The Technical Default Spread

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Abstract

We build a dynamic general equilibrium model in which endogenous loan covenants allocate investment control rights between borrowers and lenders, and study its implications for investment, risk-taking, and asset prices in the cross-section. When borrowers enter technical default by breaching a covenant, control rights switch from borrowers to lenders. Lenders optimally choose low-risk projects, thus mitigating borrowers' risk-shifting incentives and reducing the firm's cost of equity. A calibrated version of our model allows us to match the technical default spread that we find in the data: firms that are closer to technical default earn on average 4% *lower* future returns than firms that are further away from their technical default thresholds. We argue theoretically and show empirically that the technical default spread arises from different economic forces than the distress anomaly.

JEL Codes: E2, E3, G12

Keywords: Loan Covenants, Technical Default, Creditor Control Rights, Cross-Section of Stock Returns

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1 Introduction

Textbook macro-finance models of financial constraints (Bernanke and Gertler (1989), Bernanke, Gertler, and Gilchrist (1999), Kiyotaki and Moore (1997)) treat lenders as passive bystanders without active involvement in their borrowers' corporate policies. When borrowers are solvent, lenders recover the value of the loan and interest payments, and when the firm defaults lenders recover whatever is left of the firm's assets. Over the past fifteen years, however, the corporate finance literature has demonstrated an active role for lenders in ensuring loan repayment by borrowers. Before lending contracts are initiated, lenders design loan covenants to mitigate the risk of borrower default. During the life of the loan, if technical default occurs with the violation of a covenant, lenders can freeze credit lines, call back the loan, charge higher interest or fees, and directly influence corporate investment decisions (Chava and Roberts (2008), Nini, Smith, and Sufi (2009)). What are the quantitative implications of such changes in control rights for corporate investment, risk-taking, and cost of capital?

In this paper, we study the quantitative impact of changes in control rights on corporate investment policies, risk-taking behavior, and expected stock returns. We develop a dynamic general equilibrium model where entrepreneurs borrow from lenders to finance their firms. We let the loan contract between lenders and borrowers endogenously specify loan size, interest rate, and a covenant threshold based on a signal of the firm's profits. When expected cash flows are high, entrepreneurs are in control and choose relatively riskier projects due to their convex payoffs. When expected cash flows are low, covenants are violated and lenders take control of the firm, choosing relatively safer projects to safeguard their payoffs. As a result, investment risk and cost of capital are higher when entrepreneurs are in control and they are lower when lenders are in control.

In the data, we show that firms that are closer to technical default systematically display lower investment risk and expected returns than firms whose covenants are less binding. We rank firms into five portfolios based on the Murfin (2012) measure of loan covenant strictness (i.e., distance to technical default), and show that firms in the highest strictness quintile portfolio feature more conservative investment and acquisition policies (Nini, Smith, and Sufi (2012)) and earn around 4% *lower* returns than firms in the bottom strictness quintile portfolio. Importantly, we show that these empirical findings hold in the subset of firms that are not in financial distress, suggesting that our results arise from a different channel from those proposed in the literature to explain the distress anomaly (e.g., Garlappi and Yan (2011)). A calibrated version of the model allows us to replicate the investment risk and return patterns observed in the data, and highlights changes of control rights in technical default as a quantitatively important tool to mitigate risk-taking incentives.

Our analysis starts in an infinite-horizon economy populated by entrepreneurs, lenders, firms, and workers. Firms have unique access to productive capital and labor, and hire myopic entrepreneurs to make static investment and financing decisions. Entrepreneurs borrow resources from risk-neutral lenders and, absent technical default, allocate resources between productive capital and a risk-free asset. Our main theoretical contribution is to introduce endogenous covenants in the loan contract and the transfer of control rights from entrepreneurs to lenders following covenant violations. Motivated by recent empirical evidence, we make two assumptions on the structure of loan covenants. First, we assume that covenants are written on firms' profits. This assumption is motivated by recent work documenting the vast prevalence of cash-flow based covenants (as opposed to stock-based covenants) in US corporate lending (see, e.g., Lian and Ma (2018)).[1] Second, we assume that covenant violations trigger a switch of control rights to lenders who then allocate the firm's assets between risky capital and the risk-free asset by maximizing their own payoffs. This assumption captures in reduced form extensive empirical evidence on the active role of lenders in shaping corporate policies when firms enter technical default (e.g., Chava and Roberts (2008), Nini et al. (2009, 2012), Falato and Liang (2016)).[2]

In our model, the allocation of investment control rights happens *after* the loan contract has been signed but *before* payoffs are realized, based on a signal of the risky investment's idiosyncratic profitability. At the beginning each period, entrepreneurs meet with lenders and negotiate a one-period loan contract specifying loan size and interest rate. Departing from the previous literature, we let the loan contract also specify an endogenous covenant threshold based on a signal of the risky in-

[1] Popular cash-flow based covenants specify minimum levels for a firm's interest coverage ratios (EBITDA to interest expense), and fixed charge coverage ratios (EBITDA to fixed charges, the sum of interest expense, debt in current liabilities, and rent expense). Popular stock-based covenants specify maximum levels for firm leverage (debt to total assets).

[2] The assumption of full allocation of control rights to lenders can be relaxed, for example, by assuming that entrepreneurs and lenders bargain over the firm's asset allocation decision and that the lender's bargaining weight is a function of the firm's distance from technical default. In an extension of our model, we consider the implications of costly asset reallocation between entrepreneurs and lenders.

vestment's idiosyncratic profitability. The loan contract stipulates that if this idiosyncratic signal falls below the threshold specified in the contract, then investment control rights (i.e., the choice between risky and riskless assets) are assigned to the lender. If conversely the idiosyncratic signal is above the idiosyncratic covenant threshold, investment control rights remain in the hands of the entrepreneur.

In the middle of the period, the firm's idiosyncratic profitability signal is realized and control rights are assigned to either the entrepreneur (if the signal is high) or the lender (if the signal is low). We prove that, even if entrepreneurs are risk-averse, they always optimally choose to undertake risky investments. On the other hand, lenders have concave payoffs and an incentive to invest in the riskless asset to ensure loan repayment. After investment decisions have been made by either the entrepreneur or the lender, at the end of the period aggregate and idiosyncratic shocks are realized. If the value of the firm's assets is higher than the value of the loan, the firm is solvent, the lender collects the value of the loan plus interest, and the entrepreneur collects the difference between the value of the firm's assets and the loan. If the value of the firm's assets is lower than the value of the loan, the firm is in default, the lender collects a fraction of the value of the firm's assets, and the entrepreneur obtains nothing.

Our model studies how loan covenants interact with the standard theoretical trade-off between expected payoffs and default risk. We show that the entrepreneur's convex payoffs induce full investment of the firm's assets into productive capital. Conversely, the lender's concave payoffs induce full investment in the risk-free asset. Technical default translates into different levels of investment risk based on the endogenous allocation of control rights, and risky investment by the entrepreneur in control results in higher exposure to aggregate risk and higher expected stock returns. This mechanism gives the empirically-testable prediction that firms that are closer to technical default (and therefore more likely to experience a shift in control rights) should have lower investment risk and lower average stock returns than firms that are further away from technical default.

We exploit the cross-section of firm investment and stock returns to provide empirical evidence for our proposed mechanism. We use DealScan loan covenant data to construct a quarterly firm-level measure of distance to technical default. As in Murfin (2012), this covenant strictness measure is the probability that a firm will breach one of its covenant terms over the next quarter, and constitutes an ex-ante measure of future technical default. We then study the empirical relationship between strictness, investment conservatism (as measured by investment and acquisition growth, see Nini et al. (2012)), and future stock returns.

Consistent with our theory, we document a *positive* relationship between strictness and investment conservatism, and a strong *negative* relationship between strictness and expected stock returns. We show that firms in the top quintile of the strictness distribution have on average 3.6 lower investment growth rates and 3.8 lower acquisition growth rates than firms in the fourth quintile of the strictness distribution. High strictness is also associated with lower returns: a strategy that goes long on the high-strictness portfolio and short on the low-strictness portfolio earns an average *negative* excess returns of 4.12% per year.

Our empirical tests show that the negative relationship between strictness and expected returns is non-monotonic, and driven by high-strictness firms. Relative to firms in the fourth quintile of the strictness distribution, firms in the top quintile earn 7.7% lower excess returns (unconditionally), and this relationship is partly explained by different exposure to the Fama and French (2015) and Hou et al. (2015) investment and profitability factors. We interpret these results as evidence that control rights reallocation leads to constrained investment choices, thereby reducing firms' exposure to aggregate investment opportunities and profitability.

Additionally, Fama-MacBeth regressions of future returns on indicators for inclusion in strictness-based portfolios confirm that only high-strictness firms display lower excess returns than low-strictness firms. Additional tests show that these results are robust to a number of robustness checks and empirical specifications, are not driven by financially-distressed firms (Campbell, Hilscher, and Szilagyi (2008), Bharath and Shumway (2008)), and hold ex-post in a regression discontinuity design (RDD) when firms actually breach their covenants.

Using the lens of our model, we interpret the non-monotonic, negative relationship between loan covenant strictness and expected returns as evidence of a shift in investment control rights for firms that are closest to technical default. Consistent with this intuition, we show that a version of our model calibrated to match conventional macroeconomic and asset pricing moments is able to generate a significant and sizable technical default spread. As in the data, high covenant strictness is associated with lower investment risk and lower average returns. Taken together, our empirical results and calibration support control rights reallocation as a quantitatively important determinant of a firm's investment, risk-taking incentives, and cost of capital.

Related Literature Our paper contributes to three streams of literature. Starting from the seminal contributions of Bernanke and Gertler (1989), Bernanke et al. (1999), and Kiyotaki and Moore (1997), an established literature in macro-finance studies the role of financial frictions in shaping firms' investment decisions. Recent work in this area highlights that the pervasive role of financial covenants in lending contracts can have a quantitatively large impact on aggregate investment (Gete and Gourio (2015), Lian and Ma (2018)). We complement this literature by building the first asset pricing model featuring endogenous loan covenants and control rights allocation. We use this novel framework to study the quantitative implications of control rights allocation on firms' investment, risk-taking incentives, and cost of capital in the cross-section.

A long literature in corporate finance theory highlights loan covenants as a tool to mitigate agency problems between shareholders and debtholders (Jensen and Meckling (1976), Myers (1977), Smith and Warner (1979)). Recent empirical work in this area confirms that covenant violations can impact firm investment (Chava and Roberts (2008), Nini et al. (2009), Bradley and Roberts (2015)) and hiring policies (Benmelech, Bergman, and Seru (2011), Falato and Liang (2016)), ultimately affecting firm risk (Gilje (2016), Ersahin, Irani, and Le (2017)) and value (Beneish and Press (1995), Harvey, Lins, and Roper (2004), Nini et al. (2012)). Using the lens of a macro-finance model, we complement this literature by showing that the allocation of control rights between borrowers and lenders has quantitatively important implications for firms' investment and risk-taking, and manifests itself in the cost of capital.

Our paper contributes to the cross-sectional asset pricing literature by showing that the reallocation of control rights in technical default contributes to significant variation in the cross-section of expected stock returns. While our paper is related to the literature on financial distress and expected stock returns, we show that the technical default spread is strongest for the set of firms that are *not* financially-distressed. In this sense, the data provides evidence of reallocation of control rights as a distinct economic mechanism for those previously proposed in the literature to explain the Campbell, Hilscher, and Szilagyi (2008) distress anomaly. A non-exhaustive list of such explanations includes shareholder recovery in default (Garlappi and Yan (2011)) and changes in equity beta for financially-distressed firms (George and Hwang (2010), Boualam, Gomes, and Ward (2019), and Chen, Hackbarth, and Strebulaev (2019)). In this respect, it is particularly worth noting that our mechanism is economically different from the shareholder recovery in default mechanism proposed by Garlappi and Yan (2011). While their paper argues for a reallocation of risks from shareholders to creditors in financial distress, our theory hinges on a reduction of risky investment by creditors in control of the firm.

2 A General Equilibrium Model of Investment Control Rights

We present a discrete-time, infinite-horizon general equilibrium model featuring a representative household of entrepreneurs and workers, a continuum of firms, and a national lender. Our model extends the workhorse Bernanke et al. (1999) financial accelerator model to allow for the possibility of firm technical default and the allocation of investment control rights to the lender.

In each period t, entrepreneurs sign one-period contracts with the national lender to make one-period investment decisions between a risk-free asset and risky capital. The lending contract specifies the size of the loan, its interest rate, and a covenant on the firm's expected cash flows below which investment control rights are assigned to the lender. Specifically, after the lending contract is signed, but before investment decisions are made, entrepreneurs and the lender observe a signal on the firm's future idiosyncratic productivity. If this signal is above its covenant threshold, the entrepreneur maintains the firm's control rights and decides how to allocate her own funds and the bank's loan between the risk-free asset and risky capital. If the signal is below the covenant threshold, investment control rights are assigned to the lender.

2.1 Model Setup

Representative Household The representative household consists of a continuum of workers and a continuum of entrepreneurs. In each period t, workers inelastically supply labor L_t to firms and return wages W_t to the household. Entrepreneurs own and operate firms. As we describe below, entrepreneurs transfer a share Π_t of their wealth to the household for consumption and savings purposes.[3] We denote household consumption by C_t, its savings in the bank's deposits by D_t^H, and the bank's risk-free deposit rate by R_{t+1}^D. Finally, the representative household owns the national bank and it is entitled to the national bank's profits Π_t^B, but also absorbs the bank's losses in the event of bank default.[4] Given these assumptions, the household's budget constraint is

$$C_t + D_t^H = W_t L_t + R_t^D D_{t-1}^H + \Pi_t + \Pi_t^B. \tag{1}$$

We assume perfect consumption insurance within the household. The household evaluates the utility of its consumption plans according to the Epstein and Zin (1989) recursive specification

$$U_t = \left\{ (1-\beta)\left(C_t\right)^{1-\frac{1}{\psi}} + \beta \left(E_t \left[U_{t+1}^{1-\gamma} \right] \right)^{\frac{1-\frac{1}{\psi}}{1-\gamma}} \right\}^{\frac{1}{1-\frac{1}{\psi}}}, \tag{2}$$

where U_t denotes time-t utility, β denotes the household's time discount factor, ψ denotes its intertemporal elasticity of substitution, and γ denotes its relative risk aversion. Under these preferences, the household's stochastic discount factor (SDF) between time t and $t+1$ is

$$M_{t+1} \equiv \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\frac{1}{\psi}} \left(\frac{U_{t+1}^{1-\gamma}}{E_t \left[U_{t+1}^{1-\gamma} \right]} \right)^{\frac{\frac{1}{\psi}-\gamma}{1-\gamma}}, \tag{3}$$

and no arbitrage ensures that

$$E_t \left[M_{t+1} \right] R_{t+1}^D = 1. \tag{4}$$

Firms All the firms in our economy are ex-ante identical and produce the same consumption good. Each firm is indexed by $i \in [0,1]$, and is operated by an entrepreneur to produce output $Y_{i,t}$ following

[3] As in Bernanke et al. (1999), this assumption prevents entrepreneur's wealth to grow indefinitely and grow out of the financial constraint.

[4] This assumption is not restrictive and ensures that the bank's deposits are risk-free without introducing another asset in the economy.

a constant return to scale Cobb-Douglas production technology

$$Y_{i,t} = \bar{Z}_t \left(\exp(\omega_{i,t}) K_{i,t}\right)^{\alpha} \left(L_{i,t}\right)^{1-\alpha}, \tag{5}$$

where $K_{i,t}$ and $L_{i,t}$ are firm-i's capital and labor inputs, respectively, $\bar{Z}_t$ is an aggregate productivity shock, and $\omega_{i,t}$ is a firm-specific shock that transforms one unit of capital into $\exp(\omega_{i,t})$ efficiency units of capital (Bernanke et al. (1999)).

Since labor is perfectly mobile, wages are identical across all firms in this economy, and firms choose labor $L_{i,t}$ to maximize

$$\max_{L_{i,t}} Y_{i,t} - W_t L_{i,t}. \tag{6}$$

The first-order conditions of (6) allow us to show that the marginal product of capital is also constant across all firms and given by[5]

$$MPK_t \equiv \alpha \bar{Z}_t \left[\frac{(1-\alpha)\bar{Z}_t}{W_t}\right]^{\frac{1-\alpha}{\alpha}} = \alpha \bar{Z}_t K_t^{\alpha-1}. \tag{7}$$

The price Q_t of capital purchased by firms is determined by the first-order conditions of capital producers, which we detail in the appendix.

Following Romer (1990), we assume that aggregate productivity is augmented by the aggregate stock of capital K_t,

$$\bar{Z}_t = Z_t K_t^{1-\alpha}, \tag{8}$$

[5]The first-order conditions of (6) give, for all i's,

$$\frac{\exp(\omega_{i,t})K_{i,t}}{L_{i,t}} = \left[\frac{W_t}{\bar{Z}_t(1-\alpha)}\right]^{1/\alpha}.$$

Re-arranging, integrating over i, and using the labor market clearing condition $\int L_{i,t} di = 1$, we get

$$K_t = \int \exp(\omega_{i,t}) K_{i,t} di = \left[\frac{W_t}{\bar{Z}_t(1-\alpha)}\right]^{1/\alpha} \int L_{i,t} di = \left[\frac{W_t}{\bar{Z}_t(1-\alpha)}\right]^{1/\alpha},$$

where K_t is the aggregate capital stock in the economy.

where $\ln Z_t$ follows the AR(1) process

$$\ln Z_t - \ln(\bar{Z}) = \rho_a (\ln Z_{t-1} - \ln(\bar{Z})) + \sigma_a \epsilon_t, \tag{9}$$

where $\bar{Z}$ is the steady state level of Z_t, and ϵ_t is a white noise that follows an *i.i.d.* standard normal distribution. The Romer (1990) assumption that effectively injects an endogenous growth implies that production is linear in K_t at the aggregate level and simplifies our analysis [6]

Idiosyncratic Productivity Our main departure from the Bernanke et al. (1999) setup is the inclusion of endogenous loan covenants written on a signal of the firm's future cash flows. To this end, we split the idiosyncratic shock $\omega_{i,t}$ into two components:

$$\omega_{i,t} = \omega_{i,t}^0 + \omega_{i,t}^1, \tag{10}$$

where $\omega_{i,t}^0$ and $\omega_{i,t}^1$ follow *i.i.d.* normal distributions with means μ_0 and μ_1, respectively, and standard deviations σ_0 and σ_1, respectively, such that realizations of $\omega_{i,t}^0$ and $\omega_{i,t}^1$ are mutually independent from each other. Given these assumptions, $\omega_{i,t}$ also follows a normal distribution, and we impose that $\mathbb{E}_{t-1}(\exp(\omega_{i,t})) = 1$. We assume that the first component of the idiosyncratic shock, $\omega_{i,t}$, is realized *after* the loan contract is signed at $t-1$, but *before* investment decisions are made. When the entrepreneur and the lender stipulate the debt contract, the contract specifies a threshold $\bar{\omega}_{i,t}^0$ such that if the realized $\omega_{i,t}^0 \geq \bar{\omega}_{i,t}^0$, then the entrepreneur maintains control rights to make investment decisions. If $\omega_{i,t}^0 < \bar{\omega}_{i,t}^0$, then investment control rights switch from the entrepreneur to the lender.[7]

Entrepreneurs, Debt Contracts, and Investment Entrepreneur i enters period t with inherited wealth $N_{i,t}$, and borrows an amount $B_{i,t}$ from the national bank for one period. The national bank is risk-

[6]This assumption reduces the dimension of state variables while allowing us to match the basic business cycle facts on labor and capital share in the data.

[7]One can interpret this control rights allocation rule as resulting from investment Nash bargaining between lenders and borrowers, where the bargaining power of the entrepreneur η is a function of the distance between ω^0 and $\bar{\omega}^0$:

$$\eta\left(\omega^0, \bar{\omega}^0\right) = \begin{cases} 1 & \text{if } \omega^0 - \bar{\omega}^0 \geq 0, \\ 0 & \text{otherwise.} \end{cases}$$

neutral, and sets up the loan contract to make zero profits ex-ante. Absent technical default, following a realization of the idiosyncratic productivity signal, the entrepreneur decides how to allocate this budget between productive capital for production in the next period and the bank's risk-free asset. Denoting by $A_{i,t}$ entrepreneur i's total assets and by $D^E_{i,t}$ the amount invested in the risk-free asset, the balance sheet identity of entrepreneur i is therefore

$$A_{i,t} = N_{i,t} + B_{i,t} = Q_t K_{i,t+1} + D^E_{i,t}. \tag{11}$$

We denote the fraction of the entrepreneur's assets invested in productive capital by $\theta_{i,t}$, and the fraction invested in bank deposits by $1 - \theta_{i,t}$, so that $\theta_{i,t} A_{i,t} = Q_t K_{i,t+1}$, and $(1 - \theta_{i,t})\, A_{i,t} = D^E_{i,t}$. As in Bernanke et al. (1999) and Gertler and Kiyotaki (2010), we assume that the entrepreneur re-sells her entire stock of undepreciated productive capital after production. The total cash flow to entrepreneur i is $\exp(\omega_{i,t+1}) R^K_{t+1} Q_t K_{i,t+1}$, where

$$R^K_{t+1} = \frac{MPK_{t+1} + Q_{t+1}(1-\delta)}{Q_t}. \tag{12}$$

Again, note that since the marginal product of capital and its price are the same across all entrepreneurs, the return on capital is also the same across all entrepreneurs.

Time Line The timing of the model is as follows. In period t, entrepreneur i with net worth $N_{i,t}$ meets with the bank and negotiates a financial contract. The financial contract specifies the loan amount $B_{i,t}$, its interest rate $R^B_{i,t+1}$, and its covenant threshold $\bar{\omega}^0_{i,t+1}$. We rule out distressed lending from our framework by imposing that if the entrepreneur invests all available resources (including her own wealth) in the risk-free asset, she is always able to repay the loan. Formally, this implies that for all i, t, $R^B_{i,t+1} B_{i,t} < R^D_{i,t+1} A_{i,t}$.

After signing the contract, entrepreneurs and lenders perfectly observe the idiosyncratic shock component $\omega^0_{i,t+1}$. If $\omega^0_{i,t+1} \geq \bar{\omega}^0_{i,t+1}$, the entrepreneur keeps the investment control rights. If $\omega^0_{i,t+1} < \bar{\omega}^0_{i,t+1}$, investment control rights are assigned to the lender. Moreover, consistent with a long empirical literature on loan terms' renegotiation in technical default (see, e.g., Roberts and Sufi (2009b) and

Roberts and Sufi (2009a)), we allow the loan interest rate to be a function of whether the firm is in technical default. Formally, we let $R^B_{i,t+1}$ to be such that

$$R^B_{i,t+1} = \begin{cases} R^{B,E}_{i,t+1} & \text{if } \omega^0_{i,t+1} - \bar{\omega}^0_{i,t+1} \geq 0, \\ R^{B,L}_{i,t+1} & \text{otherwise,} \end{cases} \tag{13}$$

where the superscripts E and L denote the entrepreneur and the lender being in control, respectively. As we will show later, $R^{B,E}_{i,t+1}$ reflects the credit risk of capital investment when the entrepreneur is in control, while $R^{B,L}_{i,t+1}$ carries no credit risk because the lender in control optimally chooses not to invest in risky capital. That is, $R^{B,L}_{i,t+1} = R^D_{t+1}$ for all $\omega^0_{i,t+1} < \bar{\omega}^0_{i,t+1}$.

At the beginning of $t+1$, the aggregate shock $\bar{Z}$ and the residual component of the idiosyncratic shock ω_i (i.e., ω^1_i) are realized, and entrepreneurs collect the payoffs from their portfolios. For given values of $\theta_{i,t}$ and $R^B_{i,t+1}$, and for a given realization of the aggregate state, entrepreneurs default on the loan if $\omega^1_{i,t+1}$ is below the endogenous default cutoff $\hat{\omega}^1_{i,t+1}$ by which

$$\left[\theta_{i,t} \exp\left(\omega^0_{i,t+1} + \hat{\omega}^1_{i,t+1}\right) R^K_{t+1} + (1 - \theta_{i,t})\, R^D_{t+1}\right] A_{i,t} = R^B_{i,t+1} B_{i,t}. \tag{14}$$

2.2 Investment Decisions

In this section, we study the optimal investment choices θ^E for entrepreneurs and θ^L for lenders when entrepreneurs and lenders are in control (i.e., conditional on a realization of ω^0). We respectively denote by V^j and W^j, with $j \in \{E; L\}$, the payoffs of entrepreneurs and lenders when agent-j is in control (e.g., we let V^L denote the payoff of the entrepreneur when the lender is in control). In the next section, we derive the optimal loan contract by integrating the payoffs of the lender and the payoff of the entrepreneur across all possible realizations of ω^0.

Entrepreneurs are risk-averse. When in control, entrepreneurs choose their optimal portfolio mix between risky capital and risk-less deposits using the representative household's stochastic discount factor. We make the assumption that loans are issued to finance specific investment, which implies that loans and investments have the same (one-period) duration in our model. This assumption is consistent with our our empirical analyses: we find that in DealScan, loans issued to finance long-term projects such as project finance and real estate have an average duration of around 7 years. Conversely, loans issued to finance short-term investment such as working capital expenditure have an average duration of around 4 years. Importantly, this assumption allows us to write entreprenerus' problem as if entrepreneurs were myopic, and to greatly simplify the model solution.[8] Suppressing the dependency of V on its arguments, the entrepreneur's problem is to maximize her payoff in the non-default states, i.e.,

$$V^E = \max_{\theta^E_{i,t}} \mathbb{E}_t \left\{ M_{t+1} \int_{\hat{\omega}^1_{i,t+1}}^{\infty} \left\{ \left[\theta^E_{i,t} \exp\left(\omega_{i,t+1}\right) R^K_{t+1} + \left(1 - \theta^E_{i,t}\right) R^D_{t+1} \right] A_{i,t} - R^{B,E}_{i,t+1} B_{i,t} \right\} dF\left(\omega^1_{i,t+1}\right) \right\}. \tag{15}$$

Taking the entrepreneur's optimal decision for θ^E as given, the lender's payoff is

$$\begin{aligned} W^E &= \mathbb{E}_t \left\{ M_{t+1} \left[\int_{-\infty}^{\hat{\omega}^1_{i,t+1}} (1-\zeta) \left[\theta^E_{i,t} \exp\left(\omega_{i,t+1}\right) R^K_{t+1} + \left(1 - \theta^E_{i,t}\right) R^D_{t+1} \right] A_{i,t} dF\left(\omega^1_{i,t+1}\right) \right.\right. \\ &\quad \left.\left. + \int_{\hat{\omega}^1_{i,t+1}}^{\infty} R^{B,E}_{i,t+1} B_{i,t} dF\left(\omega^1_{i,t+1}\right) \right] \right\}, \end{aligned} \tag{16}$$

where $\zeta \in (0,1)$ is a deadweight loss in default (see, e.g., Elenev, Landvoigt, and Van Nieuwerburgh (2018)).

Since the household owns all the national lender's equity, the lender uses the household's stochastic discount factor to evaluate its future payoffs.[9] When in control of firm i, the national lender solves

$$\begin{aligned} W^L &= \max_{\theta^L_{i,t}} \mathbb{E}_t \left\{ M_{t+1} \left[\int_{-\infty}^{\hat{\omega}^1_{i,t+1}} (1-\zeta) \left[\theta^L_{i,t} \exp\left(\omega_{i,t+1}\right) R^K_{t+1} + \left(1 - \theta^L_{i,t}\right) R^D_{t+1} \right] A_{i,t} dF\left(\omega^1_{i,t+1}\right) \right.\right. \\ &\quad \left.\left. + \int_{\hat{\omega}^1_{i,t+1}}^{\infty} R^{B,L}_{i,t+1} B_{i,t} dF\left(\omega^1_{i,t+1}\right) \right] \right\}, \end{aligned} \tag{17}$$

[8] Without this assumption, the optimal financial contract depends on the histories of realizations of the aggregate and idiosyncratic state variables, and the model loses its tractability in a general equilibrium setting.

[9] Our results in terms of optimal investment policies are identical if we instead assume that the national lender is risk-neutral.

with associated payoffs for the entrepreneur

$$V^L = \mathbb{E}_t \left\{ M_{t+1} \int_{\hat{\omega}^1_{i,t+1}}^{\infty} \left\{ \left[\theta^L_{i,t} \exp\left(\omega_{i,t+1}\right) R^K_{t+1} + \left(1 - \theta^L_{i,t}\right) R^D_{t+1} \right] A_{i,t} - R^{B,L}_{t+1} B_{i,t} \right\} dF\left(\omega^1_{i,t+1}\right) \right\}. \tag{18}$$

In the following proposition, we show that even if the entrepreneur is risk-averse, she always chooses the risky investment when in control. Intuitively, the entrepreneur's payoff function is convex in θ, such that—absent control rights reallocation—low realizations of ω^0 would always lead the entrepreneur to full investment in the risk-free assets and high realizations of ω^0 would always lead to full investment in risky capital. However, we show that the loan contract terms are such that the entrepreneur is always (weakly) better off assigning control rights to the lender instead of choosing to invest in the risk-free asset directly. This proposition allows us to greatly simplify the equilibrium characterization in the following section.

Proposition 1. *The optimal investment choices for the entrepreneur and the lender in control are* $\theta^E = 1$ *and* $\theta^L = 0$, *respectively. Therefore,* $R^{B,L} = R^D$.

Proof. See Appendix. □

2.3 Loan Contracts

We solve the optimal loan contract by integrating the value of entrepreneurs and lenders across all possible realizations of ω^0. The loan terms are chosen so as to maximize the value of the entrepreneur subject to the lender's ex-ante break-even condition. That is, $R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}$ maximize entrepreneur i's ex-ante expected payoff,

$$\max_{R^L_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}} V\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right), \tag{19}$$

subject to lender's break-even condition

$$W\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right) = B_{i,t}, \tag{20}$$

where

$$V\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right) = \int_{-\infty}^{\bar{\omega}^0_{i,t+1}} V^L\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right), + \int_{\bar{\omega}^0_{i,t+1}}^{\infty} V^E\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right), \tag{21}$$

and

$$W\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right) = \int_{-\infty}^{\bar{\omega}^0_{i,t+1}} W^L\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right) + \int_{\bar{\omega}^0_{i,t+1}}^{\infty} W^E\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right). \tag{22}$$

In the following proposition, we show that, when we rescale the problem by the amount of the entrepreneur's initial wealth, the optimal loan contract terms are identical across all entrepreneurs.

Proposition 2. *Define by $H_{i,t}$ the debt-to-net worth ratio $H_{i,t} \equiv B_{i,t}/N_{i,t}$. The optimal debt contract features the same $H_{i,t}$, $R^{B,E}_{i,t+1}$, and $\bar{\omega}^0_{i,t+1}$ across all the entrepreneurs.*

Proof. See Appendix. □

This important result makes it easy to achieve aggregation in our model. In the following sections, we omit the subscript i in $R^{B,E}_{t+1}$, H_t and $\bar{\omega}^0_{t+1}$. In the Appendix, we provide a formal definition for a competitive equilibrium in our model.

2.4 Entrepreneurs' Wealth and Return on Equity

To close the model, we assume that a fraction $1-\lambda$ of the undefaulted entrepreneurs are hit by a liquidity shock and need to liquidate all of their net worth to the household (Bernanke et al. (1999)). Defaulted entrepreneurs and those hit by the liquidity shock draw an initial wealth χN_t, with $\chi > 0$ at the beginning of period $t+1$.[10]

We denote the wealth of the entrepreneur *before* the draw of new wealth by $\tilde{N}$. At the individual

[10] We assume that χ is small enough such that entrepreneurs do not have strategic default incentives.

level, $\tilde{N}$ evolves as

$$\tilde{N}_{i,t+1} = \begin{cases} R^D_{t+1} N_{i,t} & \text{if } \omega^0_{i,t+1} < \bar{\omega}^0_{i,t+1}, \\ \left[\exp\left(\omega_{i,t+1}\right) R^K_{t+1} \left(1 + H_t\right) - R^{B,E}_{t+1} H_t\right] N_{i,t} & \text{if } \omega^0_{i,t+1} \geq \bar{\omega}^0_{i,t+1} \text{ and } \omega^1_{i,t+1} \geq \hat{\omega}^1_{i,t+1}, \\ 0 & \text{otherwise,} \end{cases} \tag{23}$$

which allows us to obtain the return on the entrepreneur's wealth as

$$\frac{\tilde{N}_{i,t+1}}{N_{i,t}} = \begin{cases} R^D_{t+1} & \text{if } \omega^0_{i,t+1} < \bar{\omega}^0_{i,t+1}, \\ \left[\exp\left(\omega_{i,t+1}\right) R^K_{t+1} \left(1 + H_t\right) - R^{B,E}_{t+1} H_t\right] & \text{if } \omega^0_{i,t+1} \geq \bar{\omega}^0_{i,t+1} \text{ and } \omega^1_{i,t+1} \geq \hat{\omega}^1_{i,t+1}, \\ 0 & \text{otherwise.} \end{cases} \tag{24}$$

Equation (24), shows that a larger distance to technical default $\omega^0 - \bar{\omega}^0$ leads to investment in risky assets and higher returns (absent default). Finally, the aggregate law of motion for capital is

$$\begin{aligned} N_{t+1} \; = \; & N_t \lambda \int_{\bar{\omega}^0_{t+1}}^{\infty} \int_{\hat{\omega}^1_{t+1}}^{\infty} \left\{ \left[\exp\left(\omega^0_{t+1} + \omega^1_{t+1}\right) R^K_{t+1}\right] \left(1 + H_t\right) - R^{B,E}_{t+1} H_t \right\} dF\left(\omega^1_{t+1}\right) dF\left(\omega^0_{t+1}\right) \\ & + N_t \lambda \int_{-\infty}^{\bar{\omega}^0_{t+1}} R^D_{t+1} dF\left(\omega^0_{t+1}\right) + \chi N_t \left[1 - \lambda \left(1 - \int_{\bar{\omega}^0_{t+1}}^{\infty} \int_{-\infty}^{\hat{\omega}^1_{t+1}} dF\left(\omega^1_{t+1}\right) dF\left(\omega^0_{t+1}\right)\right)\right], \end{aligned} \tag{25}$$

where the first element is the wealth of the entrepreneurs not in technical default and not hit by the liquidity shock, the second element is the wealth of the entrepreneurs in technical default and not hit by the liquidity shock, and the third element is the newly-realized wealth of entrepreneurs in default and of those hit by the liquidity shock.[11]

[11] This implies that the amount of wealth Π_t transferred to the household is

$$\Pi_t = N_{t-1}\left(1 - \lambda\right) \left\{ \int_{\bar{\omega}^0_t}^{\infty} \int_{\hat{\omega}^1_t}^{\infty} \left\{ \exp\left(\omega^0_t + \omega^1_t\right) R^K_t \left(1 + H_{t-1}\right) - R^{B,E}_t H_{t-1} \right\} dF\left(\omega^1_t\right) dF\left(\omega^0_t\right) + \int_{-\infty}^{\bar{\omega}^0_t} R^D_{t+1} dF\left(\omega^0_t\right) \right\}.$$

Similarly, bank ex-post profits Π^B_t are the difference between the ex-post value of W and deposit debt repayments:

$$\begin{aligned} \Pi^B_t \; = \; & \int_{\bar{\omega}^0_t}^{\infty} \int_{\hat{\omega}^1_t}^{\infty} R^{B,E}_t B_{t-1} dF\left(\omega^1_t\right) dF\left(\omega^0_t\right) + \int_{-\infty}^{\bar{\omega}^0_t} R^D_t B_{t-1} dF\left(\omega^0_t\right) \\ & + \int_{\bar{\omega}^0_t}^{\infty} \int_{-\infty}^{\hat{\omega}^1_t} \left[\left(1 - \zeta\right) \exp\left(\omega_t\right) R^K_t A_{t-1}\right] dF\left(\omega^1_t\right) dF\left(\omega^0_t\right) - R^D_t B_{t-1}. \end{aligned}$$

3 Lender Control Rights and Expected Returns

3.1 Covenant Strictness

In this section, we describe our main measure of distance to technical default. This quarterly firm-level measure, which in the spirit of Murfin (2012) we name "strictness," represents the probability that the firm might breach one of its covenant terms in the next period. In this sense, strictness is a quarterly ex-ante measure of technical default.

To construct our strictness measure, we first make some assumptions on the process generating financial ratios on which loan covenants are written (e.g., the interest coverage ratio and the leverage ratio). Similar to Murfin (2012), we assume that, for a given firm i, the log-growth of a single financial ratio r between quarter t and quarter $t+1$ is equal to a constant plus a normally-distributed noise term, i.e.,

$$\ln(r_{i,t+1}) - \ln(r_{i,t}) = \mu_i + \varepsilon_{i,t+1}, \tag{26}$$

where μ_i is a firm-specific constant and $\varepsilon \sim N(0, \sigma^2)$.[12] If a covenant for r is written such that control rights are allocated to the lender if $r < \underline{r}$, (or, equivalently, if $\ln(r) < \ln(\underline{r})$) then the probability that the lender will be allocated control rights between t and $t+1$ is equal to

$$\Pr(r < \underline{r})_{i,t} = 1 - \phi\left(\frac{\widehat{\ln(r_{i,t+1})} - \ln(\underline{r})}{\sigma}\right), \tag{27}$$

where ϕ is the standard normal cdf, and $\widehat{\ln(r_{i,t+1})} = \ln(r_{i,t}) + \mu_i$ is the forecasted value based on process specified in Equation (26).[13]

Consider the case when more than a single financial covenant is active for firm i at time t. Then, (26) becomes

$$\ln(\mathbf{r}_{i,t+1}) - \ln(\mathbf{r}_{i,t}) = \boldsymbol{\mu}_i + \boldsymbol{\varepsilon}_{i,t+1}, \tag{28}$$

[12] In the appendix, we show that our main portfolio sorting results hold if we instead consider an AR(1) process to describe the time series evolution of firm's (log) financial ratios.

[13] Similarly, our strictness measure takes into account covenants breaches when $r > \underline{r}$ (e.g., covenants on maximum Debt-to-EBITDA ratios, see Murfin (2012)).

where $\mathbf{r}$ is a $N \times 1$ vector of financial ratios, $\boldsymbol{\mu}_i$ is a $N \times 1$ vector of firm-specific constants, and $\varepsilon \sim N_N(\mathbf{0}, \Sigma)$. Strictness is then the probability that *any* active covenant will be violated and the lender will be allocated control rights between t and $t+1$. Formally, strictness is equal to

$$\text{Strictness}_{i,t} = 1 - \Phi\left(\widehat{\ln(\mathbf{r}_{i,t+1})} - \ln(\underline{\mathbf{r}})\right), \tag{29}$$

where Φ is the multivariate standard normal cdf with mean $\mathbf{0}$ and variance Σ, and $\underline{\mathbf{r}}$ is a $N \times 1$ vector of active covenants.

3.2 Data

Our data comes from three sources. Loan covenant data comes from Loan Pricing Corporation's (LPC) DealScan database, which provides extensive coverage on syndicated and bilateral private loans made by bank and non-bank (e.g., pension funds) lenders to US borrowers since 1984 (see, e.g., Carey and Hrycray (1999) and Bradley and Roberts (2015)). The information contained in DealScan is sourced from listed firms' SEC filings or directly obtained from borrowers and lenders, and it includes pricing, amount, and maturity for individual loans (also known as facilities), as well as covenant terms for groups of loans included in the same lending contract (also known as packages). Since DealScan is only sparsely populated before 1996, and since our portfolio sorting exercise requires a sufficiently high number of observations in each portfolio, we drop pre-1996 loan observations from the data.

To construct our strictness measure, we focus on the five most common covenant ratios found on DealScan, namely maximum debt to EBITDA, minimum interest coverage (EBITDA to interest expense), minimum fixed charge coverage (EBITDA to fixed charges, the sum of interest expense, debt in current liabilities, and rent expense), maximum leverage (long-term and current debt to total assets), and minimum current ratio (current assets to current liabilities). Collectively, these five covenants represent around 60% of all the covenants in the full DealScan sample, and around 80% of all the DealScan covenant ratios.

A firm might have multiple loan packages outstanding at the same time, and each package might specify a different threshold for the same covenant ratio. Since our strictness measure captures the probability of breaching *any* covenant, for each of our five covenant ratios we compute the most restrictive covenant across all outstanding loans packages in any given quarter. For example, if in a given quarter a firm has five active packages and three of these packages include covenants restricting the firm's maximum debt-to-equity ratio, we use the smallest of these debt-to-equity covenants to compute strictness for that firm.

Quarterly financial data for the firms in our sample comes from Compustat, and monthly firm returns come from CRSP. We use Compustat to compute the realized value of each of the financial ratios included in our strictness measure, as well as the variables that we use for portfolio double-sorting. Using the DealScan link table by Sudheer Chava and Michael Roberts (see Chava and Roberts (2008)), we obtain a firm-quarter panel that contains values for the most restrictive covenant for each of our five covenant types, as well as values for the annualized financial ratios associated with these covenants.[14] Following the methodology described in Section 3.1, we use these financial ratios and covenants to construct our firm-quarter strictness measure.

Our sample starts with the first quarter of 1996 and ends with the last quarter of 2016. As standard practice in the asset pricing literature, we drop firms in the financial and utilities industries. Figure 1 shows the time series properties of covenant strictness in our sample. The figure shows that average strictness across all firms in our sample is counter-cyclical, peaking at the beginning of 2001 and during the financial crisis. As documented by Griffin, Nini, and Smith (2018), the figure also shows a general decreasing trend in covenant strictness since the early 2000's. In the appendix, we provide a validation test for our strictness measure by showing that lagged strictness positively predicts future covenant violations. Covenant violation data at the firm-quarter level comes from Greg Nini, and is an updated version of the covenant violation data in Nini, Smith, and Sufi (2012).[15]

Table 1 reports summary statistics for the main variables of the paper, including strictness, measures of firm financial constraints (the Whited and Wu (2006) (WW) Index and the Hadlock and Pierce (2010) Size-Age (SA) Index), and measures of firm default probability (failure probability as

[14]As in Demerjian and Owens (2016), when computing strictness we annualize all the flow variables (e.g., interest expense) by summing these variables over the current quarter and the past three quarters. If a covenant type is not present in any of the firm's active packages, we record a missing value for that covenant and compute strictness using the remaining covenants.

[15]We are grateful to Greg Nini for sharing the updated loan covenant violation data.

in Campbell, Hilscher, and Szilagyi (2008), and Expected Default Frequency (EDF) as in Bharath and Shumway (2008)). The table also reports summary statistics (reported at the quarterly level) for other variables commonly used in the cross-sectional asset pricing literature, such as the Book-to-Market (B/M) ratio, the Investment-to-Capital (I/K) ratio, tangibility (the ratio of purchased capital (PPENTQ) to total assets (ATQ)), profitability (measured by Return on Equity (ROE) and Return on Assets (ROA)), leverage, and the Nini et al. (2012) investment and acquisition conservatism measures.

3.3 Lender Control Rights and Expected Stock Returns

In this section, we present the main empirical results of the paper on the relationship between loan covenant strictness and expected stock returns.

3.3.1 Portfolio Sorting

In this section we document a robust negative relationship between contemporaneous strictness and subsequent stock returns at the firm-level. Consistent with our theory, we show that this negative relationship is non-monotonic and comes from firms that are closest to technical default. Moreover, we argue that this relationship does not arise from financial distress.

In our first empirical exercise, we form five strictness-based portfolios of firms in every quarter, and compare monthly excess returns across these portfolios in subsequent quarters (as in Fama and French (1992), we allow a two-quarter lag for information to be incorporated into stock returns). Table 2 shows the characteristics of these strictness-based portfolios in our sample. The table shows that high-strictness firms have on average higher failure probability, EDF, book-to-market, and leverage than low-strictness firms, and that high-strictness firms have lower profitability (as measured by ROE), dividend payouts, and credit scores (as measured by firm ratings) than low-strictness firms. Our data shows no evidence of a relationship between strictness and investment to capital ratios, and weak evidence of a positive relationship between strictness and financial constraints as measured by the SA and WW indexes.

Table 2 shows that, unconditionally, firms in the high-strictness portfolio earn 40% of the average excess returns of firms in the low-strictness portfolio—the average excess return of firms in the high-strictness portfolio is 2.64%, while the average excess return of firms in the low-strictness portfolio is 6.76%. Moreover, the relationship between current strictness and future excess returns is non-linear: firms in the high-strictness portfolio earn only 25% of the excess returns earned by firms in the fourth portfolio. In other words, Table 2 suggests that negative relationship between strictness and returns is driven by high-strictness firms.

In Panel A of Table 3, we report excess returns and Newey and West (1987) t-statistics for the five strictness-based portfolios, for a strategy that goes long in the "High" portfolio and short in the fourth portfolio (High-4), for a strategy that goes long in the "High" portfolio and short in the "Low" portfolio (High-Low), and for a strategy that goes long in the fourth portfolio and short in the "Low" portfolio (4-Low). Four sets of results emerge from this panel. First, the High-Low portfolio earns a marginally significant negative excess return of 4.12% per year, confirming an overall negative relationship between strictness and expected returns.

Second, while a cursory look at the data seems to suggest a hump-shaped relationship between strictness and excess returns (the returns of the 4-Low portfolio are unconditionally positive and significant at the 10% level), this relationship becomes economically weaker when we control for standard risk factors, and insignificant at conventional statistical levels when we control for the Fama and French (2015) risk factors. Third, the data shows a significant drop in future excess returns for firms in the highest strictness quintile: the 4-High portfolio earns a statistically significant *negative* 7.72% annual return, which is only partially explained by differential exposure to the Fama and French (2015) factors.

Fourth, the difference in expected returns for firms in the fourth strictness portfolio and in the high-strictness portfolio is partly explained by differential exposure to the aggregate investment and profitability factors. We interpret these results as evidence that low-strictness firms have similar exposure to aggregate investment opportunities and profitability (Hou et al. (2015)), while firms close to technical default are more constrained in their investment choices. In the appendix, we confirm this intuition by showing similar results for the Hou et al. (2015) q-factors.

In Panel B of Table 3, we show that firms in the high-strictness portfolio exhibit statistically *higher* investment and acquisition conservatism than firms in the fourth portfolio. Firms in the high-strictness portfolio have around 3.6 times more conservative investment policies and around 3.8 more conservative acquisition policies than firms in the fourth portfolio. These results provide additional support for the intuition that technical default increases firms' conservativeness (Nini et al. (2012)), and confirm a non-monotonic relationship between strictness and risk consistent with our theoretical model and with the empirical results of Panel A.

3.3.2 Fama-MacBeth Regressions

In Table 4, we present estimates of Fama and MacBeth (1973) regressions of future monthly excess returns on strictness. We run monthly cross-sectional regressions of future excess return on strictness, and then average the estimates of these monthly cross-sectional regressions across all months in our sample. In Column (1), our Fama-MacBeth include firm size, book-to-market, reversal, leverage, and ROA as additional control variables.[16] In Columns (2) and (3), we respectively control for failure probability and EDF, to reduce concerns that our results might be driven by financial distress instead of technical default. In Column (4), we simultaneously control for failure probability and EDF. The results of Table 4 confirm the negative relationship between strictness and expected returns documented in Table 3, and show that this negative relationship is not driven by other firm-level variables potentially correlated with both strictness and returns.

In Table 5, we confirm the second insight of Table 3—that the negative relationship between strictness and expected returns is mainly driven by firms close to technical default. To do so, we repeat the same exercise as in Table 4, but we replace our continuous measure of lagged strictness with indicators for whether a firm belongs to a different quintile of the strictness distribution. Table 5 provides strong support for our main insight. The estimates from Column (1) show that relative to a firm in the low-strictness portfolio (representing the baseline categorical variable), a firm in the high-strictness portfolio earns around 0.3% lower monthly returns, or 3.6% annual returns, on average. The baseline result of Column (1) is both economically and statistically robust when controlling for failure probability and EDF in Columns (2)-(4), confirming that the non-linear relationship between strictness-return relationship of high-strictness firms is not driven by financial distress.

[16] In the appendix, we additionally include the SA Index and the WW Index measured at the annual level to control for financial constraints.

In Table 6, we provide another test to confirm that the negative and non-monotonic relationship between strictness and returns is not driven by distressed firms. Since the financial distress puzzle is driven by firms with high default probability (see, e.g., Garlappi and Yan (2011)), in Table 6 we drop from the sample firms above the 90^{th} percentile of the EDF distribution (Columns (1) and (2)) and above the 90^{th} percentile of the failure probability distribution (Columns (3) and (4)). In Panel A, we compute the strictness-based portfolios using cutoffs from the unconditional strictness distribution in each quarter (i.e., including distressed firms). In Panel B, we first drop distressed firms and then construct strictness-based portfolios in the resulting sample. Both panels show that the results of Table 5 hold in the sub-sample of non-distressed firms, confirming that our main results are not driven by the distress anomaly.

3.3.3 Additional Robustness

In the appendix, we perform a number of robustness tests on the results from the previous sections. First, we show that the results from Table 3 are robust to a different empirical specification for the process governing the (log) growth of firm-level financial ratios used to compute strictness.[17]. Second, we include the WW Index and the SA Index (measured at the annual level) to our Fama-MacBeth specifications from Table 4 to show that our results are not driven by financial constraints. Third, we repeat the exercise from Tables 4-6 using pooled OLS regressions instead of Fama-MacBeth regressions, where we keep the firm-month panel structure of the data instead of computing averages of monthly cross-sectional regressions. These pooled OLS results are both statistically and economically similar to those from Tables 4-6, and provide additional support for the presence of a non-linear negative relationship between loan covenant strictness and expected returns.

3.3.4 Covenant Violations

One possible concern is that our portfolio sorting results (which rely on an ex-ante measure of technical default, covenant strictness) may not be driven by changes in lenders' involvement in corporate policies if managers decrease the risk of their investments to avoid technical default. To address this

[17]Specifically, we replace the the process specified in Equation (26) with an AR(1) process for the evolution of the natural logarithm of firms' financial ratios

concern, in Table 7 we provide evidence of a decrease in returns *after* covenants are violated using a regression discontinuity design (RDD) framework (e.g., Chava and Roberts (2008)).

In Table 7, we study how future returns are affected by violations of the most common covenant type in DealScan, maximum Debt-to-EBITDA. In the first two columns of the table, we report estimates of the specification

$$\text{Ex. Ret.}_{i,t+1} = a + b \times \text{Violation}_{it} + c \times \text{Distance}_{it} + d \times \text{Violation}_{it} \times \text{Distance}_{it} + X_{it} + e_{it+1}, \qquad (30)$$

where $\text{Ex. Ret.}_{i,t+1}$ is firm i's future quarterly excess return, Violation_{it} is an indicator equal to one if firm i is in violation of its most restrictive Debt-to-EBITDA covenant in quarter t, Distance_{it} is the difference between firm i's Debt-to-EBITDA value and its most restrictive Debt-to-EBITDA covenant, and X_{it} is a matrix of time-varying controls including size, market-to-book, book leverage, and ROA.[18] The coefficient of interest in (30) is b, the average difference in conditional excess returns for firms breaching their Debt-to-EBITDA covenants, relative to firms not breaching these covenants.

The first two columns of Table 7 show that breaching a covenant is associated with a 31 to 44 basis point reduction in future excess returns, depending on the specification. These results are economically and statistically similar when we include time-varying controls and when we allow for higher-order functional dependencies between returns and distance to violations in Columns (2) and (3), and hold in narrow bandwidths around covenant breaches (see Figure 2 and the appendix). Overall, the evidence in Table 7, Figure 2, and the appendix supports our control rights reallocation hypothesis, and confirms strictness as a forward-looking measure of technical default.

4 Quantitative Model Analysis

In this section, we calibrate our model and evaluate its ability to replicate key moments of both macroeconomic quantities and asset prices at the aggregate level. More importantly, we investigate its performance in terms of quantitatively accounting for key features of firm characteristics and producing a technical default spread in the cross-section.

[18] In line with our portfolio sorting exercise, we allow for a two-quarter lag between our balance sheet measures and future returns. Our results are not sensitive to alternative lag choices.

Calibration. We calibrate the model at quarterly frequency to be consistent with our data. In Table 8, we list all parameters need to be calibrated in the model, and also describe the specific empirical moments which we use to pin down these parameters.

Aggregate Moments. We now turn to the quantitative performance of the model at the aggregate level. We solve and simulate our model at the quarterly frequency and aggregate the model-generated data to compute annual moments. We show that our model is broadly consistent with the key empirical features of macroeconomic quantities and asset prices. Importantly, it produces a reasonable set of aggregate moments on the financial market, including the level and standard deviation of risk-free rate, Sharpe ratio of the aggregate stock market, credit spread and the probability of technical default.

Table 9 reports the model-simulated moments of macroeconomic quantities and asset returns and compares them to their counterparts in the data.

Cross-section implications. We now turn to the implications of our model on the cross-section of covenant strictness-sorted portfolios. The aggregation property of the model allows us to solve the aggregate quantities and prices first, and then we simulate firms in the cross-section from the model. From the model simulation, we measure the covenant strictness of firm assets, and conduct the same covenant strictness-based portfolio-sorting procedure as in the data. In Table 10, we report the average returns of the sorted portfolios along with several other characteristics from the data and those from the simulated model.

As in the data, firms with high asset strictness have a significantly lower average return than those with low strictness in our model. Quantitatively, our model produces a sizable technical default spread of around 3%, broadly consistent with the magnitude we observe in the data. Importantly, we replicate the technical default spread which is driven by firms with highest levels of strictness both inside the model and data, where the shift of control rights is triggered due to technical default.

Table 10 also reports several other characteristics of the covenant strictness-sorted portfolios that are informative about the economic mechanism we emphasize in our model. First, not surprisingly, the failure probability is monotonically increasing for strictness-sorted portfolios. However, even for the highest strictness quintile, the average default probability is still reasonably low, and indicates the firms in this portfolio are still reasonably away from financial distress. This helps to distinguish our technical default spread from the financial distress anomaly.

Second, in the data, firm size is decreasing in strictness. This implication of our model is consistent with the data. In our model, other things being equal, firms that experienced a low realization of idiosyncratic ω shock, which are smaller in size by construction, are more closer to covenant violation threshold.

Further plans on quantitative analyses of the model. As this project is still work in progress, here we lay down our further plan on the quantitative analysis of the model. First, at the aggregate level, we plan to study the cyclical pattern of covenants and its impact on macroeconomic and asset pricing. We will demonstrate that covenants alter impulse response functions, relative to Bernanke et al. (1999), and show that the time varying tightness of covenants is an important state variable of the economy.

Second, we plan to focus on model's implications on the cross-section and demonstrate they are consistent with the data. Our model predicts that the covenant strictness sorted portfolios' returns and cash flows have different exposures to aggregate shocks, due to the allocation of control rights, the main mechanism we emphasize in our paper. Second, the time varying tightness of the covenants is expected to be an important state variable that drives the technical default spread conditionally.

5 Conclusion

We build a dynamic general equilibrium model in which endogenous loan covenants allocate investment control rights between borrowers and creditors, and study its asset pricing implications in the cross-section. When borrowers' expected cash flows fall below the endogenous loan covenant threshold, creditors take control and optimally choose less-risky projects. In turn, this reduces the firm's cost of equity. In the data, we find that firms that are closer to breaching a covenant earn on average 4% lower returns than firms for which covenants are less binding. Such covenant strictness spread is not related to the financial distress anomaly, and our risk-reduction channel is different from a risk transfer from equity holders to creditors as in shareholder recovery in default.

Figure 1

Covenant Strictness: Time Series and Cross-Section

This figure provides a graphical illustration of the time series and business cycle properties of the average covenant strictness in our sample (equally-weighted aross all firms). Strictness is defined as in Section 3.1. The sample starts with the first quarter of 1996 and ends with the last quarter of 2017.

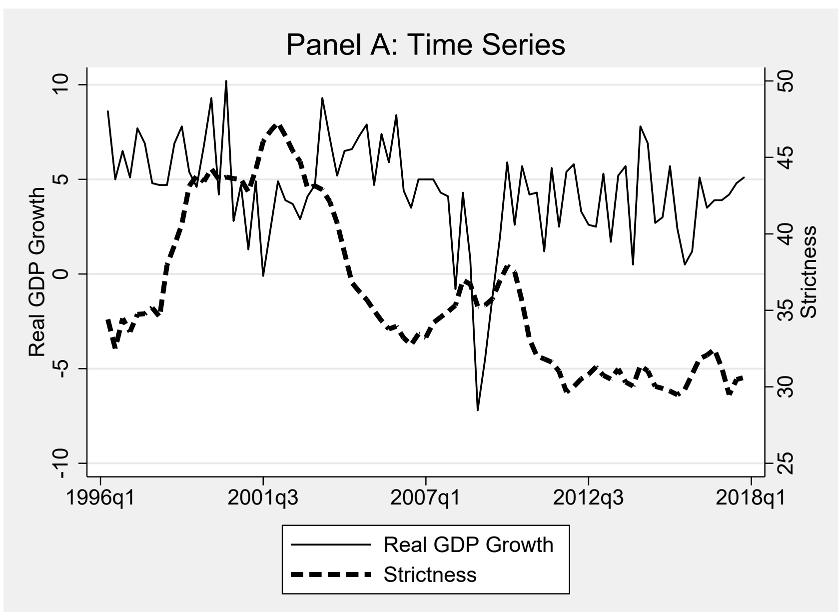

Figure 2

Covenant Violations and Stock Returns

This figure plots average annualized excess returns against a firm's distance from the Debt-to-EBITDA covenant threshold (the most common covenant in DealScan database). Observations to the right of the zero vertical line correspond to covenant violations. Each circle represents average excess returns within 28 equally-spaced distance bins around the threshold. The solid lines are fitted values from local polynomial regressions on either side of the threshold, and the dashed line are 95% confidence intervals for these estimates (using bootstrapped standard errors). The sample starts with the first quarter of 1996 and ends with the last quarter of 2017.

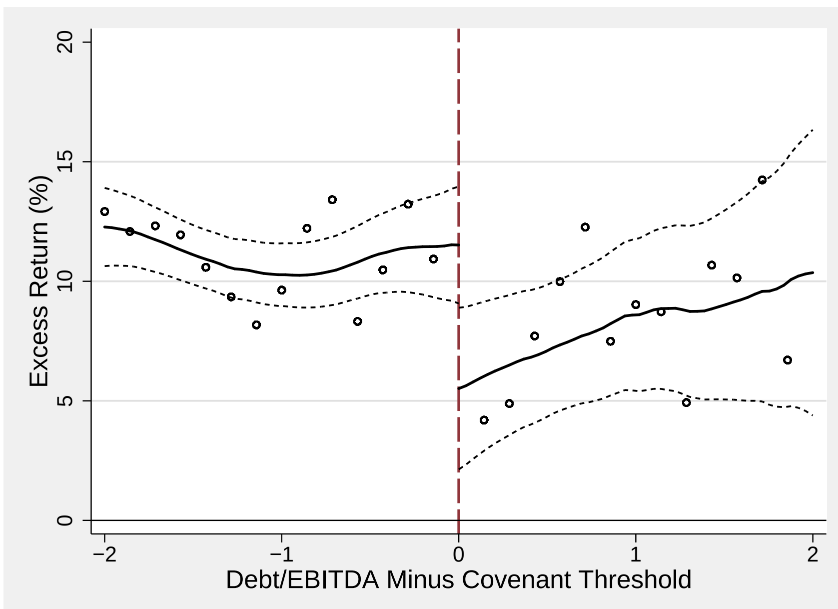

Table 1

Summary Statistics, 1996-2016

This table presents summary statistics for the main variables in the paper over the period 1996-2016. The Whited-Wu (WW) Index and the the Size-and-Age (SA) Index are constructed as in Whited and Wu (2006) and Hadlock and Pierce (2010), respectively. Strictness is constructed as described as in Section 3.1. Failure probability (Pr(Failure)) and expected default frequency are constructed following Campbell et al. (2008) and Bharath and Shumway (2008), respectively. B/M is the book-to-market ratio (the book value of a firm's equity (SEQQ) divided by the market value of the firm's outstanding shares). Investment rate (I/K) is investment (CAPXQ) over property, plant and equipment (PPENTQ). Tangibility is the ratio of purchased capital (PPENTQ) to total assets (ATQ). Rating is a discrete score based on the firm's credit rating, Return on Equity (ROE) is net income divided by firm's book value of equity, and Return on Assets (ROA) is the ratio of operating income before depreciation (OIBDPQ) over total assets (ATQ). Book leverage is the sum of long-term liabilities (DLTTQ) and current liabilities (DLCQ) divided by total assets (ATQ). Size is the natural log of firm's market capitalization. Leverage ratio is the sum of long-term liabilities (DLTTQ) and current liabilities (DLCQ) divided by stockholders' Equity (SEQQ). Reversal is the firm's one-month lagged return. Δ CAPX/Asset is the year-on-year difference in capital expenditures (CAPXQ) scaled by average assets over the same period, Δ ACQU/Asset is the year-on-year difference in cash acquisitions (CHEQ) scaled by average assets over the same period, this two variables are constructed as in Nini et al. (2012). The WW Index and the SA Index are measured at the annual frequency. Size and Reversal are measured at the monthly frequency. All the remaining variables are measured at the quarterly frequency.

	Mean	SD	p25	p50	p75	Observations
WW Index	-0.33	0.09	-0.40	-0.33	-0.26	23,874
SA Index	-3.73	0.64	-4.32	-3.66	-3.28	24,796
Strictness (pp)	35.09	36.52	1.12	20.09	67.68	83,025
Pr(Failure) (pp)	0.29	1.27	0.02	0.03	0.08	82,727
EDF (pp)	4.54	14.63	0.00	0.00	0.12	81,290
B/M	0.73	0.61	0.35	0.57	0.90	82,721
I/K	0.05	0.09	0.01	0.03	0.06	66,483
Tangibility	0.32	0.25	0.12	0.25	0.48	82,363
Rating	1.71	1.84	0.00	1.00	3.00	83,025
ROE (pp)	2.38	7.38	0.62	2.47	4.44	82,976
ROA (pp)	0.90	2.24	0.24	1.03	1.90	83,007
Leverage Ratio	1.28	2.28	0.32	0.67	1.28	82,553
Size	6.70	1.89	5.42	6.79	8.04	247,168
Reversal	0.99	13.04	-5.75	0.74	7.18	248,012
Δ CAPX/Asset	-0.10	1.34	-0.35	-0.01	0.26	77,964
Δ ACQU/Asset	-0.21	4.49	0.00	0.00	0.00	74,534

Table 2

Characteristics of Strictness-Based Portfolios

This table reports time-series averages of the cross-sectional averages of firm characteristics in five portfolios sorted by loan covenant strictness. The sample period starts in January 1996 and ends in December 2016, and the sample excludes financial and utility industries. All the variables are computed as in Table 1.

	Low	2	3	4	High
Strictness (pp)	0.13	5.10	23.36	56.41	92.75
Excess Return (pp)	6.76	8.40	6.90	10.36	2.64
Pr(Failure) (pp)	0.07	0.08	0.16	0.30	0.35
EDF (pp)	0.27	0.49	1.23	1.88	3.94
B/M	0.38	0.43	0.45	0.51	0.57
Size	10.19	10.07	9.86	9.63	9.74
I/K	0.05	0.05	0.04	0.04	0.05
ROE (pp)	6.17	4.96	4.80	3.70	1.77
Dividend Payout	0.80	0.72	0.64	0.53	0.48
Rating Score	4.06	3.64	3.34	2.97	2.87
Book Leverage	0.20	0.27	0.32	0.35	0.42
Leverage Ratio	0.85	0.98	1.32	1.69	2.20
SA Index	-4.23	-4.18	-4.10	-4.05	-4.04
WW Index	-0.46	-0.44	-0.42	-0.41	-0.41
Δ CAPX/Asset	-0.08	-0.03	-0.03	-0.03	-0.11
Δ ACQU/Asset	-0.18	-0.10	-0.19	-0.09	-0.34
Average Number of Firms	161.36	175.81	175.62	175.57	174.76

Table 3

Portfolios Sorted on Strictness

This table reports value weighted excess return and two investment conservatism measures for strictness-sorted portfolios. The sample starts in January 1996 and ends in December 2016, and it excludes financial and utility industries. In Panel A, we compute the annualized average monthly value-weighted excess returns for strictness-sorted portfolios, and their alphas and betas from the Fama and French (2015) five factor model. Portfolios are rebalanced at the end of each quarter. Firm's monthly returns are annualized and expressed in percentage terms. The *t*-statistics are estimated following Newey and West (1987). In Panel B, we repeat the same portfolio sorting procedures replacing excess returns and alphas with the Nini et al. (2012) investment conservatism measures Δ CAPX/Asset, and Δ ACQU/Asset described in Table 1. The results of this table suggest non-monotonic negative relationships between strictness and excess returns and between strictness and investment conservatism, all driven by high-strictness firms.

Panel A: Excess Returns for Strictness-sorted Portfolios

	Low	2	3	4	High	High-4	High-Low	4-Low
Excess Return (pp)	6.76*	8.40**	6.90*	10.36**	2.64	-7.72**	-4.12	3.60*
t-stat.	1.90	2.27	1.83	2.59	0.49	-2.32	-1.52	1.88
α^{FF5}	-2.76*	-2.03	-3.06	-0.79	-6.56***	-5.77*	-3.80	1.97
t-stat.	-1.84	-1.12	-1.45	-0.42	-2.68	-1.97	-1.64	1.19
β^{MKT}	1.06***	1.03***	1.08***	1.09***	1.18***	0.10	0.12*	0.02
t-stat.	30.64	27.18	29.53	21.09	24.88	1.58	1.88	0.56
β^{SMB}	0.09	0.24***	0.19***	0.30***	0.37***	0.07	0.28***	0.21***
t-stat.	1.70	3.55	2.75	4.31	6.37	0.85	3.09	3.53
β^{HML}	0.05	0.02	0.12*	0.17	0.21**	0.04	0.17**	0.13
t-stat.	0.58	0.18	1.69	1.31	2.18	0.37	2.03	1.41
β^{RMW}	0.29***	0.45***	0.32***	0.39***	-0.09	-0.48***	-0.37***	0.10
t-stat.	4.86	4.65	4.42	4.74	-0.68	-3.82	-2.75	1.38
β^{CMA}	0.06	0.13	-0.02	0.13	-0.25	-0.37***	-0.30*	0.07
t-stat.	0.80	1.28	-0.17	1.23	-1.57	-2.64	-1.87	0.76

Panel B: Investment Conservatism Measures for Strictness-sorted Portfolios

	Low	2	3	4	High	High-4	High-Low	4-Low
Δ CAPX/Asset	-0.08*	-0.03	-0.03	-0.03	-0.11*	-0.08*	-0.03	0.04*
t-stat.	-1.78	-1.10	-1.00	-0.77	-1.80	-1.94	-0.66	1.66
Δ ACQU/Asset	-0.18***	-0.10	-0.19***	-0.09	-0.34***	-0.25**	-0.17	0.08
t-stat.	-2.99	-1.09	-2.96	-1.12	-3.15	-2.36	-1.58	0.97

Table 4

Fama-MacBeth Regressions on Strictness

This table presents the results of our Fama-MacBeth analysis of the link between excess returns and strictness. The table reports average coefficients of monthly cross-sectional regressions of monthly excess returns on lagged strictness and other control variables (as in Fama and French (1992), we allow for a six-month lag between independent variables and excess returns). Column (1) is our baseline specification. Columns (2)-(4) augment this baseline specification to control for failure probability and EDF. All variables are computed as in Table 1. The sample starts in January 1996 and ends in December 2016.

	Dependent Variable: Monthly Excess Returns			
	(1)	(2)	(3)	(4)
Strictness	-0.357***	-0.327***	-0.364***	-0.330***
	(0.12)	(0.12)	(0.12)	(0.12)
Size	-0.088*	-0.100**	-0.066	-0.079*
	(0.05)	(0.05)	(0.05)	(0.05)
Log B/M	0.141	0.136	0.081	0.075
	(0.13)	(0.12)	(0.12)	(0.11)
Reversal	-0.016**	-0.016**	-0.016**	-0.017**
	(0.01)	(0.01)	(0.01)	(0.01)
Book Leverage	-0.112	-0.081	-0.415	-0.407
	(0.48)	(0.47)	(0.46)	(0.46)
ROA	5.082	3.217	5.139	3.376
	(3.87)	(3.53)	(3.65)	(3.42)
Pr(Failure)		-80.929**		-91.997***
		(31.79)		(28.05)
EDF			0.192	2.272
			(2.48)	(2.41)
R-Squared	0.041	0.047	0.049	0.054
Observations	219,331	218,952	214,750	214,699

Note: Newey-West standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 5

Fama-MacBeth Regressions on Strictness Portfolio Indicators

This table shows that the negative relationship between expected returns and strictness comes from high-strictness firms. We repeat the same exercise as in Table 4, but we replace our continuous measure of lagged strictness with indicators for whether a firm belongs to a different quintile of the strictness distribution two quarters before the excess returns' realization. As in Table 3, strictness portfolios are constructed quarterly. The low-strictness portfolio represents our baseline portfolio, and hence is omitted from our regressions. The sample starts in January 1996 and ends in December 2016.

	Dependent Variable: Monthly Excess Returns			
	(1)	(2)	(3)	(4)
Str. Portfolio 2	0.013	0.011	0.038	0.027
	(0.09)	(0.09)	(0.08)	(0.08)
Str. Portfolio 3	-0.026	-0.034	0.002	-0.008
	(0.10)	(0.09)	(0.08)	(0.08)
Str. Portfolio 4	-0.162	-0.169	-0.147	-0.147
	(0.11)	(0.11)	(0.11)	(0.10)
High Str. Portfolio	-0.310**	-0.296**	-0.317**	-0.298**
	(0.12)	(0.12)	(0.13)	(0.13)
Pr(Failure)		-84.430***		-94.865***
		(32.18)		(28.83)
EDF			0.119	2.216
			(2.52)	(2.42)
Other Controls	Yes	Yes	Yes	Yes
R-Squared	0.044	0.050	0.052	0.057
Observations	219,247	218,872	214,669	214,619

Note: Newey-West standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 6

Fama-MacBeth Regressions: Non-Distressed Firms

This table shows that the negative, non-monotonic relationship between expected returns and strictness is not generated by financially-distressed firms (Garlappi and Yan (2011)). In practice, we repeat the same exercise as in Table 5, but we drop firms above the 90^{th} percentile of the EDF distribution (Columns (1) and (2)) and above the 90^{th} percentile of the failure probability distribution (Columns (3) and (4)). In Panel A, we compute the strictness-based portfolios using cutoffs from the unconditional strictness distribution in each quarter (i.e., including distressed firms). In Panel B, we first drop distressed firms and then compute the strictness-based portfolios in the resulting sample. The sample starts in January 1996 and ends in December 2016.

Panel A: Unconditional Portfolio Dummies

	EDF $\leq$ 90th Percentile		Pr(Failure) $\leq$ 90th Percentile	
	(1)	(2)	(3)	(4)
Str. Portfolio 2	-0.005	0.011	0.022	0.031
	(0.08)	(0.08)	(0.08)	(0.08)
Str. Portfolio 3	-0.097	-0.072	-0.096	-0.085
	(0.08)	(0.08)	(0.08)	(0.08)
Str. Portfolio 4	-0.203**	-0.171*	-0.156*	-0.139
	(0.10)	(0.10)	(0.09)	(0.09)
High Str. Portfolio	-0.328**	-0.308**	-0.347***	-0.324**
	(0.14)	(0.14)	(0.13)	(0.14)
Distress Controls	No	Yes	No	Yes
Other Controls	Yes	Yes	Yes	Yes
R-Squared	0.044	0.052	0.041	0.051
Observations	193,327	193,281	197,033	193,338

Panel B: Conditional Portfolio Dummies

	EDF $\leq$ 90th Percentile		Pr(Failure) $\leq$ 90th Percentile	
	(1)	(2)	(3)	(4)
Str. Portfolio 2	0.028	0.040	0.049	0.056
	(0.09)	(0.09)	(0.08)	(0.08)
Str. Portfolio 3	-0.094	-0.072	-0.122	-0.109
	(0.08)	(0.08)	(0.09)	(0.09)
Str. Portfolio 4	-0.127	-0.096	-0.081	-0.060
	(0.10)	(0.09)	(0.09)	(0.09)
High Str. Portfolio	-0.286**	-0.266**	-0.311**	-0.299**
	(0.13)	(0.13)	(0.12)	(0.13)
Distress Controls	No	Yes	No	Yes
Other Controls	Yes	Yes	Yes	Yes
R-Squared	0.044	0.052	0.041	0.051
Observations	193,327	193,281	197,033	193,338

Note: Newey-West standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 7

RDD Regressions: Covenant Violations and Future Returns

This table presents estimates of the RDD specification (30) using maximum Debt-to-EBITDA violations. Violation_{it} is a dummy variable equal to 1 if firm i's' Debt-to-EBITDA ratio exceeds its most restrictive covenant threshold in quarter t. Distance_{it} is the difference between firm i's actual Debt-to-EBITDA ratio and its most restrictive covenant value. The sample starts in January 1996 and ends in December 2016.

	Dependent Variable: Excess Returns		
	(1)	(2)	(3)
Violation	-0.443***	-0.309***	-0.272*
	(0.11)	(0.11)	(0.15)
Distance	0.134***	0.109***	-0.017
	(0.03)	(0.03)	(0.07)
Violation × Distance	-0.224***	-0.180***	0.083
	(0.04)	(0.04)	(0.13)
Size		-0.021	-0.024
		(0.02)	(0.02)
Log B/M		0.068	0.076
		(0.05)	(0.05)
Book Leverage		-0.475**	-0.309
		(0.21)	(0.23)
ROA		4.407***	3.981**
		(1.60)	(1.62)
High Order Polynomials	No	No	Yes
Year-Quarter FE	Yes	Yes	Yes
R-Squared	0.214	0.220	0.220
Observations	67,591	64,451	64,451

Note: Standard errors (in parentheses) are clustered at the firm level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 8

Calibrated Parameter Values

This table lists the parameter values used to solve and simulate the model. We calibrate the model at the quarterly frequency.

Parameters	Symbol	Value
Discount factor	β	0.97
Relative risk aversion	γ	10
IES	ψ	2
Wage function	η	0.20
Capital share	α	0.3
Depreciation rate	δ	2.5%
Loss in Default	ζ	0.3
Persistence of TFP Shock	ρ_z	0.95
SD of TFP Shock	σ_z	0.007
steady state TFP Shock	$\bar{z}$	0
Mean of ω^0 distribution	μ_0	-0.5
SD of ω^0 distribution	σ_0	1
Mean of ω^1 distribution	μ_1	-0.5
SD of ω^1 distribution	σ_1	1

Table 9

Key Aggregate Moments under the Benchmark Parametrization

This table reports a set of key moments generated under the benchmark parameters reported in Table 8. The data source for average Sharpe ratio is from Campbell and Cochrane (1999), the data moments for real interest rate are from Campbell John Y. and Craig (1997).The average annual credit spread calculated using corporate bond data from the website of Federal Reserve Bank of St. Louis, and average quarterly probability of technical default is calculated as the fraction of firms that reported covenant violation in each quarter using covenant violation data from Thomas P. Griffin (2018).

Moments	Data	Model
Average annual risk-free rate $E[R_D]$	1%	1%
Average annual volatility of real interest rate $\sigma(R_D)$	1%	0.9 %
Average annual Sharpe ratio $\frac{E[R_D]}{\sigma(R_D)}$	0.45	0.35
Average annual credit spread $E\left(R^L - R^f\right)$	2.5%	2.0%
Average quarterly probability of technical default Prob$(\omega < \bar{\omega})$	4.7%	5.0 %

Table 10

Cross-Section Firm Characteristics and Expected Return

This table shows model simulated moments and their counterparts for portfolios sorted on strictness measure. The sample period is from January 1996 to December 2016. Panel A reports the statistics computed in the data. Panel B reports the statistic computed from the simulated data. In the simulated data, strictness measure is calculate as $\omega_{i,t+1} - \bar{\omega}_t$, size is the the level of net worth $N_{i,t}$, Age is the survival periods n, and Failure Probability is calculated as the probability of Prob($R^K_{t+1} < \hat{R}^K_{t+1}$)(%).

Panel A: Data

Firm Characteristics	Low	2	3	4	High
Strictness (pp)	0.13	5.10	23.36	56.41	92.75
Excess Return (pp)	6.76	8.40	6.90	10.36	2.64
Pr(Failure) (pp)	0.08	0.08	0.20	0.33	0.36
Size	10.19	10.07	9.86	9.63	9.74

Panel B: Model

Firm Characteristics	Low	2	3	4	High
Excess return (pp)	5.52	5.58	5.62	5.68	2.50

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A Appendix to Model Section

A.1 The Capital Goods Producer

The capital goods producer uses I_t amount of consumption goods to produce new capital using the technology

$$\Phi\left(\frac{I_t}{K_t}\right) K_t. \tag{A.1}$$

Following Jermann (1998), we let

$$\Phi\left(\frac{I_t}{K_t}\right) = \left[\frac{a_1}{1-\frac{1}{\xi}}\left(\frac{I_t}{K_t}\right)^{1-\frac{1}{\xi}} + a_2\right], \tag{A.2}$$

where a_1 and a_2 are set such that there are no adjustment costs in our model's deterministic steady state, and ξ represents the elasticity of new capital investments relative to the existing stock of capital. The law of motion of aggregate capital is therefore

$$K_{t+1} = \Phi\left(\frac{I_t}{K_t}\right) K_t + (1-\delta)K_t, \tag{A.3}$$

and taking the capital price Q_t as given, the capital producer's optimal choice of investment I_t implies

$$Q_t = \left[\Phi'\left(\frac{I_t}{K_t}\right)\right]^{-1}. \tag{A.4}$$

A.2 Competitive Equilibrium

A competitive equilibrium is a set of quantities for the household $\left\{C_t, D_t^H, L_t\right\}_{t=0}^{\infty}$, quantities for entrepreneurs $\left\{N_{i,t}, K_{i,t}, B_{i,t}, D_{i,t}^E, \bar{\omega}_{i,t}^0\right\}_{t=0}^{\infty}$, quantities for the national bank $\{B_t\}_{t=0}^{\infty}$, quantities for the capital goods producer $\{I_t, K_t\}_{t=0}^{\infty}$ and prices $\left\{R_t^D, R_{i,t}^B, Q_t, R_t^K\right\}_{t=0}^{\infty}$, such that given prices, these quantities solve household's, bank's, capital goods producer's and entrepreneurs' maximization problems, firm maximize their profits, and market clear. The market clearing conditions are

$$K_t = \int K_{i,t} di, \tag{A.5}$$

$$L_t = \int L_{i,t} di = 1, \tag{A.6}$$

$$B_t = H_t N_t = D_t^H + D_t^E, \tag{A.7}$$

and

$$Y_t = C_t + I_t + \zeta N_t \int_{\bar{\omega}_{t-1}^0}^{\infty} \int_{-\infty}^{\hat{\omega}_t^1} \exp\left(\omega_t^0 + \omega_t^1\right) R_t^K \left(1 + H_{t-1}\right) dF\left(\omega_t^1\right) dF\left(\omega_t^0\right). \tag{A.8}$$

A.3 Proof of Proposition 1

We start by showing that when lender is in control, $\theta^L = 0$. Applying Leibniz's rule to (17) and taking the derivative of (17) with respect to $\theta_{i,t}^L$,

$$\begin{aligned}
\frac{\partial W^L\left(\theta_{i,t}^L\right)}{\partial \theta_{i,t}^L} &= -\mathbb{E}_t\left\{M_{t+1} R_{i,t+1}^{B,L} B_{i,t} \frac{\partial \hat{\omega}_{i,t+1}^1}{\partial \theta_{i,t}^L} f_1(\hat{\omega}_{i,t+1}^1)\right\} \\
&\quad + \mathbb{E}_t\left\{M_{t+1}(1-\zeta)\left[\theta_{i,t}^L \exp\left(\omega_{i,t+1}^0 + \hat{\omega}_{i,t+1}^1\right) R_{t+1}^K + \left(1-\theta_{i,t}^L\right) R_{t+1}^D\right] A_{i,t} f_1(\hat{\omega}_{i,t+1}^1) \frac{\partial \hat{\omega}_{i,t+1}^1}{\partial \theta_{i,t}^L}\right\} \\
&\quad + \mathbb{E}_t\left\{M_{t+1} \int_{-\infty}^{\hat{\omega}_{i,t+1}^1} \left\{(1-\zeta)\left[\exp\left(\omega_{i,t+1}^0 + \omega_{i,t+1}^1\right) R_{t+1}^K - R_{t+1}^D\right] A_{i,t}\right\} dF\left(\hat{\omega}_{i,t+1}^1\right)\right\}, \quad \text{(A.9)} \\
&= -\mathbb{E}_t\left\{M_{t+1} \zeta R_{i,t+1}^{B,L} B_{i,t} f_1(\hat{\omega}_{i,t+1}^1) \frac{\partial \hat{\omega}_{i,t+1}^1}{\partial \theta_{i,t}^L}\right\} \\
&\quad + \mathbb{E}_t\left\{M_{t+1} \int_{-\infty}^{\hat{\omega}_{i,t+1}^1} \left\{(1-\zeta)\left[\exp\left(\omega_{i,t+1}^0 + \omega_{i,t+1}^1\right) R_{t+1}^K - R_{t+1}^D\right] A_{i,t}\right\} dF\left(\hat{\omega}_{i,t+1}^1\right)\right\}, \quad \text{(A.10)}
\end{aligned}$$

where the second equality follows from Equation (14), and where $f_1(\cdot)$ is the probability density function of ω^1. From Equation (14), we have

$$\frac{\partial \hat{\omega}_{i,t+1}^1}{\partial \theta_{i,t}^L} = \frac{R_{t+1}^D A_{i,t} - R_{i,t+1}^{B,L} B_{i,t}}{\theta_{i,t}^L \left(R_{i,t+1}^{B,L} B_{i,t} - \left(1-\theta_{i,t}^L\right) R_{t+1}^D A_{i,t}\right)}. \tag{A.11}$$

Plugging (A.11) into (A.10), and noting that, for $\omega_{i,t+1}^1 < \hat{\omega}_{i,t+1}^1$,

$$\begin{aligned}
\left[\exp\left(\omega_{i,t+1}^0 + \omega_{i,t+1}^1\right) R_{t+1}^K - R_{t+1}^D\right] A_{i,t} &< \left[\exp\left(\omega_{i,t+1}^0 + \hat{\omega}_{i,t+1}^1\right) R_{t+1}^K - R_{t+1}^D\right] A_{i,t}, && \text{(A.12)} \\
&= \frac{R_{i,t+1}^{B,L} B_{i,t} - R_{t+1}^D A_{i,t}}{\theta_{i,t}^L}, && \text{(A.13)}
\end{aligned}$$

we obtain

$$\frac{\partial W^L\left(\theta^L_{i,t}\right)}{\partial\theta^L_{i,t}} \leq -\mathbb{E}_t\left\{M_{t+1}\zeta R^{B,L}_{i,t+1}B_{i,t}f(\hat{\omega}^1_{i,t+1})\frac{\partial\hat{\omega}^1_{i,t+1}}{\partial\theta^L_{i,t}}\right\}+(1-\zeta)\mathbb{E}_t\left\{M_{t+1}\frac{R^{B,L}_{i,t+1}B_{i,t}-R^D_{t+1}A_{i,t}}{\theta^L_{i,t}}F\left(\hat{\omega}^1_{i,t+1}\right)\right\}, \tag{A.14}$$

$$= \frac{R^{B,L}_{i,t+1}B_{i,t}-R^D_{t+1}A_{i,t}}{\theta^L_{i,t}}\mathbb{E}_t\left\{M_{t+1}\left[\underbrace{\frac{\zeta R^{B,L}_{i,t+1}B_{i,t}f(\hat{\omega}^1_{i,t+1})}{\left(R^{B,L}_{i,t+1}B_{i,t}-(1-\theta^L_{i,t})R^D_{t+1}A_{i,t}\right)}}_{>0}+\underbrace{(1-\zeta)F\left(\hat{\omega}^1_{i,t+1}\right)}_{>0}\right]\right\}. \tag{A.15}$$

Given our maintained assumption that in all contracts $R^B_{i,t+1}B_{i,t} < R^D_{i,t+1}A_{i,t}$, and given the positive correlation between M_{t+1} and the default cutoff value $\hat{\omega}^1_{i,t+1}$ (both M_{t+1} and $\hat{\omega}^1_{i,t+1}$ are negatively correlated to the aggregate states), it follows that $\partial W^L\left(\theta^L_{i,t}\right)/\partial\theta^L_{i,t} < 0$, and therefore $\theta^L = 0$. Since the lender invests all of the firm's resources in the risk-free asset, it follows that $R^{B,L}_{i,t+1} = R^D_{t+1}$.

Next, we show that when the entrepreneur is in control, then $\theta^E = 1$. Unlike for the lender, the sign of

$$\frac{\partial V^E\left(\theta^E_{i,t}\right)}{\partial\theta^E_{i,t}} = \mathbb{E}_t\left\{M_{t+1}\int_{\hat{\omega}^1_{i,t+1}}^{\infty}\left\{\left[\exp\left(\omega^0_{i,t+1}+\omega^1_{i,t+1}\right)R^K_{t+1}-R^D_{t+1}\right]A_{i,t}\right\}dF\left(\hat{\omega}^1_{i,t+1}\right)\right\} \tag{A.16}$$

is ambiguous. This ambiguity arises because increasing $\theta^E_{i,t}$ leads to higher expected payoffs on the upside but it also increases the default cutoff value and the entrepreneur's default probability.[A.1] However, since

$$\frac{\partial^2 V^E\left(\theta^E_{i,t}\right)}{\partial\theta^{E,2}_{i,t}} = \mathbb{E}_t\left\{\frac{\left(R^{B,E}_{i,t+1}B_{i,t}-R^D_{t+1}A_{i,t}\right)^2}{\left(\theta^E_{i,t}\right)^2\left(R^{B,E}_{i,t+1}B_{i,t}-(1-\theta^E_{i,t})R^D_{t+1}A_{i,t}\right)}f(\hat{\omega}^1_{i,t+1})\right\} \geq 0, \tag{A.17}$$

$V^E\left(\theta^E_{i,t}\right)$ is convex in $\theta^E_{i,t}$, implying corner solutions for θ^E. In the following lemma, we prove the important intermediate result that there exists a *unique* $\tilde{\omega}^0$ such that for all realizations of ω^0 above $\tilde{\omega}^0$, the entrepreneur chooses $\theta^E = 1$, and for all realizations of ω^0 below $\tilde{\omega}^0$, the entrepreneur chooses $\theta^E = 0$.

Lemma A.1. *There exists an unique $\tilde{\omega}^0_{i,t+1}$ such that for any $\omega^0_{i,t+1} \geq \tilde{\omega}^0_{i,t+1}$, $\theta^E_{i,t} = 1$, and for any $\omega^0_{i,t+1} <$*

[A.1] This is clear from (A.11). When $R^{B,E}_{i,t+1}B_{i,t}/< R^D_{t+1}A_{i,t}$, then $\partial\hat{\omega}^1_{i,t+1}/\partial\theta_{i,t} > 0$.

$\tilde{\omega}^0_{i,t+1}$, $\theta^E_{i,t} = 0$.

Proof. Fix $R^B_{i,t+1}$ and $B_{i,t}$. If $\theta^E_{i,t} = 0$, since $A_{i,t}R^D_{t+1} > R^{B,E}_{i,t+1}B_{i,t}$, the default cutoff $\hat{\omega}^1_{i,t+1}$ in (14) is not defined, and the value of the entrepreneur can be written as

$$V^E\left(\theta^E_{i,t} = 0\right) = \mathbb{E}_t\left\{M_{t+1}\left(R^D_{t+1}A_{i,t} - R^{B,E}_{i,t+1}B_{i,t}\right)\right\}, \tag{A.18}$$

which is independent on the realization of $\omega^0_{i,t+1}$. On the other hand, if $\theta^E_{i,t} = 1$, the value of entrepreneur can be written as

$$V^E\left(\theta^E_{i,t} = 1\right) = \mathbb{E}_t\left\{M_{t+1}\int_{\hat{\omega}^1_{i,t+1}}^{\infty}\left\{\exp\left(\omega_{i,t+1}\right)R^K_{t+1}A_{i,t} - R^{B,E}_{i,t+1}B_{i,t}\right\}dF\left(\omega^1_{i,t+1}\right)\right\}. \tag{A.19}$$

Taking the derivative of (A.19) with respect to $\omega^0_{i,t+1}$ gives

$$\frac{\partial V^E\left(\theta^E_{i,t} = 1\right)}{\partial \omega^0_{i,t+1}} = \mathbb{E}_t\left\{M_{t+1}\int_{\hat{\omega}^1_{i,t+1}}^{\infty}\exp\left(\omega_{i,t+1}\right)R^K_{t+1}A_{i,t}dF\left(\omega^1_{i,t+1}\right)\right\} > 0, \tag{A.20}$$

which means that the value of the entrepreneur in control is monotonically increasing in the realization of $\omega^0_{i,t+1}$. Moreover, consider the limiting case $\omega^0_{i,t+1} \to -\infty$. From (A.11), we have

$$\lim_{\omega^0_{i,t+1}\to-\infty}\hat{\omega}^1_{i,t+1} = \lim_{\omega^0_{i,t+1}\to-\infty}\ln\left(\frac{R^{B,E}_{i,t+1}B_{i,t}}{\exp\left(\omega^0_{i,t+1}\right)R^K_{t+1}A_{i,t}}\right) \to \infty. \tag{A.21}$$

Therefore, $V^E\left(\theta^E_{i,t} = 1\right) \to 0$ when $\omega^0_{i,t+1} \to -\infty$. In the the limiting case where $\omega^0_{i,t+1} \to \infty$,

$$\lim_{\omega^0_{i,t+1}\to\infty}\hat{\omega}^1_{i,t+1} = \lim_{\omega^0_{i,t+1}\to\infty}\ln\left(\frac{R^{B,E}_{i,t+1}B_{i,t}}{\exp\left(\omega^0_{i,t+1}\right)R^K_{t+1}A_{i,t}}\right) \to -\infty, \tag{A.22}$$

and $V^E\left(\theta^E_{i,t} = 1\right) \to \infty$. Since $V^E\left(\theta^E_{i,t} = 1\right)$ is monotonically increasing from 0 to ∞ within the domain of $\omega^0_{i,t+1}$ while $V^E\left(\theta^E_{i,t} = 0\right)$ is strictly positive and independent of $\omega^0_{i,t+1}$, there exists a unique crossing point $\tilde{\omega}^0_{i,t+1}$, such that $V^E\left(\theta^E_{i,t} = 1\right) = V^E\left(\theta^E_{i,t} = 0\right)$. For any $\omega^0_{i,t+1} > \tilde{\omega}^0_{i,t+1}$, $V^E\left(\theta^E_{i,t} = 1\right) > V^E\left(\theta^E_{i,t} = 0\right)$, and it is optimal for the entrepreneur to choose $\theta^E_{i,t} = 1$. For any $\omega^0_{i,t+1} < \tilde{\omega}^0_{i,t+1}$,

$V^E\left(\theta^E_{i,t}=1\right) < V^E\left(\theta^E_{i,t}=0\right)$, and it is the optimal for the entrepreneur to choose $\theta^E_{i,t}=0$. □

Using this intermediate result, we can show that the entrepreneur in control *always* chooses $\theta^E_{i,t}=1$. We do so by showing that the optimal contract $\Theta \equiv \{R^B, B, \bar{\omega}^0\}$ has to be such that $\bar{\omega}^0_{i,t+1} \geq \tilde{\omega}^0_{i,t+1}(\Theta)$. We proceed by contradiction. Suppose that the optimal contract Θ is such that $\bar{\omega}^0_{i,t+1} < \tilde{\omega}^0_{i,t+1}(\Theta)$. By Lemma A.1, for any realization of $\omega^0_{i,t+1}$ such that $\bar{\omega}^0_{i,t+1} < \omega^0_{i,t+1} < \tilde{\omega}^0_{i,t+1}(\Theta)$, the entrepreneur chooses $\theta^E_{i,t}=0$ and obtains payoff $V^E\left(\theta^E_{i,t}=0\right) = \mathbb{E}_t\left\{M_{t+1}\left(R^D_{t+1}A_{i,t} - R^{B,E}_{i,t+1}B_{i,t}\right)\right\}$. However, if the entrepreneur were to give control rights to the lender, she would get $V^L\left(\theta^L_{i,t}=0\right) = \mathbb{E}_t\left\{M_{t+1}\left(R^D_{t+1}A_{i,t} - R^D_{t+1}B_{i,t}\right)\right\}$. Since $R^{B,E}_{i,t+1}$ carries compensation for credit risk, it must be that $R^{B,E}_{i,t+1} > R^D_{t+1}$, by which $V^E\left(\theta^E_{i,t}=0\right) < V^L\left(\theta^L_{i,t}=0\right)$, a contradiction with the optimality of Θ.

A.4 Proof of Proposition 2

To prove our statement, we show that our maximization problem can be expressed in terms of the entrepreneur's debt-to-net worth ratio $H_{i,t} = B_{i,t}/N_{i,t}$. First, note that since $N_{i,t}$ is a state variable, the contract terms that maximize (19)-(20) also solve

$$\max_{R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}} \frac{V\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right)}{N_{i,t}}, \tag{A.23}$$

subject to

$$\frac{W\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right)}{N_{i,t}} = \frac{B_{i,t}}{N_{i,t}}. \tag{A.24}$$

Next, we express the default cutoff $\hat{\omega}^1_{i,t+1}$ and the value functions of the entrepreneur and the lender in terms of $H_{i,t}$. Starting from $\hat{\omega}^1_{i,t+1}$, note that

$$\begin{aligned}
\hat{\omega}^1_{i,t+1} &= \ln\left\{\frac{R^B_{i,t+1}B_{i,t} - (1-\theta_{i,t})\,R^D_{t+1}A_{i,t}}{\theta_{i,t}\exp\left(\omega^0_{i,t+1}\right)R^K_{t+1}A_{i,t}}\right\}, \\
&= \ln\left\{\frac{R^B_{i,t+1}H_{i,t} - (1-\theta_{i,t})\,R^D_{t+1}\left(1+H_{i,t}\right)}{\theta_{i,t}\exp\left(\omega^0_{i,t+1}\right)R^K_{t+1}\left(1+H_{i,t}\right)}\right\}.
\end{aligned} \tag{A.25}$$

Moreover, define $\bar{V}\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}\right) \equiv V\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right)/N_{i,t}$, and note that

$$\begin{aligned}
\bar{V}\left(R^L_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t}\right) &= \int_{\bar{\omega}^0_{i,t+1}}^{\infty} \frac{V^E\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right)}{N_{i,t}} dF\left(\omega^0_{i,t+1}\right) \\
&\quad + \int_{-\infty}^{\bar{\omega}^0_{i,t+1}} \frac{V^L\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right)}{N_{i,t}} dF\left(\omega^0_{i,t+1}\right), \qquad \text{(A.26)} \\
&= \int_{\bar{\omega}^0_{i,t+1}}^{\infty} \bar{V}^E\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right) \\
&\quad + \int_{-\infty}^{\bar{\omega}^0_{i,t+1}} \bar{V}^L\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right), \qquad \text{(A.27)}
\end{aligned}$$

where (suppressing functional dependencies)

$$\begin{aligned}
\bar{V}^E &= \frac{V^E\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right)}{N_{i,t}}, \qquad \text{(A.28)} \\
&= \mathbb{E}_t\left\{\int_{\hat{\omega}^1_{t+1}}^{\infty}\left\{\left[\theta^E_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1} + \left(1-\theta^E_{i,t}\right)R^D_{t+1}\right]\frac{A_{i,t}}{N_{i,t}} - R^{B,E}_{i,t+1}\frac{B_{i,t}}{N_{i,t}}\right\} dF\left(\omega^1_{t+1}\right)\right\}, \qquad \text{(A.29)} \\
&= \mathbb{E}_t\left\{\int_{\hat{\omega}^1_{t+1}}^{\infty}\left\{\left[\theta^E_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1} + \left(1-\theta^E_{i,t}\right)R^D_{t+1}\right]\left(1+H_{i,t}\right) - R^{B,E}_{i,t+1}H_{i,t}\right\} dF\left(\omega^1_{t+1}\right)\right\}, \qquad \text{(A.30)}
\end{aligned}$$

and

$$\begin{aligned}
\bar{V}^L &= \frac{V^L\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right)}{N_{i,t}}, \qquad \text{(A.31)} \\
&= \mathbb{E}_t\left\{\int_{\hat{\omega}^1_{t+1}}^{\infty}\left\{\left[\theta^L_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1} + \left(1-\theta^L_{i,t}\right)R^D_{t+1}\right]\frac{A_{i,t}}{N_{i,t}} - R^{B,L}_{i,t+1}\frac{B_{i,t}}{N_{i,t}}\right\} dF\left(\omega_{i,t+1}\right)\right\}, \qquad \text{(A.32)} \\
&= \mathbb{E}_t\left\{\int_{\hat{\omega}^1_{t+1}}^{\infty}\left\{\left[\theta^L_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1} + \left(1-\theta^L_{i,t}\right)R^D_{t+1}\right]\left(1+H_{i,t}\right) - R^{B,L}_{i,t+1}H_{i,t}\right\} dF\left(\omega_{i,t+1}\right)\right\}, \qquad \text{(A.33)}
\end{aligned}$$

Similarly, let $\bar{W}\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}\right) \equiv W\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}\right)/N_{i,t}$. Then,

$$\begin{aligned}
\bar{W}\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}\right) &= \int_{\bar{\omega}^0_{i,t+1}}^{\infty} \bar{W}^E\left(R^B_{i,t+1}, H_{i,t}, \overline{\omega}^0_{i,t}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right) \\
&\quad + \int_{-\infty}^{\bar{\omega}^0_{i,t}} \bar{W}^L\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right) dF\left(\omega^0_{i,t+1}\right), \qquad \text{(A.34)}
\end{aligned}$$

where

$$
\begin{aligned}
\bar{W}^E &= \frac{W^E\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right)}{N_{i,t}}, && \text{(A.35)}\\
&= \mathbb{E}_t\left\{M_{t+1}\int_{\hat{\omega}^1_{t+1}}^{\infty} R^{B,E}_{i,t+1}\frac{B_{i,t}}{N_{i,t}}dF\left(\omega^1_{t+1}\right)\right\}\\
&\quad+\mathbb{E}_t\left\{M_{t+1}\int_{-\infty}^{\hat{\omega}^1_{t+1}}(1-\zeta)\left[\theta^E_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1}+\left(1-\theta^E_{i,t}\right)R^D_{t+1}\right]\frac{A_{i,t}}{N_{i,t}}dF\left(\omega^1_{t+1}\right)\right\}, && \text{(A.36)}\\
&= \mathbb{E}_t\left\{M_{t+1}\int_{\hat{\omega}^1_{t+1}}^{\infty} R^{B,E}_{i,t+1}H_{i,t}dF\left(\omega^1_{t+1}\right)\right\}\\
&\quad+\mathbb{E}_t\left\{M_{t+1}\int_{-\infty}^{\hat{\omega}^1_{t+1}}(1-\zeta)\left[\theta^E_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1}+\left(1-\theta^E_{i,t}\right)R^D_{t+1}\right](1+H_{i,t})dF\left(\omega^1_{t+1}\right)\right\}, && \text{(A.37)}
\end{aligned}
$$

and

$$
\begin{aligned}
\bar{W}^L &= \frac{W^L\left(N_{i,t}, R^B_{i,t+1}, B_{i,t}, \bar{\omega}^0_{i,t+1}, \omega^0_{i,t+1}\right)}{N_{i,t}}, && \text{(A.38)}\\
&= \mathbb{E}_t\left\{M_{t+1}\int_{\hat{\omega}^1_{t+1}}^{\infty} R^{B,L}_{i,t+1}\frac{B_{i,t}}{N_{i,t}}dF\left(\omega^1_{t+1}\right)\right\}\\
&\quad+\mathbb{E}_t\left\{M_{t+1}\int_{-\infty}^{\hat{\omega}^1_{t+1}}(1-\zeta)\left[\theta^L_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1}+\left(1-\theta^L_{i,t}\right)R^D_{t+1}\right]\frac{A_{i,t}}{N_{i,t}}dF\left(\omega^1_{t+1}\right)\right\}, && \text{(A.39)}\\
&= \mathbb{E}_t\left\{M_{t+1}\int_{\hat{\omega}^1_{t+1}}^{\infty} R^{B,L}_{i,t+1}H_{i,t}dF\left(\omega^1_{t+1}\right)\right\}\\
&\quad+\mathbb{E}_t\left\{M_{t+1}\int_{-\infty}^{\hat{\omega}^1_{t+1}}(1-\zeta)\left[\theta^L_{i,t}\exp\left(\omega_{i,t+1}\right)R^K_{t+1}+\left(1-\theta^L_{i,t}\right)R^D_{t+1}\right](1+H_{i,t})dF\left(\omega^1_{t+1}\right)\right\} && \text{(A.40)}
\end{aligned}
$$

Finding the optimal contract terms now boils down to maximizing entrepreneur i's expected value by choosing $R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}$

$$
\max_{R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t+1}} \bar{V}\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t}\right) \tag{A.41}
$$

subject to the lender's ex-ante breakeven condition

$$
\bar{W}\left(R^B_{i,t+1}, H_{i,t}, \bar{\omega}^0_{i,t}\right) = H_{i,t} \tag{A.42}
$$

The problem (A.41)-(A.42) does not depend on any entrepreneur-specific state variable, implying that the solution to the problem is the same for all entrepreneurs.

A.5 Finding the Optimal Contract Terms

We use the results from Propositions 1 and 2 to find the optimal contract terms in our problem. These contract terms are solutions to the three first-order conditions (A.51), (A.54), and (A.60) below.

We start by using the results of Proposition 1 to show that the ex post value functions of the entrepreneur can be rewritten as

$$\begin{aligned} V^E &= \mathbb{E}_t \left\{ M_{t+1} \int_{\hat{\omega}^1_{i,t+1}}^{\infty} \left\{ \left[\exp\left(\omega^0_{i,t+1} + \omega^1_{i,t+1} \right) R^K_{t+1} \right], A_{i,t} - R^{B,E}_{i,t+1} B_{i,t} \right\} dF\left(\omega^1_{i,t+1} \right) \right\}, && \text{(A.43)} \\ V^L &= \mathbb{E}_t \left[M_{t+1} \left(R^D_{t+1} A_{i,t} - R^{B,L}_{i,t+1} B_{i,t} \right) \right], && \text{(A.44)} \end{aligned}$$

and the ex-post value functions of lender can be rewritten as

$$\begin{aligned} W^E &= \mathbb{E}_t \left\{ M_{t+1} \int_{\hat{\omega}^1_{i,t+1}}^{\infty} R^{B,E}_{i,t+1} B_{i,t} dF\left(\omega^1_{i,t+1} \right) \right\} \\ &\quad + \mathbb{E}_t \left\{ M_{t+1} \int_{-\infty}^{\hat{\omega}^1_{i,t+1}} \left[(1-\zeta) \left[\exp\left(\omega^0_{i,t+1} + \omega^1_{i,t+1} \right) R^K_{t+1} \right] A_{i,t} \right] dF\left(\omega^1_{i,t+1} \right) \right\}, && \text{(A.45)} \\ W^L &= \mathbb{E}_t \left(M_{t+1} R^{B,L}_{i,t+1} B_{i,t} \right). && \text{(A.46)} \end{aligned}$$

Using (A.43)-(A.46), we obtain the ex-ante value function of the entrepreneur as

$$\begin{aligned} V &= \mathbb{E}_t \left\{ M_{t+1} \int_{\bar{\omega}^0_{i,t+1}}^{\infty} \int_{\hat{\omega}^1_{i,t+1}}^{\infty} \left\{ \left[\exp\left(\omega_{i,t+1} \right) R^K_{t+1} \right] A_{i,t} - R^{B,E}_{i,t+1} B_{i,t} \right\} dF\left(\omega^1_{i,t+1} \right) dF\left(\omega^0_{i,t+1} \right) \right\} \\ &\quad + \mathbb{E}_t \left\{ M_{t+1} \int_{-\infty}^{\bar{\omega}^0_{i,t+1}} \left(R^D_{t+1} A_{i,t} - R^{B,L}_{i,t+1} B_{i,t} \right) dF\left(\omega^0_{i,t+1} \right) \right\}, && \text{(A.47)} \end{aligned}$$

and the ex-ante value function of the lender as

$$\begin{aligned} W &= \mathbb{E}_t \left\{ M_{t+1} \int_{\bar{\omega}^0_{i,t+1}}^{\infty} \int_{\hat{\omega}^1_{i,t+1}}^{\infty} R^{B,E}_{i,t+1} B_{i,t} dF\left(\omega^1_{i,t+1} \right) dF\left(\omega^0_{i,t+1} \right) \right\} \\ &\quad + \mathbb{E}_t \left\{ M_{t+1} \int_{\bar{\omega}^0_{i,t+1}}^{\infty} \int_{-\infty}^{\hat{\omega}^1_{i,t+1}} \left[(1-\zeta) \left[\exp\left(\omega_{i,t+1} \right) R^K_{t+1} \right] A_{i,t} \right] dF\left(\omega^1_{i,t+1} \right) dF\left(\omega^0_{i,t+1} \right) \right\} \\ &\quad + \mathbb{E}_t \left\{ M_{t+1} \int_{-\infty}^{\bar{\omega}^0_{i,t+1}} R^{B,L}_{i,t+1} B_{i,t} dF\left(\omega^0_{i,t+1} \right) \right\}. && \text{(A.48)} \end{aligned}$$

Since $R^{B,L}_{i,t+1} = R^D_{t+1}$ by Proposition 1, the choice variables in this problem are $R^{B,E}_{i,t+1}, \bar{\omega}^0_{i,t+1}$ and $H_{i,t}$. As shown in Proposition 2, these contract terms are the same across all entrepreneurs, and we therefore drop the subscript i in what follows. To simplify notation, we also define two auxiliary functions

$$G\left(\omega^0_{t+1}, H_t, R^B_{t+1}\right) \equiv \int_{\hat{\omega}^1_{t+1}}^{\infty} \left[\exp\left(\omega^0_{t+1} + \omega^1_{t+1}\right) R^K_{t+1}\left(1 + H_t\right) - R^{B,E}_{t+1} H_t\right] dF\left(\omega^1_{t+1}\right), \tag{A.49}$$

and

$$T\left(\omega^0_{t+1}, H_t, R^B_{t+1}\right) \equiv \int_{\hat{\omega}^1_{t+1}}^{\infty} R^{B,E}_{t+1} H_t dF\left(\omega^1_{i,t+1}\right) + \int_{-\infty}^{\hat{\omega}^1_{t+1}} (1-\zeta)\exp\left(\omega_{t+1}\right) R^K_{t+1}\left(1 + H_t\right) dF\left(\omega^1_{t+1}\right). \tag{A.50}$$

Denoting by ψ the Lagrangian multiplier of lender's breakeven condition, we derive the first order condition with respect to H_t as

$$\mathbb{E}_t\left\{M_{t+1}\left(\int_{\bar{\omega}^0_{t+1}}^{\infty} \frac{\partial G}{\partial H_t} dF\left(\omega^0_{t+1}\right)\right)\right\} = \psi_t \mathbb{E}_t\left(1 - M_{t+1}\int_{\bar{\omega}^0_{t+1}}^{\infty} \frac{\partial T}{\partial H_t} dF\left(\omega^0_{t+1}\right) - M_{t+1}\int_{-\infty}^{\bar{\omega}^0_{t+1}} R^D_{t+1} dF\left(\omega^0_{i,t+1}\right)\right), \tag{A.51}$$

where

$$\frac{\partial G}{\partial H_t} = \int_{\hat{\omega}^1_{t+1}}^{\infty} \left[\exp\left(\omega^0_{t+1} + \omega^1_{t+1}\right) R^K_{t+1} - R^{B,E}_{t+1}\right] dF\left(\omega^1_{t+1}\right), \tag{A.52}$$

and (using) together with the expression of $\hat{\omega}^1_{t+1}$ and $\partial\hat{\omega}^1_{t+1}/\partial H_t$, we have

$$\frac{\partial T}{\partial H_t} = \int_{\hat{\omega}^1_{t+1}}^{\infty} R^{B,E}_{t+1} dF\left(\omega^1_{t+1}\right) + \int_{-\infty}^{\hat{\omega}^1_{t+1}} (1-\zeta)\exp\left(\omega^0_{t+1} + \omega^1_{t+1}\right) R^K_{t+1} dF\left(\omega^1_{t+1}\right) - \frac{\zeta R^{B,E}_{t+1}}{1 + H_t} f_1\left(\hat{\omega}^1_{t+1}\right). \tag{A.53}$$

Similarly, the first-order condition with respect to $R^{B,E}_{t+1}$ is

$$\mathbb{E}_t\left\{M_{t+1}\left(\int_{\bar{\omega}^0_{t+1}}^{\infty} \frac{\partial G}{\partial R^{B,E}_{t+1}} dF\left(\omega^0_{t+1}\right)\right)\right\} = -\psi_t \mathbb{E}_t\left(M_{t+1}\int_{\bar{\omega}^0_{t+1}}^{\infty} \frac{\partial T}{\partial R^{B,E}_{t+1}} dF\left(\omega^0_{t+1}\right)\right), \tag{A.54}$$

where

$$\frac{\partial G}{\partial R^{B,E}_{t+1}} = -\int_{\hat{\omega}^1_{t+1}}^{\infty} H_t dF\left(\omega^1_{t+1}\right), \tag{A.55}$$

$$\frac{\partial T}{\partial R^{B,E}_{t+1}} = \int_{\hat{\omega}^1_{t+1}}^{\infty} H_t dF\left(\omega^1_{t+1}\right) - \zeta H_t f_1\left(\hat{\omega}^1_{t+1}\right). \tag{A.56}$$

Finally, the first-order condition with respect to $\bar{\omega}^0_{t+1}$ is s

$$\begin{aligned}
&\mathbb{E}_t \left\{ M_{t+1} \left(\int_{\bar{\omega}^0_{t+1}}^{\infty} \frac{\partial G}{\partial \bar{\omega}^0_{t+1}} dF\left(\omega^0_{t+1}\right) - G\left(\bar{\omega}^0_{t+1}, H_t, R^B_{t+1}\right) f_0\left(\bar{\omega}^0_{t+1}\right) + R^D_{t+1} f_0\left(\bar{\omega}^0_{t+1}\right) \right) \right\} \\
&= -\psi_t \mathbb{E}_t \left[M_{t+1} \left(\int_{\bar{\omega}^0_{t+1}}^{\infty} \frac{\partial T}{\partial \bar{\omega}^0_{t+1}} dF\left(\omega^0_{t+1}\right) - T\left(\bar{\omega}^0_{t+1}, H_t, R^B_{t+1}\right) f_0\left(\bar{\omega}^0_{t+1}\right) + R^D_{t+1} H_t f_0\left(\bar{\omega}^0_{t+1}\right) \right) \right],
\end{aligned} \tag{A.57}$$

where

$$\frac{\partial G}{\partial \bar{\omega}^0_{t+1}} = 0, \tag{A.58}$$

$$\frac{\partial T}{\partial \bar{\omega}^0_{t+1}} = 0. \tag{A.59}$$

Since $f_0\left(\bar{\omega}^0_{t+1}\right) > 0$ and known at time t, we can divide both sides of (A.57) by $f_0\left(\bar{\omega}^0_{t+1}\right)$ to obtain the simplified first-order condition

$$\mathbb{E}_t \left\{ M_{t+1} \left(R^D_{t+1} - G\left(\bar{\omega}^0_{t+1}, H_t, R^B_{t+1}\right) \right) \right\} = \psi_t \mathbb{E}_t \left[M_{t+1} \left(T\left(\bar{\omega}^0_{t+1}, H_t, R^B_{t+1}\right) - R^D_{t+1} H_t \right) \right]. \tag{A.60}$$

B Appendix Tables

Table A1

Covenant Strictness and Future Covenant Violations

In this table we show that covenant strictness is positively correlated with future covenant violations by regressing firm-level indicators for covenant violations on past-quarter strictness. The sample period starts with the first quarter of 1996 and ends with the last quarter of 2016. The loan covenant violation data for our sample period comes from Greg Nini, and is an updated version of the covenant violation data in Nini et al. (2012).

	Dependent Variable: Covenant Violation		
	(1)	(2)	(3)
One-Quarter Lag Strictness	0.109***	0.065***	0.058***
	(0.00)	(0.01)	(0.01)
Firm FE	No	Yes	Yes
Year-Quarter FE	No	No	Yes
R-Squared	0.069	0.249	0.257
Observations	72,781	72,639	72,639

Note: Standard errors (in parentheses) are clustered at the firm level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A2

Robustness: q-Factor Regressions

In this table we show that our main results from Table 3 are robust to q-factors in Hou et al. (2015). The sample period starts with the first quarter of 1996 and ends with the last quarter of 2016.

	Low	2	3	4	High	High-4	High-Low	4-Low
α^{HXZ}	-1.70	-0.35	-1.82	0.41	-5.54**	-5.95**	-3.84*	2.11
t-stat.	-0.91	-0.18	-0.78	0.19	-2.21	-2.20	-1.77	1.36
β^{MKT}	1.04***	0.98***	1.05***	1.06***	1.16***	0.10*	0.12**	0.02
t-stat.	30.28	27.38	24.92	20.45	23.97	1.91	2.12	0.41
β^{ME}	0.01	0.11	0.07	0.19**	0.24**	0.04	0.23***	0.18***
t-stat.	0.19	1.18	0.57	1.96	2.58	0.58	2.79	2.81
$\beta^{I/A}$	0.16	0.21*	0.24**	0.37***	0.03	-0.34*	-0.14	0.21**
t-stat.	1.53	1.71	2.02	3.29	0.23	-1.86	-0.91	2.40
β^{ROE}	0.14**	0.20***	0.10*	0.18*	-0.26***	-0.44***	-0.40***	0.04
t-stat.	2.57	2.64	1.68	1.93	-3.48	-4.62	-5.25	0.58

Table A3

Robustness: AR(1) Process for Financial Ratios

This table reports the results of a robustness test where we use an AR(1) process to describe the time-series evolution of a firm's (log) financial ratios (see Equation (26) in the main text). The sample period starts with the first quarter of 1996 and ends with the last quarter of 2016.

	Low	2	3	4	High	High-4	High-Low	4-Low
Excess Return (pp)	6.73*	8.55**	6.31	10.05**	1.58	-8.47**	-5.15*	3.32*
t-stat.	1.89	2.36	1.60	2.57	0.28	-2.48	-1.86	1.80
α^{FF5}	-2.44*	-2.24	-3.55*	-1.15	-7.56***	-6.41**	-5.12**	1.29
t-stat.	-1.79	-1.25	-1.70	-0.64	-2.91	-2.20	-2.03	0.90
β^{MKT}	1.05***	1.04***	1.06***	1.11***	1.17***	0.06	0.13*	0.06
t-stat.	32.75	32.42	26.12	23.47	21.25	0.92	1.76	1.43
β^{SMB}	0.05	0.25***	0.22***	0.28***	0.37***	0.09	0.32***	0.23***
t-stat.	1.04	3.76	3.55	3.94	6.34	0.98	3.81	4.25
β^{HML}	0.04	-0.00	0.18**	0.12	0.23**	0.10	0.19**	0.08
t-stat.	0.55	-0.02	2.17	1.10	2.15	1.04	1.97	1.24
β^{RMW}	0.25***	0.47***	0.32***	0.38***	-0.04	-0.42***	-0.29*	0.13
t-stat.	4.24	4.60	4.05	4.21	-0.33	-3.32	-1.96	1.37
β^{CMA}	0.07	0.19**	-0.09	0.15	-0.31**	-0.47***	-0.38**	0.09
t-stat.	0.92	1.97	-0.54	1.49	-2.09	-2.95	-2.42	0.82

Table A4

Fama-MacBeth Regressions: Additional Controls

In this table, we add the SA Index and the WW Index to our main specification from Table 4 to control for financial constraints. All the variables in this table are defined as in Table 1. The sample period starts with the first quarter of 1996 and ends with the last quarter of 2016.

	Dependent Variable: Monthly Excess Returns			
	(1)	(2)	(3)	(4)
Strictness	-0.342***	-0.312**	-0.356***	-0.320**
	(0.12)	(0.12)	(0.12)	(0.12)
Size	-0.079	-0.101	-0.020	-0.042
	(0.09)	(0.09)	(0.09)	(0.08)
Log B/M	0.123	0.116	0.092	0.079
	(0.10)	(0.10)	(0.10)	(0.10)
Reversal	-0.015**	-0.016**	-0.016**	-0.016**
	(0.01)	(0.01)	(0.01)	(0.01)
Book Leverage	-0.101	-0.057	-0.338	-0.337
	(0.40)	(0.39)	(0.40)	(0.39)
ROA	5.105	3.518	5.252	3.550
	(3.79)	(3.48)	(3.59)	(3.39)
SA Index	-0.170**	-0.149*	-0.206***	-0.188**
	(0.08)	(0.08)	(0.08)	(0.08)
WW Index	1.169	0.890	2.102	1.828
	(1.70)	(1.64)	(1.61)	(1.57)
Pr(Failure)		-82.739***		-93.551***
		(31.43)		(26.94)
EDF			0.121	2.179
			(2.61)	(2.48)
R-Squared	0.046	0.051	0.054	0.058
Observations	214,844	214,595	210,775	210,729

Note: Newey-West standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A5

Pooled OLS Regression on Strictness

This table presents the results of a pooled OLS regression to study the link between regression analysis of the link between strictness and future excess returns. The specifications are identical to the specifications in Table 4, but here we use a firm-month panel instead of computing the average of monthly cross-sectional regressions. The sample period starts with the first quarter of 1996 and ends with the last quarter of 2016.

	Dependent Variable: Monthly Excess Returns			
	(1)	(2)	(3)	(4)
Strictness	-0.440***	-0.445***	-0.482***	-0.480***
	(0.16)	(0.17)	(0.17)	(0.17)
Size	-0.119**	-0.111*	-0.091	-0.088
	(0.06)	(0.06)	(0.06)	(0.06)
Log B/M	0.159	0.149	0.071	0.078
	(0.13)	(0.13)	(0.13)	(0.13)
Reversal	-0.032**	-0.032**	-0.033**	-0.033**
	(0.01)	(0.01)	(0.02)	(0.02)
Book Leverage	-0.116	-0.176	-0.505	-0.478
	(0.51)	(0.51)	(0.55)	(0.55)
ROA	-1.235	-0.789	-0.500	0.071
	(6.11)	(5.50)	(6.16)	(5.73)
Pr(Failure)		3.513		2.600
		(2.77)		(2.95)
EDF			2.226*	1.959
			(1.16)	(1.23)
R-Squared	0.151	0.151	0.151	0.151
Observations	219,331	218,952	214,750	214,699

Note: Standard errors (in parentheses) are clustered at the year-quarter level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A6

Pooled OLS Regression on Strictness Portfolio Indicators

This table presents the results of a pooled OLS regression to study the link between regression analysis of the link between strictness and future excess returns. The specifications are identical to the specifications in Table 5, but here we use a firm-month panel instead of computing averages of monthly cross-sectional regressions' estimates. The sample period starts with the first quarter of 1996 and ends with the last quarter of 2016.

	Dependent Variable: Monthly Excess Returns			
	(1)	(2)	(3)	(4)
Str. Portfolio 2	-0.014	0.006	0.018	0.024
	(0.09)	(0.09)	(0.08)	(0.08)
Str. Portfolio 3	-0.030	-0.008	0.010	0.014
	(0.10)	(0.09)	(0.09)	(0.09)
Str. Portfolio 4	-0.177	-0.156	-0.147	-0.141
	(0.11)	(0.11)	(0.11)	(0.11)
High Str. Portfolio	-0.434***	-0.428***	-0.455***	-0.451***
	(0.15)	(0.15)	(0.16)	(0.15)
Pr(Failure)		3.630		2.707
		(2.81)		(2.99)
EDF			2.272*	1.996
			(1.16)	(1.23)
Other Controls	Yes	Yes	Yes	Yes
R-Squared	0.151	0.151	0.151	0.151
Observations	219,247	218,872	214,669	214,619

Note: Standard errors (in parentheses) are clustered at the year-quarter level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A7

Pooled OLS Regressions: Non-Distressed Firms

This table presents the results of a pooled OLS regression to study the link between regression analysis of the link between strictness and future excess returns. The specifications are identical to the specifications in Table 6, but here we use a firm-month panel instead of computing averages of monthly cross-sectional regressions' estimates. The sample period starts with the first quarter of 1996 and ends with the last quarter of 2016.

Panel A: Unconditional Portfolio Dummies

	EDF ≤ 90th Percentile		Pr(Failure) ≤ 90th Percentile	
	(1)	(2)	(3)	(4)
Str. Portfolio 2	0.039	0.053	0.054	0.074
	(0.08)	(0.08)	(0.09)	(0.08)
Str. Portfolio 3	-0.089	-0.075	-0.123	-0.098
	(0.09)	(0.09)	(0.09)	(0.09)
Str. Portfolio 4	-0.105	-0.096	-0.089	-0.070
	(0.10)	(0.10)	(0.10)	(0.11)
High Str. Portfolio	-0.324**	-0.330**	-0.342**	-0.340**
	(0.14)	(0.14)	(0.14)	(0.14)
Distress Controls	No	Yes	No	Yes
Other Controls	Yes	Yes	Yes	Yes
R-Squared	0.167	0.168	0.169	0.170
Observations	193,327	193,281	197,033	193,338

Panel B: Conditional Portfolio Dummies

	EDF ≤ 90th Percentile		Pr(Failure) ≤ 90th Percentile	
	(1)	(2)	(3)	(4)
Str. Portfolio 2	-0.009	0.005	0.006	0.022
	(0.08)	(0.08)	(0.08)	(0.08)
Str. Portfolio 3	-0.073	-0.059	-0.088	-0.066
	(0.08)	(0.08)	(0.09)	(0.09)
Str. Portfolio 4	-0.180	-0.172	-0.165	-0.152
	(0.11)	(0.11)	(0.10)	(0.11)
High Str. Portfolio	-0.383**	-0.393**	-0.395***	-0.392**
	(0.16)	(0.16)	(0.15)	(0.15)
Distress Controls	No	Yes	No	Yes
Other Controls	Yes	Yes	Yes	Yes
R-Squared	0.167	0.168	0.169	0.170
Observations	193,327	193,281	197,033	193,338

Note: Standard errors (in parentheses) are clustered at the year-quarter level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A8

RDD Regressions: Bandwidth Robustness

This table presents results of robustness tests on Columns (1) and (2) of Table 7 using different sample bandwidths. In the table, $\pm$ 0.3 $\times$ Threshold indicates the sub-sample of firms whose Debt-to-EBITDA ratio falls into the $[0.7 \times \text{threshold}, 1.3 \times \text{threshold}]$ range. Similarly, $\pm$ 0.2 $\times$ Threshold and $\pm$ 0.1 $\times$ Threshold indicate the sub-samples with range $[0.8 \times \text{threshold}, 1.2 \times \text{threshold}]$ and $[0.9 \times \text{threshold}, 1.1 \times \text{threshold}]$, respectively. In all specifications, year-quarter fixed effects are included. The sample starts in January 1996 and ends in December 2016.

	$\pm$0.3 $\times$ Threshold		$\pm$0.2 $\times$ Threshold		$\pm$0.1 $\times$ Threshold	
	(1)	(2)	(3)	(4)	(5)	(6)
Violation	-0.594***	-0.689***	-0.588**	-0.588**	-0.712*	-0.736*
	(0.21)	(0.22)	(0.26)	(0.27)	(0.37)	(0.38)
Distance	0.259	0.312*	0.020	-0.093	1.852*	1.049
	(0.17)	(0.17)	(0.34)	(0.33)	(1.03)	(1.06)
Violation $\times$ Distance	0.179	0.331	0.494	0.663	-2.251	-1.017
	(0.32)	(0.34)	(0.60)	(0.64)	(1.77)	(1.91)
Size		-0.052		-0.060		-0.025
		(0.04)		(0.05)		(0.08)
Log B/M		0.036		-0.013		-0.036
		(0.09)		(0.12)		(0.17)
Book Leverage		-0.278		-0.565		-0.894
		(0.51)		(0.65)		(0.90)
ROA		13.533***		14.743**		7.918
		(4.87)		(6.32)		(9.73)
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.215	0.220	0.215	0.218	0.218	0.223
Observations	20,293	18,873	13,291	12,317	6,587	6,079

Note: Standard errors (in parentheses) are clustered at the firm level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.