THE JOURNAL OF FINANCE • VOL. LX, NO. 3 • JUNE 2005

Are Firms Underleveraged? An Examination of the Effect of Leverage on Default Probabilities

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ABSTRACT

A commonly held view in corporate finance is that firms are less leveraged than they should be, given the potentially large tax benefits of debt. In this paper, I study the effect of firms' leverage on default probabilities as represented by the firms' ratings. Using an instrumental variable approach, I find that the leverage's effect on ratings is three times stronger than it is if the endogeneity of leverage is ignored. This stronger effect results in a higher impact of leverage on the ex ante costs of financial distress, which can offset the current estimates of the tax benefits of debt.

EVER SINCE MODIGLIANI AND MILLER (1963), A central question in corporate finance asks why, if debt provides a large tax advantage, do firms not use debt more intensively?[1] Graham (2000) finds that by leveraging up to the point at which the marginal tax benefits begin to decline, a typical firm could add 7.5% to firm value, after netting out the personal tax penalty. So why are firms not more leveraged?

According to the traditional trade-off theory of capital structure, the (ex ante) costs of financial distress should offset the benefits of the tax shields. The

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[1] The research on agency costs (Jensen and Meckling (1976), Myers (1977)), information asymmetries (Myers and Majluf (1984)), and three American Finance Association presidential addresses (Miller (1977), Myers (1984), and Leland (1998)) demonstrate the attention this issue has attracted. More recently, Lemmon and Zender (2001), Minton and Wruck (2001), and Faulkender and Petersen (2004) investigate whether firms are indeed underleveraged or whether there are alternative explanations. The underleverage discussion also has arisen among practitioners (e.g., The Economist (2001)).

literature has made a considerable effort to estimate the benefits and costs of debt. However, while Graham's (2000) estimate for the expected tax benefits of debt appears reasonable, current estimates of financial distress costs (or indirect costs of bankruptcy) are less satisfactory because they measure the costs ex post on a sample of already distressed or defaulted firms.[2] Hence, to be compared with the potential benefits of debt, previous estimates of (ex post) costs of financial distress must be multiplied by the probability of encountering distress.

In this paper, I present an alternative measure of the ex ante costs of financial distress. I estimate the effect of an increase in a firm's leverage on the default probability represented by the firm's rating. I then multiply previous estimates of ex post costs of financial distress by the estimated effect of leverage on the firm's default probability, providing a measure of the ex ante costs of financial distress that is comparable to the current estimates of the tax benefits of debt.

However, the estimation of the effect of leverage on default probabilities requires the explicit consideration of the potential endogeneity of leverage. In particular, I consider a firm's rating as proxy for its default probability. I then argue that the endogeneity of leverage occurs because leverage and ratings are jointly determined when affected by exogenous and unobservable shocks to the firm's fundamental risk.[3] Ignoring the endogenous nature of leverage can lead to an underestimation of its effect on ratings, and consequently to an underestimation of the costs of financial distress. In fact, my estimates suggest that the effect of leverage on ratings is substantially stronger (up to three times) when I consider the endogeneity. This larger estimate translates an increase in a firm's leverage into an increase in the firm's ex ante costs of financial distress, which largely offsets the tax benefits that, as calculated in Graham (2000), the firm can obtain by leveraging up.

To see how ignoring the endogeneity can cause an underestimation of the impact of a leverage increase on ratings, I consider the following situation. If a decrease in the firm's fundamental risk occurs, the firm's prospects improve, which leads rating agencies to upgrade the firm's rating. Such a decrease in the firm's risk simultaneously allows the firm to increase its leverage, which in turn negatively affects the firm's rating. Therefore, the total impact of a risk reduction on ratings has two components: a rating upgrade directly from the firm's risk reduction, and a rating downgrade from the leverage increase induced by the risk reduction. The rating upgrade from the risk reduction partly offsets the downgrade from the increased leverage, making the total rating downgrade appear less significant than it really is.

[2] For instance, Altman (1984) considers a sample of firms prior to bankruptcy, finding that the costs of financial distress range from 11 to 17% of the firms' value up to 3 years before default. Andrade and Kaplan (1998) show that the costs of distress amount to 10 to 23% of firms' value for a group of highly leveraged firms. Alderson and Betker (1995) find that liquidation costs are on average 35% of a firm's going-concern value under restructuring, in a sample of defaulted firms.

[3] The results in Graham and Harvey's (2001) survey are consistent with the view that leverage and ratings are jointly determined; managers refer to ratings as one of the most important factors that they take into account when making capital structure decisions.

To disentangle the direct effect of leverage on ratings, I use an instrumental variable approach that accounts for the endogeneity of the leverage-rating relation. As instruments, I use two variables that significantly affect leverage, yet seem reasonably unrelated to ratings. These variables are the history of firms' past market valuations (Baker and Wurgler (2002)) and the firms' marginal tax rates (Graham (1996a, 1996b)). The instrumental variable estimates for the effect of leverage on ratings are robust to the use of any of these instruments.

The stronger effect of leverage on ratings, which I obtain by instrumenting leverage, is consistent with the actual variation of leverage ratios across rating categories. For instance, if an average firm in my sample, rated BBB with a leverage ratio of 0.27, increases its leverage by 0.08, its rating is downgraded by one category. This leverage's increase corresponds to the actual difference in leverage between BBB and BB firms. This correspondence with the actual variations of leverage ratios adds to the trade-off between the ex ante costs of financial distress and the tax benefits of debt described in this paper, contributing to an explaination of why firms use the amount of leverage that they do.

I also investigate whether the effect of leverage on ratings is present across all firms with the same intensity. Graham and Rogers (2002) and Leland (1998) show that risk-management activities impact firms' debt choice and can cause a firm engaged in risk management to respond differently to a change in its fundamental risk. Korajczyk and Levy (2003) find that only unconstrained firms are able to adjust their capital structures to time their issue choice. Baker, Stein, and Wurgler (2003) provide a rationale for why endogeneity might be less severe when firms are financially constrained (or equity dependent).

I examine these issues by separating firms according to their level of hedging activity and financial constraints. Consistent with previous arguments, I find that the impact of leverage on ratings is stronger when firms do not hedge and when firms are unconstrained. Moreover, I find that the effect of endogeneity is weakened when firms are engaged in risk management activities or are financially constrained.

The approach followed in this paper to address the underleverage question is similar to the approach that has been used to deal with other puzzles in corporate finance in which endogeneity can be central. For example, Chevalier (2004), Lamont and Polk (2001), Campa and Kedia (2002), and Graham, Lemmon, and Wolf (2002) argue that to a large extent selection bias can explain the previously documented diversification discount. Himmelberg, Hubbard, and Palia (1999) conclude that the effect of managerial ownership on firm performance is not apparent when the endogeneity in this relationship is considered. Goyal, Lehn, and Racic (2002) use a focused sample of defense firms to infer a causal relation between a firm's growth opportunities and its debt policy, taking into account that they may be jointly determined. Johnson (2003) uses a simultaneous equation approach to find that shorter debt maturity attenuates the negative effect of growth opportunities on leverage.

This paper is organized as follows. Section I proposes an empirical framework to estimate the impact of leverage on default probabilities. Section II describes the data sample and the variables I use. Section III reports the results for the econometric implementation proposed. Section IV presents an estimation of the ex ante costs of financial distress to address the underleverage question. Section V presents the robustness checks. Section VI examines the leverage impact on ratings when firms engage in hedging activities and when firms are financially constrained. Section VII concludes.

I. Empirical Framework

A. The Leverage-Rating Relation

Although it is widely accepted that a firm's leverage affects its bond ratings (and its probability of default), the empirical relation between these two variables has not been carefully examined, in that previous research on ratings has neglected the fact that leverage is an endogenous variable and has not suggested any source of exogenous variation that allows the true impact of leverage on ratings to be identified.[4]

To see how ignoring the leverage endogeneity can cause underestimation of the impact of a leverage increase on ratings (risk of default), and therefore on the ex ante financial distress costs, consider the following situation. Suppose that leverage and ratings are jointly affected by exogenous and unobservable shocks to the firm's fundamental risk. These shocks are unobservable to outsiders (specifically, to the econometrician) but can capture at least part of what the rating agencies call their subjective judgment. In this case, if I try to estimate the effect of leverage on ratings by using a reduced form estimation—which ignores the source of variation that is producing the change in ratings and leverage—the estimation will be biased. The bias will depend on the interaction of the firm's fundamental risk with the firm's leverage and rating. However, it is reasonable to argue that the impact of leverage on ratings is likely to be underestimated by the reduced form regression.

To understand why a negative bias is likely to occur, I consider the following. First, a change in a firm's risk negatively affects the amount of debt that the firm can support,[5] and a change in leverage induced by a risk adjustment, negatively affects the firm's rating (Ederington and Yawitz (1987)). Second, the change in a firm's risk also affects debt ratings directly, because rating agencies use ratings to represent the fundamental risk of the firm. Therefore, risk affects ratings both directly and through leverage (see Figure 1). Thus, I can

[4] The rating literature has focused on rating predictions and market reactions to rating changes (see Ederington and Yawitz (1987) for a survey). Kaplan and Urwitz (1979) and Ederington et al. (1987) include leverage measures in models to predict ratings. Their reported coefficients for leverage are comparable with those presented in the reduced form regressions of Section III that ignore the endogeneity of leverage.

[5] The negative effect that risk has on leverage has been documented in the literature. Castanias (1983) finds a negative relation between default probabilities and leverage. Confirming Castanias' results, Marsh (1982) and Bradley, Jarrell, and Kim (1984) find that firms with higher earnings volatility have less leverage. Titman and Wessels (1988) expect a negative effect, but using earnings volatility, they find only a weak negative relationship. Harris and Raviv (1991) present a summary of the evidence.

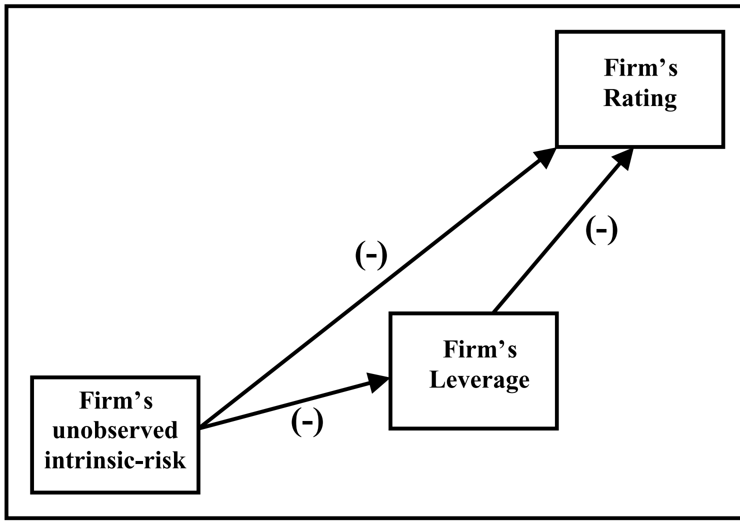

Figure 1. Leverage-rating endogenous relation. The firm's unobserved intrinsic risk affects both directly and simultaneously the firm's leverage and rating. The effect of this intrinsic risk on the leverage and the rating is negative. Higher intrinsic risk induces leverage reductions and rating downgrades. At the same time, the leverage affects the rating negatively. A leverage reduction produces a rating upgrade, resulting in an endogenous relation between leverage and rating.

argue that a decrease in the firm's fundamental risk has two components that offset each other: a rating upgrade directly from the firm's risk reduction and a rating downgrade from the leverage increase (induced by the risk reduction). Therefore, if I want to disentangle the direct impact of a leverage change on the firm's rating, I must first take into account the reason for the leverage increase.

In a different context, the literature on contingent claims models of firms' capital structures (Leland (1994), Leland and Toft (1996), Leland (1998), Titman and Tsyplakov (2003)) predicts optimal levels of leverage by maximizing the firm's value with respect to leverage. These models measure risk as the assets' volatility and, except for Leland (1998), consider risk as exogenously given. Leland (1998) analyzes the interaction between the capital structure and risk-level choices, allowing firms to choose risk endogenously; a firm may impact its risk by engaging in risk management practices. In contrast, my approach empirically estimates the impact of leverage on ratings (probability of default), considering the firm's unobservable fundamental risk to be endogenous.[6] I contribute to an explanation of the observed leverage levels without explicitly calculating an optimal level of leverage. In any case, the effect of a leverage increase on the probabilities of default proposed in this paper can be related to the relation between leverage and risk of default predicted in this strand of the literature.

[6] In Section VI.A, I follow Leland (1998) and expand my approach to consider the impact of risk management activities.

B. Modeling the Effect of Leverage on Ratings

I consider a firm's rating as proxy for its default probability, and then examine the following model to measure the leverage's impact on ratings:

$$Rat_i = \alpha_1 + \beta_1 Lev_i + \beta_2 X_{1i} + \beta_3 u_i + \varepsilon_{1i} \tag{1}$$

$$Lev_i = \alpha_2 + \beta_4 X_{1i} + \beta_5 X_{2i} + \beta_6 u_i + \varepsilon_{2i}. \tag{2}$$

In this model, u_i is the unobservable fundamental risk that creates the endogeneity problem. Equation (1), the rating equation, models the rating setting behavior by rating agencies. The equation examines the determinants of the rating (Rat_i), including the firm's leverage (Lev_i), the unobserved firm's fundamental risk (u_i), and other factors described below.

Equation (2) is the firm's leverage equation. It relates the firm's leverage to its exogenous determinants and the unobserved firm's fundamental risk (u_i). I include in X_1 a common set of determinants for leverage and rating, such as size, profitability, income volatility, uniqueness, asset tangibility, and industry dummies. In X_2, I consider the determinants of leverage that do not affect rating directly and can be used as instruments of leverage to identify the rating equation.

To estimate β_1, the coefficient that captures the true impact of leverage on ratings, I must include the unobserved firm's fundamental risk (u_i). If I ignore it, the estimation of β_1 is inconsistent, because the firm's leverage and fundamental risk are related, $\text{cov}(Lev_i, u_i) \neq 0$. In fact, if I assume that risk negatively affects leverage ($\beta_6 < 0$ in equation (2)), then $\text{cov}(Lev_i, u_i) < 0$. Consequently, if I omit u_i from the estimation, the coefficient β_1 is biased downward (in absolute value).

Intuitively, the model captures the same economic effect referred to above. A decrease in the firm's fundamental risk, u_i, improves the firm's prospects, leading rating agencies to improve the firm's rating, Rat_i. Such a decrease in the firm's risk (through equation (2) and given $\beta_6 < 0$) simultaneously allows the firm to increase its leverage, Lev_i, which in turn negatively affects the firm's rating and diminishes the importance of the coefficient β_1.

Instrumental variables can correct the econometric problem and provide a consistent estimator for β_1. To do so, I must instrument leverage with any of its determinants (in X_2) that are not correlated with the unobserved factor u_i (i.e., $\text{cov}(Lev_i, u_i) \neq 0$). In what follows, I consider two main instruments for leverage.

The first instrument is the history of past market valuations, measured by the history of market-to-book ratios. Baker and Wurgler (2002) show the strong influence of firms' past market valuations on their leverage. Firms with past high valuations (high market-to-book ratios) issue equity when funds are needed, and firms with low past valuations (low market-to-book ratios) issue debt to raise funds.

My second instrument for leverage is the firm's marginal tax rate from Graham (1996a, 1996b). As Graham (1996a) shows, high-tax-rate firms issue more debt than do their low-tax-rate counterparts.

The two instruments proposed here make significant contributions to the leverage equation (see Section III.A and Table III) and exhibit low univariate correlations with ratings (0.19 and 0.12, respectively). In addition, there are no obvious reasons why the proposed leverage's instruments affect the rating-determination process by agencies. Rating agencies' reports do not refer to these instruments when explaining the rating criteria.[7] The relation between the proposed instruments and the leverage ratios, and the fact that rating agencies pay little or no attention to past market valuations or taxes, make these candidates good instruments for leverage.

Following Kaplan and Urwitz (1979), I use an ordered-probit model for the estimation of the rating equation (1), which allows me to take into account the ordinal characteristic of a rating-dependent variable. I estimate the ordered-probit model with instrumental variables in a two-stage process by following Smith and Blundell (1986) and Nelson and Olsen (1978). To avoid concerns in the estimation of a nonlinear limited dependent variable model with endogenous variables as the one described here, I alternatively use the yields of the firms' bonds—instead of ratings—as the dependent variable in equation (1). Altman's z-scores (Altman (1968)) and firms' interest coverage ratios (Kaplan and Urwitz (1979), Ederington, Yawitz, and Roberts (1987)) are other alternatives that can be considered proxies of firms' default risks and constitute robustness checks to firms' ratings. The main advantage of using cardinal variables is that the model to estimate is transformed into a linear one. However, I use debt ratings as the base case because they are more easily translatable into default probabilities.

II. Data

The sample consists of COMPUSTAT firms for which ratings and yields data are available from the Lehman Brothers Fixed Income Database (LBFID) for the 1988–1997 period and Standard and Poor's bond guides and Moody's/Mergent bond records for the 1998–2002 period.[8] The sample period covers 1988–2002. I exclude firms from the financial sector (SICs 6000–6999), from nonclassifiable establishments (SICs 9995–9999), and from the regulated sector or utilities as defined by Fama and French (1997). The base case sample

[7] According to Standard and Poor's "Rating Methodology: Evaluating the Issuer" report, the analysis of a debt issuer is organized around 13 criteria: (1) industry risk, (2) diversification factors, (3) size considerations, (4) qualitative management evaluations, (5) organizational considerations, (6) measurement of performance and risk, (7) accounting quality, (8) profitability and coverage, (9) capital structure/leverage policies and asset protection, (10) asset valuation, (11) off-balance-sheet financing, (12) cash flow adequacy and ratios, and (13) need for capital and financial flexibility.

[8] The data in the LBFID, available only up to 1997, consists of detailed pricing information on the individual bonds that make up the Lehman Brothers Bond Indices. For a more detailed description of the LBFID, see Warga (1998). To assure time consistency in the data, I checked LBFID ratings and yield information with Standard and Poor's bond guides and with Moody's bond records for the years 1988–1997. Overall, firms' ratings were also checked with data item 280 (Standard and Poor's issuer rating) in COMPUSTAT.

contains 5,060 firm–year observations that met these criteria after the elimination of outliers.[9]

I use data in COMPUSTAT industrial files to compute the explanatory variables. All but the leverage measure are lagged by 1 year. Compiling the information for the instruments reduces the size of the sample. For instance, to calculate firms' past valuations, I need an additional 10 years prior to the original 1988–2002 sample, which reduces the sample to 3,048 firm–year observations. That is, when I use the observation for 1988, I use the 1978–1987 period to compute the proxy for past valuations, and when the observation is for 2002, I use the 1992–2001 period. After intersecting my original data with Graham's (1996a, 1996b) marginal tax rates,[10] the sample is reduced to 3,703 firm–year observations from 1988 to 2002. In the base case, I include the two instruments simultaneously, which reduces the total sample size to 2,678 firm–year observations, from 1988 to 2002.

A. Dependent Variable: Debt Rating

Debt rating is the dependent variable in equation (1). To measure debt ratings, I use an ordinal scale similar to those used by COMPUSTAT and the LBFID. My ordinal scale starts with a numerical code of nine for the best rating possible, AAA/Aaa, and ends with a numerical code of three for the worst rating considered, CCC/Caa. The rest of the numerical codes (eight to four) are assigned, in order, to ratings AA, A, BBB, BB, and B.

I exclude rating modifiers from the base case because previous studies on bond ratings have not used them. Rating category modifiers are intended to show relative standing within the major rating categories. In the robustness analysis, I use a different coding system (from 23 for AAA+ to seven for B−) that considers the rating modifiers, without affecting the results.

I calculate the base case rating variable as a weighted average of all bond ratings that the firm has outstanding, using the amount of each debt issue as weights. Using this weighted average rating (or firm rating) instead of individual bond ratings, I can better capture each firm's overall default probability and eliminate excessive reliance on information that affects only one bond issue. The base case excludes firms with weighted average ratings below CCC/Caa or that are nonrated, thus avoiding the effect of failed bond issues or the inclusion of noisy information. I use Standard and Poor's weighted average debt rating for the base case and the Moody's ratings as a robustness check.

I also look at the weighted average yield-spreads (i.e., *YieldSpread*) as an alternative to ratings in equation (1). I calculate the weighted average over

[9] As outliers, I exclude from the base case (i) 595 firm–year observations with ratings below CCC or nonrated (I reconsider these observations in a robustness check, see Section V.A); (ii) 414 firm–year observations with a negative book value of equity, which assures that the book value leverage is below 1 (see Baker and Wurgler (2002) and Graham et al. (1998)); and (iii) 97 firm–year observations after applying Hadi's (1992, 1994) outliers method to the control variables. The exclusion of these outliers does not affect the results.

[10] The data for the marginal tax rate were kindly provided by John Graham.

Table I

Descriptive Statistics

The sample consists of 2,678 firm–year observations in the base case that include firms from COMPUSTAT that have data available in the Lehman Brothers Fixed Income Database from 1988 to 1997, and with data available in Standard and Poor's bond guides and Moody's/Mergent bond records from 1998 to 2002. The data exclude SICs 6000–6999, 9995–9999, and utility firms. *Lev* is the book-value leverage, calculated as long-term debt over total book value of assets. *LevLT_MV* is the market-value leverage, calculated as long-term debt over total assets minus the book value equity plus the market value of equity. *S&PRat* and *MoodysRat* are Standard and Poor's and Moody's weighted-average rating, respectively. The weighted-average ratings consider all bond issues for each firm with the issue size as weight. *S&PRat-detail* is similar to *S&PRat* but considers category modifiers. *YieldSpread* is the spread between the weighted average of the firm's bond yields and the corresponding T-bond yield (in percent), considering the size of bond issues as weight. *OI/TA* is the ratio of operating income before depreciation over total assets. *PPE/TA* is the ratio of net fixed assets over total assets. *CV(OI)* is the time-series coefficient of variation for the firm's operating income measured over the previous 3 years, using quarterly figures. *SellExp/Sales* is the ratio of selling expenses over sales. *Assets* is the firm's total assets measured in US$billions. *(M/B)efwa* is the 10-year history of past market-valuations computed as in Baker and Wurgler (2002). *MTaxR* is Graham's (1996a, 1996b) marginal tax rate. All variables except for *(M/B)efwa* and *CV(OI)* correspond to a 1-year period.

	Mean 1	Median 2	*SD* 3	Min 4	Max 5
Lev	0.27	0.25	0.13	0.00	0.85
LevLT_MV	0.20	0.17	0.14	0.00	0.85
S&PRat	6.27	6.00	1.23	3.00	9.00
MoodysRat	6.10	6.00	1.28	3.00	9.00
S&PRat-detail	14.76	15.00	3.56	4.00	22.00
YieldSpread (%)	2.11	1.41	1.97	0.02	14.04
OI/TA	0.15	0.14	0.06	−0.11	0.36
PPE/TA	0.40	0.35	0.21	0.00	0.96
CV(OI)	0.31	0.25	0.22	0.03	1.59
SellExp/Sales	0.18	0.16	0.12	0.00	0.64
Assets (US$ bill.)	7.27	2.63	18.46	0.09	197.85
(M/B)efwa	1.45	1.30	0.65	0.00	4.20
MTaxR	0.33	0.35	0.05	0.00	0.39

all the bond issues of each firm, using the issue size as weight. To obtain the yield-spread, I subtract the yield from the corresponding T-bond of the same maturity.

B. Explanatory Variables

Table I displays the descriptive statistics of the explanatory variables defined in this section.

B.1. Leverage

I measure the firms' capital structure using alternative leverage measures. In the base case, I use book value leverage, measured as the book value of long-term debt over book value of assets (*Lev*). I use *Lev* as the base case measure because one of the variables used to instrument leverage is based on market-to-book values, which might create a mechanical relation with a market value leverage measure. Further, *Lev* considers only the long-term debt following previous rating models (Kaplan and Urwitz (1979)). As a robustness check, I also present the results, first using a market value long-term leverage measure (long-term debt over total assets minus book value equity plus market value equity, *LevLT-MV*) and, second considering the total debt instead of only the long-term debt (*Lev-BV* and *Lev-MV*). I calculate the book value of equity as total assets less total liabilities and preferred stocks plus deferred taxes and convertible debt. I calculate the market value of equity as fiscal year-end share price times shares outstanding.

B.2. Instruments

The first instrument for leverage is the firm's history of market valuations. I follow Baker and Wurgler (2002), and use their external finance weighted-average market-to-book measure (*(M/B)efwa*). The intuition behind this variable is that external financing events represent practical opportunities to change the capital structure. I define this variable as

$$(M/B)_{efwa,t} = \sum_{s=t-n}^{t} \frac{e_s + d_s}{\sum_{r=t-n}^{t} e_r + d_r} (M/B)_s. \tag{3}$$

Here, e represents the net equity issues, defined as the change in book equity minus the change in retained earnings over total assets; d is the net debt issues, defined as the change in assets minus the change in book equity divided by total assets; and n is the number of years that are taken as history. I consider 10 years of history prior to the present observation, instead of restricting my sample to IPO firms as in Baker and Wurgler (2002). This variable is a practical summary of the market-to-book ratios that prevailed when external finance decisions were being made. It takes high values for firms that raised equity or debt when the market-to-book ratio was high.

I use the marginal tax rates (*MTaxR*) from Graham (1996a, 1996b) as my second instrument for leverage. Following Graham, Lemmon, and Schallheim (1998), I use the marginal tax rates before interest (i.e., based on income before interest is deducted) to avoid endogeneity with leverage. Graham's marginal tax rates are built by simulating future profits, accounting for net operating losses, investment tax credits, and the alternative minimum tax.

B.3. Control Variables

My first control is profitability. Rating agencies consider profitable firms less risky. Standard and Poor's states that firms with higher operating margins have a greater ability to generate equity capital internally, to attract capital externally, and to withstand business adversity. I use the ratio of operating income over total assets (*OI/TA*).

My second control is the relative tangible assets position of the firm, which serves to guarantee debt. I measure tangibility of assets by the firm ratio of net property plant and equipment to total assets (*PPE/TA*).

My third control is income stability, included in previous rating models. When income or profits are more volatile, the firm is thought to be more at risk when it comes to meeting its obligations. Including this variable controls for the observable part of the firm's past income volatility. This variable does not control for the unobservable fundamental risk of the firm that is the source for endogeneity in the leverage-rating relation. I use the coefficient of variation for the operating income (*CV(OI)*). For each firm, I compute the time-series standard deviation of its quarterly operating income divided by the time-series average of the operating income absolute values, so that I obtain its coefficient of variation. For each year in my sample, I calculate *CV(OI)* for the 3-year period preceding the year in question.

The fourth control, a firm's uniqueness, is a variable that represents various effects mentioned by Moody's Industrial Rating Methodology Report. Uniqueness is usually related to the costs of bankruptcy. However, it also involves a risk component related to firms with unique products. Firms with higher levels of product uniqueness have more resources allocated to researching, advertising, and selling their products, as well as a more rigid cost structure. Following Titman and Wessels (1988), I use selling expenses over sales as a proxy for uniqueness (*SellExp/Sales*).

My fifth control is size. Rating agencies put a relatively high importance on size. Big firms are likely to be more diversified, less concentrated geographically, and more financially flexible. Smaller firms are apt to be riskier, and are seen as having less staying power or survival probability and as being more exposed to expensive bank debt. I use the logarithm of total assets (*Log[Assets]*) adjusted for inflation to control for firm size.

In addition to these control variables, I also use year and industry dummies, following the Fama and French (1997) industry classification. The univariate correlations between control variables are consistent with those reported by Titman and Wessels (1988).

As robustness checks, I use alternative control variables, including sales as size control, operating income over sales as profitability control, and research and development expenses as uniqueness control. None of these variations, nor the exclusion of some or all of these control variables, affect the main results.

III. Results

A. *Estimation of the Rating Equation*

Table II presents the results for the estimation of the rating equation (1) instrumenting for leverage. Columns 1 through 4 present estimations of ordered probit models that use the weighted average Standard and Poor's rating

Table II

Instrumental Variable Regressions—Second Stage

This table reports regressions of ratings (*S&PRat*) and yield-spreads (*YieldSpread*) on leverage (*Lev*) and control variables. *S&PRat* is Standard and Poor's weighted-average rating, which considers all bond issues for each firm with the issue size as weight. *YieldSpread* is the spread between the weighted average of the firm's bond yields and the corresponding T-bond yield, considering the size of bond issues as weight. *Lev* is the ratio of long-term debt over total book value of assets. Column 1 shows the results for the reduced-form ordered-probit regression that considers *S&PRat* as the dependent variable and uses the sample that corresponds to the base case presented in column 2. Column 2 shows the results for the base case, an ordered-probit regression that uses *S&PRat* as the dependent variable and instruments *Lev* with *(M/B)efwa* and *MTaxR*. Columns 3 and 4 report the results for ordered-probit regressions that use *S&PRat* as the dependent variable and alternate the two different instruments (*(M/B)efwa* and *MTaxR*) for *Lev*. Column 5 presents a regression that uses *YieldSpread* as the dependent variable and instruments *Lev* with *(M/B)efwa* and *MTax*. *(M/B)efwa* is the 10-year history of past market-valuations computed as in Baker and Wurgler (2002). *MTaxR* is Graham's (1996a, 1996b) marginal tax rate. *OI/TA* is the ratio of operating income before depreciation over total assets. *PPE/TA* is the ratio of net fixed assets over total assets. *CV(OI)* is the time-series coefficient of variation for the firm's operating income measured over the previous 3 years, using quarterly figures. *SellExp/Sales* is the ratio of selling expenses over sales. *Log[Assets]* is the log of the firm's total assets. All variables except for *(M/B)efwa* and *CV(OI)* correspond to a 1-year period. The instruments and controls are lagged by 1 year. The reduced-form cases for columns 3–5 are not reported, except for the reduced-form leverage coefficient (row a). The Hausman test (row b) is a specification test for the endogeneity between *Lev* and *S&PRat* (*YieldSpread*), as compared with the respective reduced-form case (p-values are in parentheses). N represents the number of observations in firm–years from 1988 to 2002. All regressions include year and Fama and French (1997) industry dummies; coefficients are not reported to save space. The *YieldSpread* regression (column 5) also includes a constant (not reported). Robust z-values (columns 1–4) and t-values (column 5) are in parentheses.

		Instrumental Variable Regressions			
		S&PRat			*YieldSpread*
Dependent Variable	*Base Case* (Reduced-Form) 1	2	3	4	5
Lev	**−5.65*****	**−13.78*****	**−17.12*****	**−11.64*****	**14.07*****
	(−22.19)	(−8.97)	(−11.11)	(−5.50)	(3.63)
OI/TA	7.38***	0.58	1.49	0.93	−0.27
	(13.01)	(0.53)	(1.37)	(0.75)	(−0.11)
PPE/TA	0.62***	1.50***	1.89***	1.20***	−1.24***
	(3.70)	(6.37)	(8.04)	(5.11)	(−3.40)
CV(OI)	−1.59***	−1.51***	−1.29***	−1.17***	2.12***
	(−11.70)	(−11.43)	(−10.49)	(−12.28)	(7.62)
SellExp/Sales	1.72***	0.74**	0.50*	0.46*	−0.24
	(6.23)	(2.49)	(1.85)	(1.75)	(−0.43)
Log[Assets]	0.58***	0.24***	0.12**	0.21***	0.03
	(23.62)	(4.88)	(2.23)	(2.73)	(0.16)
N	2,678	2,678	3,048	3,703	2,698
Instruments		*(M/B)efwa* *MTaxR*	*(M/B)efwa*	*MTaxR*	*(M/B)efwa* *MTaxR*
Lev Coefficient[a] reduced-form			−5.62***	−5.38***	3.92***
			(−24.17)	(−26.46)	(15.60)
Hausman test[b] (p-value)		28.81***	57.06***	8.83***	6.88***
		(0.00)	(0.00)	(0.00)	(0.01)

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

(*S&PRat*) as the dependent variable. Column 1 shows the noninstrumented case that ignores the endogeneity and uses the sample that corresponds to the base case presented in column 2. Column 2 shows the results for the base case, which uses *(M/B)efwa* and *MTaxR* as instruments for leverage, and can be directly compared with the reduced form results in column 1. Columns 3 and 4 report the results using the two instruments alternatively. Column 5 displays the results for a linear estimation that uses the yield-spread (*YieldSpread*) as the dependent variable and instruments leverage with *(M/B)efwa* and *MTaxR*. The regressions in columns 3 through 5 should be compared with their corresponding reduced form estimations (only the reduced form leverage's coefficient is reported in row a), which have different sample sizes from the one presented in the first column.

Table III, columns 2 through 5, reports the first-stage leverage regressions that correspond to the second-stage rating regressions in Table II, columns 2 through 5. Column 1 presents a leverage regression that only considers the controls (i.e., it excludes the instruments) and uses the sample that corresponds to the base case presented in column 2. Columns 2 and 5 only differ in their sample sizes, which correspond to the rating and yield-spread second-stage regressions of Table II, columns 2 and 5. Row a reports F-tests of joint significance for the instruments. Row b shows the relative increase in explanatory power caused by including instruments in the leverage regressions. The regression in column 2 directly compares with the regression in column 1. The regressions in columns 3 through 5 compare with the unreported regressions that exclude the instruments and use a corresponding sample. Although the added explanatory power is only 0.01–0.04, the instruments are always significant and have the predicted signs, assuring unbiased estimates for the effect of leverage on ratings (see Staiger and Stock (1997)). The history of past market valuations is negatively related to leverage, and the marginal tax rate is positively related. The joint significance of the instruments is higher when *(M/B)efwa* is used alone (column 3).

All regressions in Tables II and III include five control variables and year, and Fama and French (1997) industry dummies (coefficients are not reported to save space). The control variables are proxies for profitability (*OI/TA*), asset tangibility (*PPE/TA*), income volatility (*CV(OI)*), product uniqueness (*SellExp/Sales*), and size (*Log[Assets]*). The standard errors reported in all tables are White (1980) heteroskedasticity consistent.

In Table II, it is apparent that when I use instrumental variables, the leverage coefficient is more important economically and econometrically. This finding is consistent with the model proposed in Section I. The results in column 5, in which *YieldSpread* is the dependent variable, confirm the stronger effect of leverage on ratings. If I use Altman's (1968) z-scores or interest coverage ratios instead of *YieldSpread* as alternative proxies for the risk of default, the results are similar; the leverage coefficient is stronger when the endogeneity is considered. The results are also similar if the instruments are used alternatively as in columns 3 and 4.

Table III

First-Stage Leverage Regressions

This table reports the first-stage regressions of leverage (*Lev*) on the instruments and control variables that correspond to the instrumental variable regressions in Table II. The dependent variable *Lev* is the ratio of long-term debt over total book value of assets. Column 1 shows the results excluding instruments and using the sample that corresponds to the base case (in column 2). Two different instruments (*(M/B)efwa* and *MTaxR*) are included as independent variables (alone or combined) in columns 2–5. *(M/B)efwa* is the 10-year history of past market-valuations computed as in Baker and Wurgler (2002). *MTaxR* is Graham's (1996a, 1996b) marginal tax rate. Column 2 shows the results for the rating base case, including the two instruments. Columns 3 and 4 report the results alternating the two different instruments. Column 5 presents the results including both instruments, but using the sample that corresponds to the yield-spread second-stage regression. *OI/TA* is the ratio of operating income before depreciation over total assets. *PPE/TA* is the ratio of net fixed assets over total assets. *CV(OI)* is the time-series coefficient of variation for the firm's operating income measured over the previous 3 years, using quarterly figures. *SellExp/Sales* is the ratio of selling expenses over sales. *Log[Assets]* is the log of the firm's total assets. All variables except for *(M/B)efwa* and *CV(OI)* correspond to a 1-year period. The independent variables are lagged by 1 year. *N* represents the number of observations in firm–years that go from 1988 to 2002. Row a reports *F*-tests for the null hypothesis that the instruments' coefficients are all zero (*p*-values are in parentheses). Row b reports the adjusted R^2. Row c reports the instruments' added explanatory power by comparing each regression's adjusted R^2 with the adjusted R^2 of the corresponding regression (not reported) that excludes the instruments. All regressions include a constant and year and Fama and French (1997) industry dummies; coefficients are not reported to save space. Robust *t*-values are in parentheses.

Dependent Variable	*Lev*				
	1	2	3	4	5
(M/B)efwa		−0.02***	−0.03***		−0.02***
		(−5.77)	(−6.09)		(−5.69)
MTaxR		0.13**		0.11***	0.15***
		(2.54)		(2.63)	(3.13)
OI/TA	−0.66***	−0.59***	−0.56***	−0.59***	−0.58***
	(−13.24)	(−10.68)	(−11.17)	(−13.72)	(−10.40)
PPE/TA	0.11***	0.11***	0.11***	0.10***	0.11***
	(6.64)	(6.49)	(6.85)	(7.57)	(6.35)
CV(OI)	−0.02	−0.01	−0.01	0.00	−0.02
	(−1.57)	(−1.00)	(−0.67)	(0.06)	(−1.36)
SellExp/Sales	−0.09***	−0.07**	−0.06**	−0.08***	−0.07**
	(−3.47)	(−2.57)	(−2.25)	(−3.74)	(−2.57)
Log[Assets]	−0.03***	−0.03***	−0.03***	−0.04***	−0.03***
	(−13.77)	(−13.62)	(−15.04)	(−20.79)	(−13.61)
N	2,678	2,678	3,048	3,703	2,698
Instr. *F*-test[a]		20.06***	37.04***	6.90***	21.73***
(*p*-value)		(0.00)	(0.00)	(0.01)	(0.00)
Adjusted R^{2b}	0.30	0.31	0.32	0.32	0.31
Added explanatory power[c]		0.04	0.03	0.01	0.04

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Row b in Table II reports a modification of the Hausman test for the leverage coefficient (see Himmelberg et al. (1999) for a related calculation). This test checks the formal hypothesis of whether the unobserved and omitted effect is correlated with leverage. The Hausman tests reject the hypothesis of the exogeneity of leverage (zero correlation) for the original reduced form case in favor of the use of instrumental variables. That is, the unobserved firms' fundamental risk is correlated with leverage. This means that the coefficients estimated using an instrumental variable approach are more reliable than those estimated by using reduced form regressions, which are subject to endogeneity bias.

The signs of the control variables at both stages are consistent with the expectations and with previous literature. A larger and more profitable firm that has less income volatility, unique products, and more tangible assets is less likely to default, and consequently has a higher rating and a lower yield. In the instrumental variable regressions in Table II, some of the control coefficients, such as the profitability and size controls, change in magnitude and significance when I instrument leverage. One of the reasons for this loss in significance is that these two controls are the two most important predictors in the first stage. To eliminate concerns of endogeneity in the controls, I use an alternative specification (results not reported) in which the control variables are the residuals of regressing the original controls on leverage. By doing this, I remove any endogeneity concern in the controls with respect to the leverage-rating relation. Using these alternative controls does not affect the main result of the leverage's effect on ratings. The control's significance and signs are as expected. In any case, the exclusion of the controls, which can also be considered unobservable variables, does not change the result of a stronger effect of leverage on ratings.

In sum, the use of instruments for leverage appears essential to correctly assess the impact of leverage on ratings and default probabilities. If leverage is not instrumented, one obtains a reduced leverage coefficient due to the endogeneity between leverage and ratings. As I show next, the difference between the leverage coefficients is not only statistically significant but also economically significant.

B. Economic Significance of the Leverage Coefficient

Ignoring the endogeneity can result in misleading interpretations. For instance, if I use the reduced form model in Table II, without instrumenting leverage, to estimate the effect of leverage on ratings, the average firm in my sample (with a leverage ratio of 0.27 and control variables equal to the sample mean, which results in a rating of BBB) might seem able to increase its leverage by 0.17 (up to 0.44) without having its rating downgraded. If an average BBB firm can increase its leverage ratio from 0.27 to 0.44 without having its rating downgraded, then why does the firm not have more debt and take advantage of the debt tax benefits?

When I compare these numbers with the average leverage ratios within each rating category (see Table IV), a 0.17 increase seems very high for the firm not having its rating downgraded. For instance, a typical BBB firm has a leverage

Table IV

Leverage Detailed Descriptive Statistics

This table shows the detailed descriptive statistics for the book value leverage ratio (*Lev*), calculated as long-term debt over total book value of assets, measured within each rating category. *S&PRat* is Standard and Poor's weighted-average rating approximated to the next whole number, for the rating categories.

S&PRat	Obs.	Mean	Median	*SD*	Min.	Max.
AAA	65	0.09	0.08	0.05	0.01	0.22
AA	283	0.17	0.16	0.08	0.01	0.45
A	893	0.22	0.22	0.09	0.00	0.51
BBB	846	0.28	0.27	0.11	0.05	0.82
BB	289	0.34	0.34	0.14	0.05	0.85
B	269	0.42	0.41	0.15	0.07	0.77
CCC	33	0.46	0.46	0.13	0.28	0.66

ratio of 0.27, and a typical BB firm has a leverage ratio of 0.34. In contrast, if I instrument leverage with *(M/B)efwa* and *MTaxR* using the base case model in Table II, the same firm I refer to above would see its rating downgraded one category after an increase in its leverage of only 0.08, which very nearly corresponds to the difference between BBB and BB average leverage ratios reported in Table IV. This correspondence is consistent with the endogeneity in the leverage-rating relation.

IV. The (Ex Ante) Costs of Financial Distress

Miller (1977) notes that firms choose an optimal debt policy by considering the ex ante costs of distress. I use my previous findings to estimate ex ante the costs of financial distress that a firm incurs when increasing its use of debt. I use my result of the stronger effect of leverage on ratings to re-estimate the effects of leverage on probabilities of default. Then I examine the extent to which this re-estimation can reconcile differences of magnitude between the ex ante financial distress costs (via default probabilities) and the potential loss of tax benefits.

Graham (2000) finds that by leveraging up to the point where the marginal tax benefits begin to decline, a typical 1993 firm could add 4.5% to the firm's value, after netting out the personal tax penalty. Given Andrade and Kaplan's (1998) estimation that ex post financial distress costs equal between 10 and 23% of the firm value, this firm's debt policy is justified only if leveraging up increases the probability of encountering distress by between 20% ($0.20 * 0.23 = 0.045$) and 45% ($0.45 * 0.10 = 0.045$).[11]

[11] If Graham's (2000) entire sample period (1980–1994) is considered, the potential loss in tax benefits due to underleverage is 7.5%, and the probability of encountering distress to justify the firm's debt policy would be between 30 and 75%. According to Graham, the potential tax benefits lost is 4.5% in 1993, which corresponds better to my sample period.

Table V

Instrumental Variable Regressions to Estimate the Impact of Leverage on Ratings

This table reports ordered-probit instrumental variable regressions of ratings (*S&PRat*) on leverage (*Lev-BV*) and control variables, using proxies that fit Graham's (2000) reported data. *S&PRat* is Standard and Poor's weighted-average rating, which considers all bond issues for each firm with the issue size as weight. *Lev-BV* is the leverage variable, calculated as total debt over total book value of assets. Model 1 includes control variables and Model 2 is without control variables. *(M/B)efwa* and *MTaxR* are the instruments used in both models. *(M/B)efwa* is the 10-year history of past market valuations computed as in Baker and Wurgler (2002). *MTaxR* is Graham's (1996a, 1996b) marginal tax rate. *OI/TA* is the ratio of operating income before depreciation over total assets. *PPE/TA* is the ratio of net fixed assets over total assets. *R&D/Sales* is the ratio of R&D expenses over sales. *Log[Assets]* is the log of the firm's total assets. To save the number of observations, a zero is assigned when the R&D expenses data are missing and a dummy is included (coefficient not reported) to indicate the missing values. All variables except for *(M/B)efwa* correspond to a 1-year period. The instruments and controls are lagged by 1 year. *N* represents the number of observations in firm–years from 1988 to 2002. Regressions include year dummies (grouped according to Graham's sample period), and Fama and French (1997) industry dummies; coefficients are not reported to save space. The second panel indicates the cutpoints given by the ordered-probit model to assign a rating to each predicted value. Robust z-values are in parentheses.

Dependent Variable	*S&PRat*	
	Model 1	Model 2
Lev-BV	**−10.78*****	**−13.67*****
	(−9.37)	(−16.28)
OI/TA	4.96***	
	(6.08)	
PPE/TA	0.28*	
	(1.76)	
R&D/Sales	−0.27***	
	(−3.01)	
Log[Assets]	0.55***	
	(22.71)	
Cut (AAA)	4.79	−2.25
Cut (AA)	3.32	−3.37
Cut (A)	1.63	−4.67
Cut (BBB)	0.27	−5.69
Cut (BB)	−0.41	−6.19
Cut (B)	−1.98	−7.38
N	2,829	2,846
Instruments	*(M/B)efwa* *MTaxR*	*(M/B)efwa* *MTaxR*

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

To relate leverage changes to ratings changes, I slightly modify my base case specification, adjusting it to Graham's (2000) data. Table V presents the two specifications I use to measure the leverage effect on ratings. I run both specifications with an ordered-probit model and use *(M/B)efwa* and *MTaxR* as instrumental variables for leverage. I measure leverage by using *Lev-BV*, including all debt. Model 1 includes control variables similar to those of the base case specification, but excludes *CV(OI)* and substitutes *R&D/Sales* for *SellExp/Sales.* I set the missing values in R&D expenses data (COMPUSTAT data item 46) to zero, and include a dummy variable (coefficient not reported) indicating the presence of a missing value in the specification. Without affecting the results, I make this adjustment to limit the loss of observations due to missing values. Model 2 is without controls. The lower panel in Table V indicates the ordered-probit cutpoints that serve to assign a rating category to each predicted value.

Considering only the part of Graham's (2000) sample that corresponds to my time period, the average firm has a kink of 2.04. That is, the firm can increase its interest deductions by 2.04 times before the marginal tax benefits become negative. As noted, Graham defines kink as the ratio of the amount of interest needed to make the tax rate function slope downward (in the numerator) to actual interest expense (in the denominator).

According to Graham's (2000) sample, a firm with a kink of 2 has a debt-to-assets ratio of approximately 0.28, and values of 0.13, 0.42, 0.01, and 8.37 for *OI/TA*, *PPE/TA*, *R&D/Sales*, and *Log[Assets]*, respectively. In Table VI, Panels A and B, I use these values to show the change in ratings that occurs when leverage is increased by a kink of 2.04 (i.e., it doubles). Panel A shows the results for Model 1 (with controls) and Panel B shows the results for Model 2 (without controls).

According to my estimates, if a firm with a leverage ratio of 0.28 doubles its leverage, its rating is downgraded from A to B, if Model 1 is used, or to CCC, if Model 2 is used. According to Standard and Poor's rating performance reports, when a bond is downgraded from A to B (CCC), its 10-year cumulative default rate increases from 2 to 26% (43%), which means an increase in the cumulative default rate of 24% (41%). This increase in the default probability is indicated in column 6 of Table VI, Panels A and B.[12]

Because Graham (2000) considers the present value of all future tax benefits in his calculations, I use the long-term default probabilities to compare with Graham's tax benefit gains. According to Standard and Poor's 10-year cumulative default rates, the weighted average default probability of a firm in my sample is 7.25%, which compares favorably with the average probability of encountering financial distress suggested by table 2 in Graham (1996b).[13]

[12] Using other estimates for default probabilities, I find similar results. For example, if Moody's historical 8-year cumulative default rates are used, the referred increase in default probability is 39% (50%). If one considers Altman and Arman's (2002) estimations for default probabilities, the increase in default probabilities is 33% (50%).

[13] According to the persistent probabilities for firms' taxable income reported by Graham (1996b), and considering Asquith, Gertner, and Scharfstein's (1994) definition of financial distress, the probability of a firm having a negative taxable income in two consecutive years goes from 8 to 11% ($(1 - 0.862) * 0.577$ and $(1 - 0.813) * 0.577$)). Asquith et al. consider that for a firm to be in financial distress, it needs to either (a) fail to generate enough EBITDA to meet the interest payments for 2 years in a row, or (b) fail to generate enough EBITDA to cover at least 80% of the interest payments in a given year. When considering Graham's persistence probabilities, I conservatively ignore the (b) condition for financial distress.

Table VI

Tax Benefits versus Financial Distress Costs, Different Leverage, and Kinks

This table reports the predicted rating changes and the consequent increase in the default probabilities when a firm increases its leverage, according to the two models in Table V. Panels A and B correspond to different leverage starting points, and Panel C and D to different kinks. The kink (as in Graham (2000)) is the ratio of the amount of interest that makes the tax rate function slope downward to the actual interest expense. Panels A and C present the results for Model 1 (with controls), and Panels B and D present the results for Model 2 (with no controls). Lev_{before} represents the starting point for leverage, calculated as total debt over total book value of assets. Lev_{after} represents the leverage after increasing it to the kink. Rat_{before} and Rat_{after} represent the ratings predicted by the models in Table V and are related to the levels of leverage indicated by Lev_{before} and Lev_{after}. $\Delta Default$ indicates the increase in Standard and Poor's default probabilities due to the rating downgrade. In Panels A and B, the kink is set to 2.04 as the median firm in Graham's (2000) reported sample. The control variables (for Model 1, Table V) are set equal to the average firm with a kink of two in Graham's sample. The leverage shown in Panels C and D and the control variables in Panel C are set equal to the average firm that corresponds to each kink (from 1.2 to 4), following Graham's sample.

Lev_{before} 1	*kink* 2	Lev_{after} 3	Rat_{before} 4	Rat_{after} 5	$\Delta Default$ 6
Panel A: Different Leverage, Model 1					
0.03	2.04	0.06	AAA	AA	0.00%
0.16	2.04	0.33	AA	BBB	3.20%
0.28	**2.04**	**0.57**	**A**	**B**	**24.10%**
0.33	2.04	0.67	BBB	CCC	38.74%
0.46	2.04	0.94	BB	CCC	26.19%
Panel B: Different Leverage, Model 2					
0.12	2.04	0.24	AAA	A	1.23%
0.22	2.04	0.45	AA	B	25.37%
0.28	**2.04**	**0.57**	**A**	**CCC**	**40.67%**
0.33	2.04	0.67	BBB	CCC	38.74%
0.40	2.04	0.82	BB	CCC	26.19%
kink 1	Lev_{before} 2	Lev_{after} 3	Rat_{before} 4	Rat_{after} 5	$\Delta Default$ 6
Panel C: Different *kinks*, Model 1					
1.20	0.39	0.46	BBB	BB	12.55%
1.60	0.30	0.48	A	BB	14.48%
2.00	**0.28**	**0.56**	**A**	**B**	**24.10%**
3.00	0.28	0.83	A	CCC	40.67%
4.00	0.27	1.06	A	CCC	40.67%
Panel D: Different *kinks*, Model 2					
1.20	0.39	0.46	BBB	B	22.17%
1.60	0.30	0.48	A	B	24.10%
2.00	**0.28**	**0.56**	**A**	**CCC**	**40.67%**
3.00	0.28	0.83	A	CCC	40.67%
4.00	0.27	1.06	A	CCC	40.67%

Panels A and B in Table VI also show what happens when the same firm begins with a different leverage and rating. When a firm doubles its leverage to move to the optimal point in tax benefits, the increase in default probabilities (Δ*Default*) goes from 0% to 41%, depending on the firm's starting point.

Panels C and D in Table VI report the cases for different kinks, using the same firm's characteristics reported by Graham (2000). As it can be expected, Δ*Default* increases with respect to the kink. However, if I take firms with kinks from 1.2 to 4—firms that need to increase their leverage by 1.2–4 times to maximize their tax benefits—the corresponding increase in default probabilities (Δ*Default*) is 13%–41%, which is consistent with the 20–45% range referred to above as needed to make the firms reluctant to increase their use of debt. If firms increase their leverage to obtain the 4.5% increase in value that, according to Graham, they leave on the table in potential tax benefits, their default probabilities increase by between 13% and 41%. Assuming the financial distress costs estimated by Andrade and Kaplan (1998), this increase in default probabilities offsets Graham's tax benefit.

Table VII is similar to Panels C and D of Table VI, but examines only the minimum leverage increase needed for a downgrade in the firm's rating. For example, using Model 1, an A-rated firm with an original kink of 2 only needs to increase its leverage by 1.14 times to be downgraded to BBB. If this firm increases its leverage by 1.14 times, its default probability increases by 1.93%. Considering the 10–23% ex post financial distress costs estimated by Andrade and Kaplan (1998), this average firm increases its financial distress costs by 0.2–0.44% if it increases its leverage by 1.14.

The tax benefit generated by the leverage increase, assuming that Graham's (2000) tax benefit estimation is linear, is 0.63%. In this case, the firm is almost indifferent to whether it increases its leverage or not. Table VII shows how this is the case for different starting points. The potential tax benefit is completely offset by the increase in financial distress costs when I use higher kinks or consider Model 2 (Panel B).

To obtain a direct comparison with Graham (2000), I consider Andrade and Kaplan's (1998) estimation of ex post financial distress costs as the only counterbalance to the tax benefits, and I use Standard and Poor's default probabilities to estimate the ex ante costs of financial distress. Doing so probably is a conservative approach. First, agency costs can also be traded off against the tax benefits of debt. Leland (1998) finds that agency costs associated with risk shifting can amount to about 20% of the value of the tax shield. Although agency cost estimations alone have been found to be not sufficient to offset the tax benefit (e.g., Leland (1998), Parrino and Weisbach (1999)), they can contribute to reducing the amount of financial distress costs needed to offset previous estimates of the tax benefits of debt. Second, I would have to use the probability of encountering distress to multiply Andrade and Kaplan's ex post financial distress costs estimation, as opposed to using Standard and Poor's default probabilities. The probability of encountering financial distress should be higher than the default probability for a particular debt rating. Further,

Table VII

Tax Benefits versus Financial Distress Costs, Marginal Effects

This table compares the default costs and tax gains obtained by firms when they increase their leverage. I base the comparison on the predicted ratings of the two models in Table V, using different kinks. The kink (as in Graham (2000)) is the ratio of the amount of interest that makes the tax rate function slope downward to the actual interest expense. Panel A presents the results for Model 1 (with controls) and Panel B presents the results for Model 2 (with no controls). Column 1 shows the different original kinks according to Graham (2000), and column 3 shows the minimum kink that produces a rating downgrade on the average firm that corresponds to the original kink. The starting-point leverages (Lev_{before}) for both models and the control variables for Model 1 are equal to the average firm that corresponds to each original kink, according to Graham's (2000) sample. Leverage is the ratio of total debt over total book value of assets. Lev_{before} and Lev_{after} represent the book-value leverages before and after increasing it to the new kink in column 3. Rat_{before} and Rat_{after} represent the ratings predicted by the models in Table V, related to the levels of leverage indicated by Lev_{before} and Lev_{after}. $\Delta Default$ indicates the increase in Standard and Poor's default probabilities due to the rating downgrade. The range of the increase in financial distress costs (columns 8 and 9) results from multiplying the increase in default probabilities (column 7) by Andrade and Kaplan's (1998) estimation for ex post financial distress costs (10–23%). Column 10 shows the proportional tax gain produced by the leverage increase from Lev_{before} to Lev_{after}, assuming that Graham's (2000) estimated tax gains are linear.

Original *kink* 1	Lev_{before} 2	New *kink* 3	Lev_{after} 4	Rat_{before} 5	Rat_{after} 6	$\Delta Default$ 7	Default Costs 10% 8	Default Costs 23% 9	Tax Gain (Proport.) 10
Panel A: Model 1									
1.20	0.39	1.16	0.45	BBB	BB	12.55%	1.26%	2.89%	3.60%
1.60	0.30	1.10	0.33	A	BBB	1.93%	0.19%	0.44%	0.75%
2.00	**0.28**	**1.14**	**0.33**	**A**	**BBB**	**1.93%**	**0.19%**	**0.44%**	**0.63%**
3.00	0.28	1.16	0.33	A	BBB	1.93%	0.19%	0.44%	0.36%
4.00	0.27	1.21	0.33	A	BBB	1.93%	0.19%	0.44%	0.32%
Panel B: Model 2									
1.20	0.39	1.01	0.40	BBB	BB	12.55%	1.26%	2.89%	0.32%
1.60	0.30	1.07	0.32	A	BBB	1.93%	0.19%	0.44%	0.50%
2.00	**0.28**	**1.11**	**0.32**	**A**	**BBB**	**1.93%**	**0.19%**	**0.44%**	**0.48%**
3.00	0.28	1.15	0.32	A	BBB	1.93%	0.19%	0.44%	0.33%
4.00	0.27	1.19	0.32	A	BBB	1.93%	0.19%	0.44%	0.28%

as noted above, the average Standard and Poor's 10-year default probability is also lower than the average probability of financial distress, suggested by the persistence probabilities that are used in Graham (1996b) to calculate the marginal tax rates.

After all, firms might not be conservative in their use of debt, as Graham (2000) suggests, but the impact of a firm's leverage increase on its default probability might have been underestimated on average. Taking the previous empirical literature as a starting point, the stronger effect of leverage on ratings helps to at least partly explain why firms are not more leveraged. The possible tax benefits of higher leverage are offset by a higher probability of default and bigger ex ante costs of financial distress.

V. Robustness of the Leverage's Effect on Ratings Estimation

A. Alternative Specifications

Table VIII presents eight additional instrumental variable regressions. In these regressions, I consider alternative ways of measuring the leverage ratios and the rating proxy. I exclude control variables and examine a third instrument for leverage. The regressions in this table are ordered-probit estimations that use *(M/B)efwa* and *MTaxR* to instrument for leverage. The exception is the last regression, which includes a third instrument. I report only the leverage coefficients for both the reduced form and the instrumental variable case. Column 7 shows the Hausman test for the leverage coefficients.

In contrast to the base case in Table II, rows 8.1 and 8.2 in Table VIII use different measures of the leverage ratio: long-term market value leverage (*LevLT-MV*) and total debt book-value leverage (*Lev-BV*). Row 8.3 excludes the control variables used in the base case, which diminishes concerns about endogeneity in the controls.

In rows 8.4 through 8.7, I consider different proxies for the rating variable. First, I use Standard and Poor's most senior debt rating (*S&PSrRat*), as opposed to the weighted average rating used in the base case. Second, I use Moody's weighted-average rating (*MoodysRat*) instead of Standard and Poor's ratings. Third, I include nonrated bonds as average junk bonds (rating numerical code of four) together with Standard and Poor's weighted average ratings (*S&P-NR*). Fourth, I look at the ratings category modifiers: pluses and minuses in Standard and Poor's ratings (*S&P-detail*).

In row 8.8, I include a proxy for managerial entrenchment as a robustness check to the leverage instruments proposed in the base case. I build this proxy as the percentage of stock directly owned by the CEO (*StkOwn*) using data from the ExecuComp database, available for the 1992–2002 period. Consistent with Berger, Ofek, and Yermack (1997), I find that that when managers own a larger percentage of firms' shares, firms exhibit a higher leverage. In addition, *StkOwn* shows a low correlation with ratings (−0.18). However, using corporate governance variables as instruments of leverage is not free of problems. Corporate governance variables can be related to ratings because of the manager's propensity for risk.

When I consider different measures of ratings, exclude the controls, or use alternative instruments, the results are almost identical. Leverage is up to three times more important for ratings than it is when I ignore the endogeneity. When I use market value leverage measures, the leverage impact on ratings appears somewhat lower than in the base case, but it is still significant and at least double the respective reduced form cases. The stronger effect of leverage on ratings is robust to different measures of leverage, different ways of considering the rating variables, the exclusion of control variables, and the use of other instruments.

In addition to the results reported in Table VIII, I also use Standard and Poor's most junior debt rating and the COMPUSTAT data item 280 (Standard and Poor's issuer rating) as the rating proxy, and *StkOwn* alone as an instrument for leverage. The results (not reported) are similar. When I examine the total

Table VIII

Rating Instrumental Variable Regressions, Different Specifications

This table reports eight ordered-probit regressions of ratings on leverage and controls for different specifications. Column 4 reports the leverage coefficients for reduced-form estimations and column 5 reports the instrumental variable estimations. The instrumental variable regressions in rows 8.1 through 8.7 consider two instruments (*(M/B)efwa* and *MTaxR*). *(M/B)efwa* is the 10-year history of past market-valuations computed as in Baker and Wurgler (2002). *MTaxR* is Graham's (1996a, 1996b) marginal tax rate. *Lev* is the base case measure of leverage, equal to the ratio of long-term debt over total book value of assets. The base case measure of rating is Standard and Poor's weighted-average rating (*S&PRat*), which considers all bond issues for each firm with the issue size as weight. Rows 8.1 and 8.2 show regressions using alternative leverage measures. *LevLT-MV* is the ratio of long-term debt over total assets minus book value of equity plus market value of equity. *Lev-BV* is the ratio of total debt over total book value of assets. Row 8.3 reports a similar regression to the base case, but excludes the controls. Rows 8.4 through 8.7 show regressions that use different measures of ratings. *S&PSrRat* is Standard and Poor's most senior rating for each firm. *MoodysRat* is Moody's weighted-average rating. *S&P-NR* is Standard and Poor's weighted-average rating, but includes the not-rated issues, which are considered as average junk bonds. *S&P-detail* is Standard and Poor's weighted-average rating, but considers ratings' category-modifiers. Row 8.8 reports an instrumental variable regression that includes three instruments (*(M/B)efwa*, *MTaxR*, and *StkOwn*). *StkOwn* is the percentage of stocks owned by the CEO. Column 7 shows the Hausman tests for the endogeneity between leverage and the rating-dependent variable. *OI/TA*, *PPE/TA*, *CV(OI)*, *SellExp/Sales*, and *Log[Assets]* are the control variables; coefficients are not reported to save space. *OI/TA* is the ratio of operating income before depreciation over total assets. *PPE/TA* is the ratio of net fixed assets over total assets. *CV(OI)* is the time-series coefficient of variation for the firm's operating income measured over the previous 3 years, using quarterly figures. *SellExp/Sales* is the ratio of selling expenses over sales. *Log[Assets]* is the log of the firm's total assets. All variables except for *(M/B)efwa* and *CV(OI)* correspond to a 1-year period. The instruments and controls are lagged by 1 year. *N* represents the number of observations in firm–years from 1988 to 2002, except for the row 8.8 regression, which covers 1992–2002. All regressions include year and Fama and French (1997) industry dummies; coefficients are not reported to save space. Robust z-values are in parentheses.

	Dependent Variable	Leverage Ratio	Controls	Leverage Coefficients		Instruments	Hausman Test (χ^2)	*N*
				Reduced-Form	I.V.			
	1	2	3	4	5	6	7	8
8.1	*S&PRat*	*LevLT-MV*	Yes	−4.89*** (−26.16)	−9.82*** (−9.58)	*(M/B)efwa* *MTaxR*	23.91*** (0.00)	2,675
8.2	*S&PRat*	*Lev-BV*	Yes	−4.51*** (−20.65)	−12.02*** (−8.98)	*(M/B)efwa* *MTaxR*	32.29*** (0.00)	2,678
8.3	*S&PRat*	*Lev*	No	−6.25*** (−27.37)	−13.99*** (−16.34)	*(M/B)efwa* *MTaxR*	87.88*** (0.00)	2,678
8.4	*S&PSrRat*	*Lev*	Yes	−5.47*** (−22.05)	−13.80*** (−8.96)	*(M/B)efwa* *MTaxR*	30.06*** (0.00)	2,678
8.5	*MoodysRat*	*Lev*	Yes	−4.59*** (−19.09)	−15.32*** (−9.87)	*(M/B)efwa* *MTaxR*	48.92*** (0.00)	2,720
8.6	*S&P-NR*	*Lev*	Yes	−4.75*** (−18.50)	−13.23*** (−9.04)	*(M/B)efwa* *MTaxR*	34.60*** (0.00)	2,775
8.7	*S&P-detail*	*Lev*	Yes	−5.38*** (−23.50)	−14.60*** (−10.02)	*(M/B)efwa* *MTaxR*	41.02*** (0.00)	2,678
8.8	*S&PRat*	*Lev*	Yes	−5.00*** (−14.79)	−16.66*** (−9.14)	*(M/B)efwa* *MTaxR* *StkOwn*	42.51*** (0.00)	1,704

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

debt market value leverage, the results are equivalent to the use of long-term market value leverage in row 8.1.

I also look at different sample periods (results not reported) to observe the behavior of the leverage effect on ratings through time. I find no time effect or pattern. The main result of this paper, that there is a greater leverage effect on ratings when the endogeneity is resolved, is consistent through time.

B. Econometric Issues

In Section I, I proposed a two-stage instrumental variable approach to correct the endogeneity caused by the unobservable and simultaneous effect of firms' fundamental risk on leverage and ratings. Although this econometric approach offers a consistent and asymptotically efficient estimate for the impact of leverage on ratings, in this section I consider alternative econometric approaches to account for endogeneity.

Taking advantage of the panel data dimension of my sample, I estimate the rating equation using a fixed-effects approach. Rating equation (1) can be rewritten in a panel data framework in which the unobserved firm's fundamental risk is assumed to be time invariant and considered as fixed effects. Doing this enables me to obtain consistent estimates for the coefficient that measures the impact of leverage on ratings. A fixed-effects estimation also allows me to investigate the extent to which the empirical relation between leverage and ratings is affected by the omission of unobserved heterogeneity without requiring the consideration of instrumental variables.

The leverage's coefficients of a fixed-effects estimation (results not reported) are smaller in magnitude than those reported earlier using the instrumental variable approach, but they are still significantly higher than they are when endogeneity is ignored. One explanation for the discrepancy could be the lack of variability of ratings and yields through time, which could prevent the fixed effects from fully picking up the firm's unobservable fundamental risk.

The evidence given by fixed-effects regressions is not as strong as that given by the use of instrumental variables. However, the findings do support the main result that leverage is more important when the endogeneity is considered.

In addition to a fixed-effects estimation, I also explore a simultaneous equation model, modifying the leverage equation (2) to include rating (Rat_i) as an explanatory variable. To identify the system, I need at least one additional exogenous variable that affects ratings but not leverage. That is, I need an instrument for Rat_i. Reviewing the rating literature, I consider two alternatives: a "split-rating" dummy equal to one if the firms' bond ratings given by Moody's and Standard and Poor's disagree, which is negatively related to ratings (correlation $= -0.19$),[14] and the number of years that each firm has been rated by

[14] The disagreement between rating agencies proxies for the transparency of the firm's hard information and for the importance of the soft information considered in the rating assessment. The rating literature has discussed the impact of split ratings (i.e., different ratings given by Moody's and Standard and Poor's) on the firms' ratings and yields, finding either a negative or a null impact. In my sample, 21% of the firms' bond ratings disagree.

Standard and Poor's, which is positively related to the firm's rating, in that a longer relationship contributes to a better assessment of the firm (correlation = 0.12). To include the proxy for the relation with the rating agencies, I used a cross-sectional sample with 2000–2002 averages. The results are similar if I only use the split-rating dummy in a full-sample estimation.

The estimation uses a 3SLS approach and the yield-spread as a proxy for rating to avoid the nonlinearity of ratings. The results for the rating equation (not reported) are similar to those reported in the base case estimation of Table II. In contrast, when estimating the leverage equation, I find a positive but nonsignificant effect of ratings on leverage (not reported). The nonsignificance may occur because ratings do not directly affect the leverage ratio and the simultaneous model is misspecified, or because the instruments chosen for rating are not adequate. In any case, a more complex simultaneous equation model also offers supporting evidence for the stronger effect of leverage on ratings when the endogeneity is considered.

VI. The Leverage-Rating Endogeneity across Different Firms

In this section, I investigate whether the endogeneity in the leverage-rating relationship documented above is equally present in all firms, or whether the effects of endogeneity are stronger in some firms than in others.

A. Hedgers Compared to Non-hedgers

Firms that engage in risk management respond differently to a change in fundamental risk than firms that do not. The impact of an increase in leverage on debt ratings should be lower for firms engaged in hedging activities. These firms should be less likely to be affected by shocks in their fundamental risks and less inclined to adjust leverage as a result. In addition, the debt ratings of firms that hedge should be less sensitive to exogenous shocks on the firm's intrinsic risk, which may diminish the endogeneity of leverage.

To explore the effect of hedging on the leverage-rating relation, I split the sample into firms that hedge and firms that do not. I review the 10-Ks and proxy statements of the firms in my base case. I check each firm for the use of currency or commodity price derivatives (with hedging intentions) for the years 2000 through 2002 (Panel A.1, Table IX).

I find that during the 2000–2002 period, 72% of the firms in my sample use currency derivatives and 39% use commodity price derivatives. I do not include interest rate derivatives because almost all the firms in my base case sample hedge interest rate risks. The results reported below (Panel A.1, Table IX) are similar if I use only currency derivatives, but are weaker if I use only commodity price derivatives. I note that I utilize derivative-use data only for years 2000 through 2002 because the FASB statement No. 133, which requires reporting all derivatives (as in-balance items) and hedging activities, went into effect in June 2000. If I include derivative-use data for the 1993–1999 period, the results (not reported) do not show a clear difference between firms that use

Table IX

The Effect of Leverage on Ratings across Different Firms

This table reports ordered-probit regressions of ratings (*S&PRat*) on leverage (*Lev*) and control variables for different types of firms. In Panel A, three approaches serve to separate the sample into hedgers and nonhedgers. In Panel A.1, I use data collected from 10-Ks to decide whether the firm uses commodity or currency derivatives to hedge. I restrict this sample to the 2000–2002 period because the FASB statement No. 133 on hedging disclosure went into effect in 2000. In Panel A.2, I use the foreign pretax income as a predictor of currency risk exposure and derivatives use. I consider as hedgers firms with foreign pretax income over sales greater than 5%, and as nonhedgers, firms with no foreign pretax income. In Panel A.3, I use the ratio of imports to total output, by 4-digit SIC industry codes, as a predictor of currency risk exposure and derivate use. The data on imports of manufacturing firms are from the U.S. Department of Commerce. The half sample with higher imports is considered as being composed of hedgers and the half sample with lower imports is considered to be composed of nonhedgers. In Panel B, I use three different approaches to split the sample by the level of the firms' financial constraints. In Panel B.1, I use the five-variable Kaplan and Zingales (1997) index (*KZ-index*) to measure how constrained a firm is. The *KZ-index* looks at measures of cash flow (*CF/A*), dividends (*Div/A*), cash (*C/A*), leverage (*Lvg*), and *Q*. $KZ\text{-}index = -1.0 * CF/A - 39.4 * Div/A - 1.3 * C/A + 3.1 * Lvg + 0.3 * Q$. *A* is the firm's assets lagged by 1 year. *Lvg* is measured as total debt over total debt plus book value of equity. *Q* is the market value of equity plus assets minus the book value of equity all over assets. In Panel B.2, I use a three-variable index equal to the original *KZ-index*, but excluding the leverage and *Q* determinants. The top third sample with a higher *KZ-index* is the constrained sample and the bottom third sample is the unconstrained sample. In Panel B.3, I use the Korajczyk and Levy (2003) criteria, which defines firms that pay no dividends ($Div = 0$) and have a Tobin's *Q* larger than one as financially constrained. Columns 1 and 3 of each panel show the hedgers and financially constrained sample regressions, and columns 2 and 4 show the nonhedgers and financially unconstrained sample regressions. Columns 1 and 2 of each panel show the reduced-form regressions and columns 3 and 4 show the instrumental variable regressions. *S&PRat* is Standard and Poor's weighted-average rating, which considers all bond issues for each firm with the issue size as weight. *Lev* is the ratio of long-term debt over total book value of assets. The instrumental variable regressions consider *(M/B)efwa* and *MTaxR* as the instruments for *Lev*. *(M/B)efwa* is the 10-year history of past market valuations computed as in Baker and Wurgler (2002). *MTaxR* is Graham's (1996a, 1996b) marginal-tax-rate. *OI/TA*, *PPE/TA*, *CV(OI)*, *SellExp/Sales*, and *Log[Assets]* are the control variables. To save space I do not report their coefficients. *OI/TA* is the ratio of operating income before depreciation over total assets. *PPE/TA* is the ratio of net fixed assets over total assets. *CV(OI)* is the time-series coefficient of variation for the firm's operating income measured over the previous 3 years, using quarterly figures. *SellExp/Sales* is the ratio of selling expenses over sales. *Log[Assets]* is the log of the firm's total assets. All variables except for *(M/B)efwa* and *CV(OI)* correspond to a 1-year period. The instruments and controls are lagged by 1 year. *N* represents the number of observations in firm–years from 2000 to 2002 in Panel A.1, from 1988 to 2001 in Panel A.2, and from 1988 to 2002 in all other cases. The Hausman test (row a in Panels A and B) is a specification test for the endogeneity between *Lev* and *S&PRat*, as compared with the respective reduced-form case (*p*-values in parentheses). All regressions include year and Fama and French (1997) industry dummies; coefficients are not reported to save space. Robust *z*-values are in parentheses.

Panel A: Hedgers Compared to Non-Hedgers												
	Dependent Variable: *S&PRat*											
	Panel A.1				Panel A.2				Panel A.3			
	Firm's use of Derivatives (Exchange Rate or Commodity Prices)				Firm's Exposure to Exchange Rate Risk: Foreign Pretax Income/Sales (*FPI/SL*)				Firm's Exposure to Exchange Rate Risk: % of Imports in 4-Digit SIC Industry			
	Reduced-Form		I.V.		Reduced-Form		I.V.		Reduced-Form		I.V.	
Split Sample According to:	Hedge 1	Do not Hedge 2	Hedge 3	Do not Hedge 4	$FPI/SL >$ 5% 1	$FPI/SL =$ 0 2	$FPI/SL >$ 5% 3	$FPI/SL =$ 0 4	High Imports 1	Low Imports 2	High Imports 3	Low Imports 4
Lev	−5.04***	−9.43***	−10.25***	−24.05***	−8.91***	−5.65***	−9.24***	−20.01***	−6.52***	−8.27***	−12.98***	−24.06***
	(−6.44)	(−6.17)	(−3.73)	(−3.17)	(−8.40)	(−13.28)	(−3.22)	(−4.11)	(−10.98)	(−14.57)	(−5.27)	(−6.07)
Hausman test[a]			3.92**	3.86***			0.02	8.76***			7.32***	16.21***
(*p*-value)			(0.05)	(0.05)			(0.90)	(0.00)			(0.01)	(0.00)
N	385	117	385	117	338	910	338	910	758	759	758	759

Panel B: Constrained Compared to Unconstrained Firms

	Dependent Variable: *S&PRat*											
	Panel B.1				Panel B.2				Panel B.3			
	5-Var. Kaplan and Zingales (1997) Index:				3-Var. Kaplan and Zingales (1997) Index:				Korajczyk and Levy (2003) Criteria: Firm Is Constrained if $Div = 0$ and $Q > 1$			
	Reduced-Form		I.V.		Reduced-Form		I.V.		Reduced-Form		I.V.	
Split Sample According to:	Constrained 1	Unconstrained 2	Constrained 3	Unconstrained 4	Constrained 1	Unconstrained 2	Constrained 3	Unconstrained 4	Constrained 1	Unconstrained 2	Constrained 3	Unconstrained 4
Lev	−3.90***	−5.04***	−1.98	−17.94***	−4.79***	−7.49***	−3.32	−26.40***	−6.96***	−5.61***	−7.60**	−16.58***
	(−9.12)	(−6.64)	(−0.47)	(−3.43)	(−12.45)	(−12.48)	(−1.39)	(−4.41)	(−9.94)	(−19.19)	(−2.53)	(−8.08)
Hausman test[a]			0.21	6.22***			0.39	10.09***			0.05	29.18***
(p-value)			(0.64)	(0.01)			(0.53)	(0.00)			(0.83)	(0.00)
N	892	892	892	892	892	892	892	892	300	2,354	300	2,354

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

derivatives and firms that do not. The reason for this may be the quality of hedging disclosure. Derivative-use data for this earlier period is less available.

The other two approaches I use to separate the sample are less direct. Géczy, Minton, and Schrand (1997) find that the use of currency derivatives is associated with greater growth opportunities and tighter financial constraints, firms with foreign operations, and larger firms.

The first point that considers financial constraints is discussed below. Here, I use two of their proxies for firms' exposure to exchange rate risk to split the sample: the ratio of foreign pretax income to sales as reported by COMPUSTAT (Panel A.2, Table IX), and the percentage of 4-digit SIC industry imports over total production, as reported by the U.S. Department of Commerce for manufacturing firms (Panel A.3, Table IX).[15] I define firms as being exposed to the exchange rate risk when they exhibit a ratio of foreign pretax income to sales greater than 5%, and when they belong to an industry with imports to total production higher than the median in the sample. I define firms as less likely to use currency derivatives when they report zero foreign pretax income, and when they are in industries with a lower percentage of imports than the median.

Panel A in Table IX presents the results comparing hedgers to nonhedgers. Columns 1 and 2 of each panel show the results without instrumenting leverage, and columns 3 and 4 show the instrumental variable estimations. The results in columns 1 and 3 of each panel are for the hedger sample and the results in columns 2 and 4 are for the nonhedger sample. The regressions include control variables and year and industry dummies as in the base case, but to save space only the leverage coefficients are reported.

First, when I compare the results in Panel A, Table IX with the full sample results of Table II, I find that the instrumented leverage coefficient is significantly higher if firms do not hedge and significantly lower if firms do hedge. Second, in one of the cases (Panel A.2), when the firms are likely to hedge, the instrumented leverage coefficient is not significantly higher than it is if endogeneity is ignored.[16] Third, in two of the cases (Panels A.1 and A.3), the reduced form estimates for the leverage coefficient are higher when the firms do not hedge than when they do hedge.

Overall, these results confirm the hypothesis that leverage is more important for ratings when a firm is not engaged in hedging activities and is less important for firms that do hedge. However, the endogeneity of leverage needs to be considered, regardless of the risk management position of the firm.

By comparing the cases of firms that hedge with firms that do not, I am not considering that the decision to hedge is also endogenous. In any case, the results in this section are consistent with Graham and Rogers (2002) and with

[15] The U.S. Department of Commerce reports the data only for manufacturing firms. The last year of data available is for 2001, which limits my analysis to manufacturing firms and to the 1988–2001 sample period from which this data was compiled.

[16] I consider firms with foreign pretax income over sales higher than 5% as likely to hedge. If a lower cutoff is used, or if all firms with a positive foreign pretax income are considered likely to hedge, the leverage coefficient is then higher when leverage is instrumented.

Allayannis and Weston (2001), who find that risk management adds value, and with Nance, Smith, and Smithson (1993), who find that hedging is associated with a reduction in financial distress costs.

B. Constrained Compared to Unconstrained Firms

Firms that are financially constrained may not be able to adjust their leverage, even if its fundamental risk receives an exogenous shock. Korajczyk and Levy (2003) find that unconstrained firms adjust their capital structure in order to time their issues, while constrained firms do not, which is consistent with having a more important endogeneity effect when firms are financially unconstrained. Géczy et al. (1997) find an association between the use of derivatives and tighter financial constraints, which relates the arguments of firms that do hedging stated in the previous section with those presented here for firms that are financially constrained.

Intuitively, capital structure decisions by financially constrained firms may be driven more by investment and growth opportunities than by the firm's fundamental risk or debt pricing considerations. If this is the case, the importance of the unobserved fundamental risk effect on leverage (and thus the endogeneity bias in the leverage's effect on ratings) is diminished. On the other hand, firms that are financially unconstrained have more flexibility, and their leverage ratios are more sensible to exogenous shocks in their fundamental risks. As a result, the bias in the leverage's effect on ratings should be larger in the case of unconstrained firms.

To examine this hypothesis, I separate the sample into constrained and unconstrained firms. Following Kaplan and Zingales (1997), Lamont, Polk, and Saa-Requejo (2001), and Baker et al. (2003), I construct a synthetic five-variable Kaplan and Zingales index (i.e., *KZ-index*) of financial constraints for each firm–year, using the following linear combination given by these studies:

$$\begin{aligned} KZ - index_{it} = & -1.002\frac{CF_{it}}{A_{it-1}} - 39.368\frac{Div_{it}}{A_{it-1}} \\ & - 1.315\frac{C_{it}}{A_{it-1}} + 3.139Lvg_{it} + 0.283Q_{it}. \end{aligned} \quad (4)$$

In equation (4), *CF/A* is cash flow over assets; *Div/A* is cash dividends over assets; *C/A* is cash balances over assets; *Lvg* is book value leverage, which I measure as total debt over total debt plus book value of equity; and *Q* is the market value of equity plus assets minus the book value of equity all over assets. The top third sample with higher *KZ-index* is the constrained sample, and the bottom third sample is the unconstrained sample (Panel B.1, Table IX). To avoid endogeneity concerns, I also use a KZ-index that excludes *Lvg* and *Q*, considering only the remaining three variables (Panel B.2, Table IX).

Alternatively, I split the sample according to the criteria proposed by Korajczyk and Levy (2003): A firm is financially constrained if it pays no dividend ($Div = 0$), and has a $Q > 1$. All remaining firms are then defined as unconstrained (Panel B.3, Table IX).

Panel B in Table IX presents the results from comparing financially constrained firms to unconstrained firms. Columns 1 and 2 in each panel present the results without instrumenting leverage, and columns 3 and 4 for the instrumental variable estimations. The results in columns 1 and 3 of each panel are for the constrained sample and the results in columns 2 and 4 are for the unconstrained sample. As in Panel A, only the leverage coefficients are reported.

The main result from Panel B in Table IX is that when firms are financially unconstrained, the coefficients for the instrumented leverage remain negative but are larger in absolute value when compared with the estimates obtained with the full sample (Table II). In the case of the constrained sample, the instrumented leverage coefficients are not higher than the reduced-form coefficients, and are even insignificant when I use the two versions of the *KZ-index* to separate the sample. The nonexistence of this bias supports the argument that constrained firms have less flexibility to adjust their leverage and therefore are less sensitive to changes in fundamental risk.

The results are qualitatively and quantitatively the same for the three ways of splitting the sample. These results confirm the hypothesis that leverage is more (less) important for ratings when the firm is financially unconstrained (constrained).

Previous findings can also be related to an analysis by Baker et al. (2003), which provides a different rationale for why endogeneity is less severe when firms are financially constrained. As they point out, financially constrained firms only issue equity if they need funds to invest, which they do exclusively when their stock prices are high enough. Thereby, these firms' leverage is less sensitive to their fundamental risks and more sensitive to their stock prices, which reduces the endogeneity problem caused by shocks in the unobserved fundamental risk.

VII. Conclusion

In this paper, I attempt to empirically measure the impact of a leverage increase on the probability of default. By doing so, I present an estimation for the ex ante costs of financial distress that can offset the current estimates of debt's tax benefits. My results provide at least a partial explanation for the capital structure puzzle of why firms do not use more leverage.

By using the firm's debt rating as a proxy for the default risk and correcting for the endogeneity of leverage, I am able to measure the true impact of leverage on the probability of default. I propose a model in which leverage and ratings are jointly affected by the exogenous and unobservable firm's fundamental risk, which if ignored, produces a bias that makes the leverage's effect on ratings appear less strong than it really is. Using an instrumental variable approach, I show that leverage negatively affects debt ratings up to three times more than it does when endogeneity is ignored. I use the stronger impact of leverage on ratings to translate an increase in the use of debt into a rating downgrade, and then into an increase in default probabilities. This increase in the firm's probability of default is multiplied by the ex post financial distress costs estimated in the literature, to estimate the effect of a leverage increase on the firm's ex ante costs of financial distress. I show then that this increase in financial distress costs can offset the tax benefits estimated by Graham (2000).

The result of a stronger leverage effect on ratings is robust to different proxies for debt ratings, different specifications in the rating equation, and different time periods.

I also find that the stronger leverage effect on ratings is less evident when firms are engaged in hedging activities and when firms are financially constrained. On the other hand, the impact of leverage on ratings is even stronger when firms are less likely to hedge and when firms are financially unconstrained. Firms engaged in hedging activities are less likely to be affected by shocks in their fundamental risks and are less inclined to adjust leverage as a result, which then diminishes the endogeneity of leverage. In addition, firms that are financially constrained find it difficult to adjust their leverage because of external variations in the firm's fundamental risk, making the leverage effect on ratings weaker.

The analysis of the leverage-rating relation presented in this paper suggests new questions that warrant additional research. For instance, what is the role of rating agencies in capital structure decisions? Is the rating's influence on debt ratios direct or indirect? These are areas for future exploration.

REFERENCES

Alderson, Michael J., and Brian L. Betker, 1995, Liquidation costs and capital structure, *Journal of Financial Economics* 39, 45–69.

Allayannis, George, and James P. Weston, 2001, The use of foreign currency derivatives and firm market value, *Review of Financial Studies* 14, 243–276.

Altman, Edward I., 1968, Financial ratios, discriminant analysis, and the prediction of corporate bankruptcy, *Journal of Finance* 23, 589–609.

Altman, Edward I., 1984, A further empirical investigation of the bankruptcy cost question, *Journal of Finance* 39, 1067–1089.

Altman, Edward I., and Pablo Arman, 2002, Default and return on high yield bonds: Analysis through 2001, *Journal of Applied Finance* 12, 98–112.

Andrade, Gregor, and Steven N. Kaplan, 1998, How costly is financial (not economic) distress? Evidence from highly leveraged transactions that became distressed, *Journal of Finance* 53, 1443–1493.

Asquith, Paul, Robert Gertner, and David Sharfstein, 1994, Anatomy of a financial distress: An examination of junk-bond issuers, *Quarterly Journal of Economics* 109, 625–658.

Baker, Malcolm, Jeremy Stein, and Jeffrey Wurgler, 2003, When does the market matter? Stock prices and the investment of equity-dependent firms, *Quarterly Journal of Economics* 118, 969–1006.

Baker, Malcolm, and Jeffrey Wurgler, 2002, Market timing and capital structure, *Journal of Finance* 57, 1–32.

Berger, Philip G., Eli Ofek, and David L. Yermack, 1997, Managerial entrenchment and capital structure decisions, *Journal of Finance* 52, 1411–1438.

Bradley, Michael, Gregg Jarrell, and E. Han Kim, 1984, On the existence of an optimal capital structure: Theory and evidence, *Journal of Finance* 39, 857–878.

Campa, Jose Manuel, and Simi Kedia, 2002, Explaining the diversification discount, *Journal of Finance* 57, 1731–1762.

Castanias, Richard, 1983, Bankruptcy risk and optimal capital structure, *Journal of Finance* 38, 1617–1635.

Chevalier, Judith, 2004, What do we know about cross-subsidization? Evidence from merging firms, *The B.E. Journals in Economic Analysis and Policy: Advances in Economic Analysis and Policy* 4, Article 3.

The Economist, 2001, Debt is for you: Or so the theorists say, January 27, Survey.

Ederington, Louis H., and Jess B. Yawitz, 1987, The bond rating process, in Edward I. Altman, ed.: *Handbook of Financial Markets and Institutions*, 6th ed. (John Wiley & Sons, Inc., New York).

Ederington, Louis H., Jess B. Yawitz, and Brian E. Roberts, 1987, The informational content of bond ratings, *Journal of Financial Research* 10, 211–226.

Fama, Eugene F., and Kenneth R. French, 1997, Industry cost of equity, *Journal of Financial Economics* 43, 153–193.

Faulkender, Michael, and Mitchell A. Petersen, 2004, Does the source of capital affect capital structure? Working paper, Washington University.

Géczy, Christopher, Bernadette A. Minton, and Catherine Schrand, 1997, Why firms use currency derivatives, *Journal of Finance* 52, 1323–1354.

Goyal, Vidhan K., Kenneth Lehn, and Stanko Racic, 2002, Growth opportunities and corporate debt policy: The case of the U.S. defense industry, *Journal of Financial Economics* 64, 35–59.

Graham, John R., 1996a, Debt and the marginal tax rate, *Journal of Financial Economics* 41, 41–73.

Graham, John R., 1996b, Proxies for the corporate marginal tax rate, *Journal of Financial Economics* 42, 187–221.

Graham, John R., 2000, How big are the tax benefits of debt? *Journal of Finance* 55, 1901–1941.

Graham, John R., and Campbell R. Harvey, 2001, The theory and practice of corporate finance: Evidence from the field, *Journal of Financial Economics* 60, 187–243.

Graham, John R., Michael L. Lemmon, and James S. Schallheim, 1998, Debt, leases, taxes, and the endogeneity of corporate tax status, *Journal of Finance* 53, 131–162.

Graham, John R., Michael L. Lemmon, and Jack G. Wolf, 2002, Does corporate diversification destroy value? *Journal of Finance* 57, 695–720.

Graham, John R., and Daniel A. Rogers, 2002, Do firms hedge in response to tax incentives? *Journal of Finance* 57, 815–839.

Hadi, Ali S., 1992, Identifying multiple outliers in multivariate data, *Journal of the Royal Statistical Society, Series B* 54, 761–771.

Hadi, Ali S., 1994, A modification of a method for the detection of outliers in multivariate samples, *Journal of the Royal Statistical Society, Series B* 56, 393–396.

Harris, Milton, and Arthur Raviv, 1991, The theory of capital structure, *Journal of Finance* 46, 297–355.

Himmelberg, Charles P., R. Glenn Hubbard, and Darius Palia, 1999, Understanding the determinants of managerial ownership and the link between ownership and performance, *Journal of Financial Economics* 53, 353–384.

Jensen, Michael C., and William H. Meckling, 1976, Theory of the firm: Managerial behavior, agency costs, and ownership structure, *Journal of Financial Economics* 7, 305–360.

Johnson, Shane A., 2003, Debt maturity and the effects of growth opportunities and liquidity risk on leverage, *Review of Financial Studies* 16, 209–236.

Kaplan, Robert S., and Gabriel Urwitz, 1979, Statistical models of bond ratings: A methodological inquiry, *Journal of Business* 52, 231–261.

Kaplan, Steven N., and Luigi Zingales, 1997, Do investment-cash flow sensitivities provide useful measures of financial constraints? *Quarterly Journal of Economics* 112, 169–215.

Korajczyk, Robert A., and Amnon Levy, 2003, Capital structure choice: Macroeconomic conditions and financial constraints, *Journal of Financial Economics* 68, 75–109.

Lamont, Owen, and Christopher Polk, 2001, The diversification discount: Cash flows versus returns, *Journal of Finance* 56, 1693–1721.

Lamont, Owen, Christopher Polk, and Jesus Saa-Requejo, 2001, Financial constraints and stock returns, *Review of Financial Studies* 14, 529–554.

Leland, Hayne E., 1994, Corporate debt value, bond covenants, and optimal capital structure, *Journal of Finance* 49, 1213–1252.

Leland, Hayne E., 1998, Agency costs, risk management, and capital structure, *Journal of Finance* 53, 1213–1243.

Leland, Hayne E., and Klaus Toft, 1996, Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads, *Journal of Finance* 51, 987–1019.

Lemmon, Michael L., and Jaime F. Zender, 2001, Looking under the lamppost: An empirical examination of the determinants of capital structure, Working paper, University of Utah.

Marsh, Paul, 1982, The choice between equity and debt: An empirical study, *Journal of Finance* 37, 121–144.

Miller, Merton H., 1977, Debt and taxes, *Journal of Finance* 32, 261–275.

Minton, Bernadette A., and Karen H. Wruck, 2001, Financial conservatism: Evidence on capital structure from low leverage firms, AFA 2002 Atlanta; Dice Center, Working paper no. 2001-2006.

Modigliani, Franco, and Merton H. Miller, 1963, Corporate income taxes and the cost of capital: A correction, *American Economic Review* 53, 433–443.

Myers, Stewart C., 1977, Determinants of corporate borrowing, *Journal of Financial Economics* 5, 147–175.

Myers, Stewart C., 1984, The capital structure puzzle, *Journal of Finance* 39, 575–592.

Myers, Stewart C., and Nicholas S. Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13, 187–221.

Nance, Deana R., Clifford W. Smith Jr., and Charles W. Smithson, 1993, On the determinants of corporate hedging, *Journal of Finance* 48, 267–284.

Nelson, Forrest, and Lawrence Olsen, 1978, Specification and estimation of a simultaneous equation model with limited dependent variables, *International Economic Review* 19, 695–705.

Parrino, Robert, and Michael Weisbach, 1999, Measuring investment distortions arising from stockholder-bondholder conflicts, *Journal of Financial Economics* 53, 3–42.

Smith, Richard J., and Richard W. Blundell, 1986, An exogeneity test for the simultaneous equation Tobit model with an application to labor supply, *Econometrica* 54, 679–685.

Staiger, Douglas, and James H. Stock, 1997, Instrumental variables regression with weak instruments, *Econometrica* 65, 557–586.

Titman, Sheridan, and Sergey Tsyplakov, 2003, A dynamic model of optimal capital structure, Working paper, University of Texas at Austin.

Titman, Sheridan, and Roberto Wessels, 1988, The determinants of capital structure choice, *Journal of Finance* 43, 1–19.

Warga, Arthur, 1998, Lehman Brothers fixed income database, Unpublished manuscript, University of Houston.

White, Halbert, 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817–838.