DETERMINANTS OF FIRMS' CAPITAL STRUCTURE CHOICE, THEIR CREDIT RATINGS AND THE LEVERAGE-RATING RELATION

A Dissertation

Presented to

The Faculty of the Department

of Economics

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In Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Economics

By

Doruk Ilgaz

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Doruk Ilgaz

APPROVED:

Dietrich Vollrath, Ph.D.
Committee Chair

Chris Murray, Ph.D.

David Papell, Ph.D.

Vijay Yerramilli, Ph.D.
Department of Finance

John W. Roberts, Ph.D.
Dean, College of Liberal Arts and Social Sciences
Department of English

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Dissertation Chapter 1

How important is "target leverage?" A study of determinants of firms' capital structure adjustments

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Abstract

Both theory and practice seem to agree that firms adjust their capital structure to stay in close proximity to a target leverage ratio. However, this target leverage ratio is not accounted for as a determinant of leverage in existing empirical work. Recent findings in the leverage adjustment speed literature yield a practical way to calculate these target leverage ratios. In this paper, I calculate the deviation of actual leverage from target leverage and use it as a determinant of firm's leverage along with a set of other control variables that are traditionally used in the literature. I find that the addition of deviations from target leverage more than doubles the explanatory power compared to existing empirical specifications. Using standardized regression coefficients I show that the deviation from target leverage ratios is the most important determinant of firms' capital structure.

I. Introduction

Graham and Harvey's (2001) survey of managers points out that firms choose to operate at a firm-specific level of leverage. Lemmon, Roberts and Zender (2008) show that capital structures are remarkably stable over time; and that firms with high (low) leverage maintain relatively high (low) leverage for over twenty years, independent of being public or private. Flannery and Rangan (2006), Leary and Roberts (2005), Huang and Ritter (2009), and Frank and Goyal (2009) confirm that firms have target leverage ratios and adjust their leverage to keep in close proximity to their target level of leverage over many years.[1] Specifically, Lemmon, Roberts and Zender (2008) mention that firms use security issuances to maintain leverage ratios in a relatively confined region around a long-run mean, consistent with a dynamic rebalancing of capital structure. If the target leverage ratio is such an essential factor then it should have predictive power for future leverage adjustments. If so, how important is that relative to other factors? Particularly, how much of observed leverage adjustments can be attributed to the target leverage concept?

Although the above studies well document a firm's motive to stay near its target leverage ratio, the capital structure literature fails to include it as a factor in explaining leverage adjustments. In a panel setting, I study the relative importance of the target leverage ratio versus other traditional determinants of a firm's leverage decisions. I show that the deviations from the target leverage ratio are the most important factor

[1] In addition, Kayhan and Titman (2007), Hennessy, Livdan, and Miranda (2010), Mehrotra, Mikkelson, and Partch (2003), and Jalilvand and Harris (1984).

behind leverage adjustments. Inclusion of this factor in the empirical specification increases the explanatory power by a factor two. The estimates are similar for sub-samples of investment grade, speculative grade as well as non-rated firms.

Historically, capital structure theory is dominated by two models: the trade-off model (Kraus, Litzenberger (1973), Scott (1976)), and the pecking order model (Donaldson (1961), Myers and Majluf (1984)). Pecking order theory argues that due to information asymmetry firms prefer internal funds over external funds and equity financing is a last resort. This suggests that firms do not aim at any target leverage ratio; instead, the leverage ratio is just the cumulative result of hierarchical financing over time (Shyam-Sunder, Myers (1999)). The trade-off model, on the other hand, says that firms trade-off costs (cost of borrowing) and benefits (tax shield) of debt and operate at their optimal level of leverage. There is vast empirical literature arguing the relative merits of each model. It is well-documented that firms do operate at some particular level of leverage, [2] but it is not certain whether taxes matter.[3] Firms also seem to follow some sort of modified pecking order model (Lemmon and Zender (2004)) but their choice of funding does not seem to be driven by information asymmetry (Jung, Kim, Stulz (1996), Leary and Roberts (2010)). More recent empirical studies, such as Lemmon, Roberts and Zender (2008), model leverage in a dynamic rebalancing setting and show that capital

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[2] Taggart (1977), Marsh (1982), Auerbach (1985), Jalilvand and Harris (1984) and Howakimian, Opler and Titman (2001) find mean reversion in debt ratios and evidence that firms appear to adjust toward debt targets.

3 Titman and Wessels (1988) and Gaver, and Gaver (1993) do not find any relation between corporate debt and taxes. MacKie, Mason (1990), Givoly et al. (1992), Rajan, Zingales (1995), Graham(1996a) and Graham, Lemmon, Schalleim (1998), on the other hand, find a positive association. However, Barclay and Smith (1995a), Sharpe and Nguyen (1995) find a negative association.

structures persist over time around some firm-specific target level. The literature that studies determinants of a firm's leverage has yet to account for the target leverage ratios as a factor in a panel setting.

In this paper I follow the leverage adjustment literature to calculate target levels of leverage.[4] Then, I subtract it from the current leverage ratio to calculate the deviation from the target level of leverage. I then test for the significance of this deviation in determining subsequent changes in leverage ratios.

Specifically, I regress the leverage ratio on the deviation from the target ratios as well as growth options, profitability, income volatility, asset tangibility, product uniqueness, size, and marginal tax rate. I also run estimations for different rating groups as well as for firms classified by changes in their leverage ratios. In both cases, the addition of deviation from target leverage as a control variable doubles the explanatory power of the model. Using standardized coefficients, I compare the relative importance of these factors. My main finding is that deviations from the target leverage seem to be the most important as any other control variable in most cases. The results are robust to estimation using leverage levels or changes in leverage as the dependent variable.

The rest of this article is organized as follows. Section II describes the data. Section III explains the variables employed in my model. Section IV presents the

[4] Such as in Flannery and Rangan (2006), Lemmon, Roberts, and Zender (2008), Huang and Ritter (2009), and Faulkender, Flannery Hankins and Smith (2010). Following leverage adjustment literature, I use a standard partial-adjustment model of firm's capital structure to estimate target leverages. I calculate the deviation from the target leverage as the difference between target leverage and current leverage.

empirical findings for the proposed econometric implementation. Finally, Section V concludes.

II. Data

I calculate the variables using the data in the COMPUSTAT annual industrial files. The variable definitions are given in the Appendix. Table 2 displays the descriptive statistics of the variables.

[Table 1]

A. Data Selection

All firm-year observations are obtained from COMPUSTAT for the 1985-2010 period. Following Fama and French (1997) I exclude the firms from the financial sector (SICs 6000-6999), from non-classifiable establishments (SICs 9995-9999), and from the regulated sector or utilities (SICs 4900-4999). I discard any observations with missing values for total assets, long-term debt, total liabilities, fiscal year end share price, fiscal year end shares outstanding, operating income, property, plant and equipment and double entries from the dataset. I discard firm-year observations that yield negative book value of equity. To avoid outliers, I trim the observations that correspond to the top and bottom 0.5% values of the variables. In calculating standard deviations for variables, I eliminate the firms with less than five years of frequency from the dataset. I did not restrict the dataset to be balanced. Firms may exit and reappear in the sample. I also use Standard and Poor's issuer rating (data280)[5] as reported in COMPUSTAT. Firms that are rated below (above) BBB- are referred to as speculative (investment) grade, and firms without a debt rating at all are referred to as non-rated. Sample consists of 2,585 public and private firms and 15,860 firm-year observations. 3,820 of the observations, about a quarter of my sample have an assigned debt rating.

B. Data Manipulation

I use variables in three forms: levels, changes and standardized changes. Level form of a variable is as calculated using COMPUSTAT values. The change in a variable is the difference between its current level and its lagged level.[6] Thirdly, the standardized changes in variables are the changes in variables demeaned and divided by the standard deviation of that variable in the sample period for each firm. In calculating standard deviation, I require the firms to have at least five years of frequency in the sample period.

[5] Standard and Poor's issuer rating (data280) is decoded to an ordinal scale that starts with a numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Rating modifiers, which show relative standing within the major rating categories, are excluded as the case in other studies in literature.

[6] The observations in 1984 are lagged and only used to calculate the change in explanatory variables for 1985 then discarded.

III. Model Variables

This section explains the variables used in estimating firms' leverage ratios. First, it explains the dependent variable, the leverage ratio, then follows by the independent variables, deviation from the target leverage, market to book ratio as a proxy for growth options, operating income to total assets as proxy for profitability, coefficient of variation of quarterly operating income as proxy for income volatility, plant, property and equipment over total assets (fixed ratio) as proxy for asset tangibility, sales expenses over sales as proxy for product uniqueness, logarithm of total assets for firms' size and finally marginal tax rate.

A. Dependent Variable: Firm's Leverage Ratio

I calculate leverage ($Lev_{i,t}$) as long term debt over total assets. I also calculate other alternative measures of leverage such as, book-value leverage (i.e. total debt / total assets), and market-value leverage (i.e. total debt / (total assets + market value of equity - book value of equity)).

B. Independent Variable: Deviations from Target Leverage

Studies show that firms determine an optimal leverage ratio and follow this ratio over long years. Lemmon, Roberts and Zender (2008) specifically focus on the persistence in the leverage ratios and show that the capital structures are remarkably stable over time. Their empirical results point out to that firms with high (low) leverage remain relatively high (low) leverage for over twenty years, independent of being public or private or going to public decisions. Lemmon, Roberts and Zender (2008) note that firm fixed effects (including industry effects) only account for 10% of the variation, whereas an unobserved firm specific effect is responsible for 90% of the explained variation in leverage. They find that firms use security issuances to maintain their leverage ratios in relatively confined regions around their long-run means, consistent with a dynamic rebalancing of capital structure.

According to the trade-off model, a firm has an incentive to correct the deviation from its target level of leverage. A leverage change (at a year t) would ideally correct the previous distance (at year t-1) from the target level.

Following several studies in the leverage adjustment literature, such as Flannery and Rangan (2006), Lemmon, Roberts, and Zender (2008), Huang and Ritter (2009) and Faulkender, Flannery, Hankins, and Smith (2010) (FFHS hereafter), I start with a standard partial-adjustment model of firm capital structure to estimate a regression of the form:

$$Lev_{i,t} - Lev_{i,t-1} = \gamma\left(Lev^{*}_{i,t} - Lev_{i,t-1}\right) + \varepsilon_{i,t} \quad (1)$$

where $Lev_{i,t}$ is leverage, $Lev_{i,t-1}$ is lagged leverage and $Lev^{*}_{i,t}$ is the estimated target leverage, given firm characteristics at t-1. According to this model, the typical firm adjusts its leverage annually and at each adjustment closes γ percent (per time period) of the gap between its target leverage and its beginning of period leverage. In the leverage adjustment literature, this “gamma” value is commonly called the firm’s speed of “adjustment” toward target.

The regression in (1) relies on an estimated target leverage, $Lev^*_{i,t}$. The most challenging aspect of estimating either regression is constructing an estimate of the firm’s target leverage. Following the same procedure as FFHS, I rearrange (1) with the restriction $Lev^*_{i,t} = \beta X_{i,t-1}$ into:

$$Lev_{i,t} = \gamma\beta X_{i,t-1} + (1-\gamma)Lev_{i,t-1} + \varepsilon_{i,t} \qquad (2)$$

where β is a coefficient vector to be estimated concurrently with γ and $X_{i,t-1}$ includes:

a *constant*,

EbitTA = (Income before Extraord. Items + Interest Exp. + Income Taxes) /Tot. Assets,

MBTA = ((Book Liabilities + Market Value of Equity) / Total Assets,

DEPTA = Depreciation and Amortization / Total Assets,

LogA = log (Total Assets adjusted by the consumer price index to 2010 US dollars),

PPATA = Net property, plant and equipment / Total Assets,

XRDTA = Research and Development Expense / Total Assets,

XRDDummy = 1 if Research and Development Expense > 0, else zero, and

IndLev = Median Debt Ratio for the firm’s Fama and French (1997) industry.

This sort of dynamic panel model entails some important estimation issues (Nickell (1981), Baltagi (2008)). Flannery and Hankins (2010) review and conclude that among others the Blundell and Bond's (1998) system GMM estimation method generally provides adequate estimates.

Table 2 presents the results of this system GMM estimation for my sample.

[Table 2]

Estimation yields the coefficient vector β (as in Table 2), which I use to construct the firms' annual target leverage ratios. Then I calculate the deviation from the target leverage:

$$Dev_{i,t} = Lev^{*}_{i,t} - Lev_{i,t-1} \tag{3}$$

Deviation from the target leverage ratio ($Dev_{i,t-1}$) should be one determinant of next year's leverage change. The greater (less) the deviation, the greater (less) should be the leverage change in order to get back to the target level of leverage.

C. Firm-Specific Control Variables

Graham and Harvey's (2001) field study shows that managers value financial flexibility and firms prioritize internal funds to external funds.[7] Firms adjust their capital structure in the most cost efficient way. When considering changes in leverage, changes in firm dynamics should be taken into account.

Changes in profitability or other firm dynamics would affect availability of or need for funds, and leverage for that matter. Capital structure literature uses a set of

[7] Though, Graham and Harvey (2001) point out that this is different what original pecking order theory (Myers and Majluf, 1984) says, thus refer to this finding as financial flexibility

variables commonly accepted to affect firm's leverage ratios. Following the literature I include proxies for growth options, profitability, income volatility, asset tangibility, product uniqueness, size and tax rates.

For firm's growth options ($MB/TA_{i,t-1}$) I use the market-to-book ratio (= (market value + book liabilities) / total assets). If firm's market-to-book ratio is high enough then raising capital through equity issues is more advantageous than raising capital through debt issues. Leary and Roberts (2005) find that firms respond to equity issuances and equity price shocks by appropriately rebalancing their leverage.

I measure profitability ($OI/TA_{i,t-1}$) by the return on assets (= operating income / total assets). Standard and Poor's state that firms with higher operating margins have a greater ability to generate equity capital internally, to attract capital externally, and to withstand business adversity.

As a proxy for income volatility ($cv(OI)_{i,t-1}$), I calculate the coefficient of variation of the quarterly income. 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 $cv(OI)_{i,t}$ for the 3-year period preceding the year in question. Including this variable controls for the observable part of the firm's past income volatility.

I measure firm's asset tangibility ($PPE/TA_{i,t-1}$) by the fixed asset ratio (net plant, property and equipment / total assets).

Following Titman and Wessels (1988), I use selling expenses over sales as a proxy for uniqueness ($SE/S_{i,t-1}$). 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. It is considered as a risk factor.

For firm's size ($LogA_{i,t-1}$) I use the logarithm of its total assets adjusted for inflation (prices at 2010). 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.

As the final control for leverage, I use the marginal tax rates ($MTaxR_{i,t-1}$). The marginal tax rate dataset is the extended version of that used in Graham's (1996a, 1996b) study.[8] Tax advantage of using debt creates an incentive for increasing leverage. Following Graham, Lemmon, and Schallheim (1998), and Molina (2005) I use the marginal tax rates before interest (i.e., based on the 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.

This is the most practical way of considering the tax effects on leverage ratios. Having said that, when marginal tax rate data is plotted, the first thing to notice is clustering (bunching) around the values of 0%, 34% and 40%. This is the main motivation to also use first differenced data in my estimations. Some literature finds the

[8] The data for the marginal tax rate was kindly provided by John Graham.

effect of tax rates to be significant on leverage in a levels regression setup.[9] However, when the marginal tax rate data is first differenced all the clustering is then around 0.

IV. Results

In this section, I present the findings of the empirical analysis. Section A presents the main findings and compares levels and changes regression results. Section B presents the results for different rating groups, and Section C analyzes the case for different sizes of leverage adjustments.

A. Leverage Estimations: Levels and Changes

Traditionally, capital structure literature regresses firm's leverage ratio on a set variables. Similarly, I begin my analysis by regressing leverage on the proposed determinants, deviation from target leverage and the traditional set of control variables. In the level regression, again following literature, all the independent variables are lagged. Table 3 presents the results for the three types of estimation methods: Ordinary Least Squares (OLS), Fixed Effects (FE) and Standardized Variables Regression (Standardized OLS). In order to emphasize the effect of deviation variable, I run the regressions both with and without including $Dev_{i,t-1}$.

[9] For example Molina (2005) finds the effect of marginal tax rates on level of leverage to be significant, and even uses it as an instrument for leverage in a system of equations. And in another case, along with marginal tax rates Molina (2005) also considers external financing weighted average market-to-book ratio as an additional instrument. Molina (2005) does not report a joint F-test. When I run a joint F-test, I find that these two instruments together are insignificant also.

[Table 3]

In each regression technique, it is seen that $Dev_{i,t-1}$ increases the explanatory power of the model, the most in FE regression. In the Standardized OLS, the magnitude of the coefficients is comparable. $Dev_{i,t-1}$ has the highest absolute value coefficient, which tells that it is the most important factor among other determinants of leverage. About half as important as $Dev_{i,t-1}$ are $PPE/TA_{i,t-1}$, asset tangibility, and $LogA_{i,t-1}$, firm's size. And they are followed by $OI/TA_{i,t-1}$, profitability, $MB/TA_{i,t-1}$, growth options, and $SE/S_{i,t-1}$, product uniqueness.

Another interesting result emerging from Table 3 is regarding taxes ($MTaxR_{i,t-1}$). Similar to some findings in the literature, the OLS estimation shows that taxes matter for leverage. However, I find that this is contrary to the results of the other estimation techniques. This probably related to the high level of clustering problem in marginal tax rates data (particularly at the values 0%, 35% and 40%). For profitable terms the marginal tax rate would be greater than zero, whereas for firms at loss the tax rate would be zero and these firms will have low or high leverage independent of their tax rate. Wooldridge (2002) recommends that in families, groups of observations there may be various correlations and the most practical way of eliminating such relationship effects is simply first differencing the data. I present the estimations using the first differenced data as changes regression results in Table 4.

[Table 4]

The explanatory power of the OLS results without $Dev_{i,t-1}$ decreases from 22% in (Table 3) to 4% (Table 4). However, the explanatory power of FE regression is unchanged, and that for Standardized OLS actually increases slightly. Mainly $Dev_{i,t-1}$ is the most significant variable and adds greatly to the explanatory power of the model; even more in changes regression than it does in levels. Inclusion of $Dev_{i,t-1}$ triples the power in OLS regression, more than quadruples in FE regression, and more than doubles in standardized OLS. Among all cases, the model has the highest explanatory power in the standardized changes regression (R^2 =19%) with the inclusion of $Dev_{i,t-1}$.

I will start by looking at individual variables with taxes. $MTaxR_{i,t-1}$ seems to be insignificant in all analysis, which tells taxes actually do not matter for leverage changes. This proves against trade-off theory that says firms trade-off between costs (default risk) and benefits of debt (taxes) and eventually operate at some target optimal level of leverage.

Similar to $MTaxR_{i,t-1}$, also $cv(OI)_{i,t-1}$, income volatility, is insignificant. Firm's having a high or low income volatility implies it is a high or low risk of income generation and it is assumed as a risk factor by the credit rating agencies. However, this indirect effect does not seem to at least directly matter for firm's leverage choice. $MB/TA_{i,t-1}$, growth options, gains significance only in the standardized OLS regression.

In the standardized OLS analysis, the coefficient of $Dev_{i,t-1}$ is greatest among other leverage determinants (after the constant). Comparing the magnitudes of the coefficients in the standardized OLS, profitability ($OI/TA_{i,t-1}$), asset tangibility ($PPE/$

$TA_{i,t-1}$) and size ($LogA_{i,t-1}$) seem to be among the other important factors affecting the leverages. Along with the taxes, income volatility seems not to affect leverages.

The constant term in the standardized OLS has the greatest absolute value and tells a firm-specific factor that is not included in the model seem to matter a lot for leverages. Although this is beyond the scope of this study, it may be the reason why the explanatory power of the model is limited around 20%'s and requires further research.

[Table 5]

Next, for robustness I compare the estimation results for different measures of leverage as dependent variable. Table 5 shows that $Dev_{i,t-1}$ is the most important determinant of leverage, book-value leverage or the market value leverage. The situation is different for the other variables, however. When market-value leverage is considered taxes become significant for the first time, though, with a small coefficient. Similarly, income volatility becomes significant with a small coefficient. This may be due to that equity market may be pricing income volatility and this is captured by the market-value leverage. These additional significances increase the explanatory power of the model for the market-value leverage. On the other hand, in the case of changes regression for book-value leverage explanatory power decreases sharply, driven by insignificant control variables. Having said that this does not affect the main finding; $Dev_{i,t-1}$ has the largest coefficient and still is the single most important factor for leverage. The book-value leverage, different from the leverage, takes short-term debt (debt in current liabilities) into account, as well. Short-term debt would change the dynamics of leverage beyond the factors in the model. This would make these factors insignificant and thus the model would have low explanatory power.

The results mentioned in this section show that deviations from target leverage ($Dev_{i,t-1}$) is the most important factor for capital structure choices of firms. What happens if the firm has a low debt rating? How does the model perform for large changes in leverage versus small leverage adjustments? The following sections seek answers to these questions.

B. Leverage Estimations by Ratings

The dynamics of leverage adjustments may be different for non-rated, rated, and speculative or investment grade firms. Table 6 presents the results for firms categorized by their ratings. The explanatory power of the model is roughly below 20% for non-rated firms, and above that for the rated firms. This shows there may be slight differences among firms with different ratings.

[Table 6]

The main finding, irrespective of the rating group or whether it is a levels or changes regression, is that $Dev_{i,t-1}$ has the largest coefficient, and comes out as the most important (also highest significance in all) leverage determinant. This is consistent with the rest of the results and the main goal of this study.

As for the other variables profitability ($OI/TA_{i,t-1}$), asset tangibility ($PPE/TA_{i,t-1}$) and size ($LogA_{i,t-1}$) seem to be among the other important factors in general (Due to possible issues associated with levels regression, I focus on the findings of the changes regressions). Income volatility ($cv(OI)_{i,t-1}$) don't seem to matter for leverage adjustments. Growth options ($MB/TA_{i,t-1}$) seem to be about twice as important for rated firms (same level for speculative and investment grade firms) than non-rated firms. Asset tangibility ($PPE/TA_{i,t-1}$) on the other hand seem to matter more for non-rated firms, and actually lower the rating, the more important it becomes. This makes sense as low rating or no-rating would imply a risk and it becomes important whether the assets are tangible in case of a bankruptcy would serve as collateral.

There are also some differences between investment and speculative grade firms. Product uniqueness ($SE/S_{i,t-1}$) does not matter for leverage adjustments in speculative grade firms, but in investment grade firms it is even more important than growth options ($MB/TA_{i,t-1}$). Similarly, changes in firm size ($LogA_{i,t-1}$) is the least important factor for leverage changes in speculative grade firms, however in investment grade firms it is second important factor. On the other hand, changes in profitability is about the same importance for speculative and investment grade firms.

Lastly, one important result that comes out of analyzing leverage adjustments by rating groups is about the effect of taxes. Changes in marginal tax rate ($MTaxR_{i,t-1}$) seem to matter for changes in leverage in investment grade firms. Although, it is the least important factor, still the relationship is significant. According to the trade-off model a firm trades off costs of using debt (added default risk) to benefits of using debt (tax shield). However, I find that taxes only matter for leverage changes of investment grade firms and with a relatively small coefficient. One possible explanation may be that leverage adjustment costs working as a threshold. It may be that it is still cost effective for an investment grade firm to adjust leverage for tax benefits in the face of relevant costs simply due to scale factor, whereas tax benefits does may not suffice the leverage adjustment costs for a speculative grade firm.

C. Leverage Estimations by Adjustment Size

I sort the sample by the absolute value of the standardized leverage changes. I form five bins with 3172 firm-year observations in each, and I run estimations for each bin separately to see whether there are any differences in the leverage adjustment determinants. Table 7 shows the results for each group of firms.

[Table 7]

Model seems to have twice as explanatory power for small leverage adjustments than the largest, most aggressive leverage changes. This makes sense, as the largest leverage changes may consist of special cases raising capital which may not be related to any of the independent variables in the model. However, the R-squared is even lower for the rest of the groups.

As for variables explaining leverage adjustments, the main finding that deviations from target ($Dev_{i,t-1}$) emerges as the most critical determinant. In the smallest leverage adjustments it is about four times as important as the other variables, where growth options ($MB/TA_{i,t-1}$), income volatility ($cv(OI)_{i,t-1}$), product uniqueness ($SE/S_{i,t-1}$) and as in other results taxes ($MTaxR_{i,t-1}$) don't seem to matter. For the largest leverage adjustment group, the only variable that doesn't matter is income volatility ($cv(OI)_{i,t-1}$).

V. Conclusion

In this paper, I investigate determinants of firms' capital structure choices. The factors that are included in the model are deviations from target leverage, growth options, profitability, income volatility, asset tangibility, product uniqueness, firm size and taxes.

I begin by comparing leverage levels OLS regression with fixed effects and standardized OLS. I find that the results in the OLS are inflated and hence OLS may not be the best way to estimate leverage models. Especially, high levels of clustering in the marginal tax rates data and benefits of changes regression over the levels regression suggests first differencing the variables would yield more meaningful analysis of the motivation behind firms' capital structure choice. After comparing the findings of a variety of techniques, here, in an effort to rank the determinants in importance I choose standardized changes OLS as a method of analysis.

Target leverage has been mentioned in the literature. Also anecdotal surveys with managers (such as Harvey and Graham (2000)) show that firms do really have and care about their target level of leverages. However, it has never been studied as a determinant of leverage before. The recent relevant literature uses a partial adjustment model of leverage to calculate firm's target level of leverage. I use this variable along with the other traditional factors of leverage.

The main finding of the study is that getting back to the target level of leverage (deviations from the target leverage) is the most important factor in a firm's leverage adjustment. It has the highest significance, the largest coefficient and increases the explanatory power of the model the most in all types of level or changes regressions with all types of estimation techniques. The results are robust to other types of leverage measures. Main finding also do not change for non-rated (explanatory power slightly less), speculative grade or investment grade firms. I also control for small leverage changes (explanatory power doubles) versus large changes and in all cases the deviation factor emerges as the most critical determinant of leverage.

I contribute by showing that first-differenced variables is a better way of studying capital structure choices. And when compared to the traditional leverage determinants, getting back to the target leverage is the most important factor.

Appendix: Variable Definitions

This appendix details the variable construction for analysis of the sample. All numbers in parentheses refer to the annual Compustat item number.

Dependent Variables:

Leverage ($Lev_{i,t}$) = long-term debt / total assets = long-term debt (9) / book value of assets (6).

Book-value Leverage = total debt / total assets = [long-term debt (9) + debt in current liabilities (34)] / book value of assets (6).

Market-value Leverage = total debt / (total assets + market value of equity - book value of equity)).

Independent Variables:

Deviation from Target Leverage ($Dev_{i,t-1}$): is the lagged leverage less the historical mean level of leverage, divided by the standard deviation of the firms' leverages (at least five years of history).

Market Value of Equity = year end share price (199) * shares outstanding (25)

Book Value of Equity = total assets (6) - total liabilities (181) - preferred stocks (10) + deferred taxes (74) + convertible debt (79).

Market-to-book ratio ($MB/TA_{i,t-1}$) = market value of equity + book value of debt / total assets.

Profitability ($OI/TA_{i,t-1}$) = operating income (13) / total assets (6).

Income Volatility ($cv(OI)_{i,t-1}$) = for the preceding three year period, standard deviation of quarterly operating income / mean absolute value.

Tangiblity ($PPE/TA_{i,t-1}$) = property, plant and equipment (8) / total assets (6).

Product Uniqueness ($SE/S_{i,t-1}$) = selling expenses / sales.

Size ($logA_{i,t-1}$) = total assets (6) / inflation index for year t. Adjusted to 2004 prices.

Marginal tax rate ($MTaxR_{i,t-1}$): is the marginal tax rate before interest deductions as in Graham (1996a, 1996b) tax rate dataset.

Rating (*S&PRat*): is the Standard and Poor's issuer rating as in COMPUSTAT (280) available from 1985. I decoded this data to an ordinal scale that starts with a numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Rating modifiers, which show relative standing within the major rating categories, are excluded as the case in other studies in literature.

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Table 1. Descriptive Statistics

The descriptive statistics for firms without a debt rating, with a rating, and whole sample are presented in Panels A, B and C, respectively. The first two columns show firms' leverage and target leverage ratios. The next two columns show firms' Standard and Poor's debt rating over a nine-point scale, and then S&P detailed rating (including rating modifiers) over a twenty-two-point scale in the fourth column. The rest are the control variables: market to book ratio, operating income over total assets, coefficient of variation for quarterly operating income, plant, property and equipment over total assets, sales expenses over total sales, assets in 2010 million dollars, and marginal tax rate, respectively.

Stats	*Lev*	*Lev**	*SPRat*	*SPRatDet*	*MB/TA*	*OI/TA*	*cv(OI)*	*PPE/TA*	*SE/S*	*Assets*	*MTaxR*
A. Unrated											
N	12040	12040	0	0	12040	12040	12040	12040	12040	12040	12040
Mean	0.10	0.38			2.02	0.11	1.38	0.25	0.38	366	0.29
Median	0.05	0.37			1.47	0.13	0.49	0.21	0.28	120	0.34
SD	0.13	0.21			1.90	0.15	3.66	0.18	0.72	1315	0.12
Min	0.00	-2.40			0.20	-1.45	0.05	0.00	0.01	10	0.00
Max	0.86	1.80			52.47	0.51	57.45	0.95	24.14	66435	0.51
B. Rated											
N	3820	3820	3820	3820	3820	3820	3820	3820	3820	3820	3820
Mean	0.22	0.61	6.04	14.10	1.87	0.15	0.45	0.33	0.22	9718	0.33
Median	0.20	0.61	6.00	14.00	1.51	0.15	0.25	0.30	0.19	2985	0.35
SD	0.14	0.24	1.29	3.76	1.24	0.07	1.22	0.18	0.15	23548	0.08
Min	0.00	-0.47	0.00	1.00	0.45	0.43	0.05	0.01	0.02	16	0.00
Max	0.88	1.29	9.00	22.00	17.68	0.46	35.91	0.91	2.94	337824	0.46
C. All Sample											
N	15860	15860	3820	3820	15860	15860	15860	15860	15860	15860	15860
Mean	0.13	0.43	6.04	14.10	1.98	0.12	1.15	0.27	0.34	2619	0.30
Median	0.09	0.42	6.00	14.00	1.48	0.14	0.41	0.23	0.25	229	0.34
SD	0.14	0.24	1.29	3.76	1.76	0.14	3.27	0.18	0.63	12282	0.11
Min	0.00	-2.40	0.00	1.00	0.20	-1.45	0.05	0.00	0.01	10	0.00
Max	0.88	1.80	9.00	22.00	52.47	0.51	57.45	0.95	24.14	337824	0.51

Table 2. System GMM Estimation Results

Table 2 presents the results of estimation of firms' Leverage, Book-value Leverage, and Market-value Leverage in a partial adjustment model setting. The estimation method employed is Blundell, Bond (1998) system GMM. The estimation procedure is carried out using xtabond2 STATA package by Roodman (2006). The coefficient matrix β will be used to construct *Lev**, firms' target leverage ratios. Constructing *Lev** in this manner is as in Faulkender, Flannery, Hankins, and Smith (2010). The variables employed in the model is Leverage (also book-value leverage and market-value leverage), earnings before interest and tax over total assets, market value over total assets, depreciation over total assets, logarithm of total assets (in 2010 USD), plant, property and equipment over total assets, research and development expenses over total assets, research and development dummy (=1 if R&D expense exists, 0 otherwise) and industry leverage. Year and industry dummies are included but not reported for brevity. The sample is COMPUSTAT firms in 1985-2010.

Dep. Var.:	Leverage			Book-value Leverage			Market-value Leverage		
	β		t	β		t	β		t
Lev	0.8564	***	40.61	0.6042	***	57.69	0.5635	***	54.24
Ebit/TA	-0.0292	***	-2.71	-0.2743	***	-3.85	-0.2738	***	-3.70
MB/TA	-0.0008		-1.51	-0.0190	***	-4.47	-0.0211	***	-4.80
DP/TA	-0.0768	*	-1.85	-0.9214	***	-3.30	-1.0212	***	-4.19
LogA	0.0102	***	3.37	0.0922	***	4.77	0.1660	***	9.07
PPE/TA	0.1480	*	5.60	1.2110	***	7.53	1.2504	***	7.73
XRD/TA	-0.0424	*	-2.05	-0.2996	*	-1.93	-0.3341	**	-2.12
XRDDummy	0.0008	***	0.21	0.0273		1.14	-0.0224		-0.84
IndLev	-0.2472		-6.33	-1.7125	***	-9.55	-2.9682	***	-11.76
Constant	-0.0201	**	-1.43	-0.3552	***	-3.89	-0.7173	***	-8.01
F	189.91			144.79			164.24		
N	50007			50007			50007		
Firms	7019			7019			7019		

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year dummies are included but not reported for brevity.*

Table 3. Leverage Levels-Regression Results

Table 3 presents the results for estimating level of leverage using ordinary least squares, fixed effects and using standardized variables. Dependent variable is the level of leverage, and all the rest of the variables are a year lagged levels of deviation, market value over total assets, operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. For each method estimation results are presented with and without the *Dev* variable. Year and industry dummies are included but not reported for brevity. The sample is COMPUSTAT firms in 1985-2010.

Regression Type:	OLS				FE				Standardized OLS			
	Base Case		Including *Dev*		Base Case		Including *Dev*		Base Case		Including *Dev*	
	β		β		β		β		β		β	
Dev			-0.4382	***			-0.2215	***			-0.2690	***
MB/TA	-0.0071	***	-0.0046	***	-0.0028		-0.0020	*	-0.0210	***	-0.0222	***
OI/TA	-0.1731	***	-0.1199	***	-0.0583	**	-0.0398	***	-0.0572	***	-0.0430	***
cv(OI)	-0.0007	**	-0.0007	***	0.0002		0.0001		-0.0026		-0.0026	
PPE/TA	0.1790	***	0.4689	***	0.0925	***	0.1973	***	0.0671	***	0.1152	***
SE/S	-0.0161	***	-0.0090	**	-0.0054	**	-0.0026		-0.0195	**	-0.0185	**
LogA	0.0123	***	0.0357	***	0.0176	***	0.0278	***	0.0730	***	0.1126	***
MTaxR	0.0494	***	0.0247	**	-0.0056		-0.0007		0.0050		0.0068	
Constant	0.0528	**	-0.0629	***	0.0250		-0.0011	***	-0.0515		-0.0658	
N	15860		15860		15860		15860		15860		15860	
Firms	2585		2585		2585		2585		2585		2585	
Adj. R^2	0.22		0.49		0.04		0.18		0.10		0.16	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 4. Leverage Changes Regression Results

Table 4 presents the results for estimating change in leverage using ordinary least squares, fixed effects and using standardized variables. Dependent variable is the leverage change, and all the rest of the variables are changes is deviation, market value over total assets, operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. For each method estimation results are presented with and without the *Dev* variable. Year and industry dummies are included but not reported for brevity. The sample is COMPUSTAT firms in 1985-2010.

Regression Type:	OLS				FE				Standardized OLS			
	Base Case		Including *Dev*		Base Case		Including *Dev*		Base Case		Including *Dev*	
	β		β		β		β		β		β	
Dev			0.1950	***			0.2334	***			0.2863	***
MB/TA	-0.0001		-0.0001		0.0000		-0.0001		-0.0651	***	-0.0646	***
OI/TA	-0.0489	**	-0.0537	***	-0.0546	***	-0.0620	***	-0.1273	***	-0.1343	***
cv(OI)	0.0002		0.0001		0.0000		-0.0001		0.0009		-0.0004	
PPE/TA	0.1229	***	0.1937	***	0.1261	***	0.2209	***	0.0903	***	0.1573	***
SE/S	-0.0087	***	-0.0084	***	-0.0088	***	-0.0087	***	-0.0911	***	-0.0843	***
LogA	0.0203	***	0.0206	***	0.0242	***	0.0252	***	0.1907	***	0.1978	***
MTaxR	-0.0073		-0.0105		-0.0038		-0.0043		-0.0044		-0.0018	
Constant	-0.0098		-0.0089		-0.0124		-0.0175		-0.2785	**	-0.3591	***
N	15860		15860		15860		15860		15860		15860	
Firms	2585		2585		2585		2585		2585		2585	
Adj. R^2	0.04		0.15		0.04		0.18		0.08		0.19	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 5. Estimations for Alternative Measures of Leverage

Table 5 presents the results for leverage change estimations for different measures of leverage. The dependent variable (and correspondingly derived *Dev*) is leverage, active leverage (= leverage - passive leverage = leverage – (debt/ (total assets + next period net income))), book-value leverage (= total debt / total assets), and market-value leverage (= total debt / (total assets + market value of equity - book value of equity)). The independent variables are changes in deviation, market value over total assets, operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. All variables are standardized. Year and industry dummies are included but not reported for brevity. The sample is COMPUSTAT firms in 1985-2010.

	Leverage				Active Leverage				Book-value Leverage				Market-value Leverage			
	Levels		Changes		Levels		Changes		Levels		Changes		Levels		Changes	
Dev	-0.2690	***	0.2860	***	-0.3381	***	-0.0285	***	-0.0530	***	0.0481	***	-0.0453	***	0.0353	***
MB/TA	-0.0222	***	-0.0647	***	0.0137	*	0.0516	***	-0.0085	***	0.0198		-0.0171	***	-0.0195	***
OI/TA	-0.0430	***	-0.1332	***	0.0610	***	-0.0737	***	-0.0062	***	-0.0365	***	-0.0084	***	-0.0185	***
cv(OI)	-0.0026		0.0067		0.0057		0.0288	***	0.0014		-0.0134		0.0003		0.0024	**
PPE/TA	0.1152	***	0.1573	***	-0.0015		-0.0082		0.0116	***	-0.0066		0.0103	***	0.0067	***
SE/S	-0.0185	**	-0.0843	***	-0.0065		-0.0069		-0.0009		0.0016		-0.0010		-0.0052	***
LogA	0.1126	***	0.1986	***	-0.1507	***	-0.0955	***	0.0252	***	0.0133		0.0333	***	0.0094	***
MTaxR	0.0068		-0.0013		-0.0174	**	-0.0156	*	-0.0005		0.0189		0.0003		-0.0024	**
Const.	-0.0658		-0.3552	***	-0.1314		-1.3127	**	0.1982	***	-0.4379	**	0.1579	***	-0.0436	**
N	15860		15860		15860		15329		15860		15860		15860		15860	
Adj. R^2	0.16		0.19		0.05		0.03		0.25		0.02		0.28		0.27	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 6. Estimations by Firms' Ratings

Table 6 presents the results for estimating leverage and leverage changes within the specified rating group based on Standard and Poor's debt rating. Depending on the whether the estimation is a levels or changes regression, the dependent variable is either the level of leverage or change in leverage, and all the rest of the variables are deviation, market value over total assets, operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate, correspondingly. All variables are standardized. In levels regression all regressors are lagged by a year. Year and industry dummies are included but not reported for brevity. The sample is COMPUSTAT firms in 1985-2010. In all fairness for those firms below B rating (junk-rated) results are available but not presented due to small sample size.

	Non-Rated Firms				All Rated Firms				Speculative Grade Firms				Investment Grade Firms			
	Levels		Changes		Levels		Changes		Levels		Changes		Levels		Changes	
Dev	-0.2566	***	0.2821	***	-0.2868	***	0.2906	***	-0.2788	***	0.2521	***	-0.2808	***	0.3160	***
MB/TA	-0.0179	**	-0.0566	***	-0.0541	***	-0.0921	***	-0.0054		-0.1012	***	-0.0717	***	-0.0878	***
OI/TA	-0.0378	***	-0.1169	***	-0.0375	**	-0.1621	***	-0.0356		-0.1624	***	-0.0303		-0.1491	***
cv(OI)	-0.0033		0.0054		0.0046		0.0166		0.0385	*	0.0234		-0.0209		0.0051	
PPE/TA	0.1285	***	0.1742	***	0.0675	***	0.1010	***	0.1732	***	0.1320	***	0.1333	***	0.0960	**
SE/S	-0.0242	***	-0.0794	***	0.0085		-0.0779	**	-0.0168		-0.0361		0.0428	**	-0.0956	**
LogA	0.1063	***	0.1930	***	0.0977	***	0.1819	***	0.1675	***	0.0976	*	0.1065	***	0.2376	***
MTaxR	0.0063		0.0006		0.0071		-0.0179		-0.0001		0.0364		0.0182		-0.0613	*
Const.	-0.0658		-0.4260	***	-0.6766	***	-1.1642	***	0.5578	***	1.3797	***	-1.5984	***	-1.9475	***
N	12040		12040		3820		3820		1287		1287		1538		1538	
Adj. R^2	0.15		0.18		0.21		0.23		0.23		0.27		0.25		0.22	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 7. Estimations by Size of Leverage Change

Table 7 presents the results for estimating leverage changes based on their size. The sample is ranked based on absolute value of leverage change and divided into five equal sized groups. Each column in Table 6 presents the results for the estimation run per group, from small leverage changes to larger. The independent variables are changes in deviation, market value over total assets, operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. All variables are standardized. Year and industry dummies are included but not reported for brevity. The reported t-values represent robust errors. ***, **, * represent 1%, 5% and 10% significance levels, respectively. The sample is COMPUSTAT firms in 1985-2010.

Leverage Change	Smallest		2		3		4		Largest	
Dev	0.1223	***	0.0082	***	0.0004		0.0047	***	0.1499	***
MB/TA	-0.0109		-0.0045	**	-0.0005		0.0000		-0.0415	***
OI/TA	-0.0307	*	-0.0069	**	-0.0030	**	-0.0039	*	-0.0510	***
cv(OI)	0.0065		0.0012		-0.0005		-0.0003		-0.0085	
PPE/TA	0.0464	**	0.0118	***	0.0005		0.0005		0.0384	**
SE/S	0.0029		-0.0052	*	-0.0017		0.0020		-0.0499	***
LogA	0.0147	**	0.0028		0.0000		0.0030		0.1181	***
MTaxR	-0.0193		-0.0009		-0.0017		-0.0029	*	0.0422	***
Constant	-2.1686	***	-0.1966	***	-0.0044		0.2924	***	1.0081	***
N	3172		3172		3172		3172		3172	
Adj. R^2	0.29		0.04		0.04		0.07		0.16	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Dissertation Chapter 2

What really affects a firm's credit rating?

What really affects a firm’s credit rating?

Abstract

Following the recent financial crisis, credit ratings have been a discussion topic. The credit rating companies although give a list of criteria that they use in their evaluations, weigh on the fact that rating process involves a high degree of *subjectivity*. Prior research has been made on the determinants of credit ratings. There is a consensus on a group of accounting variables that seem to be associated with firms′ ratings. However, the explanatory power of the rating prediction models is very limited. Capital structure choice as measured by firms′ leverage ratio is an essential parameter in rating models. The endogeneity of firms′ leverage in rating estimation has recently come to consideration but has not received the attention it should have. I compare rating estimations side by side with and without controlling for endogeneity. I also use standardized regression analysis to rank the parameters by their contribution to the model. I find that the corrected impact of leverage is about ten times more than the other determinants.

I. Introduction

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. Previous research on ratings 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. But the literature 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. [10]

I argue that ignoring leverage endogeneity will cause a negative bias, an underestimation of the impact of leverage on credit ratings. To see this, 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 (Ederington and Yawitz (1987)). [11] 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 increased leverage induced by the risk reduction. The rating upgrade from the risk reduction

[10] Molina (2005) shows the best effort and he actually shows leverage ratio actually means more than it is when endogeneity is controlled for. Molina (2005) instruments leverage with firms' marginal tax rates (Graham (1996)) and a modified market-to-book ratio that is suggested by Baker and Wurgler (2002) in another context. However, a replication of the study shows that joint-F test fails to reject the null hypothesis that coefficients for these instruments are jointly equal to zero.

[11] 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. Harris and Raviv (1991) present a summary of the evidence.

partly offsets the downgrade from the increased leverage, making the total rating downgrade appear less significant than it really is.

Therefore, if I want to disentangle the direct impact of a leverage change on a firm's rating, I must first handle the endogeneity problem. Instrumental variables can correct the econometric problem and provide a consistent estimator for the coefficient on leverage. To do so, I must instrument leverage with such a determinant that is not correlated directly with ratings. In what follows, I form an instrument for leverage based on financial factors explicitly excluded from the S&P's rating methodology.

I select four factors: Market-to-Book ratio, Research and Development expenses, Capital expenditures, and Depreciation. In the literature, these factors are used as proxies for firm's investment strategy and growth options in leverage estimation models and in various corporate finance literatures. However, they are not used by rating agencies as one of the criteria to evaluate firms.[12] I run a principal component analysis among these variables and use the common factor as an instrument for leverage.

Following Kaplan and Urwitz (1979), I use an ordered-probit model for the estimation of the ratings, 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

[12] "Rating Methodology: Evaluating the Issuer" report is published by Standard and Poor's and explains the ten accounting ratio that they use in their rating process. The variables I have selected are not mentioned in this report. These variables should not be related to ratings, and yet, literature shows they impact firms' leverage ratios. Therefore, by definition they should be good candidates for instrumenting firms' leverage ratio.

Olsen (1978). I also use standardized variables in order to compare the relative impact of leverage without instrumenting it (baseline case), and after instrumenting. The results support my above argument that the impact of leverage on rating is underestimated. To give an idea of the level of underestimation; my results show that when I estimate ratings using a standardized-levels ordered-probit regression, a one standard deviation increase in level of leverage yields to a 26% of a rating grade decrease in the baseline case (other significant parameters: 20% upgrade for profitability, 11% downgrade for volatility of income). After correcting for endogeneity of leverage, on the other hand, one standard deviation increase in level of leverage yields to a 1.26 rating grade decrease (other significant parameters: 11% upgrade for profitability, 8% downgrade for volatility of income). Since levels-regression analysis with panel data may be susceptible to firm-specific effects, I have also run my estimations using first differenced data (changes regression). In the base line case a one standard deviation increase in change in leverage yields to a 17% of a rating grade decrease (other significant parameters: 21% upgrade for profitability, 6% downgrade for volatility of income). After controlling for endogeneity of leverage a one standard deviation increase in change in leverage yields to a 94% of a rating grade decrease (other significant parameters: 16% upgrade for firm size, 7% downgrade for firm uniqueness). These results show that controlling for endogeneity of leverage increase its impact on ratings about six times, and its impact relative to other parameters up to ten times. I rerun the estimation separately for investment grade and speculative grade firms, and the main finding is unchanged.

The approach followed in this paper to address the underestimation of leverage as a rating determinant 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, 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.

The rest of this article is organized as follows. Section II describes the data. Section III explains the variables employed in my model. Section IV presents the empirical findings for the proposed econometric implementation. Finally, Section V concludes.

II. Data

I calculate the variables using the data in the COMPUSTAT annual industrial files. The variable definitions are given in the Appendix. Table 1 displays the descriptive statistics of the variables.

[Table 1]

A. Data Selection

All firm-year observations are obtained from COMPUSTAT for the 1985-2010 period. Following Fama and French (1997) I exclude the firms from the financial sector (SICs 6000-6999), from non-classifiable establishments (SICs 9995-9999), and from the regulated sector or utilities (SICs 4900-4999). I discard any observations with missing values for total assets, long-term debt, total liabilities, fiscal year end share price, fiscal year end shares outstanding, operating income, property, plant and equipment and double entries from the dataset. I discard firm-year observations that yield negative book value of equity. To avoid outliers, I trim the observations that correspond to the top and bottom 0.5% values of the variables. In calculating standard deviations for variables, I eliminate the firms with less than five years of frequency from the dataset. I did not restrict the dataset to be balanced. Firms may exit and reappear in the sample. I use Standard and Poor's issuer rating (data280)[13] as reported in COMPUSTAT. Firms that are rated below (above) BBB- are referred to as speculative (investment) grade. My final sample consists of 3,513 observations.

B. Data Manipulation

I use variables in two forms: standardized levels and standardized changes. First, I download COMPUSTAT values and calculate variables (levels). Then I calculate first

[13] Standard and Poor's issuer rating (data280) is decoded to an ordinal scale that starts with a numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Rating modifiers, which show relative standing within the major rating categories, are excluded as the case in other studies in literature.

differenced series for each variable.[14] Thirdly, I standardize each levels and changes series (demean and divide by the standard deviation of that variable in the sample period for each firm). In calculating standard deviation, I require the firms to have at least five years of frequency in the sample period.

III. Model Variables

Here I explain the variables involved in the model. Section A explains the dependent variable, the S&P credit ratings, then Section B follows by the explanatory variables, leverage, operating income to total assets as proxy for profitability, coefficient of variation of quarterly operating income as proxy for income volatility, plant, property and equipment over total assets (fixed ratio) as proxy for asset tangibility, sales expenses over sales as proxy for product uniqueness and logarithm of total assets for firms' size, and Section C explains the instrumental variables, market-to-book ratio, research and development expenses over total assets, capital expenses over total expenses, depreciation over total assets.

A. Dependent Variable: Firm's Credit Rating

Rating (*S&PRat*) is the Standard and Poor's issuer rating as in COMPUSTAT (280) available from 1985. I decoded this data to an ordinal scale that starts with a

[14] The observations in 1984 are lagged and only used to calculate the change in explanatory variables for 1985 then discarded.

numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Most studies in the literature have come to use this type ratings measure. *S&PRatDet* is a more detailed measure of ratings including rating modifiers. Rating modifiers show relative standing within the major rating categories, such as A++, B-. The highest rating AAA is represented by an *S&PRatDet* of 22. The more recent studies in the literature have begun to include this ratings measure, as well.

B. Explanatory Variables

I measure the firms' capital structure using book value leverage ($Lev_{i,t}$), measured as the book value of long-term debt over book value of assets. The reason I use book-value leverage is because one of the components of my instrument measure is market-to-book values, which might create a mechanical relation with a market value leverage measure. Further, $Lev_{i,t}$ considers only the long-term debt following previous rating models (Kaplan and Urwitz (1979)).

Changes in profitability or other firm dynamics would affect availability of or need for funds, and leverage for that matter. Capital structure literature uses a set of variables commonly accepted to affect firm's ratings. Following the literature I include proxies for profitability, income volatility, asset tangibility, product uniqueness, size and tax rates.

I measure profitability ($OI/TA_{i,t-1}$) by the return on assets (= operating income / total assets). Standard and Poor's state that firms with higher operating margins have a greater ability to generate equity capital internally, to attract capital externally, and to withstand business adversity.

As a proxy for income volatility ($cv(OI)_{i,t-1}$), I calculate the coefficient of variation of the quarterly income. 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 $cv(OI)_{i,t}$ for the 3-year period preceding the year in question. 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.

A firm's relative tangible asset position serves to guarantee debt. I measure it by the fixed asset ratio ($PPE/TA_{i,t-1}$) (=net plant, property and equipment / total assets).

Following Titman and Wessels (1988), I use selling expenses over sales as a proxy for uniqueness ($SE/S_{i,t-1}$). 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. It is considered as a risk factor.

For firm's size ($LogA_{i,t-1}$) I use the logarithm of its total assets adjusted for inflation (prices at 2010). 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.

C. Instruments

Faulkender, Flannery, Hankins and Smith (2010) use a group of variables, very typical variables that are also used very commonly in the literature in estimating firm's leverage. From these list of variables, I have eliminated the ones that are mentioned in the Standard and Poor's "Rating Methodology: Evaluating the Issuer" report. These eliminated variables that impact leverage according to S&P report also used in determining firms' ratings. Hence by theory, my instruments will not be impacting firm ratings through leverage.

My first instrument is the market-to-book ratio ($MB/TA_{i,t-1}$), which is firm's market value and book liabilities over total assets. Also referred as Tobin's Q, this ratio is mostly used as a proxy for growth options the company has. It may affect firm's choice of equity issue over debt issue (decrease or increase the leverage). In general growth companies, have high market-to-book ratio and that raising capital through equity financing (rather than debt issues) is be more advantageous. However, market-to-book ratio is not used by S&P as a criterion in assigning firm ratings. Molina (2005) also uses a market-to-book ratio as an instrument.

Next instrument is the research and development expenses over total assets ratio ($RD/TA_{i,t-1}$), which shows how research oriented a company is. In general, companies that are more research oriented tend to have higher leverages.

Capital expenses over total assets ($CAPEX/TA_{i,t-1}$) is a policy decision and shows how firms respond to investment opportunities. Firms may be choosing capital intensive investment projects and this may yield to a higher level of leverage.

The final instrument is depreciation over total assets ($DP/TA_{i,t-1}$). Depreciation is also related to type of investments the firm is making and may cause a higher level of leverage.

Taking a step back, all four of the above mentioned variables are related to the concept of investments; what kind of investments the firm is making, what kind of investment strategy the firm is following. Therefore, I choose to run a principal component analysis and find a common factor index using these variables. [15] I use this factor (first factor represents 65% of variance) as an instrument for leverage in the first stage of the IV-ordered probit model.

IV. Results

In this section, I present the findings of the empirical analysis. Section A presents the main findings and compares the estimation results with and without instrumenting leverage in the rating estimation. Section B presents the case for per investment grade and speculative grade firms, and Section C compares rating upgrades versus rating downgrades.

[15] I have also used these variables separately in my estimations. The findings do not change. I am not presenting them here for brevity, but they are available upon request.

A. Rating Estimations: Levels and Changes

I begin my analysis by regressing ratings on the proposed set of determinants. This is a levels regression, and all the independent variables are lagged. I also use standardized regression analysis, hence the magnitudes of the beta coefficients can be compared with each other. Table 2 presents the results for first without, then with instrumenting leverage. The difference is the first estimation is via an ordered probit model and, then the next one, instruments leverage and uses an IV-ordered probit model.

[Table 2]

The first column presents the results of an ordered probit model, that is a single stage estimation without instrumenting leverage, in this case leverage has endogeneity problem as the other independent variables also do affect leverage, rating and rating through leverage, as well. The results show that leverage, profitability and income volatility matter significantly, respectively in that order of importance. Leverage seems to be slightly more important than profitability and about twice as important as income volatility. The second column shows the results for ratings including modifiers and results are similar; this time product uniqueness also becomes significant (the least important factor) and all other factors have similar levels of coefficients others as in first column.

The rest of the table presents the results for the IV-ordered probit model. Column 5 presents the findings for the first stage, instrumenting of leverage. Column 3 and 4 shows the results for the second stage of the estimation using instrumented leverage as a variable. The first thing to notice is the great increase in the coefficient of leverage. The other significant variables, namely profitability, income volatility and firm size seem to have coefficients of similar magnitude. However, leverage has a beta coefficient of more than ten times the other factors. This result shows that instrumenting leverage and resolving the endogeneity problem purges out the effect of leverage on ratings, and apparently it is by far the most important determinant of ratings. Column 4 shows that the findings are almost exactly the same for the case of ratings including modifiers.

Wooldridge (2002) recommends that in families of observations there may be various correlations in groups and the most practical way of eliminating such relationship effects is simply first differencing the data. Next, I present the estimations using the first differenced data as changes regression results in Table 3. Once again, all independent variables are lagged and standardized.

[Table 3]

The first two columns show that estimating rating changes without instrumenting leverage actually the most important factor is profitability, slightly above leverage, and least important factor is income volatility. The picture changes totally once leverage is instrumented. Columns 3 and 4 show that profitability and income volatility become insignificant. Leverage becomes the most important factor about six times coefficient size of firm size, which has a coefficient twice the size of product uniqueness, as the least important factor.

What emerges from Tables 2 and 3 is that the result that leverage being the most important factor for ratings; ten times the other controls for the level of ratings and six times of others for rating changes. Secondly, level of profitability and income volatility seem to matter for ratings, and changes in firm size and product uniqueness seem to matter for rating changes. The first stage results for instrumenting leverage does not seem to change much whether it's a levels or changes estimation.

B. Investment Grade versus Speculative Grade

This section will present the results of IV-ordered probit model for speculative or investment grade firms. Table 4 presents the results of the rating equation, the second stage of the model.

[Table 4]

The main finding remains unchanged. Firms' leverage is the most important factor for rating changes by a multiple of five or six be it an investment grade or speculative grade firm. The second most important factor seems to be changes in firm size. Changes in product uniqueness seem to be next important for investment grade firms. And changes in income volatility seem to matter in the case of speculative grade firms.

C. Rating Upgrades and Downgrades

This section reports the findings for rating upgrades/downgrades for investment and speculative grade firms. The upgrades and downgrades are the changes in ratings including modifiers (*S&PRatDet*). All the independent variables are lagged and standardized. The estimation model is an IV-probit model. Table 5 shows the results for each group of firms. Panel A presents the results for upgrades and per rating grade, Panel B does so for downgrades.

[Table 5]

The first column in both panels show that whether it is a rating upgrade or a downgrade the most important factor seems to be changes in firm's leverage. Leverage is followed by changes in firm's size and changes in product uniqueness as other determinants. These results are almost identical to those in Column 2, the results for investment grade firms. The results for speculative firms, however, are slightly different. Column 3 in Panel A shows that changes in leverage is the most important factor for rating upgrades. It is followed by changes in income volatility. For rating downgrades in speculative grade firms changes in profitability, income volatility and firm size seems to matter. One reason for asymmetry may be that speculative grade firms already are highly levered and maybe at that stage their profitability and income volatility is more critical than increases in their leverage for a further rating downgrade. This makes sense as such firms either may hardly issue further debt as they are closer to a default, or it may be too costly for them to do so. This would rule out further increases in leverage through debt issues, and hence increases in leverage may not be relevant anymore for a rating downgrade anyways.

V. Conclusion

In this paper, I investigate determinants of firms' credit ratings. The factors that are considered are firm's leverage, profitability, income volatility, asset tangibility, product uniqueness and firm size.

The main contribution of the paper is the comparison between two approaches using firm's leverage directly in the rating estimation versus instrumenting leverage. The idea behind instrumenting leverage is that the other independent variables that affect ratings directly, also do affect ratings through leverage, as well. Instrumenting leverage in the first stage of an IV-ordered probit model purges out its effect on firm's rating. I estimate levels of ratings as well as rating changes using the same model with first differenced variables. This controls for the family effects where group of observations are involved (Wooldridge (2002)). I follow by comparing the results for investment grade and speculative grade firms. For robustness, I also run the estimation separately for rating upgrades and downgrades. The results for various analysis show that main finding does not change. In all cases leverage is the most important determinant between five to twelve times of the other determinants.

The results point to that endogeneity of leverage in rating estimation is critical and appropriate instrumentation is essential.

Appendix: Variable Definitions

This appendix details the variable construction for analysis of the sample. All numbers in parentheses refer to the annual Compustat item number.

Dependent Variable:

Rating (*S&PRat* and *S&PRatDet*): is the Standard and Poor's issuer rating as in COMPUSTAT (280) available from 1985. I decoded this data to an ordinal scale that starts with a numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Most studies in the literature have come to use this type ratings measure. *S&PRatDet* is a more detailed measure of ratings including rating modifiers. Rating modifiers show relative standing within the major rating categories, such as A++, B-. The highest rating AAA is represented by an *S&PRatDet* of 22. The more recent studies in the literature have begun to include this ratings measure, as well.

Independent Variables:

Leverage ($Lev_{i,t}$) = long-term debt / total assets = long-term debt (9) / book value of assets (6).

Book-value Leverage = total debt / total assets = [long-term debt (9) + debt in current liabilities (34)] / book value of assets (6).

Market-value Leverage = total debt / (total assets + market value of equity - book value of equity)).

Market-to-book ratio ($MB/TA_{i,t-1}$) = market value of equity + book value of debt / total assets.

Profitability ($OI/TA_{i,t-1}$) = operating income (13) / total assets (6).

Income Volatility ($cv(OI)_{i,t-1}$) = for the preceding three year period, standard deviation of quarterly operating income / mean absolute value.

Asset Tangiblity ($PPE/TA_{i,t-1}$) = property, plant and equipment (8) / total assets (6).

Product Uniqueness ($SE/S_{i,t-1}$) = selling expenses / sales.

Size ($logA_{i,t-1}$) = total assets (6) / inflation index for year t. Adjusted to 2004 prices.

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Table 1. Descriptive Statistics

The descriptive statistics for speculative grade and investment grade firms. *S&PRat* and *S&PRatDet* are firms' Standard and Poor's debt rating over a nine-point scale, and a twenty-two-point scale (including rating modifiers), respectively. The rest are firms' leverage and the control variables: market to book ratio, operating income over total assets, coefficient of variation for quarterly operating income, plant, property and equipment over total assets, sales expenses over total sales, and assets in 2010 million dollars.

	N	Mean	Median	SD	Min	Max
A. Investment Grade						
S&PRat	2360	6.83	7	0.83	6	9
S&PRDet	2360	16.45	16	2.42	13	22
Lev	2360	0.18	0.17	0.10	0.00	0.72
MB/TA	2360	2.07	1.64	1.37	0.49	17.68
XRD/TA	2360	0.03	0.02	0.04	0.00	0.25
CAPX/TA	2360	0.06	0.06	0.04	0.00	0.35
DP/TA	2360	0.05	0.04	0.02	0.01	0.15
OI/TA	2360	0.17	0.16	0.07	-0.10	0.44
cv(OI)	2360	0.30	0.21	0.85	0.05	34.21
PPE/TA	2360	0.34	0.31	0.17	0.01	0.87
SE/S	2360	0.22	0.19	0.13	0.01	0.72
Assets (US$ bill.)	2360	12.79	4.68	24.84	0.02	292.73
B. Speculative Grade						
S&PRat	1153	4.66	5	0.54	0	5
S&PRDet	1153	10.06	10	1.36	1	12
Lev	1153	0.32	0.29	0.19	0.00	0.88
MB/TA	1153	1.45	1.25	0.75	0.57	11.72
XRD/TA	1153	0.03	0.01	0.05	0.00	0.37
CAPX/TA	1153	0.06	0.05	0.06	0.00	0.55
DP/TA	1153	0.05	0.04	0.03	0.01	0.24
OI/TA	1153	0.11	0.12	0.08	-0.43	0.46
cv(OI)	1153	0.77	0.37	2.02	0.05	39.97
PPE/TA	1153	0.33	0.27	0.20	0.02	0.91
SE/S	1153	0.22	0.19	0.18	0.02	2.39
Assets (US$ bill.)	1153	3.73	1.30	18.68	0.09	337.82

Table 1 continued…

	N	Mean	Median	SD	Min	Max
C. All Sample						
S&PRat	3513	6.12	6	1.27	0	9
S&PRDet	3513	14.35	14	3.68	1	22
Lev	3513	0.22	0.20	0.15	0.00	0.88
MB/TA	3513	1.87	1.50	1.24	0.49	17.68
XRD/TA	3513	0.03	0.02	0.04	0.00	0.37
CAPX/TA	3513	0.06	0.05	0.04	0.00	0.55
DP/TA	3513	0.05	0.04	0.02	0.01	0.24
OI/TA	3513	0.15	0.15	0.07	-0.43	0.46
cv(OI)	3513	0.46	0.24	1.37	0.05	39.97
PPE/TA	3513	0.33	0.30	0.18	0.01	0.91
SE/S	3513	0.22	0.19	0.15	0.01	2.39
Assets (US$ bill.)	3513	9.82	3.08	23.39	0.02	337.82

Table 2. Levels-Estimation Results

Table 2 presents the model estimation results for a standardized levels regression. The first two columns give the results for ordered probit regression without controlling for the endogeneity of leverage. The dependent variables are *SPRat*, firm's S&P rating (9-point scale), and *SPRatDet*, firm's S&P rating including rating modifiers (22-point scale), respectively. The third and fourth columns gives the estimation results for the second stage of the IV-ordered probit model (with standardized independent variables), and fifth column shows the results for the first stage where the endogeneity of leverage is controlled for (dependent variable in the first stage is leverage). All variables except for ratings are lagged by one year. The instrument represents the principal component analysis of market-to-book ratio, capital expenditures over total assets, depreciation over total assets and research and development expenses over total assets. The rest of the independent variables are operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. Year and industry dummies are included but not reported for brevity. ***, **, * represent 1%, 5% and 10% robust significance levels (corrected for two stages), respectively. The sample is COMPUSTAT firms in 1985-2010.

	Endo. not controlled: Dep.Var.: *SPRat*		Endo. not controlled: Dep.Var.: *SPRatDet*		Endo. controlled: Dep.Var.: *SPRat*		Endo. controlled: Dep.Var.: *SPRatDet*		Endo. control: 1st Stage: *Lev*	
Lev	-0.2550	***	-0.2425	***	-1.2633	***	-1.2664	***		
Instrument									-0.0924	***
OI/TA	0.1995	***	0.2056	***	0.1102	**	0.1116	**	-0.1696	***
cv(OI)	-0.1087	***	-0.1402	***	-0.0746	***	-0.0929	***	0.0032	
PPE/TA	-0.0126		-0.0069		0.0359		0.0401		0.0396	**
SE/S	0.0419		0.0584	**	-0.0043		0.0052		-0.0262	
LogA	-0.0602		-0.0436		0.1004	**	0.1131	**	0.1139	***
Constant									-0.0051	
N	3513		3513		3513		3513		3513	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 3. Changes-Estimation Results

Table 3 presents the model estimation results for a standardized changes regression (all variables are first differenced). The first two columns give the results for ordered probit regression without controlling for the endogeneity of leverage. The dependent variables are changes in *SPRat*, firm's S&P rating (9-point scale), and *SPRatDet*, firm's S&P rating including rating modifiers (22-point scale), respectively. The third and fourth columns gives the estimation results for the second stage of the IV-ordered probit model (with standardized independent variables), and fifth column shows the results for the first stage where the endogeneity of leverage is controlled for (dependent variable in the first stage is Δ*Lev*). All variables except for ratings are lagged. The instrument represents the principal component analysis of market-to-book ratio, capital expenditures over total assets, depreciation over total assets and research and development expenses over total assets. The rest of the independent variables are operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. Year and industry dummies are included but not reported for brevity. ***, **, * represent 1%, 5% and 10% robust significance levels (corrected for two stages), respectively. The sample is COMPUSTAT firms in 1985-2010.

	Endo. not controlled: Dep.Var.: *SPRat*		Endo. not controlled: Dep.Var.: *SPRatDet*		Endo. controlled: Dep.Var.: *SPRat*		Endo. controlled: Dep.Var.: *SPRatDet*		Endo. control: 1st Stage: *Lev*	
Lev	-0.1727	***	-0.1822	***	-0.9432	***	-0.9707	***		
Instrument									-0.0957	***
OI/TA	0.2115	***	0.2513	***	-0.0126		0.0088		-0.1872	***
cv(OI)	-0.0669	**	-0.0726	***	-0.0388		-0.0417		0.0204	
PPE/TA	-0.0444		-0.0575	**	0.0066		-0.0012		0.0441	
SE/S	0.0049		-0.0138		-0.0708	*	-0.0868	**	-0.0842	**
LogA	0.0111		0.0041		0.1564	***	0.1551	***	0.1726	***
Constant									0.1373	
N	3513		3513		3513		3513		3513	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 4. Changes-Estimation by Rating Category

Table 4 presents the rating change estimation results by rating category. The estimation method is IV-ordered probit and variables are first differenced and standardized. All variables except for rating changes are lagged. Dependent variable in the first stage is change in leverage, in the second stage it is change in firm's S&P rating (9-point scale), and change in S&P rating including rating modifiers (22-point scale). All the independent variables are lagged. The instrument represents the principal component analysis of market-to-book ratio, capital expenditures over total assets, depreciation over total assets and research and development expenses over total assets. The rest of the independent variables are operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. Year and industry dummies are included but not reported for brevity. ***, **, * represent 1%, 5% and 10% robust significance levels (corrected for two stages), respectively. The sample is COMUSTAT firms in 1985-2010.

	A. Investment Grade				B. Speculative Grade			
	2nd Stage: *SPRat*		2nd Stage: *SPRatDet*		2nd Stage: *SPRat*		2nd Stage: *SPRatDet*	
Lev	-1.0330	***	-1.0414	***	-0.8400	***	-0.9024	***
OI/TA	-0.0691		-0.0444		0.1060		0.1145	
cv(OI)	-0.0317		-0.0183		-0.0843	*	-0.1215	***
PPE/TA	0.0278		0.0247		-0.0208		-0.0345	
SE/S	-0.1034	*	-0.0982	*	0.0243		-0.0381	
LogA	0.2358	***	0.2207	***	0.0958		0.1246	*
N	2360		2360		1153		1153	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 5. Upgrades and Downgrades by Rating Category

Table 5 presents the upgrade/downgrade estimation results by rating category. The estimation method is IV-probit and variables are first differenced and standardized. The dependent variable in the first stage is change in leverage, in the second stage it is upgrade/downgrade indicator (0 or 1) which shows at least one point change in firm's S&P rating including rating modifiers (22-point scale). All variables except for upgrade/downgrade indicator are lagged. The rest of the independent variables are leverage, operating income over total assets, coefficient of variation of operating income, plant, property and equipment over total assets, sales expenses over sales, logarithm of total assets (in 2010 USD) and marginal tax rate. Year and industry dummies are included but not reported for brevity. ***, **, * represent 1%, 5% and 10% robust significance levels (corrected for two stages), respectively. The sample is COMUSTAT firms in 1985-2010.

A. Upgrades	All Upgrades		Investment Grade		Speculative Grade	
Lev	-1.1548	***	-1.1267	***	-1.2224	***
OI/TA	-0.0438		-0.0782		0.0487	
cv(OI)	-0.0317		0.0068		-0.1496	**
PPE/TA	-0.0014		0.0046		0.0054	
SE/S	-0.0828	*	-0.0495		-0.1076	
LogA	0.2088	***	0.2653	***	0.1262	
Upgrades	388		195		193	
N	3513		2360		1153	

B. Downgrades	All Downgrades		Investment Grade		Speculative Grade	
Lev	0.8334	***	1.0246	***	0.5752	
OI/TA	-0.0925		0.0001		-0.2720	**
cv(OI)	0.0488		0.0404		0.1252	**
PPE/TA	-0.0096		-0.0489		0.0668	
SE/S	0.0929	**	0.1321	**	-0.0078	
LogA	-0.1346	**	-0.2102	**	-0.2033	**
Downgrades	501		292		209	
N	3513		2360		1153	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Dissertation Chapter 3

The Leverage-Rating Relation: Is It Concurrent?

The Leverage-Rating Relation: Is It Concurrent?

Abstract

Estimating ratings based on lagged accounting information including leverage ratio has been studied in the literature. There is also recent literature that studies what happens to leverage ratios in the aftermath of rating changes. However, the direct influence of leverage and rating changes on each other has not been studied before. Survey studies show that CFOs consider the impact of their capital structure decisions on ratings and make a cost-benefit analysis. In order to finance a prospective project investment, a manager may want to reach out to debt markets, but what if that will yield to a rating decrease that would increase future financing. It will be an added shadow cost to the total cost of the project and if costs exceed the profits, manager may choose to pass up on the project. This example clearly shows that the capital structure choice and rating changes are endogenous. In this paper, I estimate leverage-rating relation simultaneously using three-stage least squares. I also use standardized regression technique to compare the marginal contribution of each parameter in the model. I find that change in rating is the most important factor for change in leverage (two to five times more than the control variables) and vice versa change in leverage is the most important factor for change in rating (three to nine times more than the control variables).

I. Introduction

Credit ratings affect a firm's cost of debt and subsequently its overall cost of capital. Firms with a higher credit rating can issue lower-yield debt and vice versa. Graham and Harvey (2001) find that maintaining financial flexibility and good credit ratings are the two most important factors that firms consider when deciding to issue additional debt. They mention that 57.1% of CFOs consider credit ratings as a very important indicator for them in how they choose the appropriate amount of debt for their firms. However, credit rating changes might mean more than just determining the level of debt to corporate managers.

Indeed managers might react differently to credit rating upgrades versus downgrades in order to adjust their capital structures. Consider a Reuters report about S&P's (Standard & Poor's Ratings Services) recent decision of downgrading Barneys New York, a US based luxury retailer, from CCC to CC. In the report, S&P mentions that "we assess the company's financial risk profile as 'highly leveraged' under our criteria because of its substantially leveraged capital structure and very thin cash flow protection measures." [16] Following this change in credit rating, Barney's management recruited a restructuring advisor to immediately resolve its existing problem in capital structure. In a contrasting case, S&P has recently assigned the Walt Disney Co.'s proposed issuance of 5- and 10-year debt an issue-level rating of 'A' because of the

[16] See "Text-S&P cuts Barneys New York to CC" in Reuters dated February 9, 2012. http://www.reuters.com/article/2012/02/09/idUSWNA986020120209

company's strong business risk profile and modest financial risk supported by their conservative capital structure and good discretionary cash flows. [17] According to Reuters, this credit rating is indeed good news for Walt Disney to persistently raise sufficient debts with minimal costs. Both incidences provide two critical messages for us. In the first case, a weak financial profile due to excessive leverage results in a downgrade in credit rating by S&P, which in turn forces Barney to restructure its existing capital structure. In the second case, healthy fundamentals enable Walt Disney to achieve a high rating on issuance, which enables them to generate external funds more economically. Therefore, credit rating changes are not fully exogenous. Further, managers might act either immediately or slowly to adjust their leverages following credit rating changes. Previous studies show that firms usually adjust debt ratios slowly towards their targets (see, Fama and French 2002). Further, Flannery and Rangan (2006) find that firms converge toward their target debt ratios at a rate of approximately 30% per year. Therefore, firms may not immediately return their leverages to its long-run mean. This has an important implication for shareholders in their future investment decisions. For instance, Masulis (1983) suggests that both stock prices and firm values are positively related to changes in debt level, and thus stockholders are on average adversely affected by a decrease in leverage. Hence, a slow adjustment in leverage following rating downgrades continues to gradually change stock prices, and that may linger of earning negative returns by existing shareholders for a certain period of time.

[17] See "Text-S&P rates Walt Disney debt A" in Reuters dated February 9, 2012. http://www.reuters.com/article/2012/02/09/idUSWNA983920120209 3

It is therefore a critical question to understand whether firms persistently change their leverage ratios following rating changes.

Although credit ratings are vital to firms' financial health, little research has been done in this area, especially with regard to the impact of credit rating changes on firms' subsequent changes in capital structure. I contribute by addressing the above issues in this paper.

Conventional wisdom suggests that credit downgrades would cause the cost of debt to rise as firms become riskier, and credit upgrades would imply an opposite effect. If firms are conscious of the cost of debt and subsequent financial distress, they should downwardly adjust leverage ratios following credit downgrades, and upwardly adjust leverage ratios following upgrades. We could expect this behavior to be non-linear and asymmetric: firms that have undergone credit downgrades could be more likely to adjust their capital structures than firms that have undergone credit upgrades, and firms that are close to speculative grade ratings as a result of credit downgrades could be more wary of further credit downgrades, and are therefore more likely to take preventive measures to avoid further downgrades that would effectively put them in the speculative category.

Kisgen (2006) is the first to directly test the impact of credit ratings on capital structure. First, Kisgen shows that firms near a credit rating upgrade or downgrade issue less debt relative to equity than firms not near a change in rating. In his next study, Kisgen (2009) argues that firms react asymmetrically to such changes, lowering leverage after downgrades but responding little to upgrades. It is therefore important to know whether the contemporary or lagged effect of credit rating changes on firm's capital structure decision is equally likely in the case of both downgrades and upgrades. Second, Kisgen (2006, 2009) examines the relationship between credit rating and leverage by examining the effect of rating changes in one year and leverage changes in the following year. However, this approach does not address the question of simultaneity between credit rating changes and leverage in the same year. This paper therefore models changes in credit rating and firm-leverage to simultaneously determine each other.

In this study, I examine the leverage-rating relation using a simultaneous equation system. Running the analysis for sample observations from 1985 to 2010, I find some interesting results. First, the results reveal a simultaneous relationship between credit rating changes and leverage changes. Using standardized regression technique allows me to rank the explanatory variables in order of their power to explain the variances in the dependent variables. I find that the most important variable that affects the leverage changes is the most recent rating change (about two to five times more than the other variables). Similarly, the most important factor underlying rating changes is the simultaneous leverage change (about three to nine times more than the other variables). Furthermore, past capital structure changes have a lingering effect on ratings (up to two lags). A leading rating change at t+1, seems to negatively affect the leverage change at t. Following literature, I also control for the impact of more traditional financial ratios that measure profitability, income volatility, asset tangibility, firm size, firm-specific risk and market-to-book ratio and they confirm to be significant factors, as well.

Second, I break down the analysis for speculative grade and investment grade firms. The significances and coefficients slightly increase for investment grade firms and decrease for speculative grade firms. For speculative grade firms the simultaneous and past rating change do not seem to matter for leverage changes, whereas firm's profitability, size and market-to-book ratio do matter. As for the rating changes in speculative grade firms, leverage is the most important factor; past leverage ratios do matter, also firm size and firm-specific risk becomes relatively more important. Bottom line is, leverage-rating relation is slightly different per speculative and investment grade firms.

The remainder of the paper is organized as follows. Section II describes about the sample data. Section III discusses the measurement of variables used in empirical analysis. Section IV discusses empirical models applied in the paper and presents the estimated results and findings. Section V concludes the paper.

II. Data

I calculate the variables using the data in the COMPUSTAT annual industrial files. The variable definitions are given in the Appendix. Table 1 displays the descriptive statistics of the variables.

[Table 1]

A. Data Selection

All firm-year observations are obtained from COMPUSTAT for the 1985-2010 period. Following Fama and French (1997) I exclude the firms from the financial sector (SICs 6000-6999), from non-classifiable establishments (SICs 9995-9999), and from the regulated sector or utilities (SICs 4900-4999). I discard any observations with missing values for total assets, long-term debt, total liabilities, fiscal year end share price, fiscal year end shares outstanding, operating income, property, plant and equipment and double entries from the dataset. I discard firm-year observations that yield negative book value of equity. To avoid outliers, I trim the observations that correspond to the top and bottom 0.5% values of the variables. In calculating standard deviations for variables, I eliminate the firms with less than five years of frequency from the dataset. I did not restrict the dataset to be balanced. Firms may exit and reappear in the sample. I use Standard and Poor's issuer rating (data280)[18] as reported in COMPUSTAT. Firms that are rated below (above) BBB- are referred to as speculative (investment) grade. Finally, I first difference my variables and after dropping missing values my final sample consists of 2,844 observations.

B. Data Manipulation

[18] Standard and Poor's issuer rating (data280) is decoded to an ordinal scale that starts with a numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Rating modifiers, which show relative standing within the major rating categories, are excluded as the case in other studies in literature.

I use variables in two forms: standardized levels and standardized changes. First, I download COMPUSTAT values and calculate variables (levels). Then I calculate first differenced series for each variable.[19] Thirdly, I standardize each levels and changes series (demean and divide by the standard deviation of that variable in the sample period for each firm). In calculating standard deviation, I require the firms to have at least five years of frequency in the sample period.

III. Model Variables

Here I explain the variables involved in the model. Section A explains the dependent variable, the S&P credit ratings, then Section B follows by the explanatory variables, leverage, operating income to total assets as proxy for profitability, coefficient of variation of quarterly operating income as proxy for income volatility, plant, property and equipment over total assets (fixed ratio) as proxy for asset tangibility, sales expenses over sales as proxy for product uniqueness and logarithm of total assets for firms' size, and Section C explains the instrumental variables, market-to-book ratio, research and development expenses over total assets, capital expenses over total expenses, depreciation over total assets.

A. Dependent Variables: Firm's Credit Rating and Leverage Ratio

[19] The observations in 1984 are lagged and only used to calculate the change in explanatory variables for 1985 then discarded.

Rating (*S&PRat*) is the Standard and Poor's issuer rating as in COMPUSTAT (280) available from 1985. I decoded this data to an ordinal scale that starts with a numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Most studies in the literature have come to use this type ratings measure. *S&PRatDet* is a more detailed measure of ratings including rating modifiers. Rating modifiers show relative standing within the major rating categories, such as A++, B-. The highest rating AAA is represented by an *S&PRatDet* of twenty-two. The more recent studies in the literature have begun to include this ratings measure, as well. I use the changes in this variable in the model and it has fourteen levels. It is well above the usual rule of thumb of seven levels (Likert scale is approximated as continuous in the literature), each level is equally spaced from each other and the distribution is normal-like; which makes it reasonable to approximate the changes in ratings variable as continuous and use OLS estimation rather than probit.

I also use changes in rating as an independent variable in the leverage equation. I include one lead and one lagged form it, as well. The lag is included to see whether past ratings have an effect on the current leverage. The lead rating change is included to see whether the impact of subsequent rating change affects managers' decision to adjust capital structure. I assume that managers correctly estimate the subsequent rating change. I include this variable because Graham and Harvey (2001) field survey CFOs mention that they care about firm's rating and when adjusting capital structure they factor in the effects of their decisions on firm's future rating.

I measure firms' capital structure position using book value leverage ($Lev_{i,t}$), measured as the book value of long-term debt over book value of assets. The reason I use book-value leverage is because one of my instruments is market-to-book values, which might create a mechanical relation with a market value leverage measure. Further, $Lev_{i,t}$ considers only the long-term debt following previous rating models (Kaplan and Urwitz (1979)). I first difference leverage ratios and standardize them before inserting into the model estimation.

Just like the case in ratings, I use change in leverage as an independent variable in rating equation. I include lags of change in leverage to see whether past capital structure choices have an impact on current rating change. I did not include a lead of change in leverage in the rating equation. Ratings are assigned by private rating companies (outsider) and they are not fully aware of firm's investment portfolio and what the firm will do next year. They base their rating evaluation on the current and past accounting information and subjective opinions as mentioned in the Standard and Poor's "Rating Methodology: Evaluating the Issuer" report. It wouldn't be meaningful to assume that rating companies would accurately estimate firms' change in leverage at t+1. They might have an expectation about it but that will probably go under their *subjective* evaluation and an analyst expectations data does not exist for firms' expected capital structures.

B. Control Variables

Changes in profitability or other firm dynamics would affect availability of or need for funds, and leverage for that matter. Capital structure literature uses a set of variables commonly accepted to affect firm's ratings. Following the literature I include proxies for profitability, income volatility, asset tangibility, product uniqueness, and size. These are almost exactly the same control variables that are used in the ratings literature. Standard and Poor's "Rating Methodology: Evaluating the Issuer" report gives out basically ten accounting ratios that they use as criteria. Ratings literature uses these control variables ratios to proxy the measures that are used by the rating companies. This section explains the control variables I have included in the model.

I measure profitability ($OI/TA_{i,t-1}$) by the return on assets (= operating income / total assets). Standard and Poor's state that firms with higher operating margins have a greater ability to generate equity capital internally, to attract capital externally, and to withstand business adversity.

As a proxy for income volatility ($cv(OI)_{i,t-1}$), I calculate the coefficient of variation of the quarterly income. 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 $cv(OI)_{i,t}$ for the 3-year period preceding the year in question. 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.

A firm's relative tangible asset position serves to guarantee debt. I measure it by the fixed asset ratio ($PPE/TA_{i,t-1}$) (=net plant, property and equipment / total assets).

Following Titman and Wessels (1988), I use selling expenses over sales as a proxy for uniqueness ($SE/S_{i,t-1}$). 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. It is considered as a risk factor.

For firm's size ($LogA_{i,t-1}$) I use the logarithm of its total assets adjusted for inflation (prices at 2010). 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.

C. Instruments

Determinants of firms' leverage as well as ratings have been widely studied in literature. More recent rating literature instruments leverage to circumvent the endogeneity problem. One appropriate instrument is market-to-book ratio. Market-to-book ratio ($MB/TA_{i,t}$) is firms' market value and book liabilities over total assets. Also referred as Tobin's Q, this ratio is mostly used as a proxy for growth options the company has. It may affect firm's choice of equity issue over debt issue (decrease or increase the leverage). In general growth companies, have high market-to-book ratio and that raising capital through equity financing (rather than debt issues) is be more advantageous. However, market-to-book ratio is not used by S&P as a criterion in assigning firm ratings. Molina (2005) also uses a market-to-book ratio as an instrument for firms' leverage ratio. Since it is econometrically common practice in multi-stage estimations to use lag(s) of a dependent variable as instrument(s), I have also included lag of change in rating in the leverage equation.

Secondly, I use firm-specific risk to instrument changes in rating. $FIRM\sigma_{i,t}$ is the residual sum of squares from the CAPM model (to measure idiosyncratic risk). Following Blume, Lim and Mackinlay (1998) I include this measure of idiosyncratic firm risk in my rating equation. I use the market model

$$r_{i,t} = \beta_{i,m} r_{m,t} + \varepsilon_{i,t}$$

where firm i's weekly returns in excess of 30-day T-bill rates are regressed on S&P market index returns for each week. From 1985 to 2010, weekly returns are collected for each Compustat firm and the market. Firms that do not have thirty observations within each year are removed. For each year τ, idiosyncratic risk for firm i is

$$\sigma_{\tau,i} = \sum_{t=1}^{52} \left(\varepsilon_{i,t}\right)^2$$

where $\sigma_{\tau,i}$ is the idiosyncratic risk of firm i at year τ. To my knowledge this measure has never been included in modeling capital structure. Firm-risk basically derived from equity markets and it is not directly relevant to debt markets, if anything it would lead the debt markets. In a Black-Scholes set-up, if we consider equity as a call option on the firm's assets, with strike equal to the face value of debt; then debt is like having a risk-free bond plus a short put option. The pay-off to debt is limited on the upside, and unlimited on the down-side. Hence, the debt analysts put major effort at the issue, then not so much. However, the pay-off to the equity is unlimited on the upside. Hence, equity analysts have to routinely monitor the firm. Therefore, an information spillover from equity market to debt market is reasonable. Firm-risk measure may capture this information. Literature uses this measure as a proxy for firms' management quality. Market risk portion of the total risk (total risk is share price volatility) is referred as un-diversifiable risk, and all firms are susceptible to it. However, the remaining part, the firm-specific risk component shows how the management is handling the business. If it is high their decisions are unexpected and market reacts by sharp moves in equity valuations. If it is low, firm is assumed a lower risk company with a reliable management. The rating analysts' *subjective* evaluation of firms' management quality may be proxied by firm-risk measure. Since market's evaluation of management quality would not be a factor in manager's capital structure choice, firm-risk is a good candidate as a rating instrument.[20] Another instrument maybe lagged values of change in leverage. Lagged leverage change is a proxy for persistence of capital structure choice. Baker and Wurgler (2002) shows that impact of large debt or equity issues persist for a longer time than the annual, small capital structure adjustments. Therefore, other than firm-specific risk and market-risk, I have also included lags of leverage as instrument in the rating equation.

[20] Some researchers prefer to see the market risk in the model, as well. They believe that it shows how firm handles the market-risk. Although, I do not agree with this opinion, in all fairness I have included market-risk measure in the model estimation. It turned out to be insignificant, and results do not change with inclusion or exclusion of it, hence I have also reported the coefficient estimates for market-risk in results.

IV. Methodology and Results

In this section, I present the methodology and the findings of the empirical analysis. Section A introduces the model, Section B presents the main findings of the model estimation. Section C presents the case for investment grade and speculative grade firms.

A. Model

It is natural that the capital structure literature and ratings literature has overlaps. As for ratings, may that be firms' rating or issuer rating per bond issue, is an evaluation of the default risk of the firm which will affect the required rate of return by the bond holders and the cost of capital for the firm. The capital structure choice of the firm at the time of a new issue, the firm's already existing debt obligations or how levered the firm already is will increase its default risk, and decrease its debt rating. Literature recently has begun to address the issue of endogeneity of leverage in estimating ratings. Molina (2005) talks about a common set of variables that are mentioned by rating agencies that they use in rating firms also known to affect firms' leverage. Therefore, when modeling ratings, Molina (2005) first instruments leverage, and then uses it in the rating estimation. Kisgen (2006), on the other hand, looks at the impact of rating changes on the capital structure. It compares the speed how firms' capital structure reacts to a rating downgrade versus an upgrade. However, neither of these studies address the concurrent dynamics of the rating-leverage relation.

Here I follow a different approach. I argue that literature misses to properly address the interaction between firms' capital structure choice and changes in ratings. A firm's manager makes a capital structure choice knowing his choice will affect the firm's rating; hence, leverage adjustment is made in the face of a possible rating change. For example, if a manager thinks cost of capital will increase in the future or if he plans for a future investment may choose to raise capital via a debt issue (leverage increase) in order to maximize the firm value. Manager knows this leverage increase will add to the current default probability and will yield to a rating downgrade, yet, if consequences of not acting now will be more costly, then he may choose to pull the trigger. Since manager's choice of capital structure may consequently yield to a rating change, he has to consider both sides of the coin; i.e. managers know and consider the probable rating decrease when they are making a decision to increase their leverage, and vice versa.

Here, I argue that choice of capital structure and rating upgrades/downgrades are the result of a simultaneous decision process. Therefore, I model leverage changes and rating changes using a simultaneous equation system as below:

$$Lev_{i,t} = \alpha_1 + \beta_1 Rat_{i,t} + \beta_2 X_{i,t} + \beta_3 Y_{i,t} + \varepsilon_{1,i,t} \quad (1)$$

$$Rat_{i,t} = \alpha_2 + \beta_4 Lev_{i,t} + \beta_5 Z_{i,t} + \beta_6 Y_{i,t} + \varepsilon_{2,i,t} \quad (2)$$

where Lev_t , leverage change at t, and Rat_t , rating change at t, are determined simultaneously. In this model, X_i represents the instruments for firm's leverage. Y_i is the common set of factors that affect both firm's leverage, as well as, its rating. Z_i stands for the rating instruments, the set of factors that affect firms' rating but not the leverage.

X_i consists of market-to-book ratio (MB/TA_t), previous rating change at t-1 (Rat_{t-1}), and next rating change at t+1 (Rat_{t+1}). Market-to-book ratio has been used as a leverage instrument in relevant literature that studies ratings (such as Molina (2005), Blume, Lim and Mackinlay (1998)).[21] In addition to market-to-book ratio, I also include lead and lag of rating changes. Ratings, as a measure of firms' default probability, have a direct effect on required rate of return by the debt holders, which in turn will affect the cost of changing leverage. Graham and Harvey (2001) surveys the managers, and reports that managers care about their firms' ratings and in their capital structure choice and that they essentially consider the impact on their firm's future ratings. In my model, I assume forward looking managers as insiders will accurately predict the subsequent rating change at t+1 and will factor that in in their leverage decision. Therefore, I include one year lead rating change in Equation 1. Aside from these two, Kisgen (2006) shows that past rating change also has an effect on future capital structure choice. Hence, I also include first lag of rating change in Equation 1.[22]

Y_i is the common set of factors that affect both firm's leverage change as well as rating change. These are measures of firms' profitability (OI/TA_t , operating income over total assets), income volatility ($cv(OI)_t$, coefficient of variation of quarterly operating income), asset tangibility (PPE/TA_t , plant, property and equipment over total assets),

[21] I have also run the estimations using some other alternative instruments such as research and development expense, capital expense and depreciation both individually, together and in various combinations. The main results remain unchanged.
[22] I have also tried model estimation with more lags but none were significant.

firm uniqueness (SE/TA_t , sales expenses over total assets), and firms' size ($LogA_t$, logarithm of asset values in 2010 USD). These factors have been widely used both in rating estimation and leverage adjustment literature as controls. I include these common set of controls both in Equations 1 and 2.

Z_i represents the instruments for firms' ratings. Here I use idiosyncratic firm risk, market risk, and the first and second lags of leverage. It is econometrically common practice in multi-stage estimations to use lag(s) of a dependent variable as instrument(s). Lagged leverage change is a proxy for persistence of capital structure choice. Baker and Wurgler (2002) shows that impact of large debt or equity issues persist for a longer time than the annual, small capital structure adjustments.[23] Lemmon, Roberts, and Zender (2008) study the time series behavior of leverage adjustments and find that capital structure choices persist over time. Although, the persistence of capital structure choice is well-documented, however, its impact on ratings has yet to be studied. Using lagged leverage changes in the rating equation, I control for this persistence effect. I also include two additional rating instruments that are derived from equity market. I run the CAPM market model to estimate the beta coefficient. Literature uses (such as Blume, Lim and Mackinlay (1998)) the beta coefficient as a proxy for systematic market risk (un-diversifiable risk) and the sum of squared residuals as a proxy for idiosyncratic firm-specific risk (diversifiable risk). I include $Firm\beta_t$ and $Firm\sigma_t$ in the rating equation to account for those types of risk,

[23] Baker and Wurgler (2002) calculate a ten-year weighted average market-to-book ratio. This ratio overweights the years where a larger equity or debt issue has been in place. Lemmon, Roberts, and Zender (2008) study the time series behavior of leverage adjustments and find that capital structure choices persist over time.

respectively. This is basically an effort to capture a *probable* information spillover from the equity market to the bond market. Standard and Poor's, aside from a list of ten financial ratios that are "key" ratios in its analysis of creditworthiness; mentions that "*subjectivity* is at the heart of every rating." A main difference between bond investors and equity investors is the return on their investment. For bonds the return is fixed at the issue, as long as the firm does not default. However, the return on stock investment is not preset. This is the main reason why equity market is accepted to analyze the companies rigorously. Although the bond market is larger in dollar volume, more analysts work in equity market. I include measures of risk that are derived from stock market valuations in the rating estimation model to control for the information that spills over from equity market to the bond market, in an effort to capture some of that subjectivity that S&P is mentioning.

I use standardized three stage least squares regression (3SLS) to estimate the model. Although two and three stage modeling is commonly used in corporate finance, their use is very limited in the ratings literature. This may be due to two reasons. Firm's rating is assigned by a credit rating agency, and firm's capital structure choice decision is made by the firm itself. On first look the rating decision and leverage decision may be thought to be exogenous. But findings in the literature have shown that leverage choices do affect ratings. Although earlier literature has realized the effect of leverage on ratings, it wasn't until recently, that endogeneity of leverage has been considered and addressed by the use of two-stage models. Here, I argue that as much as leverage choice affects the ratings, ratings also do affect the cost of capital for the firm and hence affect the leverage choice. Surveyed managers in the Graham and Harvey (2001) clearly state that they do care about their firm's rating and consider ratings in their decision making process. Therefore, the very nature of the relation between leverages and ratings calls for use of three-stage simultaneous estimation methods.

Second issue is in regards to the nature of the ratings data. Literature converts firms' letter rating grades into ordinal numbers, and having ordinal numbers as dependent variable require the use of ordered-probit models. The literature uses a nine-point scale to convert the letter ratings into ordinal numbers simply by collapsing them into consecutive numerical values (such as 9 for AAA, 8 for AA, 7 for A, 6 for BBB…). This process dismisses the rating modifiers (such as in 9 for all AAA+, AAA, AAA-). More recent literature uses a twenty-two-point scale. The increase in the number of levels of dependent variable allows for treating the dependent variable as continuous and using OLS estimation. [24] In my sample, I have fourteen levels of response variable in the rating equation, the distribution of which satisfies the OLS assumption. Since both equations satisfy the OLS assumptions, there is no econometric limitation to prevent the estimation of the model using a 3SLS regression technique.

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[24] Literature uses probit model for binary response variable. If response variable takes on more values than just two, it requires the use of ordered-probit models. The literature that uses responses to, for example, a Likert scale with five to seven responses depending on the type of the data employs OLS type estimations. The nature of the response variable defines whether an OLS estimation rather than a probit estimation can be used. Firstly, the response variable has to have equal spacing between its levels. Secondly, the distribution of the response variable has to be normal-like in order to resemble a continuous variable so that OLS assumption may be satisfied. Likert scales are usually 5-point or 7-point, whereas I have about 14 levels as dependent variable. Since I use rating modifiers and ratings they are equally spaced compared to the problems of ordering people's preferences in other literature (such as in psychology, or sociology). The distribution of my response variable also is close normal. The distributions are not reported here for brevity, but are available upon request.

B. Empirical Results

This section presents the estimation results. Table 2 reports the coefficient estimates for leverage equation in the first column, and those for the rating equation in the second column, respectively.

[Table 2]

Literature does not consider the concurrent dynamics of leverage-rating relation. My findings show that they do impact each other simultaneously. The results in first column of Table 2 show that all coefficient estimates for rating variables are significant. This implies that when rating changes and leverage changes are modeled simultaneously, firm's leverage choice is affected by its rating upgrades/downgrades. In a standardized regression, the magnitude of the coefficient estimate of a variable shows how much more that variable explains relative to the other parameters. A comparison of the coefficient estimates in the first column of Table 2 shows that Rat_t is the most important determinant in the leverage equation (about twice the median significant parameter estimate). Molina (2005) argues that if a decrease in 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 then will negatively affect the rating). Similarly, here the positive significant of coefficient estimate for Rat_t imply that a rating increase (decrease) yields to a simultaneous leverage increase (decrease). Rat_{t+1} , subsequent year rating change, on the other hand, is negatively associated to the leverage change, with half the coefficient size of Rat_t . The significant impact of following rating upgrade/downgrade on current capital structure choice may be due to firm manager. Firm's manager is in a position to control firm's risk taking activity and plan firm's investments ahead of time. If a manager undertakes riskier projects, he would expect its consequences on the firm's rating. Hence, if a manager is seeking to increase firm's leverage, he would find it advantageous to act simultaneously with a rating upgrade and/or before a rating downgrade. Vice versa, if there is currently a rating downgrade and/or an expected next year upgrade, manager would shy away from issuing debt. The other rating variable in the model, Rat_{t-1}, is also significant which implies past rating upgrade/downgrade also matters for current leverage decision; however, its impact is limited (the smallest coefficient estimate among significant variables). [25]

A change in firm's size ($LogA_t$) also seems to be a very important determinant for capital structure choice. The impact of this variable on leverage is well established in literature. Larger firms have a higher debt capacity and can use higher leverage. Another determinant seems to be almost as important is firm's profitability (OI/TA_t). Similar to the literature I find that both firm's profitability, as well as, income volatility ($cv(OI)_t$) has adverse effect on leverage. Profitable firms tend to have lower leverage, and on the other hand, firms that have high earnings volatility do not use high levels of leverage. Market-to-book ratio is commonly used as a proxy for growth options in the corporate finance literature. Following Molina (2005), I have also included market-to

[25] I have also included other lags of rating changes but after one lag and one lead, they seem to lose significance.

book ratio as a leverage instrument. MB/TA_t is negatively associated to leverage changes (below the median significant variable coefficient size).

Column 2 reports the empirical results for the rating equation (Equation 2). According to these results, the most important factor for a rating upgrade/downgrade is a leverage change. The coefficient of Lev_t is more than five times larger than the median. Most of the debt rating literature does not consider the endogeneity of leverage with ratings, and *underestimate* its impact. In order to understand the underestimation of leverage, let's consider this case. If a decrease in firm's fundamental risk occurs, firm's prospects will 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. This negative bias on the impact of leverage on ratings is an endogeneity problem and calls for instrumenting the leverage. In Equation 1, I use MB/TA_t , Rat_{t+1} , and Rat_{t-1} as instruments. This approach purges out the real impact of leverage on rating and shows that it is by far the most important determinant.

In addition to simultaneous leverage change at t, I have also included two lags of leverage change at t-1 and t-2, as instruments for rating changes.[26] They also turn out to be negatively associated to rating changes and also slightly more important than the level of the median determinant. Having past leverage adjustments as significant determinants for changes in rating actually is evidence for persistence of capital structure choices. According to the results, the combined effect of Lev_{t-1} and Lev_{t-2} reaches about half the size of coefficient estimate of Lev_t and is actually far more important than the classical control variables used in the rating literature. To my knowledge, although this persistence has been found in the speed of leverage adjustment literature (Lemmon, Roberts, and Zender (2008)), it has not been empirically studied in a panel setting before.

Following Blume, Lim and Mackinlay (1998), I have included $Firm\beta_t$ and $Firm\sigma_t$, systematic market-risk and idiosyncratic firm-risk, respectively, in the rating equation. $Firm\beta_t$ is the coefficient estimate in the CAPM market model, and $Firm\sigma_t$ is the sum of squared residuals. According to my results, market-risk, the variations in firm's stock price upon fluctuations in the market does not have an impact on ratings. However, firm-risk, the remaining variations in firm's stock price aside from fluctuations in the market is significantly negatively associated to the rating changes. Blume, Lim and Mackinlay (1998) explains firm-risk is actually a better proxy for the quality of the

[26] I have also tried further lags but after the second lag the significance disappears.

management, i.e. how the management manages the risk. The coefficient of $Firm\sigma_t$ is about 50% larger than the median significant determinant.[27]

According to S&P's report firms' size not only represents the dollar amount of assets, but also diversification, and also products has been in place over longer time and has their market. Among the traditional control variables used for ratings, similar to the literature, I find that the most important one is firms' size ($LogA_t$). The rest of the significant control variables in order of importance as determinants of ratings are asset tangibility (PPE/TA_t), income volatility ($cv(OI)_t$) and profitability (OI/TA_t), respectively.

These classical control variables used in rating literature seem to be below the median level of significant determinant, matter far less than changes in leverage. This is an interesting finding as according to S&P's list of ten accounting ratios and the findings in literature points out to that these variables should matter for rating changes. However, my findings are consistent with the more recent research (Molina (2005)) that considers the endogeneity of leverage that finds that instrumenting leverage actually increases its impact on ratings.

C. Investment Grade versus Speculative Grade

[27] I have run the estimations with and without $Firm\beta_t$ and findings are unchanged. Although insignificant, I chose to report it in case reader is interested in seeing its impact. On the other hand, $Firm\sigma_t$ represents variation in equity prices due to non-market moves, where manager would have more control over, and will be a better representative of the idiosyncratic firm risk. The sum of squared residuals from the market model proves to be a good rating instrument.

This section presents the model estimation results per investment grade and speculative grade firms. Table 3 reports the coefficient estimates for leverage equation in first and third columns, and the coefficient estimates for the rating equation in the second and fourth columns, respectively.

[Table 3]

Investment grade firms are about two thirds of my sample. Reasonably, I would expect results for investment grade firms are similar to those in Table 2. As for leverage equation, the coefficient estimates and significances reported in Column 1 of Table 3 are very similar to those in Table 2. The main finding is unchanged; simultaneous rating change is the most important determinant of leverage change. Actually, here the coefficient for Rat_t is even greater. It was five times the median coefficient size for the whole sample, now it is about nine times for investment grade firms. This implies that rating changes in investment grade firms play a great role in their capital structure choices. The case for speculative grade firms is very different as reported in Column 3. Neither the simultaneous nor the past rating change does not seem to matter for speculative grade firm's leverage choice. The only rating coefficient that is significant for speculative grade firms' leverage change estimation is that of Rat_{t+1} with a coefficient size at around the median level. These results show that impact of ratings on leverage decisions is more pronounced for investment grade firms. This may be due to a categorical difference between investment and speculative grade firms. [28] According

[28] It is a fact that bond trading funds categorize bonds by speculative grade firms as "junk bonds". While some funds underweight this category, some funds do not even take position in such bonds. These bonds have a total different, more risk taker investor profile. It is very common that yield spreads as well as

to the results here, rating changes play a very critical role in the capital structure choices of investment grade firms, however, once a firm is categorized under speculative grade rating changes do not seem to matter as much for the capital structure choices.

For speculative grade firms it is not ratings but it is profitability. The largest significant coefficient estimate in Column 3 is for OI/TA_t . Rat_{t+1} has the second, $LogA_t$ has the third and MB/TA_t has the fourth largest coefficients. For speculative grade firms changes in profitability, and growth options seem to be relatively higher in the importance ranking for leverage decisions and changes in ratings, and firm size are lower relative to investment grade firms. For investment grade firms, on the other hand, secondary to rating variables, the next most important factor for leverage changes is firm size ($LogA_t$), followed by profitability, asset tangibility, income volatility, and growth options.

The results seem to be divergent for investment grade firms and speculative grade firms. It is a fact that bond trading funds categorize bonds by speculative grade firms as "junk bonds". While some funds underweight this category, some funds do not even take position in such bonds. These bonds have a total different, more risk taker investor profile. It is very common that yield spreads as well as required returns for junk bonds are a multiple of those for investment grade bonds. The relation may not necessarily be linear and that once probability of default is closer other factors may matter more than rating upgrades/downgrades in a low rating profile grade.

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required returns for junk bonds are a multiple of those for investment grade bonds. The relation may not necessarily be linear and that once probability of default is closer other factors may matter more than rating upgrades/downgrades in a low rating profile grade.

The divergence between the findings for investment and speculative grade firms disappear when rating change estimation results are considered. The results in Columns 2 and 4 are almost the same. To start with, leverage changes seem to be the most important factor for rating upgrades/downgrades by far both for investment and speculative grade firms. Next, firm size is the second most important factor for both, as well; more so for speculative grade firms. Firm risk is the third important factor with a coefficient size slightly above the median. Rest of the control variables are about the same level of importance for investment grade firms.

The main finding is that for rating changes the most important factor is leverage changes as important as five to ten times of other determinants. As for leverage changes, rating changes are the most important factor in investment grade firms only. Other factors come into play for speculative grade firms.

V. Conclusion

Recent literature considers endogeneity problem of leverage in rating estimation and finds that impact of leverage used to be underestimated (Molina (2005)). In explaining the situation the negative bias on leverage is attributed to the dual impact of a shock to the fundamental risk; a direct impact on ratings and an indirect impact on rating through leverage. Literature also studies the response of capital structure to rating changes (Kisgen (2006)). The evidence shows that rating changes yield to a change in capital structure adjustment patterns, i.e. following a rating downgrade firms take time in adjusting their leverage due to increased costs, and following rating upgrades firm prefer to take advantage of the decrease in adjustment costs and take action in a shorter period of time. Modeling impact of rating changes on capital structure or capital structure changes on ratings literature uses lagged independent variables and does not address the concurrent dynamics of the leverage-rating relationship.

In this paper, I model changes in firms' credit rating and firms' capital structure decisions using a simultaneous equation system. The impact of leverage on ratings is well documented. Graham and Harvey (2001) survey shows that CFOs do care about their firms' rating. Then, when making a capital structure choice managers should consider the possible impact of their choice on the firm's rating. This introduces the endogeneity of change in rating in the leverage estimation. Therefore, I assume both simultaneous change in rating and change in capital structure are endogenous to each other. I instrument leverage changes using changes in market-to-book ratio and instrument rating changes using changes in idiosyncratic firm risk (residuals from CAPM market model), and also lags of leverage changes. Then I use a standardized three stage least squares (3SLS) model to estimate the model. The standardized estimation technique allows me to rank the parameters in order of their explanatory power of the variances in the dependent variable.

My results show that simultaneous leverage and rating changes have significant impact on each other. In leverage change estimation, rating change has the largest coefficient at about two to five times of other determinants. Similarly, in rating change estimation, leverage change has the largest coefficient estimate at about three to nine times of other determinants. The main finding of my study is simultaneous change in rating and change in leverage are the most important determinants for each other.

I also find that in the rating equation not only the simultaneous leverage change, but also its lags are significant with large coefficient size. This is consistent with the leverage adjustment speed literature that finds that capital structure decisions persist. The traditional control variables that proxy the ten accounting measures that are used by Standard and Poor's in evaluating the firms' ratings have significant impact on rating upgrades/downgrades, however, their effect is far less than that of leverage changes when rating and leverage changes are modeled simultaneously. This finding is consistent with the more recent literature (such as Molina (2005)) that considers the endogeneity of leverage in rating models and shows correcting for endogeneity increases the impact of leverage on ratings by three times.

In the leverage change estimation, simultaneous rating change has a positive coefficient estimate, however, following rating change at t+1 is negatively associated to change in leverage at t. This implies that managers are opportunistic and consider increase (decrease) their leverage before an expected rating downgrade (upgrade).

My sample does not homogeneously consist of investment grade firms. About one third of my sample includes speculative grade firms. I also run my estimations separately for these two groups. The findings for determinants of change in ratings are very similar for investment and speculative grade firms; that leverage changes is by far the most important determinant. However, there are differences when it comes to determinants of leverage changes. Basically, for speculative grade firms simultaneous rating changes do not seem to matter for capital structure decisions. This may be due to a categorical difference that speculative grade firms are subject to. Bonds of speculative grade firms are referred to as "junk bonds" and some bond portfolio managers have restrictions on taking position on these junk bonds. This may have an effect on the sensitivity of capital structure changes to changes in ratings. The managers of speculative firms may be fighting for their firms' survival and make decisions regardless of their already speculative considered rating. Bottom line is that the results show that the impact of change in rating on capital structure changes is non-linear.

The main contribution of the paper is modeling leverage changes and rating changes simultaneously. They turn out to be the most important determinants for each other. The link between ratings and leverages may be the opportunistic managers that consider rating changes when making capital structure choices and their choices also affect ratings. The study points out to that neither leverage nor ratings are exogenous to each other and leverage-rating relationship should be appropriately modeled using simultaneous equation systems.

Appendix: Variable Definitions

This appendix details the variable construction for analysis of the sample.

Dependent Variables:

Rating (*S&PRat* and *S&PRatDet*): is the Standard and Poor's issuer rating as in COMPUSTAT (280) available from 1985. I decoded this data to an ordinal scale that starts with a numerical code of nine for the best rating possible, AAA, and ends with a numerical code of one for the worst rating considered, C. The rest of the numerical codes (eight to two) are assigned, in order, to ratings AA, A, BBB, BB, B, CCC and CC. Most studies in the literature have come to use this type ratings measure. *S&PRatDet* is a more detailed measure of ratings including rating modifiers. Rating modifiers show relative standing within the major rating categories, such as A++, B-. The highest rating AAA is represented by an *S&PRatDet* of 22. The more recent studies in the literature have begun to include this ratings measure, as well.

Leverage ($Lev_{i,t-1}$) = long-term debt / total assets = long-term debt (9) / book value of assets (6).

Independent Variables:

Lagged Leverage ($Lev_{i,t-2}$, $Lev_{i,t-3}$) : The second and third lags of leverage.

Leverage Instrument (*$Instrument_{i,t-1}$*) : As Leverage is endogenous in the rating equation, I use instrument leverage using market-to-book ratio, research and development expenses over total assets, capital expenses over total expenses, depreciation over total assets. I run a principal component analysis and form a common factor index using these variables. I use the first factor (represents 65% of variance) as an instrument for leverage.

Market-to-book ratio ($MB/TA_{i,t-1}$) = market value of equity + book value of debt / total assets.

Research and Development ($R\&D/TA_{i,t-1}$) = XR&D/ total assets.

Capital expenses ($CAPEX/TA_{i,t-1}$) = XCAPEX/ total assets.

Depreciation ($DP/TA_{i,t-1}$) = XDP/ total assets.

Firm Risk ($FIRM\sigma_{i,t-1}$) = the residual sum of squares from the CAPM model (to measure idiosyncratic risk). Following Blume, Lim and Mackinlay (1998) I include this measure of idiosyncratic firm risk in my rating equation. I use the market model

$$r_{i,t} = \beta_{i,m} r_{m,t} + \varepsilon_{i,t}$$

where firm i's weekly returns in excess of 30-day T-bill rates are regressed on S&P market index returns for each week. From 1985 to 2010, weekly returns are collected for each Compustat firm and the market. Firms that do not have thirty observations within each year are removed. For each year τ, idiosyncratic risk for firm i is

$$\sigma_{\tau,i} = \sum_{t=1}^{52} \left(\varepsilon_{i,t}\right)^2$$

where $\sigma_{\tau,i}$ is the idiosyncratic risk of firm i at year τ.

Profitability ($OI/TA_{i,t-1}$) = operating income (13) / total assets (6).

Income Volatility ($cv(OI)_{i,t-1}$) = for the preceding three year period, standard deviation of quarterly operating income / mean absolute value.

Asset Tangiblity ($PPE/TA_{i,t-1}$) = property, plant and equipment (8) / total assets (6).

Product Uniqueness ($SE/S_{i,t-1}$) = selling expenses / sales.

Size ($logA_{i,t-1}$) = total assets (6) / inflation index for year t. Adjusted to 2004 prices.

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Table 1. Descriptive Statistics

Table 1 shows the descriptive statistics for investment grade and speculative grade firms. *Rat* is firms' Standard and Poor's debt rating over a twenty-two-point scale (including rating modifiers). The rest are firms' leverage ratio, research and development expenses over total assets, capital expenditures over total assets, depreciation over total assets, market risk, firm-specific risk, market to book ratio, operating income over total assets, coefficient of variation for quarterly operating income, plant, property and equipment over total assets, sales expenses over total sales, and assets in 2010 million dollars, respectively.

	N	Mean	Median	SD	Min	Max
A. Investment Grade						
Rat	2001	16.45	16	2.42	13	22
Lev	2001	0.18	0.17	0.10	0.00	0.72
XRD/TA	2001	0.03	0.02	0.04	0.00	0.25
CAPX/TA	2001	0.06	0.06	0.04	0.00	0.35
DP/TA	2001	0.05	0.04	0.02	0.01	0.15
Firmβ	2001	0.94	0.92	0.46	-0.59	3.39
Firmσ	2001	0.07	0.05	0.07	0.01	0.78
MB/TA	2001	2.07	1.64	1.37	0.49	17.68
OI/TA	2001	0.17	0.16	0.07	-0.10	0.44
cv(OI)	2001	0.30	0.21	0.85	0.05	34.21
PPE/TA	2001	0.34	0.31	0.17	0.01	0.87
SE/S	2001	0.22	0.19	0.13	0.01	0.72
Assets (US$ bill.)	2001	12.79	4.68	24.84	0.02	292.73
B. Speculative Grade						
Rat	843	10.06	10	1.36	1	12
Lev	843	0.32	0.29	0.19	0.00	0.88
XRD/TA	843	0.03	0.01	0.05	0.00	0.37
CAPX/TA	843	0.06	0.05	0.06	0.00	0.55
DP/TA	843	0.05	0.04	0.03	0.01	0.24
Firmβ	843	1.10	1.06	0.77	-1.64	4.33
Firmσ	843	0.21	0.16	0.18	0.01	1.75
MB/TA	843	1.45	1.25	0.75	0.57	11.72
OI/TA	843	0.11	0.12	0.08	-0.43	0.46
cv(OI)	843	0.77	0.37	2.02	0.05	39.97
PPE/TA	843	0.33	0.27	0.20	0.02	0.91
SE/S	843	0.22	0.19	0.18	0.02	2.39
Assets (US$ bill.)	843	3.73	1.30	18.68	0.09	337.82

Table 1 continued…

	N	Mean	Median	SD	Min	Max
C. All Sample						
Rat	2844	14.35	14	3.68	1	22
Lev	2844	0.22	0.20	0.15	0.00	0.88
XRD/TA	2844	0.03	0.02	0.04	0.00	0.37
CAPX/TA	2844	0.06	0.05	0.04	0.00	0.55
DP/TA	2844	0.05	0.04	0.02	0.01	0.24
Firmβ	2844	0.99	0.94	0.58	-1.64	4.33
Firmσ	2844	0.11	0.07	0.13	0.01	1.75
MB/TA	2844	1.87	1.50	1.24	0.49	17.68
OI/TA	2844	0.15	0.15	0.07	-0.43	0.46
cv(OI)	2844	0.46	0.24	1.37	0.05	39.97
PPE/TA	2844	0.33	0.30	0.18	0.01	0.91
SE/S	2844	0.22	0.19	0.15	0.01	2.39
Assets (US$ bill.)	2844	9.82	3.08	23.39	0.02	337.82

Table 2. Model Estimation Results

Table 2 presents the model estimation results. The estimation method is standardized 3SLS regression. All variables are first-differenced. Leverage Equation: Dependent Variable: Firm's leverage ratio (*Lev_t*), Endogenous: Rating (*Rat_t*), Instruments: Next year's rating (*Rat_{t+1}*), last year's rating (*Rat_{t-1}*), market-to-book ratio (*MB/TA_t*). Rating Equation: Dependent Variable: Firm's S&P rating (*Rat_t*, 22-point scale, including rating modifiers), Endogenous: Firm's leverage ratio (*Lev_t*), Instruments: Lags of leverage (*Lev_{t-1}*, *Lev_{t-2}*), market risk (*$Firm\beta_t$*), firm-specific risk (*$Firm\sigma_t$*). Common exogenous variables: Operating income over total assets (*OI/TA_t*), coefficient of variation for quarterly operating income (*$cv(OI)_t$*), plant, property and equipment over total assets (*PPE/TA_t*), sales expenses over total sales (*SE/S_t*), and log of assets in 2010 million dollars (*$LogA_t$*). Year and industry dummies are included but not reported for brevity. ***, **, * represent 1%, 5% and 10% robust significance levels (corrected for two stages), respectively. The sample is COMPUSTAT firms in 1985-2010.

	Leverage: *Lev*		Rating: *Rat*	
Rat_{t+1}	-0.1406	***		
Rat_t	0.3011	***		
Rat_{t-1}	-0.0132	*		
Lev_t			-0.5650	***
Lev_{t-1}			-0.1415	***
Lev_{t-2}			-0.0909	***
$Firm\beta_t$			-0.0033	
$Firm\sigma_t$			-0.1448	***
MB/TA_t	-0.0819	***		
OI/TA_t	-0.1606	***	-0.0663	**
$cv(OI)_t$	-0.0579	***	-0.0949	***
PPE/TA_t	-0.0334		0.1040	***
SE/S_t	-0.0133		0.0375	
$LogA_t$	0.1856	***	0.1828	***
Constant	0.1059			
N	2844		2844	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*

Table 3. Model Estimation Results by Firms' Rating Grade

Table 3 presents the model estimation results for investment grade (A-rated) and speculative grade (B-rated) companies. The estimation method is standardized 3SLS regression. All variables are first-differenced. Leverage Equation: Dependent Variable: Firm's leverage ratio (Lev_t), Endogenous: Rating (Rat_t), Instruments: Next year's rating (Rat_{t+1}), last year's rating (Rat_{t-1}), market-to-book ratio (MB/TA_t). Rating Equation: Dependent Variable: Firm's S&P rating (Rat_t, 22-point scale, including rating modifiers), Endogenous: Firm's leverage ratio (Lev_t), Instruments: Lags of leverage (Lev_{t-1} , Lev_{t-2}), market risk ($Firm\beta_t$), firm-specific risk ($Firm\sigma_t$). Common exogenous variables: Operating income over total assets (OI/TA_t), coefficient of variation for quarterly operating income ($cv(OI)_t$), plant, property and equipment over total assets (PPE/TA_t), sales expenses over total sales (SE/S_t), and log of assets in 2010 million dollars ($LogA_t$). Year and industry dummies are included but not reported for brevity. ***, **, * represent 1%, 5% and 10% robust significance levels (corrected for two stages), respectively. The sample is COMPUSTAT firms in 1985-2010.

	Investment Grade				Speculative Grade			
	Leverage: *Lev*		Rating: *Rat*		Leverage: *Lev*		Rating: *Rat*	
Rat_{t+1}	-0.2239	***			-0.1070	***		
Rat_t	0.6954	***			-0.0334			
Rat_{t-1}	-0.0211	*			0.0082			
Lev_t			-0.6905	***			-0.6336	***
Lev_{t-1}			-0.1487	***			-0.1712	***
Lev_{t-2}			-0.0863	***			-0.0981	**
$Firm\beta_t$			0.0179				-0.0074	
$Firm\sigma_t$			-0.1312	***			-0.2015	***
MB/TA_t	-0.0776	***			-0.0898	***		
OI/TA_t	-0.1646	***	-0.0737	**	-0.1349	***	-0.1018	
$cv(OI)_t$	-0.0782	***	-0.0566	***	-0.0089		-0.1626	***
PPE/TA_t	-0.0820	**	0.0825	***	0.0484		0.1527	***
SE/S_t	-0.0012		0.0096		-0.0054		0.1004	
$LogA_t$	0.3046	***	0.1775	***	0.0958	*	0.3006	***
Constant	0.2204				-0.2943			
N	2001		2001		843		843	

****, **, * represent 1%, 5% and 10% robust significance levels, respectively. Year and industry dummies are included but not reported for brevity.*