Strategic Actions and Credit Spreads: An Empirical Investigation*

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ABSTRACT

Do strategic actions of borrowers and lenders have an impact on corporate debt value? Our evidence indicates that they do, though the economic significance of the effect is limited. The possibility of renegotiation on average increases corporate debt spreads by 2-8 basis points due to the threat of strategic default, even though there may be ex-post efficiency gains to renegotiation. The effect of strategic actions increases to up to 40 basis points when bondholders' bargaining position in renegotiation is likely to be weak, including firms with high managerial shareholding, simple debt structures, and high liquidation costs. On balance, although incorporating strategic behavior may improve cross-sectional performance of debt pricing models, it is unlikely to remedy their inability to predict the general level of spreads.

Keywords: Credit spreads; Strategic debt service; Renegotiation; Liquidation costs; Bargaining power

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I. Introduction

This paper explores the empirical relationship between corporate debt pricing and firm characteristics which influence strategic actions of borrowers and lenders. Our analysis of bond yield spreads is based on a large body of corporate finance literature that studies the effect of firm's characteristics on the outcome of distressed restructuring. The key question we ask is, to what extent are firm-specific factors that influence strategic decisions about default and ex-post reorganization reflected in ex-ante prices of corporate bonds. We find that, on average, the threat of strategic default increases corporate debt spreads, even though ex-post there may be efficiency gains in renegotiation. This impact of strategic actions is economically significant for firms with little tangible assets, high equityholders' bargaining power, and low credit rating. However, for the overall sample the average economic effect of strategic variables is below transactions costs. Thus, although incorporating strategic behavior may improve cross-sectional performance of debt pricing models, it cannot remedy their inability to predict the general level of spreads.

The pricing of defaultable corporate debt has been the subject of extensive research over many years; yet market yield spreads remain largely unexplained. The conceptually appealing contingent claims models pioneered by Merton (1974) and Black and Cox (1976) were soon found to produce spreads far below empirically observed levels (Jones, Mason, and Rosenfeld, 1984). In such models, the value of the firm's assets is assumed to follow a random process, and default happens when this value falls below a certain threshold. While the basic framework has been extended to incorporate many realistic features of bond markets, such as corporate taxes and endogenous default (Leland, 1994), stochastic risk-free rate (Longstaff and Schwartz, 1995), stochastic default boundary (Santa-Clara and Saá-Requejo, 1999), and mean-reverting leverage (Collin-Dufresne and Goldstein, 2001), existing structural models are still unable to match the observed cross-section of bond spreads (Eom, Helwege and Huang, 2003).

One could argue that this lack of explanatory power may be due to the fact that the set of firm-level variables in both theoretical and empirical studies of corporate bond pricing is usually restricted to such risk factors as leverage and volatility, despite evidence that default and recovery decisions depend on a number of firm-specific factors documented in corporate finance literature. The specifics of Chapter 11 make bargaining an important factor in distressed reorganizations. Gilson, John and Lang (1990), Asquith, Gertner and Scharfstein (1994), Franks and Torous (1994), and Betker (1995) find that the complexity of debt structure, managerial share ownership, and asset tangibility, which reflect bargaining positions of different parties, affect the incidence of formal and informal reorganizations and deviations from the absolute priority, eventually having an impact on debt recovery rates. To the extent that non-distressed bond spreads reflect expected losses from default, they should, too, depend on such factors. Yet, although models like Longstaff and Schwartz (1995) allow for recovery rates which may incorporate exogenous bargaining with deviations from the absolute priority, empirical applications tend to assume a constant exogenous recovery rate for all firms, potentially reducing explanatory power in the cross-section.

Moreover, the effect of strategic actions may not be limited to recovery rates. The other channel is the equityholders' decision of *when* to default. Theoretical literature since Hart and Moore (1989, 1998) has emphasized the difference between *liquidity default*, where the firm's cash flows are insufficient to honor the debt contract, and *strategic default*, where the firm fails to pay the amount stipulated in the debt contract even though it possesses resources to do so. When liquidation is costly, creditors may prefer to forgive a part of debt, which results in equityholders' incentives to default opportunistically. Accounting only for liquidity default may thus understate the true default probability and under-predict bond spreads. Structural bond pricing models with debt renegotiation by Anderson and Sundaresan (1996) and Mella-Barral and Perraudin (1997) predict that a large part of the spread may be due to strategic default.

The impact of strategic behavior on spreads depends on liquidation costs, the distribution of bargaining power, and other factors. Ex ante the possibility of debt renegotiation may induce strategic default, depressing bond values. However, in liquidity default ex post renegotiation may be beneficial to all parties, as it allows them to avoid inefficient liquidation, increasing expected recovery rates. Generally, the stronger the bargaining position of creditors, the higher is their share in the renegotiation surplus and the lower is the equityholders' incentives to default strategically. In particular, when all bargaining power belongs to bondholders, the possibility of renegotiation in liquidity defaults should increase ex ante debt value and reduce spreads. Conversely, when creditors have no bargaining power, they do not benefit from renegotiation in liquidity defaults, and the threat of strategic default results in higher spreads. In addition, the importance of strategic behavior for spreads may also depend on other factors, such as renegotiation costs.[1]

This paper for the first time empirically documents the influence of strategic behavior on corporate bond prices. We relate credit spreads to measures of debt structure complexity and shareholder characteristics which influence strategic default and bargaining in default. Our empirical variables include measures of asset tangibility; managerial and institutional shareholding as proxies for equityholders' bargaining power in renegotiations;[2] and measures of the dispersion of debtholders' interest as proxies for how difficult it is to renegotiate the firm's debt. These include the number of different public bonds issues outstanding and the proportions of private and short-term debt in the debt structure. In their model of debt restructuring, Gertner and Scharfstein (1991) find that because of the holdout problem renegotiation is more likely to fail

[1] Mella-Barral and Perraudin (1997), Mella-Barral(1999), Fan and Sundaresan (2000), Acharya, Huang, Subrahmanyam, and Sundaram (2002), François and Morellec (2004), and Hege and Mella-Barral (2003) study how spreads depend on the distribution of bargaining power, the possibility of efficient liquidation, optimal dividend and cash management policy, renegotiation costs, and multiple renegotiation rounds.

[2] Betker (1995) and LoPucki and Whitford (1990) find that managerial equity ownership is a strong predictor of deviations from the absolute priority rule in favor of equity.

when bank debt is senior, when public debt is relatively short term or protected by seniority covenants.[3] Empirical corporate finance studies confirm that such variables influence the nature and the outcome of distressed reorganizations;[4] we relate them to ex ante spreads.

We find that all our strategic proxies are significant determinants of credit spreads. In particular, the number of bond issues, the proportion of public debt, and the ratio of short to long-term debt are negatively correlated with spreads, while managerial and institutional share ownership show positive correlation with spreads. We attempt to discriminate between two alternative mechanisms through which strategic variables can influence spreads. These are the effect of *bargaining in default* on expected recovery rates, and the *strategic default* effect of the equityholders' endogenous choice of when to default. If the timing of default is exogenous but recovery rates are an outcome of bargaining, introduction of renegotiation should always increase debt value, since it allows the firm to avoid paying deadweight liquidation costs. By contrast, if default is the equityholders' endogenous decision, the possibility of renegotiation may decrease the debt value because of strategic default. Our tests show that spreads are generally lower when potential renegotiation is difficult. We interpret this as evidence that, on average, the adverse effect on debt values of the possibility of strategic default more than offsets the expected efficiency gains from avoiding inefficient liquidation in renegotiation.

The statistical significance of strategic variables in itself suggests that traditional credit risk models which ignore the possibility of strategic behavior may disregard important features of risky debt and lack accuracy. Controlling for strategic actions does add explanatory power in the cross-section. However, we find that the economic significance of strategic variables in the overall sample is limited, with the average marginal contribution of each variable between 2 and 8 basis points. This evidence suggests that on balance strategic debt service is unlikely to be the main reason behind the inability of traditional structural models of credit risk to explain the general level os spreads.[5]

The low economic significance of strategic actions for the overall sample may be due to the fact that the distribution of bargaining power in an average firm is such that for creditors the positive ex post effect of renegotiation nearly offsets its adverse ex ante effect of making strategic default possible. Consistent with this conjecture, we find that the effect of strategic variables is significantly more pronounced, amounting to up to 40 basis points, when in distressed renegotiations debtholders are likely to be relatively weak. In particular, high bargaining power of equity

[3]Berglöf and von Thadden (1994), and Bolton and Scharfstein (1996) study the implications of the possibility of strategic debt service for the optimal choice of the ratio of short to long-term debt and the number of different creditors.

[4]LoPucki and Whitford (1990), Franks and Torous (1994), and Betker (1995) study determinants of deviations from the absolute priority; Gilson, John and Lang (1990), Asquith, Gertner and Scharfstein (1994), and Gilson (1997) compare out-of-court reorganizations with Chapter 11 bankruptcies.

[5]This conclusion is consistent with Huang and Huang (2002), who find that credit risk, including strategic debt service, explains only a small part of spreads on most bonds when estimates are based on historical default data.

results in greater sensitivity of spreads to strategic default. Moreover, the significance of strategic variables is higher when the costs of liquidation are high, as there is more surplus to bargain over. By contrast, the effect is insignificant for AAA and AA–rated bonds and for firms with low institutional and managerial shareholding and large fixed assets which may be seized in liquidation. These results suggest that, unless the debt structure is already optimally chosen considering all trade-offs involved, low-rated firms with high proportions of intangible assets can reduce their cost of borrowing by choosing complex debt structures which would make renegotiation difficult.

Our findings are robust to the choice of methodology, alternative specifications and controls. In particular, we control for non-linear effects of credit risk variables such as leverage and volatility by subtracting the credit spread implied by the Merton (1974) model, and find that the residual spread is even more significantly related to strategic variables. That the results cannot be attributed to alternative possible channels of influence of our proxies on spreads. While the endogeneity of some capital structure variables to the cost of borrowing may be an issue, we argue that the results are unlikely to be driven by endogeneity.

The rest of the paper is organized as follows. The next section presents our hypotheses. Section III describes the data, the methodology we employ to estimate debt spreads, and the choice of proxies. Section IV presents the results of our analysis of cross-sectional determinants of spreads, including strategic and non-strategic credit risk factors, under various conditions. Section V reports various robustness checks. Section VI concludes. Details of the model used to derive the hypotheses, and the procedure used to measure spreads are given in the Appendices.

II. Testable Hypotheses

To empirically evaluate the impact of strategic behavior on credit spreads, we formulate below a set of testable hypotheses that establish how debt prices are related to the possibility of renegotiation, the bargaining power of debt and equity, and liquidation costs in bankruptcy. We establish the direction of the possible influence under different assumptions, and identify conditions in which this influence is likely to be higher or lower. The hypotheses presented below are consistent with the intuition of many models of strategic debt service, starting from Hart and Moore (1989). In Appendix A we show how our hypotheses can be formally derived in a simple stylized model of strategic debt service with frictions and varying distributions of bargaining power, which is an extension of the Merton (1974) model.

Theoretical models usually take the extreme assumption that debt contract renegotiation is either impossible or perfect and costless. To evaluate the impact of the possibility of renegotiation empirically, our methodology involves relating debt spreads to *renegotiation frictions*, which measure how easily renegotiation can be carried out.[6] For different firms it may be more or less easy to restructure debt depending on specific characteristics. For example, while renegotiating with a small number of lenders may be relatively easy, dispersed bond ownership with atomistic bondholders and full collateralization may make renegotiation impossible.[7] Comparing firms with low and high renegotiation frictions allows us to draw conclusions about the effect of the possibility of renegotiation on yield spreads. Suppose that q measures how difficult it is to renegotiate the firm's debt, s is the debt spread, and the sensitivity of the spread to renegotiation frictions is $\phi = \partial s / \partial q$. If $\phi > 0$ then the possibility of renegotiation decreases spreads and increases debt prices. Bargaining power of equityholders and the costs of liquidation are two other crucial variables that influence strategic behavior. Liquidation costs can be thought of as a measure of renegotiation surplus, while the distribution of bargaining power defines the division of the surplus. These two variables may affect the sign and magnitude of ϕ as hypothesized below.

In general, strategic behavior can influence debt prices through two channels, *bargaining in default* and the *strategic default* decision. Models like Longstaff and Schwartz (1995) incorporate only the first channel by assuming that recovery rates depend on exogenously specified bargaining which may result in deviations from the absolute priority rule. Models of strategic debt service, such as Anderson and Sundaresan (1996) and Mella-Barral and Perraudin (1997), also take into account the second channel by allowing equityholders to strategically choose *when* to default. Our hypotheses establish the influence of these two channels on debt prices.

To begin with, let us assume that there are some (fixed) deadweight costs whenever the firm is liquidated in bankruptcy. Debt recovery rates in bankruptcy should be lower for higher liquidation costs. Moreover, debtholders are more willing to forgive debt if alternatively they face higher costs in bankruptcy liquidation. Therefore, when default is endogenous, high liquidation costs also result in borrowers defaulting more frequently. Thus, we have:

HYPOTHESIS 1 (**Liquidation costs and spreads**). *Higher liquidation costs result in higher debt spreads.*

If strategic actions are relevant for debt prices, higher bargaining power of equity should result in lower debt values. Indeed, once in default, higher equity's bargaining power will result in lower recovery rates, as deviations from absolute priority will be larger. Also, higher bargaining power of equity should result in higher frequency of strategic defaults, since equityholders will gain more in renegotiations. This argument supports the following hypothesis:

HYPOTHESIS 2 (**Bargaining power and spreads**). *Higher bargaining power of equity results in higher debt spreads.*

[6] For a model of strategic debt service with renegotiation frictions, see François and Morellec (2004), who incorporate time limitations and renegotiation costs in a continuous-time model.

[7] See Hege and Mella-Barral (2003) for a model of repeated renegotiation rounds with multiple bondholders.

We now turn to the central question of the study, namely, does the *possibility* of renegotiation influence spreads? What is the nature of the relation, and under what conditions is it more pronounced? As Hart and Moore (1989) first pointed out, the effect of renegotiation on debt value is twofold. On the one hand, in liquidity default the recovery effect is beneficial ex-post since deadweight liquidation costs can be avoided. On the other hand, ex-ante strategic actions may now increase the probability of default. These effects are summarized in the following:

HYPOTHESIS 3 (**Renegotiation frictions and spreads**). *Higher renegotiation frictions reduce the probability of strategic default, but also reduce recovery rates conditional on default. The overall influence on spreads depends on whether strategic default or recovery effect dominates.*

It follows that in general when both bargaining in default and strategic default effects are important, the overall impact of renegotiation on debt prices is not unambiguous, and depends in particular on the distribution of bargaining power and the relative probability of liquidity and strategic default. However, if models with exogenous default like Longstaff and Schwartz (1995) can adequately capture the effect of bargaining on spreads, then we should expect renegotiation to increase debt prices because of the bargaining in default effect. Put differently, *if the strategic default effect is irrelevant, then higher renegotiation frictions cannot result in lower spreads.*

This conclusion is central to our study. While we would not be able to conclude that strategic debt service is unimportant if debt spreads were found to be positively correlated with renegotiation frictions ($\phi > 0$, higher spreads when renegotiation is unlikely), a negative correlation ($\phi < 0$) would unambiguously indicate that strategic default is essential, and that the ex-ante increase in the default probability outweighs the ex-post increase in recovery rates in default. Such a finding would support the claim of strategic debt service models that the threat of opportunistic behavior can increase credit spreads.

We proceed to identify the conditions on bargaining power distribution and liquidation costs under which ϕ is likely to be high or low. The effect of the bargaining power can be intuitively illustrated as follows. If all bargaining power belongs to equity, then debtholders do not share in the renegotiation surplus, and there is no positive recovery effect of renegotiation on debt prices. The strategic default effect then reduces debt prices: $\phi < 0$. On the other hand, if the bargaining power fully belongs to debtholders, strategic default is of no value for equityholders as they do not receive any renegotiation surplus. Renegotiation in default then increases the ex post and ex ante debt value, and $\phi > 0$. If the effect of bargaining power on ϕ is monotonic, which in our model is true under some restrictions on parameter values,[8] we obtain the following:

[8]When the distribution of the value of assets does not change much around the face value of debt, a sufficient condition for the monotonicity is that equityholders' bargaining power and renegotiation frictions are not too small simultaneously (See details in Appendix A). The role of this restriction is to ensure that the probability of strategic default does not fall too quickly relative to the creditors' bargaining surplus decrease as renegotiation frictions increase. Under the US Chapter 11, renegotiations are neither costless, nor is the balance of power greatly tilted towards creditors. Therefore these conditions do not appear restrictive for our study.

Hypothesis 4 (**The impact of bargaining power**). *Assume that the effect of bargaining power on spread sensitivity to renegotiation frictions* ϕ *is monotonic. Then* ϕ *is a decreasing function of the bargaining power of equity.*

Finally, the distribution of bargaining power is likely to be less important when the costs of liquidation are low. This follows from renegotiation surplus being positively related to liquidation costs. For the same reason the magnitude of ϕ is expected to be lower for low liquidation costs:

Hypothesis 5 (**The impact of liquidation costs**). *The absolute value of the spread sensitivity to bargaining power is increasing in liquidation costs. Additionally, if the effect of bargaining power on* ϕ *is monotonic, the absolute value of the spread sensitivity to renegotiation frictions is also increasing in liquidation costs.*

III. Data Description

A. Data sources and sample selection

In this study we use corporate bond price data supplied by the National Association of Insurance Commissioners (NAIC). The NAIC dataset provides details of all fixed-income transaction by American insurance companies, which are major investors in corporate bonds, in years 1994-1999. Unlike some other datasets on defaultable bond prices used in academic studies, these data represent actual transactions and not dealer quotes or matrix prices. The descriptive information on each corporate bond traded is obtained from Fixed Income Securities Database (FISD) provided by LJS Global Information Systems, Inc. Where possible, we complement information on bond ratings from FISD using Moody's rating database. To estimate spreads we use daily price data on zero-coupon US Treasury securities (STRIPS). We use constant-maturity Treasury rates available from the Federal Reserve Board of Governors as explanatory variables.

We manually merge the bond data with accounting information from COMPUSTAT and equity prices from CRSP, taking account of mergers, name changes, and parent/subsidiary relationships. Our merge is conservative in that we exclude observations unless we are confident they are merged correctly. We also use data on stock holdings of five most highly paid executives of each company, recorded in Executive COMPUSTAT, and institutional equity ownership data from CDA/Spectrum. Finally, we collect more detailed information on firms' debt structure than provided by COMPUSTAT, such as data on credit lines, from the long-term debt section of printed Moody's/Mergent industrial and OTC manuals.

Over the period 1994-99, NAIC reports 685680 transactions by insurance companies involving fixed income securities. We first exclude all trades on bonds other than U.S. corporate bonds, which leaves us with 416449 trades. We proceed by eliminating all non-fixed coupon bonds, bonds with embedded optionalities, such as callable, putable, exchangeable, convertible securities, and bonds with sinking fund provisions; and asset-backed issues. Also, observations with missing trade detail data (e.g. ambiguous settlement date) and bond characteristics (e.g. face value) are excluded, and in cases where there are several trades registered in one bond on the same day at identical prices and volumes, only one is retained to avoid double-counting.[9]

We examine only bonds with time to maturity between 1 and 30 years, since the risk-free rates we use to estimate spreads have maturities lower than thirty years, and for very short maturities a small measurement error in price results in large yield deviations, making spread estimates open to large estimation errors. To make cross-sectional comparisons reliable, we exclude bonds issued by financial companies (SIC codes 6000-6999). Finally, we exclude observations for which data on total debt in the fiscal year immediately preceding the trading date is missing, and also require that data on equity returns be available for at least 126 business days preceding the trading date. Our final sample consists of 43402 trades for 2380 unique bond issues from 523 unique issuers.

B. Spread estimation

The corporate spread we examine is the difference between the yield to maturity on the corporate bond and yield to maturity on a portfolio of zero-coupon risk-free bonds most closely replicating the promised cash flows from the risky bond. We calculate the yield for each bond trade in our sample using promised future coupon payments and the trade price recorded by NAIC. We then calculate the yield on a risk-free bond with the same cash flows using U.S. Treasury STRIPS prices for the settlement date of trade. For the majority of trades there are 4 annual STRIPS returns available. We use a linear approximation of the STRIPS yield curve to discount corporate bond coupon payments which occur between maturity dates of two STRIPS; since our final sample of bond prices is for maturities in the range where STRIPS yields are available, we do not have to approximate the yield curve at the short and long ends. We then subtract the estimated cash-flow matched risk-free rate from the yield on the bond to obtain the bond spread for this trade. The details of the procedure are given in Appendix B.

Our spread estimation method is based on the risk-free yield on a bond with the same duration and convexity as those of the corporate bond. Previous studies use simpler procedures to calculate the difference between the yield to maturity on the corporate bond and the yield to maturity on a benchmark Treasury security.[10] These procedures underestimate spreads for upward sloping term

[9] An examination of sell and buy trades reveals that some trades involve insurance companies on both sides of the transaction, resulting in two entries in the NAIC database.

[10] See, for example, Collin-Dufresne, Goldstein, and Martin (2001). Duffie and Singleton (1999) use credit swap spreads. Elton, Gruber, Agrawal, and Mann (2001) calculate spreads on equivalent zero coupon bonds that they estimate from corporate bond prices. They have to combine bonds into risk groups such as rating classes to carry out this procedure. We, on the other hand, are interested in idiosyncratic spread variations, and do not use spread aggregation.

structures and overestimate them for downward sloping term structures.[11]

C. Independent variables

C.1. Strategic factor proxies

We use non-fixed assets as our main proxy for costs of liquidation; the market to book value of assets and R&D expenses over total investments are also used in robustness checks. We proxy for the bargaining power of equity in possible future renegotiations by percentages of equity owned by managers and institutional investors. Finally, we use various measures of the complexity of the capital and debt structure, mostly suggested by theoretical and empirical corporate finance research, to proxy for renegotiation frictions. Panel A of Table I presents a summary of these variables.

Costs of liquidation. Debt contracts are renegotiated when it helps avoid deadweight costs such as liquidation costs in bankruptcy. We use variables related to asset specificity and tangibility to estimate value dissipation due to failure to restructure claims, resulting in liquidation. Our main proxy for liquidation costs is the proportion of *non-fixed assets*, which is one minus the ratio of net property, plant and equipment to total assets. For robustness checks we also use the ratio of *market to book* value of assets, equal to the sum of book value of debt and market value of equity divided by the sum of book values of debt and equity; and the ratio of *R&D* expenditures to total investments. These variables are expected to be correlated with the excess value of assets in current use over their value in liquidation. Alderson and Betker (1995) find that fixed assets is the best proxy for the (lack of) costs of liquidation in Chapter 11 reorganizations. Gilson, John and Lang (1990) report that firms with high Q-ratios are more likely to restructure their claims out of court, the likely reason being the incentives to avoid large value destruction in bankruptcy.

Relative bargaining power. We use *managerial shareholding* as our main proxy for equityholders' incentives to be tough in renegotiations, increasing the bargaining power of equity vis-a-vis other claimants. Betker (1995) shows that equity deviations from the Absolute Priority Rule (APR) in Chapter 11 are significantly higher when managers own a stake in the firm. LoPucki and Whitford (1990) find that the existence of equity deviations from the APR in Chapter 11 in their sample is always associated with either a creation of an equity committee or managers having an equity stake in the firm. We measure *managerial shareholding* as the ratio of

[11] Consider the case of a ten year bond with a semiannual 8% coupon and current yield of 7.7%. Assume that the term structure is $r_t = 1.5 + 0.5t$, where r_t is a t-year zero-coupon bond, and that the ten-year Treasury bond pays a 5% coupon. Then the difference between the simple corporate-treasury spread and the spread estimated using our procedure is more than 13 basis points, or 7%. For low quality bonds the difference in spread estimates would be larger.

the number of shares in the company owned by 5 highest paid executives to the total number of shares outstanding. Similarly, for robustness checks we use *institutional shareholding*, which is the percentage of total equity held by institutional investors. Presumably, better coordinated and more sophisticated institutional investors holding large blocks of equity can bargain more efficiently and induce larger deviations from the APR than less sophisticated investors, increasing equityholders' bargaining power.

Renegotiation frictions. Renegotiation frictions measure how difficult it is to renegotiate the company's debt. They influence, for example, the probability that an out-of-court restructuring, if attempted, will prove unsuccessful, resulting in costly Chapter 11 reorganizations or a Chapter 7 liquidation. Asquith, Gertner and Scharfstein (1994) and Gilson, John and Lang (1990) document that about half of the firms attempting an informal distressed restructuring end up in Chapter 11, and relate the probability of bankruptcy to the debt structure. We use similar variables to theirs as proxies for renegotiation frictions. In a broader context, variables which make successful out-of-court restructuring more difficult are also likely to hinder Chapter 11 renegotiations, increasing time in bankruptcy and costs of reorganization. Thus our variables should proxy for factors which discourage not only out-of-court, but also Chapter 11 reorganizations which otherwise the firm might opt for.

Our measures of renegotiation frictions include the *number of bond issues* outstanding at the date of trade, the ratio of *public to total debt*, and the ratio of *short-term to total debt*. Bolton and Scharfstein (1996), Gertner and Scharstein (1991) and Berglöf and von Thadden (1994), among others, argue that renegotiations are difficult for firms with many dispersed creditors[12] and with high ratios of public to private and short to long-term debt. The reason is that for a large number of creditors the hold-out problem in renegotiations may be important; banks and institutions are informed well-coordinated sophisticated investors easier to negotiate with; and short-term lenders are less likely to be willing to make concessions which will later benefit long-term lenders. Consistent with these theories, Asquith, Gertner and Scharfstein (1994) and Gilson, John and Lang (1990) find that the probability that an out-of-court restructuring will fail is positively related to the number of bond issues outstanding and to the ratio of the public to private debt in the capital structure. Betker (1995) and Franks and Torous (1994) report that these variables are also negatively correlated with deviations from the APR.

Specifically, *Short debt* is debt in current liabilities divided by the total debt; *Public debt* is the total value of outstanding bonds and other long-term debt identified in Moody's/Mergent manuals as public securities, divided by total debt.[13] To proxy for creditor dispersion, we define the *Number*

[12] Hege and Mella-Barral (2003) show that providing secured lending to a large number of small uncoordinated creditors can make the debt effectively renegotiation-proof.

[13] Close examination of data supplied in Moody's/Mergent manuals reveals that errors and inconsistencies are common. To minimize measurement errors, in the analysis involving the *Public debt* ratio we retain only observations

of bond issues by the firm or its wholly owned subsidiaries at least partially outstanding on the date of trade according to FISD records.[14] Gilson, John and Lang (1990) use the number of entries in the Moody's/Mergent long-term debt section to proxy for the number of distinct creditors classes. However, as Moody's often reports many bond issues under one entry, depending on the firm's disclosure policy, this appears a biased measure. This problem is most severe for large issuers, for which reporting billions of dollars of debt under one entry is a common practice. We believe our variable provides greater accuracy. Following Gilson, John and Lang (1990), we normalize the number of bonds by total debt to measure bond structure complexity per dollar of debt.

We also calculate the *Herfindahl index* of outstanding bond issues. Betker (1995) finds that higher values of this index for firms in restructuring results in higher deviations from the APR in favor of equity. The index is a measure of dissimilarity of face values of public bond issues:

$$Herfindahl_i = \sum_j B_{ij}^2 / (\sum_j B_{ij})^2,$$

where B_{ij} is the face value at offering of the j-th bond of firm i. It equals one when there is a single bond in the capital structure, and becomes arbitrarily small when there are many bonds with similar face values. In actual tests we use $1 - Herfindahl$, which is positively related to renegotiation frictions.

[TABLE I HERE]

C.2. Risk factors unrelated to renegotiation

Our control variables include proxies for non-strategic credit risk, liquidity and systematic market influences. A summary of the independent non-strategic variables is presented in Table I, Panel B. Contingent claims models predict that the firm's financial leverage, volatility of its assets, and the coupon rate are all likely to influence the probability that the firm will be unable to service its debt due to a shortage of funds. We use quasi-market *leverage* calculated as the ratio of the book value of total debt at the end of the previous fiscal year to the sum of book value of debt and closing market value of equity on the business day immediately preceding the date of trade. We also include *Equity volatility* of daily equity returns for a one-year period immediately preceding the trade date to control for the (unobserved) asset volatility. Equity and asset volatility are related through leverage; later in robustness checks we also construct model-implied asset volatility estimates.

for which we can unambiguously identify as private or public more than 90 percent of the total long-term debt.

[14]Our procedure assumes that FISD includes *all* public bonds of the studied firms. The FISD database mostly starts in 1990 and does not include foreign bonds. We however do not expect the possible gaps in the bond universe to significantly bias our results in any particular way.

We include the bond's coupon rate in all specifications; we expect it to be positively correlated with credit risk, since bonds are usually issued close to par and so the coupon rate, as the initial yield, tends to be higher for riskier bonds. Higher coupon levels also increase the probability of a liquidity crisis when net cash flows are low.[15] We use *Log-assets*, the logarithm of total assets, to control for all influences that the firm size may exert on debt spreads. Although credit risk models are typically scale-free, at least two arguments in favor of size control can be put forth. Firstly, more information about large firms is usually available, which may lower the compensation investors require due to informational asymmetries. Also, the bond liquidity may be positively related to the firm's size.[16] We also include the remaining *time to maturity* as of the day of trade to control for the term premium in the corporate bond yield.

It has been predicted theoretically and confirmed empirically that the risk-free interest rates are negatively related to corporate bond spreads.[17] We use the 5-year constant-maturity Treasury rate to control for intra-period variations in the *risk-free rate*. Collin-Dufresne, Goldstein and Martin (2001) show the presence of another systematic factor behind corporate spreads, which they cannot identify. We implicitly control for all such factors by using cross-sectional regressions as in Fama and MacBeth (1973).

D. Sample statistics

Table II presents statistics on corporate bond spreads by rating from AAA to B, for the whole sample, as well as for different maturity groups (1-7, 7-15 and 15-30 years). The mean spread for the whole sample is 109 basis points, and the median is 89 basis points. Average and median spreads are always higher for lower-rated bonds across all maturities. Spreads on bonds of longer maturities are also generally higher. It is interesting to note the large difference between BBB and BB spreads. This may be attributable to lower liquidity of non-investment grade bonds, for example, due to institutional constraints on investing in low-grade bonds.

[TABLE II HERE]

Table III reports statistics by rating on proxies for non-strategic variables that influence credit risk. As one would expect, both leverage and volatility are higher for lower ratings. Leverage

[15] See Leland (1994). It should be noted that the coupon may be a strategic factor in strategic debt service models. For example, in infinite-maturity debt models such as Mella-Barral and Perraudin (1997) concessions are related to the level of coupon payments, as there is no debt principal in these models.

[16] Using our transaction data, we computed the total number and volume of trades by insurance companies over the sample period for each bond and for all bonds of each firm in the expectation that these would proxy for the bond's liquidity. However, these variables were very highly correlated with size. Normalized by total debt, they showed no systematic influence on spreads.

[17] See, for example, Longstaff and Schwartz (1995) for a theoretical model, and Collin-Dufresne, Goldstein and Martin (2001) for empirical evidence.

for different rating classes is somewhat higher but generally consistent with values used in Huang and Huang (2002). The effect of rating on equity volatility may in fact be due to higher leverage, even if the underlying volatility of assets is the same. Interestingly, the standard deviations of these estimates do not vary as much with rating, suggesting that highly rated firms represent a somewhat more diverse group. The table also documents that higher coupons generally correspond to riskier bonds as proxied by rating. The median time to maturity in the sample is between 6.8 and 7.8 years and similar across ratings.

[TABLE III HERE]

Table IV reports summary statistics on all independent variables by trade and by issuer. The per-issuer statistics are calculated by finding a mean value of each variable for each firm, and then reporting statistics for this sample of means. Our issuers have relatively long-term liabilities mostly dominated by public debt. Cantillo and Wright (2000) demonstrate that firms are more likely to issue either public debt or private debt, rather than a mixture of the two. Since our firms necessarily have public bond issues, a median public to total debt ratio of 100% is therefore not surprising; however, the low dispersion may result in the lack of statistical power for the *public debt* proxy. The median issuer's asset size is \$10Bn for the sample of trades, but only \$3.5Bn for the sample of firms. This is attributable to the fact that the sample of trades includes more trades for large companies with many liquid bond issues. The low managerial equity stake (mean of 1.73% for all firms) in fact corresponds to large dollar stakes due to the large average size of companies in our sample. Size also explains the relatively high average institutional shareholding (mean of 57.61% for all firms).

[TABLE IV HERE]

IV. Empirical Results

A. Empirical methodology

In our transaction data set large companies are over-represented due to the large number of bonds they issue, which are also likely to be more liquid and therefore traded more often. Since our main variables of interest are firm-specific rather than trade or bond-specific, such over-representation may potentially bias the results. To avoid the bias, in most of our tests we use at most one trade per firm in any given month by randomly choosing one trade for each issuer in each of the 72 calendar months during the sample period 1994–1999, if there were any such trades in that month. The analysis is then repeated for 100 such random samples. We later find that, while the whole sample and subsamples with one *bond* trade per month are biased towards large issuers, our tests on these subsamples produce results very similar to those obtained when one *firm* trade per month is selected.

The chosen subsamples are unbalanced panels, as most firms do not have their bonds traded every month. We address this issue by using the Fama and MacBeth (1973) estimation methodology.[18] On the first stage, we run a cross-sectional regression for each of the 72 calendar month. On the second stage, the 72 estimated coefficients are regressed on the constant using the Newey-West adjustment to control for serial correlation.

B. Non-strategic risk factors

Table V presents the results of spread regressions on non-strategic variables. Columns (1)–(3) report the results of Fama-Macbeth regressions estimated for all firms, while bonds in regressions (4)–(7) are grouped by rating. For the whole sample, coefficients on both equity volatility and market leverage have the expected signs and are highly significant. Based on specification (3), a one standard deviation increase in market leverage increases spreads by about 25 basis points; a one standard deviation increase in equity volatility increases spreads by about 11 basis points. There is also a statistically significant term premium in spreads of about 1 basis points per year of maturity. The economic significance of the risk-free rate is small, amounting to about 1 basis point decrease in spread for an increase in the risk-free rate of as high as 4-5 percentage points. However, the statistical significance is notable, especially given that there is little room for the risk-free rate variation within a calendar month. The table also reports a positive and very significant relation between spreads and coupon rates. An increase in coupon of one percent increases spreads by about 12 basis points. Finally, we find credit spreads to be robustly negatively related to the issuer's size, perhaps due to liquidity and information issues.

[TABLE V HERE]

C. Strategic factors and hypothesis testing

The main part of our empirical analysis relates credit spreads to variables which influence strategic actions. We proceed with tests of the hypotheses formulated in Section II. We use in the base case *non-fixed assets*, *managerial shareholding*, and the normalized *number of issues* as main proxies for liquidation costs, equity's bargaining power, and renegotiation frictions. In each regression we control for all non-strategic risk factors discussed in the previous subsection.

[18] We also estimated pooled regressions with monthly dummy variables, with very similar results. While efficient, pooled regressions ignore serial correlation, which may bias estimates and understate standard errors.

Coefficients for these variables come out stable and very significant in all our tests. To conserve space, we do not report them in the tables that follow; full results are available upon request.

The effect of liquidation costs and bargaining power on spreads. Hypotheses 1 and 2 state that higher liquidation costs and bargaining power of equity should result in higher spreads. Because of the effect of these factors on recovery in default, this should be the case irrespective of wether borrowers can or cannot choose whether to default strategically. We first address the impact of liquidation costs, controlling for other relevant characteristics. Columns (1)–(3) of Table VI show that *non-fixed assets*, *market to book* assets, and *R&D* are all positively related to spreads. Thus, consistent with both the recovery effect and the strategic default effect, higher liquidation costs result in higher debt spreads.

A one standard deviation increase in each of the three variables increases spreads by about 3 basis points. The contribution of each variable to the *level* of spreads (as opposed to its *variation*) can be calculated assuming that the value of zero corresponds to 'zero liquidation costs'; in this case the average contribution can be estimated as the product of the coefficient and the mean value of the variable. Using this approach, the contribution of non-fixed assets, the market to book ratio, and R&D is 8, 4, and 3 basis points, respectively, with the combined impact of about 15 b.p.

Table VI also shows that both managerial and institutional share ownership are positively correlated with spreads, and the coefficients are highly significant in nearly all specifications. In our experiments these two variables proxy for equityholders' bargaining power in potential renegotiations. In most specifications, the marginal contribution of a one standard deviation increase in these variables is between 1 and 3 basis points.

The signs and significance of the coefficients confirm the predictions of Hypotheses 1 and 2 that higher liquidation costs and equity's bargaining power should result in higher spreads. As such, they suggest that strategic actions influence credit spreads, and accounting for them may improve both the predictive power of theoretical models of credit risk, and the fit in empirical studies of spreads. On the other hand, the quantitative impact of the proxies is modest and is well below the round-trip transactions costs in corporate bond markets of about 27 basis points reported by Schultz (2001).

[TABLE VI HERE]

Strategic default versus bargaining in default. The impact of liquidation costs and bargaining power on spreads may be consistent with both the recovery effect in default and the strategic debt service hypothesis. To discriminate between the two competing explanations, we now turn to tests of Hypothesis 3, which is the central hypothesis in our study. It states that if the influence of strategic actions on spreads is mostly due recovery rates being determined in bargaining, then renegotiation frictions should unambiguously increase spreads, while if strategic default is important, the resulting impact depends on which effect dominates.

Table VI reports that all four proxies for renegotiation frictions we use significantly influence spreads. For all the proxies spreads are higher when renegotiation is easy. We interpret the negative correlation of spreads with frictions as evidence that in our sample the possibility of strategic default is more important for debt spreads than the possibility of avoiding liquidation costs in renegotiation. Thus, contingent claims models which allow for strategic debt service may indeed capture important features of debt markets ignored in models with exogenous default.

Consistent with this strategic default hypothesis, all coefficients for renegotiation frictions proxies have negative signs and are significant at the 1% level. However, the magnitude of the effect reflected in the coefficient values for the whole sample is not very high. A one standard deviation increase in the *number of issues* decreases spreads by 2–6 basis points, while the marginal impact of the *Herfindahl* index is 3 b.p., of the proportion of *short-term debt*, 8 b.p., and of the proportion of *public debt*, 5 b.p. The contribution of the possibility of renegotiation to the average level of spreads can be estimated by multiplying the coefficients by the average value of the variables re-normalized so that their values of zero correspond to the case of no renegotiation.[19] This contribution equals 3 basis points for both the *Herfindahl* index and the proportion of *public debt*. For the *short-term debt* it is much higher at 41 b.p., but we do not believe this can be interpreted as the contribution of the strategic threat to the level of spreads, because one can hardly assume that when all the debt in the firm is short-term, it is renegotiation-proof.[20]

The reported magnitudes of the effect of strategic default are certainly considerably less than those predicted for extreme cases in models like Anderson and Sundaresan (1996) and Mella-Barral and Perraudin (1997) where all the bargaining power is assumed to belong to equity. The results are more consistent with the assumption that creditors on average also have considerable bargaining power, resulting in a positive recovery effect for debt which partly offsets the strategic default effect. Taken at face value, these findings suggest that, while models of strategic debt service are relevant empirically, they cannot fully remedy the poor empirical performance of traditional models. There must be factors behind credit spreads other than credit risk, even when the probability of default and the recovery rate are adjusted to account for strategic debt service by borrowers.

[19] *Herfindahl*=0, *short debt*=1, and *public debt*=1 correspond to largest frictions as measured by these variables, and therefore the smallest effect of the possibility of renegotiation.

[20] By contrast, dispersedly held public debt may be impossible to renegotiate; see Hege and Mella-Barral (2003).

D. *Sensitivity of strategic actions under different conditions*

Bargaining power and spread sensitivity to renegotiation. We proceed to establish under what conditions the effect of strategic actions on spreads is likely to be more pronounced. Hypothesis 4 specifies how the impact of strategic debt service depends on the distribution of bargaining power. It states that the product of equity's bargaining power and renegotiation frictions should be negatively related to spreads. This is because as equity's power increases, the negative strategic default effect becomes dominant over the positive recovery effect. Columns (1)–(4) of Table VII confirm that this appears to be the case in our sample: the cross-terms of *non-fixed assets* and three of the proxies for renegotiations frictions are negative, and two of them significant. The cross-term with the fourth proxy, *public debt*, in specification (4) is positive, but insignificant. Overall, we find evidence supporting Hypothesis 4 that the impact of renegotiation on debt values is more adverse when creditors lack bargaining power in renegotiations.

[TABLE VII HERE]

Liquidation costs and spread sensitivity to strategic actions. Finally, we test Hypothesis 5 about the influence of liquidation costs on the importance of renegotiation and the distribution of bargaining power. With a decrease in liquidation costs the importance of strategic actions is expected to decrease, as there is less surplus to bargain over. Hypothesis 5 predicts that the product of liquidation costs with bargaining power and renegotiation frictions should have the same signs as the coefficients for those variables themselves, as higher liquidation costs amplify their effect. Columns (5)–(9) of Table VII report the results of the tests. In column (5), the cross-term is *Managerial shareholding * Non-fixed assets*. It is positive and significant. Thus, higher liquidation costs make the adverse impact of equity's bargaining power on spreads more pronounced. The cross-terms in columns (6)–(7) are between *non-fixed assets* and the four proxies for renegotiation frictions, expected to be negative. Indeed, three of the four cross-terms are negative, although only one is significant. The last one, in column (7), is positive, small and insignificant.

Overall, our findings are generally supportive of Hypothesis 5. As a general pattern, these tests show that the adverse effect of strategic default on debt spreads is higher when the bargaining position (bargaining power and the outside option) of the debtholders is likely to be weak in renegotiation. In particular, this is the case when managers have high equity stakes, and when the proportion of fixed assets that cannot be easily destroyed if renegotiations fail is low.

E. *The effect of bond ratings*

In the capital markets credit ratings are among the most important factors determining corporate bond prices. Credit rating agencies' decisions reflect a variety of factors unlikely to be fully captured by our measures of leverage and volatility. For most market participants, the credit rating process is often like a black box which provides a measure of the default risk summarized in the rating. In our tests in this section, we treat ratings in this manner, and study the effect of our strategic and non-strategic variables for different rating groups. Admittedly, a part of the credit risk captured in ratings but not the leverage/volatility-type variables must be due to strategic default. We hope to capture the variation of the importance of strategic debt service within rating classes.

We classify spreads in the sample into rating classes as of the day of trade. We first estimate regressions of spreads on non-strategic variables when the sample is stratified by rating. The results of these regressions are shown in Columns (4)–(7) of Table V. All variables have the same signs as before and are generally still highly significant. Coefficients for leverage, volatility, the size of the issuer, and bond maturity are generally both higher and more significant for lower-rated companies, in part due to higher average spreads. The explanatory power of these regressions is very similar across the first three rating groups; for junk bonds it is considerably higher, perhaps reflecting the higher relative importance of expected default losses for riskier bonds. It is interesting to note that the coupon rate remains highly significant even after controlling for rating.

We then estimate the effect of our strategic proxies on spreads for two groups of bonds: rated A and higher, and BBB and lower.[21] Our expectation is that strategic debt service should not influence spreads much for high ratings, since default (including strategic default) is a relatively less important determinant of spreads for these bonds. However, conditional on higher probability of default, both the incentives to default strategically are higher (as equityholders have little to lose when default is imminent anyway), and the expected recovery rate is also more important. The latter may be especially true when default is unavoidable, in which case the introduction of renegotiation should lower spreads.

Specifically, we include in our regressions the *high grade* dummy which equals one if the bond's rating is A or above, and zero otherwise. For each regression specification we interact this dummy with all the independent variables. Table VIII presents the results of these tests. For all our strategic proxies the effect is higher for lower-rated bonds, and except for managerial equity ownership the difference is always significant. Moreover, the values of the coefficients suggest that, while the effect may be considerable for low-grade bonds, for high-grade bonds it may be close

[21] We combine bonds in this way because there are not enough observations to study lowest and highest rating classes separately.

to zero. For example, the coefficient for the proportion of non-fixed assets in specification (1) is 0.13 for the whole sample, but much smaller (-0.02) for high-grade bonds. Similar patterns are also found for other specifications and other strategic variables. The only exception is managerial shareholding, which is insignificant but still shows the same general pattern.

It may be instructive to compare regressions (1)–(4) in Table VIII with regressions (1) and (5)–(7), respectively, in Table VI. The coefficients for liquidation costs become somewhat smaller, and for bargaining power insignificant, once we partially control for the strategic default by using the credit rating. This reinforces our conclusion that the strategic default effect dominates the recovery effect in our sample, because at the level of aggregation that we use the expected recovery rates have very little impact on ratings. Overall, we conclude that, while for high-quality bonds strategic variables are economically insignificant, their influence is more pronounced for lower-rated bonds.

[TABLE VIII HERE]

V. Robustness and alternative interpretations

A. Alternative interpretations

One can argue that, since our variables proxy only imperfectly for the strategic factors we want to study, their observed correlation with spreads may be spurious. Below we discuss potential alternative channels of influence of our proxies for bargaining power and renegotiation frictions on spreads, and argue that they cannot explain our findings.

Managerial shareholding: (Positive correlation with spreads) Managerial share ownership may change the firm's attitude towards risk. If managers' portfolios are overweight in their firms' equity, managers may attempt to decrease the volatility of cash flows by hedging at the firm level and adopting low-risk projects. This should decrease the riskiness of the bonds and result in lower spreads, contrary to what we find. Only for low-quality firms for which asset substitution may be a problem would we expect to see a positive correlation between managerial share ownership and risk. However, as evidenced in Table VIII, the impact of managerial shareholding is not systematically different for low and high-rated firms. Another possibility is that managerial share ownership is important because of its disciplining role on management. This conjecture cannot explain our finding either, because better corporate governance in firms with high managerial shareholding should, if anything, increase the value of debt and result in lower spreads.

Managerial shareholding: (Positive correlation) Institutional shareholding may be somewhat negatively correlated with risk, as some institutions cannot invest in very risky companies. However, in this case we would expect a negative correlation with spreads.

Number of bond issues/total debt: (Negative correlation) When the number of the firm's bond issues is high, all its bonds may be more liquid, resulting in lower spreads. This would be consistent with the negative correlation that we document. However, it is not clear that the *per dollar* number of bonds that we use should be positively related to liquidity. Moreover, more direct proxies for bond liquidity, such as the number and volume of bond and firm trades, come out insignificant in our regressions. We therefore do not believe that liquidity is the reason for the observed correlation of the normalized number of bonds with spreads.

Short-term/total debt: (Negative correlation) Higher short-term liabilities may imply a higher probability of a liquidity shortage, since a higher proportion of cash flows is used for day-to-day debt service. This should result in higher spreads, contrary to our findings.

Public/total debt: (Negative correlation) A higher proportion of privately held debt should result in more monitoring of the company by sophisticated investors, which should benefit all creditors and reduce bond spreads rather than increase them.

It should also be noted that all our proxies for renegotiation frictions may also influence the loss of value once the firm is in Chapter 11, due to higher restructuring costs when negotiations are difficult. This would imply lower eventual recovery rates and higher ex ante spreads, contrary to our evidence that higher frictions are associated with lower spreads. To conclude, the direction of the most obvious alternative mechanisms of influence of our proxies on spreads in most cases conflicts with the strategic mechanism hypotheses, and indeed with our empirical findings.

B. Controls for non-linear effects

In structural models of credit risk, leverage and other variables affect spreads in a non-linear way. It is possible that the importance of non-linear terms manifests in our linear regressions through the significance of the strategic proxies. Although Collin-Dufresne, Goldstein and Martin (2001) find that non-linear effects are unimportant for spread changes, we are not aware of such results in the cross-sectional analysis.

To control for possible non-linear effects, we employ the following procedure.[22]. Instead, to We estimated debt spreads implied by the Merton (1974) model, subtracted these spreads from the actual observed spreads, and repeated the analysis on the residual spreads unexplained by the Merton model. While the degree of non-linearity admittedly varies across structural models,

[22]The usage of higher order terms is impeded by multicollinearity

there is no any prior justification to prefer any model in particular. The estimation that uses the Merton model is likely to perform no worse or better than any other structural model since the most important spread determinant, asset volatility, needs to be estimated for every model.

The volatility of the firm's assets for the use in the Merton model is not observable and therefore has to be estimated. We used the calibration approach which is a simplified version of that used by KMV corporation. As inputs, the procedure uses a year-long time series of equity values and debt amounts outstanding, the latter taken to be the debt face value in the Merton model. These inputs are used to find a time series of asset values which: 1) makes the Merton-predicted equity values for the last year consistent with the observed equity prices, and 2) has the volatility which is assumed in these Merton equity value calculations. As a check, we also used equity volatility; not surprisingly, we found that this made our results slightly stronger.[23]

We then use the estimated asset volatility values to calculate the residual spread unexplained by the Merton model. Consistent with our expectations, leverage is no longer a significant determinant of the spread once the Merton spread is taken out. The coefficient for equity volatility actually changes its sign, suggesting 'overcompensation' by the Merton model, which is very sensitive to volatility estimates. However, none of our main conclusions is altered, and most of our strategic variables are even more significant in these tests.

C. Robustness to specification and regressor measurement frequency

We have checked the robustness of our results by using different proxies for liquidity, volatility, maturity and risk-free rates. Instead of using log-assets as a proxy for liquidity, we use log-sales, as well as the total number of trade observations for the firm (also counting callable and all other bonds excluded in our spread sample selection) as measures of liquidity. For equity volatility estimates we use horizons of 6 months, 1 and 3 years. We also use model-implied *asset volatility* estimates as described in the previous subsection.Instead of maturity, we also use bond duration calculated using the estimated yield to maturity. Finally, we use both short-term and longer-term risk-free interest rates as other proxies for the risk-free rate. None of our results have been significantly affected by these changes.

In our tests, we use one observation per firm to avoid a bias towards large firms with many trades. However, in doing so we may introduce a 'reverse' bias against firms with many bonds, and lose efficiency by considering only a subsample of the data. We repeat the analysis by randomly selecting one bond (rather than firm) trade per month; the results are unaltered in all cases, and even somewhat stronger due to a larger number of observations. We find that in such random samples some weakly significant and insignificant coefficients for renegotiation proxies in tests of

[23] The KMV calibration approach is described in, for example, Crosbie and Bohn (2001). The details of our implementation and all the unreported tables are available from the current authors upon request.

Hypotheses 4 and 5 changed signs and became insignifcant/significant. Overall, our main results appear robust to these changes.[24]

Corporate spreads employed in our empirical analysis are recorded within a few days form the trade date. While some independent variables we use are also measured as of the day of trade, leverage and a number of other variables use COMPUSTAT data recorded on an annual basis.[25] We explore whether the quality of the explanatory variables is sufficient for our purposes by studying only trades executed within three months after the issuer's fiscal year end, before annually reported variables become stale. The results we obtain are very similar to the base case.

D. The endogeneity problem

One potential problem with our inference is the possibility that our renegotiation friction proxies are determined endogenously and depend on credit spreads. One may argue, for example, that when credit spreads are consistently low the firm may want to increase its public debt issuance, and the number of bond issues increases as a result.

Ideally, one would like to find a set of instrumental variables that affect credit spreads only indirectly through their influence on renegotiation proxies, and are themselves independent of the spreads. Finding such instruments is difficult in our case, as variables which influence capital structure are also likely to affect spreads directly.[26]

To mitigate possible effects of endogeneity, we normalize some of our proxies by total debt. While lower credit spreads may result in higher public bond issuance and a higher numbers of bond issues as a direct consequence, the number of issues *per dollar of debt* is likely to be less endogenous to the credit spread. Moreover, for the ratio of short to total debt we expect the effect of endogeneity to work in the opposite direction to what we find: If bond spreads are low, the firm would tend to issue more public debt which usually has longer maturity, thereby decreasing the proportion of short-term debt. In our regressions, however, spreads are negatively correlated with the short to total debt ratio. Finally, it is hard to think why managerial and institutional shareholding could be endogenous to bond spreads. Given the remarkable consistency of our results across proxies and experiments, we believe that they are unlikely to be driven by endogeneity.

[24]Robustness regression results are available upon request.

[25]While some variables can be constructed on a quarterly basis, the proportion of public debt and some other important variables are only available to us annually.

[26]In their study of the diversification discount, Campa and Kedia (2002) take into account the endogeneity of the firm's decision to diversify using industry as an instrument. They remove the direct influence of industry on the dependent variable by subtracting the industry mean. We attempted to use a similar method, grouping firms by industry (in another experiment, by size), subtracting mean spreads for each group, and then using industry (size, respectively) as an instrument for the choice of debt structure. However, neither industry nor size appeared to be valid instruments, as even such robust determinants of spreads as leverage and volatility lost their significance.

VI. Concluding Remarks

Recent contingent claims models of risky debt with strategic debt service argue that strategic considerations may be an important determinant of corporate debt spreads. A large body of theoretical corporate finance research explicitly or implicitly relates valuation of corporate debt to renegotiation and bargaining in restructuring. Available empirical evidence, however, has been limited to studies of the implications of ex-post bargaining for recovery rates in default. This paper for the first time empirically documents the influence that strategic behavior of the borrowers has on ex-ante corporate debt prices.

We conduct an empirical study of the determinants of corporate spreads using a large sample of transaction prices. We use capital and debt structure complexity as well as equity ownership variables and measures of asset tangibility to proxy for renegotiation frictions, bargaining power, and liquidation costs. Our main finding is that corporate bond prices do appear affected by the possibility of ex-post debt restructuring, especially when the costs of liquidation and equityholders' bargaining power are likely to be high, capital structure does not make renegotiation difficult, and the credit quality of the issuer is relatively low.

Our results suggest that, unless the firms' debt structure is already optimally chosen taking into account all relevant trade-offs, companies for which the adverse effect of strategic debt service on spreads is substantial may be able to reduce their cost of borrowing if they commit against strategic default. This can be achieved by increasing the complexity of public debt and the proportion of short-term and public debt in the capital structure. In reality, changes in capital structure involve paying transaction costs that need to be weighed against the benefits in terms of the cost of capital. Whether such commitment is likely to create value is an open question and awaits further research.

On balance, the low economic significance of strategic variables that we document implies that strategic debt service is unlikely to be entirely responsible for the poor empirical performance of traditional contingent claims models. To match the observed levels of spreads, other factors must be incorporated into the existing paradigms.

Appendix A The model and hypothesis derivation

We modify the Merton (1974) model of risky debt to allow for varying distributions of bargaining between different parties, and for renegotiation which may be relatively easy or difficult. The Merton model makes a number of simplifying assumptions that make applying it for debt pricing problematic. However, our purpose is to use the model to derive qualitative hypotheses for empirical tests, rather than quantitatively predict debt prices. For this purpose the model presents the simplest equilibrium framework which allows to analyze the effects of main strategic and risk variables.

Consider a firm with a single zero-coupon bond with a face value of B and maturity T in the capital structure. Let V_T be the value of assets upon bond maturity. Suppose that liquidation costs of $K < B$ must be paid if the parties are to settle their claims in court, which distributes assets according to the absolute priority rule (APR). Absent renegotiation, such costs will be incurred whenever $V_T < B$. If, however, renegotiation is possible, the parties may attempt to avoid value dissipation and renegotiate the debt contract rather than go to the court, dividing the surplus according to their bargaining power. Suppose further that, once renegotiations are started, they may fail with some probability q due to exogenous factors, in which case the claims will be settled in court at a cost K according to the APR.

It is easiest to think of such renegotiation framework as corresponding to out-of-court restructuring, which may be unsuccessful with some probability, resulting in costly liquidation. Empirical studies document that firms often attempt informal workouts and exchange offers before resorting to formal bankruptcy. However, if there are many creditors with widely divergent interests, such workouts may fail, which is often observed in practice.

Technically, assume that the value of the firm's assets follows an exogenously specified stochastic process, and that upon maturity the value of assets has a cumulative distribution $F(V_T)$ and density $f(V_T)$ under the equivalent martingale measure. Suppose that the costs of liquidation are $K(V_T) = \min\{V_T, K\}$, where $K < B$. Suppose that renegotiation may be possible. At maturity, after V_T is observed, equityholders decide whether they want to serve the debt as stipulated in the original contract, or attempt renegotiation by offering a different level of debt service. In the latter case, even if the proposed level of debt service is such that debtholders agree to renegotiate, renegotiation nevertheless fails with probability q, in which case the costs of $K(V_T)$ are paid, and the remaining assets of the firm are distributed according to the APR. Further, assume that the bargaining process is such that if the proposed renegotiations are successful, the surplus relatively to the case when they fail (which equals $K(V_T)$) is divided between equity and debt in proportions θ and $1 - \theta$, so that the renegotiated payoffs are the after-cost APR payoffs plus these surplus shares. This specification corresponds to a Nash bargaining game with the court-administered APR outcome as the point of disagreement, and the sharing rule θ following from the distribution of the bargaining power between equity– and debtholders. Throughout what follows, we will simply refer to θ as the bargaining power of equity for brevity.

As derived below, the date 0 value of the bond is given by:[27]

$$D_0 = e^{-rT}\left[\int_0^{\bar{V}} \left(V_T - (q + \theta - q\theta)\min\{K, V_T\}\right) dF + \int_{\bar{V}}^{\infty} B\; dF\right], \tag{A1}$$

where

$$\bar{V} = B + (1-q)\theta K. \tag{A2}$$

The optimal strategy for shareholders is to renegotiate whenever $V_T < \bar{V}$, and to repay the full principal B when $V_T > \bar{V}$. Strategic debt service occurs when $B \leq V_T \leq \bar{V}$. In this region equityholders propose renegotiations even though the value of assets is enough to repay B in full. Observe that the payoff to debt as a function of V_T experiences a jump at $\bar{V}$ from $B - qK$ to B. If ex-post $B \leq V_T \leq \bar{V}$, then debtholders are always worse off compared to the case when

[27] One can assume a specific form of $F(\cdot)$ to obtain closed-form expressions for D_0. However, for our purposes the hypotheses remain invariant to different distributional assumptions.

no renegotiation is possible. If, on the other hand, $V_T < B$, then because no liquidation costs are paid the debtholders are better off, depending on their bargaining power. The overall ex-ante effect of the possibility of renegotiation on the debt value depends on the bargaining power θ, liquidation costs K, the initial leverage $w = D_0/V_0$, and the distribution of assets $F(V_T)$.

The model incorporates three special cases. Firstly, for $K = 0$, and for any $0 < K < B$ when $q = \theta = 0$, the model is equivalent to the standard Merton model. These two cases correspond, respectively, to costless liquidation as assumed in Merton (1974), and to frictionless renegotiation when the surplus fully accrues to debtholders. Secondly, when $q = 1$, the model reduces to the Merton model with bankruptcy costs of K. Thirdly, when $q = 0$ and $\theta = 1$, the model is equivalent to the one-period case of the Anderson and Sundaresan (1996) model of strategic debt service when renegotiation is costless and equity expropriates all the surplus.

Formula (A1) can be used to derive predictions about the influence of strategic factors on the promised debt spread $s = \frac{1}{T} \ln \frac{B}{D_0}$. Let us introduce the following additional notation:

$E^0(V_T) = \max\{0, V_T - B\}$: equityholders' payoff when renegotiation is impossible

$D^F(V_T) = \min\{V_T - K(V_T), B\}$: debt's payoff when renegotiation fails

$E^F(V_T) = V_T - K(V_T) - D^F(V_T)$: equity's payoff when renegotiation fails

$D^S(V_T) = D^F(V_T) + (1-\theta)K$, $E^S(V_T) = E^F(V_T) + \theta K$: debt's and equity's payoffs in successful renegotiations (Nash bargaining solution)

Equityholders' expected payoff if they propose renegotiation is:

$$
\begin{aligned}
E^R(V_T) &= (1-q)E^S(V_T) + qE^F(V_T) \\
&= (1-q)\left[E^F(V_T) + \theta K(V_T)\right] + qE^F(V_T) \\
&= V_T - K(V_T) - \min\{V_T - K(V_T), B\} + (1-q)\theta K(V_T) \\
&= \max\{0, V_T - B - K(V_T)\} + (1-q)\theta K(V_T).
\end{aligned}
$$

Equityholders propose renegotiation if and only if $E^R(V_T) \geq E^0(V_T) = \max(V_T - B, 0)$. This yields the renegotiation condition:

$$
V_T \leq \bar{V} \equiv B + (1-q)\theta K. \tag{A3}
$$

Clearly, under Nash bargaining debtholders never reject proposed renegotiations. Their expected payoff in equilibrium equals the contract-specified B whenever $V_T > \bar{V}$. If $0 < V_T \leq \bar{V}$:

$$
\begin{aligned}
D_T(V_T) &= \left[(1-q)D^S(V_T) + qD^F(V_T)\right] \\
&= \left[D^F(V_T) + (1-q)(1-\theta)K(V_T)\right] \\
&= \left[V_T - (q + \theta - q\theta)\min\{V_T, K\}\right].
\end{aligned}
$$

The date 0 value of the debt is the expectation of the payoff under the equivalent martingale measure:

$$\begin{aligned} D_0 &= e^{-rT}E^*\left[D_T(V_T)\right] \\ &= e^{-rT}\left[\int_0^{\bar{V}} V_T\ dF + \int_{\bar{V}}^{\infty} B\ dF - (q+\theta-q\theta)\left(\int_0^{K} V_T\ dF + \int_K^{\bar{V}} K\ dF\right)\right] \\ &= e^{-rT}\left[\int_0^{\bar{V}} (V_T - (q+\theta-q\theta)\min\{K, V_T\})\, dF + \int_{\bar{V}}^{\infty} B\ dF\right]. \end{aligned}$$

which is formula (A1). Next, we prove Hypotheses 1–5.[28] Define $D = D_0 e^{rT}$.

Hypothesis 1

$$\frac{\partial D}{\partial K} = -\int_0^{\bar{V}} (q+\theta-q\theta)dF - q(1-q)\theta K f(\bar{V}) < 0.$$

Hypothesis 2:

$$\frac{\partial D}{\partial \theta} = -\int_0^{\bar{V}} (1-q)\min(K, V_T)dF - q(1-q)K^2 f(\bar{V}) < 0.$$

Hypothesis 3: The probability of default $P = \int_0^{\bar{V}} dF$. Therefore:

$$\frac{\partial P}{\partial q} = -\theta K f(\bar{V}) < 0.$$

Conditional on default, the recovery rate is:

$$\rho = \frac{\int_0^{\bar{V}} (V_T - (q+\theta-q\theta)\min(K, V_T))\, dF}{F(\bar{V})},$$

and so

$$\frac{\partial \rho}{\partial q} = \frac{-\int_0^{\bar{V}} (1-\theta)\min(K, V_T)dF \cdot F(\bar{V}) - \theta K f(\bar{V})\rho}{F(\bar{V})^2} < 0.$$

Hypothesis 4: The following assumptions are sufficient for the result to hold.

Assumption 1: $f(V_T)$ is an increasing function in the neighborhood of $\bar{V}$.

Assumption 2: $q \geq \frac{1-2\theta}{2(1+\theta)}$.

Assumption 1 places restrictions on the convexity of function F near $\bar{V}$. Assumption 2 excludes

[28] Hypotheses are derived for debt prices rather than spreads, which results in changing the signs of the derivatives.

cases where q and θ are simultaneously small.

$$\frac{\partial^2 D}{\partial q \partial \theta} = \int_0^{\bar{V}} \min(K, V_T) dF + qK^2 f - (1-\theta)(1-q)K^2 f.$$

Using Taylor's expansion and Assumptions 1–2:

$$\frac{\partial^2 D}{\partial q \partial \theta} > qK^2 f - (1-\theta)(1-q)K^2 f + K^2 f(1-q)\theta = 2(q+\theta+q\theta) - 1 > 0.$$

Hypothesis 5:

$$\frac{\partial^2 D}{\partial K \partial \theta} = -\int_K^{\bar{V}} (1-q) dF - 2q(1-q)Kf - (1-q)^2 \theta K f < 0.$$

This establishes the first part of the hypothesis. For the second part the following assumptions are sufficient:

Assumption 1: $f(V_T)$ is an increasing function in the neighborhood of $\bar{V}$.

Assumption 2: $q \geq \frac{1-\theta}{2+\theta}$.

Assumptions play the same role as in Hypothesis 4.

$$\frac{\partial^2 D}{\partial q \partial K} = -\int_K^{\bar{V}} (1-\theta) dF + 2q\theta K f - (1-\theta)\theta(1-q)Kf.$$

Using Assumptions 1–2 and Taylor's expansion,

$$\frac{\partial^2 D}{\partial q \partial K} < -2Kf\theta(q - (1-\theta)(1-q)) < 0.$$

Appendix B Details of the Spread Estimation Procedure

For each observation retained in the sample we calculate the accrued interest for the settlement day. A problem with the dataset that we use (bond trades recorded by the National Association of Insurance Commissioners) is that insurance companies may choose the day they record as the settlement day themselves.[29] Therefore, some prices could be observed on trading days, while others on settlement days. Furthermore, in the U.S. corporate bond market settlement days may vary and depend upon the agreement of parties. We treat all trades as if they occurred on the settlement day. Potential errors caused by doing so are mitigated when we calculate spreads as discussed below. Numerical simulations suggest that while the magnitude of potential errors is very small for the majority of cases, it becomes relatively more important for very short maturity bonds with large coupon. We deal with this by excluding from the sample all bonds which have less than 1 year to maturity at the date of trade.

[29] This became apparent after comparing the calendar accrued interest and accrued interest recorded in the data set. We can not use the latter since it is given only for buy transactions.

Two main day-count conventions used in the corporate bond market are actual/actual and 30/360. The accrued interest is calculated therefore as $AC = \frac{t-\tau}{T}\frac{c}{f}$, where $t - \tau$ is the period in days between settlement date and the last coupon date (using the specified convention), T is either 360 or 365 (366 for leap years), c is the annual coupon payment, and f is the frequency of interest payments.[30]

Next, using the invoice price of the bond (equal to the flat price recorded in the NAIC plus accrued interest) and cash flows structure in the FISD, we calculate the annual yield to maturity of the bond.

On the second stage of the estimation we obtain the yield to maturity on a portfolio of risk-free zero-coupon bonds that replicates the promised stream of cash flows from the corporate bond using STRIPS yields at the trade date. STRIPS have quarterly or semiannual seasonal cycles with maturities on 15th of February, May, August and November.[31] We replicate each cash flow using linear approximation technique. In particular, if T_0 is time to maturity of a corporate bond payment, and T_{-1} and T_1 are the maturities of two sequential zero coupon bonds with shorter and longer maturity respectively and yields y_{-1} and y_1 respectively, the yield on this cash flow is

$$y_0 = y_{-1}\frac{T_1 - T_0}{T_1 - T_{-1}} + y_1\frac{T_0 - T_{-1}}{T_1 - T_{-1}}.$$

Discounting each cash flow by resulting risk-free rate gives the price of the constructed government bond with matched cash flows. Using this invoice price, we estimate yield to maturity using the same formula as for the corporate bond. Finally, subtracting the matched risk-free yield to maturity from the corporate bond yield gives the corporate bond spread.

[30] There are bonds making payments 2, 4 and 12 times a year in our final sample as well as zero coupon bonds.

[31] The U.S. Treasury used to issue 30-year bond quarterly. It changed the issuance cycle of these bonds recently to semi-annual. Therefore, for very long term maturities the period between STRIPS' maturity is half a year and for all others it is three months.

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Table I. Independent variables

The table describes independent variables used as explanatory variables for credit spreads. FISD is Fixed-Income Securities Database provided by LJS Global Information Systems. CRSP is University of Chicago's Center for Research in Security Prices database. Moody's/Mergent refers to the long-term debt section of printed Moody's/Mergent Industrial and OTC manuals. CDA/Spectrum refers to the dataset of institutional quarterly holdings taken from SEC forms 13F.

Variable	Factor	Description	Source
		Panel A: Proxies for strategic factors	
Non-fixed assets	Liquidation costs	(Book total assets – Net property, plant and equipment)/ Book total assets	COMPUSTAT
Market to book	Liquidation costs	(Market value of equity + Book value of debt)/Book total assets	CRSP and COMPUSTAT
R&D	Liquidation costs	Research and development expenses divided by total investment	COMPUSTAT
Managerial shareholding	Equity's bargain. power	Percentage of total equity owned by 5 highest paid executives	ExecCOMPUSTAT
Institutional shareholding	Equity's bargain. power	Percentage of total equity owned by institutional investors	CDA/Spectrum
No. of bond issues	Renegotiation frictions	Number of bond issues of the issuer outstanding on trade date	FISD
1 – Herfindahl index	Renegotiation frictions	$1 - \sum_j B_j^2/(\sum_j B_j)^2$, where B_j is the face value of bond j	FISD
Short debt	Renegotiation frictions	Short-term debt divided by total debt	COMPUSTAT
Public debt	Renegotiation frictions	Public bonds and other public debt divided by total debt	Moody's/Mergent
		Panel B: Non-strategic variables	
Leverage	Credit risk	Book debt/(Book debt + Market equity on trade date)	CRSP and COMPUSTAT
Equity volatility	Credit risk	Volatility of daily equity returns over one year before trade date	CRSP
Coupon	Credit risk	Coupon rate on the bond	FISD
Assets	Liquidity, Information	Book value of total assets	COMPUSTAT
Maturity	Term yield	Remaining time to maturity as of trade date	FISD
Risk-free rate	Systematic factor	5-year constant-maturity Treasury rate	Fed Board of Governors

Table II. Summary Statistics on Credit Spreads

This table reports summary statistics on credit spreads for straight fixed-coupon corporate bonds in the industrial sector over the period 1994–1999 by rating. Panel A reports statistics for all maturities. Panels A, B, and C report statistics for bonds with 1-7, 7-15, and 15-30 years remaining until maturity as of the trade date, respectively. The benchmark risk-free yield is the yield on a cash-flow-matched portfolio of STRIPS. Details of the procedure for estimating spreads is given in Section B. and Appendix C. Ratings are reported using the S&P convention as of the trade date. The spreads are given in annualized yield in basis points.

	All	AAA	AA	A	BBB	BB	B
Panel A: Spreads for all maturities							
Mean	109	48	55	81	120	223	400
Median	85	49	51	71	103	197	334
Std. Dev.	119	34	40	53	140	143	310
5% quantile	36	15	20	35	54	96	102
95% quantile	263	90	102	156	230	398	806
N	43402	192	3969	19238	15585	3910	508
Panel B: Spreads for maturity 1-7 years							
Mean	105	38	56	77	115	220	412
Median	79	40	50	66	95	192	326
Std. Dev.	151	29	47	61	194	164	380
5% quantile	33	9	18	32	48	84	99
95% quantile	271	79	105	157	235	410	1150
N	19857	100	1741	9084	6988	1650	294
Panel C: Spreads for maturity 7-15 years							
Mean	104	43	51	74	115	220	385
Median	82	45	49	67	98	195	358
Std. Dev.	86	16	30	42	67	130	157
5% quantile	36	20	18	35	60	102	105
95% quantile	257	67	89	137	212	385	675
N	16139	11	1776	6707	5822	1634	189
Panel D: Spreads for maturity 15-30 years							
Mean	128	60	71	103	143	235	386
Median	109	58	65	92	126	208	310
Std. Dev.	78	37	36	44	70	118	267
5% quantile	56	30	33	57	81	124	126
95% quantile	253	94	136	181	242	388	1014
N	7406	81	452	3447	2775	626	25

Table III. Summary Statistics on Credit Risk Variables

This table reports summary statistics on non-strategic risk determinants for straight fixed-coupon corporate bonds in the industrial sector over the period 1994–1999 by rating. Leverage is the ratio of book value of debt to the book value of debt plus the market value of equity on the last business day before the trade date. Equity volatility is the annualized volatility of daily share price returns over 252 business days before the trade date. Maturity is the remaining time to maturity on the trade date. Ratings are reported using the S&P convention as of the trade date. Leverage, equity volatility, and coupon rate are in %, maturity is in years.

	All	AAA	AA	A	BBB	BB	B
Panel A: Leverage							
Mean	32.24	11.54	14.80	28.80	36.70	45.76	65.58
Median	30.28	5.19	13.40	26.16	36.04	44.01	64.57
Std. Dev.	18.10	17.29	9.13	17.11	15.57	17.34	16.21
5% quantile	7.31	1.46	4.08	7.24	13.59	17.09	39.30
95% quantile	66.71	50.35	33.11	66.82	63.33	78.22	95.66
Panel B: Equity volatility							
Mean	33.85	29.78	30.05	32.01	34.88	40.27	53.07
Median	29.32	24.71	26.98	27.06	30.47	37.57	49.92
Std. Dev.	17.38	14.38	12.23	14.68	20.80	14.56	22.70
5% quantile	17.25	17.36	16.91	16.43	18.38	23.41	20.91
95% quantile	65.81	58.77	58.35	64.77	67.21	71.79	99.11
Panel C: Coupon rate							
Mean	7.57	6.98	7.18	7.33	7.76	8.15	9.20
Median	7.38	6.95	7	7.13	7.50	7.95	9.38
Std. Dev.	1.20	0.59	1.05	1.12	1.15	1.31	1.57
5% quantile	5.88	5.90	5.60	5.78	6.25	6.75	7
95% quantile	9.75	7.88	8.88	9.50	9.88	10	10.88
Panel D: Maturity							
Mean	9.43	13.69	8.77	9.56	9.51	9.29	6.73
Median	7.49	6.82	7.57	7.33	7.62	7.79	6.40
Std. Dev.	7.15	12.38	6.09	7.55	7.09	6.04	3.89
5% quantile	1.96	1.13	2.17	1.87	1.99	2.69	2.06
95% quantile	27.28	29.73	25.32	27.92	27.25	25.29	13.89
N (all panels)	43402	192	3969	19238	15585	3910	508

Table IV. Summary Statistics on Independent Variables

This table reports summary statistics on independent variables for the whole sample of trades, and by firm. Statistics by firm are calculated by finding a mean value of each variable for each firm, and then averaging the means across firms. *Non-fixed assets* is total assets less net property, plant and equipment divided by total assets. *Market to book* is the ratio of the quasi-market value of assets to their book value. *R&D* is the ratio of research and development expenses to total investments. *Institutional shareholding* and *Managerial shareholding* are percentages of common equity owned by institutional investors and 5 highest paid executives, respectively. *No. of issues* is the number of different public debt issues outstanding on the trade date. *Herfindahl* is the Herfindahl index of public issues outstanding. *Short debt* is the ratio of debt in current liabilities to total debt. *Public debt* is the ratio of public to total debt. *Leverage* is the book value of total debt divided by the sum of the book value of debt and the market value of equity on the last business day before the observation date. *Equity volatility* is the historical annualized volatility of daily equity returns over the last 252 business days before the trade date. *No. of trades* are total numbers of trades for the bond (by trade panel) and for the issuer (by firm panel), registered in the NAIC database over 1994–1999. *Bond face value* is the face value of the bond at issue. *Maturity* is the remaining time to maturity on the trade date. *Risk-free rate* is the 5-year constant maturity Treasure rate. *Assets* and *Sales* are given in billions of dollars, *Bond face value* in millions of dollars, and all other variables except *Market to book* and *No. of trades* are in %.

	Observations by trade						Observations by firm					
	Mean	Median	Std. Dev.	5%	95%	N	Mean	Median	Std. Dev.	5%	95%	N
Non-fixed assets	57.86	58.53	43.21	18.30	88.70	43402	61.25	59.52	65.12	17.60	89.65	523
Market to book	1.86	1.47	1.30	0.93	4.25	43006	2.03	1.52	1.61	0.95	5.45	517
R&D	2.40	1.03	3.24	0	9.28	23498	2.53	1.52	3.40	0	10.12	271
Managerial shareholding	1.73	0.25	4.65	0.02	10.05	40269	2.14	0.42	4.88	0.05	11.62	469
Institutional shareholding	57.61	59.30	17.07	27.27	82.43	43355	56.72	59.12	18.74	19.90	83.06	523
No. of bond issues	34.44	12	113.51	2	104	43402	15.83	5.15	55.31	1	44.42	523
1 – Herfindahl index	80.65	87.37	20.27	46.88	96.91	43402	64.36	73.72	28.70	0	94.70	523
Short debt	16.82	11.24	17.18	0	54.41	43402	15.83	11.73	15.68	0.07	51.74	523
Public debt	88.37	100	17.79	49.46	100	18280	85.98	98.36	19.52	44.86	100	311
Leverage	32.24	30.28	18.10	7.31	66.71	43402	31.78	29.51	17.85	7.92	65.82	523
Equity volatility	33.85	29.32	17.38	17.25	65.81	43402	34.94	32.79	13.11	18.10	57.51	523
Assets	19.72	10.06	36.14	1.36	55.95	43402	7.81	3.45	19.18	0.62	24.69	523
Sales	17.05	7.95	27.76	0.88	75.09	43402	6.63	2.98	12.93	0.43	19.66	523
Coupon rate	7.57	7.38	1.20	5.88	9.75	43402	7.66	7.45	1.19	6.25	9.75	523
No. of trades	65.42	52	55.98	10	172	43402	38.90	31.75	31.95	4.99	88.60	523
Bond face value	268	200	202	50	750	43402	177	150	126	29.59	423	523
Maturity	9.43	7.49	7.15	1.96	27.28	43402	9.02	8.04	5.04	3.11	18.90	523
Duration	6.03	5.78	2.82	1.84	11.58	43402	5.85	5.77	1.98	2.76	9.65	523
Risk-free rate	5.93	5.94	0.73	4.55	7.11	43402	5.96	5.96	0.36	5.35	6.60	523

Table V. Non-Strategic Determinants of Credit Spreads

This table reports results of regression analysis of credit spreads on non-strategic variables, for the whole sample and for rating groups as of the date of trade. Ratings are reported using the S&P standard. The dependent variable is the annualized credit spread in basis points relative to a cash-flow-matched portfolio of STRIPS. *Leverage* is calculated as the book value of total debt divided by the sum of the book value of debt and the market value of equity on the last business day before the observation date. *Equity volatility* is the historical volatility of daily equity returns over the last 252 business days before the trade date. *Log(Assets)* is the logarithm of the total assets of the issuing firm in millions of dollars. *Risk-free rate* is the 5-year constant maturity Treasure rate. Fama-MacBeth regressions with Newey-West standard errors adjustment were estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings on each factor on a constant. N is the average number of observations in monthly cross-sectional observations. t-statistics are reported in parentheses.

	All			AAA-AA	A	BBB	BB-B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Leverage	1.49	1.33	1.35	0.44	0.30	0.68	2.06
	(12.37)	(11.41)	(13.26)	(5.85)	(5.91)	(7.89)	(7.73)
Equity Volatility	0.94	0.86	0.81	0.13	0.19	0.42	3.22
	(7.86)	(7.32)	(7.60)	(1.49)	(4.53)	(5.22)	(6.19)
Coupon rate		12.91	12.13	4.81	4.74	5.53	12.42
		(13.76)	(13.46)	(6.47)	(5.49)	(5.45)	(3.85)
Log(Assets)			-13.20	-2.14	-2.87	-7.28	-16.20
			(-8.50)	(-1.47)	(-3.83)	(-3.01)	(-6.99)
Time to maturity	1.14	0.85	0.95	0.63	1.04	1.53	2.07
	(14.86)	(8.28)	(9.39)	(3.07)	(10.90)	(10.85)	(3.13)
Risk-free rate	-0.17	-0.20	-0.21	-0.25	-0.20	-0.27	0.24
	(-1.83)	(-2.52)	(-2.50)	(-2.85)	(-3.11)	(-2.53)	(0.76)
R^2	0.25	0.31	0.37	0.25	0.24	0.24	0.37
N	195.07	195.07	195.07	18.01	81.89	75.28	22.92
	(72)	(72)	(72)	(72)	(72)	(72)	(72)

Table VI. Strategic Variables and Credit Spreads

The dependent variable is the annualized credit spread in basis points relative to a cash-flow-matched portfolio of STRIPS. *Non-fixed assets* is total assets less net property, plant and equipment divided by total assets. *Institutional shareholding* and *Managerial shareholding* are percentages of common equity owned by institutional investors and 5 highest paid executives, respectively. *Norm. no. of issues* is the ratio of logarithm of the number of different public debt issues outstanding on the trade date to the logarithm of total assets. *Herfindahl* is the Herfindahl index of public bond issues outstanding. *Short-term debt* is the ratio of debt in current liabilities to total debt. *Public debt* is the ratio of public to total debt. *Leverage*, *Equity volatility*, *Log(Assets)*, *Risk-free rate* and the intercept were also included in all specifications. Fama-MacBeth regressions with Newey-West standard errors adjustment were estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings on each factor on a constant. N is the total number of observations. t-statistics are reported in parentheses.

Factor	Proxy	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bankruptcy	*Non-fixed assets*	0.15			0.18	0.16	0.30	0.14	0.31	0.21
costs		(5.13)			(4.82)	(4.95)	(10.02)	(1.81)	(1.68)	(6.08)
	Market to book		2.13						1.51	2.33
			(3.32)						(1.84)	(4.22)
	R&D			1.10					1.51	
				(3.20)					(2.48)	
Bargaining	*Managerial shares*	0.56	0.55	2.08		0.57	0.53	0.39	2.57	0.54
power		(4.08)	(3.97)	(6.78)		(4.23)	(4.07)	(1.39)	(4.33)	(4.04)
	Institutional shares				0.13				-0.25	0.11
					(3.67)				(-2.36)	(2.84)
Renegotiation	*Norm. no. of issues*	-37.11	-42.38	-19.61	-44.84				-48.98	
frictions		(-8.24)	(-10.37)	(-3.23)	(-11.19)				(-3.38)	
	1 − Herfindahl index					-0.15			0.20	-0.21
						(-3.90)			(2.25)	(-5.66)
	Short-term debt						-0.49		-0.66	-0.50
							(-14.68)		(-4.53)	(-12.10)
	Public debt							-0.41	-0.44	
								(-5.05)	(-3.08)	
R^2		0.35	0.35	0.35	0.40	0.35	0.37	0.39	0.39	0.37
		(72)	(72)	(72)	(72)	(72)	(72)	(48)	(42)	(72)
N		180.54	178.21	97.39	194.15	180.54	180.54	110.90	79.90	178.10

Table VII. Spread Sensitivity to Strategic Variables

The dependent variable is the annualized credit spread in basis points relative to a cash-flow-matched portfolio of STRIPS. *Non-fixed assets* is total assets less net property, plant and equipment divided by total assets. *Managerial shareholding* is percentage of common equity owned by 5 highest paid executives. *Norm. no. of issues* is the ratio of logarithm of the number of different public debt issues outstanding on the trade date to the logarithm of total assets. *Herfindahl* is the Herfindahl index of public bond issues outstanding. *Short-term debt* is the ratio of debt in current liabilities to total debt. *Public debt* is the ratio of public to total debt. *Leverage*, *Equity volatility*, *Log(Assets)*, *Risk-free rate* and the intercept were also included in all specifications. Fama-MacBeth regressions with Newey-West standard errors adjustment were estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings on each factor on a constant. N is the total number of observations. t-statistics are reported in parentheses.

		Hypothesis 4				Hypothesis 5				
Factor	Proxy	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bankruptcy	*Non-fixed assets*	0.08	0.09	0.16	0.15	0.04	0.16	0.07	0.14	0.10
costs		(6.25)	(7.80)	(9.74)	(2.58)	(2.30)	(6.75)	(2.48)	(7.56)	(2.56)
Bargaining	*Managerial shareholding*	2.29	2.11	0.89	-8.18	1.68	0.57	0.60	0.54	0.34
power		(7.46)	(5.54)	(4.44)	(-0.93)	(3.96)	(4.61)	(4.85)	(4.67)	(1.20)
Renegotiation	*Norm. no. of issues*	-30.15				-38.55	-70.33			
frictions		(-7.71)				(-9.97)	(-6.74)			
	1 − Herfindahl index		-0.13					-0.17		
			(-4.07)					(-2.22)		
	Short-term debt			-0.38					-0.49	
				(-12.19)					(-8.58)	
	Public debt				-0.46					-0.41
					(-5.79)					(-4.76)
Bargaining power * Frictions		-7.46	-0.02	-0.02	0.09					
		(-5.51)	(-3.85)	(-1.55)	(0.98)					
Bankruptcy costs * Bargain. power						0.02				
						(2.83)				
Bankruptcy costs * Frictions							-0.38	0.003	-0.003	-0.001
							(-3.50)	(0.07)	(-1.37)	(-0.03)
R^2		0.36	0.35	0.37	0.41	0.35	0.35	0.34	0.35	0.40
		(72)	(72)	(72)	(48)	(72)	(72)	(72)	(72)	(48)
N		181.7	181.7	181.7	111.4	181.7	181.7	181.7	181.7	111.4

Table VIII. Credit Quality and Spread Sensitivity to Strategic Variables

The dependent variable is the annualized credit spread in basis points relative to a cash-flow-matched portfolio of STRIPS. *High grade* is a dummy variable equal to 1 if the bond rating at the date of trade is A or above, and 0 otherwise. *Non-fixed assets* is total assets less net property, plant and equipment divided by total assets. *Managerial shareholding* is percentage of common equity owned by 5 highest paid executives. *Norm. no. of issues* is the ratio of logarithm of the number of different public debt issues outstanding on the trade date to the logarithm of total assets. *Herfindahl* is the Herfindahl index of public bond issues outstanding. *Short-term debt* is the ratio of debt in current liabilities to total debt. *Public debt* is the ratio of public to total debt. *Leverage*, *Equity volatility*, *Log(Assets)*, *Risk-free rate*, and their products with the *High grade* dummy, as well as the intercept, were also included in all specifications. Fama-MacBeth regressions with Newey-West standard errors adjustment were estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings on each factor on a constant. N is the total number of observations. t-statistics are reported in parentheses.

Factor	Proxy	(1)	(2)	(3)	(4)
Liquidation costs	*Non-fixed assets*	0.13	0.12	0.19	0.20
		(5.96)	(5.70)	(7.84)	(1.86)
	*Non-fixed assets * High grade*	-0.11	-0.11	-0.15	-0.19
		(-3.85)	(-3.45)	(-4.93)	(-1.76)
Bargaining power	*Managerial shareholding*	0.00	-0.02	-0.001	-0.36
		(0.00)	(-0.07)	(-0.02)	(-0.58)
	*Managerial shares * High grade*	0.42	0.42	0.20	-0.48
		(1.36)	(1.36)	(0.59)	(-0.64)
Renegotiation frictions	*Norm. no. of issues*	-45.08			
		(-7.15)			
	*Norm. no. of issues * High grade*	48.97			
		(6.29)			
	1 – Herfindahl		-0.29		
			(-7.63)		
	*(1 – Herfindahl) * High grade*		0.32		
			(7.52)		
	Short-term debt			-0.59	
				(-11.43)	
	*Short-term debt * H.grade*			0.44	
				(7.56)	
	Public debt				-0.38
					(-5.08)
	*Public debt * High grade*				0.21
					(2.17)
R^2		0.44	0.44	0.44	0.48
		(72)	(72)	(72)	(48)
N		181.67	181.67	181.67	111.35