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What Can We Learn About Capital Structure from Bond Credit Spreads?

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ABSTRACT

Bond credit spreads have been shown to reflect the issuing firm's default probability. In an efficient market, spreads will reflect both the firm's current risk and investors' expectations about how that risk level might change in the future. Collin-Dufresne and Goldstein (2001) show analytically that the expected future behavior of a firm's leverage importantly influences the appropriate credit spread on long-term bonds. We implement this insight empirically, by using current information to proxy for investors' expectations about future leverage changes. We find that expected future leverage affects bond credit spreads, and that expectations formed under the trade-off and pecking order theories of capital structure both enjoy empirical support.

I. Introduction

As credit risk modeling has become more formalized, researchers have focused increasing attention on the information content of bond credit spreads. Financial theory indicates that any change in a firm's default risk should be reflected in the prices of its debt claims. Merton (1974) specifies bond credit spreads in terms of a firm's asset volatility, initial leverage, and term to maturity. Subsequent empirical studies have sought to explain credit spreads using (among other things) firm leverage and a variety of proxies for asset volatility (e.g. Collin-Dufresne *et al.* (2001), Krishnan *et al*. (2005), Avramov *et al.* (2005), Campbell and Taksler (2003)). Researchers agree that default risk accounts for at least part of a corporate bond rate's spread over Treasury. Some studies conclude that the spread is entirely caused by default risk (Longstaff *et al.* (2005)) while others assert that taxes (Elton *et al.* (2001)) and liquidity (Chen, Lesmond, and Wei (2005)) also contribute.

Of course, bond prices (credit spreads) should reflect not only current information about a firm's condition, but also changes in investors' expectations about future, firm-specific information. Collin-Dufresne and Goldstein (2001) illustrate how expected future leverage changes affect a credit spread's response to a contemporaneous leverage change. They point out that the credit spreads implied by Merton's (1974) structural model seem to unrealistically small. Merton (1974) assumes that a firm will maintain its current debt level until the debt matures. Because expected asset returns are positive, this implies an expected decline in leverage over time, which generates relatively low expected default losses. Collin-Dufresne and Goldstein (2001) and others recognize that a firm may change its outstanding debt over time, with potentially important effects on the riskiness of today's multi-period debt obligations. By modeling leverage as mean-reverting, they can simulate credit spreads that conform much more closely to those observed in the market. They conclude that "the appropriate credit spread for a corporate bond [reflects]… both the firm's current liability structure, and its right to alter this structure in the future." (p.1930)

Previous empirical studies of credit spreads have not explicitly incorporated investors' expectations about a firm's subsequent condition, most likely because those expectations are unobservable. However, various theories of a firm's capital structure adjustment permit us to incorporate expected future leverage changes into an empirical model of credit spreads. The literature on corporate capital structure suggests (at least) two possible mechanisms for predicting future leverage.[1] First, the ***trade-off theory*** of capital structure maintains that each firm has a value-maximizing, target leverage ratio. Whenever leverage deviates from this target, firms adjust back toward it. With positive adjustment costs, however, firms generally find it more cost effective to approach their target leverage gradually (Leary and Roberts (2005)). The trade-off theory implies that investors should expect a future increase in leverage whenever the firm's leverage is below its target and a decrease whenever the firm's leverage presently exceeds the target. If investors believe firms exhibit trade-off behavior, credit-spread changes should reflect not only contemporaneous leverage changes but also changes in target leverage.

The ***pecking order theory*** of capital structure provides a second mechanism for predicting future leverage changes. If the adverse selection (transaction) costs of issuing risky securities are substantial, firms should prefer to issue debt rather than equity when they need to raise external funds. Conversely, firms with excess internally-generated funds will tend to retire debt in order to preserve future options to borrow again (Lemmon and Zender (2004)). The pecking order

[1] Two additional theories of capital structure have recently emerged, which we are unsure how to implement in the present context. Baker and Wurgler (2002) propose a market-timing theory under which managers issue equity shares whenever these relatively overvalued and thus exploit informational asymmetries to benefit current shareholders. Welch (2004) proposes a managerial inertia theory under which observed changes in leverage are the result of general movements in equity values rather than specific managerial actions.

theory implies no leverage target; leverage simply reflects the past imbalances between internal cash flows and investment opportunities. Under this theory, a financing deficit should be matched dollar-for-dollar by a change in firm debt (Shyam-Sunder and Myers (1999), Lemmon and Zender (2005)). Thus, investors should expect that firms about to face a financing deficit will be increasing their leverage, and hence their probability of default (*ceteris paribus*). Conversely, firms expected to run a financing surplus should be reducing their leverage.

If investors can use current information to form expectations of firms' future leverage, they should price these expectations at the time they are formed. And if investors consider capital structure theories relevant, their implications should be reflected in corporate-bond credit spreads above and beyond current leverage changes. In this study, we examine whether credit spreads reflect investors' expectations of future leverage, and whether these expectations are consistent with the target-adjustment and/or pecking-order theories of capital structure.[2] We use a sample of publicly traded firms with outstanding bonds from 1986 to 1998. We first confirm that credit spread changes can predict leverage changes up to a year before these materialize in a firm's accounting reports. We then investigate whether bondholders' expected leverage changes are consistent with the trade-off and/or pecking-order theories of capital structure. When tested against each other, neither theory seems to dominate as a basis for forming investors' expectations. The financing decisions of our sample firms seem to be characterized by both target-adjustment and pecking-order considerations. Our main results are robust to alternative leverage definitions and alternative methods for forming expectations.

The rest of the study is organized as follows. In Section II we develop our model and derive our main testable hypotheses. Section III describes our data sources and sample selection criteria.

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[2] The traditional ways of testing capital structure theories often encounter unusually challenging econometric obstacles, which cast doubt on the legitimacy of the hypothesis tests.

Section IV presents our empirical findings on how changes in leverage expectations affect credit-spread changes. Section V concludes.

II. A Model of Credit Spreads in the Context of Corporate Financing Decisions

In modeling a firm's credit spread we begin with structural models of default risk. These models are based on the insight of Black and Scholes (1973) and Merton (1974) that limited liability allows for the application of contingent-claim analysis to the valuation of a firm's equity and debt. In structural models, a firm defaults when the firm-value process crosses a default threshold. Thus, variables governing the firm-value process and default threshold will ultimately determine credit spreads and credit-spread changes. We focus on leverage as one such variable and explicitly incorporate the notion that prices of financial assets reflect not only current information but also investors' expectations of changes in this information over the life of the assets. That is, credit-spreads and credit-spread changes should be determined by both contemporaneous leverage changes and by changes in investors' expectations of future leverage. We rely on existing capital structure theories to provide the mechanism through which investors form these leverage expectations.

When firm *i* releases its quarter *t* accounting information, investors assess the firm's default probability and incorporate this information into the credit spreads at time *t*. Default probability depends on current leverage and investors' expectations of future (time *t+1*) leverage. That is,

$$CS_{i,t} = \alpha \cdot LEV_{i,t} + \gamma \cdot E_t LEV_{i,t+1} + \theta \cdot \mathrm{Z}_{\mathrm{i,t}} + \tilde{\omega}_{i,t} \qquad (1)$$

where $CS_{i,t}$ is the i$^{\text{th}}$ firm's credit spread at the end of quarter *t*,

$LEV_{i,t}$ is the ith firm's debt-to-assets ratio, and

$\mathbf{Z_{i,t}}$ is a vector of control variables motivated by structural models of credit risk, as in Collin-Dufresne *et al.* (2001).

Re-writing equation (1) as a difference equation eliminates unobserved, bond-specific features that may affect the credit spread:

$$\Delta CS_{i,t} = \alpha \cdot \Delta LEV_{i,t} + \gamma \cdot \Delta E_t LEV_{i,t+1} + \boldsymbol{\theta} \cdot \boldsymbol{\Delta Z_{i,t}} + \varepsilon_{i,t} \qquad (2)$$

where $\varepsilon_{i,t} = \Delta\tilde{\omega}_{i,t}$.

One naturally expects that $\alpha > 0$: an increase in leverage raises the probability of default and hence the credit spread on outstanding bonds. We also expect that $\gamma > 0$ in (2). Note that α could be zero if investors expected a firm to reverse any leverage change very quickly. However, $\Delta E_t LEV_{i,t+1}$ must carry a nonzero coefficient if investors form expectations about future leverage changes from contemporaneous information. In modeling investors' expectations of future leverage we turn to the two dominant theories of corporate capital structure – a partial-adjustment version of the trade-off theory, and the pecking-order theory.

The ***trade-off theory*** of capital structure argues that firms would select a target leverage ratio by trading off the costs and benefits of debt financing. It is typically assumed that target leverage can vary over time in response to changes in firm characteristics. The partial adjustment modification of the trade-off theory recognizes that leverage adjustments can be costly, which might make it optimal for firms to adjust back to their target partially over several years rather than fully in any given year. In fact, recent studies document adjustment speeds of less than 100 percent consistent with the existence of such adjustment costs (Fama and French (2002), Flannery and Rangan (2006) and Leary and Roberts (2005)). To account for these recent findings, we specify a partial-adjustment model based on Flannery and Rangan (2006) in which target leverage is based on firm characteristics. Each quarter, the target-adjustment hypothesis specifies that a firm will change its leverage in the following manner:

$$LEV_{i,t+1} - LEV_{i,t} = \lambda\left(LEV^{*}_{i,t+1} - LEV_{i,t}\right) + \delta_{i,t+1} \tag{3}$$

where $LEV_{i,t}$ is defined above,

$LEV^{*}_{i,t}$ is firm *i*'s target debt-to-assets ratio at time *t*. $LEV^{*}_{i,t}$ depends on a vector of firm characteristics, described below.

λ is the annual adjustment speed.

In words, the typical firm closes a proportion λ of the distance between its actual and its target leverage every quarter. Under this hypothesis, expected leverage at the end of time t+1 is given by:

$$E_t LEV_{i,t+1} = [\hat{\lambda}\, LEV^{*}_{i,t+1} + (1-\hat{\lambda}\,) \cdot LEV_{i,t}] \tag{4}$$

where $\hat{\lambda}$ is the estimated adjustment speed.

Substituting equation (4) into (2) gives a model of credit-spread changes conditional on the target-adjustment behavior of firm's leverage ratios:

$$\Delta CS_{i,t} = [\alpha + \gamma(1-\hat{\lambda})] \cdot \Delta LEV_{i,t} + [\gamma\hat{\lambda}] \cdot \Delta LEV^{*}_{i,t+1} + \theta \cdot \mathbf{\Delta Z_{i,t}} + \varepsilon_{i,t} \tag{5}$$

If investors form leverage expectations based on the trade-off theory, we anticipate $\gamma > 0$ in (5).

The ***pecking-order theory*** of capital structure proposes an alternative mechanism for forming expectations of a firm's future leverage. The basic idea is that a firm has either excess or surplus cash available during each time period. In particular, we define a firm's net need to raise external funds as

$$FINDEFA_{i,t} = (DIV_{i,t} + I_{i,t} + \Delta W_{i,t} - C_{i,t}) \,/\, Assets_{i,t} \tag{6}$$

where $DIV_{i,t}$ is cash dividends paid during the quarter ending at *t*,

$I_{i,t}$ is net investments during the quarter ending at *t*,

$\Delta W_{i,t}$ is the change in working capital during the quarter ending at *t*,

$C_{i,t}$ is the firm's net cash flow after interest and taxes during quarter *t,* and

$Assets_{i,t}$ is the book value of the firm's assets at the end of quarter t. [3]

As presented by Myers (1984), the pecking order hypothesis is based on a refutable presumption that transaction costs – in particular the asymmetric information component of those costs – are higher on equity issuances than bond issuances. Retained earnings represent the preferred source of investment financing. If high desired investment makes (6) negative, firms strongly prefer to issue external debt. Equity is issued only as a last resort. Shyam-Sunder and Meyers (1999) specify that the pecking order hypothesis should result in leverage changes following the pattern

$$LEV_{i,t+1} - LEV_{i,t} = FINDEFA_{i,t+1} + \delta_{i,t+1}$$

Re-arrange this equation to get an expression for expected future leverage under the pecking order theory:

$$E_t LEV_{i,t+1} = E_t FINDEFA_{i,t+1} + LEV_{i,t} \tag{7}$$

Substituting equation (7) into (2) results in a model of credit-spread changes in which changes in investors' expectations of the firm's financing needs are added to the set of standard structural-model variables:

$$\Delta CS_{i,t} = (\alpha + \gamma) \cdot \Delta LEV_{i,t} + \gamma \cdot \mathbf{\Delta} E_t FINDEFA_{i,t+1} + \boldsymbol{\theta} \cdot \mathbf{\Delta Z_{i,t}} + \varepsilon_{i,t} \tag{8}$$

If investors form expectations based on the pecking-order theory, we anticipate that $\gamma > 0$ in specification (8).

III. Data

This study uses corporate bond data from the Warga-Lehman Brothers Fixed Income Database. The database reports monthly price quotes for the major private and government debt issues traded in the United States. Bond prices are available from January 1973 until March 1998, but

[3] The financing deficit is defined by the following annual Compustat item numbers: DIV [89] + I [91-85-109+90-83+94-112] +ΔW[74-103-104-105-106-107-75-112] – C [76+77+78+79+80+102+82+ 114].

we begin our sample in January 1986 because one of our macro control variables (VIX) is unavailable before that time. We use only actual trader quotes on fixed-rate, coupon-paying bonds issued by U.S. industrial firms.[4] We eliminate secured bonds, those with a call or put feature, and those backed by mortgages/assets. As in Collin-Dufresne *et al.* (2001), we also require that bonds have at least 4 years to maturity or 25 monthly observations during the period 1986 – March 1998.

In order to compute a credit-risk spread, we collect yields on constant-maturity Treasury bonds from the Federal Reserve Board's H.15 releases. For each bond *i*, we define a credit spread ($CS_{i,t}$) as the difference between its yield and the corresponding constant-maturity Treasury yield at the end of month *t*. When there is no precise match, we interpolate to obtain an appropriate Treasury yield. We then retain only the spread observations corresponding to the quarter-ends for which Compustat provides financial information on the issuing firm. We eliminate from our sample observations for which $CS_{i,t}$ is negative or greater than 10%, as these are likely to be data entry errors or bonds in distress (for which a linear model like (2) is unlikely to be appropriate). We define a change in credit spread ($\Delta CS_{i,t}$) as the change in a bond's credit spread between two consecutive quarter ends and winsorize the quarterly $\Delta CS_{i,t}$ observations at the 1st and 99th percentiles to reduce the effect of outliers. Our final sample includes 626 bonds issued by 246 unique firms.

We obtain financial information for each of these 246 firms from the quarterly Compustat file. Our primary leverage measure is defined using the market value of firm assets[5]:

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[4] While most prices reflect "live" trader quotes, some are "matrix" prices estimated from price quotes on bonds with similar characteristics. Sarig and Warga (1989) have shown that these matrix prices can be problematic, so we exclude them from our sample.

[5] Our findings are robust to the use of book-valued assets in place of market valuation.

$$LEV = \left[\frac{Long\ TermDebt\,[51] + Short\ Term\ Debt\,[45]}{Total\ assets\,[44] - Book\ Equity\,[60] + Market\ Equity\,[12*61]} \right]$$

where the numbers in brackets indicate the quarterly Compustat item numbers. Compustat also provides the financial data required to generate investor expectations about a firm's future leverage. (See below.) Consistent with previous capital-structure studies, we convert .nominal accounting values to real 1983 values using the consumer price index. We then mitigate the effect of outliers by winsorizing the raw data and any resulting ratios at the 1st and 99th percentiles.

Finally, we follow Collin-Dufresne, *et al.* (2001) in selecting macroeconomic series to control for bond market conditions (Z_t in equation (1) above):

> R_t^{10} = the 10-year, constant maturity Treasury bond rate at the end of month t
>
> $SLOPE_t$ = the difference between the 10-year and 2-year Treasury yields at the end of month t
>
> VIX_t = the implied volatility of the S&P 100 index, calculated by the Chicago Board of Options Exchange on the basis of historical data on the S&P 100 index options.[6]
>
> $S\,\&\,P_t$ = the return on the S&P 500 index for the quarter ending at t
>
> $JUMP_t$ = the slope of the "smirk" of implied volatilities from options on S&P 500 futures. We calculate this variable as described in Collin-Dufresne *et al.* (2001), using option and futures prices obtained from the Chicago Mercantile Exchange.
>
> $CRPREM_t$ the difference between Moody's average yield on Baa and Aaa-rated bond indices, as a measure of market aversion to default risk.

The treasury and corporate bond rates for these variables are obtained from the Federal Reserve Board's H.15 releases. VIX comes from the Chicago Board of Options Exchange, and the S&P return comes from CRSP.

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6 Strictly speaking, "VIX" refers to the implied volatility in S&P 500 index options, but these data are unavailable before 1990. We therefore use the implied S&P 100 volatility to measure market uncertainty throughout our sample period.

Table 1 provides summary statistics for our final sample of 626 bonds issued by 264 U.S. industrial firms. The average number of quarterly quotes per bond is 18. The average credit spread is 1.11% and the average quarterly credit-spread change is -0.013%. The average market–valued leverage for firms in our sample is 24%, with a mean quarterly change of -0.3%. Book-valued leverage averages 33%, with a mean quarterly change of -0.2%.

IV. Expected Future Leverage and Credit Spreads

A. Do Credit Spreads Predict Leverage Changes?

We begin by testing whether credit-spread changes can predict leverage changes, by regressing leverage changes on lagged credit-spread and leverage changes:

$$\Delta LEV_{i,t} = a_0 + \sum_{k=1}^{3} a_{1k} \Delta CS_{i,t-k} + \sum_{j=1}^{3} a_{2k} \Delta LEV_{i,t-j}$$

The estimated coefficients on ΔCS measure the correlation with future leverage changes after controlling for the contemporaneous leverage change. Table 2 reports the OLS estimation results. The positive coefficients on lagged credit-spread changes suggest that investors do anticipate subsequent leverage changes: a 1% increase in CS corresponds to leverage three quarters later that is about 7% larger.[7] The last two rows of Table 2 indicate that the lagged ΔCS coefficients jointly differ from zero and that their sum is reliably negative (pr < .01). Note that this regression could suffer from reverse causality: a decline in its credit spread might induce a firm to issue additional bonds. However, this effect would be manifested in *negative* coefficients on ΔCS and the estimated coefficients in Table 2 are positive. While the coefficients on ΔCS might underestimate the connection between credit spreads and future leverage, there is no doubt that credit spreads predict subsequent leverage changes. Furthermore, the ΔCS coefficients' size and significance indicate that credit spreads do not reflect near-term (one-quarter ahead) leverage

[7] The coefficients' scale reflects the fact that CS is measured in percentage points (a spread of one percent = 1.0) and leverage is measured as a fraction (0.33 = 33%).

changes, but rather those occurring further in the future.[8] The most important point for our purposes is that credit-spread changes can predict leverage changes up to three quarters into the future. The coefficients on lagged ΔLEV in Table 2 indicate that leverage mean-reverts, as hypothesized by Collin-Dufresne and Goldstein (2001). Approximately 15.8% of any change in LEV is reversed within three quarters. All of these conclusions are robust to the inclusion of bond or firm fixed effects in the regression (not tabulated).

Given this evidence that credit spreads predict subsequent leverage changes, we can test whether bond prices are consistent with alternative bases for investors' leverage-change expectations. Specifically, we test whether the expectations are consistent with the target-adjustment and/or on the pecking-order theories of capital structure. Note that it is possible for both theories to explain investors' reactions to leverage changes as long as some firms behave according to each theory.

B. Tests of the Trade-Off Theory

Equation (5), indicates that credit-spread changes will be affected not only by contemporaneous leverage changes but also by changes in investors' expectations about the firm's target leverage. Because estimating target leverage entails several important econometric difficulties, we use a variety of estimates.

In general, previous researchers have estimated target leverage models that permit targets to vary across firms and over time:

$$LEV^{*}_{i,t+1} = \beta X_{i,t} \tag{9}$$

where $X_{i,t}$ is a vector of firm *i*'s characteristics designed to proxy for the costs and benefits of debt.

[8] When we add a fourth lag of ΔCS to the specification, its coefficient is very small and statistically insignificant (pr = 0.8).

Previous studies have identified a small set of variables related to a firm's target leverage. We use the following set (***X***):

EBIT_TA = earnings before interest and taxes, divided by book assets

MB = the ratio of assets' market to book values

DEP_TA = depreciation expense as a proportion of total assets

Ln(TA) = log of total book assets (a measure of firm size)

FA_TA = fixed assets as a proportion of total assets

R&D_TA = research and development expenses as a proportion of total assets

R&D_DUM = a dummy variable equal to unity when R&D expenditures are not reported; otherwise zero.

IND_Median = the prior quarter's median leverage ratio for the firm's industry. Industries are defined according to Fama and French (1997).

RATED = a dummy variable equal to unity if the firm has a bond rating; otherwise zero.

Table 1 provides summary statistics for these variables.

Flannery and Rangan (2006) and Lemmon *et al.* (2006) assert that partial adjustment is important, and that firm fixed effects (F_i) should be added to the RHS of (9):

$$LEV^*_{i,t+1} = \beta X_{i,t} + F_i \tag{10}$$

Substituting equation (10) into (3) produces the following estimable model:

$$LEV_{i,t+1} = (\lambda \cdot \beta) \cdot X_{i,t} + (1-\lambda) \cdot LEV_{i,t} + \lambda \cdot F_i + \delta_{i,t+1} \tag{11}$$

Equation (11) represents a dynamic panel regression, which cannot be estimated properly using OLS. Following Flannery and Rangan (2006), we therefore substitute a fitted value for the lagged dependent variable, using the lagged book value of leverage and $\mathbf{X_t}$ as instruments (Greene, 2003).[9] The estimation results are presented in column (1) of Table 3. The estimated

[9] In a dynamic panel, the error term in the lagged dependent variable is correlated with the firm fixed effect, yielding downward-biased estimates of (1-λ) in (11). (Ssee Baltagi (2001), chapter 8.) Using an

quarterly adjustment speed of 12.5% implies an annual rate of about 41%. Although this adjustment speed is likely biased upwards, Leary and Roberts (2005) and Flannery and Rangan (2006) document annual adjustment speeds in the 30-40% range. However, this adjustment speed is a matter of considerable uncertainty for econometric reasons. For example, Lemmon *et al*. (2006) and Hankins (2006) report annual adjustment speeds of 20-22% per year.

Given the importance of econometric issues in properly estimating the target leverage ratio, we present results using a variety of target leverage proxies. Column (2) of Table 3 therefore re-estimates equation (9) without the lagged dependent variable. This specification imposes the assumption that the typical firm is *at* its long-run target leverage. The resulting coefficients on the $\mathbf{X_t}$ variables should be compared to the estimated long-run effects $(\hat{\beta})$ from column (1). Column (3) of Table 3 removes the fixed effects from the specification in column (2) and yields broadly similar results. Finally, note that the book leverage results in columns (4) – (6) of Table 2 closely resemble those for market leverage in the first three columns.

We use the estimated, long-run targets implied by the three specifications in Table 2 to form alternative target leverage estimates for each firm in our sample at each point in time. We will also proxy for the leverage target with a lagging average of the firm's own observed leverage, as in Shyam-Sunder and Myers (1999) and others.

Table 4 reports the results of estimating our basic regression for *ΔCS* (equation (5)), using alternative proxies for firm target leverages. Panel A defines leverage using the market value of firm assets; Panel B uses book values. The first column of Table 4, Panel A defines the expected future change in leverage as a change in the firm's long-run target leverage and includes bond

appropriate instrument for the lagged dependent variable eliminates this bias. When the dependent variable is book leverage, we use market leverage as an instrument.

fixed effects.[10] Both ΔLEV and ΔLEV^* are statistically significant at conventional levels. This implies that credit-spread changes are affected not only by contemporaneous leverage changes but also by changes in investors' expectations based on the trade-off theory. The rest of Table 4, Panel A demonstrates that this basic result does not depend on how we estimate leverage targets. Column (2) includes the target leverage computed from the estimated coefficients in column (2) of Table 3, which assumes that the typical firm always operates at its target leverage. Column (3) is based on a target computed without fixed effects, estimated in the third column of Table 3. Columns (4) and (5) of Table 4A specify each firm's target leverage as its average observed leverage over the preceding one or three years. Regardless of how the market-valued target leverage is measured, credit spreads respond significantly to changes in that target, *beyond* their response to contemporaneous leverage changes. Panel B of Table 4 repeats these same regression specifications for book-valued measures of leverage and the leverage target. The control variables are basically unchanged from Panel A, but the estimated effect of contemporaneous leverage on credit spreads has become smaller and (in all cases except column (1)) statistically insignificant.

C. Tests of the Pecking-Order Theory

If bond investors form expectations of future leverage in a manner consistent with the pecking-order theory, then equation (8) implies that credit-spread changes will be affected by changes in investors' expectations about a firm's future financing deficit. We thus need a model for forecasting a firm's future financing deficit:

$$FINDEFA_{i,t+1} = \boldsymbol{\varphi}\mathbf{Y_{i,t}} + \upsilon_{i,t+1} \tag{12}$$

where $\mathbf{Y_{i,t}}$ is a vector of firm *i*'s characteristics at the end of quarter *t.*

[10] Unlike regression (11), (5) includes no lagged dependent variable; estimating (5) as a panel regression involves no bias.

We know of no prior study evaluating the components of $\mathbf{Y_{i,t}}$ and therefore simply include the following firm-specific variables:

- Up to four lags of the dependent variable: $FINDEFA_{i,t-k}$, k=1,4
- An industry dummy, based on the industries defined in Fama and French (1997)
- Current earnings (EBIT) as a proportion of total assets.

The results of these OLS estimations are presented in the first four columns of Table 5, for a variety of included lags of the dependent variable. The first lag of the financing deficit measure has the strongest explanatory power and adding additional lags does not improve the model's fit from an adjusted $R^2 = 0.36$.[11] Column (5) of Table 5 incorporates the data's panel characteristics by adding firm fixed effects to control for unobserved variables that are relatively stable over time for each firm. The resulting coefficient estimates and fit are similar to those in column 4. However, the dynamic panel specification in column (5) might provide biased coefficient estimates on the lagged dependent variable. We re-estimate this regression substituting an instrumental variable for the lagged dependent variable and then report the results in the last column of Table 5. This correction does not materially affect the model's fit or the estimated coefficients.

We treat the fitted values from the six alternative specifications of equation (12) as our measures of financing-deficit expectations and use them to explain credit spread changes via regression specification (8). The results from a panel regression with bond fixed effects are reported in Panel A of Table 6 for market-valued leverage. The coefficient on $\Delta E_t FINDEFA_{t+1}$ is positive and strongly significant in all cases, consistent with the hypothesis that investors adjust their expectations of a firm's future leverage as that firm's expected financing needs change. To put

[11] Adding other accounting variables to equation (12) did not improve the explanatory power of the financing deficit forecasting model.

this differently, investors seem to believe that firms' leverage decisions are affected by their financing deficit or surplus, as implied by the pecking-order theory of capital structure.

Panel B of Table 6 replicates our analysis using book-leverage instead of market-leverage ratios. Unlike Panel A, contemporaneous leverage now shows no significant effect on the change in credit spreads, but the change in expected future leverage remains highly significant. For all six alternative proxies for expected financing deficits, an increase in that deficit raises the market's expected future leverage, and hence raises the observed spread.

One of the problems with measuring firm leverage targets is that CS should be more sensitive to leverage changes when a firm is already highly levered. Moreover, Lemmon and Zender (2004). Argue that debt capacity constraints might prevent highly-levered firms from following the pecking-order theory. Likewise, some firms with extremely low leverage will be unable to reduce leverage further even if they generate financing surpluses. To test whether high leverage is responsible for the significance of LEV* in Table 4, we undertake separate regressions for firms in three leverage groups (terciles). We therefore expect $\Delta E_t FINDEFA_{t+1}$ to be most significant in the middle tercile but may be less so in the extreme terciles. Table 7 reports our results, which are somewhat confusing. Contemporaneous leverage changes affect firms in proportion to their lagged leverage level, consistent with the theory of bonds carrying a default option. However, the changed in expected future leverage ($\Delta E_t FINDEFA_{t+1}$) also increase with the level of firm leverage. It appears that the "top third" of levered firm are not constrained in the manner suggested by Lemmon and Zender (2004), and we cannot explain the negative coefficient on $\Delta E_t FINDEFA_{t+1}$ for the lowest leverage tercile. Clearly, this issue requires further investigation.

D. Joint Tests of the Trade-off and the Pecking-Order Theories

The analysis so far provides individual support for the target-adjustment and pecking-order theories in isolation. However, investors might believe that both theories are important in firms' leverage decisions. We use the following specification to test this possibility:

$$\Delta CS_{i,t} = \alpha \cdot \Delta LEV_{i,t} + \gamma' \cdot \mathbf{\Delta E}_t FINDEFA_{i,t+1} + \gamma'' \cdot \mathbf{\Delta} LEV^*_{i,t+1} + \boldsymbol{\theta} \cdot \mathbf{\Delta Z_{i,t}} + \varepsilon_{i,t} \quad (13)$$

If investors believe largely in the target adjustment model of leverage, we should find that $\Delta LEV^*_{i,t+1}$ carries a positive coefficient while the one on $\Delta E_t FINDEFA_{i,t+1}$ is zero. If instead, investors believe largely in the pecking order model, we should find $\Delta E_t FINDEFA_{i,t+1}$ with the positive coefficient and $\Delta LEV^*_{i,t+1}$ showing no significant effect. If each model applies to a non-trivial number of firms, both estimated coefficients could be non-zero.

Table 8 presents the results from a panel estimation of equation (13) with bond fixed effects. For simplicity, we use the PO6 Model from Table 5 for pecking order expectations in all columns of the Table. Panel A measures leverage in market value terms; Panel B presents book-valued leverage results. In Panel A, both ΔLEV^* and $\Delta E_t FINDEFA_{t+1}$ uniformly carry significantly positive coefficients. This suggests that bond investors consider both the firm's target leverage and its expected financing needs when they form expectations about future leverage . This is consistent with recent evidence that firms might have target debt ratios, but also prefer internal funds to external financing (Hovakimian *et al*. (2001), Hovakimian *et al*. (2004) and Strebulev (2003)). The book leverage results in panel B carry the same implication about investor expectations. Once again, however, the contemporaneous leverage measures have no significant effect on credit spreads.

V. Conclusion

Collin-Dufresne and Goldstein (2001) show that a firm's option to adjust its leverage can have a first-order impact on bond credit spreads. Despite the fact that there is an extensive literature on firms' capital structure decisions, recent studies examining the information contained in bond credit spreads have made no explicit connection to the literature on corporate capital structure.

In this study we examine investors' pricing decisions to infer their beliefs about how firms make capital structure choices. We find that investors' expectations about future leverage changes do significantly affect credit spread changes. There is empirical support for expectations based on both the target-adjustment and pecking-order theories: changes in a firm's target leverage and changes in its expected financing needs both have a positive and significant effect on that firm's bond spreads. A joint test of the two theories is consistent with the hypothesis that investors use information on both target leverage and expected financing deficits when forming expectations about a firm's future leverage.

We intend to explore the implications of bond maturity and firm leverage levels for the conclusions presented here.

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Table 1: Summary Statistics

Summary statistics are on our sample of 626 bonds issued by 246 unique industrial firms. The sample covers the period January 1986 – March 1998 (when the data source ceased publishing).

Variables	Definition	Mean	StdDev	Median	Min	Max
Bond characteristics:						
CS	Credit spread measured as the difference between the bond's yield and the yield on a Treasury with equal maturity (%)	1.11	0.77	0.89	0.10	9.82
ΔCS	Change in credit spread between two consecutive quarter-ends	-0.013	0.224	-0.010	-0.777	0.927
Maturity	Bond maturity in years	12.93	8.27	9.10	4.01	39.73
Duration	Bond duration in years	7.15	2.49	6.47	3.16	13.35
Issue Amount	Bond issue amount still outstanding in $thousands	207,674	133,945	175,000	9,211	1,250,000
Moody's Rating	Moody's credit rating on an ordinal scale with 1=Aaa	7.23	2.59	7.00	1.00	18.00
Leverage-related variables:						
LEV (market)	Book value of debt ([51]+[45]) / (Total assets [44] - Book value of equity[60] + Market value of equity [12*61])	0.24	0.12	0.22	0.00	0.75
ΔLEV (market)	Change in LEV	-0.003	0.024	-0.003	-0.080	0.076
LEV (book)	Book value of debt ([51]+[45]) / Total assets [44]	0.33	0.13	0.32	0.00	0.85
ΔLEV (book)	Change in BLEV	-0.002	0.026	-0.002	-0.094	0.103
FINDEFA	Financing deficit / Total assets [44]	0.01	0.05	0.00	-0.16	0.31
Variables used to predict target leverage:						
EBIT_TA	Earnings before interest and taxes ([8]+[22]+[6]) / Total assets [44]	0.02	0.02	0.02	-0.05	0.09
MB	Book value of debt plus market value of equity ([51]+[45]+[55]+[14]*[61]) / Book value of total assets [44]	1.55	0.55	1.41	0.77	4.14
DEP_TA	Depreciation [5] as a proportion of total assets [44]	0.01	0.01	0.01	0.00	0.03
lnTA	Log of total assets [44], measured in 1983 dollars	22.45	1.13	22.54	18.22	25.56
FA_TA	Property, plant, and equipment [42] / Total assets [44]	0.43	0.21	0.39	0.00	0.92
RD_TA	R&D expenses [4] / Total assets [44]	0.00	0.01	0.00	0.00	0.03
RD_DUM	An indicator variable equal to 1if a firm did not report R&D expenses and equal to 0 otherwise	0.40	0.49	0.00	0.00	1.00
RATED	An indicator variable equal to 1 if the firm has a public debt rating in Compustat and equal to 0 otherwise	0.98	0.14	1.00	0.00	1.00
MVE ($M)	Market value of equity	11,359	16,629	5,284	31	168,574
Macro variables measuring bond market conditions						
ΔR^{10}	Change in the spot rate measured as the 10-year Treasury yield	-0.05	0.55	-0.04	-2.71	2.31
ΔSLOPE	Chang in the slope of the yield curve measured as the difference between the 10-year and 2-year Treasury yields	-0.05	0.27	-0.04	-1.09	1.20
S&P	Quarterly return on the S&P 500	0.04	0.05	0.04	-0.30	0.20
ΔVIX	Change in the implied volatility of the S&P 500 index	0.26	3.80	0.11	-25.86	44.96
ΔJUMP	Change in the slope of the "smirk" of implied volatilities of options on S&P 500 futures	0.00	1.19	0.12	-5.89	6.78
ΔCRPREM	Change in the credit risk premium measured as the difference between the yields on Aaa and Baa rated bonds	-0.01	0.10	0.00	-0.38	0.39

*Winsorizing ΔVIX does significantly alter any of our findings.

Table 2: Predicting leverage changes

Using OLS, we estimate the following model for our sample of 626 bonds over the 1986-1998 period:

$$\Delta LEV_{i,t} = a_0 + \sum_{k=1}^{3} a_{1k} \Delta CS_{i,t-k} + \sum_{j=1}^{3} a_{2k} \Delta LEV_{i,t-j}$$

LEV is the ratio of outstanding debt to the market value of total assets. *CS* is the bond's credit spread. *ΔLEV* and *ΔCS* are the quarterly changes in *LEV* and in *CS*, respectively. Standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

Intercept	-0.003	***
	(0.000)	
ΔCS_{t-1}	0.00055	
	(0.00078)	
ΔCS_{t-2}	0.00164	**
	(0.00078)	
ΔCS_{t-3}	0.00492	***
	(0.00076)	
ΔLEV_{t-1}	-0.073	***
	(0.008)	
ΔLEV_{t-2}	-0.037	***
	(0.008)	
ΔLEV_{t-3}	-0.048	***
	(0.008)	
F-test: $\Delta CS_{t-1} = \Delta CS_{t-2} = \Delta CS_{t-3} = 0$	14.36	***
F-test: $\Delta CS_{t-1} + \Delta CS_{t-2} + \Delta CS_{t-3} = 0$	21.46	***

Table 3: Estimation of Target Leverage

This is an estimation of the following model on the quarterly accounting data for the 246 bond issuers in our sample:

$$LEV_{i,t+1} = (\lambda \cdot \beta) \cdot X_{i,t} + (1-\lambda) \cdot LEV_{i,t} + \lambda \cdot F_i + \delta_{i,t+1} \quad (11)$$

LEV is a debt-to-assets ratio. *EBIT_TA* is earnings before interest and taxes scaled by total assets. *MB* is the ratio of market-to-book value of assets. *DEP_TA* is depreciation expense to total assets. *lnTA* is the natural log of total assets. *FA_TA* is the ratio of fixed-to-total assets. *R&D_DUM* is an indicator variable for whether the firm reports an R&D expenditure or not. *R&D_TA* is R&D expenditures scaled by total assets. *RATED* is an indicator for whether the firm has rated debt. *IND_MED* is the median leverage for each firm's industry. FE is a dynamic panel estimation of the model and uses instruments for the lagged independent variable. FE λ=1 assumes full adjustment towards target every period (i.e. λ=1). BIASED is an OLS estimation. Standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	PANEL A. MARKET LEVERAGE			**PANEL B. BOOK LEVERAGE**		
	(1) FE	**(2) FE λ=1**	**(3) OLS λ=1**	**(4) FE**	**(5) FE λ=1**	**(6) OLS λ=1**
LEV_{t-1}	0.875			0.887		
	(0.004)***			(0.004)***		
$EBIT\_TA_{t-1}$	-0.138	-0.872	-1.314	-0.120	-0.860	-1.215
	(0.019)***	(0.036)***	(0.056)***	(0.021)***	(0.042)***	(0.067)***
MB_{t-1}	-0.002	-0.046	-0.041	0.000	0.005	0.011
	(0.001)*	(0.002)***	(0.002)***	(0.001)	(0.002)***	(0.002)***
DEP_TA_{t-1}	-0.117	-0.521	0.501	0.031	-0.077	0.978
	(0.067)*	(0.134)***	(0.187)***	(0.076)	(0.153)	(0.202)***
$lnTA_{t-1}$	0.000	0.011	0.002	-0.002	-0.001	-0.001
	(0.001)	(0.001)***	(0.001)**	(0.001)***	(0.002)	(0.001)***
FA_TA_{t-1}	0.022	0.102	0.038	0.018	0.077	0.044
	(0.004)***	(0.008)***	(0.006)***	(0.005)***	(0.010)***	(0.007)***
$R\&D\_DUM_{t-1}$	0.002	-0.003	0.025	-0.004	-0.023	0.005
	(0.002)	(0.005)	(0.004)***	(0.003)	(0.005)***	(0.004)
$R\&D\_TA_{t-1}$	0.019	-0.865	-1.677	-0.241	-2.301	-4.142
	(0.152)	(0.305)***	(0.239)***	(0.173)	(0.349)***	(0.278)***
$RATED_{t-1}$	0.001	0.005	0.015	0.008	0.028	0.023
	(0.001)	(0.002)***	(0.002)***	(0.001)***	(0.002)***	(0.003)***
IND_MED_{t-1}	0.014	0.472	0.609	-0.009	0.394	0.690
	(0.006)**	(0.010)***	(0.014)***	(0.006)	(0.011)***	(0.016)***
Constant	0.019	-0.025	0.103	0.066	0.182	0.091
	(0.012)	(0.024)	(0.014)***	(0.013)***	(0.027)***	(0.016)***
Observations	17031	17031	17031	17173	17173	17173
R^2	0.92	0.33	0.36	0.92	0.28	0.30

Table 4: Tests of the Target-adjustment Theory

This is a panel estimation with bond fixed effects of the following model on the sample of 626 bonds from 1986 to 1998:

$$\Delta CS_{i,t} = [\alpha + \gamma(1-\hat{\lambda})] \cdot \Delta LEV_{i,t} + [\gamma\hat{\lambda}] \cdot \Delta LEV^{*}_{i,t+1} + \theta \cdot \mathbf{\Delta Z_{i,t}} + \varepsilon_{i,t} \quad (5)$$

ΔCS=change in bond credit spreads. ΔLEV=change in debt-to-assets ratio. ΔLEV*=change in target debt-to-assets ratio. ΔZ includes the following structural-model motivated variables: ΔR=change in the spot rate measured by the 10-year Treasury yield. ΔSLOPE=change in the slope of the yield curve measured as the difference between 10-year and 2-year Treasury yields. ΔVIX=change in the implied volatility on the S&P 500 index. S&P=quarterly S&P 500 return. ΔJUMP=change in the slope of the "smirk" of implied volatilities of options on S&P 500 futures. ΔCRPREM=change in the spread between the yield on Aaa and Baa-rated bonds. Changes are measured over consecutive quarters. FE is a dynamic panel estimation of the base model and uses instruments for the lagged independent variable. FE λ=1 assumes that the adjustment speed is unity. BIASED is an OLS estimation. TRAIL 1 YR and TRAIL 3 YR use the 1-year and 3-year trailing average of that firm's leverage as a measure of its leverage target. Standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	PANEL A. MARKET LEVERAGE				
	(1) FE	**(2) FE λ=1**	**(3) OLS λ=1**	**(4) TRAIL 1 YR**	**(5) TRAIL 3 YR**
$\Delta LEV_{i,t}$	0.541	0.481	0.818	0.331	0.444
	(0.142)***	(0.142)***	(0.157)***	(0.141)**	(0.141)***
$\Delta LEV^{*}_{i,t+1}$	0.298	0.461	0.242	1.348	2.761
	(0.135)**	(0.145)***	(0.095)**	(0.243)***	(0.381)***
ΔR_t^{10}	-0.116	-0.116	-0.114	-0.116	-0.114
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***
$(\Delta R_t^{10})^2$	0.096	0.096	0.097	0.097	0.096
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***
$\Delta SLOPE_t$	-0.127	-0.126	-0.127	-0.130	-0.135
	(0.008)***	(0.008)***	(0.008)***	(0.008)***	(0.008)***
ΔVIX_t	0.005	0.005	0.005	0.005	0.006
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
$S\&P$	-0.002	-0.002	-0.002	-0.002	-0.001
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)**
$\Delta JUMP$	0.023	0.023	0.023	0.023	0.024
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
$\Delta CRPREM_t$	0.296	0.297	0.295	0.301	0.305
	(0.033)***	(0.033)***	(0.033)***	(0.033)***	(0.033)***
Intercept	-0.045	-0.045	-0.045	-0.044	-0.045
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Observations	10618	10618	10631	10843	10843
R^2	0.13	0.13	0.13	0.13	0.13

Table 4: Tests of the Target-adjustment Theory (Cont.)

	PANEL B. BOOK LEVERAGE				
	(1) **FE**	**(2)** **FE λ=1**	**(3)** **OLS λ=1**	**(4)** **TRAIL 1 YR**	**(5)** **TRAIL 3 YR**
$\Delta LEV_{i,t}$	0.176 (0.085)**	0.135 (0.084)	0.113 (0.094)	0.093 (0.090)	0.108 (0.087)
$\Delta LEV^*_{i,t+1}$	0.306 (0.143)**	0.373 (0.135)***	0.212 (0.089)**	0.592 (0.170)***	1.863 (0.359)***
ΔR_t^{10}	-0.117 (0.006)***	-0.117 (0.006)***	-0.115 (0.006)***	-0.118 (0.006)***	-0.117 (0.006)***
$(\Delta R_t^{10})^2$	0.095 (0.007)***	0.095 (0.007)***	0.093 (0.007)***	0.095 (0.007)***	0.094 (0.007)***
$\Delta SLOPE_t$	-0.127 (0.008)***	-0.126 (0.008)***	-0.119 (0.008)***	-0.127 (0.008)***	-0.130 (0.008)***
ΔVIX_t	0.005 (0.001)***	0.005 (0.001)***	0.005 (0.001)***	0.005 (0.001)***	0.006 (0.001)***
$S\&P$	-0.002 (0.001)***	-0.002 (0.001)***	-0.002 (0.001)***	-0.002 (0.001)***	-0.002 (0.001)***
$\Delta JUMP$	0.023 (0.002)***	0.023 (0.002)***	0.024 (0.002)***	0.023 (0.002)***	0.023 (0.002)***
$\Delta CRPREM_t$	0.297 (0.033)***	0.298 (0.033)***	0.301 (0.034)***	0.301 (0.033)***	0.307 (0.033)***
Intercept	-0.043 (0.003)***	-0.043 (0.003)***	-0.043 (0.003)***	-0.043 (0.003)***	-0.045 (0.003)***
Observations	10630	10630	10160	10843	10843
R^2	0.12	0.12	0.12	0.12	0.12

Table 5: Estimation of Expected Financing Deficit

This is an estimation of the following model on the sample of 626 bonds from 1986 to 1998:

$$FINDEFA_{i,t+1} = \boldsymbol{\varphi}\mathbf{Y_{i,t}} + \upsilon_{i,t+1} \quad (12)$$

FINDEFA is a measure of financing deficit scaled by total assets. **Y** is a vector of firm characteristics, which includes the following variables in addition to lags of *FINDEFA*. *IND_DUM* is an industry indicator variable based on the Fama-French 47 industry categorizations. *EBIT_TA* is earnings before interest and taxes scaled by total assets. PO1-PO4 are OLS estimations of the model. PO5 is a panel estimation that includes bond fixed effects. PO6 is a dynamic panel estimation with bond fixed effects and instruments for the lagged independent variable. Standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
$FINDEFA_{i,t-1}$	0.568 (0.018)***	0.576 (0.018)***	0.588 (0.017)***	0.591 (0.015)***	0.531 (0.008)***	0.467 (0.015)***
$FINDEFA_{i,t-2}$	-0.018 (0.017)	-0.024 (0.017)	-0.003 (0.015)			
$FINDEFA_{i,t-3}$	-0.027 (0.015)*	0.037 (0.013)***				
$FINDEFA_{i,t-4}$	0.103 (0.013)***					
$IND\ DUM_{t-1}$	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)	0.000 (0.000)*
$EBIT\_TA_{t-1}$	-0.047 (0.026)*	-0.051 (0.025)**	-0.042 (0.026)*	-0.022 (0.026)	0.022 (0.027)	-0.007 (0.026)
Intercept	0.002 (0.001)*	0.002 (0.001)*	0.002 (0.001)*	0.002 (0.001)	-0.002 (0.005)	-0.002 (0.005)
Observations	11201	11443	11705	11950	11950	11705
R^2	0.35	0.35	0.36	0.36	0.35	0.36

Table 6: Tests of the Pecking-order Theory

This is a panel estimation with bond fixed effects of the following model on the sample of 626 bonds from 1986 to 1998:

$$\Delta CS_{i,t} = (\alpha + \gamma) \cdot \Delta LEV_{i,t} + \gamma \cdot \mathbf{\Delta} E_t FINDEFA_{i,t+1} + \boldsymbol{\theta} \cdot \mathbf{\Delta Z_{i,t}} + \varepsilon_{i,t} \qquad (8)$$

ΔCS=change in bond credit spreads. ΔLEV=change in debt-to-assets ratio. ΔE FINDEFA=change in expected financing deficit scaled by total assets. ΔZ includes the following structural-model motivated variables: ΔR=change in the spot rate measured by the 10-year Treasury yield. ΔSLOPE=change in the slope of the yield curve measured as the difference between 10-year and 2-year Treasury yields. ΔVIX=change in the implied volatility on the S&P 500 index. S&P=quarterly S&P 500 return. ΔJUMP=change in the slope of the "smirk" of implied volatilities of options on S&P 500 futures. ΔCRPREM=change in the spread between the yield on Aaa and Baa-rated bonds. Changes are measured over consecutive quarters. Standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	PANEL A. MARKET LEVERAGE					
Prosy for FINDEFA	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
$\Delta LEV_{i,t}$	0.481	0.465	0.462	0.462	0.465	0.464
	(0.148)***	(0.147)***	(0.147)***	(0.147)***	(0.148)***	(0.147)***
$\mathbf{\Delta} E_t FINDEFA_{i,t+1}$	0.312	0.384	0.385	0.382	0.416	0.479
	(0.095)***	(0.099)***	(0.098)***	(0.097)***	(0.108)***	(0.123)***
ΔR_t^{10}	-0.116	-0.116	-0.116	-0.116	-0.116	-0.116
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***
$(\Delta R_t^{10})^2$	0.095	0.095	0.095	0.095	0.095	0.095
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***
$\Delta SLOPE_t$	-0.127	-0.127	-0.127	-0.127	-0.127	-0.127
	(0.008)***	(0.008)***	(0.008)***	(0.008)***	(0.008)***	(0.008)***
ΔVIX_t	0.005	0.005	0.005	0.005	0.005	0.005
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
$S\&P_t$	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
$\Delta JUMP_t$	0.023	0.023	0.023	0.023	0.023	0.023
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
$\Delta CRPREM_t$	0.301	0.301	0.301	0.301	0.301	0.301
	(0.033)***	(0.033)***	(0.033)***	(0.033)***	(0.033)***	(0.033)***
Intercept	-0.043	-0.043	-0.043	-0.043	-0.043	-0.043
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Observations	10843	10843	10843	10843	10843	10843
R^2	0.13	0.13	0.13	0.13	0.13	0.13

Table 6: Tests of the Pecking-order Theory (Cont.)

Prosy for FINDEFA	PANEL B. BOOK LEVERAGE PO1	PO2	PO3	PO4	PO5	PO6
$\Delta LEV_{i,t}$	0.094 (0.088)	0.079 (0.088)	0.077 (0.088)	0.078 (0.088)	0.081 (0.088)	0.079 (0.088)
$\Delta E_t FINDEFA_{i,t+1}$	0.414 (0.093)***	0.485 (0.097)***	0.485 (0.096)***	0.482 (0.095)***	0.527 (0.105)***	0.606 (0.120)***
ΔR_t^{10}	-0.118 (0.006)***	-0.118 (0.006)***	-0.118 (0.006)***	-0.118 (0.006)***	-0.118 (0.006)***	-0.118 (0.006)***
$(\Delta R_t^{10})^2$	0.094 (0.007)***	0.094 (0.007)***	0.094 (0.007)***	0.094 (0.007)***	0.094 (0.007)***	0.094 (0.007)***
$\Delta SLOPE_t$	-0.127 (0.008)***	-0.127 (0.008)***	-0.127 (0.008)***	-0.127 (0.008)***	-0.127 (0.008)***	-0.127 (0.008)***
ΔVIX_t	0.005 (0.001)***	0.005 (0.001)***	0.005 (0.001)***	0.005 (0.001)***	0.005 (0.001)***	0.005 (0.001)***
$S\&P_t$	-0.003 (0.001)***	-0.003 (0.001)***	-0.003 (0.001)***	-0.003 (0.001)***	-0.003 (0.001)***	-0.003 (0.001)***
$\Delta JUMP_t$	0.023 (0.002)***	0.023 (0.002)***	0.023 (0.002)***	0.023 (0.002)***	0.023 (0.002)***	0.023 (0.002)***
$\Delta CRPREM_t$	0.302 (0.033)***	0.302 (0.033)***	0.301 (0.033)***	0.301 (0.033)***	0.302 (0.033)***	0.302 (0.033)***
Intercept	-0.042 (0.003)***	-0.042 (0.003)***	-0.042 (0.003)***	-0.042 (0.003)***	-0.042 (0.003)***	-0.042 (0.003)***
Observations	10843	10843	10843	10843	10843	10843
R^2	0.12	0.12	0.12	0.12	0.12	0.12

Table 7: Tests of Pecking-order Theory by Lagged Leverage Terciles

This is a panel estimation with bond fixed effects of the following model by lagged leverage terciles:

$$\Delta CS_{i,t} = (\alpha + \gamma) \cdot \Delta LEV_{i,t} + \gamma \cdot \mathbf{\Delta} E_t FINDEFA_{i,t+1} + \boldsymbol{\theta} \cdot \mathbf{\Delta Z_{i,t}} + \varepsilon_{i,t} \quad (8)$$

It uses the sample of 626 bonds from 1986 to 1998. ΔCS=change in bond credit spreads. ΔLEV=change in market debt-to-assets ratio. ΔE FINDEFA=change in expected financing deficit scaled by total assets as estimated by model PO1 above. ΔZ includes the following structural-model motivated variables: ΔR=change in the spot rate measured by the 10-year Treasury yield. ΔSLOPE=change in the slope of the yield curve measured as the difference between 10-year and 2-year Treasury yields. ΔVIX=change in the implied volatility on the S&P 500 index. S&P=quarterly S&P 500 return. ΔJUMP=change in the slope of the "smirk" of implied volatilities of options on S&P 500 futures. ΔCRPREM=change in the spread between the yield on Aaa and Baa-rated bonds. Changes are measured over consecutive quarters. T-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	Low Leverage	Middle Leverage	High Leverage
$\Delta LEV_{i,t}$	0.531	0.815	1.247
	(3.19)***	(4.20)***	(4.00)***
$\mathbf{\Delta} E_t FINDEFA_{i,t+1}$	-0.388	0.251	0.570
	(3.72)***	(1.82)*	(3.39)***
ΔR_t^{10}	-0.065	-0.072	-0.205
	(10.53)***	(10.65)***	(14.99)***
$(\Delta R_t^{10})^2$	0.064	0.087	0.123
	(7.24)***	(7.89)***	(7.55)***
$\Delta SLOPE_t$	-0.097	-0.112	-0.208
	(8.77)***	(8.55)***	(11.07)***
ΔVIX_t	0.005	0.006	0.005
	(7.19)***	(7.05)***	(3.93)***
$S\&P_t$	-0.001	0.001	-0.004
	(2.07)**	(1.70)*	(3.08)***
$\Delta JUMP_t$	0.014	0.026	0.025
	(4.66)***	(8.43)***	(5.03)***
$\Delta CRPREM_t$	0.099	0.298	0.448
	(2.36)**	(6.50)***	(7.45)***
Intercept	-0.033	-0.059	-0.037
	(8.03)***	(14.00)***	(5.34)***
Observations	3563	3633	3647
R^2	0.12	0.13	0.18

Table 8: Joint Tests of Target-adjustment and Pecking-order Theories

This is a panel estimation with bond fixed effects of the following model on the sample of 626 bonds from 1986 to 1998:

$$\Delta CS_{i,t} = \alpha \cdot \Delta LEV_{i,t} + \gamma' \cdot \mathbf{\Delta} E_t FINDEFA_{i,t+1} + \gamma'' \cdot \mathbf{\Delta} LEV^*_{i,t+1} + \boldsymbol{\theta} \cdot \mathbf{\Delta Z_{i,t}} + \varepsilon_{i,t} \qquad (13)$$

ΔCS=change in bond credit spreads. ΔLEV=change in debt-to-assets ratio. ΔLEV*=change in target debt-to-assets ratio. ΔE FINDEFA=change in expected financing deficit scaled by total assets. ΔZ includes the following structural-model motivated variables: ΔR=change in the spot rate measured by the 10-year Treasury yield. ΔSLOPE=change in the slope of the yield curve measured as the difference between 10-year and 2-year Treasury yields. ΔVIX=change in the implied volatility on the S&P 500 index. S&P=quarterly S&P 500 return. ΔJUMP=change in the slope of the "smirk" of implied volatilities of options on S&P 500 futures. ΔCRPREM=change in the spread between the yield on Aaa and Baa-rated bonds. Changes are measured over consecutive quarters. Standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	PANEL A. MARKET LEVERAGE				
	FE	**FE λ=1**	**OLS λ=1**	**TRAIL 1 YR**	**TRAIL 3 YR**
$\Delta LEV_{i,t}$	0.454	0.414	0.730	0.215	0.343
	(0.148)***	(0.148)***	(0.161)***	(0.147)	(0.146)**
$\Delta LEV^*_{i,t+1}$	0.294	0.238	0.240	1.436	2.860
	(0.135)**	(0.089)***	(0.094)**	(0.245)***	(0.388)***
$\mathbf{\Delta} E_t FINDEFA_{i,t+1}$	0.422	0.419	0.391	0.491	0.469
	(0.110)***	(0.110)***	(0.106)***	(0.109)***	(0.110)***
ΔR_t^{10}	-0.116	-0.116	-0.114	-0.116	-0.114
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***
$(\Delta R_t^{10})^2$	0.096	0.096	0.096	0.097	0.096
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***
$\Delta SLOPE_t$	-0.128	-0.128	-0.128	-0.131	-0.137
	(0.008)***	(0.008)***	(0.008)***	(0.008)***	(0.008)***
ΔVIX_t	0.005	0.005	0.005	0.005	0.006
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
$S\&P_t$	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
$\Delta JUMP$	0.023	0.023	0.023	0.023	0.024
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
$\Delta CRPREM_t$	0.296	0.297	0.295	0.301	0.305
	(0.033)***	(0.033)***	(0.033)***	(0.033)***	(0.033)***
Intercept	-0.044	-0.045	-0.044	-0.043	-0.045
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Observations	10618	10618	10631	10843	10843
R^2	0.13	0.13	0.13	0.13	0.13

Table 8: Joint Tests of Target-adjustment and Pecking-order Theories (Cont.)

	PANEL B. BOOK LEVERAGE				
	FE	FE λ=1	OLS λ=1	TRAIL 1 YR	TRAIL 3 YR
$\Delta LEV_{i,t}$	0.079	0.040	0.032	-0.022	0.004
	(0.089)	(0.087)	(0.091)	(0.095)	(0.091)
$\Delta LEV^{*}_{i,t+1}$	0.319	0.376	0.211	0.695	1.971
	(0.143)**	(0.135)***	(0.089)**	(0.172)***	(0.365)***
$\Delta E_t FINDEFA_{i,t+1}$	0.553	0.549	0.586	0.578	0.569
	(0.109)***	(0.108)***	(0.107)***	(0.108)***	(0.108)***
ΔR_t^{10}	-0.117	-0.117	-0.115	-0.117	-0.117
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***
$(\Delta R_t^{10})^2$	0.095	0.095	0.093	0.095	0.094
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***
$\Delta SLOPE_t$	-0.128	-0.128	-0.120	-0.130	-0.133
	(0.008)***	(0.008)***	(0.008)***	(0.008)***	(0.008)***
ΔVIX_t	0.005	0.005	0.005	0.005	0.006
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
$S\&P_t$	-0.002	-0.003	-0.002	-0.003	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
$\Delta JUMP_t$	0.023	0.023	0.024	0.023	0.023
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
$\Delta CRPREM_t$	0.296	0.297	0.299	0.300	0.306
	(0.033)***	(0.033)***	(0.034)***	(0.033)***	(0.033)***
Intercept	-0.043	-0.043	-0.042	-0.043	-0.044
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Observations	10630	10630	10160	10843	10843
R^2	0.12	0.12	0.12	0.13	0.13