data and assess whether it resembles the one predicted by our model.

⁵The unreported investigation of proportional stock and bond price impact yields both additional predictions from our model and further empirical evidence in its support; see also the discussion in Section 3.1.

securities are information-sensitive), as postulated by our model. Neither findings can be easily reconciled with inventory management (and related funding, risk-aversion, or search) 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 equilibrium 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 informational 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 leverage and only increasing in asset volatility. 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 — 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 risk-neutral speculators are equipped with a binary signal primarily about either the mean or the volatility of firm value (as drawn from a mixture of lognormals). In their setting, market-making is generalized (i.e., by way of cross-order flow observability) to investigate the return spillover effects of trading in U.S. equity and corporate bonds (i.e., the cross-price impact of their signed volume) at the daily frequency. Relatedly, Back (1993) uses a similar setting to study order and price correlation in a market for an asset and a European call option on its liquidation payoff, while Glebkin et al. (2023) characterize the illiquidity of option contracts when risk-averse investors internalize their price impact and asset payoffs are non-Gaussian. Relative to these and other complementary studies of strategic multi-asset speculation and cross-asset price discovery with generalized dealership (e.g., Caballé and Krishnan, 1994; Pasquariello, 2007; Albuquerque and Vega, 2009; Pasquariello and Vega, 2015; Keller and Tseng, 2022), our distinct focus is on studying equity-specific and debt-specific price discovery and market quality within the canonical one-period Kyle (1985) model under specialized market-making (i.e., by

way of direct order flow observability; e.g., Chowdhry and Nanda, 1991; Subrahmanyam, 1991a; Baruch et al., 2007; Pasquariello and Vega, 2009; Boulatov et al., 2013; Pasquariello, 2018). These issues remain important for academics, practitioners, and policy-makers (e.g., O’Hara, 2003; Dudley, 2015; U.S. SEC, 2017). The specialization assumption is a more plausible (yet not pivotal) reduced-form representation of high-frequency price formation in the less-than-perfectly integrated and differentially liquid and transparent U.S. stock and corporate bond markets under our investigation, i.e., where contemporaneous or high-speed such spillover effects are potentially ambiguous and seemingly uncommon (e.g., Coughenour and Deli, 2002; Naik and Yadav, 2003; Coughenour and Saad, 2004; Harris, 2015; Choi and Kim, 2018; Sandulescu, 2020; Holden et al., 2021; Wittwer, 2021; Chen et al., 2023; Wittwer and Uthemann, 2025).⁶

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 (He and Milbradt, 2014; Hanselaar et al., 2019; Nadarajah et al., 2021).⁷ 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

⁶We discuss these issues further in Sections 2.2 and 3.1. Other studies investigate the effects of asymmetric information on price formation in integrated markets where multiple contingent claims are traded and risk-averse investors act competitively; see, e.g., Chabakauri et al. (2022) and references therein. In such a setting, Banerjee et al. (2024) argue that private information disagreement and noise trading intensity may affect the relationship between equity and debt valuations and default risk. Relatedly, Davis and Gondhi (2023) analyze the feedback loop between asset prices and managerial learning and investment decisions in equity and debt markets in which competitive, risk-neutral, endogenously heterogeneously informed investors in either security cannot condition their limit orders on the price of the other security as well as can only place unit trades in their security; see also Albagli et al. (2015). Relative to this complementary literature, our original theoretical investigation and accompanying novel empirical evidence highlight the role of adverse selection risk from strategic speculation in stocks and corporate bonds for their market quality in the presence of ex ante default uncertainty.

⁷Relatedly, several studies examine the contemporaneous or predictive relationship between credit ratings and various measures of stock or corporate bond liquidity; see, e.g., Odders-White and Ready (2006), Kisgen and Strahan (2010), Lovo et al. (2022), and references therein.

assessment 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 specialized 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 (theoretically and empirically) asymmetric information to financial market quality (see, e.g., the literature surveyed in O’Hara, 1995; Hasbrouck, 2007; 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 while dealers clear their markets by regression inference from observed trading activity. 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 .⁸ Following Merton (1974), both asset payoffs depend on firm

⁸Allowing for more complex securities, e.g., such as coupon, secured, subordinated, 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 et al. (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:

$$D \equiv \min(v, P), \quad (1)$$

$$E \equiv \max(v - P, 0), \quad (2)$$

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.⁹

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:

$$E(D) = P[1 - \Phi(P_z)] + E(R)\Phi(P_z), \quad (3)$$

$$E(E) = [E(C) - P][1 - \Phi(P_z)], \quad (4)$$

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

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

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

⁹Equivalently, 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 the illustrative numerical example 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 $\text{var}(R) \equiv \text{var}(v|v \leq P) = \sigma_v^2 [1 - \Delta^-(P_z)]$ is the unconditional variance of recovered firm value upon default, $\text{var}(C) \equiv \text{var}(v|v > P) = \sigma_v^2 [1 - \Delta^+(P_z)]$ 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:

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

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 or for bond and stock payoff correlation 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 ($E(D) \approx P$ and $\text{var}(D) \approx 0$; Figures 1b and 1c, solid lines) while its stock is close to be a residual claim against its risky value ($E(E) \approx v_0 - P$ and $\text{var}(E) \approx \sigma_v^2$; 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 ($E(D) \approx v_0$ and $\text{var}(D) \approx \sigma_v^2$) while leaving equityholders only with limited liability protection ($E(E) \approx 0$ and $\text{var}(E) \approx 0$). Accordingly, in either polar case, the comovement of bond and equity payoffs is low ($\text{cov}(D, E) \approx 0$; 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 payoffs of both its risky bond and stock depend positively on its residual value at liquidation (upon recovery and continuation, respectively; see, e.g., $E(R)$ in $E(D)$ and $E(C)$ in $E(E)$), 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 materially high or low default probability in the economy of

Figure 1a, i.e., either high $P = 110 > v_0$ (such that $\frac{1}{2} < \Phi(P_z) < 1$) or low $P = 90 < v_0$ ($0 < \Phi(P_z) < \frac{1}{2}$); at $P = 100 = v_0$, default probability ($\Phi(P_z) = \frac{1}{2}$) is trivially insensitive to σ_v^2 (and $\text{var}(D) = \text{var}(E)$). For ease of representation only, we set those high and low bond principals as equidistant from the firm's unconditional expected value v_0 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 with 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.¹⁰

At relatively high debt principal ($P = 110 > v_0$), decreasing default probability remains nonetheless high enough to make the unconditional expected bond (equity) value $E(D)$ ($E(E)$) 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 covariation 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 $E(C)$ while bondholders' expected recovery value $E(R)$ 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 — raising their comovement ($\text{cov}(D, E)$ of Eq. (7)) — bond payoff volatility ($\text{var}(D)$ of Eq. (5)) increases more than equity payoff volatility ($\text{var}(E)$ of Eq. (6)) as firm value becomes more uncertain.

Vice versa, when debt principal is relatively low ($P = 90 < v_0$), increasing 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 decreasingly likely

¹⁰Specifically, $\frac{\partial \Phi(P_z)}{\partial \sigma_v^2} = -\frac{P_z \psi(P_z)}{2\sqrt{\sigma_v}}$ whose sign is that of $v_0 - P$.

solvency more than bondholders' expected recovery value at decreasingly unlikely liquidation. Accordingly (and symmetrically), stocks become increasingly riskier than bonds in Figure 2c and their covariance is 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 agents 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: $E(D|v) = D$ of Eq. (1) and $E(E|v) = E$ of Eq. (2).¹¹ 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 $\pi = (D - p_D)x_D + (E - p_E)x_E$. As customarily assumed in the Kyle (1985) framework (to prevent fully revealing prices and no-speculation outcomes; see, e.g., Spiegel and Subrahmanyam, 1992), uninformed liquidity (or *noise*) traders generate random, normally distributed bond and stock demands u_D and u_E , both with zero mean (without loss of generality), variance σ_u^2 , and zero covariance with v . For simplicity, u_D and u_E are also assumed to be independent from each other.¹²

¹¹Allowing for noisy private information (e.g., as in Subrahmanyam, 1991a; Spiegel and Subrahmanyam, 1992; Pasquariello, 2018, 2024), for a discrete number of variously informed speculators (e.g., as in Subrahmanyam, 1991b; Foster and Viswanathan, 1996; Pasquariello and Vega, 2007, 2009, 2015), and/or for multi-period or continuous trading (e.g., as in Kyle, 1985; Holden and Subrahmanyam, 1992; Back, 1993; Boulatov et al., 2013) in the model would make its analysis more involved without altering its main implications.

¹²See, e.g., Pasquariello (2007); Boulatov et al. (2013); Pasquariello and Vega (2015). Exogenously differential

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), such that cross-asset price discovery is absent by construction. As noted in Section 1, specialized market-making (i.e., by way of direct order flow observability; e.g., see Coughenour and Deli, 2002; Naik and Yadav, 2003; Coughenour and Saad, 2004; Wittwer and Uthemann, 2025) captures, both plausibly and parsimoniously, the relatively opaque and less-than-perfectly integrated nature of cross-price formation in unevenly liquid U.S. stock and corporate bond markets (see, e.g., Choi and Kim, 2018; Sandulescu, 2020; Chen et al., 2023, and references therein), while considerably simplifying the theoretical analysis that follows (yet without driving its main insights).¹³ These considerations are especially relevant at the high frequency of our subsequent empirical investigation — one at which cross-trading price spillovers are presumably less likely — 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; Harris, 2015; Holden et al., 2022). 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:

noise trading intensity (e.g., Subrahmanyam, 1991a) would add trivially differential equilibrium illiquidity without altering the intuition. 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 generalized or specialized dealership, respectively; see also Chowdhry and Nanda (1991). As we discuss further in Section 2.3, relaxing this assumption does not materially affect our insights.

¹³E.g., Wittwer (2021) shows that the equilibrium prices of two correlated assets in the presence of strategic informed speculation in both remain efficient irrespective of the degree of connectedness among the markets where they are traded — i.e., of whether contingent cross-orders in either asset can be submitted — despite potentially affecting speculative rent extraction from noise traders. See also the discussion in Caballé and Krishnan (1994) and Pasquariello and Vega (2015), among others.

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

Condition 2 *Semi-strong market efficiency*: $p_D = E(D|\omega_D)$ and $p_E = E(E|\omega_E)$.¹⁴

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, 2024). In this paper, we follow Pasquariello (2014b, 2024) by representing dealers' conditional first moments $E(D|\omega_D)$ and $E(E|\omega_E)$ as linear regressions of the corresponding asset payoff on its order flow (ω_D and ω_E), whose intercept and slope coefficients can be expressed explicitly:

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

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

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).¹⁵ According to Pasquariello (2014b), inference from this approach is both accurate and robust to its expansion to higher-order polynomials

¹⁴Market-order trading and the customary absence of post-trade arbitrageurs in this class of models preclude the riskless exploitation of any resulting gap between equilibrium prices and security payoffs after the market clears but before those payoffs are liquidated (see, e.g., Subrahmanyam, 1991a; Pasquariello and Vega, 2009; Pasquariello, 2018). Condition 2 can also be interpreted as the outcome of dealers' competition in either market forcing their expected profits to zero (Kyle, 1985; Caballé and Krishnan, 1994). Because of speculative risk-neutrality, dealership specialization in Condition 2 then makes solving the above game equivalent to solving for the Bayesian Nash equilibrium of each of two separate economies populated by two distinct yet identical informed traders; see the proof of Proposition 1 next.

¹⁵Alternatively, 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).

in numerical analysis; see also Bernardo and Judd (2000) and Roşu (2019).¹⁶ Proposition 1 describes the unique linear closed-form noisy REE that obtains in this case.

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

$$p_D = E(D) + \lambda_D \omega_D, \quad (10)$$

$$p_E = E(E) + \lambda_E \omega_E, \quad (11)$$

where:

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

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

and by the speculator's market orders:

$$x_D = \frac{1}{2\lambda_D} [D - E(D)], \quad (14)$$

$$x_E = \frac{1}{2\lambda_E} [E - E(E)]. \quad (15)$$

Although the equilibrium of Proposition 1 can be expressed in appealing closed forms, its explicit expressions remain analytically complicated. 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 $vol_D \equiv E(|x_D|)$ and $vol_E \equiv E(|x_E|)$ (e.g., Vives, 2008; Pasquariello, 2014b), since signed risk-neutral speculation in a riskless asset is indeterminate as profitless in a

¹⁶In addition, it can be shown that the ensuing equilibrium (i.e., within-model) coefficients of determination of Eqs. (8) and (9) with respect to D and E are by construction the same as for the dealers' inference problem in Kyle (1985) with respect to v , i.e., 50%.

Kyle (1985) setting, as follows:

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

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

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

where $E(E)_z \equiv \frac{E(E)+P-v_0}{\sigma_v}$, 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:*

$$\lambda_D^{\Phi=1} = \frac{\sigma_v}{2\sigma_u}, \quad (18)$$

$$\lambda_E^{\Phi=1} = 0, \quad (19)$$

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

$$vol_E^{\Phi=1} = 0; \quad (21)$$

or:

$$\lambda_D^{\Phi=0} = 0, \quad (22)$$

$$\lambda_E^{\Phi=0} = \frac{\sigma_v}{2\sigma_u}, \quad (23)$$

$$vol_D^{\Phi=0} = 0, \quad (24)$$

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

Comfortingly, both of 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 ($\text{cov}(p_D^{\Phi=1}, p_E^{\Phi=1}) = \text{cov}(p_D^{\Phi=0}, p_E^{\Phi=0}) = 0$). 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 from more informed speculation — 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.¹⁷ Hence, equilibrium price volatility and informativeness ($\text{var}(p_D^{\Phi=1}) = \frac{1}{2}\sigma_v^2$ or $\text{var}(p_E^{\Phi=0}) = \frac{1}{2}\sigma_v^2$) 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 (information effect) reverberates exactly in equilibrium market depth ($\frac{1}{\lambda_D^{\Phi=1}}$ or $\frac{1}{\lambda_E^{\Phi=0}}$; liquidity effect).

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 debt 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 ($\text{var}(p_D) = \frac{1}{2}\text{var}(D)$) are*

¹⁷Specifically, $\frac{\partial \lambda_D^{\Phi=1}}{\partial \sigma_v^2} = \frac{\partial \lambda_E^{\Phi=0}}{\partial \sigma_v^2} = \frac{1}{4\sigma_u\sigma_v} > 0$ and $\frac{\partial \lambda_D^{\Phi=1}}{\partial \sigma_u^2} = \frac{\partial \lambda_E^{\Phi=0}}{\partial \sigma_u^2} = -\frac{\sigma_v}{4\sqrt{\sigma_u^3}} < 0$.

increasing in P and σ_v^2 , and decreasing in v_0 ; equilibrium stock price impact (λ_E of Eq. (13)) and price variance ($\text{var}(p_E) = \frac{1}{2}\text{var}(E)$) are decreasing in P , and increasing in v_0 and σ_v^2 ; equilibrium price covariance ($\text{cov}(p_D, p_E) = \frac{1}{4}\text{cov}(D, E)$) 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 2.1, 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 — as stemming from speculation in bonds and stocks; by construction, in its absence there would be neither price impact in each security nor price comovement among them.¹⁸ We start by examining equilibrium bond and stock price formation as a function of the bond's principal P in Figure 3. As noted in Section 2.1, equivalent analysis with respect to mean firm value v_0 yields identical insights, while equilibrium price covariance and correlation can be shown to have those same properties.¹⁹

Ceteris paribus, when the firm is ex ante very likely to be solvent (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 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 — $\text{var}(E) \approx \sigma_v^2$ and expected equilibrium unsigned equity speculation $\text{vol}_E \approx \text{vol}_E^{\Phi=0}$ (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 — $\text{var}(D) \approx 0$ and expected equilibrium unsigned bond speculation $\text{vol}_D \approx \text{vol}_D^{\Phi=0} = 0$ (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

¹⁸In particular, as in Kyle (1985), the properties of equilibrium stock and bond prices in Corollary 2 reflect those of their payoffs of Eqs. (1) and (2) (as described in section 2.1 and Figures 1 and 2) only in the presence of informed trading in both. Without such activity, ceteris paribus, it is straightforward to show that stock and bond markets would be infinitely liquid ($\lambda_D = 0$ and $\lambda_E = 0$) as free from adverse selection risk, such that equilibrium stock and bond prices would neither move ($p_D = E(D)$ and $p_E = E(E)$) nor comove ($\text{cov}(p_D, p_E) = 0$).

¹⁹In such circumstances, covariance expressions are commonly preferred when describing equilibrium comovement as simpler (see, e.g., Boulatov et al., 2013).

that stock prices are significantly more volatile than bond prices ($\text{var}(p_E) \approx \text{var}(p_E^{\Phi=0}) = \frac{1}{2}\sigma_v^2$ of Kyle, 1985, while $\text{var}(p_D) \approx \text{var}(p_D^{\Phi=0}) = 0$; Figure 3c) and barely comove ($\text{cov}(p_D, p_E) \approx \text{cov}(p_D^{\Phi=0}, p_E^{\Phi=0}) = 0$; Figure 3d, dotted line).²⁰

As the ex ante probability of default $\Phi(P_z)$ increases (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 stocks but declines in bonds, yet so does their corresponding illiquidity. In equilibrium, the former information effect decisively prevails upon the latter liquidity effect on strategic trading in bonds while being mostly offset by it for stocks (vol_D of Eq. (16) versus 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 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 $\Phi(P_z) < \frac{1}{2}$ (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 $\Phi(P_z) = \frac{1}{2}$ (for $P = v_0$). Once default becomes more likely ($\Phi(P_z) > \frac{1}{2}$; for $P > v_0$), limited liability makes

²⁰However, 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 ($\text{var}(D)$ and $\text{var}(E)$) 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 ($\text{cov}(u_D, u_E) = 0$) would allow for circumstances when $\text{cov}(p_D, p_E)$ may be negative (i.e., for sufficiently negative $\text{cov}(u_D, u_E)$ in the ensuing $\text{cov}(p_D, p_E) = \frac{1}{4} \left[\text{cov}(D, E) + \text{corr}(u_D, u_E) \sqrt{\text{var}(D)} \sqrt{\text{var}(E)} \right]$, where $\text{corr}(u_D, u_E) = \frac{1}{\sigma_u^2} \text{cov}(u_D, u_E)$); see also Back and Crotty (2015), Pasquariello (2018), and references therein.

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. Accordingly, as the probability of default increases, equity and bond price formation continue to diverge, such that equity prices are less volatile than bond prices and their comovement declines.

Lastly, when the firm is ex ante very likely to default (at high P and $\Phi(P_z) \approx 1$), informed risk-neutral speculation nearly fully migrates 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 $vol_D \approx vol_D^{\Phi=1}$). 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 ($\lambda_D \approx \lambda_D^{\Phi=1}$) and volatile ($\text{var}(p_D) \approx \text{var}(p_D^{\Phi=1}) = \frac{1}{2}\sigma_v^2$ of Kyle, 1985), the stock market is most deep ($\lambda_E \approx \lambda_E^{\Phi=1} = 0$ of Eq. (19)) and calm ($\text{var}(p_E) \approx \text{var}(p_E^{\Phi=1}) = 0$), and their price formation is nearly independent ($\text{cov}(p_D, p_E) \approx \text{cov}(p_D^{\Phi=1}, p_E^{\Phi=1}) = 0$).²¹ 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. 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.

²¹The 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 generalized bond and equity dealership (i.e., by way of cross-order flow observability) 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).

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 2.1, for simplicity only, we set low and high P as equidistant to mean firm value $v_0 = 100$ 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 firm leverage is low ($P = 90 < v_0$), the probability of default is low yet increasing in σ_v^2 , as extreme positive 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 (λ_E versus λ_D ; Figure 4a) and more volatile ($\text{var}(p_E)$ versus $\text{var}(p_D)$; Figure 4c). Intuitively, when σ_v^2 increases, private fundamental information is always more valuable to speculation (as in Kyle, 1985) — yet more so to strategic equity trading than to strategic bond trading at low P ; hence, equity dealers face increasingly greater adverse selection risk — and raise price impact more — than bond dealers. In equilibrium, the former information effect is strong enough to dominate the latter liquidity effect on speculation in either security (unlike in Kyle, 1985; see also Corollary 1), yet decreasingly more so for stocks than for bonds. Thus, informed bond trading volume is both decreasingly smaller and significantly more sensitive to fundamental uncertainty than informed stock trading volume (vol_D versus vol_E ; Figure 4b).

Vice versa, at high firm leverage ($P = 110 > v_0$), 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 decreasingly likely to be invoked by equityholders. Hence, the value of private fundamental information and the ensuing adverse selection risk are increasingly greater in bonds than in stocks at high P , making bond market depth increasingly lower than stock market depth, bond prices increasingly more volatile than equity prices, and equity speculation decreasingly smaller than virtually flat bond speculation. In either case, however, a firm's greater fundamental

uncertainty is accompanied by higher equilibrium comovement of its bond and equity prices (higher $\text{cov}(p_D, p_E)$; Figure 4d), since so is the comovement of their terminal payoffs as both become more sensitive to firm value (see also Section 2.1).

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 of trading driven by their payoff nonlinearity. In particular, the model in Section 2 implies the following original, testable observations about that process in the presence of strategic, informed speculation in either asset.

Hypothesis 1 *A firm’s stock (bond) informational price impact of trading — or inverse market depth — is generally decreasing (increasing) in its default probability, decreasing (increasing) in its leverage, and increasing in its fundamental volatility.*

Hypothesis 2 *A firm’s stock and corporate bond price comovement is positive, first increasing and then decreasing in its default probability and leverage, as well as increasing in its fundamental 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 (2021) provide recent surveys of their main institutional features and properties. In our empirical analysis, we merge multiple canonical databases of firm-level time-stamped stock and corporate bond trades, prices, as well as corresponding corporate issue and issuer characteristics: DTAQ,

TRACE, as well as CRSP, Compustat, and Mergent FISD, among others. We describe data and sample selection in more depth in Section B.1 of the Appendix.

Importantly, as noted earlier, stock trading and stock price changes occur at very high frequency (including milliseconds) on organized exchanges. Corporate bonds instead trade only infrequently and in larger sizes (but their prices change less) in relatively less liquid and less transparent OTC markets (e.g., Bessembinder and Maxwell, 2008; Bao et al., 2011; Bao and Pan, 2013; Holden and Jacobsen, 2014; Harris, 2015; O’Hara et al., 2018). Therefore, we estimate λ_E and λ_D in Proposition 1 with two sets of commonly used proxies for absolute (i.e., dollar) informational 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 set measures 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 (2021), we compute $\$_PRICEIMPACT_ID_{i,t}^E$ and $\$_PRICEIMPACT_ID_{i,t}^D$ as the daily average of firm i ’s permanent intraday stock price change (in dollar cents) and bond price change (in cents per hundred dollars of par) per corresponding trade on day t . We additionally compute a set of equivalent measures of price impact of *net* order flow (buying minus selling) over a longer, daily horizon — hence also likely informational (e.g., Hasbrouck, 1991, 2007). Specifically, we define $\$_PRICEIMPACT_D_{i,t}^E$ and $\$_PRICEIMPACT_D_{i,t}^D$ as firm i ’s permanent dollar stock and bond price change (in cents) on day t per one percent of corresponding daily order imbalance (i.e., the difference between the number of buyer-initiated and seller-initiated trades divided by their sum; see, e.g., Jones et al., 1994; Chordia and Subrahmanyam, 2004; Pasquariello and Vega, 2015).

Analogous proxies for percentage price impact may not adequately capture the economic impact of security-level illiquidity on market participants — e.g., by implying its uniformity across trade sizes, a more plausible assumption for corporate bonds than for stocks. 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.²² Nonetheless, the analysis of such proportional measures (unreported for brevity) yields similarly supportive inference for our model’s predictions once considering its corresponding, albeit more complex, equilibrium variables – i.e., ex ante price-*scaled* inverse depths $\frac{\lambda_D}{E(D)}$ and $\frac{\lambda_E}{E(E)}$ (like in Back and Crotty, 2015).²³

Equally important to our empirical analysis is firm-level perceived probability of default, $\Phi(P_z)$ 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 volatility, 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.²⁴

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

²²More 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 tests of 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.

²³Back and Crotty (2015) argue that equilibrium scaled stock (corporate bond) price impact, both within and across markets, either decreases or increases (always decreases) in credit ratings in their model of generalized liquidity provision and strategic cross-trading (discussed in Section 1) depending on (irrespective of) whether speculators are assumed to be endowed with binary private information primarily about either the mean or the variance of firm asset value. They then report that estimates of the contemporaneous relationship between stock or corporate bond returns and both their signed volumes (normalized by shares or principal outstanding) are greater for investment-grade issuers than for speculative-grade issuers in their sample of 77 firms over 2002-2011 — which they interpret as *jointly* consistent with the former assumption and ensuing prediction.

²⁴Credit Default Swap (CDS) spreads are a popular alternative measure of a firm’s probability of default. However, these spreads are neither available for all firms in our sample nor an exogenous primitive to high-frequency stock and corporate bond price formation like $\Phi(P_z)$ in our model, but rather the endogenous outcome of trading activity in CDS contracts — i.e., potentially reflecting not only the same information frictions we propose as determinants of equity and debt market quality in this study but also CDS investors’ aggregate risk preferences as well as such CDS market-specific considerations as illiquidity and counterparty risk, among others (e.g., see Bharath and Shumway, 2008; Bao et al., 2011; Oehmke and Zawadowski, 2017; Boyarchenko et al., 2020, and references therein). Nonetheless, in unreported analysis, we find the in-sample correlation between (physical) $DEFPROB_{i,t}$ and corresponding CDS (par) spreads or their implied (risk-neutral) default probability (from Markit; see, e.g., Markit, 2023) to be high (0.58 and 0.51, respectively, consistent with Bharath and Shumway, 2008) such that replacing the former with either of the latter, when available (over less than 40% of our sample), yields broadly similar inference.

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 it since its inception in July 2002 (e.g., Bessembinder et al., 2009). 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; Bessembinder et al., 2018; 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 for the main variables of interest in our study 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, 2021) — although not directly comparable across asset classes and frequencies because of the aforementioned differing security characteristics, market structure, and measure construction. 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 price impact measures are also relatively more volatile than intraday ones. Median firm-day default probability is unsurprisingly low in our sample (e.g., a median of 0.0%, as in Bharath and Shumway, 2008, Table 1) since it would otherwise limit a firm’s access to borrowing in general, and to the corporate bond market in particular. The conventional filtering of TRACE data in the literature (used here and described in Section B.1 of the Appendix) also screens out smaller, less frequently traded securities, hence their corporate issuers.

Accordingly, more granular analysis (unreported for brevity) indicates that most bonds in our sample are large (a median issue size of \$800 million), investment-grade (e.g., a median Standard & Poor’s credit rating of *BBB*), with relatively high maturity (an average of 8.6 years), thinly traded (by an average monthly volume of \$102 million over two trades per day), and issued by relatively large firms (e.g., average total assets of \$20 billion) with high-volume stocks (\$159 million daily across more than 3.5 million shares traded) — again consistent with that literature

(see, e.g., among many others, Bao et al., 2011; Bao and Pan, 2014). However, $DEFPROB_{i,t}$ still 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 volatility exhibit similar properties, albeit to a lesser extent. Therefore, 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:

$$LAMBDA_{i,t}^g = \alpha + \alpha_j + \alpha_d + \alpha_n + \beta^g DEFPROB_{i,t} + \gamma' X_{i,t}^g + \varepsilon_{i,t}, \quad (26)$$

where $LAMBDA_{i,t}^g$ is one of the two measures of informational price impact for firm i ’s security g (D or E) on day t , α_j are (two-digit SIC-code) industry fixed effects (to absorb industry-specific heterogeneity; e.g., Chordia et al., 2000; Chava and Jarrow, 2004; Kargar et al., 2021), α_d are weekday fixed effects (for such calendar seasonality; e.g., Chordia et al., 2001; O’Hara and Zhou, 2021), 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 (to focus on either cross-time or cross-firm variability), and $X_{i,t}^g$ is a vector of controls most commonly associated with dispersion in (absolute and relative measures of) equity illiquidity (firm size: $MKTCAP_{i,t}$; stock price: $PRC_{i,t}^E$) or corporate debt illiquidity ($MKTCAP_{i,t}$; principal-weighted bond price: $PRC_{i,t}^D$) in the literature (e.g., Hasbrouck, 1991, 2009; Brown et al., 2008; Holden and Jacobsen, 2014; Benmelech and Bergman, 2018; O’Hara et al., 2018).²⁵ Details on variable construction are in Section B.2 of

²⁵Some specifications in the analysis that follows include both industry and firm fixed effects, since firm-level industry classifications occasionally change over time within the sample (making them less than perfectly

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 price impact. 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). In this and subsequent analysis, all independent variables (except returns) 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 of 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 ($\$_PRICEIMPACT_ID_{i,t}^E$) 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 ($\$_PRICEIMPACT_ID_{i,t}^D$) of 6.8 and 5.9 cents per trade, respectively (Panel B; versus a median of 38.5 cents).²⁶

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

$$\begin{aligned} EXRET_{i,t}^E &= \alpha + \alpha_j + \alpha_d + \alpha_n + \rho EXRET_{i,t}^D + \delta DEFPROB_{i,t} \\ &+ \chi EXRET_{i,t}^D \times DEFPROB_{i,t} + \gamma' X_{i,t}^{D,E} + \varepsilon_{i,t}, \end{aligned} \quad (27)$$

collinear); in unreported analysis, our inference is unaffected by excluding the former when including the latter.

²⁶Daily such estimates are analogous, albeit noisier for stocks (as well as samplewide; see Section 3.1 and Table 1). 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. Benmelech and Bergman (2018) show that declines in prices of corporate bonds are accompanied by an increase in various measures of their illiquidity, especially when their information sensitivity is high because of deteriorating credit conditions.

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 (beginning with firm size; e.g., Vuolteenaho, 2002; Dickerson et al., 2022).²⁷ Their summary statistics in Table 1 are consistent with the literature discussed in Section 3.1. In particular, daily excess-of-market returns are more volatile for stocks ($EXRET_{i,t}^E$, a standard deviation of 210 basis points [bps] in Panel A) than for corporate bonds ($EXRET_{i,t}^D$, 69 bps in Panel B), in line with the relative variance of their payoffs and prices for low samplewide default probability ($DEFPROB_{i,t}$, in Panel C; e.g., see Figures 1c and 3c).

Estimates of various specifications of Eq. (27) are presented in Panel A of Table 3.²⁸ Hypothesis 2 implies that the coefficient ρ , while positive, should be first increasing and then decreasing in $DEFPROB_{i,t}$. However, as just noted, firm-level default probability is generally low, while 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 $DEFPROB_{i,t}$ ($\chi \approx 0.06$, or by 6 bps of return comovement for one standard deviation of default probability). Therefore, we elicit that potential nonmonotonicity by estimating Eq. (27) within terciles ($T_m(\cdot)$) of $DEFPROB_{i,t}$ and when $DEFPROB_{i,t}$ is large (i.e., close to one), after removing its explicit terms. 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 nontrivial (in its terciles 2 and 3: T_2 and T_3) and both stocks and bonds are information-sensitive.²⁹ Lastly,

²⁷It is trivial to show that the correlations of bond and stock prices, price changes, and returns are identical in the equilibrium of Proposition 1, hence so are their properties — which, as discussed in Section 2.3, are in turn identical to those in Corollary 2 for bond and stock price covariance.

²⁸In unreported analysis, we find our ensuing inference to be unaffected by replacing $EXRET_{i,t}^E$ and $EXRET_{i,t}^D$ in Eq. (27) with their corresponding raw returns ($RET_{i,t}^E$ and $RET_{i,t}^D$, respectively) or with each other.

²⁹Relatedly, Dickerson et al. (2022) find that the comovement between monthly stock and corporate bond returns can be predicted by such measures of firm-level default risk as leverage, distance-to-default, and credit spreads, both in the cross-section and in the time series; see also Schaefer and Strebulaev (2008) for a detailed empirical investigation of the predictions of structural models of credit risk based on Merton (1974) for the sensitivities of a firm's corporate bond returns to both its equity and riskless bond returns at the monthly

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-day observations displaying high $DEFPROB_{i,t}$, i.e., when $> 99\%$ in $\overline{T}$), such that only bonds are information-sensitive.³⁰

Altogether, 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 nontrivial 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 (and related funding, risk aversion, or search) 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 (and costs of) holding a firm’s bonds may increase with its default probability, as their payoffs become increasingly dependent upon that firm’s uncertain fundamentals (impeding collateralized financing, or if credit conditions otherwise deteriorate; see, e.g., Rossi, 2014; Chen et al., 2018; Rapp, 2019; Goldberg and Nozawa, 2021), thus hindering liquidity provision in its debt securities (like in Panel B of frequency.

³⁰In unreported analysis, employing equally material percentile-based thresholds for $\overline{T}(\cdot)$ does not qualitatively affect our evidence; alternatively, augmenting Eq. (27) to include both direct and interaction quadratic terms for $DEFPROB_{i,t}$ also yields similar inference (i.e., negative and statistically significant coefficient estimates on the latter, while both $\rho > 0$ and $\chi > 0$ as in Panel A of Table 3), despite their ensuing high correlation with extant regressors and the aforementioned scarcity of firm-day observations with high default probability in our sample.

Table 2). However, dealers’ inventory risk from (and costs of) holding that firm’s stocks may also increase, since the (pledgeable) value of its equity securities (while less volatile) correspondingly declines (or if financial constraints are firm-wide), potentially leading to worsening stock market depth (unlike in Panel A of Table 2).³¹ 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) exclusively focus on measures of permanent (i.e., likely informational) price impact as well as explicitly control for firm characteristics also commonly associated with inventory bearing capacity (such as price, industry, or weekday; see, e.g., Hendershott and Seasholes, 2007 and references therein).³²

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 sets of controls $X_{i,t}^g$ and $X_{i,t}^{D,E}$ 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;

³¹More generally, the possible role played by dealership and/or speculative risk aversion for market quality under those circumstances is even more complex and ambiguous, especially in the presence of asymmetric information (for instance clouding the effects of payoff uncertainty on adverse selection risk); see, e.g., the analysis and discussion in Subrahmanyam (1991b), Chordia and Subrahmanyam (2004), and Liu and Wang (2016), among others.

³²Those considerations may be especially relevant for speculative-grade bonds, i.e., high-yield and high-risk securities, ultimately leading to worse liquidity conditions (see, e.g., Harris, 2015; Bessembinder et al., 2018). As noted in Section 3.1, our sample is customarily made predominantly of investment-grade bonds (e.g., comprising 60% of firm-days). In unreported analysis, we nonetheless find the baseline evidence in Section 3.2 to be consistent across both subsamples of firm-days made of either investment-grade or speculative-grade bonds.

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) and/or interest rate risk (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 χ , in columns (V) to (VII) of Table 4, Panel A of Table 5, and Figure 5d, are often similar to (and sometimes absolutely larger 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 $\$_{PRICEIMPACT_ID_{i,t}^g}$) 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 daily stock-bond return comovement (ρ and χ) in Panel A of Table 5 and Figure 5d also remains increasing in nontrivial $DEFPROB_{i,t}$ 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) model 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 informational 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 $\$_{PRICEIMPACT_D_{i,t}^E}$ (bond price impact $\$_{PRICEIMPACT_D_{i,t}^D}$) 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 $\$_{PRICEIMPACT_D_{i,t}^E}$ and $\$_{PRICEIMPACT_D_{i,t}^D}$ in columns (I) to (IV) of Table 7 (with an average of 1.26 cents and 0.04 cents) are higher in correspondence with a one standard deviation increase in firm-level fundamental volatility (13%), since in those circumstances adverse selection increases for both stocks and bonds (Figure 4a), 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 (when $> 90\%$ in $\bar{T}$; albeit with a total upward slope χ of 14 bps per standard deviation change in Panel B of Table 3, akin to $DEFPROB_{i,t}$ in Section 3.2) as debt becomes more

information-sensitive than equity (Figure 3d). Those estimates are instead only increasing in firm-level fundamental volatility in Figure 5c (and Panel C of Table 3, by 40% of its baseline estimated ρ per standard deviation change) as both securities become more information-sensitive (Figure 4d), consistent with Hypothesis 2.³³

Overall, the above discussion and additional analysis suggest that high-frequency, firm-level permanent stock and bond market depth are 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 through their trading activity.

We first develop a tractable model of trading in stock and corporate bond 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 specialized competitive dealership is assumed to clear each separately via regression inference. We show that the relative intensity of speculation in either asset depends on the firm’s perceived probability of default, in that its accrual makes informed trading in corporate debt relatively more valuable than in equity. In equilibrium, this effect worsens adverse selection risk and market depth in bonds and improves them in stocks. 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

³³Figures 5c and 5f do not include the tail grouping $\overline{T}(FIRMVOL_{i,t})$ as there is no conceptually “high” level for volatility of firm value (unlike realizations close to one for $DEFPROB_{i,t}$ and $LEVERAGE_{i,t}$; their robustness thresholds for $\overline{T}$ are lower, 96% and 85% in Figures 5d and 5e, respectively, due to smaller samples in specifications V to VII). Adding $\overline{T}$ for in-sample high $FIRMVOL_{i,t}$ yields similar inference.

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).

We then find supportive evidence for our model within the most comprehensive feasible sample of intraday stock and corporate bond trades and prices between 2010 and 2019. In particular, we show that various measures of firm-level, permanent intraday and daily (i.e., likely information-driven) price impact in either security and their daily (excess-of-market) return comovement are nontrivially 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, specialization between bond and equity dealers in Section 2.2, and Conditions 1 and 2 imply that $x_D(v) = \arg \max E[x_D(D - p_D)|v] = \arg \max x_D \{D - E[E(D|\omega_D)|v]\}$ and $x_E(v) = \arg \max E[x_E(E - p_E)|v] = \arg \max x_E \{E - E[E(E|\omega_E)|v]\}$, 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 ensues that:

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

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

By similar substitutions 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 can then be expressed as:

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

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

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), $p_D = E(D|\omega_D)$ and $p_E = E(E|\omega_E)$. Eqs. (1) and (2) and the law of total expectation imply that:

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

$$E(E|\omega_E) = [E(C|\omega_E) - P] \Pr\{v > P|\omega_E\}, \quad (\text{A-10})$$

where $E(R|\omega_D) \equiv E(v|v \leq P, \omega_D)$ and $E(C|\omega_E) \equiv E(v|v > P, \omega_E)$. 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 equity dealers' inference to stem from linear regressions of asset payoffs on the corresponding aggregate order flow, as in Pasquariello (2014b, 2024). Specifically, the aforementioned conjectures lead to:

$$E(\omega_D) = B_{0,D} + B_{1,D}E(D), \quad (\text{A-11})$$

$$E(\omega_E) = B_{0,E} + B_{1,E}E(E), \quad (\text{A-12})$$

$$\text{var}(\omega_D) = B_{1,D}^2 \text{var}(D) + \sigma_u^2, \quad (\text{A-13})$$

$$\text{var}(\omega_E) = B_{1,E}^2 \text{var}(E) + \sigma_u^2, \quad (\text{A-14})$$

$$\text{cov}(D, \omega_D) = B_{1,D} \text{var}(D), \quad (\text{A-15})$$

$$\text{cov}(E, \omega_E) = B_{1,E} \text{var}(E). \quad (\text{A-16})$$

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

$$E(D|\omega_D) \approx E(D) + \frac{B_{1,D} \text{var}(D)}{B_{1,D}^2 \text{var}(D) + \sigma_u^2} [\omega_D - B_{0,D} - B_{1,D}E(D)], \quad (\text{A-17})$$

$$E(E|\omega_E) \approx E(E) + \frac{B_{1,E} \text{var}(E)}{B_{1,E}^2 \text{var}(E) + \sigma_u^2} [\omega_E - B_{0,E} - B_{1,E}E(E)]. \quad (\text{A-18})$$

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

$$A_{0,D} = E(D) - A_{1,D}B_{0,D} - A_{1,D}B_{1,D}E(D), \quad (\text{A-19})$$

$$A_{1,D} = \frac{B_{1,D} \text{var}(D)}{B_{1,D}^2 \text{var}(D) + \sigma_u^2}, \quad (\text{A-20})$$

$$A_{0,E} = E(E) - A_{1,E}B_{0,E} - A_{1,E}B_{1,E}E(E) \quad (\text{A-21})$$

$$A_{1,E} = \frac{B_{1,E} \text{var}(E)}{B_{1,E}^2 \text{var}(E) + \sigma_u^2}. \quad (\text{A-22})$$

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 $A_{0,D} = E(D)$ and $A_{0,E} = E(E)$. 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:

$$B_{1,D}^2 \text{var}(D) + \sigma_u^2 = 2B_{1,D}^2 \text{var}(D), \quad (\text{A-23})$$

$$B_{1,E}^2 \text{var}(E) + \sigma_u^2 = 2B_{1,E}^2 \text{var}(E). \quad (\text{A-24})$$

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 $A_{0,D} = E(D)$ and $A_{0,E} = E(E)$ into Eqs. (A-19) and (A-21), and rewriting the resulting expressions with respect to $B_{0,D}$ and $B_{0,E}$ we obtain $B_{0,D} = -B_{1,D}E(D) = -\frac{\sigma_u}{\sqrt{\text{var}(D)}}E(D)$ and $B_{0,E} = -B_{1,E}E(E) = -\frac{\sigma_u}{\sqrt{\text{var}(E)}}E(E)$. 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 $\Phi = 1$) or a.s. solvent ($\Phi(P_z) = 0$) at liquidation (such that a.s. $D = P$ and $E = v - P$; labeled $\Phi = 0$). 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. Further details are available from the authors on request.

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 sat-

isfying 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 for corporate bonds, as well as an indicator of whether each trade were customer-initiated 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. Bond-specific characteristics — such as bond type, credit rating, issue and maturity date, offering amount, amount outstanding, and 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 in the literature; for instance, among others, we exclude bonds that are convertible, variable-rate, issued under U.S. SEC Rule 144A, junior (subordinated) debentures, or with a maturity of less than one year; we discard bond trades with principal volume below \$10,000 (i.e., for less than ten units, as the minimum trade size is one unit of a \$1,000 par bond); as well as we eliminate bond prices implying a proximate reversal of more than 50%; see, e.g., Dick-Nielsen (2014), Rossi (2014), Schestag et al. (2016), Bai et al. (2019), Dick-Nielsen and Rossi (2019), Sandulescu (2020). In addition, since our study focuses on high-frequency measures of price impact, we restrict our analysis to bonds that trade at least ten days within a given month (e.g., Bao et al., 2011).

Equity data for the issuing firms containing price, shares outstanding, trading volume, 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.

B.2 Variable Definition

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

$$\$_{\lambda_{k,i,t}}^{\text{E}} = 2 \times 100 \times D_{k,i,t} \times (M_{k+5,i,t} - M_{k,i,t}), \quad (\text{B-1})$$

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.

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

$$\$_{\lambda_{k,i,t}}^{\text{D}} = 2 \times 100 \times (\text{Price}_{k,i,t} - \text{Benchmark}_{k-1,i,t}) \times D_{k,i,t}, \quad (\text{B-2})$$

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 Holden and Jacobsen (2014) and O'Hara and Zhou (2021). Bond transaction data are from TRACE Enhanced. When a firm has multiple bonds trading on day t , we aggregate their intraday dollar price impact estimates at the firm level by weighted-averaging these individual daily averages by their corresponding bond principal outstanding, from Mergent FISD, as common in the literature (e.g., Bao et al., 2011; Dick-Nielsen et al., 2012).

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

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

$$\$_PRICEIMPACT_D_{i,t}^E = 2 \times 100 \times (PRC_{i,t}^E - PRC_{i,t-1}^E) / (OIB_{i,t}^E \times 100), \quad (\text{B-3})$$

where $OIB_t^E = (B_t^E - S_t^E) / (B_t^E + S_t^E)$, B_t^E = number of stock buys on day t , and S_t^E = number of stock sales on day t , from DTAQ.

$\$_PRICEIMPACT_D_{i,t}^D$: Firm i 's permanent 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,

$$\$_PRICEIMPACT_D_{i,t}^D = 2 \times 100 \times (P_{i,t}^D - P_{i,t-1}^D) / (OIB_{i,t}^D \times 100), \quad (\text{B-4})$$

where P_t^D is that bond's last transaction price on day t , $OIB_t^D = (B_t^D - S_t^D) / (B_t^D + S_t^D)$, B_t^D = number of bond buys on day t , and S_t^D = 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 weighted-averaging these individual estimates by their corresponding bond principal outstanding, from Mergent FISD.

$MKTCAP_{i,t}$: Market capitalization of firm i on day t , computed as the product of its closing stock price $PRC_{i,t}^E$ and its corresponding number of shares outstanding, from CRSP, then winsorized at the 1% and 99% levels as in Bharath and Shumway (2008).

$DEBT_{i,t}$: 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, then winsorized at the 1% and 99% levels.

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

$ERET_{i,t}$: 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 rolling stock return over the previous year from its corresponding closing stock prices $PRC_{i,t}^E$, then winsorized at the 1% and 99% levels.

STOCKVOL_{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 $PRC_{i,t}^E$.

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

$$FIRMVOL_{i,t} = (1 - LEVERAGE_{i,t}) \times STOCKVOL_{i,t} + LEVERAGE_{i,t} \times (0.05 + 0.25 \times STOCKVOL_{i,t}), \quad (B-5)$$

then winsorized at the 1% and 99% levels.

DEFPROB_{i,t} = $\Phi(-NAÏVE_DD_{i,t})$: 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)),

$$NAÏVE_DD_{i,t} = \frac{\ln(1/LEVERAGE_{i,t}) + (ERET_{i,t} - 0.5 \times FIRMVOL_{i,t}^2) \times T}{FIRMVOL_{i,t} \times \sqrt{T}}, \quad (B-6)$$

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

RET_{i,t}^E : Daily stock return of firm i on day t , from CRSP.

MKTRET_t^E : Daily stock market return on day t , computed as the value-weighted average of all daily stock returns in our sample on that day, $RET_{i,t}^E$.

EXRET_{i,t}^E = $RET_{i,t}^E - MKTRET_t^E$: Daily stock return of firm i on day t , in excess of its market.

PRC_{i,t}^D : 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 daily prices at the firm level by weighted-averaging these individual prices by their corresponding bond principal outstanding, from Mergent FISD.

RET_{i,t}^D = $(PRC_{i,t}^D / PRC_{i,t-1}^D) - 1$: Daily corporate bond return of firm i on day t (e.g., as in Bessembinder et al., 2009; Back and Crotty, 2015). For firms having multiple bonds outstanding on day t , we aggregate their daily returns at the firm level by weighted-averaging these individual returns by their corresponding bond principal outstanding, from Mergent FISD.

MKTRET_t^D : Daily corporate bond market return on day t , computed by weighted-averaging all daily bond returns in our sample on that day, $RET_{i,t}^D$, by their corresponding bond principal outstanding, from Mergent FISD.

EXRET_{i,t}^D = $RET_{i,t}^D - MKTRET_t^D$: Daily corporate bond return of firm i on day t , in excess of its market.

STKSYNC_{i,t} : Stock return synchronicity for firm i on day t , computed at the monthly frequency following Morck et al. (2000) as $\ln[R^2/(1 - R^2)]$, where R^2 is the coefficient of determination from regressing daily stock returns in excess of the risk-free rate from WRDS Factors, $RET_{i,t}^E - RF_t$, on the value-weighted stock market return within a month from CRSP, $VWRET D_t$, when at least 15 daily observations are available in that month.

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 Cvitanic et al. (2006) as the standard deviation of analysts' trade recommendation scores: 1 (Strong Buy), 2 (Buy), 3 (Hold), 4 (Underperform), and 5 (Sell).

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

$$TANGIBILITY_{i,t} = (0.715 \times RECTQ_{i,t} + 0.547 \times INVTQ_{i,t} + 0.535 \times CSTKQ_{i,t} + CHEQ_{i,t}) / ATQ_{i,t}, \quad (B-7)$$

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

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

$$FINCONST_{i,t} = -0.091 \times CFA_{i,t} - 0.062 \times DIVPOS_{i,t} + 0.021 \times TLTD_{i,t} - 0.044 \times LNTA_{i,t} + 0.102 \times ISG - 0.035 \times SG, \quad (B-8)$$

where CFA is the ratio between a firm's cash flows and its ATQ , $DIVPOS$ 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 ATQ , $LNTA = \ln(ATQ)$, ISG is the average sales growth rate within that firm's three-digit SIC industry, and SG is that firm's sales growth rate.

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.

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 weighted-averaging these durations by their corresponding bond principal outstanding, also from Mergent FISD.

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 the main variables of interest in our analysis, as defined in Section B.2 of the Appendix: Dollar (in cents, i.e., multiplied by 100), permanent intraday ($\$_{\text{PRICEIMPACT_ID}}^g$, per trade) or daily ($\$_{\text{PRICEIMPACT_D}}^g$, per one percent order imbalance) price impact and daily return in excess of the corresponding market (EXRET^g , in basis points [bps], i.e., multiplied by 10,000) 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 ; all in percentage; 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				
$\$_{\text{PRICEIMPACT_ID}}^E$ (\$ cents)	2.15	1.30	2.57	1,260,772
$\$_{\text{PRICEIMPACT_D}}^E$ (\$ cents)	7.86	2.94	146.6	1,260,190
EXRET^E (bps)	-1.82	-3.50	210.3	1,260,785
Panel B: Corporate Bonds				
$\$_{\text{PRICEIMPACT_ID}}^D$ (\$ cents)	62.8	38.5	84.8	373,665
$\$_{\text{PRICEIMPACT_D}}^D$ (\$ cents)	0.50	0.06	9.86	373,643
EXRET^D (bps)	0.13	-0.10	68.6	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 of the relationship between each measure of dollar (in cents, i.e., multiplied by 100), permanent intraday ($\$_{\text{PRICEIMPACT_ID}}^g$, per trade) or daily ($\$_{\text{PRICEIMPACT_D}}^g$, per one percent order imbalance) price impact for stocks ($g = E$; Panel A) or corporate bonds ($g = D$; Panel B) and firm-level default probability (DEFPROB), from various specifications of the firm-day panel regressions of Eq. (26). Specification I includes no additional covariates; specification II adds (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, as well as baseline controls in $X_{i,t}^g$ (firm size: MKTCAP; either stock price: PRC^E , or 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_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.

	\$ _PRICEIMPACT _ID				\$ _PRICEIMPACT _D			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
DEFPROB	-0.242*** [0.026]	-0.155*** [0.035]	-0.146*** [0.020]	-0.163*** [0.036]	-1.48*** [0.159]	-0.395 [0.249]	-0.469*** [0.137]	-0.154 [0.272]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Weekday FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	No	Yes	No	No	No	Yes	No
Time FE	No	No	No	Yes	No	No	No	Yes
R ² _a	0.88%	37.17%	67.25%	37.81%	0.01%	0.67%	0.89%	0.71%
N	1,260,772	1,260,770	1,260,770	1,260,770	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	10.1*** [1.81]	7.65*** [1.41]	6.82*** [1.45]	5.93*** [1.14]	0.128*** [0.027]	0.100*** [0.025]	0.113*** [0.029]	0.085*** [0.025]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Weekday FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	No	Yes	No	No	No	Yes	No
Time FE	No	No	No	Yes	No	No	No	Yes
R ² _a	1.60%	5.03%	12.08%	9.02%	0.02%	0.04%	0.07%	0.07%
N	365,383	365,383	365,383	365,383	365,361	365,361	365,361	365,361

Table 3. Stock and Bond Return Comovement: Baseline Analysis

This table reports estimates of the relationship between firm-level daily excess-of-market stock returns ($EXRET^E$) and both the corresponding excess-of-market 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 adds (mutable two-digit SIC-code) industry fixed effects (FEs), weekday 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 independent variables (except returns) 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*** [0.046]	0.416*** [0.046]	0.413*** [0.046]	0.325*** [0.046]	0.363*** [0.041]	0.363*** [0.041]	0.361*** [0.041]	0.363*** [0.040]	0.435*** [0.040]	0.434*** [0.040]	0.431*** [0.040]	0.433*** [0.040]
CH	-0.0004*** [0.000]	-0.0004*** [0.000]	-0.0006*** [0.000]	-0.0005*** [0.000]	-0.0003*** [0.000]	-0.0003*** [0.000]	-0.0011*** [0.000]	-0.0003*** [0.000]	0.0002*** [0.000]	0.0005*** [0.000]	0.0007*** [0.000]	0.0005*** [0.000]
$CH \times EXRET^D$	0.064*** [0.013]	0.064*** [0.013]	0.064*** [0.013]	0.064*** [0.013]	0.141*** [0.026]	0.140*** [0.026]	0.139*** [0.026]	0.140*** [0.026]	0.174*** [0.031]	0.174*** [0.030]	0.173*** [0.031]	0.173*** [0.031]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Weekday FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No
Time FE	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
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 of the relationship between each measure of dollar (in cents, i.e., multiplied by 100), permanent intraday ($\$_{\text{PRICEIMPACT_ID}}^{\text{E}}$, per trade) or daily ($\$_{\text{PRICEIMPACT_D}}^{\text{E}}$, per one percent order imbalance) price impact for stocks ($g = \text{E}$; Panel A) or corporate bonds ($g = \text{D}$; Panel B) and firm-level default probability (DEFPROB), from various amended specifications of the firm-day panel regressions of Eq. (26). Specification V includes (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP; either stock price: PRC^{E} , or principal-weighted bond price: PRC^{D}) and additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or principal-weighted bond duration: DURATION; governance: EINDEX) in $X_{i,t}^g$; 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_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.

	\$_PRICEIMPACT_ID			\$_PRICEIMPACT_D		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
DEFPROB	-0.227*** [0.046]	-0.142*** [0.028]	-0.246*** [0.046]	0.041 [0.338]	-0.182 [0.260]	0.275 [0.368]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Controls+	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	No
Time FE	No	No	Yes	No	No	Yes
R ² _a	40.40%	66.83%	41.19%	0.78%	1.01%	0.81%
N	860,411	860,411	860,411	860,424	860,424	860,424
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
DEFPROB	10.7*** [1.78]	9.47*** [1.88]	8.90*** [1.45]	0.095*** [0.035]	0.096*** [0.036]	0.085*** [0.034]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Controls+	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	No
Time FE	No	No	Yes	No	No	Yes
R ² _a	15.08%	19.19%	18.40%	0.08%	0.05%	0.07%
N	287,459	287,459	287,459	287,444	287,444	287,444

Table 5. Stock and Bond Return Comovement: Robustness Analysis

This table reports estimates of the relationship between firm-level daily excess-of-market stock returns ($EXRET^E$) and both the corresponding excess-of-market corporate bond returns ($EXRET^D$) 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 (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP) and additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; market-to-book: MTB; principal-weighted bond duration: DURATION; governance: EINDEX) in $X_{i,t}^{D,E}$; specification VI adds firm FEs to specification V; specification VII adds time (quarterly) FEs to specification V. All independent variables (except returns) 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		
	V	VI	VII	V	VI	VII	V	VI	VII
$EXRET^D$	0.339*** [0.042]	0.338*** [0.042]	0.339*** [0.042]	0.312*** [0.036]	0.311*** [0.036]	0.313*** [0.036]	0.434*** [0.040]	0.431*** [0.040]	0.433*** [0.040]
CH	-0.0005*** [0.000]	-0.0006*** [0.000]	-0.0006*** [0.000]	-0.0006*** [0.000]	-0.0012*** [0.000]	-0.0006*** [0.000]	0.0005*** [0.000]	0.0007*** [0.000]	0.0005*** [0.000]
$CH \times EXRET^D$	0.064*** [0.013]	0.088*** [0.016]	0.088*** [0.016]	0.175*** [0.030]	0.174*** [0.030]	0.174*** [0.030]	0.174*** [0.030]	0.173*** [0.031]	0.173*** [0.031]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls+	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	No	No	Yes	No
Time FE	No	No	Yes	No	No	Yes	No	No	Yes
R_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 of the relationship between each measure of dollar (in cents, i.e., multiplied by 100), permanent intraday ($\$_{\text{PRICEIMPACT_ID}}$, per trade) or daily ($\$_{\text{PRICEIMPACT_D}}$, per one percent order imbalance) price impact for stocks ($g = E$; Panel A) or corporate bonds ($g = D$; Panel B) and firm-level leverage ratio (LEVERAGE), from various specifications of the firm-day panel regressions of Eq. (26). Specification I includes no additional covariates; specification II adds (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, as well as baseline controls in $X_{i,t}^g$ (firm size: MKTCAP; either stock price: PRC^E , or 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_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.

	\$ _ PRICEIMPACT _ ID				\$ _ PRICEIMPACT _ D			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
LEVERAGE	-0.384*** [0.069]	-0.224*** [0.086]	-0.387*** [0.055]	-0.224*** [0.089]	-3.35*** [0.529]	-0.540 [0.484]	-1.16*** [0.327]	-0.178 [0.513]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Weekday FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	No	Yes	No	No	No	Yes	No
Time FE	No	No	No	Yes	No	No	No	Yes
R _a ²	2.23%	37.41%	67.60%	38.01%	0.05%	0.67%	0.89%	0.72%
N	1,260,772	1,260,770	1,260,770	1,260,770	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	10.3*** [1.85]	6.04*** [1.51]	7.13*** [2.70]	4.83*** [1.38]	0.115*** [0.026]	0.108*** [0.025]	0.201*** [0.060]	0.103*** [0.025]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Weekday FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	No	Yes	No	No	No	Yes	No
Time FE	No	No	No	Yes	No	No	No	Yes
R _a ²	1.49%	4.71%	11.83%	8.84%	0.01%	0.04%	0.07%	0.07%
N	365,383	365,383	365,383	365,383	365,361	365,361	365,361	365,361

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

This table reports estimates of the relationship between each measure of dollar (in cents, i.e., multiplied by 100), permanent intraday ($\$_{\text{PRICEIMPACT_ID}}$, per trade) or daily ($\$_{\text{PRICEIMPACT_D}}$, per one percent order imbalance) price impact for stocks ($g = E$; Panel A) or corporate bonds ($g = D$; Panel B) and firm-level fundamental volatility (FIRMVOL), from various specifications of the firm-day panel regressions of Eq. (26). Specification I includes no additional covariates; specification II adds (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, as well as baseline controls in $X_{i,t}^g$ (firm size: MKTCAP; either stock price: PRC^E , or 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_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.

	\$ _PRICEIMPACT_ID				\$ _PRICEIMPACT_D			
	Panel A: Stocks							
	I	II	III	IV	I	II	III	IV
FIRMVOL	-0.096*	0.020	-0.066*	0.072	0.336	1.95***	0.971***	1.80***
	[0.056]	[0.049]	[0.039]	[0.050]	[0.493]	[0.464]	[0.274]	[0.468]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Weekday FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	No	Yes	No	No	No	Yes	No
Time FE	No	No	No	Yes	No	No	No	Yes
R _a ²	0.14%	36.85%	67.07%	37.51%	0.00%	0.68%	0.89%	0.72%
N	1,260,772	1,260,770	1,260,770	1,260,770	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	9.54***	7.20***	5.75***	4.45***	0.092***	0.038	0.016	0.027
	[1.76]	[1.33]	[1.35]	[1.09]	[0.022]	[0.023]	[0.028]	[0.025]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Weekday FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	No	Yes	No	No	No	Yes	No
Time FE	No	No	No	Yes	No	No	No	Yes
R _a ²	1.13%	4.86%	11.91%	8.82%	0.01%	0.04%	0.07%	0.06%
N	365,383	365,383	365,383	365,383	365,361	365,361	365,361	365,361

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

This table reports estimates of the relationship between each measure of dollar (in cents, i.e., multiplied by 100), permanent intraday ($\$_{\text{PRICEIMPACT_ID}}$, per trade) or daily ($\$_{\text{PRICEIMPACT_D}}$, per one percent order imbalance) price impact for stocks ($g = E$; Panel A) or corporate bonds ($g = D$; Panel B) and firm-level leverage ratio (LEVERAGE), from various amended specifications of the firm-day panel regressions of Eq. (26). Specification V includes (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP; either stock price: PRC^E , or principal-weighted bond price: PRC^D) and additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or principal-weighted bond duration: DURATION; governance: EINDEX) in $X_{i,t}^g$; 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_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.

	\$_PRICEIMPACT_ID			\$_PRICEIMPACT_D		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
LEVERAGE	-0.343*** [0.110]	-0.473*** [0.084]	-0.356*** [0.113]	0.443 [0.634]	-1.18** [0.575]	0.797 [0.663]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Controls+	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	No
Time FE	No	No	Yes	No	No	Yes
R ² _a	40.84%	67.23%	41.63%	0.78%	1.01%	0.81%
N	860,411	860,411	860,411	860,424	860,424	860,424
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
LEVERAGE	8.53*** [1.57]	11.9*** [2.80]	7.31*** [1.32]	0.134*** [0.036]	0.221*** [0.079]	0.135*** [0.036]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Controls+	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	No
Time FE	No	No	Yes	No	No	Yes
R ² _a	14.60%	18.95%	18.11%	0.05%	0.07%	0.08%
N	287,459	287,459	287,459	287,444	287,444	287,444

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

This table reports estimates of the relationship between each measure of dollar (in cents, i.e., multiplied by 100), permanent intraday ($\$_{\text{PRICEIMPACT_ID}}$, per trade) or daily ($\$_{\text{PRICEIMPACT_D}}$, per one percent order imbalance) price impact for stocks ($g = E$; Panel A) or corporate bonds ($g = D$; Panel B) and firm-level fundamental volatility (FIRMVOL), from various amended specifications of the firm-day panel regressions of Eq. (26). Specification V includes (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, as well as both baseline controls (firm size; MKTCAP; either stock price: PRC^E , or principal-weighted bond price: PRC^D) and additional (+) controls (price synchronicity: STKSYNC; dispersion of analyst recommendations: DISPERSION, tangibility: TANGIBILITY; financial constraints: FINCON; either market-to-book: MTB, or principal-weighted bond duration: DURATION; governance: EINDEX) in $X_{i,t}^g$; 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_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.

	\$_PRICEIMPACT_ID			\$_PRICEIMPACT_D		
	Panel A: Stocks					
	V	VI	VII	V	VI	VII
FIRMVOL	-0.143** [0.067]	-0.112** [0.047]	-0.105 [0.069]	2.03*** [0.525]	0.893* [0.463]	2.09*** [0.518]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Controls+	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	No
Time FE	No	No	Yes	No	No	Yes
R ² _a	40.23%	66.80%	40.90%	0.79%	1.01%	0.82%
N	860,411	860,411	860,411	860,424	860,424	860,424
	Panel B: Corporate Bonds					
	V	VI	VII	V	VI	VII
FIRMVOL	5.61*** [1.50]	5.71*** [1.42]	2.95** [1.17]	0.022 [0.025]	-0.014 [0.027]	0.016 [0.028]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Controls+	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	No
Time FE	No	No	Yes	No	No	Yes
R ² _a	14.41%	18.89%	17.86%	0.05%	0.06%	0.07%
N	287,459	287,459	287,459	287,444	287,444	287,444

Figure 1. Bond and Equity Payoffs: Unconditional Moments versus Debt 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 — $E(D)$ and $E(E)$ 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 — $cov(D, E)$ of Eq. (7) in Figure 1d (dotted line) — as a function of the bond's principal P when mean firm value $v_0 = 100$ (Figure 1b, solid gray line) and fundamental uncertainty $\sigma_v^2 = 100$ (Figure 1c, solid gray line).

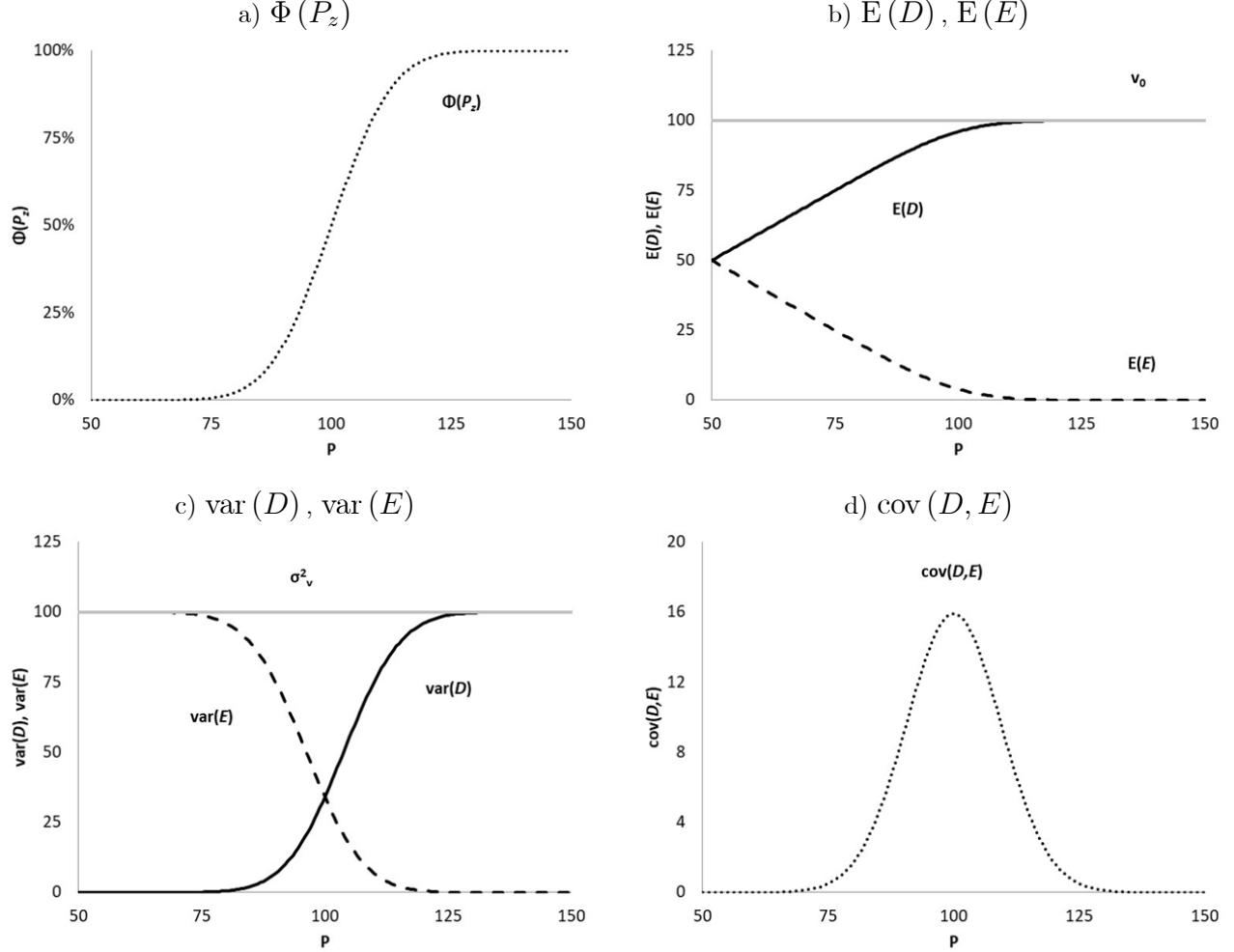


Figure 2. Bond and Equity Payoffs: Unconditional Moments versus Fundamental Uncertainty

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 — $E(D)$ and $E(E)$ of Eqs. (3) and (4) in Figure 2b; $\text{var}(D)$ and $\text{var}(E)$ of Eqs. (5) and (6) in Figure 2c — as well as their covariance — $\text{cov}(D, E)$ of Eq. (7) in Figure 2d (dotted line) — as a function of the firm's fundamental uncertainty σ_v^2 when mean firm value $v_0 = 100$ (Figure 2b, solid gray line) and either its debt principal $P = 110$ or $P = 90$.

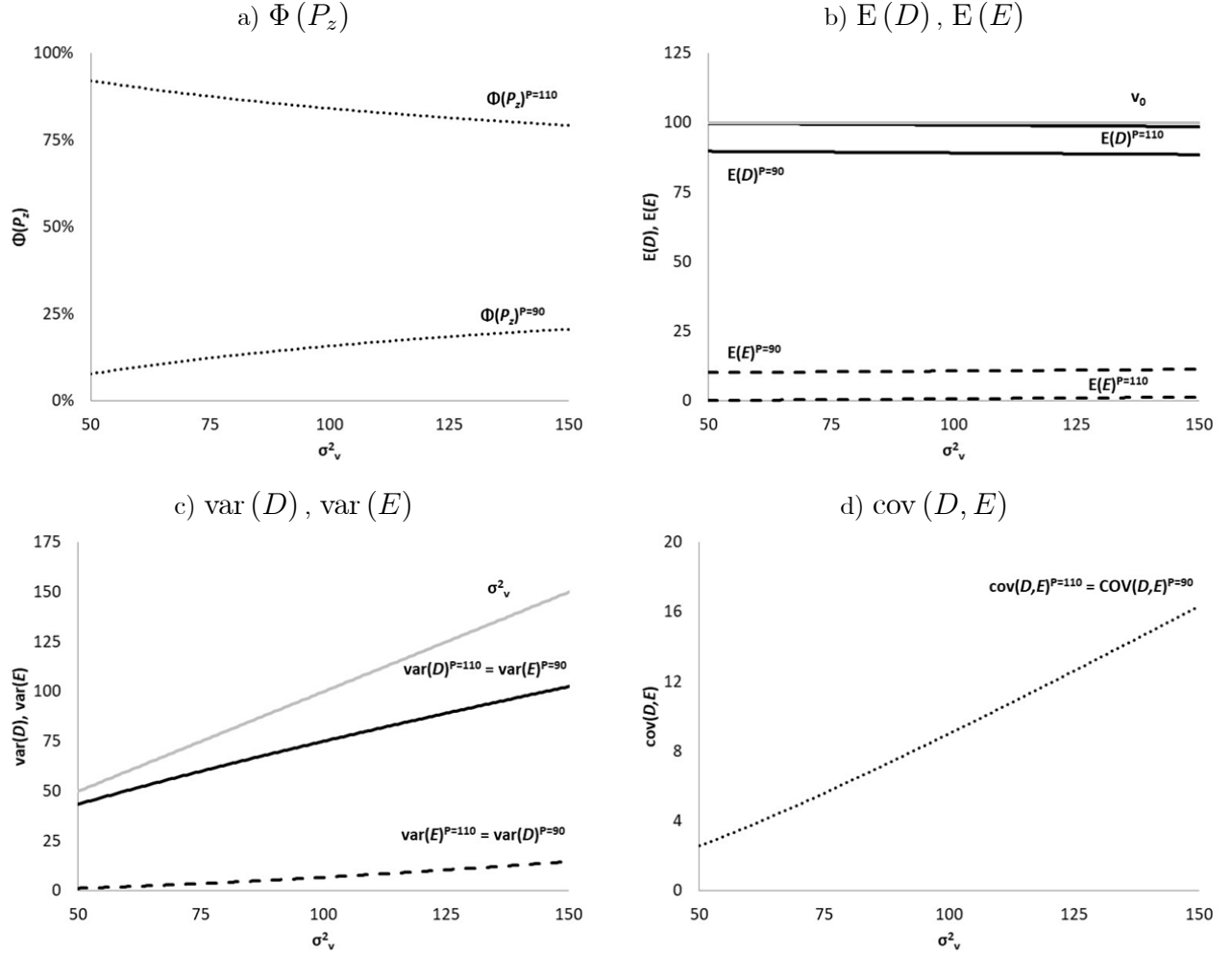


Figure 3. Bond and Equity Equilibrium versus Debt Principal

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 $\text{var}(p_D^{\Phi=1}) = \text{var}(p_E^{\Phi=0}) = \frac{\sigma_v^2}{2}$ in Figure 3c (while $\text{var}(p_D^{\Phi=0}) = \text{var}(p_E^{\Phi=1}) = 0$); 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 $\text{cov}(p_D^{\Phi=0}, p_E^{\Phi=0}) = \text{cov}(p_D^{\Phi=1}, p_E^{\Phi=1}) = 0$) — as a function of the bond's principal P when mean firm value $v_0 = 100$, fundamental uncertainty $\sigma_v^2 = 100$, and noise trading intensity $\sigma_u^2 = 100$.

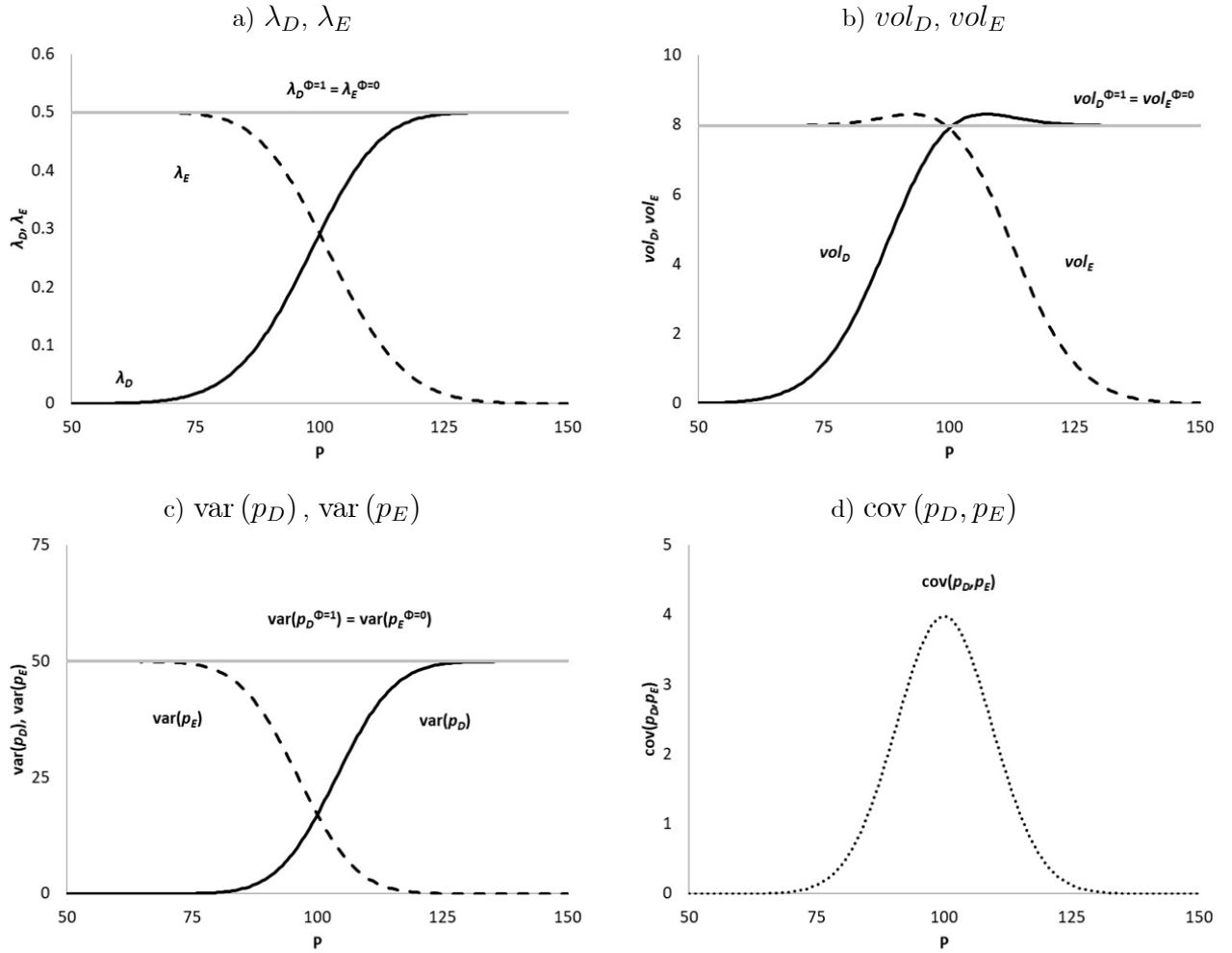


Figure 4. Bond and Equity Equilibrium versus Fundamental Uncertainty

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 $\text{var}(p_D) = \frac{1}{2}\text{var}(D)$ of Eq. (5) and $\text{var}(p_E) = \frac{1}{2}\text{var}(E)$ of Eq. (6), and $\text{var}(p_D^{\Phi=1}) = \text{var}(p_E^{\Phi=0}) = \frac{\sigma_v^2}{2}$ in Figure 4c (while $\text{var}(p_D^{\Phi=0}) = \text{var}(p_E^{\Phi=1}) = 0$); and price covariance $\text{cov}(p_D, p_E) = \frac{1}{4}\text{cov}(D, E)$ of Eq. (7) in Figure 4d (dotted line; while $\text{cov}(p_D^{\Phi=0}, p_E^{\Phi=0}) = \text{cov}(p_D^{\Phi=1}, p_E^{\Phi=1}) = 0$) — as a function of the firm's fundamental uncertainty σ_v^2 when mean firm value $v_0 = 100$, noise trading intensity $\sigma_u^2 = 100$, and either debt principal $P = 110$ or $P = 90$.

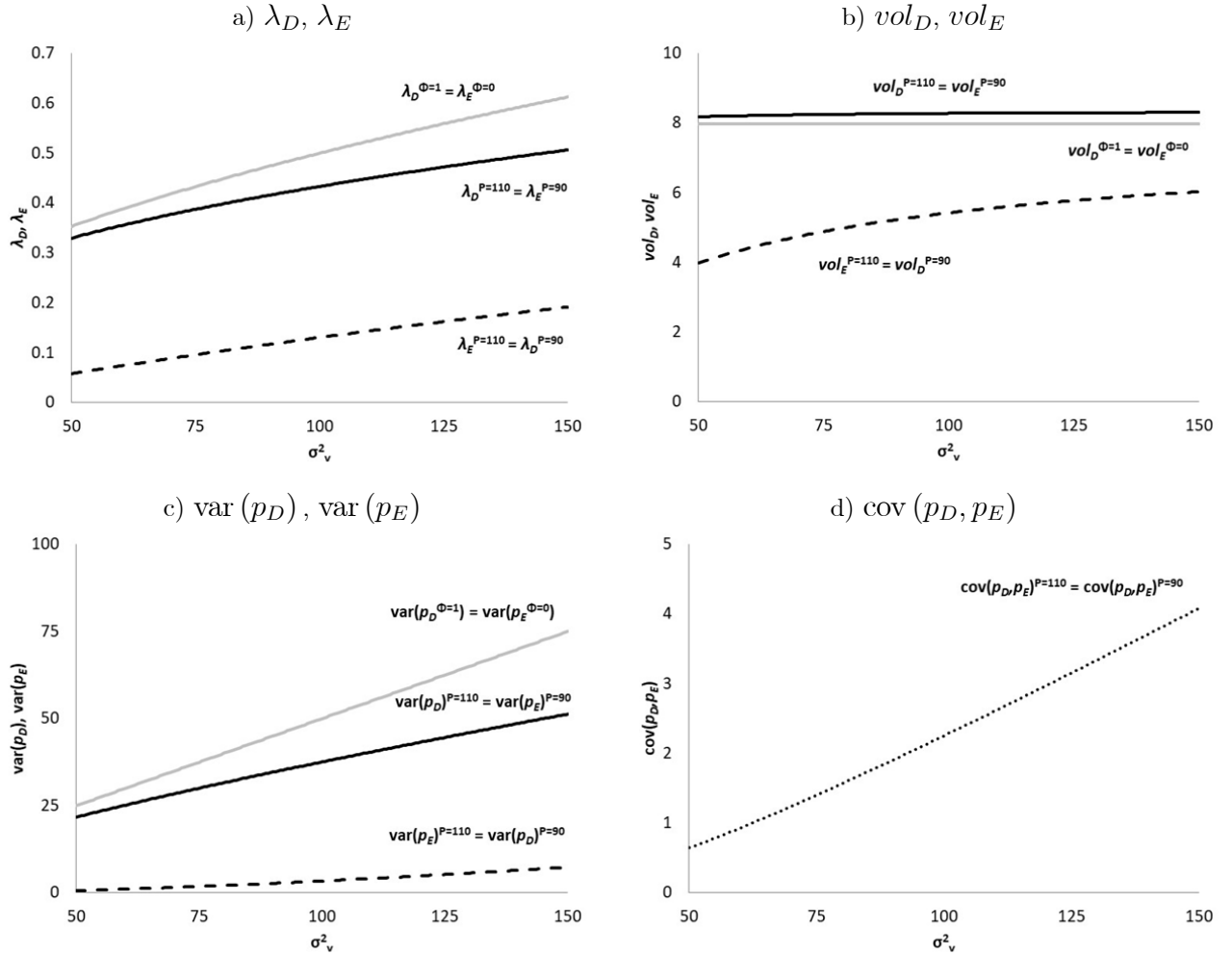


Figure 5. Stock-Bond Return Comovement: Tercile Analysis

This figure plots estimates of excess-of-market stock-bond return 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, $\bar{T}$, i.e., $> 99\%$, 96% for the former and $> 90\%$, 85% for the latter, respectively), or fundamental volatility (FIRMVOL; Figure 5c, 5f) without their explicit terms. In Figures 5a to 5c (Baseline), specification I includes no additional covariates; specification II adds (mutable two-digit SIC-code) industry fixed effects (FEs), weekday FEs, and 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; market-to-book: MTB; principal-weighted bond duration: DURATION; governance: EINDEX) in specification II; specification VI adds firm FEs to specification V; specification VII adds time (quarterly) FEs to specification V. All independent variables (except returns) are standardized.

