Debt Refinancing and Equity Returns[*]

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First Version: October 31, 2015

This Version: June 14, 2017

[*]We are grateful to Jennie Bai, Jules van Binsbergen, Harjoat Bhamra, John Y. Campbell, Gian Luca Clementi, Thomas Dangl, Christian Riis Flor, Lorenzo Garlappi, Thomas Gehrig, Li He, Søren Hvidkjær, Alexandre Jeanneret, Michael Kisser, Christian Laux, Nathalie Moyen, Guillermo Ordonez, Lasse Pedersen, Roberto Steri, Alexander Wagner, Ramona Westermann, Toni Whited, Josef Zechner, and participants at the 2017 European Winter Finance Summit (EWFS), the Western Finance Association (WFA) Meetings 2016, the European Finance Association (EFA) Meetings 2016, the SDU Finance Workshop 2016, the 2016 Meeting of the Swiss Society for Financial Market Research (SGF), the 2015 VGSF conference, as well as seminar participants at Aarhus University, Copenhagen Business School, the Helsinki Finance Seminar, the Norwegian School of Economics (NHH), and the University of Lugano for providing helpful comments and suggestions. Christian Wagner acknowledges support from the Center for Financial Frictions (FRIC), grant no. DNRF102.

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Abstract

Previous studies report mixed evidence on how financial leverage affects expected stock returns. Our theoretical and empirical results suggest that these inconclusive findings are driven by differences in firms' debt maturity structures and refinancing needs. In our model, the firm optimizes its capital structure by jointly choosing leverage and the mix of short- and long-term debt, which determines the firm's debt refinancing intensity. Since shareholders commit to cover potential shortfalls from debt rollover, they require a return that increases in, both, leverage and debt refinancing intensity. Our empirical results confirm this model prediction and show that firms with higher (lower) leverage earn higher (lower) stock returns when controlling for the immediacy of debt refinancing. Furthermore, our model implies that a firm's book-to-market ratio and its size depend on, both, the firm's leverage and its refinancing intensity. As a consequence, the mapping of size and book-to-market into expected equity returns depends on the firm's particular combination of leverage and refinancing intensity as well. Empirically, we find that size and book-to-market capture leverage effects on stock returns but that the refinancing intensity conveys return-relevant information beyond these characteristics.

JEL Classification: G12, G32, G33.

Keywords: Equity returns, optimal capital structure, leverage, debt refinancing, book-to-market, size effect.

I. Introduction

Empirical research reports mixed evidence on how a firm's financial leverage affects the expected return on its equity. Our paper complements these previous findings by showing, theoretically and empirically, that firms' expected equity returns increase with leverage when controlling for the immediacy of debt refinancing. In the model, the firm optimizes its capital structure by jointly choosing the amount of debt as well as the maturity structure of debt. The firm has to refinance debt according to its maturity structure and shareholders commit to cover potential shortfalls arising from the rollover of maturing debt. For shareholders to accept this commitment, expected equity returns have to increase with the firm's leverage *and* with the firm's debt refinancing intensity, which measures the immediacy of debt refinancing needs. As a consequence, leverage alone is insufficient to gauge the effect of debt related risks on expected equity returns.

To model the interaction between leverage, debt refinancing, and equity returns, we use the model of Leland (1998) and embed insights from the recent bond literature on rollover risk (e.g., He and Xiong, 2012; Chen et al., 2013). The firm optimizes its capital structure by simultaneously choosing the amount of debt (i.e. its leverage) as well as the underlying debt maturity structure. More specifically, the firm decides optimally on how much debt to raise by issuing a short-term bond and how much to raise through a long-term bond. Along this maturity dimension, the firm faces a trade-off: On the one hand, short-term debt is cheaper compared to long-term debt, i.e., the fixed issuance costs of short-term debt are lower. On the other hand, increasing the fraction of debt issued through the short-term bond exposes the firm to debt refinancing risk. Given this trade-off, the model implies that firms with comparably low cash flow risk choose higher leverage and longer debt maturities, whereas firms with higher cash flow risk choose lower leverage and shorter debt maturities. These leverage/debt maturity patterns are in line with empirical evidence reported by, e.g., Barclay and Smith (1995) or Custódio et al. (2013).

Initially, when the firm chooses its optimal capital structure and debt policy, the model implies a one-to-one mapping between leverage, refinancing intensity, and equity returns. Subsequently, the firm's leverage can change because of fluctuations in the market value of equity but the firm's refinancing intensity remains unchanged. As a consequence, the relation between leverage and refinancing intensity and the link of both to expected equity returns becomes more complex. For a given refinancing intensity, expected stock returns increase with leverage. Similarly, for given leverage, expected stock returns increase with refinancing intensity. Hence, neither leverage nor the refinancing intensity alone are sufficient to understand the impact of a firm's debt related risks on equity returns: a firm with high leverage and low debt refinancing intensity may have the same expected return as a firm with low leverage but high debt refinancing intensity. Put differently, the model implies that, in the cross-section of firms, expected equity returns increase with leverage only when controlling for firms' refinancing intensities.

Additionally, our model implies that a firm's book-to-market ratio as well as its size (market value of equity) should be related to the firm's leverage and debt refinancing intensity: the higher the firm's leverage and/or the higher the firm's refinancing intensity, the higher is the model-implied book-to-market ratio and the smaller is the firm's size. As a consequence, our model implies that expected returns increase with book-to-market ratios and that small firms have higher expected returns than big firms. On the one hand, these model implications are consistent with empirical relations of size and book-to-market to equity returns, as well as with the notion that size and book-to-market capture to some extent leverage effects on stock returns (e.g., Fama and French, 1992). On the other hand, our framework implies that a firm's refinancing intensity should convey return-relevant information beyond these characteristics.

For the empirical analysis, we merge the CRSP- and COMPUSTAT-databases to obtain a sample of approximately 1.4 million firm-month observations across more than $12,000$ different firms over the period from 1972 to 2014. Our empirical results generally provide strong support for the model predictions. First, we use portfolio double-sorts to show that the data matches the general predictions of our model. In a cross-section of 100 portfolios, obtained from 10×10 double sorts on refinancing intensities and leverage, we find that average equity excess returns increase with leverage for a given refinancing intensity and vice versa. Using the same 100 portfolios, we show that the data also supports the model predictions with respect to book-to-market ratios and firm size: Firms with high (low) leverage and high (low) refinancing intensities have high (low) book-to-market ratios and are small (big) in size. Accordingly, we find that size and book-to-market effects in stock returns are related to, both, leverage and debt refinancing intensities.

We then explore the role of debt refinancing for equity returns more rigorously in Fama-MacBeth (FMB) regressions. Here, we show that equity returns are significantly related to firms' debt refinancing intensities. In regressions of returns on leverage and refinancing intensities the coefficient estimates for both are significantly positive, also when including beta. Once we add size and book-to-market to these regressions, the coefficient on leverage becomes insignificant but the estimate for the debt refinancing intensity remains significantly positive. We employ several empirical proxies for leverage and refinancing intensities and show that our conclusions remain the same by using alternative specifiactions. Furthermore, the significance of the coefficient on debt refinancing also survives the inclusion of several additional variables, which could matter for the extent to which shareholders care about their firm's debt refinancing risk. Specifically, we add proxies for firms' cash holdings, profitability, and other variables used in the literature on financial constraints.

Overall, this paper provides new insights for the cross-sectional relation between equity returns and leverage by explicitly elaborating on the role of a firm's debt refinancing policies. Our main finding is that equity returns increase with leverage when accounting for firms' refinancing risk. This finding suggests that previous evidence on how stock returns relate to leverage may have remained inconclusive because it ignores firms' debt maturity profiles. Moreover, our results are in line with the notion that size and book-to-market capture leverage effects on stock returns but they also show that firms' refinancing intensities convey return-relevant information beyond these characteristics.

Related literature. Our paper is related to the literature that elaborates on the relation between leverage and stock returns. Gomes and Schmid (2010) argue that the mixed empirical evidence on whether this relation is positive, negative, or whether there is no significant relation at all may be a result of previous papers not accurately accounting for the complexity of the link between a firm's financial leverage and the return on its equity (see, e.g., Bhandari, 1988; Fama and French, 1992; Penman et al., 2007; George and Hwang, 2010). Specifically, they argue that the link between leverage and stock returns depends on a firm's investment opportunities. We explore the relation between leverage and stock returns from a different angle which does not require to model the firm's investment policies but emphasizes the role of a firm's debt maturity profile and refinancing risk.

Several empirical studies provide evidence that firms issue debt with dispersed maturity dates and that firms' choices of leverage and debt maturity profile depend on their risk attributes. Choi et al. (2015) argue that firms spread out their debt maturity dates over time in order to avoid lumpiness in the aggregate issuance amount of debt. More specifically, the optimal capital structure implications of our model that firms with comparably low (high) cash flow risk choose higher (lower) levels of leverage with longer (shorter) debt maturities are consistent with empirical evidence provided by, for instance, Barclay and Smith (1995), Stohs and Mauer (1996), Johnson (2003), Custódio et al. (2013), and Gopalan et al. (2014).

The conceptual framework employed in our paper is motivated by trade-off models of optimal capital structure in the spirit of Fischer et al. (1989), Leland (1994b), Leland and Toft (1996) or Leland (1998). These models endogenize a firms' optimal leverage and default decisions. Bhamra et al. (2010a,b) and Chen (2010) are among the first to discuss the asset pricing implications of dynamic leverage models and relate leverage and default decisions to the time-series patterns of equity returns and credit spreads. More recently, these frameworks are applied in the structural debt pricing literature that elaborates on the relation between rollover risk and credit risk. He and Xiong (2012) show that short-term debt exacerbates default risk via the rollover channel due to its higher sensitivity to shocks to debt funding costs. Other models that feature a mechanism where debt refinancing costs are bourne by equityholders include, among others, Acharya et al. (2011), Cheng and Milbradt (2012), Chen et al. (2017), Chen et al. (2013), and He and Milbradt (2014).

Interestingly, most studies which rely on these structural frameworks treat leverage, debt maturity, or both as exogenous. Noteable exceptions are Dangl and Zechner (2016) or He and Milbradt (2017), however, their focus is very different compared to the objective of this paper. Dangl and Zechner (2016) study the role of bankruptcy costs for leverage and debt maturity dynamics. He and Milbradt (2017) study a firm's optimal choice of debt maturity structure and default timing, both without commitment. Our paper is the first to explore how refinancing risk associated with the rollover of debt affects equity returns, specifically through its interaction with leverage.

Finally, we revisit the relation between leverage, size and book-to-market from a new perspective, without relying on arguments related to a firm's investment policy, operating leverage, and/or profitability (e.g. Fama and French, 1993; Carlson et al., 2004; Zhang, 2005; Novy-Marx, 2011, 2013; Fama and French, 2015). In our model, the firm's size and book-to-market ratio are both directly related to its leverage and its debt maturity structure and can be interpreted as measures of how far a firm's capital structure deviates from its (initial) optimum, i.e. the capital structure arising from jointly choosing leverage and the mix of short- and long-term debt. Consistent with the model implications, our empirical results show that size and book-to-market capture leverage effects on equity returns but that a firm's refinancing intensity conveys information for returns beyond these characterisitcs.

The remainder of the paper is organized as follows. Section II describes the structural model and Section III discusses the model's implications for expected equity returns as well as for book-to-market and size. Section IV describes the data. In Section V, we present and discuss the results of our empirical analysis. The last section concludes, and the Appendix contains technical details.

II. Structural Model

In this section, we present a simple model of the firm's capital structure that follows the spirit of Leland (1994a, 1998) but endogenizes the firm's optimal choice of leverage and debt maturity. In the next section, we then use this framework to derive implications for the firm's expected equity returns and discuss the interactions between leverage and debt refinancing as well as their effects on the firm's book-to-market ratio and its size.

A. Firm value and optimal capital structure

We assume that the firm's instantaneous cash flow (X_t) follows a Geometric Brownian Motion (GBM) under the risk-neutral probability measure ($\mathbb{Q}$) with drift $\mu^{\mathbb{Q}}$ and volatility σ. The instantaneous risk-free rate is denoted by r. The standard trade-off theory of capital structure postulates that a firm maximizes its value by levering up to the extent that the benefits of debt equal its costs. For a debt principal amount P, the value of the levered firm is given by

$$F(X,P) = U(X) + DB(P) \cdot \left[1 - \pi^{\mathbb{Q}}(X,P)\right],$$

where DB and $\pi^{\mathbb{Q}}$ denote the benefits of debt and the probability of default, respectively, which both increase with P.

Understanding a firm's debt maturity profile is important because the optimal choice of debt maturities is also subject to a tradeoff. Previous research provides various arguments as to why short-term debt offers benefits compared to long-term debt. Most closely related to our paper, the recent literature on rollover risk argues that fixed issuance costs are lower for short-term compared to long-term debt (see e.g., Chen et al., 2013; He and Milbradt, 2014). Furthermore, short-term debt may offer benefits relative to long-term debt by reducing information asymmetries (e.g., Flannery, 1986; Diamond, 1991; Custódio et al., 2013) or by mitigating agency conflicts (Datta et al., 2005; Brockman et al., 2010). These benefits of short-term debt, however, come at the cost of frequently rolling over the firm's debt which exposes the firm to refinancing risk.

In what follows, we discuss the valuation of debt and equity claims as well as the optimal capital structure for a firm that raises debt capital by issuing short-term bonds and long-term bonds. The model implies that firms with comparably low (high) cash flow volatility optimally choose higher (lower) levels of leverage with longer (shorter) debt maturities. These patterns are consistent with empirical evidence on the link between firm risk and debt financing policies (e.g., Barclay and Smith, 1995; Johnson, 2003; Custódio et al., 2013).

A.1 Short-term and long-term debt

As in He and Xiong (2010), the firm has access to two types of debt instruments: a short-term zero-coupon bond (S) and a long-term zero-coupon bond (L). At time $t = 0$, the firm raises a principal amount P^i from issuing bond $i \in \{S, L\}$, thus, the aggregate principal amount of debt is given by $P = P^S + P^L$. We model the maturity of bond i by a Poisson process with intensity ϕ^i, and $\phi^S > \phi^L$ reflects the earlier redemption of S relative to L. Assuming a stationary debt structure, refinancing short-term and long-term debt can be equivalently thought of as continuously refinancing the amounts $\phi^S P^S$ and $\phi^L P^L$, respectively.[1] The key question for a value-maximizing firm is to decide on the amounts of short-term and long-term

[1] The assumption that the firm commits to a stationary debt structure follows Leland and Toft (1996), Leland (1998), and He and Xiong (2012) who argue that tight covenants prohibit the firm from changing its debt structure; Fama and French (2002), Baker and Wurgler (2002), Welch (2004), Strebulaev (2007), and Lemmon et al. (2008) provide empirical evidence that firms' debt structures are indeed stationary over time.

debt to raise. To determine the market value of type-i debt (D^i), we start from the required return on debt (rD^i), which is given by

$$rD^i = \underbrace{\mu^{\mathbb{Q}} X D^i_X + \frac{1}{2}\sigma^2 X^2 D^i_{XX}}_{\text{sensitivity of } D^i \text{ to cash flow}} + \underbrace{\phi^i (P^i - D^i)}_{\text{debt refinancing}}. \tag{1}$$

The above equation illustrates the two driving forces behind changes in debt value. The first is the sensitivity of D^i to the firm's cash flows. The second captures the value change in type-i debt due to the firm refinancing the fraction ϕ^i by issuing new debt with identical characteristics. To solve Equation (1) for the value of debt D^i, we impose two standard boundary conditions by evaluating the limits of the cash flow at infinity and at the default boundary, respectively (see, e.g., Leland, 1994b). We discuss the solution below but delegate technical details to Appendix A.1.

In the first case ($X_t = \infty$), the firm never defaults and the associated 'default-free value of debt' (p^i) is given by

$$p^i = \frac{P^i}{1 + r/\phi^i}. \tag{2}$$

In the second case, shareholders choose to optimally default ($X_t = X_B$, where X_B is the endogenous default boundary) and bondholders take over the firm with a debt value given by

$$D^i(X_B) = \frac{X_B}{r - \mu^{\mathbb{Q}}} \lambda^i, \tag{3}$$

where λ^i denotes the fraction of debt i to total debt (P^i/P).[2] The difference in debt values in the two boundary scenarios in Equations (3) and (2), $D^i(X_B) - p^i < 0$, reflects the bondholders' loss given default. The market value of bond i is given by

$$D^i(X_t) = p^i + \left[D^i(X_B) - p^i\right] \pi_t^{i,\mathbb{Q}}, \tag{4}$$

where $\pi_t^{i,\mathbb{Q}}$ is a scaling factor approaching zero if ($X_t = \infty$) or one if ($X_t = X_B$). Thus, the bond value is given by its default-free value adjusted by the expected loss due to default risk.

[2] Note that the boundary condition implies short-term and long-term bondholders to share the remaining value of the firm proportionally to P in the event of default, i.e. there is no maturity-related debt seniority.

A.2 Equity valuation

With shareholders being the residual claimants of the firm, the value of equity (E) is given by the differential of the levered firm value (F) minus the value of debt (D), i.e., $E(X_t) = F(X_t) - \sum_i D^i(X_t)$. Changes in the equity value (rE), thus, depend on the firm's current cash flow, the sensitivity of the equity value to the underlying cash flow process, and debt-related flows (debt benefits and refinancing of, both, short-term and long-term debt). In particular, the equity value satisfies the equation

$$rE = \underbrace{X}_{\text{cash flow}} + \underbrace{\mu^{\mathbb{Q}} X E_X + \frac{1}{2}\sigma^2 X^2 E_{XX}}_{\text{sensitivity of } E \text{ to cash flow}} + \underbrace{k \sum_i \phi^i P^i}_{\text{debt benefits}} - \underbrace{\sum_i \phi^i (P^i - D^i)}_{\text{debt refinancing}}, \tag{5}$$

where $k > 0$ is a scaling factor for the debt benefits. Equation (5) shows how the tradeoff between short- and long-term debt matters for the value of equity. The value of equity increases with debt benefits and decreases with costs related to debt refinancing. The cost of debt refinancing depends on the fraction of debt that has to be rolled over, i.e. the refinancing intensity (ϕ^i), and on the discount at which debt is refinanced, i.e. on the difference between the principal (P^i) and debt value (D^i_t). Since ϕ^i remains constant over time, any time-variation in debt-related flows that matter for the equity value arises from the bond's discount $P^i - D^i_t$, which depends on the firm's current cash flow X_t. In periods with high (low) cash flows, the firm moves further away from (closer to) the default boundary and hence the discount $P^i - D^i_t$ is small (large). Therefore, the trade-off between the benefits of a high level of short-term debt and increased exposure to refinancing risk matters for the firms' optimal leverage and refinancing intensity choice.

A.3 Optimal capital structure

Based on the valuation of the firm's debt and equity, we now explore the implications for the firm's optimal capital structure. At time $t = 0$, the firm chooses the principal amounts for short-term and long-term debt to maximize the initial value of the firm. By simultaneously choosing P^S and P^L, the firm decides on the overall amount of debt to issue as well as on the maturity structure of its debt. In other words, the firm jointly optimizes its leverage and refinancing intensity.

With P^S and P^L being the only decision variables, we fix all other parameters in accordance with the structural equity and bond pricing literature.[3] In particular, we set the initial cash flow level $X_0 = 1$, the riskless rate $r = 5\%$, and the risk-neutral drift of the cash flow process $\mu^{\mathbb{Q}} = 1\%$. Furthermore, we assume short- and long-term debt maturities of one and ten years, respectively, implying refinancing intensities of $\phi^S = 1$ and $\phi^L = 0.1$, and we set the scaling factor for debt benefits to $k = 0.01$. Using these parameter values, we study the leverage and debt maturity choices of firms that optimize their capital structure for a given level of cash flow risk σ. We define the firm's leverage as

$$L(X_t) = \frac{P}{P + E(X_t)}, \tag{6}$$

which corresponds to the leverage measure applied in empirical research such as, e.g., Strebulaev and Yang (2013) or Danis et al. (2014). The firm's aggregate refinancing intensity is determined by its optimal debt maturity mix and given by

$$\Phi = \lambda^S \phi^S + \lambda^L \phi^L. \tag{7}$$

Figure 1 presents the optimization results by illustrating how leverage and debt refinancing intensity relate to cash flow risk. Panel A shows that a firm's choice of initial leverage (L) is decreasing in cash flow risk, which reflects that firms with lower cash flow risk have a higher debt bearing capacity. This result matches the implications of standard structural models (e.g, Leland, 1994b) and also lines up well with empirical research that finds an inverse relation between firms' cash flow volatility and leverage (e.g., Lemmon et al., 2008).

Panel B shows that the firm's optimal refinancing intensity (Φ) increases with cash flow volatility, implying that the fraction of short-term relative to long-term debt increases as cash flows become more risky. The intuition is that it is too costly for a firm with very volatile cash flows to issue large amounts of long-term debt. This is the case because the discount $P^i - D_t^i$

[3]See, e.g., Leland (1994b), Leland and Toft (1996), Goldstein et al. (2001), Dangl and Zechner (2016), Garlappi and Yan (2011), He and Xiong (2012), Chen et al. (2017), Chen et al. (2013), Medhat (2014), He and Milbradt (2014) or Diamond and He (2014). We also present robustness for the optimization in Figures IA.1 to IA.9 in the Internet Appendix. Specifically, we show that the qualitative nature of the model's predictions remains unchanged by varying the level of debt benefits.

of the long-term bond is more sensitive to cash flow volatility compared to the discount of the short-term bond. Recent empirical work provides evidence that supports this notion by documenting that riskier firms issue relatively more short-term debt (e.g., Gopalan et al., 2014).

Figure 1 about here

Overall, our model implies that firms with comparably low (high) cash flow volatility optimally choose higher (lower) levels of leverage with longer (shorter) debt maturities. These implications are consistent with empirical evidence as, e.g., in Barclay and Smith (1995), Stohs and Mauer (1996), Johnson (2003), and Custódio et al. (2013). In the next section, we show how expected equity returns relate to the firm's leverage and refinancing intensity.

III. Leverage, debt refinancing, and expected equity returns

In this section, we use the model presented above to illustrate how the interaction between leverage and debt refinancing affects expected equity returns. We show that equity returns increase with leverage as well as with the immediacy of debt refinancing needs. As a consequence, leverage alone is not sufficient to gauge the effect of debt-related risks on equity returns. Finally, we discuss the model implied relations of book-to-market and size to leverage, debt refinancing intensity, and expected equity returns.

A. Expected equity returns

Following previous research that derives equity return implications from structural models, such as Carlson et al. (2004) and Garlappi and Yan (2011), we define expected returns on equity via the sensitivity of equity to cash flows. The intuition is that, since equity can be viewed as a call option on the firm's assets and cash flows represent the only source of risk, any change in the equity value must be driven by innovations in cash flows. Defining the asset risk premium as the difference in the real-world and risk-neutral drift parameters of the cash flow process, i.e. $\xi_t = \mu_t^{\mathbb{P}} - \mu_t^{\mathbb{Q}}$, one can express the time-t expected stock return as

$$\mathbb{E}^{\mathbb{P}}[R_t] = r + b_t^X \cdot \xi_t \tag{8}$$

where

$$b_t^X = \frac{d\log E(X_t)}{dX_t} \tag{9}$$

measures the sensitivity of the (log) equity value to cash flows. In our analysis below, we assume a time-invariant risk premium $\xi = 5\%$; for all other parameters, we keep the values that we have used for the optimization of the firm's capital structure in the previous section.

To understand the link between a firm's time-t expected equity returns and its debt structure, we need to distinguish model-implications at the point in time when the firm chooses its optimal capital structure (i.e. at $t = 0$) and implications after the capital structure has been determined (i.e. at $t > 0$). This distinction is important because changes in the equity value affect the firm's leverage ratio (L) over time.[4] Our empirical analysis naturally focuses on the more general predictions of our model for equity returns at any time $t > 0$.

B. Expected equity returns at time t=0

At $t = 0$, the firm optimizes its capital structure by jointly choosing the amount and maturity of debt. Specifically, there is a one-to-one relation between the firm's leverage $L(X_0)$ and its refinancing intensity Φ as illustrated in Figure 1. As a result, there is also a one-to-one relation between the firm's leverage and expected equity excess return as shown in Figure 2: the lower the firm's cash flow risk, the higher the leverage of the firm, and the higher its expected equity excess return because the sensitivity to cash flows (b_0^X) increases.

Figure 2 about here

C. Expected equity returns at times t>0

By contrast, there may not be a one-to-one mapping between leverage and refinancing intensity at times $t > 0$, because leverage changes over time whereas the refinancing intensity does not. As a consequence, expected equity returns at times $t > 0$ depend on the firm's leverage *and* on the firm's refinancing intensity.

[4] Given that the firm commits to a stationary debt structure, changes in the leverage ratio are only driven by changes in the equity value. This appears consistent with empirical evidence provided by Welch (2004) who concludes that variation in equity value is the primary determinant of changes in a firm's leverage ratio. This also seems consistent with the notion that most firms do not actively manage their capital structures and that capital structure adjustments occur infrequently; see e.g., Leary and Roberts (2005) and Strebulaev (2007).

Figure 3 illustrates two stylized examples based on firm value paths implied by our model. Panel A illustrates that two firms that optimally decide on different leverage ratios at $t = 0$ may exhibit the same leverage at $t > 0$, because the low (high) risk firm experiences good (bad) cash flows which naturally decrease (increase) the leverage ratio. Since the debt maturity structure is kept fixed from $t = 0$, these firms have the same leverage ratio but differ with respect to their refinancing risk. Panel B illustrates the opposite case, with two firms that are identical at $t = 0$ but subsequently experience opposing cash flow shocks and evolutions of their leverage ratios while maintaining an identical debt maturity structure.

Figure 3 about here

To see how stock returns relate to leverage and debt maturity, Figure 4 plots expected equity excess returns for different combinations of leverage and refinancing intensity. Panel A shows that equity returns increase with leverage (for a given refinancing intensity) and increase with refinancing intensity (for given leverage). More specifically, the figure suggests that leverage alone is not sufficient to understand how a firm's debt financing affects expected equity returns. For instance, a firm with high leverage (solid line) but low refinancing intensity may have the same expected return as a firm with medium leverage (dotted line) and medium refinancing intensity or a firm with low leverage (dashed line) and high refinancing intensity. Hence, an (empirical) analysis on how stock returns relate to leverage should account for differences in firms' refinancing risk due to differences in their debt maturity profiles.

Figure 4 about here

D. Implications for book-to-market

Assuming that equity is priced at its book value when the firm decides on its capital structure at time $t = 0$, the model-implied book-to-market ratio is given by $BM(X_t) = E(X_0)/E(X_t)$. All firms start from an initial book-to-market ratio of 1, but BM changes over time as the value of equity evolves in response to cash flow realizations, similar to the firm's leverage L. More specifically, at $t > 0$, a book-to-market ratio of one corresponds to the firm's time-t leverage being at the level initially chosen at $t = 0$ in the joint optimization of leverage and debt maturity structure. Conversely, $BM > 1$ ($BM < 1$) corresponds to leverage having increased (decreased) over time, and hence BM reflects the firm's leverage evolution relative to its initial level chosen in accordance with its debt maturity profile.

Panel A of Figure 5 presents BM-values different all combinations of leverage and refinancing intensity, showing that BM increases with leverage (for a given refinancing intensity) and increases with refinancing intensity (for given leverage). Other things equal, firms with more (less) leverage have higher (lower) BM values and the difference in BM of high- compared to low-leverage firms increases with refinancing intensity. Since, BM provides a summary measure of how a firm's leverage has changed compared to its initial, optimal choice, the relation between BM and expected stock returns depends on the firm's debt policies.

Panel B of Figure 5 shows that the relation between BM and expected excess returns on equity depends on the firm's leverage. While expected returns generally increase with BM, these returns are higher for high- compared to low-leverage firms. Bearing the results from Panel A in mind, the implications are twofold. On the one hand, for a given refinancing intensity, two firms may have different BM due to different levels of leverage, and the firm with higher BM (due to higher leverage) has higher expected returns than the firm with lower BM (which has lower leverage). This result appears consistent with empirical evidence that book-to-market ratios capture leverage effects on stock returns to some extent (e.g., Fama and French, 1992) and that the return differential of high- relative to low-BM stocks is directly related to leverage (e.g., Choi, 2013; Doshi et al., 2014). On the other hand, two firms with the same leverage may differ in BM values and expected returns due to differences in the refinancing intensities, suggesting that the link between BM and stock returns cannot be understood in terms of leverage alone.

FIGURE 5 ABOUT HERE

E. Implications for size

We follow the convention in empirical (asset pricing) studies and define size as the firm's market value of equity $E(X_t)$ at time t. In our model the evolution of leverage is driven by changes in the equity value, hence, there is a direct link between size and leverage. At time $t = 0$ there is a one-to-one mapping between leverage and size, i.e. high leverage firms are small and low leverage firms are big. At times $t > 0$, the relation between size and leverage becomes more complex and depends on the firm's refinancing intensity, as illustrated in Panel A of Figure 6. For a given refinancing intensity firm size decreases with leverage, and, for a given leverage firm size decreases with refinancing intensity. In other words, the model implies that firms are small (big) when they have high (low) leverage and/or a high (low) refinancing intensity.

The relation of size to leverage and refinancing intensity gives rise to a 'size effect' in stock returns, consistent with empirical evidence that small firms have higher (expected) returns than big firms. The smallest firms with the lowest expected returns are firms with high leverage and high refinancing intensity whereas the biggest firms earning lowest returns are those with low leverage and low refinancing intensity. For two firms with the same leverage, their refinancing intensities determine their size and their expected equity return, and vice versa when we fix the refinancing intensity.

Figure 6 about here

IV. Data and Descriptive Statistics

In our empirical analysis, we use monthly data on stock returns from the Center for Research in Security Prices (CRSP) and data on firm characteristics from COMPUSTAT. For a firm to be included in the sample, we require the availability of all data items necessary to compute the firm's leverage, refinancing intensity, and book-to-market ratio, as well as stock returns with CRSP share code 10 or 11 (common equity). We exclude financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999) due to their special financial structures. This selection procedure results in a sample of $12,130$ unique firms with a total of $1,382,615$ firm-month observations from January 1972 to December 2014.

We compute the firm's leverage (lev), refinancing intensity (ri), book-to-market ratio (bm), and its size (market value, mv) following standard definitions established in the literature.[5] We measure size mv by the firm's market value of equity (stock price times the number of common shares outstanding) and bm as the value of book equity divided by mv. Furthermore, we measure leverage as the ratio of book debt to book debt plus market value of equity (e.g., Strebulaev and Yang, 2013; Danis et al., 2014) and the refinancing intensity as the ratio of

[5]We briefly describe these measures here and refer to Appendix B for detailed definitions based on the COMPUSTAT data items used for their computation.

debt maturing within one year to total assets (e.g., Almeida et al., 2012; Chen et al., 2013; Gopalan et al., 2014). To account for (varying) time lags between a firm's fiscal year-end and information becoming publicly available, we apply a conservative lag of six months before we update information on the firm's debt position in our analysis of stock returns.

Table I presents summary statistics for monthly equity excess returns, the firm characteristics defined above, and some other variables that we use as regression controls later. On average, our sample contains $2,963$ firms per month.

TABLE I ABOUT HERE

V. Empirical Results

In our empirical analysis, we first provide evidence that the data supports the general predictions of our model using portfolio double sorts. Then, we run Fama-MacBeth regression at the level of the individual firm and show that debt refinancing intensities convey return-relevant information for equity returns beyond leverage, size, book-to-market and other firm characteristics such as cash holdings, profitability, and proxies for financial constraints.

A. Portfolio double sorts

We start by exploring the model's prediction on the relation between leverage, refinancing intensity, and equity returns in double-sorted stock portfolios. At the end of every month, we sort firms into decile portfolios based on their refinancing intensity, and within each of these refinancing intensity-deciles, we sort firms into ten leverage portfolios. For this cross-section of $10 \times 10 = 100$ portfolios, we compute average excess returns of equally-weighted and value-weighted portfolios. Figure 7 shows that the data support the prediction of our model that equity returns increase with leverage and refinancing intensity (as in Figure 4 above). For a given refinancing intensity, portfolios with higher (lower) leverage have higher (lower) returns. For a given leverage, average excess returns increase with refinancing intensities. The results are very similar for equally- and value-weighted portfolios.

FIGURE 7 ABOUT HERE

Next, we compute average book-to-market ratios and firm sizes (i.e. log of the market capitalization) for the double-sorted portfolios, to check whether the relations of these characteristics to leverage and refinancing intensity in the data comply with the implications of our model. Figure 8 suggests that this is indeed the case. Panel A shows that B/M ratios increase with leverage and refinancing intensity, with the patterns being qualitatively identical to those implied by the model and presented in Figure 5 B above. Similarly, we find in Figure 8 that firm size is inversely related to leverage and inversely related to refinancing intensity. In other words, the biggest firms have low leverage and low refinancing intensites, whereas small firms have high leverage and high refinancing intensities, just as predicted by our model (compare to Figure 6 B).

Figure 8 about here

Finally, we look at the relation of book-to-market and size to average portfolio excess returns. Figure 9 uses the 100 portfolios to illustrate that there is a strong link between book-to-market and portfolio returns in Panel A and a strong size effect in Panel B. Among the 100 portfolios, we mark the firms that have high, medium, or low leverage, conditional on their refinancing intensity being high, medium, or low. We first look at B/M and find that the empirical patterns match those implied by the model (in Figure 5 C) well: high (low) B/M firms tend to be high (low) leverage firms, and for similar values of B/M (and hence a similar level of leverage) returns increase with refinancing intensity. These results suggest that the refinancing intensity may be provide return-relevant information beyond B/M and leverage. In line with our model, we find for instance that low B/M firms with high refinancing intensities earn about the same return as high B/M firms with low refinancing intensities.

The empirical results on the size effect in Panel B of Figure 9 are also in line with the predictions of our model, illustrated above in Figure 6 C: small firms with high returns are highly levered and have high refinancing intensities, whereas the biggest firms with low returns have low leverage and low refinancing intensities. The results suggest that the inverse relation between size and returns is linked to increasing leverage and refinancing intensities but at the same time the results also suggest that leverage and refinancing intensity may convey additional return-relevant information beyond size.

Figure 9 about here

Overall, this preliminary analysis based on portfolio double sorts supports the general predictions of our model. Equity returns increase with leverage and refinancing intensities and the high returns to small stocks and firms with high B/M ratios reflect, at least to some extent, that these firms are most risky in terms of their leverage and refinancing needs.

B. Fama-MacBeth regressions

To study the relation between equity returns and debt refinancing in more depth, we now conduct Fama-MacBeth regressions at the level of the individual firm. At the outset, we repeat the exercise of Fama and French (1992) that has led them to conclude that size and book-to-market jointly account for leverage effects on stock returns. We then show that equity returns are significantly related to refinancing intensities, even after controlling for size and book-to-market, as well as for leverage and for other firm variables such as cash holdings, profitability or measures of financial constraints.

We first replicate the empirical analysis of Fama and French (1992) in our data and show that we come to the same conclusions in Panel A of Table II. First, we find that returns are positively related to market leverage, defined as log assets to market equity, but unrelated to book leverage, defined as log assets to book equity. When we include both leverage variables in the regression, we find that they are both significant and have similar coefficient estimates in absolute terms but with opposing signs. Adding beta and size as explanatory variables, the coefficient estimate for market leverage is 0.32 and the estimate for book leverage is -0.32, implying that effectively the asset component of the leverage variables cancel out and we are left with book to market equity. Consequently, in the last specification, in which we add book-to-market, we find that the coefficient estimate for B/M is 0.32 and the estimate for market leverage is zero. The results in Panel B of Table II show that any predictability that other measures of market leverage disappears when controlling for size and book-to-market.

Table II about here

Tables III and IV present regression results suggesting that the refinancing intensity matters for equity returns beyond size, book-to-market, leverage, and other control variables. In these regressions we use measures of leverage and refinancing intensity that directly correspond to the respective quantities in our model. We define market leverage as the ratio of book debt to the sum book debt plus market equity, $\frac{BD}{BD+ME}$, and we define the refinancing intensity as the fraction of debt due next year to total book debt, $\frac{DD1}{BD}$. In Table III we report results based on by taking the logarithms of leverage and refinancing intensity, whereas we do not rake logarithms for the analysis reported in Table IV. By taking logarithms, we follow Fama and French (1992) who also take logarithms for size, book-to-market, and leverage variables in their regressions, but we have to sacrifice part of our sample, i.e. the firms with zero leverage and/or zero refinancing intensity, leaving us with around 1.10 million out of 1.38 million observations; without taking logs, we can keep levered firms that have no immediate refinancing needs, i.e. a refinancing intensity of zero, giving us a sample of around 1.25 million observations.

The results are very similar in both cases. Tables III shows that equity returns are significantly related to refinancing intensities alone (specification i) as well as when including other explanatory variables (specifications ii to vi). In the specification that includes both leverage and refinancing intensity, we find both coefficient estimates to be virtually identical (0.14) and highly significant and this result remains unchanged when adding beta to the regression. These results suggest that, effectively, what matters for equity returns is the (logarithm of the) ratio of $DD1$ to $BD + ME$. Adding size, the point estimates of both leverage and refinancing intensity drop and the significance of leverage weakens (with a t-statistic of 2.0) whereas the refinancing intensity becomes even more significant (with a t-statistic of 5.33). Notably, the point estimates of leverage and refinancing intensity are still identical. Once we include B/M, leverage becomes insignificant but the refinancing intensity remains highly significant with a t-statistic of around 4.3. These results confirm the prediction of our model that the refinancing intensity should matter for equity returns over and above size, book-to-market, and leverage.

Table III about here

In the last specification (vi), we augment the regression by including several additional control variables, which previous research has shown to be predictors of stock returns and/or which could be relevant in terms of a potential channel through which debt refinancing may matter for equity returns. First, we include the firm's cash holdings, the idea being that firms with a lot of cash may not have rely on shareholders to step in when rollover risk materializes. Second, following an analogous reasoning we include a proxy for profitability; moreover, recent research suggests that profitability itself is an important explanatory variable for the cross-section of equity returns . Extending the idea that the refinancing intensity matters less for shareholders of firms that are profitable and/or have a lot of cash, we include additional control variables that have been used as proxies for financial constraints. We add the age of the firm, a dummy that indicates whether the firm has paid dividends in the past, as well as the number of years since the last dividend. Finally, we add the firm's stock return over the past year, skipping the latest month, in line with conventional definitions for momentum. Adding all these controls to the regression, we find that the refinancing intensity remains significant and that the coefficient estimate is unchanged.

The results in Table IV, without taking the logarithms of leverage and refinancing intensity, are very similar, i.e. our conclusions are not changed when including levered firms that have no need to refinance debt in the next year. Stock returns increase with the refinancing intensity and in general also with leverage. Once we control for size and book-to-market, the coefficient estimate for leverage is not different from zero. The regression coefficient for the refinancing intensity remains highly significant, also when including the additional control variable for cash holdings, profitability, proxies for financial constraints, as well as past returns.

Table IV about here

Finally, we repeat the empirical analysis using the market leverage definition of Fama and French (1992), i.e. $\log\left(\frac{A}{ME}\right)$. Tables V and VI presents results when using the log of refinancing intensity and the untransformed refinancing intensity, respectively. The results are qualitatively identical to those reported above. The refinancing intensity significantly matters for equity returns over and above size, book-to-market, leverage, and other control variables.

Tables V and VI about here

VI. Conclusion

This paper complements previous mixed evidence on the relation between stock returns and leverage by showing that equity returns increase with leverage when controlling for debt refinancing risk. Our model, which draws on the recent bond literature on debt rollover risk, implies that shareholders demand a premium for holding high- compared to low-leverage firms that increases with the immediacy of debt refinancing needs. Because firms optimally choose their capital structure by jointly optimizing the level and the maturity structure of debt, leverage alone is insufficient to understand the cross-sectional relation between debt-related risk and equity returns. In a similar vein, size and book-to-market capture leverage effects on stock returns only when controlling for firms' rollover risk.

Our empirical results, based on the merged CRSP-COMPUSTAT-universe from 1972 to 2014, match the predictions of the model. We find that stocks of firms with high leverage earn returns in excess of stocks of low leverage firms when controlling for firms' debt refinancing intensities. Size and book-to-market capture leverage effects on stock returns in Fama-MacBeth regressions at the individual firm level, akin to Fama and French (1992), but firms' refinancing intensities convey return-relevant information beyond other characteristics. We provide several additional tests and show that our conclusions remain unchanged when we account for firms' cash holdings, profitability and other firm variables used as proxies for financial constraints.

Appendix

A. Model Solutions

A.1. Debt value

Equation (1) has a particular and a general solution which satisfies the equation,

$$D^i(X) = p^i + A_1^i X^{\beta_1^i} + A_2^i X^{\beta_2^i} \tag{A.1}$$

with β_1^i and β_2^i being the roots of the fundamental quadratic which are given by

$$\beta_1^i = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) + \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2(r + \phi^i)}}{\sigma^2} \quad > \quad 0 \tag{A.2}$$

and

$$\beta_2^i = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) - \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2(r + \phi^i)}}{\sigma^2} \quad < \quad 0. \tag{A.3}$$

The two boundary conditions imposed on debt value are (at $X = \infty$)

$$\lim_{X \to \infty} \qquad D^i(X) = p^i \tag{A.4}$$

and (at $X = X_B$)

$$\lim_{X \to X_B} \qquad D^i(X_B) = \frac{X_B}{r - \mu^{\mathbb{Q}}} \lambda^i. \tag{A.5}$$

These conditions imply $A_1^i = 0$, in order to exclude bubbles, and A_2^i is given by

$$A_2^i = \left[\frac{X_B}{r - \mu^{\mathbb{Q}}} \lambda^i - p^i \right] \left(\frac{1}{X_B} \right)^{\beta_2^i}. \tag{A.6}$$

Therefore, the scaling factor used in Equation (4) is defined by

$$\pi_t^{i,\mathbb{Q}} = \left(\frac{X_t}{X_B} \right)^{\beta_2^i}. \tag{A.7}$$

A.2. Levered firm value

The value of debt benefits DB^i satisfies the equation (where we define $k^i = k \cdot \phi^i$)

$$DB^i(X) = \frac{k^i P^i}{r} + G_1^i X^{\gamma_1} + G_2^i X^{\gamma_2} \tag{A.8}$$

with γ_1 and γ_2 being the roots of the fundamental quadratic which are defined as

$$\gamma_1 = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) + \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2 r}}{\sigma^2} \quad > \quad 0 \tag{A.9}$$

and

$$\gamma_2 = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) - \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2 r}}{\sigma^2} \quad < \quad 0. \tag{A.10}$$

The two boundary conditions imposed on the value of debt benefits are (at $X = \infty$)

$$\lim_{X \to \infty} \quad DB^i(X) = \frac{k^i P^i}{r} \tag{A.11}$$

and (at $X = X_B$)

$$\lim_{X \to X_B} \quad DB^i(X_B) = 0. \tag{A.12}$$

In order to exclude bubbles these conditions imply $G_1^i = 0$. Moreover, G_2^i is given by

$$G_2^i = -\frac{k^i P^i}{r} \left(\frac{1}{X_B} \right)^{\gamma_2}. \tag{A.13}$$

Given the value of debt benefits DB^i, the levered firm value F can be computed as

$$F(X_t) = \frac{X_t}{r - \mu^{\mathbb{Q}}} + \sum_i \frac{k^i P^i}{r} \left[1 - \left(\frac{X_t}{X_B} \right)^{\gamma_2} \right]. \tag{A.14}$$

In this expression, the first term represents the value of an unlevered firm and the second term the value of debt benefits. Thus, the scaling factor (probability of default) in this case is defined by

$$\pi_t^{\mathbb{Q}} = \left(\frac{X_t}{X_B} \right)^{\gamma_2}. \tag{A.15}$$

A.3. Optimal default boundary

We adopt the endogenous default notion of, e.g., Black and Cox (1976), Fischer et al. (1989) or Leland (1994b), which postulates that the ex-post optimal default boundary X_B for equityholders satisfies the smooth-pasting condition

$$\left.\frac{\partial E(X_t)}{\partial X_t}\right|_{X_t=X_B} = 0. \tag{A.16}$$

This condition implies that the optimal default boundary is given by

$$X_B = \frac{\frac{k^L P^L}{r}\gamma_2 + \frac{k^S P^S}{r}\gamma_2 - p^L \beta_2^L - p^S \beta_2^S}{\frac{1}{r-\mu^{\mathbb{Q}}}\left(1 - \beta_2^L \lambda^L - \beta_2^S \lambda^S\right)}. \tag{A.17}$$

In the case of debt with only one maturity type, this default boundary is similar to the case of Leland (1994a) for a zero-coupon bond with no exogenous bankruptcy costs. Generally, an increase in the scaling factor k of debt benefits decreases the default boundary (since $\gamma_2 < 0$), whereby short-term debt is more sensitive to a change in k. Moreover, an increase in P^i increases the default boundary since we have that $\gamma_2 k(r+\phi^i) - \beta_2^i r > 0$. The default boundary is more sensitive to an increase in long-term debt compared to short-term debt (since $\beta_2^S < \beta_2^L$). In any case, an increase in P^i increases the likelihood of default.

B. Definition of Variables

This section defines the variables used in the empirical analysis. The capitalized words correspond to the COMPUSTAT data items. We define leverage (lev) following, e.g., Strebulaev and Yang (2013) or Danis et al. (2014) as book debt over book debt plus market value of equity, hence,

$$lev = \frac{\text{DLTT} + \text{DLC}}{\text{DLTT} + \text{DLC} + \text{PRCC\_F} \cdot \text{CSHO}} \tag{B.1}$$

where DLTT denotes item "Long-Term Debt - Total", DLC denotes "Debt in Current Liabilities - Total", PRCC_F denotes "Price Close - Annual - Fiscal" and CSHO denotes "Common Shares Outstanding".

We define our refinancing intensity measure (ri) in accordance with the empirical literature on rollover risk (e.g. Almeida et al., 2012; Chen et al., 2013; Gopalan et al., 2014) as the fraction of debt maturing within one year to total assets, thus

$$ri = \frac{\text{DD1}}{\text{DLTT} + \text{DLC}}, \tag{B.2}$$

where DD1 refers to item "Long-Term Debt Due in One Year".

We define the book-to-market ratio (bm) following, e.g., Friewald et al. (2014) as

$$bm = \frac{\text{CEQ}}{\text{PRCC\_F} \cdot \text{CSHO}} \tag{B.3}$$

and market value (mv) as

$$mv = \text{PRCC\_F} \cdot \text{CSHO}, \tag{B.4}$$

where CEQ is "Common/Ordinary Equity - Total".

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Table I: Descriptive Statistics.

This table reports summary statistics of the variables used in the empirical analysis. We report the mean, median, standard deviation, 25%- and 75%-quantiles, and the number of observations for the excess return, leverage ($mlev$), log leverage ($log.mlev$), refinancing intensity (ri), log refinancing intensity ($log.ri$), market value (mv), book-to-market (bm), cash ($cash$), profitability ($profit$), a dummy indicating that the firm did never pay dividends (div), the time since the last dividend payment in years ($divy$), the number of years since the firm is recorded in COMPUSTAT ($com.age$), and the number of firms in each month. The dataset comprises joint observations of stock prices and firm characteristics obtained from CRSP and COMPUSTAT for the time period from 1972 to 2014 where we have excluded financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999).

	Mean	Median	SD	$Q_{25\%}$	$Q_{75\%}$	Observations
Excess Return (in %)	1.00	−0.39	18.07	−7.32	7.41	1382615
Leverage (lev)	0.25	0.18	0.24	0.03	0.40	1382615
Log Leverage ($log.lev$)	−1.92	−1.48	1.59	−2.48	−0.83	1207818
Refinancing Intensity (ri)	0.13	0.06	0.20	0.01	0.15	1207818
Log Refinancing Intensity ($log.ri$)	−2.79	−2.63	1.55	−3.59	−1.78	1070262
Market Value (mv)	1726.49	97.81	11378.77	21.73	525.77	1382615
Book-to-Market (bm)	0.83	0.61	0.86	0.34	1.05	1382615
Cash ($cash$)	0.16	0.08	0.19	0.03	0.21	1382400
Profitability ($profit$)	0.09	0.12	0.21	0.06	0.18	1379565
No Dividend Payment Dummy (div)	0.41	0.00	0.49	0.00	1.00	1382615
No Dividend Payment Period ($divy$)	4.56	0.00	6.84	0.00	8.00	1382615
Years Recorded in Compustat ($com.age$)	17.93	14.09	12.15	8.01	24.02	1382615
Number of Firms	2963.63	2933.00	648.49	2498.50	3348.00	

Table II: Leverage and Equity Returns

We conduct Fama-MacBeth regressions at the individual firm level using monthly data on equity excess returns, betas, and firm characteristics. The regression specifications include beta (β), size $log(ME)$, book-to-market $log(\frac{BE}{ME})$, and different measures of financial leverage. In Panel A, we include market leverage measured as $log(\frac{A}{ME})$ and book leverage measured as $log(\frac{A}{BE})$. In Panel B, we consider three different measures of market leverage: $log(\frac{BD}{BD+ME})$, $\frac{BD}{BD+ME}$, and finally we use again $\frac{BD}{BD+ME}$ but only keep observations where market leverage is greater than zero. We report coefficient estimates and associated t-statistics (in square brackets), based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The dataset comprises joint observations of stock returns and firm characteristics obtained from CRSP and COMPUSTAT for the time period from 1972 to 2014 where we have excluded financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999). The last row reports the number of observations available for each regression specification in thousands.

Panel A: Market Leverage, Book Leverage, and Equity Returns

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
β				0.28	0.29	0.29
				[1.13]	[1.15]	[1.15]
$log(ME)$					-0.11	-0.11
					[-2.21]	[-2.21]
$log\left(\frac{BE}{ME}\right)$						0.32
						[5.18]
MLEV: $log\left(\frac{A}{ME}\right)$	0.34		0.45	0.45	0.32	0.00
	[4.06]		[5.25]	[6.03]	[4.17]	[0.01]
BLEV: $log\left(\frac{A}{BE}\right)$		-0.04	-0.39	-0.41	-0.32	
		[-0.52]	[-5.21]	[-6.98]	[-5.18]	
Obs	1382.62	1382.62	1382.62	1382.62	1382.62	1382.62

Panel B: Other Measures of Market Leverage and Equity Returns

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
β	0.22	0.21	0.20	0.28	0.29	0.27
	[0.88]	[0.83]	[0.80]	[1.09]	[1.16]	[1.07]
$log(ME)$				-0.10	-0.11	-0.11
				[-2.16]	[-2.25]	[-2.23]
$log\left(\frac{BE}{ME}\right)$				0.34	0.37	0.36
				[5.45]	[6.18]	[6.02]
$log\left(\frac{BD}{BD+ME}\right)$	0.09			-0.03		
	[2.43]			[-1.12]		
$\frac{BD}{BD+ME}$		0.35			-0.42	
		[1.27]			[-1.74]	
$\frac{BD}{BD+ME} > 0$			0.47			-0.40
			[1.63]			[-1.59]
Obs	1207.82	1382.62	1207.82	1207.82	1382.62	1207.82

Table III: Debt Refinancing and Equity Returns (1)

We conduct Fama-MacBeth regressions at the individual firm level using monthly data on equity excess returns, betas, and firm characteristics. The regression specifications include beta (β), size $log(ME)$, book-to-market $log(\frac{BE}{ME})$, the firm's market leverage measured as $log(\frac{BD}{BD+ME})$, and its refinancing intensity measured as $log(\frac{DD1}{BD})$. The additional controls in specification (vi) include cash holdings, profitability, a dummy indicating that the firm did never pay dividends, the time since the last dividend payment in years, and the number of years since the firm is recorded in COMPUSTAT, and the stock's return over the past year skipping the most recent month. We report coefficient estimates and associated t-statistics (in square brackets), based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The dataset comprises joint observations of stock returns and firm characteristics obtained from CRSP and COMPUSTAT for the time period from 1972 to 2014 where we have excluded financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999). The last row reports the number of observations available for each regression specification in thousands.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
β			0.24	0.25	0.28	0.31
			[0.95]	[0.97]	[1.12]	[1.27]
$log(ME)$				-0.13	-0.09	-0.14
				[-2.92]	[-2.05]	[-3.74]
$log\left(\frac{BE}{ME}\right)$					0.33	0.31
					[5.38]	[5.94]
MLEV: $log\left(\frac{BD}{BD+ME}\right)$		0.14	0.14	0.07	-0.02	0.03
		[3.05]	[3.24]	[2.00]	[-0.57]	[1.09]
RI: $log\left(\frac{DD1}{BD}\right)$	0.10	0.14	0.14	0.07	0.05	0.05
	[3.35]	[4.85]	[4.80]	[5.33]	[4.34]	[4.17]
Additional controls						X
Obs	1102.28	1102.28	1102.28	1102.28	1070.26	1059.56

Table IV: Debt Refinancing and Equity Returns (2)

We conduct Fama-MacBeth regressions at the individual firm level using monthly data on equity excess returns, betas, and firm characteristics. The regression specifications include beta (β), size $log(ME)$, book-to-market $log(\frac{BE}{ME})$, the firm's market leverage measured as $\frac{BD}{BD+ME}$, and its refinancing intensity measured as $\frac{DD1}{BD}$. The additional controls in specification (vi) include cash holdings, profitability, a dummy indicating that the firm did never pay dividends, the time since the last dividend payment in years, and the number of years since the firm is recorded in COMPUSTAT, and the stock's return over the past year skipping the most recent month. We report coefficient estimates and associated t-statistics (in square brackets), based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The dataset comprises joint observations of stock returns and firm characteristics obtained from CRSP and COMPUSTAT for the time period from 1972 to 2014 where we have excluded financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999). The last row reports the number of observations available for each regression specification in thousands.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
β			0.21	0.23	0.27	0.32
			[0.81]	[0.87]	[1.05]	[1.29]
$log(ME)$				-0.13	-0.09	-0.15
				[-2.93]	[-2.07]	[-3.87]
$log\left(\frac{BE}{ME}\right)$					0.36	0.33
					[6.01]	[6.82]
MLEV: $\frac{BD}{BD+ME}$		0.73	0.67	0.29	-0.31	-0.20
		[2.13]	[2.27]	[1.04]	[-1.28]	[-0.91]
RI: $\frac{DD1}{BD}$	0.75	0.92	0.90	0.45	0.46	0.43
	[3.12]	[3.88]	[4.12]	[3.56]	[3.67]	[3.70]
Additional controls						X
Obs	1246.23	1246.23	1246.23	1246.23	1207.82	1195.88

Table V: Debt Refinancing and Equity Returns (3)

We conduct Fama-MacBeth regressions at the individual firm level using monthly data on equity excess returns, betas, and firm characteristics. The regression specifications include beta (β), size $log(ME)$, book-to-market $log(\frac{BE}{ME})$, the firm's market leverage measured as $log(\frac{A}{ME})$, and its refinancing intensity measured as $log(\frac{DD1}{BD})$. The additional controls in specification (vi) include cash holdings, profitability, a dummy indicating that the firm did never pay dividends, the time since the last dividend payment in years, and the number of years since the firm is recorded in COMPUSTAT, and the stock's return over the past year skipping the most recent month. We report coefficient estimates and associated t-statistics (in square brackets), based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The dataset comprises joint observations of stock returns and firm characteristics obtained from CRSP and COMPUSTAT for the time period from 1972 to 2014 where we have excluded financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999). The last row reports the number of observations available for each regression specification in thousands.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
β			0.25	0.25	0.27	0.30
			[0.99]	[1.00]	[1.09]	[1.24]
$log(ME)$				-0.10	-0.09	-0.13
				[-2.18]	[-2.01]	[-3.74]
$log\left(\frac{BE}{ME}\right)$					0.32	0.27
					[5.05]	[4.82]
MLEV: $log\left(\frac{A}{ME}\right)$		0.35	0.34	0.24	0.01	0.07
		[4.09]	[4.38]	[3.01]	[0.09]	[0.94]
RI: $log\left(\frac{DD1}{BD}\right)$	0.10	0.12	0.12	0.07	0.06	0.05
	[3.35]	[4.17]	[4.34]	[5.54]	[4.50]	[4.03]
Additional controls						X
Obs	1102.28	1102.28	1102.28	1102.28	1070.26	1059.56

Table VI: Debt Refinancing and Equity Returns (4)

We conduct Fama-MacBeth regressions at the individual firm level using monthly data on equity excess returns, betas, and firm characteristics. The regression specifications include beta (β), size $log(ME)$, book-to-market $log(\frac{BE}{ME})$, the firm's market leverage measured as $log(\frac{A}{ME})$, and its refinancing intensity measured as $\frac{DD1}{BD}$. The additional controls in specification (vi) include cash holdings, profitability, a dummy indicating that the firm did never pay dividends, the time since the last dividend payment in years, and the number of years since the firm is recorded in COMPUSTAT, and the stock's return over the past year skipping the most recent month. We report coefficient estimates and associated t-statistics (in square brackets), based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The dataset comprises joint observations of stock returns and firm characteristics obtained from CRSP and COMPUSTAT for the time period from 1972 to 2014 where we have excluded financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999). The last row reports the number of observations available for each regression specification in thousands.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
β			0.24	0.25	0.27	0.31
			[0.96]	[0.99]	[1.05]	[1.26]
$log(ME)$				-0.10	-0.09	-0.14
				[-2.16]	[-1.93]	[-3.70]
$log\left(\frac{BE}{ME}\right)$					0.30	0.26
					[4.87]	[4.60]
MLEV: $log\left(\frac{A}{ME}\right)$		0.36	0.35	0.24	0.03	0.09
		[4.17]	[4.61]	[3.12]	[0.34]	[1.14]
RI: $\frac{DD1}{BD}$	0.75	0.91	0.89	0.58	0.55	0.48
	[3.12]	[4.00]	[4.24]	[4.53]	[4.39]	[4.14]
Additional controls						X
Obs	1246.23	1246.23	1246.23	1246.23	1207.82	1195.88

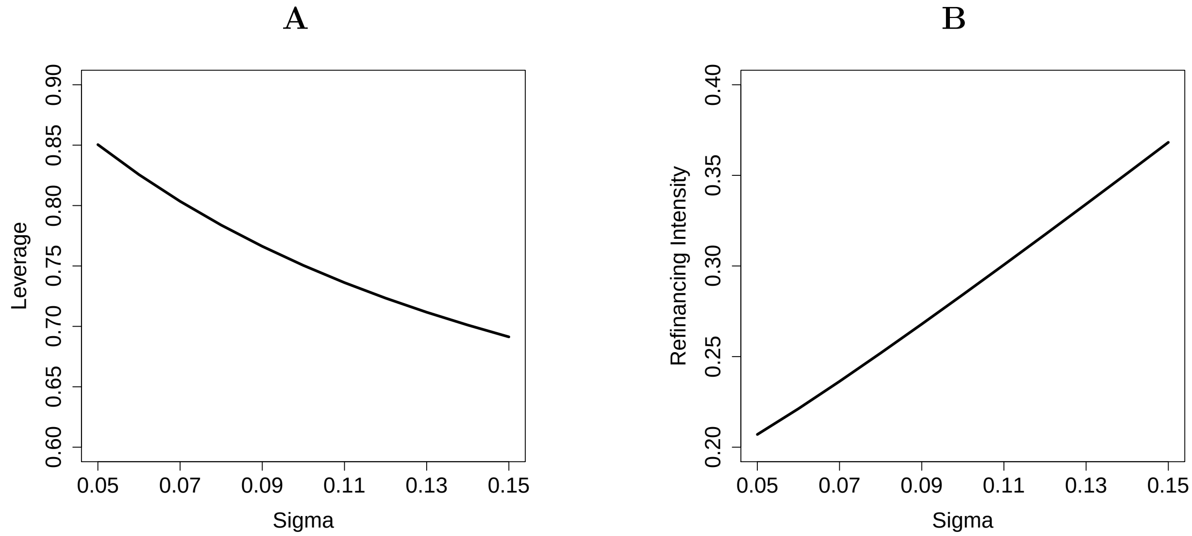


Figure 1: Optimal Financing Choice at $t = 0$. This figure reports the optimal initial financing choices of firms with respect to different cash flow risks given by σ. Panel A shows the leverage and Panel B the refinancing intensity. We set the initial cash flow level $X_0 = 1$, riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$, short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.01$.

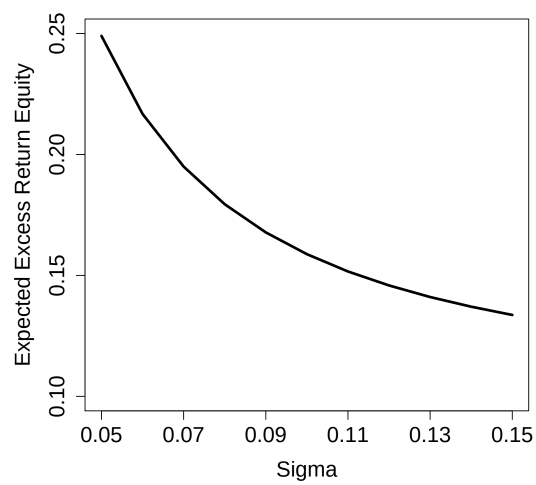


Figure 2: Equity Returns at $t = 0$. This figure reports the relation between expected excess returns on equity and cash flow risk at $t = 0$, hence, at the optimal initial financing choices of firms. We set the initial cash flow level $X_0 = 1$, riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$, short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$, debt benefits $k = 0.01$ and equity risk premium $\xi = 5\%$.

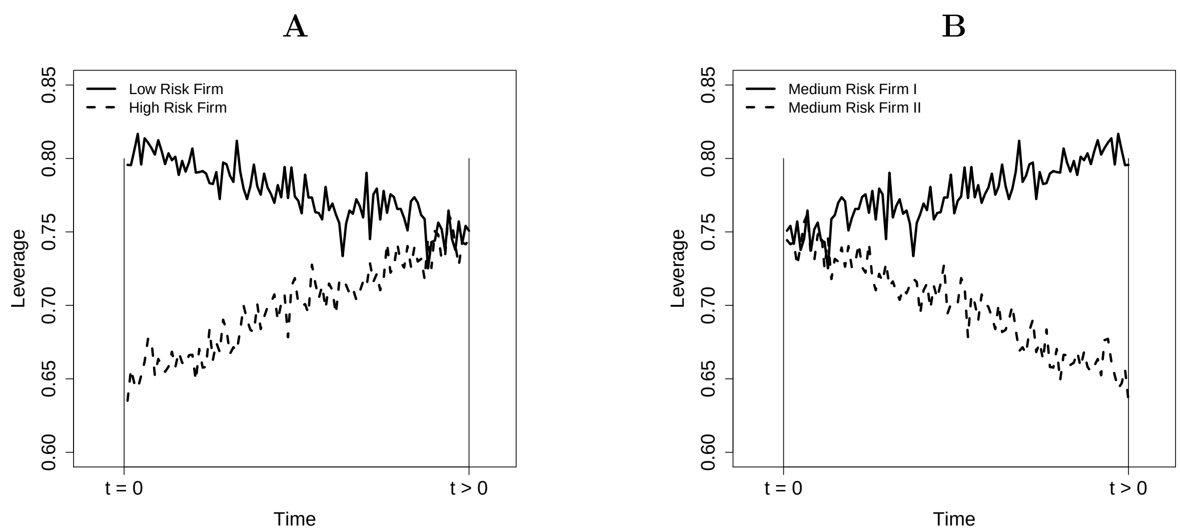


Figure 3: Example of Leverage Evolution. This figure displays examples of the evolution of leverage between the initial financing choice at $t = 0$ and at some time $t > 0$. Panel A shows examples for two firms exhibiting high and low cash flow risk, respectively. Panel B displays two examples for a medium risk firm.

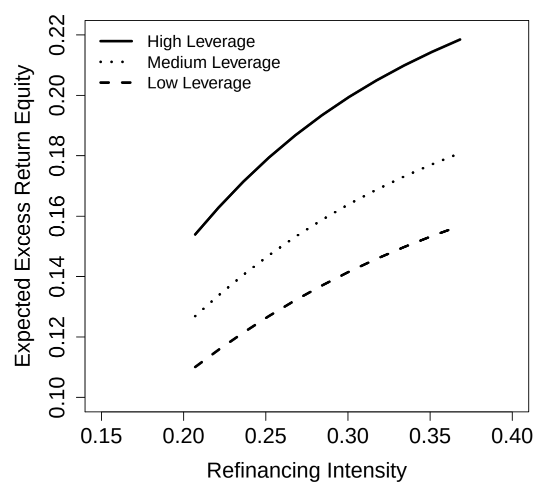


Figure 4: Cross-Section of Expected Equity Returns at $t > 0$. This figure reports the cross-sectional relation between leverage and expected excess returns on equity across different levels of the refinancing intensity. We report three levels of leverage given by high leverage = 78%, medium leverage = 75% and low leverage = 72%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.01$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

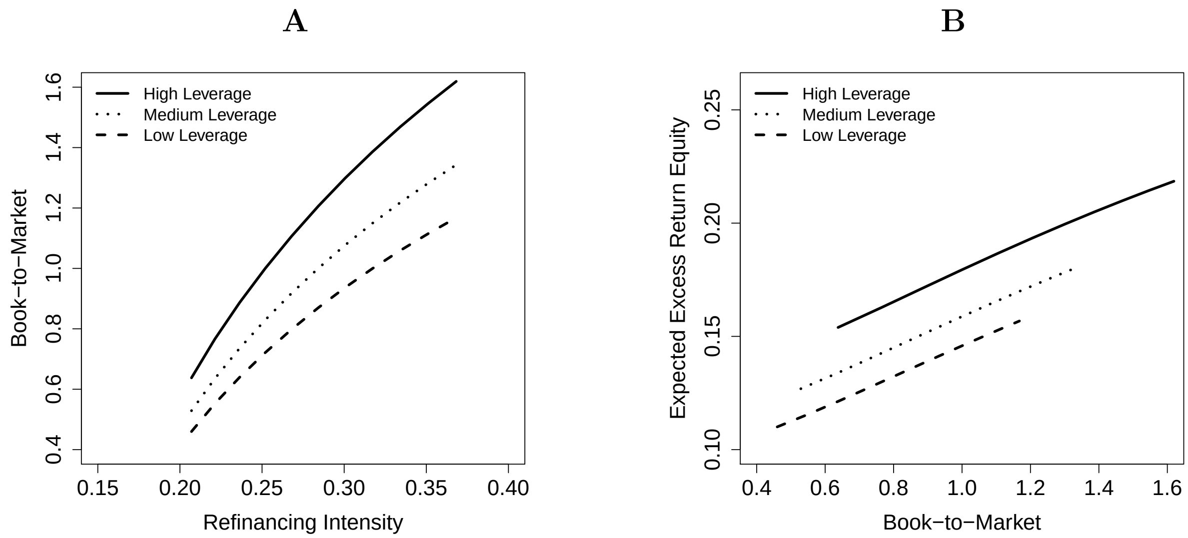


Figure 5: Book-to-Market. This figure reports the cross-sectional relation between book-to-market, leverage and expected excess returns on equity at $t > 0$. Panel A reports the cross-sectional relation between leverage and book-to-market for a given level of the refinancing intensity. Panel B reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of book-to-market. We report three levels of leverage given by high leverage = 78%, medium leverage = 75% and low leverage = 72%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.01$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

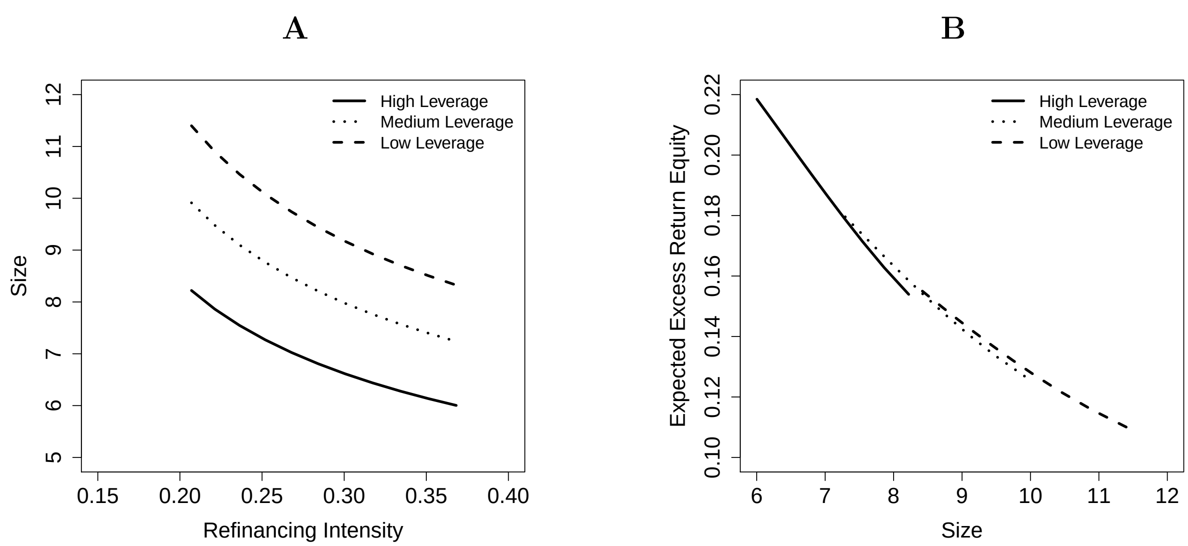
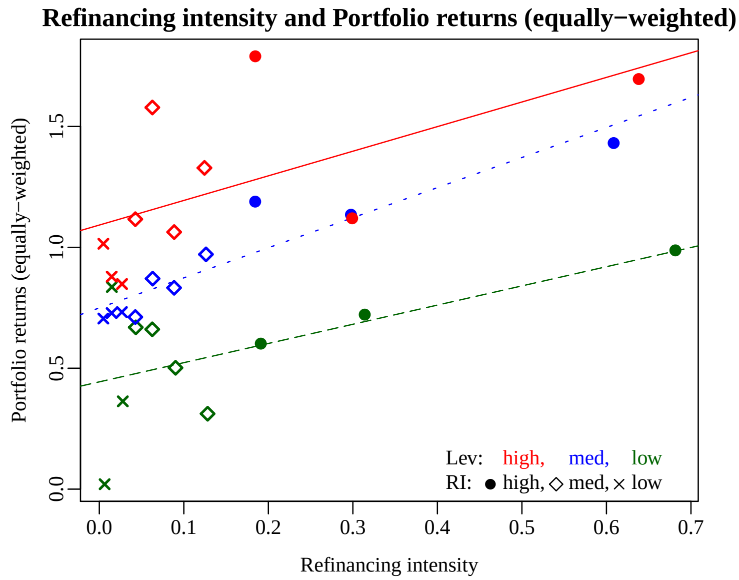


Figure 6: Size. This figure reports the cross-sectional relation between size, leverage and expected excess returns on equity at $t > 0$. Panel A reports the cross-sectional relation between leverage and size for a given level of the refinancing intensity. Panel B reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of size. We report three levels of leverage given by high leverage = 78%, medium leverage = 75% and low leverage = 72%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.01$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

A



B

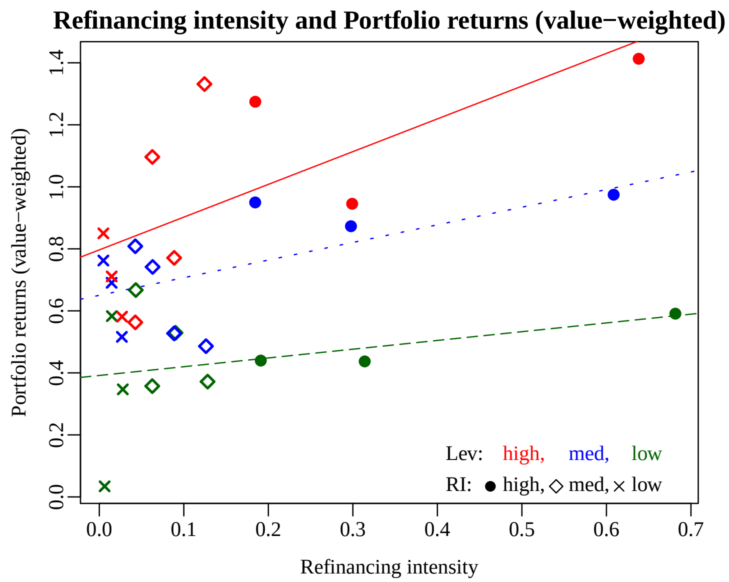
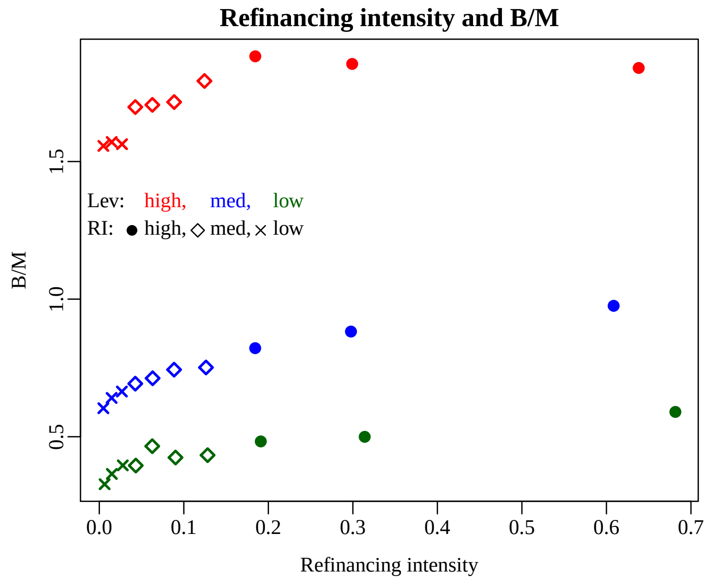


Figure 7: Leverage, debt rollover risk, and equity returns. We present average equity excess returns of portfolios double-sorted on firms' market leverage and refinancing intensity. At the end of every month, we assign firms to decile portfolios based on their refinancing intensity. Within each refinancing intensity-decile, we sort firms into ten portfolios based on their market leverage. From these $10 \times 10 = 100$ portfolios, we illustrate the relation between average equity excess returns and average refinancing intensities for firms that have high leverage (top leverage decile, conditional on refinancing intensity; in red), medium leverage (fifth decile, in blue), and low leverage (bottom decile, in green). Panels A and B report results for equally- and value-weighted portfolios, respectively. The plot symbol used corresponds to the average refinancing intensity across firms in the portfolio being high (filled circles), medium (diamonds), or low (crosses). The sample covers all levered firms included in the merged CRSP-COMPUSTAT dataset, excluding financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999), from 1972 to 2014.

A



B

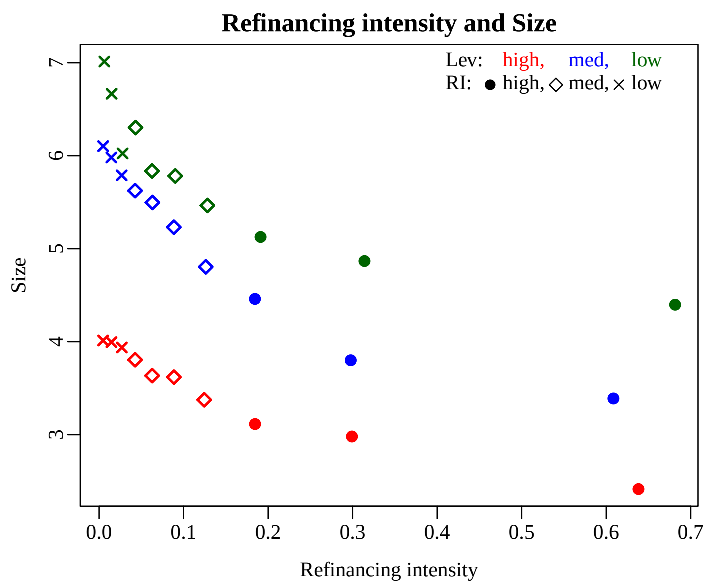
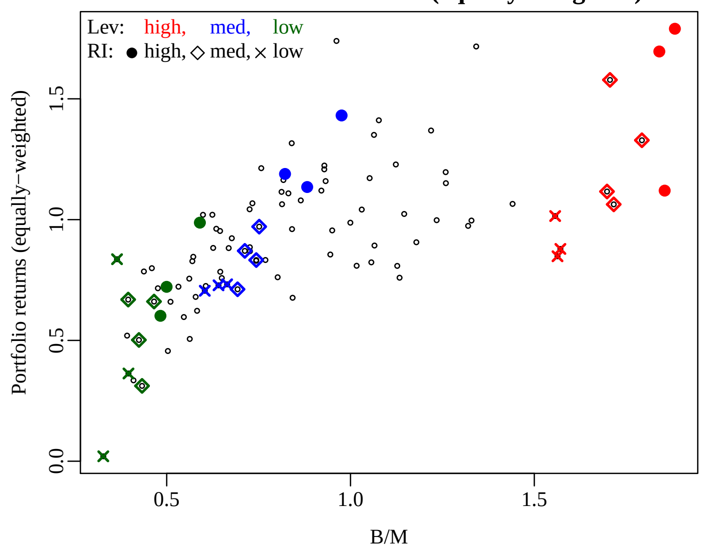


Figure 8: The relation of book-to-market and size to leverage and debt refinancing intensity. We present average book-to-market ratios (Panel A) and average firm sizes (Panel B) of firms double-sorted into portfolios based on their market leverage and refinancing intensity. At the end of every month, we assign firms to decile portfolios based on their refinancing intensity. Within each refinancing intensity-decile, we sort firms into ten portfolios based on their market leverage. From these $10 \times 10 = 100$ portfolios, Panel A illustrates the relation between average book-to-market ratios and average refinancing intensities for firms that have high leverage (top leverage decile, conditional on refinancing intensity; in red), medium leverage (fifth decile, in blue), and low leverage (bottom decile, in green). The plot symbol used corresponds to the average refinancing intensity across firms in the portfolio being high (filled circles), medium (diamonds), or low (crosses). Panel B reports analogous results for firm (log) size. The sample covers all levered firms included in the merged CRSP-COMPUSTAT dataset, excluding financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999), from 1972 to 2014.

A

B/M and Portfolio returns (equally−weighted)



B

Size and Portfolio returns (equally−weighted)

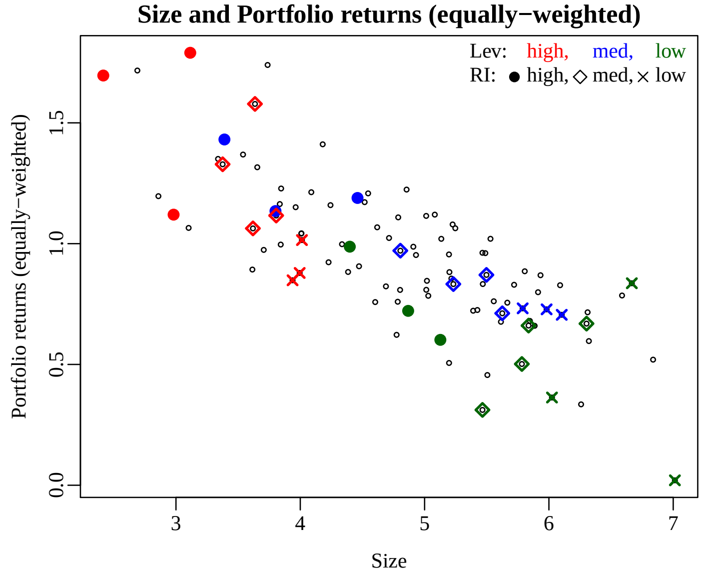


Figure 9: The relation of book-to-market and size to expected equity returns. This figure shows how the average equity excess returns of portfolios double-sorted on firms' market leverage and refinancing intensity relate to average book-to-market ratios (Panel A) and average firm sizes (Panel B). At the end of every month, we assign firms to decile portfolios based on their refinancing intensity. Within each refinancing intensity-decile, we sort firms into ten portfolios based on their market leverage. For these $10 \times 10 = 100$ portfolios, Panel A illustrates the relation between average equity excess returns and average book-to-market ratios (small circles in black). Among these 100 firms, we mark firms that have high leverage (top leverage decile, conditional on refinancing intensity; in red), medium leverage (fifth decile, in blue), and low leverage (bottom decile, in green). The plot symbol used corresponds to the average refinancing intensity across firms in the portfolio being high (filled circles), medium (diamonds), or low (crosses). Panel B reports analogous results for firm (log) size. All results are for equally-weighted portfolios. The sample covers all levered firms included in the merged CRSP-COMPUSTAT dataset, financials (SIC codes 6000–6999) and utilities (SIC codes 4900–4999), from 1972 to 2014.

Internet Appendix for

Debt Refinancing and Equity Returns

(not for publication)

IA.A. Figures

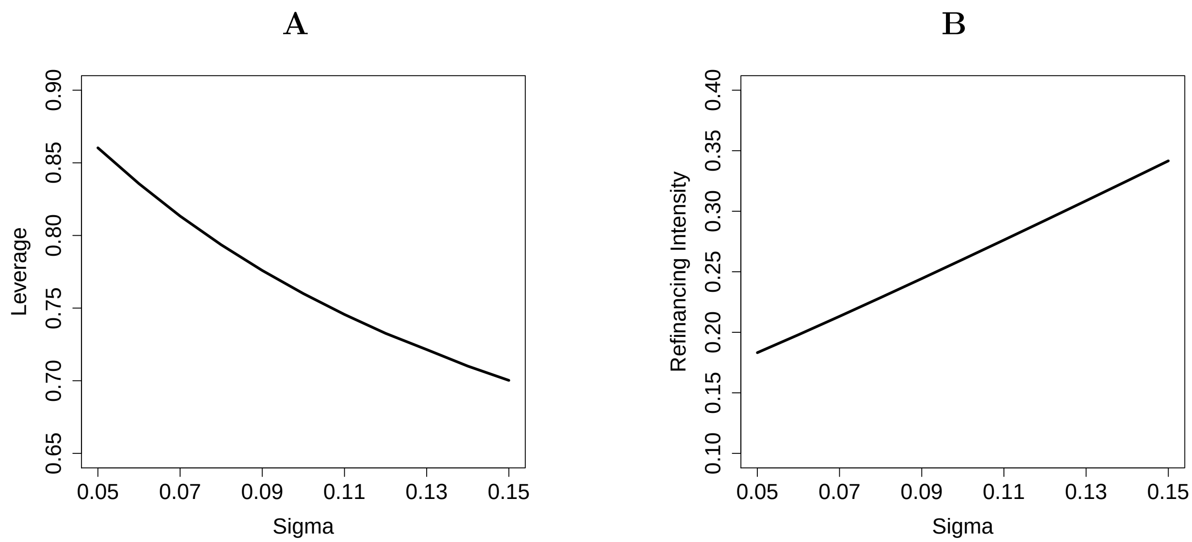


Figure IA.1: Optimal Financing Choice at $t = 0$: Robustness Increase in Debt Benefits. This figure reports the optimal initial financing choices of firms with respect to different cash flow risks given by σ. Panel A shows the leverage and Panel B the refinancing intensity. We set the initial cash flow level $X_0 = 1$, riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$, short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.02$.

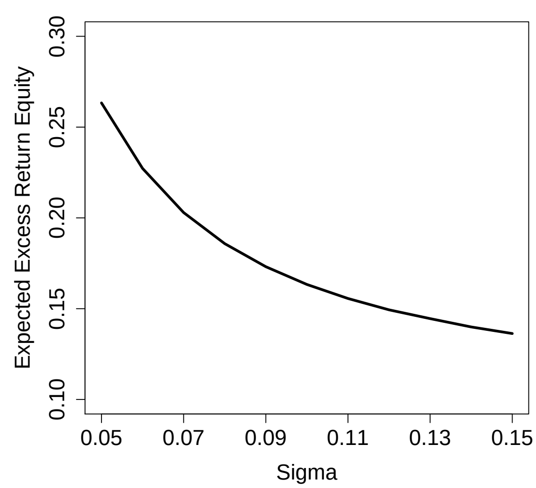


Figure IA.2: Equity Returns at $t = 0$: Robustness Increase in Debt Benefits. This figure reports the relation between expected excess returns on equity and cash flow risk at $t = 0$, hence, at the optimal initial financing choices of firms. We set the initial cash flow level $X_0 = 1$, riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$, short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$, debt benefits $k = 0.02$ and asset risk premium $\xi = 5\%$.

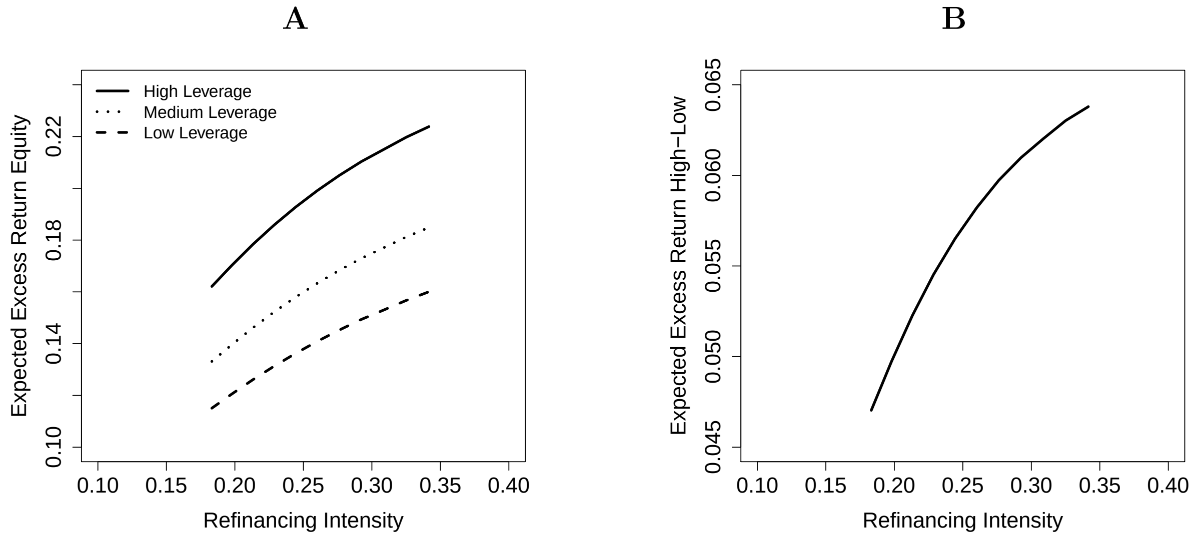


Figure IA.3: Cross-Section of Returns at $t > 0$: Robustness Increase in Debt Benefits. This figure reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of the refinancing intensity. Panel A gives the expected excess return on equity and Panel B the expected return of a long-short portfolio based on leverage. We report three levels of leverage given by high leverage = 79%, medium leverage = 76% and low leverage = 73%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.02$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

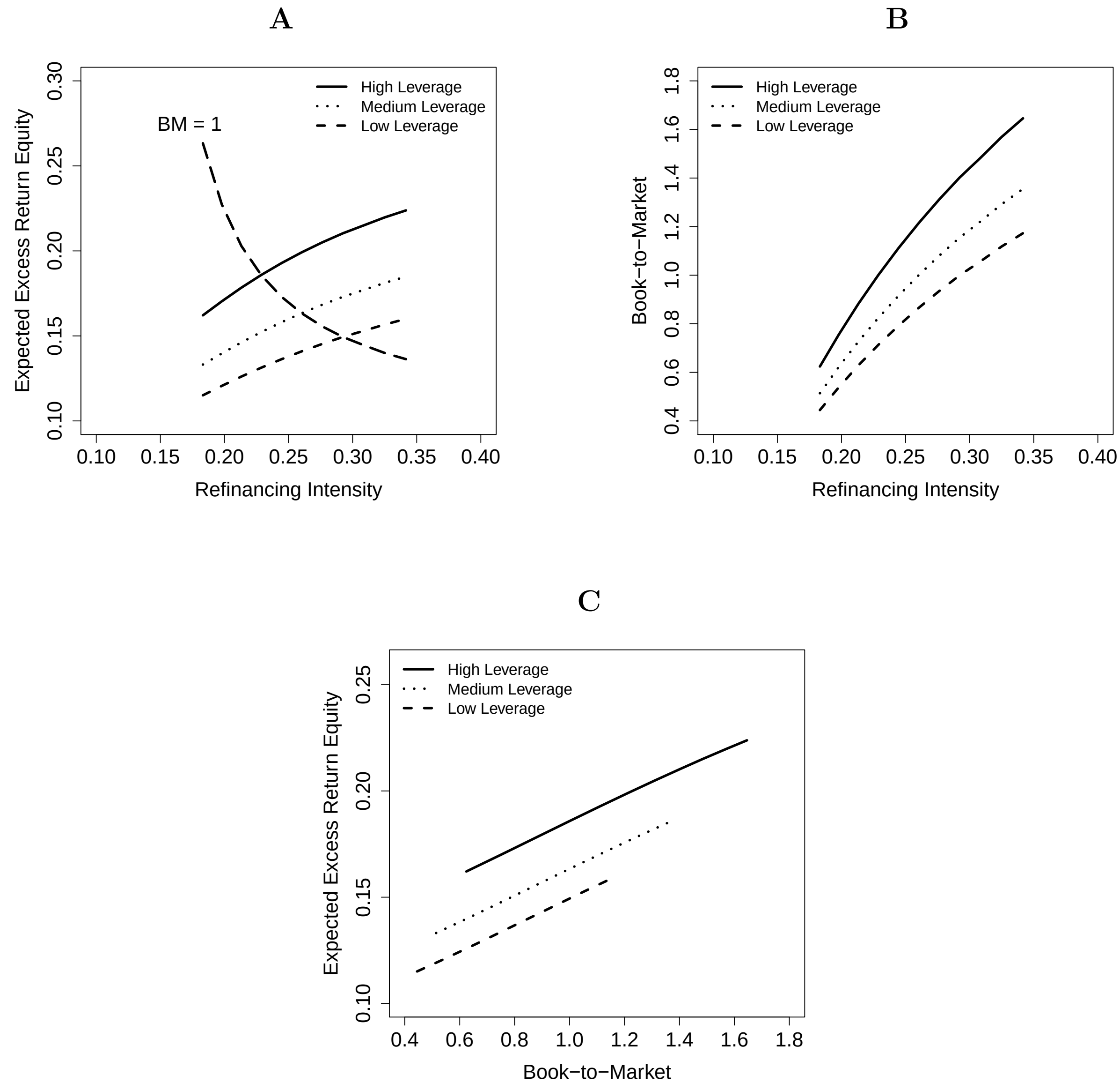


Figure IA.4: Book-to-Market: Robustness Increase in Debt Benefits. This figure reports the cross-sectional relation between book-to-market, leverage and expected excess returns on equity at $t > 0$. Panel A reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of the refinancing intensity. Panel B reports the cross-sectional relation between leverage and book-to-market for a given level of the refinancing intensity. Panel C reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of book-to-market. We report three levels of leverage given by high leverage = 79%, medium leverage = 76% and low leverage = 73%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.02$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

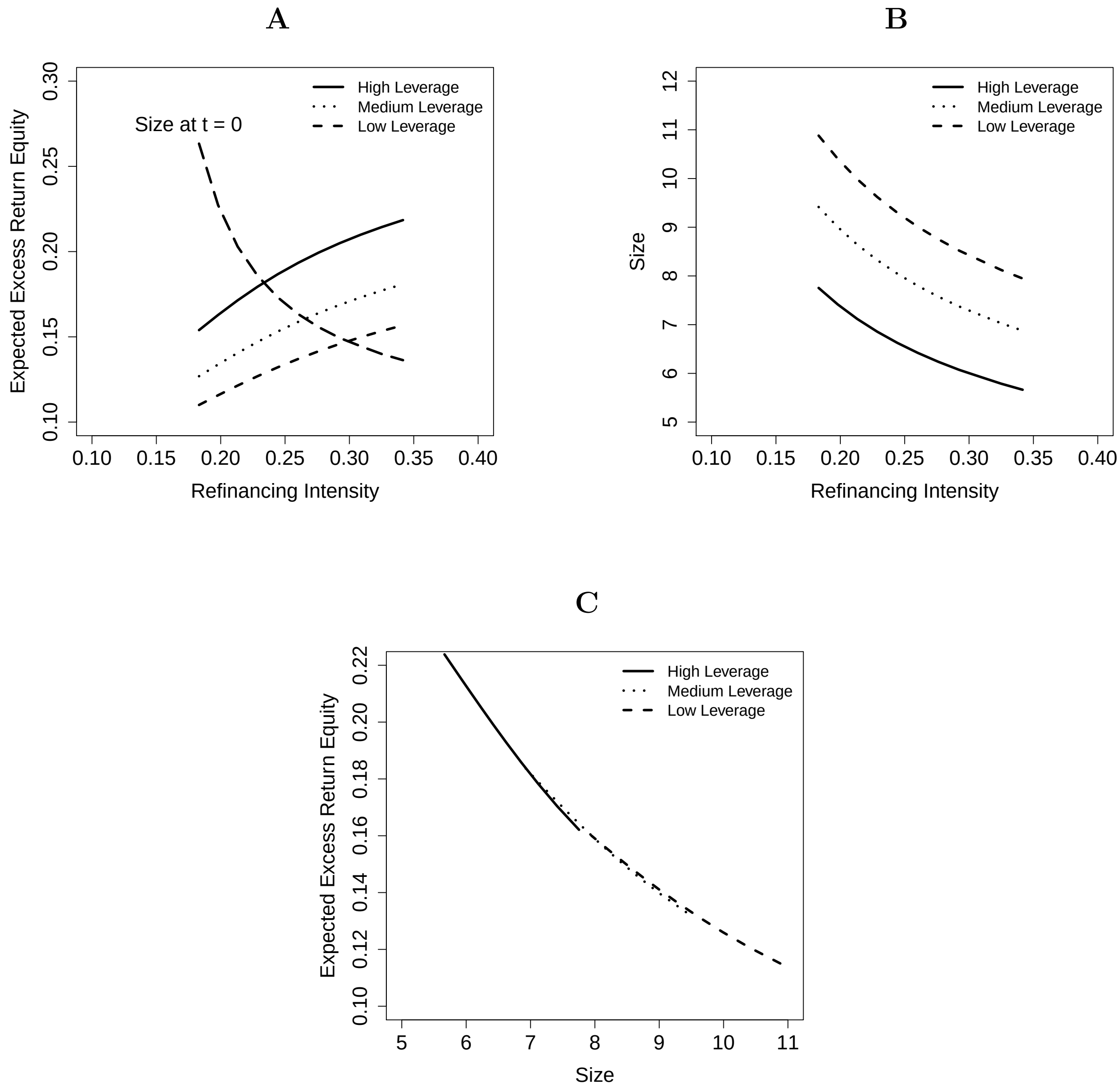


Figure IA.5: Size: Robustness Increase in Debt Benefits. This figure reports the cross-sectional relation between size, leverage and expected excess returns on equity at $t > 0$. Panel A reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of the refinancing intensity. Panel B reports the cross-sectional relation between leverage and size for a given level of the refinancing intensity. Panel C reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of size. We report three levels of leverage given by high leverage = 79%, medium leverage = 76% and low leverage = 73%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.02$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

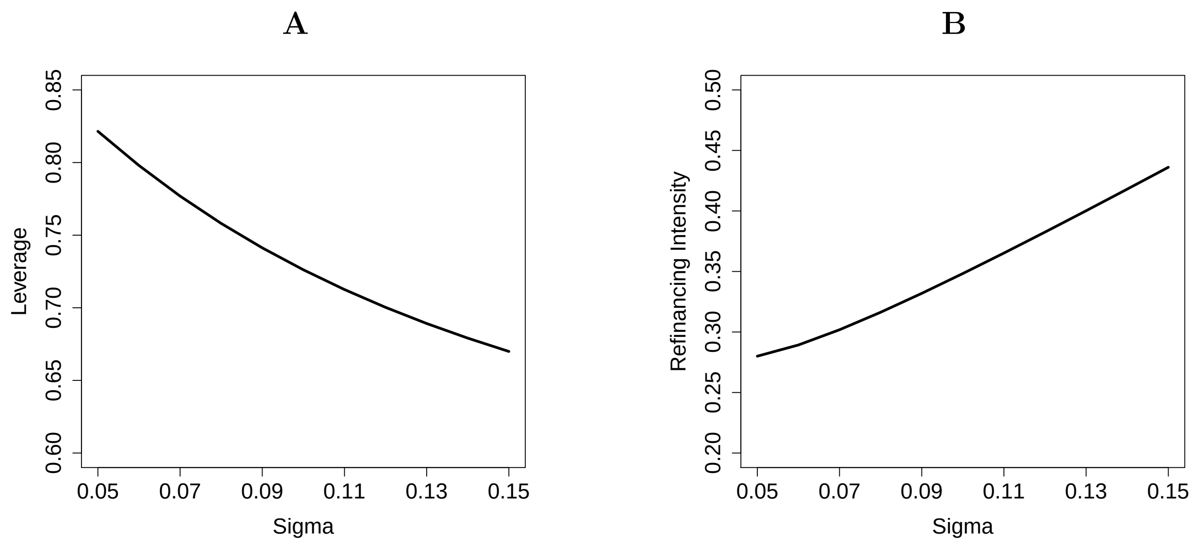


Figure IA.6: Optimal Financing Choice at $t = 0$: Robustness Decrease in Debt Benefits. This figure reports the optimal initial financing choices of firms with respect to different cash flow risks given by σ. Panel A shows the leverage and Panel B the refinancing intensity. We set the initial cash flow level $X_0 = 1$, riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$, short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.005$.

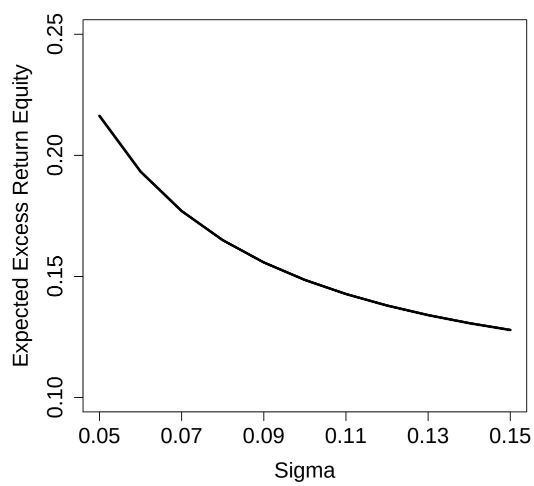


Figure IA.7: Equity Returns at $t = 0$: Robustness Decrease in Debt Benefits. This figure reports the relation between expected excess returns on equity and cash flow risk at $t = 0$, hence, at the optimal initial financing choices of firms. We set the initial cash flow level $X_0 = 1$, riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$, short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$, debt benefits $k = 0.005$ and asset risk premium $\xi = 5\%$.

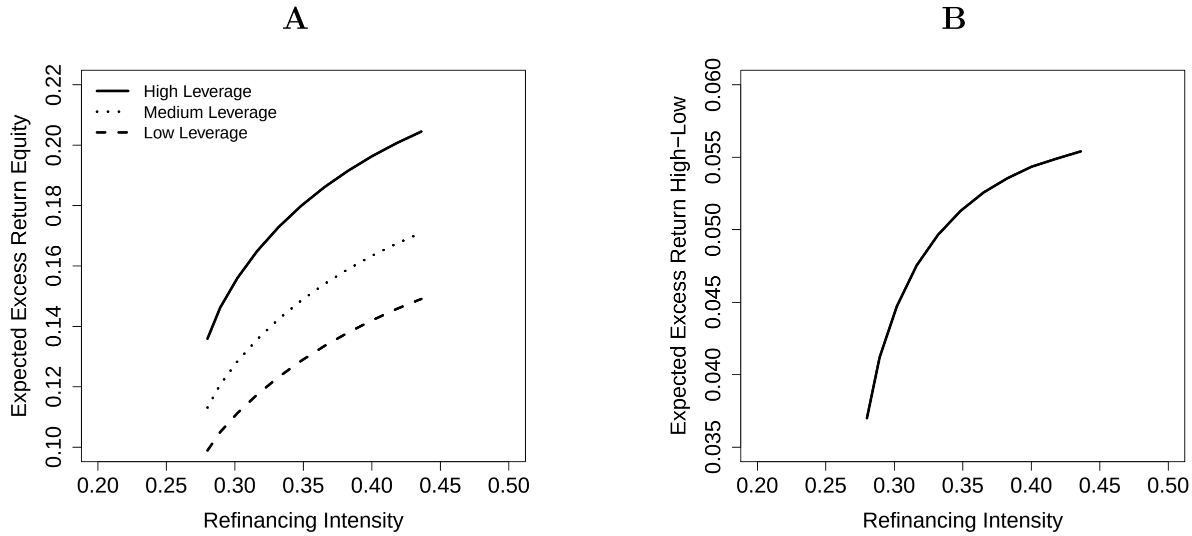


Figure IA.8: Cross-Section of Returns at $t > 0$: Robustness Decrease in Debt Benefits. This figure reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of the refinancing intensity. Panel A gives the expected excess return on equity and Panel B the expected return of a long-short portfolio based on leverage. We report three levels of leverage given by high leverage = 75%, medium leverage = 72% and low leverage = 70%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.005$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

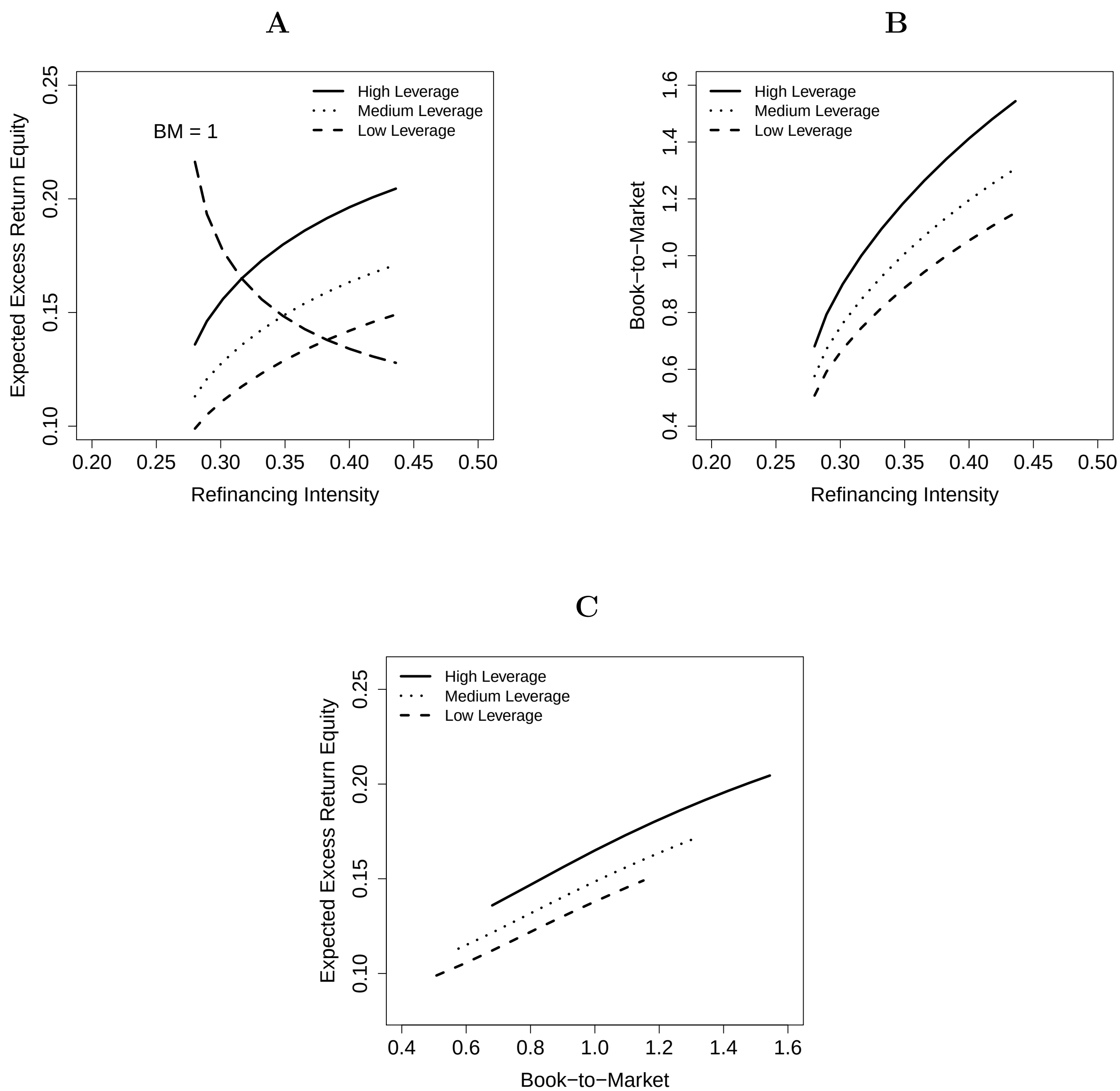


Figure IA.9: Book-to-Market: Robustness Decrease in Debt Benefits. This figure reports the cross-sectional relation between book-to-market, leverage and expected excess returns on equity at $t > 0$. Panel A reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of the refinancing intensity. Panel B reports the cross-sectional relation between leverage and book-to-market for a given level of the refinancing intensity. Panel C reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of book-to-market. We report three levels of leverage given by high leverage = 75%, medium leverage = 72% and low leverage = 70%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.005$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.

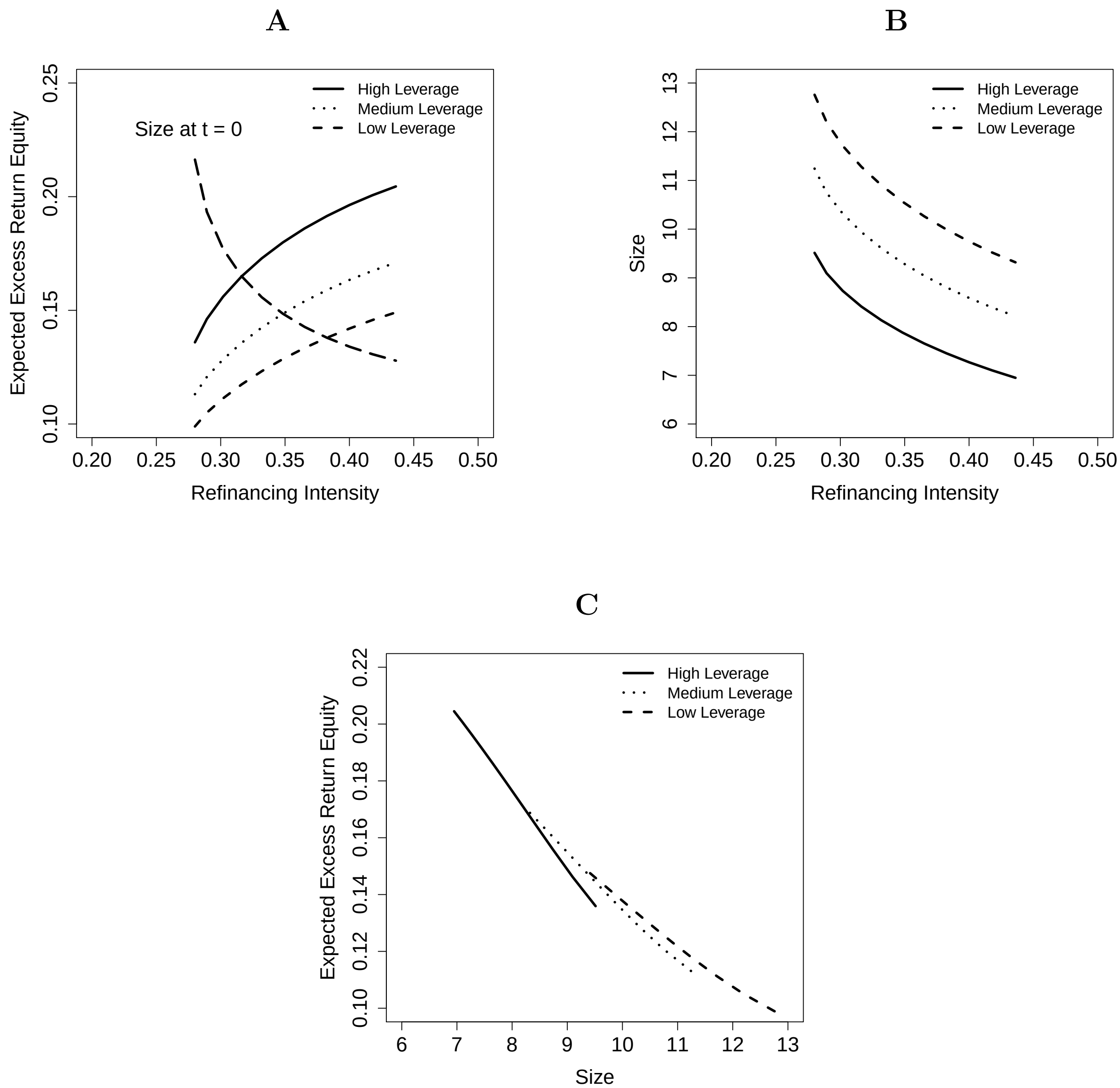


Figure IA.10: Size: Robustness Decrease in Debt Benefits. This figure reports the cross-sectional relation between size, leverage and expected excess returns on equity at $t > 0$. Panel A reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of the refinancing intensity. Panel B reports the cross-sectional relation between leverage and size for a given level of the refinancing intensity. Panel C reports the cross-sectional relation between leverage and expected excess returns on equity for a given level of size. We report three levels of leverage given by high leverage = 75%, medium leverage = 72% and low leverage = 70%. We set the short-term debt refinancing intensity $\phi^S = 1$, long-term debt refinancing intensity $\phi^L = 0.1$ and debt benefits $k = 0.005$. Furthermore, we set the riskless interest rate $r = 5\%$, risk-neutral drift $\mu^{\mathbb{Q}} = 1\%$ and asset risk premium $\xi = 5\%$.