# Debt Refinancing and Equity Returns

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# ABSTRACT

This paper presents empirical evidence that the maturity structure of financial leverage affects the cross-section of equity returns. We find that short-term leverage is associated with a positive premium, whereas long-term leverage is not. The premium for short-term compared to long-term leverage reflects higher exposure of equity to systematic risk. To rationalize our findings, we show that the same patterns emerge in a model of debt rollover risk with endogenous leverage and debt maturity choice. Our results suggest that analyses of leverage effects in asset prices and corporate financial applications should account for the maturity structure of debt.

**JEL Classification:** G12; G32; G33

**Keywords:** Equity returns, risk premia, financial leverage, debt maturity, empirical cross-sectional asset pricing

Financial leverage plays a central role in corporate finance and asset pricing. In this paper, we empirically revisit the cross-sectional relation between market leverage and equity returns from a novel perspective. Specifically, we investigate the possibility that shareholders care about firms' debt maturity structures and therefore price leverage associated with short-term and long-term debt differently. To do so, we decompose firms' leverage ratios into short-term and long-term leverage, that is, leverage due to debt maturing in the next three years and after the next three years, respectively. Our results indeed suggest that shareholders do not price all leverage-related risks equally: Figure 1 shows that equity returns increase in short-term leverage, but not in long-term leverage. This effect arises because short-term leverage increases the exposure of equity to systematic risk, while long-term leverage does not. As a result, shareholders demand a premium for short-term compared to long-term leverage.

FIGURE 1 ABOUT HERE

Our analysis is motivated by theoretical insights about the relative costs and benefits of short-term debt compared to long-term debt in the literature on structural models of credit risk. Conceptually, there are two economic forces associated with debt maturity that impact a firm's equity risk in opposite directions. On the one hand, He and Xiong (2012) highlight that short-term debt exposes equity holders to debt rollover risk, while long-term debt naturally does not. On the other hand, there is the notion that short-term debt increases a firm's financial flexibility (see, e.g., Dangl and Zechner, 2020; DeMarzo and He, 2020). The underlying idea is that short-term debt mitigates agency conflicts, most notably debt overhang. In a nutshell, the first channel suggests that equity risk increases in short-term leverage, while the second channel implies the opposite. Our empirical analysis clearly reveals that refinancing risk plays the dominant role in understanding leverage-related equity risk premia.

Our sample comprises all levered, non-financial firms listed on the Amex, Nasdaq, and NYSE over the period from 1976 to 2019. Following the empirical corporate finance literature, we define short-term (long-term) debt as debt maturing in (after) the next three years.

Using this information, we measure a firm's refinancing intensity as the ratio of short-term to total debt (i.e., the sum of short-term and long-term debt). This allows us to decompose firms' market leverage ratios into short-term leverage and long-term leverage. Equipped with these measures, we study debt maturity effects in the cross-section of stocks, first, by *jointly* analyzing firms' (total) leverage ratios and refinancing intensities and, second, by *jointly* analyzing their short-term and long-term leverage.

We start our analysis by presenting cross-sectional regression evidence for a significantly positive link between debt refinancing intensities and stock returns, controlling for leverage. In other words, equity returns increase in the fraction of short-term to total debt. This finding is robust for different weight specifications as well as for excluding almost-zero leverage firms and micro-caps. This first evidence for how debt maturity relates to the cross-section of stocks speaks towards refinancing risk as the dominant force in understanding leverage-related effects in equity returns.

To measure premia associated with firms' debt maturity structures and to assess how such premia are related to systematic risk, we apply the factor-mimicking portfolio procedures developed in the empirical asset pricing literature. It is worth emphasizing at the outset that we are *not* in search of new (debt-related) equity factors. We use these procedures to estimate premia associated with debt maturity structures in a way that is consistent with the construction of portfolio risk factors that have been shown to successfully price the cross-section of equity returns. This consistency facilitates the interpretation of how debt-related premia are linked to systematic risk by studying whether and how such premia are spanned by standard risk factors. To do so, we run spanning tests using the q-factor model recently proposed by Hou, Xue, and Zhang (2015, HXZ), which has been shown to subsume other models in summarizing cross-sectional features of stock returns (see Hou et al., 2019). Additionally, we use the factor models proposed by Fama and French (1993, FF3) and Fama and French (2015, FF5), which represent standard benchmarks in empirical asset pricing that are commonly used to interpret leverage-related return patterns.

First, we conduct a triple-sort of firms into portfolios based on their market capitalization, leverage ratios, and debt refinancing intensities. This procedure allows us to disentangle premia associated with leverage from premia associated with debt refinancing risk, and vice versa, as well as to control for size effects. We find a significantly positive premium for debt refinancing risk, that is, controlling for leverage and size effects, the returns of firms with high refinancing intensities exceed those of firms with low refinancing intensities by approximately 2% per year. Moreover, we show that this premium is spanned by positive exposures to the risk factors proposed by HXZ and FF, with the most significant exposure being the one on the market factor. By contrast, the leverage premium, controlling for refinancing risk and size, is not significantly different from zero and exhibits quite different linkages to risk factors in the time-series. In light of previous research that documents a close relation between leverage and book-to-market ratios, a noteworthy difference is that the leverage premium is most significantly related to the HML factor, whereas the HML-exposure of the premium for debt refinancing risk is zero in the FF5 spanning regressions.

These results suggest that not all debt-related risks are priced equally in equity markets and that firms' levered equity risk as measured by exposures to standard risk factors depends on their debt maturity structures. To explicitly account for the interaction of the level of leverage and the maturity structure of debt, we use our decomposition of firms' leverage ratios into short-term and long-term leverage. That is, we conduct a triple sort of firms into portfolios based on their size, long-term leverage and short-term leverage, which allows us to disentangle premia for long-term and short-term leverage while controlling for size effects. Using these portfolio returns, plotted in Figure 1 above, we obtain a significant premium for short-term leverage of 0.22% per month ($t$-statistic of 2.64) whereas the premium for long-term leverage of $-0.05\%$ per month is insignificant ($t$-statistic of $-0.40$).

The premium for short-term leverage is spanned by positive exposures to the HXZ and FF factors, which suggests that this premium reflects compensation for systematic risk. By contrast, the premium for long-term leverage exhibits some positive and some negative factor exposures and, moreover, negative alphas relative to the FF models. Hence, it appears ambiguous whether long-term leverage increases or decreases a firm's exposure to systematic risk, or, in other words, it appears that long-term leverage provides a hedge against some dimensions of systematic risk. To make the differential pricing of short-term compared to long-term leverage more explicit, we present results for the differential of the premium on short-term leverage minus the premium on long-term leverage. The premium differential (controlling for size effects) is about 3.2% per year and reflects that the premium for short-term leverage is significantly more exposed to market and profitability risk factors than the premium for long-term leverage.

Taken together, our empirical results are consistent with the notion that the immediacy of a firm's debt refinancing needs, measured by refinancing intensities or short-term leverage, exposes its equity to systematic risk.

As clarified at the outset, our goal is not to 'find' a new equity risk factor or to propose a new trading strategy, rather, we emphasize the corporate financial implications. Our empirical results imply that a firm's level of leverage and its debt maturity structure *jointly* matter for the riskiness and thus for the cost of its equity. To show that our findings are consistent with compensation for debt rollover risk, the final part of our paper presents a model in the spirit of He and Xiong (2012) and elaborates on its asset pricing implications.

In the model, firms' choices of leverage ratios and debt maturity structures are endogenous. The optimal debt policy needs to balance that short-term and long-term leverage work against each other in determining the returns that investors require on the firm's equity and debt. On the one hand, the refinancing risk of short-term leverage increases the exposure of equity to systematic risk, and thereby the return required by shareholders. On the other hand, while long-term leverage provides a hedge against debt refinancing risk, the discounts required by bondholders include a liquidity spread that increases in bond maturity and systematic cash flow risk. As a consequence, it is not optimal for firms to simultaneously choose high leverage ratios and high refinancing intensities. The model implies that firms with low systematic cash flow risk optimally choose higher leverage ratios and lower refinancing intensities. Conversely, firms with high systematic cash flow risk choose lower leverage ratios and higher refinancing intensities.

The dependence of leverage and debt maturity choices on systematic cash flow risk allows the model to rationalize our key empirical findings: (i) equity returns are unrelated to leverage, (ii) equity returns increase in refinancing intensity, and (iii) equity returns increase in short-term leverage but not in long-term leverage. Additionally, we provide external validity for the model by showing that it captures other default risk-related patterns in equity returns, that have been documented by previous empirical research, as well. For example, the model generates expected equity returns that are negatively related to default probabilities, akin to the 'distress puzzle' (e.g., Campbell, Hilscher, and Szilagyi, 2008), and positively related to credit risk premia (e.g., Friewald, Wagner, and Zechner, 2014).

Overall, our article provides novel insights into the pricing of debt-related risks in the cross-section of stock returns. Equity investors require a premium for short-term over long-term leverage as compensation for debt refinancing risk. Our findings imply that debt maturities matter for understanding leverage effects in asset pricing as well as in corporate finance.

Our findings also suggest several avenues for future research that are beyond the scope of this paper. One direction would be to derive the asset pricing implications of short-term and long-term leverage from a dynamic equilibrium model with optimal leverage and debt maturity choice, for example, by extending the 'structural equilibrium' framework of Bhamra, Kuehn, and Strebulaev (2010). Similarly, it would be useful to derive the asset pricing implications of debt maturity choice in a dynamic model that features both endogenous financing and investment policies, thereby extending the work of Gomes and Schmid (2010). Another direction would be to study the cross-sectional equity return implications of corporate debt maturity choice in a macro-finance context, in which firms are exposed to inflation risk due to nominal rigidities associated with long-term nominal debt (e.g., Bhamra, Fisher, and Kuehn, 2011; Gomes, Jermann, and Schmid, 2016; Bhamra et al., 2018). Since our analysis does not distinguish between nominal debt and the real burden of debt, it is an open question for future research, whether and how our finding that there is a premium for short-term leverage but not for long-term leverage can be connected to a potential debt maturity trade-off with respect to inflation risk.

**Related literature.** Our paper naturally relates to previous research on leverage- and default risk-related patterns in the cross-section of equity returns, which we discuss below. The key difference between these articles and ours is that we focus on the role of debt maturity structures, jointly with leverage, and the differential implications of short-term compared to long-term leverage. Conceptually, our analysis builds on the theoretical corporate finance literature on debt maturity choice and structural models of credit risk, which we discuss in our motivation (Section I) and when we present the model (Section IV).

There is a large literature that explores the link between different measures of firms' leverage ratios and equity returns. Our review focuses on work that uses measures of market leverage, as we do in this paper. A prominent stream of this literature studies leverage effects in equity returns in the light of linkages between leverage and book-to-market ratios. Building on the finding of Bhandari (1988) that equity returns are positively related to leverage after controlling for beta and size, Fama and French (1992) provide evidence that leverage effects are captured by firms' book-to-market ratios. Gomes and Schmid (2010) rationalize these stylized facts in a model with endogenous corporate financing and investment decisions. In the face of financial frictions, leverage and investment decisions are correlated, implying that firms with high leverage also have high book-to-market ratios. Along similar lines, Ozdagli (2012), Choi (2013), Doshi et al. (2019), and Bretscher et al. (2020) study the role of leverage in generating the value premium. In contrast to all of these papers, we explicitly account for debt maturity structures in our analysis of leverage effects and find, for instance, that the exposures to the value factor (HML) are significantly different for premia associated with short-term and long-term leverage, respectively.

Other papers provide empirical evidence and/or theoretical arguments that the relation between equity returns and leverage is or should be positive, insignificant, or negative. For example, Penman, Richardson, and Tuna (2007) empirically decompose book-to-market ratios into asset and leverage components and find that stock returns are negatively related to leverage. The model of George and Hwang (2010), as generalized by Johnson et al. (2011), suggests that such a negative relation arises because firms with high distress costs choose low leverage ratios. Ippolito, Steri, and Tebaldi (2017) examine deviations from target leverage ratios and find that the sign of the relation between equity returns and leverage depends on whether firms are under- or over-levered. We offer a new perspective by emphasizing the relevance of firms' debt maturity choices. Our empirical and model results show that equity returns increase with short-term leverage, but remain unchanged or decrease with long-term leverage.

A related stream of the literature studies how equity returns relate to measures of default or distress risk. While Vassalou and Xing (2004) find that stock returns are positively related to a Merton model-based default indicator, most other papers find a negative link between equity returns and proxies for default risk; e.g., Dichev (1998) and Campbell, Hilscher, and Szilagyi (2008). Attempts to explain this 'distress puzzle' include, among others, the aforementioned arguments of George and Hwang (2010) and Johnson et al. (2011), deviations from the absolute priority rule as a consequence of equity-creditor-bargaining (e.g., Garlappi, Shu, and Yan, 2008; Garlappi and Yan, 2011; Hackbarth, Haselmann, and Schoenherr, 2015), or time-varying systematic risk exposures of distressed firms (e.g., O'Doherty, 2012). Chen, Hackbarth, and Strebulaev (2020) endogenize such time-variation in a capital structure model, where the optimal financing policies generate the negative relation between equity returns and failure probabilities. The model also features a positive relation between equity returns and a distress risk premium, in line with the evidence of Friewald, Wagner, and Zechner (2014), who show that risk premia measured from credit instruments relate positively to equity returns.

Our model provides an alternative rationale for the distress puzzle, credit risk premia in equity returns, and the relation of both. Specifically, our model implies that a high level of leverage is associated with a high default probability and a low credit risk premium, whereas a high refinancing intensity comes with a low default probability and a high credit risk premium. In other words, leverage and refinancing intensity affect default probabilities and credit risk premia in opposite directions, precisely as needed to reconcile the empirical evidence.

One recent paper that also studies debt maturity effects in equity returns is Chaderina, Weiss, and Zechner (2020). Using a double sort on size and debt maturity (defined as the ratio of long-term to total debt), they find evidence that returns increase with debt maturity. Since we emphasize the necessity to study leverage and debt maturity effects jointly, to account for the endogeneity of the underlying capital structure decisions, our results should be compared to their robustness exercise, in which they double sort on leverage and debt maturity. In that exercise, there is little evidence for a debt maturity premium, which appears consistent with our finding that the premium associated with long-term leverage, controlling for size and short-term leverage, is not different from zero.

The rest of the paper is organized as follows. Section I discusses the theoretical motivation for our analysis. Section II introduces the data, and Section III presents the empirical analysis. In Section IV we introduce a rollover risk model that rationalizes our findings. Appendix A contains technical details related to the model and the Internet Appendix reports additional empirical results.

# I. Motivation

Ever since Modigliani and Miller (1958, MM), financial leverage has played a key role in corporate finance and asset pricing. Embedding standard asset pricing assumptions in MM provides a powerful conceptual tool to think about levered equity returns: Fixing asset beta, an increase in leverage raises the exposure of equity to priced risk. Hence, expected equity returns should, other things being equal, increase with leverage. However, previous research discussed in the related literature above has shown that the empirical link between leverage and equity returns is not as clear and simple as proposed by MM.

In this paper, we argue that one reason as to why the link between leverage and equity returns is more intricate than a simple positive relation is that firms' debt maturity structures matter for the pricing of leverage-related risks. Put differently, while previous empirical and theoretical research assumes (implicitly) that equity holders price all leverage-related risks equally, we investigate the possibility that shareholders demand different risk premia for short-term compared to long-term leverage.

Our claim is motivated by insights from the literature on structural models of credit risk, which shows that leverage and debt maturity *jointly* matter for equity risk. While this literature agrees that a firm's debt maturity structure affects its equity risk, different models emphasize different economic sources of the relative costs and benefits of short-term versus long-term debt. As a consequence, the short-term versus long-term debt-related implications for equity risk can be fundamentally different. Since our objective is to provide a more nuanced view on the asset pricing implications of leverage for equity returns, and not to test a particular structural model, our discussion focuses on the two key opposing economic forces behind debt maturity effects in these models.

One channel for debt maturity effects, pioneered by He and Xiong (2012), emphasizes that short-term debt exposes firms to rollover risk whereas long-term debt naturally mitigates the immediacy of debt refinancing needs.[1] Equity holders, as residual claimants to firms' cash flows, commit to cover potential shortfalls arising from the rollover of maturing debt, that is, they face potential losses due to debt rollover. The framework of He and Xiong (2012) implies that, for a given level of leverage, shareholders' expected rollover losses increase in a firm's refinancing intensity, that is, with the firm's ratio of short-term to total debt. In other words, decomposing a given leverage ratio into the sum of short-term and long-term leverage, rollover risk models imply that equity risk increases in short-term leverage but decreases in long-term leverage.

Other papers emphasize that short-term debt provides firms with more financial flexibility than long-term debt. Such flexibility is crucial to alleviate (agency) costs due to debt overhang. The key idea is that short-term debt is considered to act as a (commitment) device for equity holders to reduce leverage when cash flows deteriorate, whereas long-term debt cannot exert such a (disciplining) effect; for recent theoretical work see Dangl and Zechner (2020) and DeMarzo and He (2020).[2] With such benefits of short-term compared to long-term debt, the equity risk implications are opposite to the ones implied by debt rollover risk. For a given leverage ratio, a higher debt refinancing intensity reflects more flexibility to adjust the firm's capital structure and thus reduces equity risk. Similarly, decomposing a firm's leverage ratio into short-term and long-term leverage, equity risk increases in

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[1] Other theories that study rollover risk by building on and extending the framework of He and Xiong (2012) include, among others, Cheng and Milbradt (2012), He and Milbradt (2014), Diamond and He (2014), He and Milbradt (2016), Chen et al. (2018), Geelen (2019), Chen, Xu, and Yang (2020), and Della Seta, Morellec, and Zucchi (2020). Diamond (1991) shows that short-term debt can lead to early liquidation, and Gertner and Scharfstein (1991) find that it can lead to more debt overhang. Moreover, Acharya, Gale, and Yorulmazer (2011) model the role of collateral in rolling over debt, while Brunnermeier and Oehmke (2013) study a strategic game between lenders in determining rollover frequencies.

[2] Myers (1977) first describes the debt overhang problem and suggests short-term debt as a potential solution. Childs, Mauer, and Ott (2005), Moyen (2007), and Titman and Tsyplakov (2007) provide quantitative models that connect short-term debt and agency costs.

long-term leverage but decreases in short-term leverage.

With these two economic mechanisms in mind, we let the equity data speak for itself. Both channels suggest the same empirical strategy to test for debt maturity effects in the cross-section of stock returns by answering two related questions. First, controlling for leverage, how are firms' debt refinancing intensities related to equity returns? Second, do shareholders require the same premium for short-term leverage and for long-term leverage? To answer these question we proceed in two steps. First, controlling for leverage, we use cross-sectional regressions and portfolio sorts to study whether and how firms' debt maturities matter for equity returns. In the next step, we use portfolio sorts to assess the premia for short-term and long-term leverage and study their factor risk exposures.

## II. Data

Our sample covers levered, non-financial U.S. firms from January 1976 to December 2019. We obtain monthly stock returns from the Center for Research in Security Prices (CRSP) and accounting information from the Compustat Annual and Quarterly Fundamental Files. To ensure that accounting data is known before it is used in analyses of subsequent returns, we apply a conservative six month lag when we merge these datasets.[3] Following Hou, Xue, and Zhang (2015), we exclude financial firms (SIC codes 6000–6999) and firms with non-positive book equity (defined as in Davis, Fama, and French, 2000). We also exclude firms with non-positive total assets and non-positive market equity. Additionally, since we are interested in studying debt maturity effects, we require firms' leverage ratios to be non-zero,

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[3] For most of our sample this implies exactly the timing that has become standard since Fama and French (1992), that is, for firms with their fiscal year ending in December, we first use their accounting data end of June in the subsequent year. Empirically, the results are very similar for both approaches, that is, either using a constant accounting lag of six months also for firms with fiscal years not ending in December, or, measuring the latest available accounting data end of December (even if that is not the end of the fiscal year) and to first use this information end of June.

as detailed below.

To investigate the effect of debt maturity in stock returns, we require information on corporate debt maturity structures. Following the literature in empirical corporate finance (see below), we focus our analysis on debt with an original maturity at issuance of more than one year.[4] Historically, Compustat has separated these data into two items ($dd1$ and $dltt$): $dd1$ is debt that matures within one year from the balance sheet date, and $dltt$ is debt that matures after one year from the balance sheet date. We follow Cooper, Gulen, and Schill (2008) and set missing values of $dd1$ and $dltt$ to zero. Barclay and Smith (1995) discuss that with the fiscal year 1974, Compustat has started to report data on debt maturing in years two, three, four, and five from the balance sheet date (items $dd2$, $dd3$, $dd4$, and $dd5$). The start of our sample period is thus motivated by the availability of items $dd2$ to $dd5$ in Compustat. We set missing values of $dd2$ to $dd5$ to zero if at least one is non-missing. We require all debt items ($dd1$ to $dd5$, $dltt$) to be non-negative. We further follow Almeida et al. (2011) and apply two additional filters: we remove observations where total debt ($dd1 + dltt$) is greater than total assets, and observations for which debt maturing in more than one year ($dltt$) is lower than the sum of debt maturing in two, three, four, and five years ($dd2 + dd3 + dd4 + dd5$) from the balance sheet date.

Using this data, we measure market leverage ratios and debt refinancing intensities in accordance with the existing literature (e.g., Barclay and Smith, 1995; Almeida et al., 2011; Harford, Klasa, and Maxwell, 2014). That is, we define leverage, $LEV$, by total debt ($dd1 + dltt$) relative to the sum of total debt and the market value of equity (ME),

$$LEV = \frac{dd1 + dltt}{dd1 + dltt + ME}, \tag{1}$$

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[4] Harford, Klasa, and Maxwell (2014) discuss that non-financial firms use debt with a maturity at issuance below one year mostly to finance seasonal short-term liquidity needs, while debt with maturity at issuance above one year is used to finance long-term assets. Stohs and Mauer (1996) and Guedes and Opler (1996) provide empirical evidence for this type of asset-liability matching.

and we define the debt refinancing intensity, $RI$, as short-term debt ($dd1 + dd2 + dd3$) relative to total debt,

$$RI = \frac{dd1 + dd2 + dd3}{dd1 + dltt}. \tag{2}$$

With total debt being the sum of short-term and long-term debt, we have that long-term debt is debt that matures after three years ($dltt - dd2 - dd3$).

The purpose of our paper is to study debt maturity effects, which naturally requires us to focus on observations with $LEV > 0$, because otherwise $RI$ is not defined. We will use the sample covering all levered firms (All-LEV) in our main analyses but repeat all analyses in a sample that excludes almost-zero-leverage (AZL) firms. Following Almeida et al. (2011) and Strebulaev and Yang (2013), we define AZL firms by observations with $LEV < 0.05$. Using this All-but-AZL sample ensures that our inference regarding the role of debt maturity in equity returns is not driven by firms that have very little leverage.

In our analysis, we work with the $q$-factor model of Hou, Xue, and Zhang (2015, HXZ) as well as the Fama and French (1993, FF3) and Fama and French (2015, FF5) models. For consistency, we require the availability of all characteristics underlying these models, that is, beta, $\beta$, market value of equity, $ME$, investment-to-assets, $I/A$, return on equity, $ROE$, book-to-market ratio, $BM$, and operating profitability, $OP$. We estimate $\beta$ by regressing a stock's returns on FF market factor returns over the preceding 60 months, requiring a minimum of 24 monthly returns. For the other characteristics, we follow the respective original papers and the detailed descriptions in Hou et al. (2019) and Hou, Xue, and Zhang (2020). Additionally, we download the HXZ, FF3, and FF5 factor returns from the web.[5]

TABLE I ABOUT HERE

Table I presents summary statistics for our data. Over the sample period from January 1976 to December 2019, the sample of all levered firms (All-LEV) comprises 964,984 obser-

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[5] We retrieve the HXZ-factors from `http://global-q.org/index.html`, and the FF-factors from Kenneth French's webpage `http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html`.

vations from 10,202 firms, and the sample that excludes AZL firms (All-but-AZL) comprises 808,867 observations from 8,935 firms. Panel A presents sample averages and standard deviations of returns and firm characteristics, which are very similar for both samples. Panel B presents sample correlations of $LEV$ and $RI$ with each other and with the other firm characteristics. From these correlations, we note that $LEV$ and $RI$ are negatively correlated, with coefficients of $-0.25$ and $-0.11$ in the All-LEV and All-but-AZL samples, respectively. That is, firms with high leverage ratios tend to have lower debt refinancing intensities than low-leverage firms. We also note the positive correlation between $LEV$ and $BM$, with coefficients of 0.49 and 0.47. This relation has been documented by previous research (e.g., Gomes and Schmid, 2010; Choi, 2013) and is typically attributed to value firms (high $BM$) having 'safer' assets than growth firms (low $BM$), which allows them to choose comparably higher leverage ratios. Interestingly, the correlation between $RI$ and $BM$ is very low, with coefficients of 0 and 0.07.

## III. Empirical Analysis

Our empirical analysis of debt maturity effects in stock returns proceeds in two steps. First, we use cross-sectional regressions and portfolio sorts to study whether and how debt refinancing intensities matter for equity returns. Second, we decompose a firm's leverage ratio into short-term leverage and long-term leverage. We then use portfolio sorts to disentangle premia associated with short-term leverage from premia associated with long-term leverage and analyze their differences. At the end of this section, we discuss our findings and how these should be featured in structural models of debt rollover risk, such as the one that we present in the subsequent Section IV.

## *A. Debt Refinancing Risk: Evidence from Cross-Sectional Regressions*

To start our investigation of the role of debt maturity for equity returns, we use Fama and MacBeth (1973) cross-sectional regressions. Using monthly returns, we implement the regressions at the individual stock level in two ways: First, we follow related research (e.g., Fama and French, 1992; Doshi et al., 2019) and run ordinary least squares regressions (FMB-OLS). Second, to avoid potential concerns that the results may be unduly effected by micro-caps, we run weighted least squares regressions (FMB-WLS), using equity market capitalizations as weights (as suggested by Hou, Xue, and Zhang, 2020).[6] All $t$-statistics are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991).

Table II about here

Table II presents regression results for the sample of all levered firms (All-LEV) in Panel A and for the sample that excludes almost zero leverage firms (All-but-AZL) in Panel B. In models (i) and (ii) we run univariate regressions of firms' excess returns on their leverage ratios ($LEV$) or debt refinancing intensities ($RI$), and model (iii) includes both $LEV$ and $RI$ jointly. We report the time-series averages of the estimated coefficients and the corresponding $t$-statistics in square brackets. On the one hand, our results suggest that equity returns are unrelated to leverage, that is, the coefficient estimate for $LEV$ is insignificant in all specifications (highest $|t|$ is 0.62). On the other hand, we find that there is a positive link between $RI$ and equity returns, which implies that equity returns increase in a firm's fraction of short-term relative to total debt. In the All-LEV sample, the coefficient estimate for $RI$ is significant in the univariate FMB-OLS regression ($t$: 2.29) as well as in the joint FMB-OLS and FMB-WLS regressions ($t$: 2.36 and 2.21). The results for $RI$ are statistically even

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[6] We also repeat the analysis with return-weights, suggested by Asparouhova, Bessembinder, and Kalcheva (2013) to account for micro-structure noise. Table IA.I in the Internet Appendix shows that these results are qualitatively similar to the ones presented in this section.

stronger in the sample that excludes AZL firms, with significant coefficient estimates in all univariate and joint regressions ($t$ between 1.99 to 2.97).

Since Hou, Xue, and Zhang (2020) emphasize that the inference in FMB-regressions is sensitive to micro-caps, we repeat the analysis for the subset of stocks with market equity greater or equal to the 20th percentile of NYSE stocks. Table III shows that our findings are robust to excluding micro-caps, that is, equity returns are unrelated to $LEV$ but positively related to $RI$, and more so when excluding AZL firms. Specifically, the coefficient estimate for $RI$ is significantly positive in all joint regressions ($t$ between 2.17 to 2.97). Additionally, for all-but-AZL firms, $RI$ is significant in the univariate FMB-OLS regression ($t$: 2.68) and, albeit at a lower level, in the univariate FMB-WLS regression ($t$: 1.88).

Table III about here

In sum, the regression evidence suggests a positive link between firms' equity returns and debt refinancing intensities. Finding that equity returns increase in the fraction of short-term debt (relative to total debt) provides first evidence for debt maturity effects in the cross-section of stocks and speaks towards a debt rollover risk channel rather than towards a financial flexibility channel. While the regression coefficients for leverage are insignificant in all specifications, our finding that the $RI$-results are stronger when controlling for leverage and/or excluding AZL firms highlights the necessity for a joint analysis of leverage and debt maturity effects.

## *B. The Premium for Debt Refinancing Risk*

To explore whether and how the maturity structure of leverage matters for the cross-section of stock returns, we apply portfolio procedures developed in the empirical asset pricing literature. Our goal is to measure the premium associated with debt refinancing risk and to study how this premium relates to standard factors that proxy for systematic risk.

To disentangle premia for leverage and debt refinancing risk, as well as to control for potential size effects, we conduct a triple 2-by-3-by-3 sort on firms' size ($i = 1, 2$), leverage ($j = 1, 2, 3$), and debt refinancing intensity ($k = 1, 2, 3$). This portfolio setup directly follows Hou, Xue, and Zhang (2015, HXZ), that is, we construct the portfolios from independent sorts, we use NYSE breakpoints, and we focus on value-weighted returns.[7] We denote the excess returns of the eighteen portfolios by $R_t^{ijk}$ and measure return differentials associated with size ($R_{ME,t}$), leverage ($R_{LEV,t}$), and debt refinancing intensity ($R_{RI,t}$) from the respective portfolio intersections as

$$R_{ME,t} \equiv \frac{1}{9}\left(\sum_{j=1}^{3}\sum_{k=1}^{3} R_t^{1jk} - \sum_{j=1}^{3}\sum_{k=1}^{3} R_t^{2jk}\right), \tag{3}$$

$$R_{LEV,t} \equiv \frac{1}{6}\left(\sum_{i=1}^{2}\sum_{k=1}^{3} R_t^{i3k} - \sum_{i=1}^{2}\sum_{k=1}^{3} R_t^{i1k}\right), \tag{4}$$

$$R_{RI,t} \equiv \frac{1}{6}\left(\sum_{i=1}^{2}\sum_{j=1}^{3} R_t^{ij3} - \sum_{i=1}^{2}\sum_{j=1}^{3} R_t^{ij1}\right). \tag{5}$$

### *B.1. Portfolio Summary Statistics*

Table IV presents summary statistics for the portfolios that we use to compute the premia for size, leverage, and debt refinancing risk. First, we note that the portfolios generated by the procedure are indeed suitable to disentangle the premium for debt refinancing risk from the premium for leverage, and vice versa. More specifically, we find that there is little dispersion in $RI$ for the high vs low $LEV$ portfolios (0.28 vs 0.32) and that average $LEV$ is 0.30 in both the low and the high $RI$ portfolios. Second, we note that the variation in firm size across $LEV$ and $RI$ portfolios is small relative to the $ME$ averages reported for small

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[7] In the empirical factor model literature, it is a standard approach to measure premia from portfolio double- or triple-sorts that include size as one of the sort variables. This procedure helps to mitigate concerns that premia may be disproportionately driven by small stocks (e.g., Fama and French, 2008; Hou, Xue, and Zhang, 2020) and is also used by Hou, Xue, and Zhang (2015) and Fama and French (1993, 2015) in the construction of their factors that we consider in the empirical analysis.

and big firms and that none of the $LEV$ or $RI$ portfolios is dominated by small firms.

TABLE IV ABOUT HERE

By taking a closer look at the portfolio averages of firm characteristics commonly used to construct risk factors, we note some interesting differences between the leverage and debt refinancing risk portfolios. First, $\beta$ appears to relate positively to debt refinancing intensities but negatively to leverage. Second, consistent with previous research, the (average) book-to-market ratio, $BM$, is much higher for high than for low $LEV$ firms. By contrast, we find that $BM$ is quite similar for low and high $RI$ firms. Third, there is a similar, inverse relation between $LEV$ and investment-to-assets, $I/A$, and between $RI$ and $I/A$. For operating profitability, $OP$, we find little variation across the $LEV$ and $RI$ portfolios. Moreover, we find that high $LEV$ firms have a lower average return on equity, $ROE$, than low leverage firms, whereas there is no discernible difference for the low compared to the high $RI$ portfolio.

In the last two rows, we report the portfolios' average excess returns, equally-weighted (EW) and value-weighted (VW). Consistent with previous research, we find that there is a small-minus-big return differential of 0.23% per month (EW and VW). The sign of a potential premium for leverage is unclear, with the high-minus-low return differential being $-0.05\%$ equally-weighted and 0.10% value-weighted. By contrast, the high-minus-low return differential for $RI$ is positive and similar for equally- and value-weighted portfolios, with 0.19% and 0.16% per month, respectively. At first glance, the positive premium for debt refinancing risk appears consistent with the differential in characteristics of the high compared to the low $RI$ portfolios, in particular their higher $\beta$ and their lower $I/A$ ratios.

### *B.2. Spanning Regression Results*

For our analysis of the premia associated with leverage and debt refinancing risk, we use the respective value-weighted high-minus-low returns from Equations (4) and (5). Our objective is to examine whether these return differentials compensate equity holders for exposure to systematic risk. To do so, we run spanning regressions using the $q$-factors proposed by HXZ. This choice is motivated by recent research (Hou et al., 2019) showing that the $q$-factor model subsumes other models in summarizing the systematic risk structure of the cross-section of stock returns. Additionally, we repeat the analysis using the factor models proposed in Fama and French (1993, FF3) and Fama and French (2015, FF5), which represent standard benchmarks for interpreting leverage-related return patterns.

Table V presents the time-series averages of the high-minus-low return differentials based on leverage, $R_{LEV}$, and refinancing intensity, $R_{RI}$, as well as results for the spanning regressions using the $q$-factors. All $t$-statistics, reported in square brackets, are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991).

TABLE V ABOUT HERE

The results in specification (i) show that the $LEV$ premium is not different from zero whereas the $RI$ premium is significantly positive with an estimate of 0.16% per month ($t$: 2.21). The CAPM-style regression in specification (ii) shows that the $LEV$ premium is unrelated to market risk whereas the $RI$ premium's loading is significantly positive ($t$: 3.92). In addition to its significant market exposure, the $RI$ premium delivers a significant alpha of 0.14% ($t$: 1.99). In specification (iii), we add the remaining $q$-factors constructed by HXZ, that is, the size ($R_{Me}$), investment ($R_{I/A}$), and profitability ($R_{Roe}$) factors, to the spanning regressions. For the leverage premium, we find a significantly positive loading on the investment factor ($t$: 9.63) and a significantly negative loading on the profitability factor ($t$: $-2.34$). Adding the remaining $q$-factors also spans the premium for debt refinancing risk, with positive loadings on the market ($t$: 4.97), the investment factor ($t$: 2.70), and the profitability factor ($t$: 1.72).

These results show that the cross-section of stock returns reflects a positive premium for debt refinancing risk. A higher immediacy of debt refinancing is associated with higher equity returns due to increased exposure to systematic risk. The positive exposures to market risk, the investment factor, and the profitability factor also show how the compensation for debt refinancing risk differs from the relation between equity returns and leverage. The leverage premium is zero on average, is not exposed to market risk, has a (larger) positive exposure to the investment factor, and a negative exposure to the profitability factor. Hence, it is ambiguous whether leverage increases or decreases a firm's exposure to systematic risk; it appears that high leverage increases the exposure to investment risk but serves as a hedge against profitability risk.[8] One statement that we can make very clearly is that not all leverage-related risks are priced equally in equity markets.

Table VI reports results for spanning regressions using the FF factors. Our conclusions are qualitatively similar. Specification (i) repeats the CAPM-style regression. Similar to above, we do not find a significant link between the leverage premium and the market factor. For the debt refinancing premium, we find a significantly positive loading on the market factor and an insignificant alpha. Specification (ii) report results for the FF3 model, which additionally includes the size (SMB) and value (HML) factors. In line with previous research, we find a significantly positive loading of the leverage premium on HML (0.66 with $t$ of 19.27). By contrast, the premium for debt refinancing risk has a significantly positive loading on the market factor ($t$: 4.92) and the link to HML is much weaker (0.07 with $t$ of 1.91). Finally, specification (iii) presents spanning regressions using the FF5 model, which additionally includes investment (CMA) and operating profitability (RMW) factors. For the leverage premium we find positive exposures, with different degrees of significance, to all factors except for RMW and a significantly negative alpha of $-0.17\%$ ($t$: $-1.98$). The most

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[8] According to the economic model described by HXZ, expected equity returns should, all else equal, decrease in investments and, all else equal, increase in profitability. The empirical construction of their factors avoids an interdependence of investments and profitability by using independent sorts, hence the negative profitability exposure we find for the leverage premium is not mechanically related to its positive investment exposure. The positive investment exposure itself is consistent with the HXZ model in that high (low) market leverage firms correspond to low (high) investment firms, as HXZ illustrate in their Figure 1.

significant driver, economically and statistically, of the leverage premium is HML with an exposure of 0.59 ($t$: 12.67). The premium for debt refinancing risk is spanned by positive exposures to the market factor ($t$: 5.03) as well as to SMB ($t$: 2.03) and RMW ($t$: 2.01). In contrast to the leverage premium, the exposure to HML is zero.

Table VI about here

Overall, the results of the FF spanning regressions corroborate the evidence for a premium for debt refinancing risk. Both sets of results show that the $RI$ premium is spanned by positive risk factor exposures. While there is some variation across specifications which factors turn out to be (in)significant, we find across all HXZ and FF specifications that the statistically most significant exposure to systematic risk is the loading on the respective market factors ($t$ of 3.92 or higher).

The results of both the HXZ and FF spanning regressions are also consistent in that we cannot establish an unambiguous relation between leverage, controlled for debt refinancing risk, and systematic risk. To start with, the leverage premium is zero on average. Recall from above that the HXZ spanning regressions suggests that the leverage premium loads positively on investment risk but negatively on profitability risk; hence, leverage appears to generate exposure to some dimensions of systematic risk but provides a hedge against others.

In the FF regressions, the results are dominated by a high, significantly positive exposure to the HML factor. This loading reflects the previously documented close relation between measures of leverage and book-to-market ratios. In the FF5 model, we also find (mostly significant) positive exposures to the other factors but also that the alpha is significantly negative. Put differently, highly levered firms earn lower returns than low leverage firms, after accounting for systematic risk as measured by the positive exposures to the FF5 risk factors. At first sight, this result may appear counter-intuitive and reminiscent of the 'distress puzzle', that is, the finding that the stocks of firms with high distress risk deliver lower returns but higher loadings on FF factors than stocks of firms with lower distress risk (e.g., Campbell, Hilscher, and Szilagyi, 2008; Garlappi and Yan, 2011). This finding suggests that the FF5 model does not fully span the leverage premium but only some of its exposure to systematic risk. In other words, the leverage premium is associated with a negative residual return relative to FF5 because it provides a hedge against other dimensions of systematic risk. By contrast, the $q$-factor model generates an alpha of zero.

To ensure that our results are not driven by firms with (economically) very low leverage ratios, we repeat the analysis in the subsample that excludes AZL firms. To conserve space, we report the detailed results in the Internet Appendix (in Tables IA.II to IA.IV), but we can ascertain here that our overall insights remain unchanged: There is no premium for leverage but a significantly positive premium for debt refinancing risk (0.19% per month with $t$ of 2.26). The refinancing risk premium is spanned by positive risk factor exposures, with the market factors playing the most important role in the spanning regressions.

## C. Premia for Short-Term versus Long-Term Leverage

In the previous section, we studied debt maturity effects, controlling for leverage, in the cross-section of stock returns and provided evidence for a premium associated with debt refinancing risk. In the next step, we explore debt maturity effects from a related but different angle by decomposing firms' leverage ratios into short-term leverage and long-term leverage. We define short-term leverage by

$$STLEV = RI \cdot LEV, \tag{6}$$

that is, leverage arising from debt due in the next three years, and long-term leverage by

$$LTLEV = (1 - RI) \cdot LEV, \tag{7}$$

that is, leverage arising from debt due in more than three years, respectively, such that $LEV = STLEV + LTLEV$. Economically, this analysis is different from the one above, because it directly interacts the maturity of debt with the level of leverage. This interaction implies, for example, that a firm with high refinancing intensity will not necessarily be assigned to the high short-term leverage portfolio; instead, if the firm's leverage ratio is sufficiently low, it may well be allocated to the portfolio of firms with low short-term leverage. Hence, to complement our analysis of the premium for debt refinancing risk, we now assess the (potential difference in the) pricing of short-term leverage and long-term leverage in the cross-section of equity returns. The portfolio sort procedure is analogue to the one described above, that is, we conduct a triple 2-by-3-by-3 sort on firms' size, long-term leverage, and short-term leverage, and compute the respective return differentials as

$$R_{ME,t} \equiv \frac{1}{9}\left(\sum_{j=1}^{3}\sum_{k=1}^{3} R_t^{1jk} - \sum_{j=1}^{3}\sum_{k=1}^{3} R_t^{2jk}\right), \tag{8}$$

$$R_{LTLEV,t} \equiv \frac{1}{6}\left(\sum_{i=1}^{2}\sum_{k=1}^{3} R_t^{i3k} - \sum_{i=1}^{2}\sum_{k=1}^{3} R_t^{i1k}\right), \tag{9}$$

$$R_{STLEV,t} \equiv \frac{1}{6}\left(\sum_{i=1}^{2}\sum_{j=1}^{3} R_t^{ij3} - \sum_{i=1}^{2}\sum_{j=1}^{3} R_t^{ij1}\right). \tag{10}$$

### *C.1. Portfolio Summary Statistics*

Table VII presents summary statistics for the portfolios that constitute the long and short legs in the premium computations. Starting with long-term leverage, we report that the low $LTLEV$ portfolio (with an average of 0.04) and the high $LTLEV$ portfolio (with an average of 0.44) are both associated with an average $STLEV$ of 0.08. The low and high short-term leverage portfolios, with $STLEV$ averages of 0.01 and 0.18, respectively, have very similar averages of $LTLEV$, that is 0.22 and 0.23. There is some variation in firm size across the four leverage portfolios but none of the portfolios is dominated by small firms and specifically for $STLEV$ the difference in average size for the low compared to the high portfolio is very small.

There is an inverse relation between $LTLEV$ and $RI$ whereas $STLEV$ relates positively to $RI$. Moreover, $LTLEV$ and $STLEV$ are both positively related to $LEV$, with somewhat higher dispersion across the $LTLEV$ portfolios than across the $STLEV$ portfolios. These summary statistics show that the portfolios are distinct from the ones used in the analysis of premia for leverage and debt refinancing risk in Section III.B.

Table VII about here

With respect to the portfolio averages of the other firm characteristics, we find an inverse relation between $\beta$ and long-term leverage but $\beta$ is very similar for the low and high $STLEV$ portfolios. We find a positive link between both leverage measures and $BM$ ratios, with larger dispersion for $LTLEV$ than for $STLEV$. While there is little variation in $OP$ across the short- and long-term leverage portfolios, we find that low leverage firms, both long-term and short-term, have higher $ROE$ than high leverage firms. Finally, there is no difference in $I/A$ for the $LTLEV$ portfolios but firms with high short-term leverage have lower $I/A$ than firms with high $STLEV$.

The last two rows report the portfolios' average equally-weighted (EW) and value-weighted (VW) excess returns. For the EW portfolios, we find that the high-minus-low $LTLEV$ portfolio return is $-0.14\%$ per month, whereas the high-minus-low differential return is 0.21% for $STLEV$. For the value-weighted portfolios, the respective returns correspond to those plotted in Panel A of Figure 1, reported above at the outset of the paper. While average returns tend to decrease as $LTLEV$ increases (with a small high-minus-low differential of $-0.05\%$), the returns for the $STLEV$ portfolios increase from 0.76% (low) to 0.80% (medium) and 0.98% (high), which generates a high-minus-low differential of 0.22% per month.

### *C.2. Spanning Regression Results*

Table VIII presents the premia for short-term and long-term leverage, as well as their differential, and results for spanning regressions using the $q$-factors of HXZ. Panel A reports that the premium for short-term leverage, $R_{STLEV}$, is significantly positive with 0.22% per month ($t$: 2.64) and that the premium for long-term leverage, $R_{LTLEV}$, is negative but not significantly different from zero. The results of the spanning regressions using the HXZ market factor show that the loading of the $LTLEV$ premium is significantly negative ($t$: $-2.70$). For $STLEV$ we find no significant exposure to market risk and that the market factor alone cannot explain the $STLEV$ premium, that is, its alpha is 0.22% ($t$: 2.72). However, once we include the full set of $q$-factors in the regressions, the $STLEV$ premium is spanned, that is, the alpha becomes insignificant with positive loadings on the market, investment, and profitability factors. For the premium on $LTLEV$, we find a significantly positive loading on the investment factor and a significantly negative loading on the profitability factor.

Table VIII about here

To make the differential pricing of short-term compared to long-term leverage more explicit, Panel B presents regression results for the differential of the premium on short-term leverage minus the premium on long-term leverage, that is, $R_{STLEV} - R_{LTLEV}$. With this differential, we can directly assess the drivers of the compensation for short-term in excess of long-term leverage.

Specification (i) reports that the premium for $STLEV$ in excess of the premium for $LTLEV$ is 0.27% per month ($t$: 2.11). Specification (ii) shows that the differential premium remains (marginally) significant when controlling for its significantly positive exposure to market risk. The premium is spanned when adding the other $q$-factors in Specification (iii). Economically, the higher premium for $STLEV$ can be understood by positive loadings on the market and profitability factors ($t$ of 3.42 and 4.70, respectively); additionally, there is a marginally significant size effect ($t$: 1.74) and a borderline significant inverse relation to the investment factor ($t$: $-1.65$).

Table IX reports the results for the spanning regressions with the FF factors. For $LTLEV$ in Panel A we find in the market model (i) a significantly negative loading on the market, in the FF3 model (ii) a significantly negative alpha, a negative loading on the market, and a positive loading on HML, and in the FF5 model (iii) a negative alpha associated with a positive loading on HML. For $STLEV$ we find (i) a positive alpha in the market model, (ii) positive loadings on the market factor and HML in the FF3 model, and (iii) positive loadings on all FF5 factors, most significant on the market factor. While both $R_{LTLEV}$ and $R_{STLEV}$ are positively exposed to HML, the coefficient estimate is much higher for the premium on long-term leverage (0.51, $t$: 11.05) compared to that on short-term leverage (0.19, $t$: 3.25). This finding is in line with differences in the dispersion of $BM$ (and $LEV$) across high and low portfolios for $LTLEV$ and $STLEV$, respectively, reported above in Table VII.

Table IX about here

Panel B reports results for the differential of short-term and long-term leverage premia, $R_{STLEV} - R_{LTLEV}$. The spanning regression (i) results in a significantly positive loading on the market factor that renders the premium insignificant. In the FF3 model in column (ii), the loading on the market remains significantly positive but at the same time the alpha becomes significantly positive and is associated with a significantly negative loading on HML.

In the FF5 model in column (iii), the exposures to the market and profitability factors are significantly positive, very similar to our findings for the HXZ $q$-factor spanning regressions. Similar to the HXZ regression, there is a mild size effect. Finally, as in the FF3 regression, we find a significantly negative exposure to the HML factor. These negative HML loadings reflect our finding from Panel A that $R_{STLEV}$ is less exposed to HML than $R_{LTLEV}$.

To control for the possibility that our findings may be driven by firms with very low leverage ratios, we repeat the analysis in the sample that excludes AZL firms and present the results in Tables IA.V to IA.VII in the Internet Appendix. Our results are qualitatively the same. We obtain a $STLEV$-minus-$LTLEV$ premium of 0.28% per month ($t$: 2.20). The premium is fully spanned by the HXZ model, in particular by significantly positive exposures to the market and profitability factors. The results for the FF factor spanning regressions remain very similar as well, in particular the negative exposure to the HML factor. In the FF5 model, we additionally find a significantly positive exposure to the investment factor.

### *D. Summary of Empirical Evidence and Implications*

Our empirical analysis shows that short-term leverage and long-term leverage have fundamentally different implications for equity returns. Shareholders demand a premium for short-term leverage over and above the compensation they require for long-term leverage. Since we also find that shareholders require a premium for a firm's debt refinancing risk, but not for the level of its leverage, our evidence suggests that the economic source of the premium for short-term leverage is debt rollover risk.[9]

The premia for short-term leverage and debt refinancing risk are spanned by the HXZ and FF models, with positive factor exposures. This result is consistent with the notion that the immediacy of a firm's debt refinancing needs exposes its equity to systematic risk. Our findings are very similar, when we analyze the premium for short-term leverage in excess of the premium for long-term leverage, thereby emphasizing that short-term leverage indeed exposes a firm's equity more to systematic risk than long-term leverage. This is true despite our finding that the premium differential exhibits a negative exposure to HML in the FF regressions; this is a mechanic effect reflecting that the previously documented relation between leverage and book-to-market ratios (and hence to HML) is more pronounced for the long-term than the short-term component of leverage.

One interesting observation is that the market factors play an important role in explain-

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[9] In additional analyses, we consider the possibility that cash may be viewed as 'negative debt'. To do so, we construct net leverage ratios by subtracting cash and short-term investments from the numerator and denominator of a firm's leverage ratio and repeat the portfolio sort procedure and spanning tests of Sections III.B and III.C. Using net leverage does not affect the qualitative nature of our insights, for details see Tables IA.VIII to IA.XI in the Internet Appendix. For example, we obtain a significantly positive short-term net leverage premium of 23 bps per month ($t$: 2.40) that is fully spanned by positive risk-factor exposures in the HXZ and FF models. We also find that the premium for long-term net leverage is insignificant.

ing premia associated with short debt maturities. Specifically, for the premium for debt refinancing risk, we find that the market exposure estimate is always associated with the highest $t$-statistic compared to all other factors in the HXZ, FF3, and FF5 models. Similarly, the premium for short-term leverage in excess of the premium for long-term leverage always exhibits significantly positive loadings (with $t \geq 2.8$) on the market factors.

As emphasized at the outset, we are not in search of new equity factors. Our aim is to show that there is a differential pricing of short-term compared to long-term leverage because short-term leverage exposes a firm's equity more to systematic risk than long-term leverage. Our empirical results clearly speak towards a rollover risk channel for debt maturity effects in the cross-section of equity returns, and these findings have important implications for fundamental tasks in corporate finance, such as capital structure choice and cost of (equity) capital estimation. In the next section, we make this argument more explicit in a debt rollover risk model à la He and Xiong (2012).

# IV. Model

In this section, we introduce a rollover risk model in the spirit of He and Xiong (2012) and elaborate on its asset pricing implications for the cross-section of equity returns. We present the cornerstones of the model and discuss its implications below, but delegate detailed derivations to Appendix A.

In the model, the firm faces systematic and idiosyncratic cash flow risk and endogenously chooses its optimal leverage ratio and debt refinancing intensity. Firms' choices take into account that bondholders apply a liquidity spread and that shareholders require compensation for debt rollover risk. The optimal financing policy implies a negative relation between a firm's systematic cash flow risk and leverage, as is standard in trade-off models, and a positive relation between a firm's systematic cash flow risk and its refinancing intensity. The resulting model implications for expected equity returns, which we illustrate in a simulation study, rationalize the key empirical findings of our analysis in Section III: In the cross-section, equity returns are (i) unrelated to leverage ratios, (ii) increase in debt refinancing intensities, and (iii) increase in short-term leverage but not in long-term leverage.

In addition, to provide external validity for the model, we go beyond explaining the empirical evidence presented in our paper. That is, we illustrate that the model captures other default risk-related patterns in equity returns that have been documented by previous empirical research as well. The model implies that expected equity returns are negatively related to default probabilities, akin to the 'distress puzzle' (e.g., Campbell, Hilscher, and Szilagyi, 2008), and positively related to credit risk premia (e.g. Friewald, Wagner, and Zechner, 2014).

## *A. Model Structure*

This section introduces the setup for our structural model of the firm. We discuss the sources of the firm's cash flow risk, its debt structure, and its expected equity returns.

### *A.1. Sources of Cash Flow Risk*

We assume that the firm's cash flow, $X_t$, follows a Geometric Brownian Motion, GBM, under the physical probability measure, $\mathbb{P}$, with drift rate $\mu^{\mathbb{P}}$. Similarly as in Chen (2010), the cash flow is governed by two independent Brownian shocks. There is a firm-specific shock with volatility $\sigma_f$ as well as a systematic shock with volatility $\beta^X \sigma_m$, where $\beta^X$ is the cash flow (asset) beta, that is, the exposure of unlevered equity to priced risk. The total volatility of the cash flow growth thus is $\sigma = \sqrt{\sigma_f^2 + (\beta^X \sigma_m)^2}$. We define $\mu^{\mathbb{P}} - \mu^{\mathbb{Q}} = \beta^X \lambda_m$ as the asset risk premium, where $\mu^{\mathbb{Q}}$ is the risk-neutral drift of the cash flow process under the measure $\mathbb{Q}$, and $\lambda_m$ is the market risk premium. We denote by $r$ the instantaneous risk free rate and by $\tau$ the marginal tax benefit rate of debt. The value of the unlevered firm, $U(X_t)$, is

$$U(X_t) = \mathbb{E}^{\mathbb{Q}} \left[ \int_t^{\infty} (1-\tau) X_s e^{-rs} ds \right] = (1-\tau) \frac{X_t}{r - \mu^{\mathbb{Q}}}. \tag{11}$$

### *A.2. Debt Structure*

Following Leland (1998) the firm commits to a stationary debt structure and rolls over a constant amount of debt, $\phi P$, at each point in time; $P$ denotes the total face (book) value of debt and $\phi$ the refinancing intensity, where we have that $0 < \phi \leq 1$. Following DeMarzo and He (2020), the instantaneous coupon payment, $cP$, increases in the face value of debt, where $c = r/(1-\tau)$ is a constant. As in Leland (1994) we further assume that there are bankruptcy costs, $\alpha$, and debt holders take over the firm in the event of default and recover only a fraction, $1-\alpha$, of the unlevered firm value.

In the spirit of He and Xiong (2012), we assume a liquidity spread, $l$, at which corporate debt is discounted relative to equity and other liquid assets. There is ample empirical evidence that liquidity spreads are higher for riskier firms and that the liquidity in the corporate bond market deteriorates in bad times.[10] We assume that bondholders require an instantaneous liquidity spread that is proportional to systematic cash flow risk,

$$l = l_0 \beta^X, \tag{12}$$

where $l_0 > 0$, as compensation for liquidity risk (e.g., Acharya and Pedersen, 2005).[11] To provide direct empirical evidence for this assumption, Table IA.XII in the Internet Appendix shows that firms' asset betas are positively related to the bid-ask spreads on their corporate

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[10] For example, Bao, Pan, and Wang (2011) find that bid-ask spreads are positively related to the beta of a bond with respect to either the bond market or the equity market. Friewald, Jankowitsch, and Subrahmanyam (2012) and Dick-Nielsen, Feldhütter, and Lando (2012) show that liquidity is a more important determinant of yield spreads in times of crisis, especially for speculative-grade bonds.

[11] While our assumption is motivated by empirical evidence from the corporate bond market, there is also evidence that bank loans are costlier for firms with more systematic cash flows (Acharya, Almeida, and Campello, 2013). This effect arises because the business model of banks is to pool idiosyncratic risks, so they dislike lending to firms with more systematic risk.

bonds.[12]

### *A.3. Expected Return on Equity*

Equity holders are the residual claimants of the cash flows to the firm. Specifically, the time-$t$ cash flow to equity, $CFE_t$, is given by

$$CFE_t = (X_t - cP)(1-\tau) - \phi[P - D(X_t)]. \tag{13}$$

Positive $CFE$ are paid out as dividends, while negative $CFE$ require equity injections. As discussed by He and Xiong (2012), the first term is the after-tax cash flow while the second term captures the rollover gain or loss. The equity value, $E(X_t)$, is thus determined by expected after-tax cash flows and expected rollover gains or losses. If $X_t$ deteriorates to an endogenous level, $X_B$, then equity holders default and receive nothing. The endogenous default boundary, $X_B$, satisfies the smooth pasting condition, $E'(X_B) = 0$.

Since equity is a contingent claim on the firm's cash flows, any change in the equity value is driven by innovations in cash flows. Given the asset risk premium, $\beta^X \lambda_m$, one can thus express the time-$t$ expected excess return on equity by

$$\mathbb{E}^{\mathbb{P}}\left[R_t\right] - r = \gamma_t \beta^X \lambda_m = \beta_t^E \lambda_m, \tag{14}$$

where $\gamma_t = \frac{\partial E}{\partial X}\frac{X}{E}$ is the cash-flow sensitivity of the value of equity. We refer to $\beta_t^E$ as the exposure of levered equity to systematic risk.

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[12] We run firm-level panel regressions of firms' asset betas on their corporate bond bid-ask spreads. To measure a firm's asset beta, we delever its equity beta. To compute a firm's corporate bond bid-ask spread we use academic TRACE data, which reports bond transaction data at the dealer-level, and we proceed as follows: For each firm, we first compute the bond-level bid-ask spreads as the volume-weighted averages across dealers. Second, we compute the firm-level spread as the average bid-ask spread across bonds. For details, see Table IA.XII in the Internet Appendix.

## *B. Model Implications*

To illustrate how expected equity returns relate to firms' optimal choices of leverage ratios and refinancing intensities, we simulate a cross-section of 500 firms. We generate cross-sectional variation by drawing parameter values for baseline liquidity spreads, $l_0$, as well as for variables that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$, from reasonable parameter intervals used in the literature, as summarized in Table X.[13] All other parameters, also listed in the table, are also fixed in accordance with the existing literature.

TABLE X ABOUT HERE

### *B.1. Optimal Financing Policies*

For each of the 500 firms, we compute their optimal financing policies, that is, the mix of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$.[14] In line with our empirical analysis, we define the leverage ratio, $L(X_0)$, as the ratio of the book value of debt to the book value of debt plus the market value of equity, $E(X_0)$,

$$L(X_0) = \frac{P}{P + E(X_0)}. \tag{15}$$

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[13] See, for example, Leland (1994), Leland and Toft (1996), Goldstein, Ju, and Leland (2001), Garlappi and Yan (2011), He and Xiong (2012), Chen et al. (2018), He and Milbradt (2014), Diamond and He (2014), Chen, Xu, and Yang (2020), or Chen, Hackbarth, and Strebulaev (2020).

[14] Motivated by empirical evidence that firms' capital structures are persistent over extended time periods (Welch, 2004; Lemmon, Roberts, and Zender, 2008), we take a static approach. That is, we generate a cross-section of firms that are at their optimal financing choices and study the implications for the cross-section of equity returns, but we do not simulate cash flow paths. If we did simulate cash flow paths, non-stationarity would become an issue because the leverage of non-defaulting firms would eventually converge to zero, as is common to all models in this class. Developing a dynamic model is beyond the scope of our paper and we leave this for future research.

Figure 2 about here

Figure 2 illustrates how a firm's systematic cash flow risk, $\beta^X$, affects its optimal financing policy. Panel A shows the traditional negative effect of $\beta^X$ in a trade-off model on leverage. That is, an increase in $\beta^X$ reduces the present value of the tax shield relative to bankruptcy costs, which leads to lower optimal leverage, $L(X_0)$. In our setup with endogenous leverage and refinancing intensity, the optimal choice of refinancing intensity $\phi$ depends on cash flow beta as well. Panel B shows that a higher $\beta^X$ leads to an increase in $\phi$, that is, to a shorter debt maturity. To provide the intuition for this effect, consider the value of default-free debt with maturity $m = 1/\phi$. For this debt, the discount factor is $df = (1 + r \cdot m + l \cdot m)^{-1}$, which includes a liquidity spread, $l \cdot m = l_0 \beta^X \cdot m$. Given that $df$ decreases in the liquidity spread, a firm's incentive to reduce its debt maturity increases in $\beta^X$ because this decreases the present value of liquidity costs. Thus, with firms' optimal leverage and maturity choices both depending on systematic cash flow risk but with opposite signs, the model implies that, in the cross-section, high (low) leverage firms tend to have lower (higher) refinancing intensities.[15]

### *B.2. Implications for Equity Returns*

Having established firms' optimal financing policies, we now turn to the equity return implications. Figure 3 shows that the relations of expected equity excess returns, $\mathbb{E}^{\mathbb{P}}[R_t] - r$, to leverage ratios and refinancing intensities in our cross-section of simulated firms are very similar to the empirical relations that we have presented in Sections III.A and III.B. Panel A suggests that equity returns are only weakly related to leverage, akin to the insignificant leverage premium in our empirical analysis. In the model, this almost flat relation between leverage and equity risk is due to the opposing leverage linkages of a firm's equity cash flow sensitivity and of its systematic cash flow risk that affect $\beta_t^E = \gamma_t \beta_t^X$. That is, on the one

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[15] While our empirical analysis focuses on equity return implications, our summary statistics in Table I suggest that leverage and refinancing intensities are negatively correlated in the data as well.

hand, the equity of firms with high leverage is highly sensitive to cash flow shocks, but, on the other hand, such firms that choose high leverage ratios are the ones that have comparably low systematic cash flow risk (as shown in Figure 2).

Panel B shows that equity returns increase in refinancing intensities. In a standard rollover risk model, for any level of leverage, firms would want to issue long-term debt to avoid rollover losses. In our setup, however, firms with high systematic cash flow risk face particularly high liquidity spreads on long-term debt (as discussed above), which destroy firm value. Besides reducing leverage, model firms with high systematic cash flow risk find it therefore optimal to use more short-term relative to long-term debt. This effect reduces deadweight losses due to liquidity spreads but increases the (expected) rollover losses of equity. Refinancing intensity is thus positively related to equity returns because it is directly linked to the exposure of equity to systematic shocks. In this way the model provides a rationale for our empirical finding of a significantly positive premium for debt refinancing risk that is spanned by systematic risk factors.

Figure 3 about here

To illustrate the joint leverage and debt maturity implications for expected equity returns, we follow our empirical approach and use firms' leverage ratios and refinancing intensities to decompose total leverage into short-term and long-term leverage. That is, we define short-term leverage, $STL(X_t) = \phi L(X_t)$, and long-term leverage, $LTL(X_t) = (1 - \phi)L(X_t)$, such that $L(X_t) = STL(X_t) + LTL(X_t)$.

Figure 4 shows that long-term and short-term leverage have opposite implications for expected equity returns in our model. There is a strong positive relation of returns to short-term leverage whereas the relation to long-term leverage is negative and relatively weaker. These expected return patterns resemble those of the empirical portfolio returns presented in Figure 1 and are consistent with the differential pricing of short-term and long-term leverage reported in Section III.C. Empirically, stock returns tend to decrease in long-term leverage, albeit the premium associated with long-term leverage is not significantly different from zero. By contrast, the premium associated with short-term leverage is significantly positive.

FIGURE 4 ABOUT HERE

Overall, our model emphasizes the importance of the endogeneity of leverage *and* debt maturity choices in understanding leverage-related equity risk premia.

## *C. Default Probabilities and Credit Risk Premia*

As an external validity check of our model, we use the simulated data to explore other (default risk-related) patterns in equity returns that have been documented by previous empirical research.

First, we study the link between expected equity returns and default probabilities in our model. There is ample empirical evidence that measures of bankruptcy and distress risk are negatively related to stock returns (e.g., Dichev, 1998; Campbell, Hilscher, and Szilagyi, 2008), a finding commonly referred to as 'distress puzzle'. Our model is indeed consistent with this empirical observation, that is, expected equity returns decrease in firms' probabilities of default, as we show in Panel A of Figure 5. In the model, this negative relation is due to default probabilities increasing in leverage, as is standard in structural models of credit risk, but decreasing in refinancing intensities, as illustrated in Figure IA.1 in the Internet Appendix. These model-implied relations could stimulate novel research on the role of default probabilities in returns; for example, it could be interesting for future research to account for debt maturity effects in the context of the distress puzzle as well.[16] Such an analysis would further be motivated by our model as credit risk premia (defined as

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[16] While outside the scope of this paper, it would, for instance, be interesting to analyze how shareholders' commitment to cover potential shortfalls arising from debt rollover (as in our model) can be related to bargaining between shareholders and creditors as in Garlappi, Shu, and Yan (2008), Garlappi and Yan (2011), and Hackbarth, Haselmann, and Schoenherr (2015).

the (log) differences in risk-neutral and physical default probabilities) decrease in leverage but increase in refinancing intensity, as illustrated in Figure IA.2 in the Internet Appendix. In other words, leverage and refinancing intensity affect default probabilities and credit risk premia in opposite directions.

Figure 5 about here

Second, we further show in Panel B of Figure 5 that in our model expected equity returns increase in credit risk premia. This finding is consistent with empirical evidence that stock returns are positively related to risk premia embedded in credit instruments, such as corporate bonds (e.g., Campello, Chen, and Zhang, 2008) and credit default swaps (e.g., Friewald, Wagner, and Zechner, 2014).

Taken together, our simulation evidence suggests that the model successfully accounts for leverage- and distress risk-related empirical patterns in the cross-section of equity returns.

## V. Conclusion

This paper studies the role of debt maturity for leverage-related premia in the cross-section of equity returns. We decompose firms' leverage ratios into short-term leverage and long-term leverage, that is, leverage due to debt expiring in the next three years and debt maturing in more than three years, respectively. Our empirical analysis reveals that equity premia associated with short-term and long-term leverage are fundamentally different: equity returns increase in short-term leverage, but not in long-term leverage. The premium differential (controlling for size effects) is about 3.2% per year and reflects the distinct systematic risk exposures of stocks due to short-term and long-term leverage.

We argue that our finding is consistent with the notion of debt rollover risk. That is, shareholders require a premium for stocks of firms with high compared to low ratios of short-term to total debt, because of their comparably higher debt refinancing risk. Empirically, we provide evidence for such a debt refinancing risk premium, after controlling for size and leverage effects. Conceptually, we show that our empirical findings are consistent with the equity pricing implications that we derive from a rollover risk model in the spirit of He and Xiong (2012).

To establish our empirical results for premia associated with debt refinancing risk and short-term leverage, we use portfolio sort techniques popularized by the empirical asset pricing literature. We also use this approach to show how debt refinancing risk exposes stocks to risk factors proposed in the literature and how premia for short-term and long-term leverage are spanned differently by these factors. Our results suggest that in the $q$-factor model of Hou, Xue, and Zhang (2015) as well as in the Fama and French (2015) model, the largest differences in the systematic risk attributes are due to the premium for short-term leverage being significantly more exposed to market and profitability risk than the premium for long-term leverage.

These findings have important implications for corporate financial applications. Our results suggest that shareholders price debt refinancing risk, and firms should take this into account when choosing their debt maturity structure. This also implies that leverage-adjustments in estimates of a firm's cost of capital should not only account for the level of leverage but also its underlying composition of short-term relative to long-term debt. The more short-term the leverage of a firm is, the more expensive is its equity capital.

# Appendix A. Model Solutions

## *A.1. Debt Value*

The value of debt, $D(X_t)$, is given by

$$D(X_t) = p + [D(X_B) - p]\left(\frac{X_t}{X_B}\right)^{\beta_2}, \tag{A.1}$$

where $p = P(c+\phi)/(r+\phi+l)$ is the default-free value of debt. The value of debt satisfies the equation

$$D(X) = p + A_1 X^{\beta_1} + A_2 X^{\beta_2}, \tag{A.2}$$

where $\beta_1$ and $\beta_2$ are the roots of the fundamental quadratic given by

$$\beta_1 = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) + \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2(r+\phi+l)}}{\sigma^2} \quad > \quad 0 \tag{A.3}$$

and

$$\beta_2 = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) - \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2(r+\phi+l)}}{\sigma^2} \quad < \quad 0. \tag{A.4}$$

The two boundary conditions (see, e.g., Leland, 1994) imposed on debt value are

$$\lim_{X\to\infty} \quad D(X) = p \qquad \text{and} \qquad \lim_{X\to X_B} \quad D(X_B) = \frac{X_B}{r-\mu^{\mathbb{Q}}}(1-\tau)(1-\alpha). \tag{A.5}$$

To exclude bubbles these conditions imply $A_1 = 0$, and $A_2$ is given by

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

## *A.2. Firm Value*

We first derive the value of the tax-shield, $TS(X_t)$, and the value of the bankruptcy costs, $BC(X_t)$. Define

$$\gamma_1 = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) + \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2 r}}{\sigma^2} \quad > \quad 0 \tag{A.7}$$

and

$$\gamma_2 = \frac{-(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2) - \sqrt{(\mu^{\mathbb{Q}} - \frac{1}{2}\sigma^2)^2 + 2\sigma^2 r}}{\sigma^2} \quad < \quad 0. \tag{A.8}$$

The value of the tax shield satisfies the equation

$$TS(X) = \frac{\tau c P}{r} + G_1 X^{\gamma_1} + G_2 X^{\gamma_2}. \tag{A.9}$$

The two boundary conditions are

$$\lim_{X\to\infty} \quad TS(X) = \frac{\tau c P}{r} \qquad \text{and} \qquad \lim_{X\to X_B} \quad TS(X_B) = 0. \tag{A.10}$$

These conditions imply $G_1 = 0$, and $G_2$ is given by

$$G_2 = -\frac{\tau c P}{r}\left(\frac{1}{X_B}\right)^{\gamma_2}. \tag{A.11}$$

The value of bankruptcy costs satisfies the equation

$$BC(X) = B_1 X^{\gamma_1} + B_2 X^{\gamma_2}, \tag{A.12}$$

with boundary conditions

$$\lim_{X\to\infty} \quad BC(X) = 0 \qquad \text{and} \qquad \lim_{X\to X_B} \quad BC(X_B) = \alpha \frac{X_B}{r - \mu^{\mathbb{Q}}}(1-\tau). \tag{A.13}$$

These conditions imply $B_1 = 0$, and $B_2$ is given by

$$B_2 = \alpha \frac{X_B}{r - \mu^{\mathbb{Q}}}(1-\tau)\left(\frac{1}{X_B}\right)^{\gamma_2}. \tag{A.14}$$

In the Leland (1998) framework the value of the firm, $F_0(X_t)$, is given by

$$F_0(X_t) = U(X_t) + TS(X_t) - BC(X_t). \tag{A.15}$$

In our setup bondholders discount cash flows at an additional spread, $l$, relative to other claim holders. Due to this debt liquidity friction, we need to adjust Equation (A.15) for the present value of the liquidity spread. Define $D_0(X_t)$ as the value of debt for $l = 0$ (i.e., in a world with no liquidity spread on debt). The value of the firm, $F(X_t)$, is then given by

$$F(X_t) = F_0(X_t) - \underbrace{[D_0(X_t) - D(X_t)]}_{\text{value of liquidity spread}}. \tag{A.16}$$

The value of equity is then given by

$$E(X_t) = F(X_t) - D(X_t) = F_0(X_t) - D_0(X_t). \tag{A.17}$$

## *A.3. Endogenous Default Boundary*

We adopt the endogenous default notion of, for example, Black and Cox (1976), Fischer, Heinkel, and Zechner (1989), or Leland (1994), which implies that the ex-post optimal default boundary, $X_B$, for equity holders satisfies the smooth-pasting condition

$$\left.\frac{\partial E(X_t)}{\partial X_t}\right|_{X_t = X_B} = 0. \tag{A.18}$$

This condition implies that the optimal default boundary is given by

$$X_B = \frac{\beta_{0,2} p_0 - \gamma_2 \tau c P / r}{\beta_{0,2}(1-\tau)(1-\alpha)/(r-\mu^{\mathbb{Q}}) + \gamma_2 \alpha (1-\tau)/(r-\mu^{\mathbb{Q}}) - (1-\tau)/(r-\mu^{\mathbb{Q}})}, \tag{A.19}$$

where $\beta_{0,2}$ is the fundamental quadratic of Equation (A.4) for $l = 0$, and $p_0 = P(c+\phi)/(r+\phi)$.

## *A.4. Excess Return on Equity*

Using standard arguments, the time-$t$ expected excess return on equity is given by

$$\mathbb{E}^{\mathbb{P}}\left[R_t\right] - r = -Cov^{\mathbb{P}}\left(\frac{dE(X_t)}{E(X_t)}, \frac{d\Lambda_t}{\Lambda_t}\right) = \frac{\partial E}{\partial X}\frac{X}{E}\beta^X \sigma_m \Theta = \frac{\partial E}{\partial X}\frac{X}{E}\beta^X \lambda_m = \beta_t^E \lambda_m, \tag{A.20}$$

where $d\Lambda_t$ are the dynamics of the stochastic discount factor, SDF, that follows a GBM under the physical probability measure, $\mathbb{P}$, with drift rate, $-r$, and volatility, $-\Theta$, (i.e., the market price of risk). Further, $\beta_t^E$ is the exposure of levered equity to priced risk.

## *A.5. Default Probabilities*

The risk neutral default probability, $\pi_t^{\mathbb{Q}}$, is given by

$$\pi_t^{\mathbb{Q}} = \left(\frac{X_t}{X_B}\right)^{\beta_2}, \tag{A.21}$$

and the physical default probability, $\pi_t^{\mathbb{P}}$, we obtain following Chen, Hackbarth, and Strebulaev (2020) as

$$\log(\pi_t^{\mathbb{P}}) = \log(\pi_t^{\mathbb{Q}}) - \left[\left(\frac{2(\mu^{\mathbb{P}} - \mu^{\mathbb{Q}})}{\sigma^2} - 1\right)\log\left(\frac{X_t}{X_B}\right)\right]. \tag{A.22}$$

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## Table I
## Summary Statistics

In Panel A we report the mean and the standard deviation of excess returns, $RET$, leverage, $LEV$, refinancing intensity, $RI$, beta, $\beta$, market value of equity, $ME$, investment-to-assets, $I/A$, return on equity, $ROE$, book-to-market ratio, $BM$, and operating profitability, $OP$. Panel B reports the correlation of the various characteristics with $LEV$ and $RI$, respectively. We report the summary statistics for all levered firms (All-LEV) and for a sample where we exclude almost-zero leverage firms (All-but-AZL), defined as firms with a leverage ratio below 5%. The data is sampled at a monthly frequency and covers levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019.

Panel A: Summary Statistics

| | All-LEV | | All-but-AZL | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| $RET$ [in %] | 0.95 | 16.19 | 0.97 | 15.80 |
| $LEV$ | 0.28 | 0.22 | 0.33 | 0.21 |
| $RI$ | 0.40 | 0.32 | 0.35 | 0.30 |
| $\beta$ | 1.11 | 0.71 | 1.08 | 0.68 |
| $ME$ [in $1 billion] | 3.32 | 18.45 | 3.16 | 17.29 |
| $I/A$ | 0.14 | 0.36 | 0.13 | 0.33 |
| $ROE$ | 0.01 | 0.11 | 0.01 | 0.11 |
| $BM$ | 0.88 | 0.86 | 0.95 | 0.91 |
| $OP$ | 0.19 | 0.42 | 0.20 | 0.41 |
| Observations | 964,984 | | 808,867 | |
| Firms | 10,202 | | 8,935 | |

Panel B: Correlations

| | All-LEV | | All-but-AZL | |
|---|---|---|---|---|
| | $LEV$ | $RI$ | $LEV$ | $RI$ |
| $LEV$ | 1.00 | −0.25 | 1.00 | −0.11 |
| $RI$ | −0.25 | 1.00 | −0.11 | 1.00 |
| $\beta$ | −0.06 | 0.04 | −0.01 | −0.00 |
| $ME$ | −0.08 | −0.06 | −0.10 | −0.05 |
| $I/A$ | −0.07 | −0.05 | −0.05 | −0.09 |
| $ROE$ | −0.05 | −0.10 | −0.10 | −0.07 |
| $BM$ | 0.49 | 0.00 | 0.47 | 0.07 |
| $OP$ | 0.01 | −0.16 | −0.04 | −0.12 |

## Table II
## Leverage, Debt Refinancing, and Equity Returns

This table reports Fama and MacBeth (1973) cross-sectional regressions at the individual firm level using ordinary least squares (FMB-OLS) as well as weighted-least squares (FMB-WLS), where we weight by the market value of equity. *LEV* and *RI* refer to leverage and refinancing intensity, respectively. We report the time-series mean of the estimated coefficients and the associated $t$-statistics in square brackets. The $t$-statistics are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Panel A reports the results for all levered firms (All-LEV), and Panel B for a sample where we exclude almost-zero leverage firms (All-but-AZL), that is, we exclude firms with a leverage ratio of less than 5%. The All-LEV (All-but-AZL) sample comprises of 964,984 (808,867) monthly return observations of 10,202 (8,935) firms. Both samples cover levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019.

Panel A: All-LEV

| | FMB-OLS | | | FMB-WLS | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| *LEV* | −0.06 | | 0.03 | 0.02 | | 0.06 |
| | [−0.20] | | [0.09] | [0.07] | | [0.19] |
| *RI* | | 0.36 | 0.38 | | 0.19 | 0.27 |
| | | [2.29] | [2.36] | | [1.49] | [2.21] |

Panel B: All-but-AZL

| | FMB-OLS | | | FMB-WLS | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| *LEV* | −0.19 | | −0.14 | −0.07 | | −0.03 |
| | [−0.62] | | [−0.42] | [−0.24] | | [−0.11] |
| *RI* | | 0.46 | 0.46 | | 0.35 | 0.37 |
| | | [2.97] | [2.84] | | [1.99] | [2.22] |

## Table III
## Leverage, Debt Refinancing, and Equity Returns: Excluding Micro-Caps

This table reports Fama and MacBeth (1973) cross-sectional regressions at the individual firm level using ordinary least squares (FMB-OLS) as well as weighted-least squares (FMB-WLS), where we weight by the market value of equity. *LEV* and *RI* refer to leverage and refinancing intensity, respectively. We report the time-series mean of the estimated coefficients and the associated *t*-statistics in square brackets. The *t*-statistics are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). We exclude micro-caps, that is, stocks smaller than the 20th percentile of the market equity for NYSE stocks. Panel A reports the results for firms with non-zero leverage (All-LEV), and Panel B for a sample of firms where we exclude almost-zero leverage firms (All-but-AZL). We define almost-zero leverage firms as those with a leverage ratio of less than 5%. The All-LEV (All-but-AZL) sample comprises of 512,357 (437,325) monthly return observations of 5,310 (4,612) firms. Both samples cover levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019.

Panel A: All-LEV

| | FMB-OLS | | | FMB-WLS | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| *LEV* | 0.13 | | 0.23 | 0.01 | | 0.05 |
| | [0.49] | | [0.86] | [0.03] | | [0.16] |
| *RI* | | 0.20 | 0.27 | | 0.18 | 0.26 |
| | | [1.47] | [2.35] | | [1.41] | [2.24] |

Panel B: All-but-AZL

| | FMB-OLS | | | FMB-WLS | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| *LEV* | 0.00 | | 0.07 | −0.09 | | −0.04 |
| | [0.01] | | [0.28] | [−0.28] | | [−0.13] |
| *RI* | | 0.40 | 0.41 | | 0.34 | 0.37 |
| | | [2.68] | [2.97] | | [1.88] | [2.17] |

## Table IV

### Portfolio Characteristics of Sorts on Size, Leverage, and Refinancing Intensity

We summarize the characteristics of portfolios from independent 2-by-3-by-3 sorts on size, $ME$, leverage, $LEV$, and refinancing intensity, $RI$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $LEV$, and 3 $RI$ groups, we compute the monthly average characteristics of the $2 \times 3 \times 3 = 18$ portfolios. Small (Big) are the average characteristics of the 9 small (big) portfolios. Low (High) are the average characteristics of the 6 low (high) portfolios of $LEV$ and $RI$, respectively. We report averages for $LEV$, $RI$, beta, $\beta$, market value of equity, $ME$, investment-to-assets, $I/A$, return on equity, $ROE$, book-to-market ratio, $BM$, operating profitability, $OP$, and equally (EW) and value-weighted (VW) excess returns, $RET$, respectively. Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

| | $ME$ | | $LEV$ | | $RI$ | |
|---|---|---|---|---|---|---|
| | Small | Big | Low | High | Low | High |
| $LEV$ | 0.312 | 0.294 | 0.080 | 0.555 | 0.303 | 0.300 |
| $RI$ | 0.321 | 0.270 | 0.323 | 0.278 | 0.052 | 0.611 |
| $\beta$ | 1.168 | 1.053 | 1.175 | 1.068 | 1.099 | 1.165 |
| $ME$ [in \$1 billion] | 0.395 | 9.980 | 7.380 | 3.732 | 3.172 | 5.898 |
| $I/A$ | 0.134 | 0.144 | 0.167 | 0.123 | 0.171 | 0.117 |
| $ROE$ | 0.000 | 0.034 | 0.024 | 0.006 | 0.017 | 0.014 |
| $BM$ | 0.980 | 0.712 | 0.527 | 1.240 | 0.795 | 0.891 |
| $OP$ | 0.160 | 0.314 | 0.241 | 0.222 | 0.237 | 0.225 |
| $RET$ [EW in %] | 1.017 | 0.784 | 0.888 | 0.842 | 0.785 | 0.978 |
| $RET$ [VW in %] | 0.954 | 0.726 | 0.759 | 0.861 | 0.749 | 0.912 |

## Table V

## Spanning Tests of Return Differentials associated with Leverage and with Refinancing Intensity against the $q$-Factors

We present results for spanning regressions of high-minus-low return differentials associated with leverage and with refinancing intensity. We estimate leverage and refinancing risk premia from independent 2-by-3-by-3 sorts on size, $ME$, leverage, $LEV$, and refinancing intensity, $RI$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $LEV$, and 3 $RI$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LEV}$ ($R_{RI}$) is the difference between the average returns on the 6 high and on the 6 low $LEV$ ($RI$) portfolios. In the spanning regressions, we use the market ($R_{Mkt}$), size ($R_{Me}$), investment ($R_{I/A}$), and profitability ($R_{Roe}$) factors of the $q$-factor model of Hou, Xue, and Zhang (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

| | $R_{LEV}$ | | | $R_{RI}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.10<br>[0.78] | 0.12<br>[0.87] | −0.07<br>[−0.61] | 0.16<br>[2.21] | 0.14<br>[1.99] | 0.03<br>[0.40] |
| $R_{Mkt}$ | | −0.06<br>[−1.09] | 0.03<br>[0.73] | | 0.08<br>[3.92] | 0.11<br>[4.97] |
| $R_{Me}$ | | | 0.04<br>[0.49] | | | 0.06<br>[1.35] |
| $R_{I/A}$ | | | 0.82<br>[9.63] | | | 0.15<br>[2.70] |
| $R_{Roe}$ | | | −0.18<br>[−2.34] | | | 0.07<br>[1.72] |

# Table VI

## Spanning Tests of Return Differentials associated with Leverage and with Refinancing Intensity against the FF-Factors

We present results for spanning regressions of high-minus-low return differentials associated with leverage and with refinancing intensity. We estimate leverage and refinancing risk premia from independent 2-by-3-by-3 sorts on size, $ME$, leverage, $LEV$, and refinancing intensity, $RI$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $LEV$, and 3 $RI$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LEV}$ ($R_{RI}$) is the difference between the average returns on the 6 high and on the 6 low $LEV$ ($RI$) portfolios. In the spanning regressions, we use the Fama-French market (MKTRF), size (SMB), value (HML), profitability (RMW), and investment (CMA) factors, for specifications (i) and (ii) as defined in Fama and French (1993) and for specification (iii) as defined in Fama and French (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

| | $R_{LEV}$ | | | $R_{RI}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.15 | −0.11 | −0.17 | 0.11 | 0.08 | 0.00 |
| | [1.03] | [−1.39] | [−1.98] | [1.48] | [1.01] | [0.04] |
| MKTRF | −0.07 | 0.03 | 0.05 | 0.08 | 0.09 | 0.11 |
| | [−1.26] | [1.33] | [1.75] | [4.13] | [4.92] | [5.03] |
| SMB | | 0.09 | 0.11 | | 0.04 | 0.08 |
| | | [1.63] | [2.40] | | [0.86] | [2.03] |
| HML | | 0.66 | 0.59 | | 0.07 | 0.00 |
| | | [19.27] | [12.67] | | [1.91] | [0.07] |
| RMW | | | 0.08 | | | 0.12 |
| | | | [1.12] | | | [2.01] |
| CMA | | | 0.12 | | | 0.12 |
| | | | [1.78] | | | [1.53] |

## Table VII

## Portfolio Characteristics of Sorts on Size, Long-Term Leverage, and Short-Term Leverage

We summarize the characteristics of portfolios from independent 2-by-3-by-3 sorts on size, $ME$, long-term leverage, $LTLEV$, and short-term leverage, $STLEV$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTLEV$; independently, sort stocks into 3 $STLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STLEV$. Taking the intersections of the 2 size, 3 $LTLEV$, and 3 $STLEV$ groups, we compute the monthly average characteristics of the $2 \times 3 \times 3 = 18$ portfolios. Small (Big) are the average characteristics of the 9 small (big) portfolios. Low (High) are the average characteristics of the 6 low (high) portfolios of $LTLEV$ and $STLEV$, respectively. We report averages for $LTLEV$, $STLEV$, leverage, $LEV$, refinancing intensity, $RI$, beta, $\beta$, market value of equity, $ME$, investment-to-assets, $I/A$, return on equity, $ROE$, book-to-market ratio, $BM$, operating profitability, $OP$, and equally (EW) and value-weighted (VW) excess returns, $RET$, respectively. Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

| | $ME$ | | $LTLEV$ | | $STLEV$ | |
|---|---|---|---|---|---|---|
| | Small | Big | Low | High | Low | High |
| $LTLEV$ | 0.233 | 0.222 | 0.043 | 0.442 | 0.223 | 0.229 |
| $STLEV$ | 0.091 | 0.069 | 0.084 | 0.076 | 0.009 | 0.180 |
| $LEV$ | 0.323 | 0.291 | 0.127 | 0.517 | 0.233 | 0.410 |
| $RI$ | 0.351 | 0.283 | 0.585 | 0.133 | 0.154 | 0.503 |
| $\beta$ | 1.163 | 1.031 | 1.173 | 1.016 | 1.137 | 1.111 |
| $ME$ [in \$1 billion] | 0.392 | 8.941 | 6.573 | 2.828 | 4.282 | 3.988 |
| $I/A$ | 0.133 | 0.141 | 0.141 | 0.138 | 0.176 | 0.107 |
| $ROE$ | -0.001 | 0.033 | 0.019 | 0.007 | 0.017 | 0.012 |
| $BM$ | 0.988 | 0.721 | 0.637 | 1.154 | 0.702 | 1.062 |
| $OP$ | 0.159 | 0.304 | 0.219 | 0.221 | 0.228 | 0.225 |
| $RET$ [EW in %] | 1.007 | 0.805 | 0.950 | 0.807 | 0.816 | 1.022 |
| $RET$ [VW in %] | 0.938 | 0.752 | 0.857 | 0.808 | 0.756 | 0.978 |

## Table VIII

## Spanning Tests of Return Differentials associated with Long-Term Leverage and with Short-Term Leverage against the *q*-Factors

We present results for spanning regressions of high-minus-low return differentials associated with long-term leverage and with short-term leverage. We estimate long-term and short-term leverage premia from independent 2-by-3-by-3 sorts on size, $ME$, long-term leverage, $LTLEV$, and short-term leverage, $STLEV$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTLEV$; independently, sort stocks into 3 $STLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STLEV$. Taking the intersections of the 2 size, 3 $LTLEV$, and 3 $STLEV$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LTLEV}$ ($R_{STLEV}$) is the difference between the average returns on the 6 high and on the 6 low $LTLEV$ ($STLEV$) portfolios. Panel A presents results from spanning regressions for $R_{LTLEV}$ and $R_{STLEV}$, respectively, and Panel B for their differential, $R_{STLEV} - R_{LTLEV}$. In the spanning regressions, we use the market ($R_{Mkt}$), size ($R_{Me}$), investment ($R_{I/A}$), and profitability ($R_{Roe}$) factors of the *q*-factor model of Hou, Xue, and Zhang (2015). The *t*-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

### Panel A: Premia for Long-Term and Short-Term Leverage

| | $R_{LTLEV}$ | | | $R_{STLEV}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | −0.05<br>[−0.40] | −0.01<br>[−0.10] | −0.09<br>[−0.82] | 0.22<br>[2.64] | 0.22<br>[2.72] | −0.04<br>[−0.49] |
| $R_{Mkt}$ | | −0.13<br>[−2.70] | −0.05<br>[−1.38] | | 0.02<br>[0.42] | 0.10<br>[3.43] |
| $R_{Me}$ | | | −0.07<br>[−1.23] | | | 0.04<br>[0.53] |
| $R_{I/A}$ | | | 0.65<br>[7.88] | | | 0.50<br>[6.32] |
| $R_{Roe}$ | | | −0.22<br>[−3.02] | | | 0.13<br>[2.43] |

### Panel B: Short-Term Minus Long-Term Leverage Premium

| | $R_{STLEV} - R_{LTLEV}$ | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| Intercept | 0.27<br>[2.11] | 0.23<br>[1.77] | 0.05<br>[0.40] |
| $R_{Mkt}$ | | 0.14<br>[2.90] | 0.15<br>[3.42] |
| $R_{Me}$ | | | 0.11<br>[1.74] |
| $R_{I/A}$ | | | −0.15<br>[−1.65] |
| $R_{Roe}$ | | | 0.35<br>[4.70] |

## Table IX

## Spanning Tests of Return Differentials associated with Long-Term Leverage and With Short-Term Leverage against the FF-Factors

We present results for spanning regressions of high-minus-low return differentials associated with long-term leverage and with short-term leverage. We estimate long-term and short-term leverage premia from independent 2-by-3-by-3 sorts on size, $ME$, long-term leverage, $LTLEV$, and short-term leverage, $STLEV$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTLEV$; independently, sort stocks into 3 $STLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STLEV$. Taking the intersections of the 2 size, 3 $LTLEV$, and 3 $STLEV$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LTLEV}$ ($R_{STLEV}$) is the difference between the average returns on the 6 high and on the 6 low $LTLEV$ ($STLEV$) portfolios. Panel A presents results from spanning regressions for $R_{LTLEV}$ and $R_{STLEV}$, respectively, and Panel B for their differential, $R_{STLEV} - R_{LTLEV}$. In the spanning regressions, we use the Fama-French market (MKTRF), size (SMB), value (HML), profitability (RMW), and investment (CMA) factors, for specifications (i) and (ii) as defined in Fama and French (1993) and for specification (iii) as defined in Fama and French (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

Panel A: Premia for Long-Term and Short-Term Leverage

| | $R_{LTLEV}$ | | | $R_{STLEV}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.04<br>[0.32] | −0.16<br>[−2.09] | −0.16<br>[−1.91] | 0.21<br>[2.52] | 0.09<br>[1.16] | −0.08<br>[−0.94] |
| MKTRF | −0.13<br>[−2.95] | −0.04<br>[−1.82] | −0.04<br>[−1.38] | 0.02<br>[0.44] | 0.07<br>[2.63] | 0.11<br>[4.76] |
| SMB | | −0.01<br>[−0.44] | −0.03<br>[−0.87] | | −0.00<br>[−0.04] | 0.09<br>[1.99] |
| HML | | 0.54<br>[16.66] | 0.51<br>[11.05] | | 0.31<br>[5.73] | 0.19<br>[3.25] |
| RMW | | | −0.04<br>[−0.74] | | | 0.30<br>[3.98] |
| CMA | | | 0.08<br>[1.33] | | | 0.22<br>[3.49] |

Panel B: Short-Term minus Long-Term Leverage Premium

| | $R_{STLEV} - R_{LTLEV}$ | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| Intercept | 0.17<br>[1.24] | 0.26<br>[2.04] | 0.09<br>[0.69] |
| MKTRF | 0.15<br>[3.18] | 0.11<br>[2.80] | 0.15<br>[3.88] |
| SMB | | 0.01<br>[0.11] | 0.12<br>[2.14] |
| HML | | −0.23<br>[−4.10] | −0.32<br>[−4.32] |
| RMW | | | 0.34<br>[4.47] |
| CMA | | | 0.13<br>[1.30] |

## Table X
## Model Parameters

This table lists the parameters that we use to compute the optimal financing choices for a cross-section of 500 firms. We fix all parameters except for the baseline liquidity spread, $l_0$, and those that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$. We uniformly draw these parameters in reasonable intervals. For each firm we find the combination of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$.

| | | |
|---|---|---|
| Initial Cash Flow | $X_0$ | 1 |
| Marginal Tax Benefit Rate of Debt | $\tau$ | 0.2 |
| Risk-Free Rate | $r$ | 0.05 |
| Bankruptcy Costs | $\alpha$ | 0.4 |
| Baseline Liquidity Spread | $l_0$ | $\mathcal{U}[0.0075, 0.0125]$ |
| Systematic Volatility | $\sigma_m$ | 0.1 |
| Market Risk Premium | $\lambda_m$ | 0.04 |
| Cash Flow Growth under $\mathbb{Q}$ | $\mu^{\mathbb{Q}}$ | $\mathcal{U}[0, 0.04]$ |
| Cash Flow Beta | $\beta^X$ | $\mathcal{U}[0.5, 1.5]$ |
| Firm-Specific Volatility | $\sigma_f$ | $\mathcal{U}[0.05, 0.15]$ |

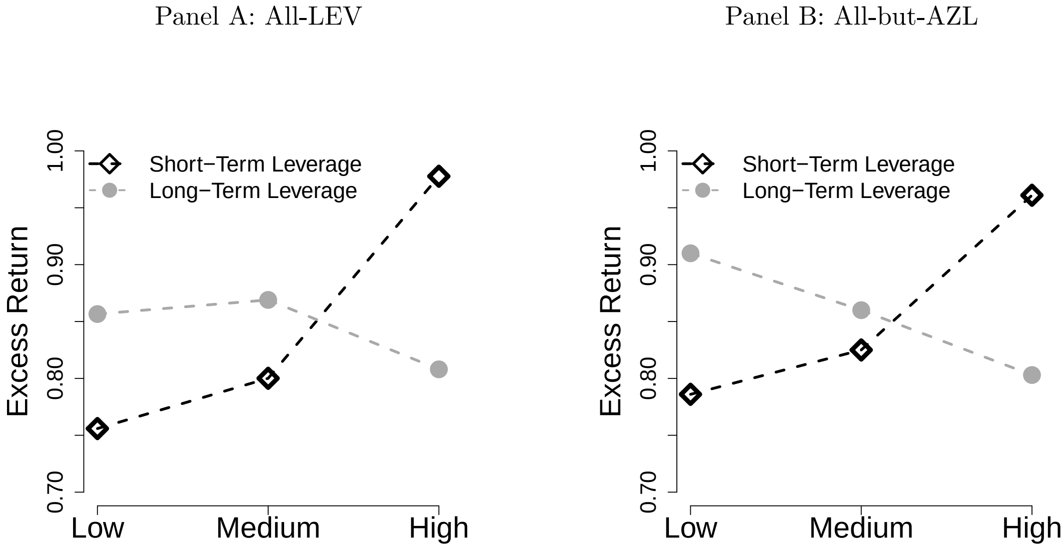
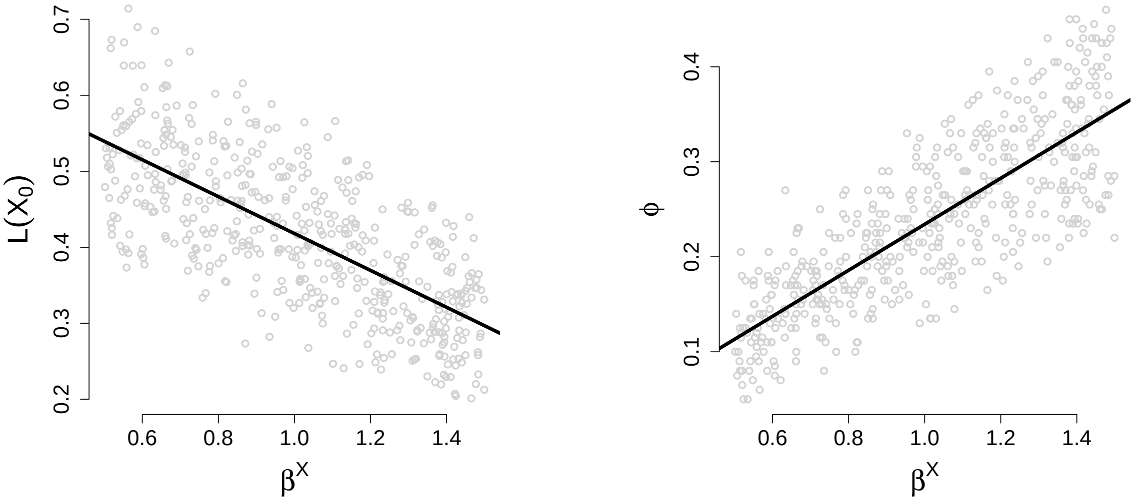


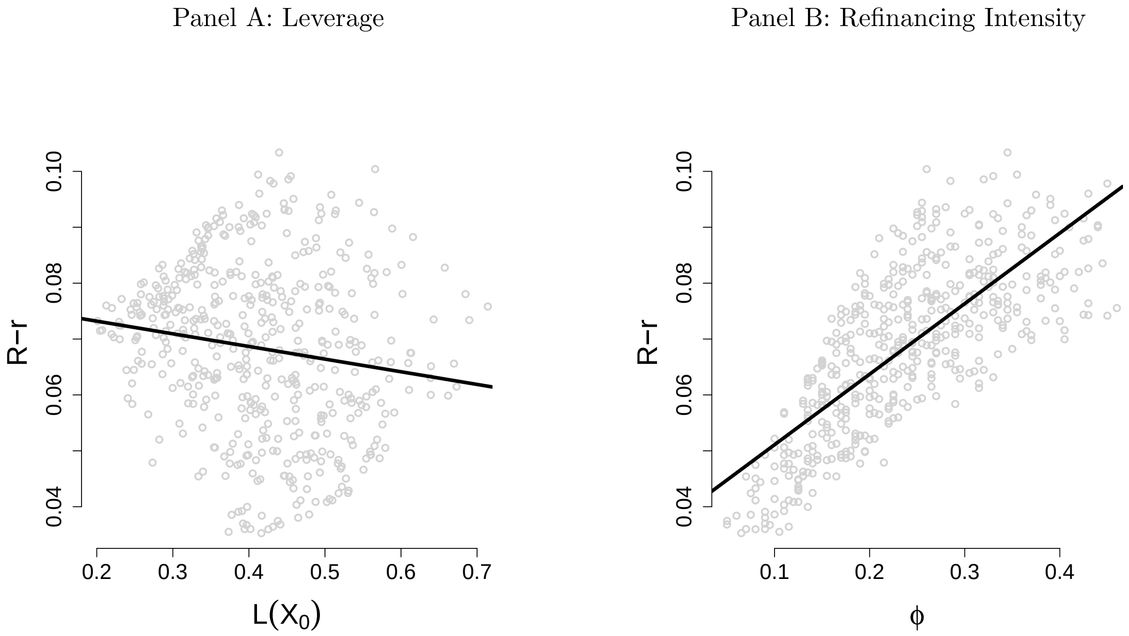
**Figure 1: Excess Returns of Sorts on Short-Term Leverage and Long-Term Leverage.** We plot the excess returns from independent 2-by-3-by-3 sorts on size, $ME$, short-term leverage, $STLEV$, and long-term leverage, $LTLEV$. $STLEV$ is leverage based on debt maturing in the next three years, and $LTLEV$ is leverage based on debt maturing after three years. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $STLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STLEV$; independently, sort stocks into 3 $LTLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTLEV$. Taking the intersections of the 2 size, 3 $STLEV$, and 3 $LTLEV$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. Low/Medium/High are the average returns on the 6 low/medium/high $STLEV$ and $LTLEV$ portfolios, respectively. Panel A covers all levered, non-financial NYSE, Amex, and NASDAQ firms, in total 964,984 monthly return observations of 10,202 firms. In Panel B we exclude from the sorts almost-zero leverage firms, that is, firms with a leverage ratio of less than 5%, which results in 808,867 monthly return observations of 8,935 levered firms. Both samples cover the period from 1976 to 2019.



Panel A: Leverage

Panel B: Refinancing Intensity

**Figure 2: Cash Flow Beta and Optimal Financing Choice.** We compute for a cross-section of 500 firms the optimal financing choice. We fix all parameters except for the baseline liquidity spread, $l_0$, and those that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$. We uniformly draw these parameters in reasonable intervals. Table X provides the details about our parameter choices. For each firm we find the combination of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$. Panel A plots cash flow beta, $\beta^X$, against leverage, $L(X_0)$, and Panel B plots cash flow beta, $\beta^X$, against refinancing intensity, $\phi$.



Panel A: Leverage

Panel B: Refinancing Intensity

**Figure 3: Leverage, Refinancing Intensity, and Equity Returns.** This figure shows the equity return implications of firms' optimal financing choices. We compute for a cross-section of 500 firms the optimal financing choice. We fix all parameters except for the baseline liquidity spread, $l_0$, and those that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$. We uniformly draw these parameters in reasonable intervals. Table X provides the details about our parameter choices. For each firm we find the combination of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$. In Panel A we plot leverage, $L(X_0)$, against the excess return on equity, $R-r$, and in Panel B we plot refinancing intensity, $\phi$, against the excess return on equity, $R-r$.

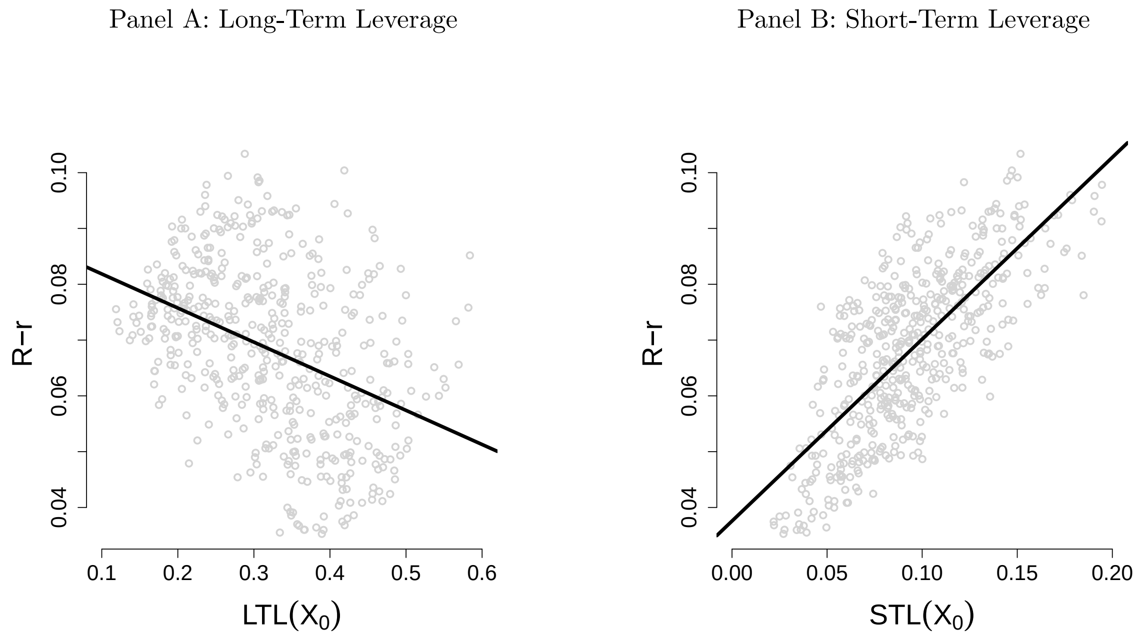


**Figure 4: Long-Term Leverage, Short-Term Leverage, and Equity Returns.** This figure shows the equity return implications of firms' optimal financing choices. We compute for a cross-section of 500 firms the optimal financing choice. We fix all parameters except for the baseline liquidity spread, $l_0$, and those that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$. We uniformly draw these parameters in reasonable intervals. Table X provides the details about our parameter choices. For each firm we find the combination of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$. In Panel A we plot long-term leverage, $LTL(X_0) = (1-\phi)L(X_0)$, against the excess return on equity, $R-r$, where $L(X_0)$ is the total leverage ratio and $\phi$ is the refinancing intensity, and in Panel B we plot short-term leverage, $STL(X_0) = \phi L(X_0)$, against the excess return on equity, $R-r$.

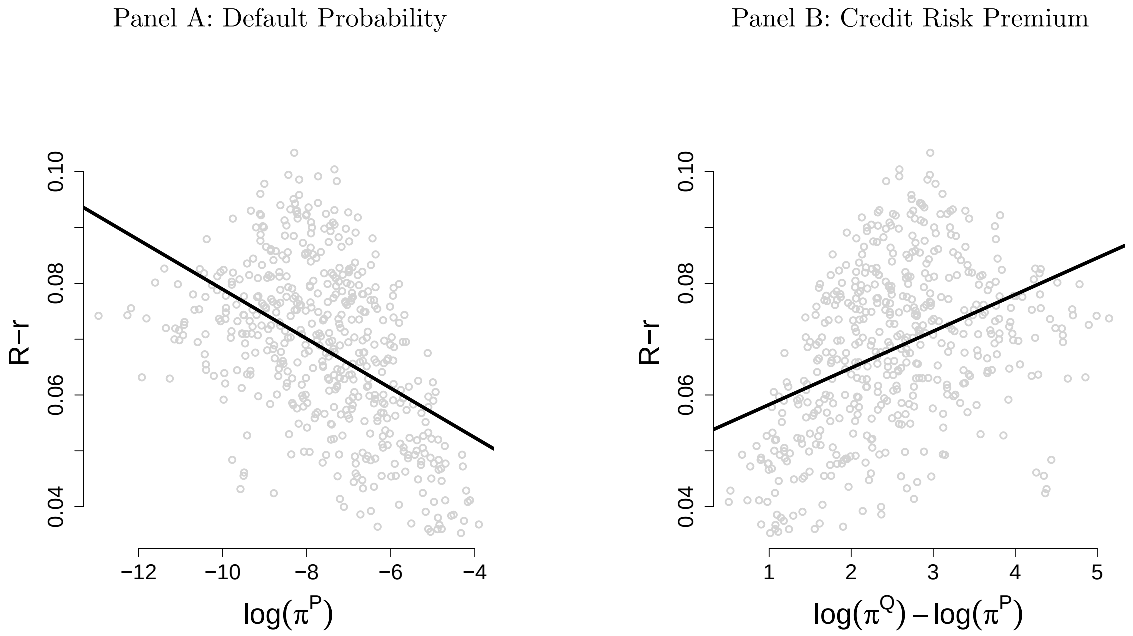


**Figure 5: Default Probability, Credit Risk Premium, and Equity Returns.** This figure shows the equity return implications of firms' optimal financing choices. We compute for a cross-section of 500 firms the optimal financing choice. We fix all parameters except for the baseline liquidity spread, $l_0$, and those that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$. We uniformly draw these parameters in reasonable intervals. Table X provides the details about our parameter choices. For each firm we find the combination of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$. In Panel A we plot the (log of the) physical default probability, $\log(\pi^{\mathbb{P}})$, against the excess return on equity, $R - r$, and in Panel B we plot the credit risk premium defined as the (log) difference in risk-neutral and physical default probabilities, $\log(\pi^{\mathbb{Q}}) - \log(\pi^{\mathbb{P}})$, against the excess return on equity, $R - r$.

Internet Appendix for

# "Debt Refinancing and Equity Returns"

NILS FRIEWALD, FLORIAN NAGLER, and CHRISTIAN WAGNER[*]

This Internet Appendix contains supplemental material for the article "Debt Refinancing and Equity Returns."

- Figure IA.1 presents the model-implied relation between leverage, refinancing intensity, and default probability.
- Figure IA.2 presents the model-implied relation between leverage, refinancing intensity, and credit risk premium.
- Table IA.I presents cross-sectional weighted-least squares regressions of leverage and refinancing intensity onto equity returns at the firm-level using return-weights.
- Table IA.II presents portfolio characteristics of sorts on size, leverage, and refinancing intensity when excluding almost-zero leverage firms.
- Table IA.III presents spanning tests of return differentials associated with leverage and with refinancing intensity when excluding almost-zero leverage firms from the sorts against the $q$-factors of Hou, Xue, and Zhang (2015).
- Table IA.IV presents spanning tests of return differentials associated with leverage and with refinancing intensity when excluding almost-zero leverage firms from the sorts against the Fama and French (1993) and Fama and French (2015) factors.

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[*] Friewald, Nils, Florian Nagler, and Christian Wagner, Internet Appendix to "Debt Refinancing and Equity Returns."

- Table IA.V presents portfolio characteristics of sorts on size, long-term leverage, and short-term leverage when excluding almost-zero leverage firms.

- Table IA.VI presents spanning tests of return differentials associated with long-term leverage and with short-term leverage when excluding almost-zero leverage firms from the sorts against the $q$-factors of Hou, Xue, and Zhang (2015).

- Table IA.VII presents spanning tests of return differentials associated with long-term leverage and with short-term leverage when excluding almost-zero leverage firms from the sorts against the Fama and French (1993) and Fama and French (2015) factors.

- Table IA.VIII presents spanning tests of return differentials associated with net leverage and with refinancing intensity against the $q$-factors of Hou, Xue, and Zhang (2015).

- Table IA.IX presents spanning tests of return differentials associated with net leverage and with refinancing intensity against the Fama and French (1993) and Fama and French (2015) factors.

- Table IA.X presents spanning tests of return differentials associated with long-term net leverage and with short-term net leverage against the $q$-factors of Hou, Xue, and Zhang (2015).

- Table IA.XI presents spanning tests of return differentials associated with long-term net leverage and with short-term net leverage against the Fama and French (1993) and Fama and French (2015) factors.

- Table IA.XII presents firm-level panel regressions of equity and asset betas onto bid-ask spreads of corporate bonds.

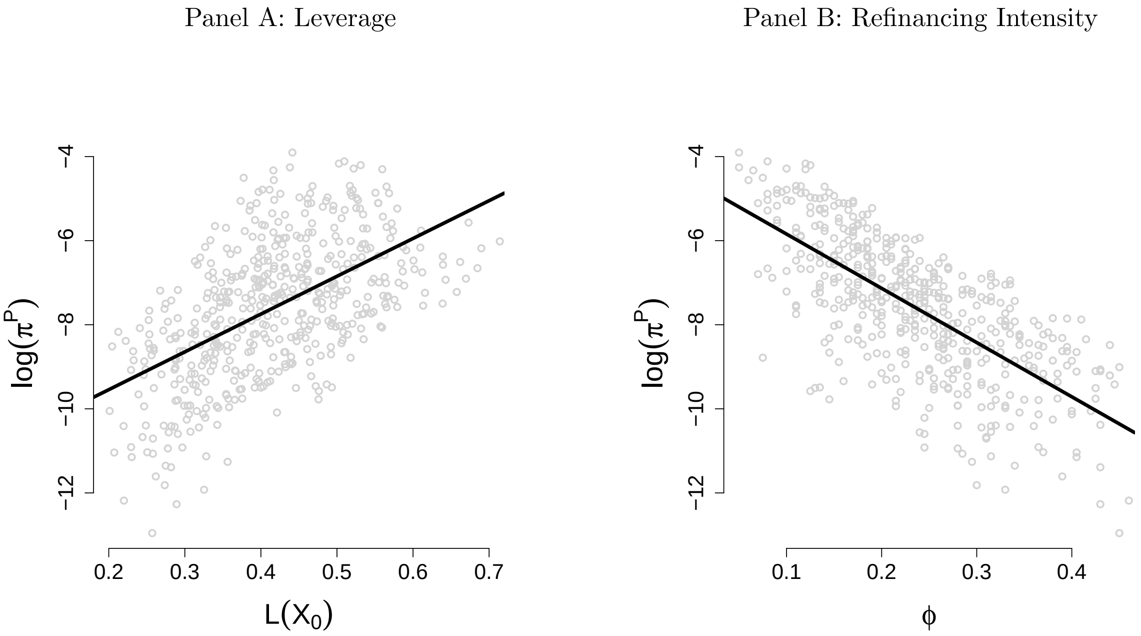
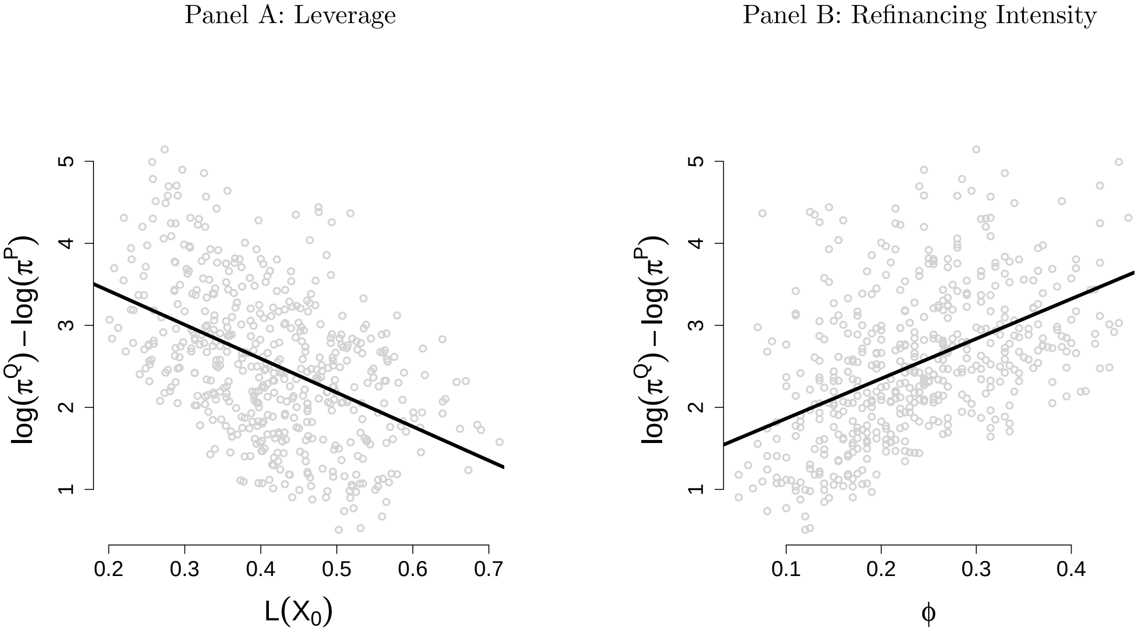


**Figure IA.1: Leverage, Refinancing Intensity, and Default Probability.** This figure shows the default risk implications of firms' optimal financing choices. We compute for a cross-section of 500 firms the optimal financing choice. We fix all parameters except for the baseline liquidity spread, $l_0$, and those that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$. We uniformly draw these parameters in reasonable intervals. Table X provides the details about our parameter choices. For each firm we find the combination of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$. In Panel A we plot leverage, $L(X_0)$, against the (log of the) physical default probability, $\log(\pi^{\mathbb{P}})$, and in Panel B we plot refinancing intensity, $\phi$.



Panel A: Leverage

Panel B: Refinancing Intensity

**Figure IA.2: Leverage, Refinancing Intensity, and Credit Risk Premium.** This figure shows the credit risk premium implications of firms' optimal financing choices. We compute for a cross-section of 500 firms the optimal financing choice. We fix all parameters except for the baseline liquidity spread, $l_0$, and those that determine cash flow risk, that is, cash flow growth, $\mu^{\mathbb{Q}}$, cash flow beta, $\beta^X$, and firm-specific volatility, $\sigma_f$. We uniformly draw these parameters in reasonable intervals. Table X provides the details about our parameter choices. For each firm we find the combination of total debt, $P$, and refinancing intensity, $\phi$, that maximizes firm value, $F(X_0)$. In Panel A we plot leverage, $L(X_0)$, against the credit risk premium defined as the (log) difference in risk-neutral and physical default probabilities, $\log(\pi^{\mathbb{Q}}) - \log(\pi^{\mathbb{P}})$, and in Panel B we plot refinancing intensity, $\phi$.

## Table IA.I
## Leverage, Debt Refinancing, and Equity Returns: Weighted-Least Squares with Return-Weights

This table reports Fama and MacBeth (1973) cross-sectional weighted-least squares regressions at the individual firm level using return-weights (FMB-WLS-RW), following Asparouhova, Bessembinder, and Kalcheva (2013), to account for micro-structure noise. *LEV* and *RI* refer to leverage and refinancing intensity, respectively. We report the time-series mean of the estimated coefficents and the associated *t*-statistics in square brackets. The *t*-statistics are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Panel A reports the results for all levered firms (All-LEV), and Panel B for a sample where we exclude almost-zero leverage firms (All-but-AZL), which we define as firms with a leverage ratio of less than 5%. The All-LEV (All-but-AZL) sample comprises of 964,984 (808,867) monthly return observations of 10,202 (8,935) firms. In Panels C and D we repeat the analysis by excluding micro-caps, that is, stocks smaller than the 20th percentile of the market equity for NYSE stocks. Here, the All-LEV (All-but-AZL) sample comprises of 512,357 (437,325) monthly return observations of 5,310 (4,612) firms. All samples cover levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019.

Panel A: All-LEV

| | FMB-WLS-RW | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| *LEV* | −0.05<br>[−0.16] | | −0.00<br>[−0.01] |
| *RI* | | 0.23<br>[1.49] | 0.24<br>[1.55] |

Panel B: All-but-AZL

| | FMB-WLS-RW | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| *LEV* | −0.22<br>[−0.69] | | −0.19<br>[−0.57] |
| *RI* | | 0.32<br>[2.10] | 0.31<br>[1.98] |

Panel C: All-LEV Excluding Micro-Caps

| | FMB-WLS-RW | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| *LEV* | 0.20<br>[0.72] | | 0.29<br>[1.06] |
| *RI* | | 0.16<br>[1.18] | 0.24<br>[2.06] |

Panel D: All-but-AZL Excluding Micro-Caps

| | FMB-WLS-RW | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| *LEV* | 0.06<br>[0.22] | | 0.12<br>[0.49] |
| *RI* | | 0.38<br>[2.50] | 0.40<br>[2.83] |

## Table IA.II

## Portfolio Characteristics of Sorts on Size, Leverage, and Refinancing Intensity: Excluding Almost-Zero Leverage Firms

We summarize the characteristics of portfolios from independent 2-by-3-by-3 sorts on size, $ME$, leverage, $LEV$, and refinancing intensity, $RI$. We exclude almost-zero leverage firms from the sample, that is, firms with a leverage ratio of less than 5%. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $LEV$, and 3 $RI$ groups, we compute the monthly average characteristics of the $2 \times 3 \times 3 = 18$ portfolios. Small (Big) are the average characteristics of the 9 small (big) portfolios. Low (High) are the average characteristics of the 6 low (high) portfolios of $LEV$ and $RI$, respectively. We report averages for $LEV$, $RI$, beta, $\beta$, market value of equity, $ME$, investment-to-assets, $I/A$, return on equity, $ROE$, book-to-market ratio, $BM$, operating profitability, $OP$, and equally (EW) and value-weighted (VW) excess returns, $RET$, respectively. The sample covers all non-financial NYSE, Amex, and NASDAQ firms, but excludes almost-zero leverage firms, over the period from 1976 to 2019, in total 808,867 monthly return observations of 8,935 levered firms.

| | $ME$ | | $LEV$ | | $RI$ | |
|---|---|---|---|---|---|---|
| | Small | Big | Low | High | Low | High |
| $LEV$ | 0.343 | 0.322 | 0.125 | 0.568 | 0.330 | 0.333 |
| $RI$ | 0.302 | 0.248 | 0.291 | 0.265 | 0.050 | 0.567 |
| $\beta$ | 1.149 | 1.034 | 1.134 | 1.066 | 1.095 | 1.135 |
| $ME$ [in $1 billion] | 0.405 | 8.990 | 6.577 | 3.491 | 2.652 | 5.826 |
| $I/A$ | 0.128 | 0.138 | 0.147 | 0.125 | 0.170 | 0.106 |
| $ROE$ | 0.001 | 0.031 | 0.025 | 0.004 | 0.015 | 0.015 |
| $BM$ | 1.013 | 0.753 | 0.579 | 1.264 | 0.826 | 0.938 |
| $OP$ | 0.170 | 0.309 | 0.252 | 0.219 | 0.236 | 0.231 |
| $RET$ [EW in %] | 1.025 | 0.804 | 0.926 | 0.867 | 0.789 | 1.005 |
| $RET$ [VW in %] | 0.972 | 0.722 | 0.815 | 0.860 | 0.744 | 0.930 |

### Table IA.III

### Spanning Tests of Return Differentials associated with Leverage and with Refinancing Intensity against the $q$-Factors: Excluding Almost-Zero Leverage Firms

We present results for spanning regressions of high-minus-low return differentials associated with leverage and with refinancing intensity. We exclude almost-zero leverage firms from the sample, that is, firms with a leverage ratio of less than 5%. We estimate leverage and refinancing risk premia from independent 2-by-3-by-3 sorts on size, $ME$, leverage, $LEV$, and refinancing intensity, $RI$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $LEV$, and 3 $RI$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LEV}$ ($R_{RI}$) is the difference between the average returns on the 6 high and on the 6 low $LEV$ ($RI$) portfolios. In the spanning regressions, we use the market ($R_{Mkt}$), size ($R_{Me}$), investment ($R_{I/A}$), and profitability ($R_{Roe}$) factors of the $q$-factor model of Hou, Xue, and Zhang (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The sample covers all non-financial NYSE, Amex, and NASDAQ firms, but excludes almost-zero leverage firms, over the period from 1976 to 2019, in total 808,867 monthly return observations of 8,935 levered firms.

| | $R_{LEV}$ | | | $R_{RI}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.04 | 0.05 | −0.02 | 0.19 | 0.17 | 0.04 |
| | [0.39] | [0.46] | [−0.19] | [2.26] | [2.11] | [0.44] |
| $R_{Mkt}$ | | −0.03 | 0.01 | | 0.07 | 0.10 |
| | | [−0.70] | [0.38] | | [2.69] | [4.03] |
| $R_{Me}$ | | | 0.05 | | | 0.04 |
| | | | [0.95] | | | [0.80] |
| $R_{I/A}$ | | | 0.62 | | | 0.19 |
| | | | [8.56] | | | [2.49] |
| $R_{Roe}$ | | | −0.26 | | | 0.09 |
| | | | [−4.17] | | | [1.79] |

## Table IA.IV

### Spanning Tests of Return Differentials associated with Leverage and with Refinancing Intensity against the FF-Factors: Excluding Almost-Zero Leverage Firms

We present results for spanning regressions of high-minus-low return differentials associated with leverage and with refinancing intensity. We exclude almost-zero leverage firms from the sample, that is, firms with a leverage ratio of less than 5%. We estimate leverage and refinancing risk premia from independent 2-by-3-by-3 sorts on size, $ME$, leverage, $LEV$, and refinancing intensity, $RI$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $LEV$, and 3 $RI$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LEV}$ ($R_{RI}$) is the difference between the average returns on the 6 high and on the 6 low $LEV$ ($RI$) portfolios. In the spanning regressions, we use the Fama-French market (MKTRF), size (SMB), value (HML), profitability (RMW), and investment (CMA) factors, for specifications (i) and (ii) as defined in Fama and French (1993) and for specification (iii) as defined in Fama and French (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The sample covers all non-financial NYSE, Amex, and NASDAQ firms, but excludes almost-zero leverage firms, over the period from 1976 to 2019, in total 808,867 monthly return observations of 8,935 levered firms.

| | $R_{LEV}$ | | | $R_{RI}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.07 | −0.14 | −0.11 | 0.14 | 0.10 | 0.00 |
| | [0.57] | [−1.79] | [−1.43] | [1.67] | [1.12] | [0.02] |
| MKTRF | −0.04 | 0.03 | 0.03 | 0.07 | 0.09 | 0.11 |
| | [−0.83] | [1.19] | [1.04] | [2.84] | [3.80] | [4.29] |
| SMB | | 0.13 | 0.09 | | 0.02 | 0.07 |
| | | [4.29] | [2.68] | | [0.30] | [1.55] |
| HML | | 0.53 | 0.50 | | 0.10 | 0.02 |
| | | [12.59] | [12.26] | | [2.00] | [0.30] |
| RMW | | | −0.09 | | | 0.16 |
| | | | [−1.31] | | | [2.41] |
| CMA | | | 0.05 | | | 0.13 |
| | | | [0.69] | | | [1.49] |

## Table IA.V
## Portfolio Characteristics of Sorts on Size, Long-Term Leverage, and Short-Term Leverage: Excluding Almost-Zero Leverage Firms

We summarize the characteristics of portfolios from independent 2-by-3-by-3 sorts on size, $ME$, long-term leverage, $LTLEV$, and short-term leverage, $STLEV$. We exclude almost-zero leverage firms from the sample, that is, firms with a leverage ratio of less than 5%. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTLEV$; independently, sort stocks into 3 $STLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STLEV$. Taking the intersections of the 2 size, 3 $LTLEV$, and 3 $STLEV$ groups, we compute the monthly average characteristics of the $2 \times 3 \times 3 = 18$ portfolios. Small (Big) are the average characteristics of the 9 small (big) portfolios. Low (High) are the average characteristics of the 6 low (high) portfolios of $LTLEV$ and $STLEV$, respectively. We report averages for $LTLEV$, $STLEV$, leverage, $LEV$, refinancing intensity, $RI$, beta, $\beta$, market value of equity, $ME$, investment-to-assets, $I/A$, return on equity, $ROE$, book-to-market ratio, $BM$, operating profitability, $OP$, and equally (EW) and value-weighted (VW) excess returns, $RET$, respectively. The sample covers all non-financial NYSE, Amex, and NASDAQ firms, but excludes almost-zero leverage firms, over the period from 1976 to 2019, in total 808,867 monthly return observations of 8,935 levered firms.

| | $ME$ | | $LTLEV$ | | $STLEV$ | |
|---|---|---|---|---|---|---|
| | Small | Big | Low | High | Low | High |
| $LTLEV$ | 0.254 | 0.244 | 0.071 | 0.454 | 0.253 | 0.246 |
| $STLEV$ | 0.097 | 0.075 | 0.091 | 0.082 | 0.013 | 0.187 |
| $LEV$ | 0.351 | 0.320 | 0.162 | 0.536 | 0.266 | 0.433 |
| $RI$ | 0.299 | 0.258 | 0.466 | 0.140 | 0.074 | 0.486 |
| $\beta$ | 1.147 | 1.018 | 1.142 | 1.015 | 1.103 | 1.114 |
| $ME$ [in \$1 billion] | 0.412 | 8.482 | 6.173 | 2.816 | 3.807 | 4.009 |
| $I/A$ | 0.130 | 0.136 | 0.131 | 0.136 | 0.166 | 0.106 |
| $BM$ | 1.020 | 0.760 | 0.667 | 1.187 | 0.737 | 1.098 |
| $OP$ | 0.172 | 0.301 | 0.237 | 0.220 | 0.240 | 0.225 |
| $ROE$ | 0.001 | 0.031 | 0.021 | 0.006 | 0.018 | 0.011 |
| $RET$ [EW in %] | 1.020 | 0.814 | 0.968 | 0.815 | 0.830 | 1.025 |
| $RET$ [VW in %] | 0.970 | 0.746 | 0.910 | 0.803 | 0.786 | 0.961 |

## Table IA.VI

## Spanning Tests of Return Differentials associated with Long-Term Leverage and with Short-Term Leverage against the $q$-Factors: Excluding Almost-Zero Leverage Firms

We present results for spanning regressions of high-minus-low return differentials associated with long-term leverage and with short-term leverage. We exclude almost-zero leverage firms from the sample, that is, firms with a leverage ratio of less than 5%. We estimate long-term and short-term leverage premia from independent 2-by-3-by-3 sorts on size, $ME$, long-term leverage, $LTLEV$, and short-term leverage, $STLEV$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTLEV$; independently, sort stocks into 3 $STLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STLEV$. Taking the intersections of the 2 size, 3 $LTLEV$, and 3 $STLEV$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LTLEV}$ ($R_{STLEV}$) is the difference between the average returns on the 6 high and on the 6 low $LTLEV$ ($STLEV$) portfolios. Panel A presents results from spanning regressions for $R_{LTLEV}$ and $R_{STLEV}$, respectively, and Panel B for their differential, $R_{STLEV} - R_{LTLEV}$. In the spanning regressions, we use the market ($R_{Mkt}$), size ($R_{Me}$), investment ($R_{I/A}$), and profitability ($R_{Roe}$) factors of the $q$-factor model of Hou, Xue, and Zhang (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The sample covers all non-financial NYSE, Amex, and NASDAQ firms, but excludes almost-zero leverage firms, over the period from 1976 to 2019, in total 808,867 monthly return observations of 8,935 levered firms.

### Panel A: Premia for Long-Term and Short-Term Leverage

| | $R_{LTLEV}$ | | | $R_{STLEV}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | −0.11<br>[−0.98] | −0.08<br>[−0.71] | −0.07<br>[−0.79] | 0.17<br>[2.21] | 0.16<br>[2.16] | −0.04<br>[−0.54] |
| $R_{Mkt}$ | | −0.10<br>[−2.56] | −0.06<br>[−1.86] | | 0.04<br>[1.48] | 0.10<br>[4.27] |
| $R_{Me}$ | | | −0.04<br>[−1.01] | | | 0.06<br>[1.04] |
| $R_{I/A}$ | | | 0.48<br>[8.44] | | | 0.41<br>[6.21] |
| $R_{Roe}$ | | | −0.27<br>[−4.57] | | | 0.08<br>[1.74] |

### Panel B: Short-Term Minus Long-Term Leverage Premium

| | $R_{STLEV} - R_{LTLEV}$ | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| Intercept | 0.28<br>[2.20] | 0.24<br>[1.84] | 0.03<br>[0.27] |
| $R_{Mkt}$ | | 0.14<br>[3.02] | 0.16<br>[3.84] |
| $R_{Me}$ | | | 0.10<br>[1.79] |
| $R_{I/A}$ | | | −0.07<br>[−0.92] |
| $R_{Roe}$ | | | 0.35<br>[5.01] |

## Table IA.VII

## Spanning Tests of Return Differentials associated with Long-Term Leverage and with Short-Term Leverage against the FF-Factors: Excluding Almost-Zero Leverage Firms

We present results for spanning regressions of high-minus-low return differentials associated with long-term leverage and with short-term leverage. We exclude almost-zero leverage firms from the sample, that is, firms with a leverage ratio of less than 5%. We estimate long-term and short-term leverage premia from independent 2-by-3-by-3 sorts on size, $ME$, long-term leverage, $LTLEV$, and short-term leverage, $STLEV$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTLEV$; independently, sort stocks into 3 $STLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STLEV$. Taking the intersections of the 2 size, 3 $LTLEV$, and 3 $STLEV$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LTLEV}$ ($R_{STLEV}$) is the difference between the average returns on the 6 high and on the 6 low $LTLEV$ ($STLEV$) portfolios. Panel A presents results from spanning regressions for $R_{LTLEV}$ and $R_{STLEV}$, respectively, and Panel B for their differential, $R_{STLEV} - R_{LTLEV}$. In the spanning regressions, we use the Fama-French market (MKTRF), size (SMB), value (HML), profitability (RMW), and investment (CMA) factors, for specifications (i) and (ii) as defined in Fama and French (1993) and for specification (iii) as defined in Fama and French (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). The sample covers all non-financial NYSE, Amex, and NASDAQ firms, but excludes almost-zero leverage firms, over the period from 1976 to 2019, in total 808,867 monthly return observations of 8,935 levered firms.

### Panel A: Premia for Long-Term and Short-Term Leverage

| | $R_{LTLEV}$ | | | $R_{STLEV}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | −0.04<br>[−0.31] | −0.20<br>[−2.42] | −0.14<br>[−1.64] | 0.14<br>[1.88] | 0.05<br>[0.67] | −0.08<br>[−1.10] |
| MKTRF | −0.11<br>[−2.82] | −0.04<br>[−1.49] | −0.05<br>[−1.82] | 0.05<br>[1.57] | 0.08<br>[3.48] | 0.12<br>[5.41] |
| SMB | | 0.03<br>[1.21] | −0.02<br>[−0.53] | | 0.04<br>[0.62] | 0.10<br>[2.26] |
| HML | | 0.43<br>[10.10] | 0.44<br>[8.90] | | 0.23<br>[5.17] | 0.10<br>[2.10] |
| RMW | | | −0.16<br>[−2.55] | | | 0.21<br>[3.21] |
| CMA | | | 0.01<br>[0.07] | | | 0.24<br>[4.21] |

### Panel B: Short-Term minus Long-Term Leverage Premium

| | $R_{STLEV} - R_{LTLEV}$ | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| Intercept | 0.18<br>[1.32] | 0.25<br>[2.00] | 0.05<br>[0.45] |
| MKTRF | 0.15<br>[3.32] | 0.12<br>[2.99] | 0.17<br>[4.58] |
| SMB | | 0.00<br>[0.06] | 0.12<br>[2.27] |
| HML | | −0.20<br>[−3.30] | −0.34<br>[−4.74] |
| RMW | | | 0.36<br>[5.01] |
| CMA | | | 0.23<br>[2.45] |

## Table IA.VIII
## Spanning Tests of Return Differentials associated with Net Leverage and with Refinancing Intensity against the $q$-Factors

We present results for spanning regressions of high-minus-low return differentials associated with net leverage and with refinancing intensity. To measure net leverage, we deduct cash and short-term investments (Compustat item *che*) in the numerator and denominator of a firm's leverage ratio. We estimate net leverage and refinancing risk premia from independent 2-by-3-by-3 sorts on size, $ME$, net leverage, $NLEV$, and refinancing intensity, $RI$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $NLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $NLEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $NLEV$, and 3 $RI$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{NLEV}$ ($R_{RI}$) is the difference between the average returns on the 6 high and on the 6 low $NLEV$ ($RI$) portfolios. In the spanning regressions, we use the market ($R_{Mkt}$), size ($R_{Me}$), investment ($R_{I/A}$), and profitability ($R_{Roe}$) factors of the $q$-factor model of Hou, Xue, and Zhang (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

| | $R_{NLEV}$ | | | $R_{RI}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.06<br>[0.45] | 0.08<br>[0.62] | −0.11<br>[−0.87] | 0.14<br>[1.85] | 0.11<br>[1.54] | 0.03<br>[0.43] |
| $R_{Mkt}$ | | −0.09<br>[−1.69] | 0.01<br>[0.15] | | 0.09<br>[4.31] | 0.10<br>[4.55] |
| $R_{Me}$ | | | 0.00<br>[0.02] | | | 0.05<br>[1.15] |
| $R_{I/A}$ | | | 0.83<br>[9.10] | | | 0.09<br>[1.46] |
| $R_{Roe}$ | | | −0.17<br>[−2.08] | | | 0.06<br>[1.29] |

## Table IA.IX

## Spanning Tests of Return Differentials associated with Net Leverage and with Refinancing Intensity against the FF-Factors

We present results for spanning regressions of high-minus-low return differentials associated with net leverage and with refinancing intensity. To measure net leverage, we deduct cash and short-term investments (Compustat item *che*) in the numerator and denominator of a firm's leverage ratio. We estimate net leverage and refinancing risk premia from independent 2-by-3-by-3 sorts on size, $ME$, net leverage, $NLEV$, and refinancing intensity, $RI$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $NLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $NLEV$; independently, sort stocks into 3 $RI$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $RI$. Taking the intersections of the 2 size, 3 $NLEV$, and 3 $RI$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{NLEV}$ ($R_{RI}$) is the difference between the average returns on the 6 high and on the 6 low $NLEV$ ($RI$) portfolios. In the spanning regressions, we use the Fama-French market (MKTRF), size (SMB), value (HML), profitability (RMW), and investment (CMA) factors, for specifications (i) and (ii) as defined in Fama and French (1993) and for specification (iii) as defined in Fama and French (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

| | $R_{NLEV}$ | | | $R_{RI}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.12 | −0.13 | −0.20 | 0.08 | 0.06 | 0.01 |
| | [0.88] | [−1.44] | [−2.19] | [1.02] | [0.79] | [0.08] |
| MKTRF | −0.10 | 0.00 | 0.02 | 0.09 | 0.09 | 0.10 |
| | [−1.88] | [0.12] | [0.85] | [4.52] | [4.58] | [4.43] |
| SMB | | 0.04 | 0.07 | | 0.04 | 0.07 |
| | | [0.82] | [1.80] | | [0.87] | [0.84] |
| HML | | 0.65 | 0.58 | | 0.04 | −0.01 |
| | | [19.09] | [11.94] | | [0.92] | [−0.25] |
| RMW | | | 0.11 | | | 0.09 |
| | | | [1.39] | | | [1.48] |
| CMA | | | 0.14 | | | 0.08 |
| | | | [1.95] | | | [1.00] |

## Table IA.X
## Spanning Tests of Return Differentials associated with Long-Term Net Leverage and with Short-Term Net Leverage against the $q$-Factors

We present results for spanning regressions of high-minus-low return differentials associated with long-term net leverage and with short-term net leverage. To measure net leverage, $NLEV$, we deduct cash and short-term investments (Compustat item *che*) in the numerator and denominator of a firm's leverage ratio. We then decompose net leverage into short-term net leverage, $STNLEV = RI \cdot NLEV$, and long-term net leverage, $LTNLEV = (1 - RI) \cdot NLEV$, where $RI$ denotes the firm's debt refinancing intensity. We estimate long-term and short-term net leverage premia from independent 2-by-3-by-3 sorts on size, $ME$, long-term net leverage, $LTNLEV$, and short-term net leverage, $STNLEV$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTNLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTNLEV$; independently, sort stocks into 3 $STNLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STNLEV$. Taking the intersections of the 2 size, 3 $LTNLEV$, and 3 $STNLEV$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LTNLEV}$ ($R_{STNLEV}$) is the difference between the average returns on the 6 high and on the 6 low $LTNLEV$ ($STNLEV$) portfolios. Panel A presents results from spanning regressions for $R_{LTNLEV}$ and $R_{STNLEV}$, respectively, and Panel B for their differential, $R_{STNLEV} - R_{LTNLEV}$. In the spanning regressions, we use the market ($R_{Mkt}$), size ($R_{Me}$), investment ($R_{I/A}$), and profitability ($R_{Roe}$) factors of the $q$-factor model of Hou, Xue, and Zhang (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

### Panel A: Premia for Long-Term and Short-Term Net Leverage

| | $R_{LTNLEV}$ | | | $R_{STNLEV}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | −0.09<br>[−0.76] | −0.05<br>[−0.41] | −0.10<br>[−0.80] | 0.23<br>[2.40] | 0.23<br>[2.36] | −0.04<br>[−0.35] |
| $R_{Mkt}$ | | −0.14<br>[−2.97] | −0.08<br>[−1.75] | | −0.01<br>[−0.35] | 0.07<br>[2.12] |
| $R_{Me}$ | | | −0.09<br>[−1.96] | | | 0.04<br>[0.50] |
| $R_{I/A}$ | | | 0.57<br>[7.29] | | | 0.46<br>[5.67] |
| $R_{Roe}$ | | | −0.22<br>[−2.86] | | | 0.17<br>[3.31] |

### Panel B: Short-Term Minus Long-Term Net Leverage Premium

| | $R_{STNLEV} - R_{LTNLEV}$ | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| Intercept | 0.32<br>[1.88] | 0.29<br>[1.64] | 0.06<br>[0.33] |
| $R_{Mkt}$ | | 0.13<br>[2.11] | 0.15<br>[2.34] |
| $R_{Me}$ | | | 0.13<br>[1.63] |
| $R_{I/A}$ | | | −0.11<br>[−0.99] |
| $R_{Roe}$ | | | 0.40<br>[4.02] |

## Table IA.XI

### Spanning Tests of Return Differentials associated with Long-Term Net Leverage and With Short-Term Net Leverage against the FF-Factors

We present results for spanning regressions of high-minus-low return differentials associated with long-term net leverage and with short-term net leverage. To measure net leverage, $NLEV$, we deduct cash and short-term investments (Compustat item *che*) in the numerator and denominator of a firm's leverage ratio. We then decompose net leverage into short-term net leverage, $STNLEV = RI \cdot NLEV$, and long-term net leverage, $LTNLEV = (1 - RI) \cdot NLEV$, where $RI$ denotes the firm's debt refinancing intensity. We estimate long-term and short-term net leverage premia from independent 2-by-3-by-3 sorts on size, $ME$, long-term net leverage, $LTNLEV$, and short-term net leverage, $STNLEV$. Each month, we use the median NYSE market capitalization to split firms into 2 groups, small and big; independently, sort stocks into 3 $LTNLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $LTNLEV$; independently, sort stocks into 3 $STNLEV$ groups using the NYSE breakpoints for the low 30%, middle 40%, and high 30% of the ranked $STNLEV$. Taking the intersections of the 2 size, 3 $LTNLEV$, and 3 $STNLEV$ groups, we compute the monthly value-weighted returns of the $2 \times 3 \times 3 = 18$ portfolios. $R_{LTNLEV}$ ($R_{STNLEV}$) is the difference between the average returns on the 6 high and on the 6 low $LTNLEV$ ($STNLEV$) portfolios. Panel A presents results from spanning regressions for $R_{LTNLEV}$ and $R_{STNLEV}$, respectively, and Panel B for their differential, $R_{STNLEV} - R_{LTNLEV}$. In the spanning regressions, we use the Fama-French market (MKTRF), size (SMB), value (HML), profitability (RMW), and investment (CMA) factors, for specifications (i) and (ii) as defined in Fama and French (1993) and for specification (iii) as defined in Fama and French (2015). The $t$-statistics (in square brackets) are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991). Our sample covers all levered, non-financial NYSE, Amex, and NASDAQ firms over the period from 1976 to 2019, in total 964,984 monthly return observations of 10,202 levered firms.

Panel A: Premia for Long-Term and Short-Term Net Leverage

| | $R_{LTNLEV}$ | | | $R_{STNLEV}$ | | |
|---|---|---|---|---|---|---|
| | (i) | (ii) | (iii) | (i) | (ii) | (iii) |
| Intercept | 0.01 | −0.18 | −0.14 | 0.24 | 0.15 | −0.06 |
| | [0.05] | [−2.02] | [−1.45] | [2.31] | [1.44] | [−0.61] |
| MKTRF | −0.15 | −0.06 | −0.07 | −0.01 | 0.03 | 0.09 |
| | [−3.25] | [−2.01] | [−2.02] | [−0.29] | [1.10] | [3.14] |
| SMB | | −0.03 | −0.08 | | −0.03 | 0.09 |
| | | [−0.91] | [−2.01] | | [−0.34] | [1.94] |
| HML | | 0.51 | 0.52 | | 0.23 | 0.08 |
| | | [14.10] | [9.84] | | [3.81] | [1.30] |
| RMW | | | −0.12 | | | 0.37 |
| | | | [−2.21] | | | [4.79] |
| CMA | | | 0.02 | | | 0.28 |
| | | | [0.28] | | | [3.69] |

Panel B: Short-Term minus Long-Term Net Leverage Premium

| | $R_{STNLEV} - R_{LTNLEV}$ | | |
|---|---|---|---|
| | (i) | (ii) | (iii) |
| Intercept | 0.23 | 0.33 | 0.07 |
| | [1.28] | [1.96] | [0.47] |
| MKTRF | 0.14 | 0.09 | 0.15 |
| | [2.36] | [1.70] | [3.11] |
| SMB | | 0.00 | 0.17 |
| | | [0.02] | [2.52] |
| HML | | −0.27 | −0.44 |
| | | [−3.68] | [−4.58] |
| RMW | | | 0.49 |
| | | | [5.19] |
| CMA | | | 0.26 |
| | | | [1.88] |

## Table IA.XII
## Beta and Corporate Bond Bid-Ask Spreads

We present panel regression results at the individual firm level for the relation of bid-ask spreads of corporate bonds to equity beta, $\beta$, and asset beta, $\beta^A = \beta(1 - LEV)$, respectively, where $LEV$ is the firm's leverage ratio. For each dealer and bond we compute the difference between monthly volume-weighted ask and bid prices and scale it by the mid price (i.e., one-half of bid price plus one-half of ask price), and then compute a bond's bid-ask spread as the volume-weighted average across dealers. To obtain firm-level bid-ask spreads, we then take for each firm the average bid-ask spread across its bonds. In Panel A we show results of ordinary least squares (OLS), and in Panel B of weighted-least squares (WLS), where we weight by the market value of equity. The *t*-statistics (in square brackets) are two-way clustered at the firm and year-month level. Corporate bond transactions are obtained from the academic version of the Trade Reporting and Compliance Engine (TRACE) database. The dataset is sampled at a monthly frequency over the period 2003 to 2013, covers non-financial NYSE, Amex, and NASDAQ firms, in total 60,392 monthly bid-ask spread observations of 1,101 firms.

Panel A: OLS

| | Equity Beta | | Asset Beta | |
|---|---|---|---|---|
| | (i) | (ii) | (i) | (ii) |
| $\beta$ | 0.05<br>[3.09] | 0.06<br>[4.12] | | |
| $\beta^A$ | | | 0.06<br>[2.65] | 0.08<br>[3.99] |
| Year-Month FE | | X | | X |

Panel B: WLS

| | Equity Beta | | Asset Beta | |
|---|---|---|---|---|
| | (i) | (ii) | (i) | (ii) |
| $\beta$ | 0.04<br>[2.55] | 0.06<br>[3.85] | | |
| $\beta^A$ | | | 0.05<br>[2.23] | 0.08<br>[3.82] |
| Year-Month FE | | X | | X |