

Does the Source of Capital Affect Capital Structure?

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Prior work on leverage implicitly assumes capital availability depends solely on firm characteristics. However, market frictions that make capital structure relevant may also be associated with a firm's source of capital. Examining this intuition, we find firms that have access to the public bond markets, as measured by having a debt rating, have significantly more leverage. Although firms with a rating are fundamentally different, these differences do not explain our findings. Even after controlling for firm characteristics that determine observed capital structure, and instrumenting for the possible endogeneity of having a rating, firms with access have 35% more debt.

Under the tradeoff theory of capital structure, firms determine their preferred leverage ratio by calculating the tax advantages, costs of financial distress, mispricing, and incentive effects of debt versus equity. The empirical literature has searched for evidence that firms choose their capital structure, as this theory predicts, by estimating firm leverage as a function of firm characteristics. Firms for whom the tax shields of debt are greater, the costs of financial distress lower, and the mispricing of debt relative to equity more favorable are expected to be more highly levered. When these firms discover that the net benefit of debt is positive, they will move toward their preferred capital structure by issuing additional debt and/or reducing their equity. The implicit assumption has been that a firm's leverage is completely a function of a firm's demand for debt. In

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other words, the supply of capital is infinitely elastic at the correct price, and the cost of capital depends only on the risk of the firm's projects.

Although the empirical literature has been successful, in the sense that many of the proposed proxies are correlated with firms' actual capital structure choices, some authors have argued that certain firms appear to be significantly under-levered. For example, based on estimated tax benefits of debt, Graham (2000) argues that firms appear to be missing the opportunity to create significant value by increasing their leverage and thus reducing their tax payments, assuming that the other costs of debt have been measured correctly.¹ This interpretation assumes that firms have the opportunity to increase their leverage and are choosing to leave money on the table. An alternative explanation is that firms may not be able to issue additional debt. The same type of market frictions that make capital structure choices relevant (information asymmetry and investment distortions) also imply that firms sometimes are rationed by their lenders [Stiglitz and Weiss (1981)]. Thus, when estimating a firm's leverage, it is important to include not only the determinants of its preferred leverage (the demand side) but also the variables that measure the constraints on a firm's ability to increase its leverage (the supply side).

The literature often has described banks or private lenders as being particularly good at investigating informationally opaque firms and deciding which are viable borrowers. This suggests that the source of capital may be intimately related to a firm's ability to access debt markets. Firms that are opaque (and thus difficult to investigate *ex ante*), or that have more discretion in their investment opportunities (and thus are difficult for lenders to constrain contractually), are more likely to borrow from active lenders; they are also the type of firms that theory predicts may be credit constrained. In this article, we investigate the link between where firms obtain their capital (the private versus public debt markets) and their capital structure (leverage ratio). In Section 1, we briefly describe the tradeoff between financial intermediaries (the private debt markets), which have an advantage at collecting information and restructuring but are a potentially more expensive source of capital, and the public debt markets. The higher cost of private debt capital may arise from the expenditure on monitoring or because of the tax disadvantage of the lender's organizational form [Graham (1999)]. Additionally, not all firms may be able to choose the source of their debt capital. If firms that do not have access to the public debt markets are constrained by lenders as to the amount of debt capital they may raise, then we should see this manifest itself in the form of lower debt ratios. This is what we find in Section 2. Firms that have access to the public debt markets (defined as

¹ Using a calibrated dynamic capital structure model, Ju et al. (2005) argue that firms are not under-levered.

having a debt rating) have leverage ratios that are more than 50% higher than firms that do not have access (28.4 versus 17.9%).

Debt ratios should depend on firm characteristics as well. Thus, a difference in leverage does not necessarily imply that firms are constrained by the debt markets. The difference could be the product of firms with different characteristics optimally making different decisions about leverage. However, this does not appear to be the case. In Section 2, we show that even after controlling for the firm characteristics, which theory and previous empirical work argue determine a firm's choice of leverage, firms with access to the public debt market have higher leverage that is both economically and statistically significant.

Finally, in Section 3, we consider the possibility that access to the public debt markets (having a debt rating) is endogenous. Even after controlling for the endogeneity of a debt rating, we find that firms with access to the public debt markets have significantly higher leverage ratios.

1. Empirical Strategy and the Basic Facts

1.1 Relationship versus arm's length lending

In a frictionless capital market, firms are always able to secure funding for positive net present value (NPV) projects. But in the presence of information asymmetry in which the firm's quality and the quality of its investment projects cannot easily be evaluated by outside lenders, firms may not be able to raise sufficient capital to fund all of their good projects [Stiglitz and Weiss (1981)].² Such market frictions create the possibility for differentiated financial markets or institutions to arise [Diamond (1984, 1991), Fama (1985), Haubrich (1989), Leland and Pyle (1977), and Ramakrishnan and Thakor (1984)]. These financial intermediaries are lenders who specialize in collecting information about borrowers, which they then use in the credit approval decision [Carey, Post, and Sharpe (1998)]. By interacting with borrowers over time and across different products, the financial intermediary may be able to partially alleviate the information asymmetry that causes the market's failure. These financial relationships have been empirically documented to be important in relaxing capital constraints [Berger and Udell (1995), Hoshi, Kashyap, and Scharfstein (1990a, 1990b), and Petersen and Rajan (1994, 1995)].

² The model in Stiglitz and Weiss (1981) is a model of credit (or debt) constraints. The lenders are unwilling to lend sufficient capital to the firm for it to undertake all of its positive NPV projects. Thus, the firms are constrained by the debt markets. Since debt is the only source of capital in the model, these firms are also capital constrained. If these firms were able to issue equity, they would no longer be capital constrained (they would have sufficient capital to take all positive NPV projects); however, they would still be credit constrained; that is, they would have less debt. We empirically examine this distinction below.

Financial intermediaries (e.g., banks) also may have an advantage over arm's length lenders (e.g., bond markets) after the capital is provided. If *ex post* monitoring raises the probability of success (through either enforcing efficient project choice or the expenditure of the owner's effort), then they may be a preferred source of capital [Diamond (1991) and Mester, Nakamura, and Renault (2004)]. In addition, financial intermediaries may be more efficient at restructuring firms that are in financial distress [Bolton and Freixas (2000), Bolton and Scharfstein (1996), and Rajan (1992)].

This intuition is the basis for the empirical literature that examines firms' choices of lenders. Firms that are riskier (more likely to need to be restructured), smaller, and about whom less is known are those that are most likely to borrow from financial intermediaries [Cantillo and Wright (2000), Faulkender (2005), and Petersen and Rajan (1994)]. Larger firms, about which much is known, will be more likely to borrow from arm's length capital markets.

However, the monitoring that is done by financial intermediaries and the resources devoted to restructuring firms are costly. This cost must be passed back to the borrower. It means that the cost of capital for firms in such an imperfect market depends not only on the risk of their projects but also on the resources needed to verify the viability of their projects. Although the institutional response (the development of financial intermediaries and lending relationships) can partially mitigate the market distortions, it is unlikely that these distortions are eliminated completely. If monitoring is costly and imperfect, then for two firms with identical projects, the one that needs to be monitored (e.g., an entrepreneur without a track record) will find that the cost of debt capital is higher. The cost of monitoring will be passed on to the borrower in the form of higher interest rates, causing the firm to reduce its use of debt capital. In addition, if the monitoring and additional information collection performed by the financial intermediary cannot completely eliminate the information asymmetry, then credit still may be rationed. So, if we compare firms that are able to borrow from the bond market with those that cannot, we will find that firms with access to the bond market have more leverage. This result can occur directly through a quantity channel (lenders who are willing to lend more) or indirectly through a price channel (firms with access to a cheaper source of capital borrow more). Either way, opening a new supply of debt capital to a firm will increase the firm's leverage.

1.2 Empirical strategy

To examine the role of credit constraints and help to explore the difference between the public debt markets (e.g., bonds) and the private debt market (e.g., banks), we consider the leverage of firms to be a function of the firm's capital market access. If firms without access to public debt markets are constrained in the amount of debt they may issue, then they

should be less levered, even after controlling for other determinants of capital structure. The observed level of debt is a function of the supply of debt and the firm's demand for debt, both of which depend on the price of debt capital and supply and demand factors.

$$\begin{aligned} Q_{\text{demand}} &= \alpha_0 \text{Price} + \alpha_1 X_{\text{demand factors}} + \varepsilon_{\text{demand}} \\ Q_{\text{supply}} &= \beta_0 \text{Price} + \beta_1 X_{\text{supply factors}} + \varepsilon_{\text{supply}} \end{aligned} \quad (1)$$

If there are no supply frictions, then firms can borrow as much debt as they want (at the correct price), and the observed level of debt will equal the demanded level. This is the traditional assumption in the empirical capital structure literature. Only demand factors explain variation in the firm's debt level, where demand factors are any firm characteristic that raises the net benefit of debt. Some examples of these are higher marginal tax rates and lower costs of financial distress.

However, if firms without access to public debt markets are constrained in the amount of debt that they may issue (private lenders do not fully replace the lack of public debt), then they will have lower leverage ratios, even after controlling for the firm's demand for debt. Equating the demand and supply, we can express the above equations as two reduced-form equations—one for quantity and the other for price—so that each is only a function of the demand and supply factors.

$$\begin{aligned} Q_{\text{observed}} &= \gamma_D X_{\text{demand factors}} + \gamma_S X_{\text{supply factors}} + \mu \\ &= \gamma_D X_{\text{demand factors}} + \gamma_S \text{Bond market access} + \mu. \end{aligned} \quad (2)$$

This is the regression that we run throughout the article. We examine whether the firms that have access to public debt markets have access to a greater supply of debt, and thus are more highly levered. We use whether the firm has a bond rating or a commercial paper rating as a measure of access to the public bond markets. Previous research on the source of debt capital has focused on small, hand-collected data samples to accurately document the source of each of the firm's debt issuances [Cantillo and Wright (2000) and Houston and James (1996)]. In these samples, the correspondence between having a debt rating and having public debt outstanding is quite high. Very few firms without a debt rating have public debt, and very few firms have a debt rating but no public debt.³

Although having a bond rating is an indication of having access to the bond market, the two are not exactly the same. Firms may not have a debt rating, either because they do not have access to the bond market or

³ "When a corporation is rated, it almost always has a positive amount of publicly traded debt: in the older data set (where the authors hand collected information on all debt), there are only 18 of 5529 observations (0.3%) where a company had a bond rating and no publicly traded debt and 135 observations (2.4%) where a firm had some public debt and no bond rating" [Cantillo and Wright (2000)].

because they do not want a debt rating or public debt (see Figure 1). Thus, in Equation (2), a positive coefficient on having a rating could be either the supply effect we are testing for or unobserved demand factors that are correlated with having a rating. To argue that the bond rating variable in fact is a supply variable, we use two separate approaches. First, we control for firm characteristics that measure the amount of debt a firm would like to have. If we could completely control for variation in the demand for debt with our other independent variables, then the rating variable would only measure variation in supply. After controlling for observed and unobserved variation in firm characteristics (demand factors), we find that leverage is significantly higher for firms with a rating. These results are reported in Section 2.

Our second approach is to examine the variation in supply directly. We do this by estimating an instrumental variables version of the model. By first predicting which firms are able to access the public bond markets, we can distinguish between firms that cannot get a rating and those that do not want a rating. Such an approach ensures that we are capturing a

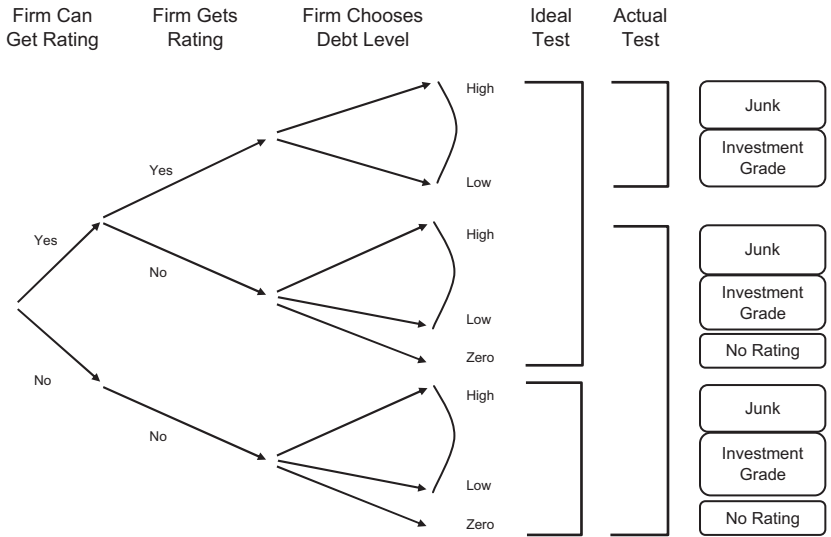


Figure 1
Bond market access, bond rating, and leverage

The figure describes the path of decisions available to the firm. First, the firm either has access to the bond market or it does not. We cannot directly observe this classification. Firms that have access to the bond market then choose whether to get a bond rating and issue public bonds. Then, conditional on their bond market access and whether they have chosen to issue public bonds, they choose their leverage. Finally, based on the firm's leverage and characteristics, the firm receives a debt rating, but only if it has issued public bonds [see Molina (2004), for an empirical test of this relationship]. We have diagrammed the rating a firm could expect if it does not issue public bonds, but this hypothetical rating is not observable.

supply factor rather than an unmeasured demand factor. These results are reported in Section 3.

1.3 Data source

Our sample of firms is taken from Compustat for the years 1986–2000 and includes both the industrial/full coverage file and the research file. We exclude firms in the financial sector (6000s SICs) and the public sector (9000s SICs). We also exclude observations if the firm's sales or assets are less than \$1 million. Since the firms we examine are publicly traded, they should in theory be less sensitive to credit rationing than the private firms which are the focus of much of the literature [Berger and Udell (1995) and Petersen and Rajan (1994)].

Throughout the article, we measure leverage as the firm's debt-to-asset ratio. Debt includes both long-term and short-term debt (including the current portion of long-term debt). We measure the debt ratio on both a book value (BV) and a market value (MV) basis. Thus, the denominator of the ratio will be either the BV of assets or the MV of assets, which we define as the BV of assets minus the BV of common equity plus the MV of common equity. As a robustness test, we also use the interest coverage as an additional measure of the firm's leverage (see Section 2.4).

1.4 Rarity of public debt

Even for public companies (firms with publicly traded equity), public debt is uncommon [Himmelberg and Morgan (1995)]. Only 19% of the firms in our sample have access to the public debt markets in a given year, as measured by the existence of a debt rating. Across the sample period, this average ranges from a low of 17% (in 1995) to a high of 22% (in 2000, see Figure 2). Conditioning on having debt raises the fraction of firms with a debt rating to only 21%. The prevalence of public debt is greater if we weight by dollars rather than firms. Of the outstanding debt issued by firms in our sample, 78% is issued by firms with a public debt rating (see Figure 2), even though they comprise only 19% of the firms.⁴ Despite the large aggregate size of the market, public debt is not a source of capital for most firms, even most public firms.

1.5 Debt market access and leverage

Traditional discussions of optimal capital structure usually assume that firms can issue whatever form of securities they wish, with the pricing conditioned on the risk of the security. However, in this article, we document that the source of the firm's debt, and whether it has access

⁴ Although we cannot observe the source of debt (public versus private) for a specific firm, using aggregate data we can estimate the average fraction of debt that is public for firms with a debt rating. We discuss these estimates in Appendix.

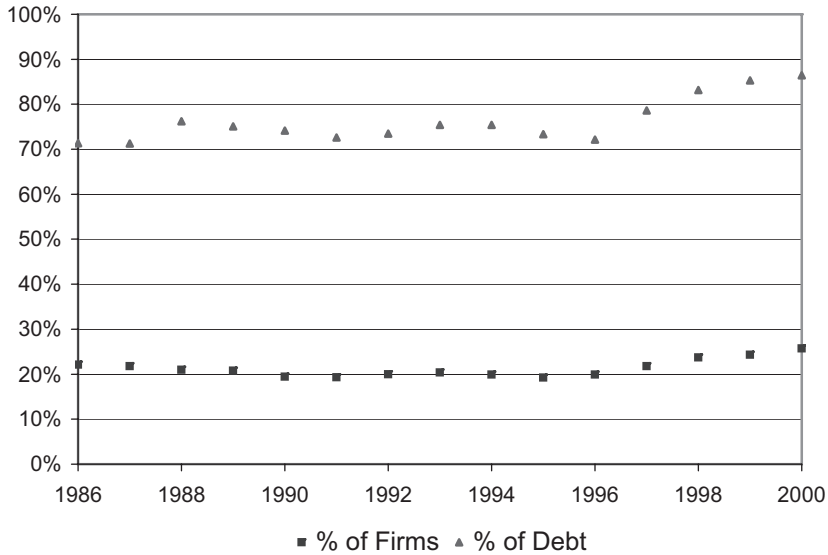


Figure 2

Percent of firms or debt with a debt rating

The figure shows the percent of firms with a debt rating (squares) or the percent of outstanding debt (in dollars) issued by firms with a debt rating (triangles). A firm has a debt rating if it reports either a bond rating or a commercial paper rating. The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt.

to the public debt markets, strongly influences its capital structure choice. To measure the importance of capital market access, we compared the leverage of the firms with access to the public debt markets (those with a debt rating) to those without access. Independent of how we measure leverage, we find that firms with debt ratings have significantly greater leverage than firms without a debt rating (see panel A of Table 1). If we measure leverage using market debt ratios, the firms with a debt rating have a debt ratio that is almost 10.5 percentage points higher. These firms' average debt ratio is 28.4 versus 17.9% for the sample of firms without a rating (p -value < .01). When we examine debt ratios based on BVs, the difference is slightly larger: 37.2 versus 23.5% (p -value < .01).⁵ These are large differences in debt. A debt rating increases the firm's debt by 59% [(28.4 – 17.9)/17.9].

⁵ The book debt ratios for some of the firms are extremely high. To prevent the means from being distorted by a few observations, we re-coded the book debt ratio to be equal to 1 if it was above 1 (1.3% of the sample). The re-coding moves the mean of the entire distribution from 26.9 to 26.1%, which is closer to the median of 23.1%. The difference in leverage between the two samples (with and without bond market access) does not change. Houston and James (1996) report the leverage ratio (debt over book assets) for their sample of 250 firms divided by whether the firms have public debt outstanding or not. Firms with public debt have higher leverage (47 versus 34%, Table V), but the article does not note this finding.

Table 1
Leverage by bond market access

	Mean	25%	Median	75%
<i>Panel A: All firm-years</i>				
Debt/asset (MV)				
Total Sample	19.9	3.0	15.3	31.7
Bond market access	28.4	14.8	25.7	38.4
No access	17.9	1.6	12.0	29.1
Difference	10.5*		13.7*	
Debt/asset (BV)				
Total sample	26.1	6.2	23.1	39.4
Bond market access	37.2	23.9	34.5	46.8
No access	23.5	3.4	18.8	36.8
Difference	13.8*		15.7*	
<i>Panel B: Firm-years with positive debt</i>				
Debt/asset (MV)				
Total sample	22.2	6.3	18.3	33.7
Bond market access	28.5	14.9	25.8	38.5
No access	20.5	4.6	15.7	31.9
Difference	8.0*		10.1*	
Debt/asset (BV)				
Total sample	29.1	11.5	26.5	41.4
Bond market access	37.4	24.0	34.6	46.8
No access	26.9	8.7	23.2	39.5
Difference	10.5*		11.4*	

The table reports summary statistics on firms' total debt ratios by whether they have access to the public debt markets. We use whether the firm has a debt rating as a measure of whether it has access to the public debt markets. The market value (MV) ratio is total (short- and long-term) debt divided by the book value (BV) of assets minus the BV of equity plus the MV of equity. The BV debt ratio is debt divided by the BV of assets. The BV ratio is not always between 0 and 1; it is above 1 for 1.3% of the sample. We re-coded the BV ratio to 1 for these observations. The table reports the mean, the 25th, 50th (median), and 75th percentile in each cell, except for the difference row. This row contains the difference in the means (or medians) and the associated significance levels (* indicates statistical significance at 1% level). In panel A there are 77,659 firm-year observations of which 19.0% have a debt rating. Panel B contains only firm-years in which the firm had a positive amount of debt. In panel B, there are 69,589 firm-year observations of which 21.1% have a debt rating. The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000.

The difference in leverage is also very robust. We see the same pattern across the entire distribution. The firms with a debt rating have higher leverage at the 25th, 50th, and 75th percentiles of the distribution (see panel A of Table 1). For the median firm, having a debt rating raises the MV debt ratio by 13.7 percentage points (from 12.0 to 25.7) and the BV ratio by 15.7 percentage points. Both changes are statistically significant (p -value $\leq .01$) and economically large. Finally, the higher leverage of the firms with public debt appears in each year of our sample period (1986–2000). The difference between the MV debt ratio of firms with and without a debt rating varies from 5.7 to 13.7% across years (or 7.2 to 18.7% for BV ratios). The difference is always statistically significant.

A fraction of the firms in our sample have zero debt. These firms may be completely rationed by the debt markets. Alternatively, they may have access to the (public) debt markets but choose to finance themselves only

with equity. If they do not want debt capital, and thus do not have a bond rating, they will be incorrectly classified as not having access to the bond market. To be conservative, we initially exclude the zero debt firms from our sample. In the instrumental variables section of the article, we can include these firms and test whether they have access to the bond market (see Section 3.2). When we recalculate the average debt ratios including only firms that have debt, our results do not change dramatically because only a small fraction of firms have zero debt (10% of the firm-years in our sample). Firms with access to the public debt markets have significantly more debt: 8.0 percentage points higher market debt ratio or 39% more debt (8.0/20.5, see panel B of Table 1).

Throughout the article, we use whether the firm has a debt rating as a proxy for whether it has access to the capital market. We find that firms with access have significantly greater leverage. However, if our proxy is an imperfect measure of market access (e.g., firms without a debt rating actually have access to the public debt markets), then our estimates of debt ratios across the two classifications will be biased toward each other. Some of the firms with access to the public debt markets, but without a debt rating, will be incorrectly classified as not having access to the public debt markets.⁶ The incorrect inclusion of these firms in the sample of firms without market access will bias upward the debt ratio of this group. For the sample labeled as having debt market access, there will be a downward bias in the debt ratio. Thus, our estimated differences will be smaller than the true difference.

2. Empirical Results: Causes and Implications

2.1 Differences in firm characteristics

Now that we have documented that firms with access to the public debt markets (those with a debt rating) are more highly levered, we must ask why this is true and what it means. This difference could be driven by either demand or supply considerations. It may be that the type of firms that have access to the public debt market is also the type of firms that find debt more valuable. For such firms, the benefits of debt (e.g., tax shields or contracting benefits) may be greater and/or the costs of debt (e.g., financial distress) may be lower. This has been the view taken by much of the empirical capital structure literature. Although Modigliani–Miller irrelevance (1958) is assumed not to hold on the demand side of the

⁶ For example, since our data comes from Compustat, only firms with a debt rating from S&P are classified as having a bond rating. Firms with a rating only from Moody's and/or Fitch will be incorrectly classified as not having a bond rating. Discussions with the ratings agencies and other data samples suggest that the magnitude of this misclassification should be small. For example, in Ljungqvist, Marston, and Wilhelm's (2006) sample, 97.8% of the public bond issues were rated by S&P and 97.6% were rated by Moody's. We thank Alexander Ljungqvist for providing us with these numbers.

market, it is assumed to hold on the supply side.⁷ Our univariate results cannot distinguish between demand side (by firm characteristics) and supply side considerations (the firms without access to public debt are constrained in their ability to borrow).

To determine why firms with access to the bond market are more leveraged, we first must determine how the two samples are different and whether this difference explains the difference in leverage we present in Table 1. On the basis of the firm characteristics examined in the empirical literature, we find that firms with a debt rating are clearly different than firms without one [see Barclay and Smith (1995b), Graham (1996), Graham, Lemmon, and Schallheim (1998), Hovakimian, Opler, and Titman (2001), and Titman and Wessels (1988)]. First, the average size of issues in the public debt market is larger, and the fixed costs of issuing public bonds are greater than in the private debt markets. Consistent with this, the firms with a debt rating are appreciably larger (see Table 2). Whether we examine the BV of assets, the MV of assets, or sales, we find that firms with a debt rating are about 300% larger (difference in natural logs) than firms without a debt rating ($p < .01$). The firms with a debt rating also differ in the type of assets on which their businesses are based. These firms have more tangible assets in the form of property, plant, and equipment (42 versus 31% of book assets), are significantly older, but spend less on research and development (R&D) (1.8 versus 6.1% of sales). They also have smaller mean market-to-book ratios, suggesting fewer intangible assets such as growth opportunities [Myers (1977)].

As previous work has noted, the maturity of a firm's debt also is correlated with the source of the debt. Maturities in the bond markets tend to be greater than those in the private (bank debt) market [Barclay and Smith (1995a)]. From its balance sheet, we do not know the exact maturity of each firm's debt, but we do know the amount of debt due in each of the next five years. The percentage of debt due in 1–5 years plus the percentage of debt due in more than five years is reported in Table 3. As expected, firms with a debt rating have debt with significantly longer maturities. An average of 59% of their debt is due in more than five years as compared to only 28% for firms without a debt rating ($p < .01$). Firms with a debt rating have only 16% of their debt due in the following year as compared with 37% for firms without a debt rating ($p < .01$). The difference in maturity is centered around year four: firms without a debt rating have 60% of their debt due in the next three years and only 34% due in years five and beyond; and firms with a debt rating have only 28% of their debt due in the next three years, but 65% due in years five and beyond.

⁷ The literature that has examined a firm's choice of maturity [Baker, Greenwood, and Wurgler (2003), Barclay and Smith (1995a), Guedes and Opler (1996), Johnson (2003), and Stohs and Mauer (1996)], priority [Barclay and Smith (1995b) and Dennis, Nandy, and Sharpe (2000)], or choice of lender [Cantillo and Wright (2000), Gilson and Warner (2000), Johnson (1997), and Krishnaswami, Spindt, and Subramaniam (1999)] obviously focuses on the cost and benefits differing across the type of debt security.

Table 2
Summary statistics of firm characteristics

	Access	No access	Difference
Log(MV of assets)	7.74 (7.69)	4.56 (4.47)	3.18* (3.22*)
Log(BV of assets)	7.41 (7.34)	4.11 (4.06)	3.30* (3.29*)
Log of sales	7.21 (7.22)	4.11 (4.10)	3.10* (3.12*)
Log(1 + firm age)	2.61 (2.89)	1.83 (1.95)	0.78* (0.94*)
Profit margin (%)	16.23 (14.51)	2.4 (8.08)	13.83* (6.43*)
Plant, property, and equipment/assets (BV) (%)	42.39 (38.63)	30.84 (24.35)	11.55* (14.28*)
MV of assets/BV of assets (%)	1.59 (1.30)	1.88 (1.36)	-0.30* (-0.06*)
R&D/sales (%)	1.77 (0.00)	6.11 (0.00)	-4.34* (0.00)
Advertising/sales (%)	1.11 (0.00)	1.31 (0.00)	-0.20* (0.00)
Marginal tax rate (%) (before interest expense)	32.61 (34.99)	26.46 (34.00)	6.15* (1.00*)
Equity return previous year (%)	13.35 (9.02)	10.97 (-1.33)	2.38* (10.35*)
Implied asset volatility (%)	18.89 (16.13)	40.73 (34.19)	-21.84* (-18.06*)

The table contains summary statistics for the sample of firms with and without access to the public debt markets. Firms that have a debt rating are classified as having access; those without a bond rating are classified as having no access. Values are expressed in mean (median). The third column contains the difference in the means and medians as well as the statistical significance of the difference (* indicates statistical significance at 1% level). Missing values for R&D and advertising expense are set equal to zero. The market-to-book ratio and the implied asset volatility variables are truncated at the 1st and 99th percentiles. The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt. R&D, research and development.

Table 3
Maturity of debt by bond market access

	1	2	3	4	5	>5
Total sample	32.7 (20.5)	11.6 (4.6)	8.8 (3.2)	6.6 (1.6)	5.6 (0.4)	34.8 (24.6)
Bond market access	16.4 (8.8)	5.7 (2.4)	6.1 (2.5)	6.4 (2.4)	6.9 (2.2)	58.5 (61.6)
No access	37.1 (26.2)	13.2 (5.8)	9.5 (3.6)	6.6 (1.3)	5.3 (0.1)	28.3 (11.4)
Difference	-20.7* (-17.4*)	-7.5* (-3.3*)	-3.4* (-1.2*)	-0.2** (-1.0*)	1.7* (2.1*)	30.1* (50.3*)

The table reports the mean (median) fraction of outstanding debt by maturity. Firms that have a debt rating are classified as having access. The first five columns contain the fraction of debt due in years 1 through five. The final column contains the fraction of debt with a maturity of greater than five years. The debt due in one year includes both debt with an initial maturity of less than one year and the current portion of long-term debt. The last row contains the difference in the means (or medians) between firms with and without bond market access (a debt rating). The associated significance levels also are reported (* indicates statistical significance at 1% level; ** indicates statistical significance at 5% level). The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt.

Given the firm characteristics reported in Tables 2 and 3, we should not be surprised that firms with a debt rating have higher leverage ratios. They have characteristics that theory predicts would cause a firm to

demand more debt. Therefore, to argue that the difference in leverage from having a debt rating is a supply effect, it is essential that we control for firm characteristics that determine a firm's demand for debt.

2.2 Demand side determinants of leverage

In this section, we regress the firm's leverage (debt-to-MV of assets) on a set of firm characteristics and whether the firm has a debt rating. The firm characteristics are intended to control for demand factors (the relative benefits and costs of debt), with any remaining variability which is explained by the debt rating variable measuring differences in access to capital (i.e., supply). The variables we include measure the size of the firm, its asset type, its risk, and its marginal tax rate.⁸ We examine variation in the supply of debt capital directly in Section 3 when we use an instrumental variables approach.

We start with asset type and follow the literature in our choice of variables. Firms that have more tangible, easily valued assets are expected to have lower costs of financial distress [Pulvino (1998)]. We use the ratio of the firm's property, plant, and equipment to assets as a measure of the firm's asset tangibility [Rajan and Zingales (1995) and Titman and Wessels (1988)]. Investments in brand name and intellectual capital may be more difficult to measure, so we use the firm's spending on R&D and advertising (scaled by sales) as a measure of the firm's intangible assets [Graham (2000) and Mackie-Mason (1990)]. We also include the firm's market-to-book ratio as an additional control for firms' intangible assets or growth opportunities [Hovakimian, Opler, and Titman (2001) and Rajan and Zingales (1995)].

Our findings mirror the previous work on leverage. Increases in the tangibility of assets raise the firm's debt ratio (see Table 4). Moving a firm's ratio of property, plant, and equipment to assets from the 25th (14%) to the 75th percentile (49%) raises the firm's debt ratio by 5.4 percentage points ($p < .01$). Increases in the firm's intangible assets lower the firm's debt-to-asset ratio. Moving a firm's R&D expenditure (scaled by sales) from the 25th to the 75th percentile lowers the firm's leverage by a half a percentage point ($p < .01$). The economic significance of variability in a firm's advertising-to-sales ratio is even smaller. Part of the reason these ratios have less impact is that some of the effect is picked up by the market-to-book ratio. Dropping the market-to-book ratio from the regression significantly increases the coefficient on R&D. We also find that more profitable firms (EBITDA/Sales) have lower leverage [Hovakimian,

⁸ Each regression also includes a full set of year dummies. Although the increase in explanatory power from year dummies is not large, the R^2 increases from 0.231 to 0.242 (Table 4, column I), they are jointly statistically significant (p -value $< .01$). In addition, the year-to-year variability is not trivial. The coefficients range from a low of -2.0 (1993) to a high of 4.2% (1999) relative to the base year of 1986.

Table 4
Determinants of market leverage: firm characteristics

	I	II	III	IV	V
Firm has a debt rating (1 = yes)	0.083* (0.005)	0.080* (0.006)	0.078* (0.005)	0.078* (0.004)	0.071* (0.004)
Ln(market assets)	-0.010* (0.001)	-0.010* (0.001)	-0.007* (0.001)	-0.025* (0.001)	-0.026* (0.001)
Ln(1 + firm age)	-0.007* (0.001)	-0.007* (0.001)	-0.014* (0.002)	-0.016* (0.001)	-0.016* (0.001)
Profits/sales	-0.067* (0.007)	-0.075* (0.009)	-0.056* (0.009)	-0.073* (0.006)	-0.074* (0.006)
Tangible assets	0.151* (0.008)	0.151* (0.007)	0.131* (0.009)	0.129* (0.007)	0.116* (0.007)
Market-to-book (assets)	-0.040* (0.001)	-0.044* (0.002)	-0.047* (0.001)	-0.020* (0.001)	-0.019* (0.001)
R&D/sales	-0.180* (0.009)	-0.195* (0.014)	-0.198* (0.011)	-0.079* (0.007)	-0.083* (0.007)
Advertising/sales	-0.116* (0.024)	-0.070** (0.024)	-0.071 (0.045)	-0.036*** (0.022)	-0.036*** (0.021)
Marginal tax rate			-0.139* (0.014)		
Stock return previous year				-0.006* (0.001)	-0.008* (0.001)
σ (asset return)				-0.334* (0.009)	-0.326* (0.009)
% of debt due in ≤ 1 year					-0.027* (0.004)
% of debt due in > 5 years					0.026* (0.004)
Number of observations	63,272	63,272	48,021	59,562	59,562
R^2	0.242	0.230	0.242	0.368	0.373

The dependent variable is the ratio of total debt to the market value (MV) of the firm's assets. White heteroscedastic consistent errors, corrected for correlation across observations of a given firm, are reported in parentheses [Rogers (1993) and White (1980)] except in column II. In column II, the coefficients and standard errors are estimated using the Fama-MacBeth method (1973). The MV of assets is the book value (BV) of assets minus the BV of equity plus the MV of debt. All models also include year dummy variables and a dummy variable for the regulated utility industry (4900-4939). The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt. * indicates statistical significance at 1% level; ** indicates statistical significance at 5% level; *** indicates statistical significance at 10% level.

Opler, and Titman (2001) and Titman and Wessels (1988)], consistent with such firms using their earnings to payoff debt.

Historically, leverage has been found to be positively correlated with size [Graham, Lemmon, and Schallheim (1998) and Hovakimian, Opler, and Titman (2001)]. Larger firms are less risky and more diversified, and therefore the probability of distress and the expected costs of financial distress are lower. They may also have lower issue costs (owing to economies of scale) which would suggest that they have higher leverage. In our sample, however, we find that larger firms are less levered, and the magnitude of this effect is not small. Increasing the MV of the firm from \$38 million (25th percentile) to \$804 million (75th percentile) lowers the firm's leverage by almost 3 percentage points ($p < .01$) (see Figure 3).⁹

Why do we find such different results? One possibility is the positive correlation between a firm's size and whether it has a debt rating ($\rho = 0.60$).

⁹ To test that we have correctly specified the functional form of size, we replace the log of MV of assets with 20 dummy variables, one for each of the 20 vigintiles. The R^2 increases by only 0.003 and the estimated leverage based on this model is almost identical to the estimated leverage based on the initial model.

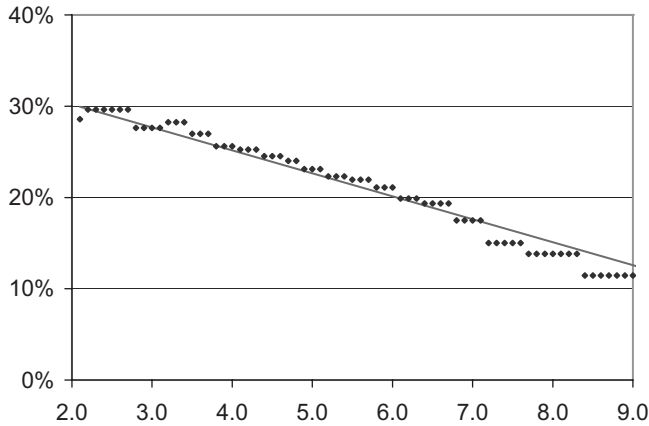


Figure 3

Effect of firm size on leverage: semi-parametric approach

The figure graphs predicted leverage as a function of firm size [log of the market value (MV) of assets]. The straight line is the predicted leverage based on the coefficient estimates in Table 4, column IV. We then estimate a second model in which the log of the MV of assets is replaced by 20 dummy variables, one for each of 20 vigintiles based on the firm's MV of assets. The diamonds graph the predicted leverage as a function of firm size based on the second model. Allowing for a non-linear relationship between leverage and size raises the explanatory power of the model trivially (the R^2 rises from 0.368 to 0.371).

However, even when we drop having a debt rating from the regression, the coefficient on size is slightly negative ($\beta = -0.000$, $t = -0.1$, regression not reported). There are two reasons for the difference between our results and previous work. First, our dependent variable is total debt-to-assets, whereas some of the previous papers looked at long-term debt to assets [Graham, Lemmon, and Schallheim (1998)]. If we use long-term debt-to-assets and rerun the regression without the debt rating variable, the coefficient on size becomes positive and is similar in magnitude to prior findings ($\beta = 0.007$, $p < .01$, regression not reported).¹⁰ Including the debt rating, dummy causes the size coefficient to shrink to zero ($\beta = 0.000$, regression not reported), consistent with the intuition that only the largest firms have debt ratings because there are economies of scale in the bond markets (see Table 2 and Section 3). The second reason is that we only include firm-years that report positive debt. If we include all observations and rerun the regression without the debt rating variable, then the coefficient on size is again positive ($\beta = 0.004$, $p < .01$, regression not reported). The interpretation is subtle. Larger firms are more likely to have some debt. However, conditional on

¹⁰ This difference is also consistent with previous work on debt maturity. Barclay and Smith (1995a) find that larger firms have longer maturity debt. Together these results imply that large firms have more long-term and less short-term debt.

having some debt, larger firms are less levered. For the reasons discussed above including the debt rating variable turns the coefficient on size negative again and leads to a slightly larger coefficient on having a debt rating (0.089 versus 0.083 in Table 4, column I).¹¹ Before returning to the effect of having a debt rating, we want to consider three other variables that have been used less consistently in the literature to explain differences in leverage. First, firms with higher marginal tax rates before the deduction of interest expenditures should have higher interest tax shields and thus have more leverage. The empirical support for this idea was weak until Graham devised a way to simulate the marginal tax rate facing a firm before its choice of leverage [Bradley, Jarrell, and Kim (1984), Fisher, Heinkel, and Zechner (1989), Graham (1996, 2000), Graham, Lemmon, and Schallheim (1998), and Scholes, Wilson, and Wolfson (1990)]. When we include the simulated marginal (pre-interest income) tax rates, we find a negative, not a positive, coefficient. The difference between our results and previous work again may be driven by our definition of the debt ratio. When we use long-term debt-to-MV of assets as a dependent variable, the coefficient on the simulated marginal tax rate is positive (regression not reported).

Firms with more volatile assets will have higher probabilities and expected costs of distress. These firms are expected to choose lower leverage and are also more likely to go to banks to obtain financing [Cantillo and Wright (2000)]. We estimate the volatility of the firm's assets by multiplying the equity volatility of the firm (calculated over the previous year) by the equity-to-asset ratio.¹² We also include the

¹¹ We calculate White heteroscedastic consistent errors corrected for possible correlation across observations of a given firm (Rogers standard errors) in all of the regressions [Rogers (1993) and White (1980)]. Since the residuals for a given firm are correlated across different years, the normal OLS standard errors are understated. For example, the OLS *t*-statistic on having a bond rating is 40.6, but the *t*-statistic based on the corrected standard errors is 18.2.

The coefficients and standard errors also can be estimated using the Fama–MacBeth approach [Fama and MacBeth (1973)], and these numbers are reported in column II of Table 4. The Fama–MacBeth approach corrects for correlation in the residuals between two different firms in the same year (e.g., ε_{it} and ε_{kt}). Cochrane (2001) refers to this as “cross-sectionally correlated at a given time.” Since our regressions already include time dummies, this correlation has been removed from the residuals. Consistent with this intuition, the Rogers standard errors are similar to those produced by the Fama–MacBeth approach (a standard error of 0.0057 versus 0.0045 on the “firm has a debt rating” variable).

¹² The correct formula for asset volatility is:

$$\sigma_A = \sqrt{\left(\frac{E}{A}\right)^2 \sigma_E^2 + \left(\frac{D}{A}\right)^2 \sigma_D^2 + 2\left(\frac{D}{A}\right)\left(\frac{E}{A}\right)\rho\sigma_D\sigma_E}.$$

Thus, our estimate of asset volatility understates the true asset volatility. More importantly, the magnitude of the error is increasing in the debt-to-asset ratio. For an all-equity firm, our estimate is correct. This type of measurement error will bias our coefficient away from 0. To estimate the magnitude of the bias, we also estimated the asset volatility using a Merton model [see Ronn and Verma (1986)]:

$$\sigma_A = \frac{\frac{E}{A}\sigma_E}{\Delta(\sigma_A)}.$$

When we re-estimated the model using this estimate of the asset volatility, the coefficient on the asset volatility was slightly closer to zero and the coefficient on having a rating was slightly larger (0.079 versus 0.078).

previous year's equity return to account for partial adjustment in the firm's debt-to-asset ratio [Hovakimian, Opler, and Titman (2001), Korajczyk, Lucas, and McDonald (1990), and Welch (2004)]. If the firm does not constantly adjust its capital structure, then after an unexpected increase in its asset (equity) value, we will see the firm de-lever. We see both effects in Table 4. Firms whose equity, and presumably asset value, has risen over the past year have lower leverage. The magnitude of this effect is tiny. A 59 percentage point increase in equity values (the inter-quartile range) lowers the firm's leverage by only 40 basis points. This may be due to the fact that the firms in our sample adjust their capital structure often.¹³

We include the firm characteristics to determine whether the difference in observed leverage between firms with and without a debt rating arose because of fundamental differences in the firms, and thus in their demand for leverage. The firms are clearly different (Table 2), and these variables do explain a significant fraction of the variability in debt ratios across firms and across time (Table 4). However, even after the inclusion of the firm characteristics, firms with a debt rating are significantly more levered ($p < .01$), with debt levels of 7.8–8.3% of the MV of the firm higher than firms without access to public debt markets.¹⁴

As discussed above, firms with a debt rating issue bonds that have longer maturities than debt from private markets (see Table 3). We would expect firms for whom it is difficult to write contracts constraining their behavior to issue shorter term debt and to be more likely to borrow from banks [Von Thadden (1995)]. Thus, it is not surprising that leverage and maturity are correlated [Barclay and Smith (1995a)]. To verify that our measure of bond market access is not proxying for contracting problems as measured by maturity, we include the fraction of the firm's debt that is due in one year or less and the fraction of the firm's debt that is due in

¹³ In 50% of the firm-years, the firms in our sample change their debt or equity (changes which are not because of changes in retained earnings) by more than 5% of the MV of assets in the previous year. This number is similar to what Kisgen (2004) and Leary and Roberts (2005) find in their respective samples. Since firms do not actively adjust their capital structure each year, this may affect our results. To verify that this is not a problem, we reran our regressions on the sub-sample of firms which significantly adjusted their leverage (change of more than 5%) and on the sub-sample which did not. We found that the coefficient on having a rating, as well as firm size and past equity return, do not change significantly across the two sub-samples.

¹⁴ We replicated Table 4 using the ratio of debt to the BV of assets. Across the models, firms with a debt rating have leverage that is 11.9–12.9 percentage points higher ($p < .01$). This compares to the univariate difference of 13.7% (Table 1). We also estimated Table 4 using net debt (debt minus cash and marketable securities) as the dependent variable. The coefficients on having a debt rating become larger. For example, the coefficient on having a rating rises from 7.8 (Table 4, column IV) to 8.2 when we use net debt. Thus, firms without access to the bond market not only have less debt, but also hold slightly more cash [see Opler et al. (1999) for evidence that firms with a bond rating hold less cash]. Next, we estimated Table 4 using debt-plus-accounts-payable as the dependent variable. Again the coefficient on having a rating rises slightly from the 7.8% we report in column IV to 8.2% when we include accounts payable as debt. Finally, we included the capitalized value of operating lease payments as defined in Graham, Lemmon, and Schallheim (1998). Capital leases are already included in our definition of debt. Including operating leases raises the coefficient on having a rating slightly to 8.2%.

more than five years. This does not imply that maturity is chosen first and leverage second. The decision is most likely simultaneous. The purpose of this regression is to verify that the two effects (debt rating and maturity) are in fact distinct. We find that they are. A firm that changed its debt maturity from totally due in one year to totally due in more than five years would raise its predicted debt ratio by 5 percentage points (see Table 4, column V). Even after controlling for maturity, however, we find that firms with a debt rating have significantly more debt ($\beta = 0.071$, $t = 16.6$).¹⁵

To verify that our results are not driven by a few years, we re-estimate our model (Table 4, column IV), allowing the coefficient on having a rating to vary by year (i.e., we interact the year dummies with the debt rating variable). We have graphed the debt rating coefficients against time in Figure 4. There are several things to note. First, there is variation over time in the effect of having a rating, although the coefficient is always significantly greater than zero. The rating coefficient varies from a low of 5.3% in 1991 (meaning firms with a debt rating have a leverage ratio that is 5.3% higher than an otherwise identical firm) to a high of 8.6% in 1998. The variability in the coefficients is also statistically significant [F -stat(14,60435) = 3.75, p -value < .01]. Although there is variability in the coefficient, it does not rise or fall systematically over the sample period. The effect of having a bond rating is low during the 1990–1991 recession, but this effect seems to both pre- and post-date the recession. In addition, if the recession was associated with a banking credit crunch [as discussed in Bernanke and Lown (1991)], we would have expected the coefficient to rise during the recession because bank-dependent firms have less access to debt capital and thus would be increasingly under-levered relative to firms with access to the bond market [Calomiris, Himmelberg, and Wachtel (1995) and Korajczyk and Levy (2003)].¹⁶

Our results demonstrate that firms without access to the bond market may be credit (debt) constrained or under-levered. This is consistent with these firms also being capital constrained, although it does not prove it. Several papers in the literature have used whether the firm has a bond rating as a proxy for being capital constrained [Almeida, Campello, and Weisbach (2004), Gilchrist and Himmelberg (1995), Kashyap, Lamont,

¹⁵ The finding that firms with access to the bond market have greater leverage could be because of a quantity restriction or could operate through the price mechanism. If bank debt is more expensive than bonds, to cover the cost of *ex ante* investigation and *ex post* monitoring, for example, then a firm with access to the bond market would choose higher leverage than an otherwise identical firm that did not have access because they have access to cheaper debt (by assumption). Bharath (2002) finds that bond debt is cheaper for firms that are rated A and above, but more expensive for firms with lower ratings. However, one must be careful in interpreting these results in our context as the sample is conditioned on having a bond rating, and thus cannot compare the cost of debt for firms that have access to the bond market and those that do not.

¹⁶ We also interacted having a rating with firm size, based on the idea that a rating may expand the supply of debt capital more for smaller firms. We find that having a rating raises leverage by 12.4% for a median-sized firm and by 3.2% for a firm at the 95th percentile of the distribution.

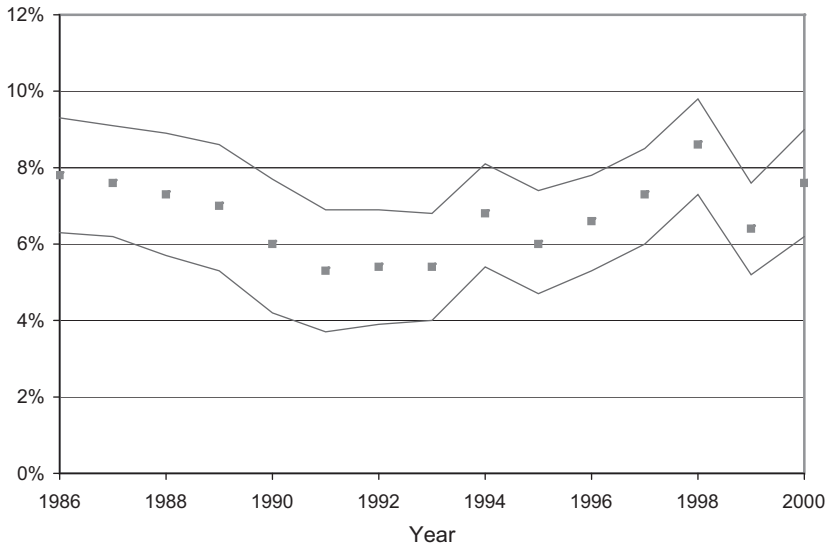


Figure 4
Effect of rating on leverage: time variation

The figure contains the estimated coefficients from a regression of leverage on the firm having a rating, where a separate coefficient is estimated for each year. The regression includes the same controls as are reported in Table 4, column IV. The lines denote the 99% confidence interval around the estimates.

and Stein (1994), Kashyap, Stein, and Wilcox (1993), and Whited (1992)], so it is worth examining this more closely. Firms that are constrained by the debt markets may substitute equity for debt, and our evidence is consistent with this notion. Firms without access to the bond market pay lower dividends (the ratio of dividends to the MV of assets is 0.64% smaller), repurchase less stock (their repurchases relative to the MV of their assets is 0.41% lower), and issue more equity (their equity issues relative to the MV of their assets is 1.88% higher). Thus, firms without a bond rating pay a 2.94% smaller net dividend (dividends plus repurchases minus equity issues divided by firm value) than firms with a bond rating (p -value $< .01$). We find similar results when we instrument for having a bond rating. The fact that firms without a bond rating use significantly less debt, and slightly more equity is evidence that they are credit constrained. The evidence on whether they are capital constrained is weaker.

2.3 Industry and firm fixed effects

Since many of the benefits and costs of debt depend on the type of assets the firm uses in its operations, the firm's industry may be useful in

predicting its leverage. So far our estimates have ignored the panel structure of our data (except for our adjustment of the standard errors). However, by estimating the effect of having a debt rating from both within variation (deviations from industry means) and between variation (differences between industry means), we can test the robustness of our findings. By including industry dummies (the within estimates), we can completely control for any determinant of leverage that is constant within an industry and verify that having a debt rating is not a proxy for industry. We report both results in Table 5. The results are qualitatively similar to the previous results. The effect of a debt rating on leverage falls slightly when we include controls for each of the 396 industries (four-digit SIC) in our sample (from 7.8% in Table 4, column IV to 6.8% in Table 5, column I). When we run the regression on industry means instead, which includes the effects of unobserved industry effects, the coefficient is larger (13.9%).

A finer robustness test is to estimate the between and within estimates based on firm, as opposed to industry, variation. In this specification, having a bond rating cannot be a proxy for any unobserved firm factor that influences the firm's demand for debt. Once we include a dummy for each firm in the sample, the coefficient on a firm having a debt rating drops to 5.1%, but it is still large, both economically and statistically (see Table 5, column III). Although the estimated coefficient is based only on those firms whose rating status changes during the sample period—firms which comprise approximately 15.5% of our sample—it closely matches the results in Table 4. When we include firm-specific dummies in the regression, we are able to explain a significant fraction of the variability in firm's leverage ($R^2 = 76\%$), and we still find that firms with access to the debt markets are significantly more levered.

Given the inclusion of firm-specific dummies in the regression, constant unobserved firm characteristics cannot explain our results. Thus, the only remaining way in which our rating variable could be a proxy for demand factors is if a firm's demand for debt rises over the sample period in unobserved ways. If the firm also obtains a rating during the sample period, then this could induce a spurious correlation between having a rating and leverage. To test this hypothesis, we estimate a first-difference version of the model (see Table 5, column V). If, over the sample period, demand for debt is rising in unobservable ways, then the estimate in column III (the difference between the average debt ratio in years when the firm had a debt rating and the average debt ratio in years in which it does not) will be much larger than the estimates in column V (first-difference estimates). This is not what we find. The first-difference coefficient (4.1%) is almost as large as the within estimate (5.1%), meaning that 81% of the leverage difference is accounted for in the first year the firm

Table 5
Determinants of market leverage: panel data estimation

	I	II	III	IV	V
Firm has a debt rating (1 = yes)	0.068* (0.002)	0.139* (0.030)	0.051* (0.002)	0.090* (0.005)	0.041* (0.003)
Ln(market assets)	-0.025* (0.000)	-0.041* (0.006)	-0.006* (0.001)	-0.022* (0.001)	0.011* (0.002)
Ln(1 + firm age)	-0.009* (0.001)	-0.077* (0.008)	.037* (0.001)	-0.023* (0.002)	0.041* (0.002)
Profits/sales	-0.072* (0.003)	-0.002 (0.046)	-0.055* (0.004)	-0.073* (0.006)	-0.044* (0.004)
Tangible assets	0.122* (0.004)	0.097* (0.022)	0.160* (0.006)	0.130* (0.006)	0.119* (0.009)
Market-to-book (assets)	-0.020* (0.001)	-0.004 (0.009)	-0.018* (0.001)	-0.016* (0.001)	-0.015* (0.001)
R&D/sales	-0.053* (0.006)	.178** (0.076)	-0.047* (0.009)	-0.060* (0.009)	-0.028* (0.008)
Advertising/sales	-0.034** (0.014)	-0.145 (0.186)	-0.033 (0.020)	-0.026 (0.020)	-0.018 (0.021)
Stock return previous year (asset return)	-0.008* (0.001)	-0.072*** (0.039)	-0.017* (0.001)	-0.005 (0.004)	-0.020* (0.001)
Number of observations	59,562	59,562	59,562	59,562	49,742
R ²	0.442	0.612	0.763	0.465	0.272
Controls	Industry	Industry	Firm	Firm	Firm
Estimation method	Within	Between	Within	Between	Changes

The dependent variable is the ratio of total debt to the market value (MV) of the firm's assets. The MV of assets is the book value (BV) of assets minus the BV of equity plus the MV of debt. All models also include year dummy variables and a dummy variable for the regulated utility industry (4900–4939). The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt. Column I—within industry estimates. The coefficients are estimated based on variation of the variable from the industry-specific means. There are 396 distinct four-digit SIC industry dummies. The reported R^2 includes the explanatory power of the industry dummies. The R^2 is 0.288 if we exclude the explanatory power of the industry dummies. Column II—between industry estimates. The coefficients are estimated based on differences between industry-specific means. Column III—within firm estimates. The coefficients are estimated based on variation of the variable from the firm-specific means. There are 9742 distinct firms. The reported R^2 includes the explanatory power of the firm dummies. The R^2 is 0.266 if we do not include the explanatory power of the firm dummies. Column IV—between firm estimates. The coefficients are estimated based on differences between firm-specific means. Column V—first-difference estimates. Estimates are based on the first differences in all variables. * indicates statistical significance at 1% level; ** indicates statistical significance at 5% level; *** indicates statistical significance at 10% level.

obtains a rating (Figure 5).¹⁷ The only way our finding could be driven by unobserved demand factors is if these factors are constant across time, then change dramatically in the year the firm obtains a debt rating, and finally then remain constant for the rest of the sample period. Although possible, it seems unlikely that the firm's industry, asset type, or tax situation would change only in the year the bond rating is obtained. To

¹⁷ A numerical example may help to illustrate this point. Take a case where the firm's desired leverage ratio rises 1 percentage point per year over the 10-year sample period in an unobserved way (the straight line in Figure 5). Assume that the firm obtains a debt rating in year 6 and maintains it for the rest of the sample. The within estimate is the difference between the average debt ratio in years when the firm had a debt rating (years 6–10) and years in which it did not (years 1–5). The within coefficient is 5% in this case. The two averages are denoted by the squares in Figure 5 (i.e., 22.5 and 17.5%). The first-difference coefficient is the difference between the debt ratio in the first year the firm has a debt rating and the debt ratio the previous year (the diamonds in Figure 5). The difference coefficient is 1% (20 – 19). Since the change in the desired debt ratio (the line in Figure 5) is slow, the difference coefficient is only 20% of the within coefficient (0.20 = 1/5) compared to a ratio of 81% in our data (4.1/5.1).

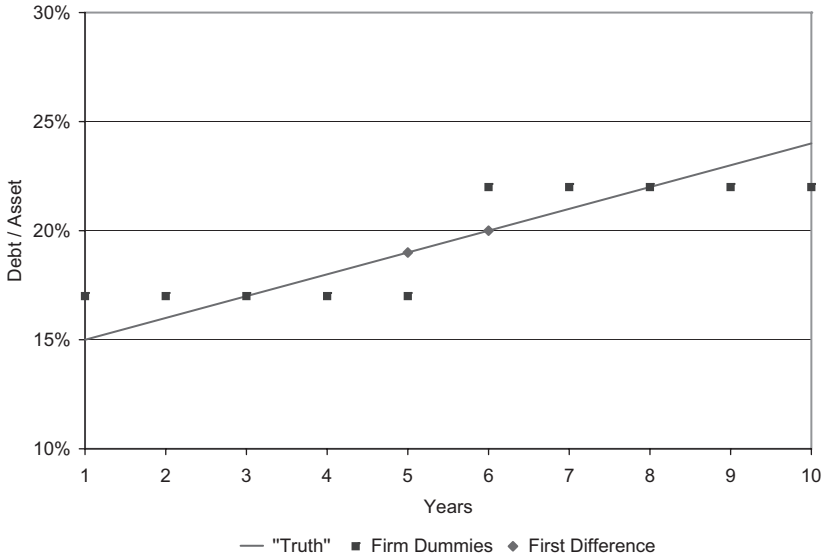


Figure 5

Illustration of panel data estimates

This figure is an illustration of the relative magnitudes of the within and the first-difference estimates of the rating coefficient in a panel data set. In this illustration, the firm's desired but unobserved leverage rises 1% per year over the sample period (the straight line). In the sixth year of the sample, the firm obtains a bond rating and maintains it for the rest of the sample period. The within estimate (like column IV of Table 4) is the difference between the average debt ratio in years when the firm had a debt rating (years 6–10) and years in which it did not (years 1–5). These averages are reported as squares and the difference in the averages is 5% (22.5 – 17.5). The difference coefficient is the difference between the debt ratio in the first year the firm has a debt rating and the debt ratio in the previous year (diamonds). The difference coefficient is 1% in this illustration (20.0 – 19.0). Since the change in the desired debt ratio is slow, the difference coefficient is only 20% of the within coefficient ($0.20 = 1/5$).

check this possibility, we read a sample of the 10Ks of firms the year before and after they obtain a debt rating and find no evidence of such dramatic changes in the firm's characteristics. We can more formally test whether unobserved firm demand factors are driving our results by examining the instrumental variable results. We turn to them in Section 3.

2.4 Interest coverage

Most of the literature on leverage has focused on the debt-to-asset ratio as a measure of leverage. However, some authors have argued that interest coverage is an alternative measure of leverage [Andrade and Kaplan (1997) and Berens and Cuny (1995)]. For a mature firm with low expected growth, measuring leverage by debt ratios or interest coverage ratios will lead to similar conclusions. However, firms whose cash flows are expected to grow rapidly can appear to have low leverage when measured on a debt-to-asset ratio basis (low debt relative to large future expected cash

flows), but high leverage when measured on an interest coverage basis (large required interest payments relative to low current cash flows). Since having a bond rating is correlated with firm age and the market-to-book ratio, and thus may be correlated with growth (see Table 2), we want to verify that our findings are robust to how leverage is measured. To do so, we re-estimate our leverage regressions using interest coverage (operating earnings before depreciation divided by interest expense) as the dependent variable. Since an increase in coverage from 100 to 101 is not as large as an increase from 1 to 2, we take the log of one plus interest coverage as our variable of interest. This also has the advantage of making the distribution more symmetric. An additional problem occurs when earnings are negative, because the interest coverage ratio is not well defined in these cases. To solve this problem, we code interest coverage equal to zero when earnings are negative and then account for this truncation in the estimation procedure by estimating a tobit model with a lower limit of zero (which translates into interest coverage of zero).¹⁸

The intuition that we found based on debt ratios is replicated with interest coverage, although the magnitudes are larger. Firms that have access to the public debt market have significantly lower interest coverage (are more levered). Since the dependent variable is logged, the coefficient can be interpreted as percent changes in interest coverage. A firm with a debt rating has interest coverage that is 65% lower than an otherwise identical firm (see Table 6, column I). The magnitude of this effect remains unchanged as we add the additional control variables (see Table 6, columns II–V).

3. Determinants of a Firm's Source of Capital

3.1 Who borrows from the bond market?

In this section, we examine which firms have access to the public bond market. This is useful for two reasons. First, a firm's source of capital is part of its capital structure decision and the theoretical literature has hypothesized why active monitors, such as banks, developed to cater to informationally opaque firms. There has been little empirical work, however, describing why some firms either choose to or are allowed to borrow from the bond market while others rely exclusively on private lenders such as banks [see Cantillo and Wright (2000), Denis and Mihov (2003), Himmelberg and Morgan (1995), Krishnaswami, Spindt, and Subramaniam (1999), Lemmon and Zender (2004), and Sunder (2002)]. Thus,

¹⁸ We also checked that the truncation point did not materially change our estimates. When we set the lower limit on income to be -0.5 times interest expense, an interest coverage of -0.5 instead of 0.0 , the coefficient on having a debt rating rises slightly in absolute value from -0.646 (Table 6, column III) to -0.658 (column V).

Table 6
Determinants of interest coverage: firm characteristics

	I	II	III	IV	V
Firm has a debt rating (1 = yes)	-0.650* (0.015)	-0.560* (0.016)	-0.646* (0.015)	-0.586* (0.016)	-0.658* (0.016)
Ln(market assets)	0.105* (0.003)	0.019* (0.004)	0.137* (0.004)	0.144* (0.004)	0.147* (0.004)
Ln(1 + firm age)	0.127* (0.005)	0.111* (0.006)	0.148* (0.005)	0.145* (0.005)	0.150* (0.006)
Profits/sales	5.639* (0.040)	4.406* (0.045)	5.554* (0.041)	5.591* (0.041)	6.145* (0.042)
Tangible assets	-1.345* (0.025)	-0.914* (0.026)	-1.316* (0.025)	-1.261* (0.025)	-1.399* (0.026)
Market-to-book (assets)	0.150* (0.005)	0.225* (0.005)	0.090* (0.005)	0.086* (0.005)	0.069* (0.006)
R&D/sales	-0.810* (0.084)	-0.169** (0.089)	-1.308* (0.089)	-1.307* (0.089)	-1.677* (0.093)
Advertising/sales	-0.768* (0.176)	-0.555* (0.187)	-0.783* (0.178)	-0.729* (0.178)	-0.941* (0.187)
Marginal tax rate		5.011* (0.061)			
Stock return previous year			0.105* (0.009)	0.110* (0.009)	0.137* (0.010)
σ (asset return)			0.800* (0.030)	0.755* (0.030)	0.702* (0.031)
% of debt due in ≤ 1 year				0.018 (0.021)	
% of debt due in > 5 years				-0.323* (0.019)	
Number of observations	60,701	47,063	57,127	57,127	57,127
Censored observations (%)	17.4	15.9	17.0	17.0	15.1
Pseudo- R^2	0.181	0.214	0.187	0.189	0.195

The dependent variable is the natural log of 1 plus the interest coverage ratio. Interest coverage is operating earnings before depreciation divided by interest expense. The dependent variable is re-coded to zero for observations with negative earnings; the model is then estimated as a tobit with a lower limit of zero (which corresponds to interest coverage of zero), except in column V. In column V, we used a lower limit of -0.69 which corresponds to interest coverage of -0.5 [$-0.69 = \text{Ln}(1 - 0.5)$]. The percent of observations that are censored also are reported in the table. White heteroscedastic consistent errors, corrected for correlation across observations of a given firm, are reported in parentheses [Rogers (1993) and White (1980)]. All models also include year dummy variables and a dummy variable for the regulated utility industry (4900-4939). The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt. * indicates statistical significance 1% level; ** indicates statistical significance 10% level. R&D, research and development.

understanding how firms and lenders are matched is an interesting question in and of itself.

We are also interested in the determinants of bond market access as a way to control for the possible endogeneity of a firm having a rating. In the previous section, we tried to disentangle the firm's demand for debt capital from the supply of debt capital available to it by controlling for firm characteristics that determine the net benefit of debt—including industry and firm dummies—and thus the firm's demand for debt. The implicit assumption in the previous results is that having a bond rating is determined exogenously. We know that firms whose assets are mainly tangible—those with high property, plant, and equipment-to-asset ratios—are more likely to have a bond rating (see Table 2) and choose to have higher leverage ratios (Table 4). If there are other such variables that we do not observe, then our coefficient could be biased. To address

this potential problem, we re-estimate our model using an instrumental variables approach.

The first stage in instrumental variables estimation is to estimate the endogenous variable (whether a firm has a bond rating) as a function of the exogenous variables in the second stage plus additional instruments. The instruments capture the variation as to which firms have access to the bond market or supply side factors. We report the first-stage results in Table 7. Notice that some of the firm characteristics that are correlated with higher leverage ratios also are associated with having a bond rating. Older firms, firms with more tangible assets, and firms with less volatile assets are more likely to have access to the public bond markets. Although each of these effects is statistically significant ($p < .01$), the economic magnitude of the effects differs (see Table 7, column I). Increasing a firm's property, plant, and equipment-to-asset ratio from the 25th (14%) to the 75th percentile (49%) raises the probability of having a bond rating by only 0.9%, whereas lowering a firm's asset volatility from the 75th (48%) to the 25th percentile (17%) raises the probability of having a bond rating by 9.0% [Hadlock and James (2002)].¹⁹ The variable with the most economic impact is the size of the firm. Raising the MV of the firm's assets from the 25th to the 75th percentile raises the probability of having a bond rating by 26 percentage points (from 3 to 29%). This is consistent with a large fixed cost of issuing public bonds relative to bank debt as well as a minimum critical size for a bond issue to be viable (liquid). We return to this issue below.

For instruments, we need variables that are correlated with whether a firm has a bond rating, but uncorrelated with the firm's desired level of leverage (i.e., the net benefit of debt). To start our search, we spoke with the investment banks that underwrite the debt issues and the agencies that rate the debt.²⁰ One of the first characteristics we searched for was how well known or visible the firm was. We were told that the less the banks had to introduce and explain a new issuer to the market, the more likely a public bond issue (and thus a debt rating) would be. As measures of whether the firm is widely known to the markets, we used two variables: whether the firm is in the Standard & Poor's (S&P) 500 Index and whether the firm's equity trades on the NYSE. S&P includes firms in the index to make it representative of the important industries in the

¹⁹ To calculate estimated probabilities, we set all variables equal to their actual value except the variable of interest (e.g., asset volatility). We set this variable equal to the 25th percentile of the distribution for all firm-years in the sample and calculate an average probability of having a bond rating based on our model. We then set the variable of interest to the 75th percentile and calculate a second-average probability. The difference between these two averages is the estimated change in probability.

²⁰ In theory, either or both institutions could be the gatekeeper to the public bond markets. We were told by members of both institutions that the investment banks act as the predominant gatekeeper. If the banks feel that they cannot place the bonds, there is no reason to secure a rating. If a bank feels that it can place a firm's bonds in the market, then the firm secures a rating. The rating agencies charge an initial fee that can range from \$50K to \$200K, and then an additional fee each year to cover the cost of maintaining the rating.

Table 7
Determinants of bond market access (first stage of instrumental variable regression)

	I	II	III	IV	V	VI
Firm is in the S&P 500		0.550* (0.081)	0.555* (0.081)	0.551* (0.081)	0.562* (0.081)	0.599* (0.080)
Firm trades on the NYSE		0.134* (0.044)	0.137* (0.044)	0.135* (0.044)	0.139* (0.044)	0.121* (0.043)
Log[1 + Pr(rating)] (% of other firms in industry)			0.300*** (0.156)		0.308** (0.155)	0.324** (0.155)
Log[1 + Pr(rating)] (% of other assets in industry)				0.128 (0.099)		
Firm is young (age ≤ 3)					-0.076 (0.048)	-0.071 (.048)
Firm is small (18.3% MV asset < Leh min)						-0.425* (0.049)
Ln(market assets)	0.547* (0.018)	0.490* (0.019)	0.484* (0.019)	0.488* (0.019)	0.485* (0.019)	0.405* (0.022)
Ln(1 + firm age)	0.132* (0.017)	0.075* (0.018)	0.076* (0.018)	0.075* (0.018)	0.051*** (0.027)	0.056** (0.027)
Profits/sales	-0.240* (0.090)	-0.242* (0.088)	-0.220** (0.088)	-0.241* (0.088)	-0.224** (0.088)	-0.220** (0.089)
Tangible assets	0.168** (0.084)	0.165** (0.083)	0.127 (0.084)	0.153*** (0.084)	0.124 (0.084)	0.120 (0.084)
Market-to-book (assets)	-0.153* (0.019)	-0.158* (0.019)	-0.155* (0.019)	-0.157* (0.019)	-0.155* (0.019)	-0.161* (0.019)
Advertising/sales	0.781** (0.379)	0.619 (0.383)	0.634*** (0.380)	0.595 (0.385)	0.643*** (0.381)	0.635 (0.387)
σ (asset return)	-1.730* (0.126)	-1.787* (0.128)	-1.743* (0.129)	-1.781* (0.128)	-1.747* (0.130)	-1.751* (0.131)
Number of observations	59,562	59,562	59,562	59,558	59,562	59,562
Pseudo- <i>R</i> ²	0.459	0.466	0.466	0.466	0.466	0.471
<i>F</i> -statistic (β _{instruments} = 0)		54.3*	59.0*	57.6*	61.5*	125.8*

The table contains estimates from a probit model where the dependent variable is whether the firm has a bond rating (access to the public debt markets). Positive coefficients imply that increases in the variable are associated with a higher probability of a bond rating. White heteroscedastic consistent errors, corrected for correlation across observations of a given firm, are reported in parentheses [Rogers (1993) and White (1980)]. The Pseudo-*R*² is the log-likelihood of the maximum likelihood minus the log-likelihood when only the constant is included. The instruments are (i) whether the firm is in the S&P 500 (0 or 1); (ii) whether the firm's equity trades on the NYSE (0 or 1); (iii) log of 1 plus the percentage of firms in the same three-digit SIC industry that have a bond rating; (iv) log of 1 plus the percentage of firms in the same three-digit SIC industry that have a bond rating weighted by the market value (MV) of assets; (v) whether the firm's age is three years or less (0 or 1); and (vi) whether the firm's MV of assets times the median debt ratio (0.183) is less than the minimum bond size required to be included in the Lehman Brothers Corporate bond index. All models also include year dummy variables and a dummy variable for the regulated utility industry (4900–4939) as well as the firm's research and development-to-sales ratio and its stock return over the previous year. The last row contains the *F*-statistic and its significance level for the test that the coefficients on all the instruments are jointly zero. The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt. * indicates statistical significance at 1% level; ** indicates statistical significance at 5% level; *** indicates statistical significance at 10% level.

economy, not based on the value of the debt tax shield or the costs of financial distress. Thus, it is a good candidate for an instrument. Where a firm's stock is traded may affect its equity returns, but since it also can raise the firm's visibility, it makes a good potential instrument. Both variables are positively correlated with having a debt rating, and the

relationship is statistically significant (Table 7, column II, p -value $< .01$).²¹ However, the economic impact of being included in the S&P 500 is larger (raising the probability of having a bond rating by 10%) than the economic impact of moving a firm's equity trading venue to the NYSE (raising the probability of having a bond rating by 2%).²²

The probability of having public debt also is related to the firm's uniqueness. A new firm that manufactures automobiles will be able to issue bonds more easily, because the bond market already knows the industry and the competitors, as most automobile manufacturers have outstanding public debt [Ben Dor (2004) finds similar results in the initial public offering market]. This lowers the costs of investigating the firm and its new public debt issue. Alternatively, a firm for whom there are no comparable firms with outstanding bonds will find issuing bonds more difficult, since the bankers must start from scratch to explain the firm, its competitors, and the industry to potential investors. In such a case, we have been told, the likelihood that a bank would be willing to underwrite a bond issue is lower. To test empirically for this effect, we calculate for each firm-year the percentage of firms in the same three-digit industry that have a bond rating, excluding the firm of interest. We included the log of one plus this percentage as an additional instrument.²³ Consistent with our hypothesis, if more firms in a given industry have a bond rating, this raises the probability of a firm in that industry having a debt rating (see Table 7, column III, p -value = .054).²⁴ Raising the fraction of other firms in your industry with a bond rating (lowering the costs of collecting information for a bond underwriting) from zero to one raises the probability of having a bond rating by 3.3%. As a robustness check, we also calculate the percentage using the MV of each firm's assets as weights (Table 7, column IV). Thus, the percentage is the fraction of assets,

²¹ If the instruments are only weakly correlated with the endogenous variable, then IV estimates will be biased toward the OLS estimates in finite samples [Staiger and Stock (1997)]. To verify that this is not a problem, we calculated the F -statistic for the hypothesis that all instrument coefficients are zero (see Table 7). Since the F -statistics are large and statistically significant, the IV estimates will be unbiased.

²² Both the S&P 500 and the NYSE dummy are correlated with size, although the correlations are not huge (0.48 and 0.43, respectively). This is why including these dummy variables does not change the coefficient on size dramatically (compare the coefficient in columns I and II of Table 7). However, if these variables are picking up a non-linear relationship between leverage and size, then they would not be valid instruments. This is why we verified that the relationship between leverage and size is linear (see note 9 and Figure 3). These two variables are therefore valid instruments.

²³ We use the log of 1 plus the probability, as opposed to the actual probability, since we expect the marginal effect of increases in the probability to decline (e.g., raising the fraction of firms in the industry with a rating from 0 to 10% is expected to have a greater effect than raising the probability from 50 to 60%). The data confirm this intuition. When we replace the log of 1 plus the probability with the probability, the coefficient drops from 0.300 to 0.189 and the t -statistic drops from 1.9 to 1.6.

²⁴ This variable is correlated with industry but it is not a simple proxy for industry. Remember, when we included dummy variables for each industry, the coefficient on having a bond rating remained economically large and statistically significant (Table 5, column I). If we instrument for having a rating and include dummy variables for each industry, the coefficient estimate on "firm has a debt rating" is still large and statistically significant ($\beta = 0.053$, p -value $< .01$ versus 0.061 in Table 8, column III).

excluding the firm's assets, which are from firms with a public bond rating. The coefficient on this variable is also statistically significant, but the magnitude is smaller (0.128 versus 0.300).

As a firm ages, it becomes better known to the market, and this can expand its access to capital [see Table 4; Berger and Udell (1995) and Petersen and Rajan (1994, 2002)]. However, until a firm has a sufficient track record, it may not be able to access the public debt markets. While private debt providers often have built relationships with firms before they go public, this is less common for the public debt markets [Schenone (2004)]. To capture this idea, we included a dummy variable for whether the firm was three years old or younger (see Table 7, column V). We find that these firms are less likely to have a debt rating, but the economic size of the effect is small (1.2%) and is less significant statistically than the other instruments ($p = .111$). Other age cut-offs produced even weaker results.

For our final instrument, we return to our previous result that size is the strongest predictor of which firms have a debt rating. This is consistent with issuing bonds having a large fixed cost. It is also consistent with the market requiring a minimum amount of outstanding bonds to create a liquid market. Unlike the equities market, the bond market is essentially an institutional market, and thus, the minimum required size of an issue is probably much larger. One requirement for inclusion of a bond issue in the Lehman Brothers Corporate Bond Index is that the amount of a firm's outstanding bonds exceeds a minimum threshold.²⁵ Thus, we created a dummy variable that is equal to one if the firm is too small to issue enough public debt to be in the Lehman Corporate Bond Index. The variable is defined as equal to one if the size of the firm (the MV of assets) times 0.183 (the median debt ratio from panel B of Table 1) is less than the minimum required bond issue size. Firms that are large enough to issue public bonds and have them included in the index have a 6.6% higher probability of having a bond rating (Table 7, column VI).

3.2 Instrumental variables estimates

To examine the importance of the bond rating being endogenous, we estimated our leverage equations using the instruments discussed above. The results are reported in Table 8. The first column contains OLS estimates (from Table 4, column IV) for comparison, while the remaining columns are the second-stage estimates based on the first-stage estimation

²⁵ We collected the components of the Lehman Brothers Corporate Bond Index for the years 1990 through 2000, and then used the data to calculate the minimum required size of a bond issue to be included in the index. The amounts specified in the components of the index are the total par amount outstanding for index-eligible bonds (i.e., no floaters or maturities shorter than one year). For the years prior to 1990, we relied on the documentation for the Index. The minimum bond issue size is: \$1 million (1986–1988); \$50 million (1989–1992); \$100 million (1993–1998); and \$150 million (1999–2000). When we used only the years for which we have the actual components of the Bond Index (1990–2000), the coefficient on the instrument is slightly larger ($\beta = 0.454$, $t = 7.5$).

Table 8
Determinants of market leverage (second stage of instrumental variable regression)

	I	II	III	IV	V	VI	VII
Firm has a debt rating (1 = yes)	0.078* (0.004)	0.059* (0.011)	0.061* (0.011)	0.060* (0.011)	0.063* (0.011)	0.057* (0.011)	0.065* (0.010)
Ln(market assets)	-0.025* (0.001)	-0.023* (0.001)	-0.023* (0.001)	-0.023* (0.001)	-0.023* (0.001)	-0.023* (0.001)	-0.020* (0.001)
Ln(1 + firm age)	-0.016* (0.001)	-0.016* (0.002)	-0.016* (0.002)	-0.016* (0.002)	-0.016* (0.002)	-0.015* (0.002)	-0.016* (0.001)
Profits/sales	-0.073* (.006)	-0.075* (.006)	-0.074* (.006)	-0.075* (.006)	-0.074* (.006)	-0.075* (.006)	-0.080* (.006)
Tangible assets	0.129* (0.007)	0.130* (0.007)	0.130* (0.007)	0.130* (0.007)	0.130* (0.007)	0.130* (0.007)	0.142* (0.007)
Market-to-book (assets)	-0.020* (0.001)	-0.020* (0.001)	-0.020* (0.001)	-0.020* (0.001)	-0.020* (0.001)	-0.020* (0.001)	-0.016* (0.001)
R&D/sales	-0.079* (0.007)	-0.081* (0.008)	-0.081* (0.008)	-0.081* (0.008)	-0.081* (0.008)	-0.082* (0.008)	-0.089* (0.007)
Advertising/sales	-0.036** (0.022)	-0.035 (0.022)	-0.035 (0.022)	-0.035 (0.022)	-0.035 (0.022)	-0.035 (0.022)	-0.058* (0.019)
Stock return previous year	-0.006* (0.001)	-0.007* (0.001)	-0.007* (0.001)	-0.007* (0.001)	-0.007* (0.001)	-0.007* (0.001)	-0.005* (0.001)
σ (asset return)	-0.334* (0.009)	-0.334* (0.009)	-0.334* (0.009)	-0.334* (0.009)	-0.334* (0.009)	-0.334* (0.009)	-0.322* (0.008)
Number of observations	59,562	59,562	59,562	59,558	59,562	59,562	66,537
R^2	0.368	0.367	0.367	0.367	0.367	0.367	0.373
Estimation method	OLS	IV	IV	IV	IV	IV	IV

The table contains second stage, instrumental variable estimates, except for column I. In column I, the OLS estimates from Table 4, column I are reproduced. The instruments used in each column (II–VI) are the ones used in the same column of Table 7 (II–VI). In column VII, we use the coefficients from column VI of Table 7 to predict the probability of having a rating for all firms, not just those with positive debt. We then include the firms with zero debt in the second-stage IV estimation. The instruments are: (i) whether the firm is in the S&P 500 (0 or 1); (ii) whether the firm's equity trades on the NYSE (0 or 1); (iii) log of 1 plus the percentage of firms in the same three-digit SIC industry that have a bond rating; (iv) log of 1 plus the percentage of firms in the same three-digit SIC industry that have a bond rating weighted by the market value (MV) of assets; (v) whether the firm's age is three years or less (0 or 1); and (vi) whether the firm's MV of assets times the median debt ratio (0.183) is less than the minimum bond size required to be included in the Lehman Brothers Corporate bond index. White heteroscedastic consistent errors, corrected for correlation across observations of a given firm, are reported in parentheses [Rogers (1993) and White (1980)]. The sample is based on firms from Compustat that report sales and assets above \$1 million between 1986 and 2000 and only includes firm-years with debt, except column VII which also includes firm-years with zero debt. * indicates statistical significance at 1% level; ** indicates statistical significance at 10% level. R&D, research and development.

in the corresponding column of Table 7.²⁶ Instrumenting for having a bond rating does lower the estimated coefficient from the original 0.078; however, the estimated coefficient is still large. Depending on the instruments used, having a bond rating raises the leverage of the firm by between 5.7 and 6.3% ($p < .01$).

²⁶ Since the dependent variable in the first stage is a binary variable, standard instrumental variables estimation will not work in our case. It assumes the first stage is a linear probability model, which is a mis-specification of the data. Instead, we estimated the first stage as a probit (Table 7). We then used the predicted probability from the probit as an instrument in the second stage of the estimation. This method gives us consistent coefficients as well as the correct standard errors [see Wooldridge (2001)].

In most of our results, we have excluded firms with zero debt because of the possible endogeneity of having a bond rating. Since the second stage of the IV estimates does not use information on whether the firm has a debt rating, we can include in the sample firms that do not have debt. We use the coefficients from column VI of Table 7 to predict the probability of having a rating for all firms, not just those with positive debt. We then include the firms with zero debt in the second-stage instrumental variable estimation (Table 8, column VII). In the expanded sample, having access to the bond market increases a firm's leverage by 6.5%. This coefficient is larger than the estimate in column VI (5.7%), which confirms our initial impression that excluding the zero-debt firms was being conservative. Zero-debt firms, like Microsoft, which could get a debt rating but do not, are not representative of the zero-debt firms in our sample. Instead, most of the zero-debt firms have characteristics that our first-stage regression suggests make them unlikely to be able to access public debt markets (their predicted probability of having a debt rating is 4.8 versus 21.9% for the firms with positive debt). Thus, including the zero-debt firms in our examination increases the estimated difference in leverage.

4. Conclusion

In this article, we examine how firms choose their capital structure. By combining the literature on optimal choice of leverage with the literature on credit constraints, we are able to better explain the observed patterns of leverage seen in publicly traded firms. When examining small private firms, it is not surprising to find that they are credit constrained. Very little public information is available about such firms, and given their small size, the relative cost of collecting this information can be quite high. When we instead examine publicly traded firms, the landscape is different. Not only are these firms much larger, but the regulatory requirements of issuing public equity also mean that there is much more information available about them. However, even in this situation, we find that these firms' capital structure decisions (ability to issue debt) are constrained by the capital markets [see Titman (2002), for a general discussion].

The fact that firms that need to borrow from financial intermediaries (they are more informationally opaque) have lower leverage is not surprising. The costs of monitoring and imperfect financial contracting will raise the costs of debt capital for these firms and thereby lower their desired leverage. If monitoring and contracting solutions are not sufficient, these firms may face quantity constraints, not just more expensive capital. What is surprising is that this variability is not captured by traditional measures used in the capital structure literature. Even after controlling for the firm characteristics and unobserved heterogeneity, the

magnitude of the difference in leverage is quite large and may go a long way toward explaining the perceived under-leverage, upon which other authors have commented.

Our findings also raise the possibility that shocks to certain parts of the capital markets may affect firms differentially. Slovin, Sushka, and Polonchek (1993) document that firms whose banks suffer shocks to their capital, independent of the firm's demand for capital, can affect the firm's financing. If, as we speculate and as our instrumental variable results imply, firms cannot easily move from the private debt markets to the public debt markets, then shocks to the banking market may have a more dramatic impact than shocks to the public bond market. In addition, since the firms that may not have access to the public debt markets are the least transparent, the impact on their finances will probably be greater. This is an area for future exploration.

Appendix: Public versus Private Debt for Firms with a Debt Rating

We cannot observe which of a firm's debt issues are public or private in the Compustat data, and thus we cannot measure directly the fraction of debt that is public for firms with a debt rating. However, by comparing the aggregate numbers from our sample with the aggregate numbers from the Federal Reserve's flow of funds data (Table L.102), which does report private and public debt, we can roughly estimate that fraction of debt which is public for firms with a debt rating.

There are two ways to do this. The first is to divide the total amount of non-farm, non-financial corporate public debt (from the flow of funds data) by the total debt of firms with a debt rating (from our sample). Over our sample period, this ratio averages 93%, suggesting that 93% of the debt issued by firms with a debt rating is public debt.

In the second approach, we use the flow of funds data to calculate the fraction of debt that is public for all corporations. Over our sample periods, this ratio has averaged 54%. This ratio is a weighted average of the fraction of debt which is public, conditional on the firm having a debt rating, and the fraction of debt which is public, conditional on the firm not having a debt rating. The weights are the fraction of debt that is issued by firms with and without a debt rating.

$$\begin{aligned}
 \frac{\text{Public debt}}{\text{Total debt}} &= \frac{\text{Total debt}_{\text{no rate}}}{\text{Total debt}} \left(\frac{\text{Public debt}_{\text{no rate}}}{\text{Total debt}_{\text{no rate}}} \right) + \frac{\text{Total debt}_{\text{rate}}}{\text{Total debt}} \left(\frac{\text{Public debt}_{\text{rate}}}{\text{Total debt}_{\text{rate}}} \right) \\
 &= \frac{\text{Total debt}_{\text{no rate}}}{\text{Total debt}} (0) + \frac{\text{Total debt}_{\text{rate}}}{\text{Total debt}} \left(\frac{\text{Public debt}_{\text{rate}}}{\text{Total debt}_{\text{rate}}} \right) \\
 &= (1 - \alpha)(0) + \alpha \left(\frac{\text{Public debt}_{\text{rate}}}{\text{Total debt}_{\text{rate}}} \right) \\
 0.540 &= (1 - 0.777)(0) + 0.777 \left(\frac{\text{Public debt}_{\text{rate}}}{\text{Total debt}_{\text{rate}}} \right)
 \end{aligned} \tag{A1}$$

We can calculate the fraction of debt issued by firms with a debt rating [α in Equation (A1)] and it is 78% in our Compustat sample. If we assume that the firms without a debt rating have zero public debt, these numbers imply that 69% of the debt of firms with a debt rating is public ($0.540/0.777$).

Both sets of calculations incorrectly assume that our Compustat sample and the flow of funds sample are the same. Since the flow of funds sample includes more firms than our Compustat sample (e.g., private firms), our estimates need to be interpreted with caution. The 93% estimate probably overestimates the true percentage, as the numerator includes public debt issued by private firms, but the denominator does not include the debt of these firms. The 69% estimate probably underestimates the true percentage. Our estimate of α is based only on firms in our sample, and thus excludes private firms. Since most private firms do not have a debt rating, we will overestimate α and thus underestimate the percent of debt which is public for firms which have a debt rating. Thus the true percentage is probably between 69 and 93%, implying that a majority, but far from all, of the debt of firms with a debt rating is public debt.

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