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Strategic Actions and Credit Spreads: An Empirical Investigation

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ABSTRACT

Do strategic actions of borrowers and lenders affect corporate debt values? We find higher bond spreads for firms that can renegotiate debt contracts relatively easily. Consistent with theories of strategic debt service, the threat of strategic default depresses bond values ex ante, even though there may be efficiency gains from renegotiation ex post. However, the economic significance of the net effect is small, suggesting that bondholders have considerable bargaining power. The effect of strategic actions is higher when creditors are particularly vulnerable to strategic threats, including risky firms with high managerial shareholding, simple debt structures, and high liquidation costs.

THIS PAPER EXPLORES THE EMPIRICAL RELATIONSHIP between corporate debt prices and firm characteristics that influence strategic decisions concerning default and distressed renegotiations. A large body of corporate finance literature documents the effects of firm-specific factors on the outcome of distressed restructuring. We investigate whether such factors are reflected ex ante in the prices of nondistressed firms' bonds. We find that, on average, the possibility of strategic default increases corporate debt spreads, even though ex post there may be efficiency gains from renegotiation. The impact of strategic actions on spreads is larger for firms whose creditors are more vulnerable to the threat of strategic default, including low-rated firms with few tangible assets, high managerial equity ownership, and simple debt structures. However, despite robust statistical significance of our strategic proxies, their quantitative contribution to both the average level and the cross-sectional variation of spreads for the whole sample is small. The evidence suggests that, contrary to the extreme assumptions of some models, bond investors are likely to have significant bargaining power that allows them to extract surplus in renegotiations. As a result, strategic default

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is unlikely to be an important contributor to the poor empirical performance of traditional contingent claims models of debt pricing.

While the pricing of defaultable corporate debt has been the subject of extensive research over many years, market yield spreads remain largely unexplained.[1] This lack of explanatory power may be unsurprising given that the set of firm-level variables considered in both theoretical and empirical credit risk research is usually restricted to such risk factors as leverage and volatility despite the importance of other firm characteristics for default and recovery-related decisions. For instance, the specifics of the U.S. Bankruptcy Code's Chapter 11 make bargaining an important factor in distressed reorganizations, both in formal bankruptcy and in out-of-court renegotiations. Empirical studies find that factors determining the bargaining positions of different parties in negotiations, including complexity of debt structure, managerial share ownership, and asset tangibility, affect the incidence of formal and informal reorganizations, deviations from absolute priority, and eventually debt recovery rates.[2] To the extent that nondistressed bond spreads reflect expected losses from default, they too should depend on such factors. Yet, although some models allow for recovery rates that may incorporate exogenous bargaining with deviations from absolute priority (e.g., Longstaff and Schwartz (1995)), extant empirical applications tend to assume a constant exogenous recovery rate for all firms, reducing the explanatory power in the cross-section.

Moreover, the effect of strategic actions may extend beyond recovery rates to equityholders' decisions of *whether* and *when* to default. The theoretical literature since Hart and Moore (1994, 1998) emphasizes 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 the resources to do so. When firm liquidation upon default results in a loss of value relative to the going concern, creditors may prefer to forgive some of the debt if doing so allows the firm to survive. This creates incentives for equityholders to default opportunistically in order to secure debt concessions. As a result, if one accounts only for liquidity defaults, the true default probability may be understated and bond spreads underpredicted. Structural debt pricing models with debt renegotiation introduced by Anderson and Sundaresan (1996) and Mella-Barral and Perraudin (1997) suggest that when creditors have little bargaining power, a large part of the spread may be due to the risk of strategic default. A number of more recent models incorporate the possibility of strategic renegotiation,

[1] Contingent claims models of risky debt were pioneered by Merton (1974) and Black and Cox (1976) and later extended along a number of dimensions by Leland (1994), Longstaff and Schwartz (1995), Leland and Toft (1996), and Collin-Dufresne and Goldstein (2001), among others. Jones, Mason, and Rosenfeld (1984) and Eom, Helwege, and Huang (2004) find that existing models cannot explain empirically observed bond spreads.

[2] Important contributions include Gilson, John, and Lang (1990), Asquith, Gertner, and Scharfstein (1994), Franks and Torous (1994), and Betker (1995).

but the empirical importance of strategic actions for spreads thus far remains unexplored.[3]

Fan and Sundaresan (2000) demonstrate that the relevance of strategic actions for spreads crucially depends on the distribution of bargaining power in renegotiations. In liquidity default ex post, renegotiation may be beneficial to all parties, as inefficient liquidation can be avoided and higher recovery rates achieved. However, when equityholders' bargaining power is high, the possibility of renegotiation ex ante may induce strategic default and depress bond values. The stronger the creditors' bargaining position, the higher their share in the renegotiation surplus and the lower the equityholders' incentive to default strategically. In particular, if all bargaining power belongs to creditors, renegotiation in liquidity defaults should increase ex ante debt values 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. For intermediate distributions of bargaining power the impact of renegotiation depends on the net effect of strategic default ex ante and bargaining in default ex post.

This paper provides an empirical study of the importance of strategic variables for spreads. Previous corporate finance research shows that debt structure complexity and shareholder characteristics are important determinants of the nature and hence the outcome of distressed reorganizations.[4] The essence of our study is to relate firm-specific variables that are likely to be important in renegotiations to ex ante spreads. Our strategic factors include measures of asset tangibility as proxies for liquidation costs, measures of managerial and institutional shareholding and of managerial entrenchment as proxies for equityholders' bargaining power in renegotiations, and measures of the dispersion of debtholders' and shareholders' interests as proxies for renegotiation frictions. These measures include the number of different public outstanding bond issues, the number of shareholders, and the proportions of private and short-term debt in the debt structure, which have been shown in the literature to affect renegotiation.

We find our strategic proxies to be statistically significant determinants of credit spreads. In particular, spreads are negatively correlated with the number of bond issues, the number of shareholders, the ratio of public to private debt, and the ratio of short- to long-term debt, while managerial and institutional share ownership shows positive correlation with spreads. We attempt

[3] Fan (1997), Mella-Barral (1999), Acharya et al. (2006), François and Morellec (2004), and Hege and Mella-Barral (2005) provide a number of extensions of the basic framework, including varying distribution of bargaining power, the possibility of efficient liquidation, optimal dividend and cash management policy, renegotiation costs, and multiple renegotiation rounds.

[4] See Gilson et al. (1990), LoPucki and Whitford (1990), Asquith et al. (1994), Franks and Torous (1994), Betker (1995), Helwege (1999), Kahl (2002), Chen (2003), and Bris, Welch, and Zhu (2006). Corporate finance models such as Berglöf and von Thadden (1994), Bolton and Scharfstein (1996), and Hackbarth, Hennessy, and Leland (2007) study the implications of the possibility of strategic debt service for the optimal choice of the ratio of short to long-term debt, the number of different creditors, and the mix of public and private debt.

to discriminate between two mechanisms through which strategic variables can influence spreads, namely, the *bargaining in default* effect on expected recovery rates, and the *strategic default* effect of the equityholders' endogenous default decision. If the timing of default is exogenous but recovery rates are an outcome of bargaining, then the introduction of efficiency-enhancing renegotiation should always increase debt value. By contrast, if default is the equityholders' endogenous decision, the possibility of renegotiation may decrease debt values because of strategic default. Our tests show that spreads are generally lower when renegotiation is likely to be difficult. The evidence suggests that, on average, the adverse effect of the possibility of strategic default more than offsets the expected efficiency gains from avoiding inefficient liquidation through renegotiation.

The statistical significance of the strategic variables confirms the empirical relevance of models with endogenous strategic default. Furthermore, consistent with theory, we find that the negative effect of strategic default is significantly more pronounced when, in distressed renegotiations, debtholders' bargaining position is likely to be relatively weak. In particular, higher bargaining power of equity and higher liquidation costs result in a greater sensitivity of spreads to strategic default. The strategic effect is highest for low-grade bonds but less significant for highly rated bonds.

Despite the robust statistical significance of our strategic proxies, their average quantitative contribution to both the average level and the cross-sectional variation of spreads is below transactions costs in the corporate bond markets. This could be due to the relatively low importance of strategic default for debt pricing. Alternatively, its effect, while considerable, may be nearly offset by the positive recovery effect. Indeed, the contribution of strategic behavior to the average spread level depends on the distribution of bargaining power for all firms in the sample. The ability of credit risk models with strategic debt service to attribute a large part of spreads to strategic default depends critically on the assumption that all bargaining power belongs to the borrower. Our evidence that the impact on spread levels is small suggests that creditors do have some bargaining power, and that for them the positive effect of renegotiation on recovery rates nearly offsets the adverse effect of strategic default.

Our numerical estimates should be interpreted with caution, as our proxies are noisy measures of the underlying strategic factors. Moreover, strategic variables may also affect spreads indirectly if leverage and other characteristics depend on the possibility of debt renegotiation. These caveats notwithstanding, our findings suggest that 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 of spreads. This conclusion is consistent with Huang and Huang (2003), who find that for most bonds, credit risk, including strategic debt service, explains only a small part of the spread when estimates of expected bond losses are based on historical default data.

Our results are robust to the choice of methodology, model specification, and controls for the nonlinear effects of credit risk variables such as leverage and volatility. We show that the results cannot be attributed to other possible sources of correlation 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. Section I presents our hypotheses. Section II describes the data, discusses our choice of independent variables, and reports sample statistics. Section III presents our main results, and Section IV reports various robustness checks. Section V concludes. Details of the model used to derive the hypotheses and the procedure used to measure spreads are given in Appendices A and B, respectively.

I. Testable Hypotheses

This section introduces testable hypotheses that establish how debt prices are related to the possibility of renegotiation, the relative 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 under 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. Appendix A illustrates how our hypotheses can be formally derived in a simple stylized model of strategic debt service with frictions, which is an extension of the Fan and Sundaresan (2000) model.[5]

Theoretical models often make 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] Firms may find it more or less easy to restructure their debt depending on their specific characteristics. For example, while negotiating with a small number of lenders may be relatively easy, dispersed bond ownership with atomistic bondholders and full collateralization may make debt contracts effectively renegotiation-proof (Hege and Mella-Barral (2005)). By comparing firms with low and high renegotiation frictions, we can draw conclusions about the effect of the *possibility* of renegotiation on spreads. Suppose that q measures how difficult it is to renegotiate the firm's debt, s denotes the debt spread, and $\phi = \partial s/\partial q$ represents the sensitivity of the spread to renegotiation frictions. A positive value of ϕ implies that the possibility of renegotiation decreases spreads and increases debt values. In addition to frictions, bargaining power and liquidation costs are two other crucial variables that influence strategic behavior. Liquidation costs are a measure of surplus that can be preserved

[5] In the previous version of this paper, we use the Merton (1974) model with renegotiation to derive the same hypotheses.

[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.

through renegotiation, while the distribution of bargaining power gives the division of the surplus. These two variables may affect the sign and magnitude of ϕ, as we discuss below.

In general, strategic behavior can influence debt prices through *bargaining in default* and the *strategic default* decision. Models such as 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 absolute priority. Models of strategic debt service also take into account the second channel by allowing equityholders to choose *when* to default strategically. Our hypotheses establish the influence of these two channels on spreads.

Suppose there are some deadweight costs whenever a firm is liquidated in bankruptcy. Given a particular default threshold, debt recovery rates should in general be lower for higher liquidation costs. Moreover, debtholders should be more willing to forgive debt if their alternative is to face high costs in liquidation, and hence when default is endogenous, high liquidation costs should result in borrowers defaulting more frequently to extract concessions from creditors. In either case, it follows that higher liquidation costs should result in higher debt spreads.

Furthermore, if strategic actions are relevant for debt prices, higher bargaining power of equity should result in lower debt values. Indeed, once in default, higher bargaining power of equity will result in lower recovery rates, since deviations from absolute priority will be larger. Moreover, higher bargaining power of equity should also result in a high incidence of strategic defaults, since equityholders gain more in renegotiation. This argument supports the following hypothesis:

HYPOTHESIS 1 (Bargaining power and spreads): *Higher bargaining power of equity results in higher debt spreads.*

Of central interest is the question: Does the *possibility* of renegotiation influence spreads, and if so, when is the effect most pronounced? As Hart and Moore (1998) and Fan and Sundaresan (2000) point 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 increase the probability of default. These effects are summarized in the following hypothesis:

HYPOTHESIS 2 (Renegotiation frictions and spreads): *Higher renegotiation frictions reduce the probability of strategic default, but also the recovery rates conditional on default. The overall influence of renegotiation on spreads depends on whether the strategic default or the recovery effect dominates.*

In general, when both the bargaining in default and strategic default effects are important, the overall impact of renegotiation on debt prices is ambiguous, depending on the distribution of bargaining power and the relative probability of liquidity and strategic default. However, if models with exogenous default, such as Longstaff and Schwartz (1995), can adequately capture the effect of bargaining on spreads, then one should expect renegotiation to unambiguously 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 implies that if debt spreads were found empirically to be positively correlated with renegotiation frictions ($\phi > 0$, higher spreads when renegotiation is costlier), it could be either because strategic default is completely irrelevant, or just because its effect is dominated by the recovery rate effect. By contrast, negative correlation of spreads with renegotiation frictions ($\phi < 0$) would unambiguously indicate that a strategic default effect is present and dominates the recovery effect, supporting the claim of strategic debt service models that the threat of the borrower's opportunistic behavior increases credit spreads.

The magnitude of the effect of strategic actions depends on bargaining power and liquidation costs. If all the bargaining power belongs to equity, then debtholders receive no share of the renegotiation surplus and there is no positive recovery effect of renegotiation on debt prices. The strategic default effect then increases spreads, and renegotiation frictions should benefit creditors, implying $\phi < 0$. On the other hand, if the bargaining power fully belongs to debtholders, strategic default is of no value for equityholders as they do not share in the renegotiation surplus. The recovery effect in this case increases the value of debt, so that $\phi > 0$. If the effect of bargaining power on ϕ is monotonic, then ϕ must be a decreasing function of bargaining power. In Appendix A we show that this is also the case whenever the strategic default effect dominates the recovery effect, so that $\phi < 0$.

HYPOTHESIS 3 (Bargaining power and the effect of renegotiation frictions): *Assume that either (1) the effect of bargaining power on spread sensitivity to renegotiation frictions, ϕ, is monotonic, or (2) that $\phi < 0$. Then ϕ is a decreasing function of the bargaining power of equity.*

The distribution of bargaining power is likely to be less important when the costs of liquidation are low. This is due to the fact that low liquidation costs correspond to low bargaining surplus, making all bargaining-induced effects less important. For similar reasons, if we assume that the strategic effect dominates the recovery effect, then the magnitude of ϕ should be lower for low liquidation costs. This yields:

HYPOTHESIS 4 (Liquidation costs and the effect of bargaining power): *The absolute value of the spread sensitivity to bargaining power is increasing in liquidation costs.*

HYPOTHESIS 5 (Liquidation costs and the effect of renegotiation frictions): *If $\phi < 0$, then the absolute value of the spread sensitivity to renegotiation frictions is increasing in liquidation costs.*

II. Data Description

A. Data Sources and Sample Selection

In this study we use corporate bond price data for the years 1994 to 1999. These data, supplied by the National Association of Insurance Commissioners (NAIC), provide details of all fixed income transactions by the U.S. insurance companies, which are major investors in corporate bonds. Note that these data represent actual transactions and not dealer quotes or matrix prices. Descriptive bond information comes from the Fixed Income Securities Database (FISD) provided by LJS Global Information Systems, Inc. Where possible, we complement information on bond ratings from FISD using data on ratings from Moody's. We use daily prices of risk-free zero-coupon securities (STRIPS) to estimate the corporate spread over the equivalent risk-free U.S. Treasury yield. We also use constant maturity Treasury rates, available from the Federal Reserve Board of Governors, as explanatory variables.

We manually merge the bond data with both accounting information from Compustat and equity prices from CRSP, taking account of mergers, name changes, and parent/subsidiary relationships; we exclude firms that we cannot merge reliably. We use ExecuComp data on executive stock and option holdings, as well as some CEO characteristics, and institutional equity ownership data from Thomson Financial Ownership Data. Finally, we manually collect detailed information on firms' debt structure, such as data on bank debt, from the long-term debt section of Moody's/Mergent industrial and OTC manuals.

For the period 1994 to 1999, NAIC reports 685,680 transactions by insurance companies involving fixed income securities. We first exclude all trades in bonds other than the U.S. corporate bonds with unambiguous trade details and bond characteristics. We then eliminate all nonfixed coupon bonds, asset-backed issues, and bonds with embedded options, such as callable, puttable, exchangeable, convertible securities bonds, and bonds with sinking fund provisions. In instances in which 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.[7]

We examine only bonds with the remaining time to maturity at the trade date of between 1 and 30 years, since the risk-free rates that we use to estimate spreads have maturities lower than 30 years, and for very short maturities small price measurement error results in large yield deviations, making spread estimates noisy. To render cross-sectional comparisons reliable, we exclude bonds issued by financial companies (SIC codes 6000-6999). Finally, we exclude any observations for which data on total debt in the fiscal year immediately preceding the trading date are missing, and we require that data on equity returns be available for at least 126 business days preceding the trading date. Our final sample consists of 43,402 trades for 2,380 unique bond issues from 523 unique issuers.

[7] 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.

B. Spread Estimation

The corporate spread we examine is the difference between the yield to maturity on the corporate bond and the 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 in the NAIC database. We then calculate the yield on a risk-free bond with the same cash flow stream using the U.S. Treasury STRIPS prices for the settlement date of trade. For the majority of trades four annual STRIPS rates are available. We use a linear approximation of the STRIPS yield curve to discount corporate bond coupon payments that occur between the maturity dates of two STRIPS. Since our final sample of bond prices is for maturities in the range in which STRIPS's yields are available, we do not need to approximate the yield curve at the short and long ends of the curve. We 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 yield on a synthetic risk-free bond with exactly 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.[8] These procedures underestimate spreads for upward-sloping term structures and overestimate them for downward-sloping term structures.[9]

C. Independent Variables

C.1. Strategic Factor Proxies

Our choice of empirical proxies for strategic factors is motivated by existing empirical and theoretical studies of corporate reorganizations and capital structure. We use nonfixed assets as our main proxy for the costs of liquidation; the market-to-book asset ratio, R&D investment, and the utility industry dummy are used as additional proxies. We proxy for the bargaining power of equity in potential renegotiations by the fractions of equity owned by the firm's CEO and institutional investors, and by the CEO's tenure with the firm. Finally, to proxy for renegotiation frictions, we use the number of outstanding public bond issues, the bond Herfindahl index, the number of shareholders, and the ratios of

[8] Collin-Dufresne, Goldstein, and Martin (2001) use the difference between the bond yield and the approximated Treasury yield for the same maturity. Eom et al. (2004) use the spread over constant maturity Treasuries. Duffie and Singleton (1999) use credit swap spreads.

[9] As an illustration, consider the case of a 10-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 10-year Treasury bond pays a 5% coupon. Then the difference between the simple corporate-Treasury spread and the spread estimated using our procedure is 13 basis points, or 7%. For low-quality bonds the difference in spread estimates would be larger.

public and short-term debt to total debt. Panel A of Table I presents a summary of these variables. We discuss them in detail below.[10]

Costs of liquidation. Debt contracts are renegotiated to avoid possible costs that would be incurred if the original contract were to be upheld, such as value dissipation in liquidation. We proxy for liquidation costs by the ratio of *nonfixed assets*, defined as one minus the ratio of net property, plant, and equipment to total assets, by the *market-to-book* asset ratio, which is equal to the sum of book debt and market equity divided by the sum of book debt and equity, and by the ratio of *R&D expenditures* to total investments. These choices are motivated by a large body of empirical work on capital structure and on outcomes of distressed reorganizations. Alderson and Betker (1996) provide direct estimates of liquidation costs for a sample of bankrupt firms and study their association with a number of commonly used observable proxies. They conclude that fixed assets, the market-to-book ratio, and R&D expenses are the best variables to use to proxy for liquidation costs (see also references therein). As an additional proxy, we also use the *nonutility* industry dummy, which equals zero if the firm is a utility and one otherwise. Utility firms typically have valuable tangible assets that are easy to sell in bankruptcy. Consequently, studies of defaulted firms (e.g., Acharya, Bharath, and Srinivasan (2007)) find that creditors of utility firms enjoy significantly higher recovery rates (other industry differences are typically found to be unimportant).

Relative bargaining power. Shareholders' bargaining power determines their share of the renegotiation surplus ultimately reflected in observed deviations from the absolute priority rule (APR). Based on existing studies of APR deviations, our primary proxy for bargaining power is *CEO shareholding*, which is the proportion of the firm's shares that are held by the CEO.[11] Betker (1995) finds that a 10% increase in CEO shareholdings increases equity deviations from the APR in Chapter 11 by as much as 1.2% of firm value. LoPucki and Whitford (1990) find that equity deviations from the APR in Chapter 11 occur *only* when shareholders are aggressively represented by either the management, or alternatively, by an equity committee. We proxy for the probability of an equity committee formation using *institutional shareholding*, which is the percentage of equity held by institutional investors. Even in the absence of an equity committee, better coordinated and more sophisticated institutional investors should be able to bargain more efficiently and induce larger deviations from the APR than individual investors. Baird and Jackson (1988) argue that equity deviations from absolute priority could be interpreted as compensation to existing shareholders, which creditors are prepared to pay for their unique

[10] The intrinsic characteristics of some bonds may imply special renegotiation conditions. For example, asset-backed securities may be particularly difficult to renegotiate (Fan (1997)), while puttable securities may have special strategic value for creditors (David (2001)). It would be interesting to study the pricing of such bond types. Unfortunately, we do not have a sufficient number of them in our sample. We thank the referee for pointing out this interesting research possibility.

[11] We also use the proportion of shares owned by the five highest-paid executives instead of the CEO, with very similar results.

Table I

Independent Variables

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

Variable	Factor	Description	Source
		Panel A: Proxies for Strategic Factors	
Nonfixed assets	Liquidation costs	1 − Net PPE/Book total assets	Compustat
Market-to-book	Liquidation costs	(Market equity + Book debt)/Book total assets	CRSP and Compustat
R&D	Liquidation costs	Research and development expenses divided by total investment	Compustat
Nonutility	Liquidation costs	1 − Utility industry dummy	Compustat
CEO shareholding	Equity's bargain. power	Percentage of total equity owned by the CEO	ExecuComp
Institutional shareholding	Equity's bargain. power	Percentage of total equity owned by institutional investors	TFOD
CEO tenure	Equity's bargain. power	(Trade date − Date current CEO appointed)/365	ExecuComp
Norm. no. of issues	Renegotiation frictions	Log(Number of outstanding bond issues)/Log(Total debt)	FISD and Compustat
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-term debt	Renegotiation frictions	Short-term debt divided by total debt	Compustat
Public debt	Renegotiation frictions	Public debt outstanding divided by total debt	Moody's/Mergent
Norm. no. of shareholders	Renegotiation frictions	Log(Number of institutional shareholders)/Log(Market equity)	TFOD and CRSP
		Panel B: Nonstrategic Variables	
Leverage	Credit risk	Book debt/(Book debt + Market equity on trade date)	CRSP and Compustat
Asset volatility	Credit risk	Constructed using equity vol. and data on debt vol. by rating	CRSP and Compustat
Assets	Liquidity, Information	Book value of total assets	Compustat
Time to 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

input into the restructured firm.[12] Based on this idea, we use the *CEO's tenure* with the firm, defined as the time period since the CEO's appointment, as an additional proxy for bargaining power. If the CEO is entrenched and has high firm-specific human capital as measured by her tenure, she may be in a better position to bargain on behalf of shareholders in renegotiations.

Renegotiation frictions. Proxies for renegotiation frictions measure how difficult it is to renegotiate the company's debt. They influence, for example, the probability that an out-of-court work out, if attempted, will prove unsuccessful, resulting in costly bankruptcy. Asquith et al. (1994) and Gilson et al. (1990) document that about one half of the firms attempting an informal distressed restructuring end up in Chapter 11. They relate the probability of bankruptcy to the complexity of the firm's debt structure. We use similar variables to theirs as proxies for renegotiation frictions. In a broader context, variables that make successful out-of-court work outs more difficult are also likely to hinder Chapter 11 renegotiations, increasing the time in bankruptcy and the costs of reorganization (Helwege (1999), Bris et al. (2006)). Thus, our variables proxy for factors that discourage not only out-of-court renegotiations, but also Chapter 11 reorganizations, which the firm might otherwise opt for.

Renegotiations are difficult when they involve many parties with diverse interests. Gertner and Scharfstein (1991) and Bolton and Scharfstein (1996) argue that, due to coordination failures and the free-rider problem, the presence of many dispersed bondholders impedes renegotiation. Hege and Mella-Barral (2005) demonstrate that borrowing from a large number of uncoordinated creditors can be effectively renegotiation-proof. Bris et al. (2006) argue that the time that a Chapter 11 firm needs to confirm a reorganization plan "can be considered a proxy for the degree of difficulty in the bargaining process." They find that this time is positively and significantly related to the number of creditors. Since data on bondholders' dispersion for nonbankrupt firms are difficult to obtain, extant empirical studies tend to use the number of outstanding bond issues as a proxy. Gilson et al. (1990), Asquith et al. (1994), and Chen (2003) find that empirically the probability that an out-of-court restructuring succeeds is negatively and significantly related to the number of outstanding bond issues.

Following these studies, our primary proxy for renegotiation frictions is the *number of bond issues* outstanding on the date of trade that were issued by the firm and its wholly owned subsidiaries. Following Gilson et al. (1990), we normalize the number of issues by total debt in order to measure bond structure complexity per dollar of debt. We also calculate the *Herfindahl index* of outstanding bond issues. The index is a measure of dissimilarity of face values of public bond issues

$$\textit{Herfindahl index}_i = \sum_j B_{ij}^2 \bigg/ \left(\sum_j B_{ij}\right)^2,$$

[12] See also Hart and Moore (1994) on the economic consequences of the inalienability of human capital.

where B_{ij} is the face value at offering of the jth bond of firm i. This index 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. Betker (1995) finds that higher values of this index correspond to larger equity deviations from absolute priority. In actual tests we use $1 - $ *Herfindahl index*, which is positively related to renegotiation frictions.

Much like the dispersion of public bondholders, the dispersion of equityholders can also hinder renegotiations due to coordination problems. We therefore expect renegotiation frictions to be higher for firms with many different shareholders, which we proxy by the number of *institutional* shareholders. Specifically, the *normalized number of shareholders* is defined as the logarithm of the number of different institutional shareholders divided by the logarithm of the market value of the firm's equity.

As alternative proxies, we use the proportions of public (as opposed to private) and short-term (as opposed to long-term debt) debt in the capital structure. Gertner and Scharfstein (1991) and Rajan (1992), among others, argue that the presence of privately held debt makes renegotiations easier, because private creditors such as banks and institutions are informed, sophisticated, easily accessed investors not subject to coordination problems common to dispersed public bondholders. Gertner and Scharfstein (1991) and Berglöf and von Thadden (1994) also demonstrate that the presence of short-term debt decreases the incentives for the firm to renegotiate the debt contract, because short-term lenders rarely forgive debt when the concessions accrue to effectively subordinated long-term creditors. Consistent with these theories, Gilson et al. (1990) and Kahl (2002) find that the probability of filing for bankruptcy for financially distressed firms is negatively related to the proportion of bank and privately held debt in the capital structure. Betker (1995) and Franks and Torous (1994) find deviations from absolute priority to be negatively correlated with these variables.[13] The specific proxies that we use are *short-term debt*, defined as debt in current liabilities (i.e., due in 1 year) divided by the total debt, and *public debt*, defined as the total par value of outstanding bonds and other long-term debt identified in Moody's/Mergent manuals as public securities divided by total debt.[14]

C.2. Risk Factors Unrelated to Renegotiation

A summary of the independent nonstrategic variables is presented in Panel B of Table I. Contingent claims models invariably predict that a firm's financial

[13] Although Asquith et al. (1994) and Helwege (1999) find evidence that banks may impede rather than facilitate reorganizations, we believe their results are specific to the original junk issuers they focus on. Markets for original junk are different from those for investment grade bonds, as investors in junk bonds may be more skilled and coordinated in negotiations. Secured bank lenders, on the other hand, may not behave differently.

[14] Close examination of debt structure 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 for which we can unambiguously identify as private or public more than 90% of the total long-term debt.

leverage and asset volatility affect the probability of financial distress. We estimate *leverage* as the ratio of the book value of total debt at the end of the previous fiscal year to the sum of the book value of debt and the closing market value of equity on the trade date. Unfortunately, the *volatility of assets* is not directly observable. Following Schaefer and Strebulaev (2005), we estimate asset volatility as a leverage-weighted average of the firm's one-year historic equity volatility and average bond volatility for the same rating.[15]

We use the logarithm of *total assets* to control for all influences that the firm's size may exert on debt spreads. Although credit risk models are typically scale free, there are several reasons to control for size, such as its correlation with information asymmetry and bond liquidity. 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. We use the 5-year constant maturity Treasury rate to control for intraperiod variations in the *risk-free rate*. Previous theoretical and empirical work shows that the risk-free interest rate is negatively related to corporate bond spreads (Longstaff and Schwartz (1995), Duffee (1998)). In addition, Collin-Dufresne et al. (2001) document the presence of a systematic factor behind corporate spreads that 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 for the whole sample as well as for different maturity and rating groups. The mean spread is 109 basis points, and the median is 85 basis points. 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 (120 vs. 223 basis points). This jump in the spread may be attributable not only to different probabilities of default, but also to the lower liquidity of speculative grade bonds. Statistics for nonstrategic credit risk variables are reported in Table III. As expected, leverage ratios monotonically increase as ratings deteriorate. However, no such pattern can be seen for asset volatility estimates. This lack of correlation of asset volatility and credit quality is consistent with the idea that firms' operating performance is independent of their capital structure, an assumption typically adopted by structural models of credit risk. Estimated leverage for different rating classes is somewhat higher but generally consistent with values used in Huang and Huang (2003). Median asset volatilities for investment grade bonds of 0.19 to 0.23 are similar to those estimated by Schaefer and Strebulaev (2005). The median time to maturity in the sample is between 6.4 and 7.8 years and is similar across ratings.

Table IV gives summary statistics on all other independent variables by trade and by issuer. The per-issuer statistics are calculated by finding a mean value

[15] When we use historical equity volatility instead of asset volatility in robustness checks, there is no change in the results.

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 and remaining maturity. The benchmark risk-free yield is the yield on a cash flow-matched portfolio of STRIPS. STRIPS's yields are observed as of the date of trade, and are linearly approximated for dates between the maturity dates of two STRIPS. 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	43,402	192	3,969	19,238	15,585	3,910	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	1,150
N	19,857	100	1,741	9,084	6,988	1,650	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	16,139	11	1,776	6,707	5,822	1,634	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	1,014
N	7,406	81	452	3,447	2,775	626	25

of each variable for each firm, and then reporting the statistics for this sample of means. 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. Our issuers have relatively long-term liabilities 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

Table III

Summary Statistics on Credit Risk Variables

This table reports summary statistics on nonstrategic risk determinants for straight fixed-coupon corporate bonds in the industrial sector over the 1994 to 1999 period, by rating. *Leverage* is the ratio of the book value of debt to the book value of debt plus the market value of equity on the trade date. *Asset volatility* is the leverage-weighted average of the firm's 1-year historic equity volatility and average bond volatility for the same rating. *Time to maturity* is the remaining time to maturity on the trade date. Leverage and equity volatility are in percentage points; 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
Ste. 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: Asset Volatility				
Mean	0.239	0.265	0.260	0.236	0.233	0.245	0.274
Median	0.204	0.218	0.231	0.194	0.202	0.216	0.240
Ste. Dev.	0.128	0.133	0.119	0.136	0.127	0.091	0.088
5% quantile	0.105	0.118	0.127	0.095	0.110	0.149	0.198
95% quantile	0.511	0.577	0.527	0.537	0.487	0.457	0.477
			Panel C: Time to 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
Ste. 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)	43,402	192	3,969	19,238	15,585	3,910	508

debt ratio of 98% to 100% is not surprising; however, the low dispersion may result in a lack of statistical power for the *public debt* variable. The low relative CEO and managerial equity stakes correspond to large dollar stakes due to the large average size of firms in our sample. Size also explains the relatively high average institutional shareholding, with a mean of 56.7% for all firms.

III. Empirical Results

A. Empirical Methodology

In our transaction data set, big companies are overrepresented 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 overrepresentation may potentially bias the results. To mitigate this issue, in our tests we use at most one trade per firm in any given month, by randomly choosing one trade for each

Table IV

Summary Statistics on Independent Variables

This table reports summary statistics on independent variables, by trade and by firm. Statistics by firm are calculated by finding the mean value of each variable for each firm, and then averaging the means across firms. *Nonfixed assets* are one minus the ratio of net property, plant, and equipment to 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 investment expenditure. *CEO*, *Institutional*, and *Managerial shareholdings* are the percentages of common equity owned by the CEO, institutional investors, and the five highest-paid executives, respectively. *No. of issues* is the number of bond issues outstanding on the trade date. *CEO tenure* is the number of years since the CEO's appointment as of the date of trade. *Herfindahl* is the Herfindahl index of public 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* 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 trade date. *Asset volatility* is the leverage-weighted average of the firm's 1-year historic equity volatility and average bond volatility for the same rating. *Bond face value* is the face value of the bond at issue. *Time to maturity* is the remaining time to maturity at the trade date. *Risk-free rate* is the 5-year constant maturity Treasury rate. *Book total assets* are in billions of dollars, *Bond face value* and *Debt trading volume* are in millions of dollars, and all ratios are in percentage points.

	Observations by Trade						Observations by Issuer					
	Mean	Median	Std. Dev.	5%	95%	*N*	Mean	Median	Std. Dev.	5%	95%	*N*
Nonfixed assets	57.9	58.5	43.2	18.3	88.7	43,402	61.3	59.5	65.1	17.6	89.6	523
Market-to-book ratio	1.86	1.47	1.30	0.93	4.25	43,006	2.03	1.52	1.61	0.95	5.45	517
R&D	2.40	1.03	3.24	0	9.28	23,498	2.53	1.52	3.40	0	10.12	271
CEO shareholding	0.935	0.100	3.331	0.007	4.704	39,414	1.267	0.202	3.601	0.016	7.233	453
Institutional shareholding	57.6	59.3	17.1	27.3	82.4	43,355	56.7	59.1	18.7	19.9	83.1	523
Managerial shareholding	1.73	0.25	4.65	0.02	10.05	40,269	2.14	0.42	4.88	0.05	11.62	469
CEO tenure	6.73	4.03	7.76	0.82	28.55	12,964	5.23	2.78	6.23	0.83	17.35	226
No. of issues	34.4	12.0	113.5	2.0	104.0	43,402	15.8	5.2	55.3	1.0	44.4	523
1-Herfindahl index	80.6	87.4	20.3	46.9	96.9	43,402	64.4	73.7	28.7	0	94.7	523
Short-term debt	16.8	11.2	17.2	0	54.4	43,402	15.8	11.7	15.7	0.1	51.7	523
Public debt	88.4	100.0	17.8	49.5	100	18,280	86.0	98.4	19.5	44.9	100	311
No. of inst. shareholders	323.3	276	197.0	76	726	43,402	214.3	171.6	157.9	43.1	542.6	523
Leverage	32.2	30.3	18.1	7.3	66.7	43,402	31.8	29.5	17.8	7.9	65.8	523
Asset volatility	0.239	0.204	0.128	0.105	0.511	43,402	0.249	0.235	0.099	0.108	0.434	523
Book total assets	19.7	10.1	36.1	1.4	55.9	43,402	7.81	3.45	19.18	0.62	24.69	523
Bond face value	268	200	202	50	750	43,402	177	150	126	29.59	423	523
Time to maturity	9.43	7.49	7.15	1.96	27.28	43,402	9.02	8.04	5.04	3.11	18.90	523
Risk-free rate	5.93	5.94	0.73	4.55	7.11	43,402	5.96	5.96	0.36	5.35	6.60	523

Table V

Nonstrategic Determinants of Credit Spreads

This table reports the results of regression analysis of credit spreads on nonstrategic variables, for the whole sample and for rating groups as of the date of trade. 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 observation date. *Asset volatility* is the leverage-weighted average of the firm's 1-year historic equity volatility and average bond volatility for the same rating. *Log(Assets)* is the logarithm of the total book assets of the issuing firm in millions of dollars. *Risk-free rate* is the 5-year constant maturity Treasury rate. Fama–MacBeth regressions with the Newey–West standard errors adjustment are estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings for each factor on a constant. Only one randomly selected observation per firm is included every month. N is the average number of observations in monthly cross-sectional observations. Values of t-statistics are reported in parentheses. Coefficients marked ***, **, and * are significant at the 1%, 5%, and 10% significance level, respectively.

	All			AAA-AA	A	BBB	BB-B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Leverage	1.66***	1.69***	1.70***	0.790***	0.318***	0.793***	2.22***
	(17.40)	(17.95)	(19.75)	(5.78)	(6.76)	(7.12)	(5.25)
Asset volatility	116***	118***	109***	26.7***	19.1***	53.4***	258***
	(11.29)	(11.56)	(14.07)	(2.86)	(3.27)	(4.72)	(2.58)
Time to maturity		1.26***	1.27***	0.740***	1.25***	1.61***	2.85***
		(12.87)	(13.63)	(3.96)	(13.20)	(17.33)	(5.47)
Log(Assets)			−13.2***	−2.71*	−2.82***	−6.34***	−12.4***
			(−14.74)	(−1.80)	(−3.82)	(−3.23)	(−6.09)
Risk-free rate	−0.078	−0.101	−0.121	−0.341**	−0.158**	−0.286**	0.197
	(−0.97)	(−1.30)	(−1.49)	(−2.33)	(−2.08)	(−2.22)	(0.44)
Const.	67.7	69.0	197***	255***	178***	274***	−38.7
	(1.47)	(1.56)	(4.10)	(2.89)	(4.00)	(3.68)	(−0.14)
$\bar{R}^2$	22.2%	25.5%	32.4%	53.5%	24.1%	27.0%	54.1%
N	190.65	190.65	190.65	18.292	80.986	73.056	20.814
	(72)	(72)	(72)	(72)	(72)	(72)	(72)

issuer in each of the 72 calendar months during the sample period 1994 to 1999. The analysis is then repeated for 100 such random samples.

The randomly selected 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. In the first stage, we run a cross-sectional regression for each of the 72 calendar months. In the second stage, the 72 estimated coefficients are regressed on the constant, using the Newey–West adjustment to control for serial correlation.[16]

B. Nonstrategic Risk Factors

Table V presents the results of regressions of credit spreads on nonstrategic variables. Columns (1) to (3) report the results for all firms, while in

[16] While the whole sample and subsamples with one *bond* trade per month are biased toward large issuers, our tests on these subsamples produce results similar to those obtained when one *firm* trade per month is selected. We also estimate pooled regressions with monthly dummy variables, with very similar results.

regressions (4) to (7) bonds are grouped by rating. Coefficients for both asset 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 30 basis points; a one-standard deviation increase in asset volatility increases spreads by about 14 basis points. There is also a statistically significant term premium of about 1.3 basis points per year of maturity. The economic significance of the risk-free rate is small, amounting to a decrease in spread of about 1 basis point for an increase in the risk-free rate of as high as 8 to 10 percentage points. The table also indicates that spreads are negatively related to the issuer's size, perhaps due to liquidity and information issues. It is interesting to compare regression results for different rating classes; we discuss these in more detail later in this section.

C. Strategic Factors and Hypothesis Testing

The main part of our empirical analysis relates credit spreads to variables that influence strategic actions, based on the hypotheses formulated in Section I. In our base case specification, we use *nonfixed assets*, *CEO shareholding*, and the *number of bond issues* to proxy for liquidation costs, equity's bargaining power, and renegotiation frictions, respectively. We also control for all nonstrategic risk factors discussed in the previous subsection. Coefficients for these variables are stable and very significant in all our tests. To conserve space, we do not report them in the tables that follow, with the exception of the robustness table.

We hypothesize that higher liquidation costs and bargaining power of equity result in higher spreads regardless of whether equityholders can default strategically or not. Columns (1) to (4) of Table VI show that *nonfixed assets*, *market-to-book asset ratio*, *R&D*, and the *nonutility dummy* are all positively and significantly related to spreads. In regressions (1)–(3), a one-standard deviation increase in each variable increases spreads by about 1–10 basis points. The contribution of each proxy to the *level* of spreads (as opposed to their *variation*) can be calculated assuming that the value of zero corresponds to "zero liquidation costs"; in this case the average effect can be estimated as the product of the coefficient and the mean value of the variable. Using this approach, the contribution of nonfixed assets is 5 basis points, while the market-to-book ratio and R&D contribute about 2 basis points each. Regression (4) shows that spreads for utility firms are 21.4 basis points lower than for similar nonutility firms. This is consistent with low liquidation costs for utility firms, although some of the quantitative impact is likely attributable to other special features of regulated utilities that make their bonds safer.

Table VI also shows the effect of bargaining power in potential future renegotiations. Coefficients for both *CEO* and *institutional shareholding* are positive and highly statistically significant. A one-standard deviation increase in these variables typically increases spreads by about 4 basis points. The coefficient for *CEO tenure*, which is related to managerial entrenchment and firm-specific human capital, is insignificant, but has the predicted sign.

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. *Nonfixed assets* are one minus the ratio of net property, plant, and equipment to 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 investment expenditure. *Nonutility* is a dummy variable equal to zero if the firm is a utility, and one otherwise. *CEO shareholding* and *Institutional shareholding* are the percentages of common equity owned by the CEO and institutional investors, respectively. *CEO tenure* is the number of years since the CEO's appointment as of the date of trade. *Norm. no. of issues* is the ratio of the logarithm of the number of bond issues outstanding on the trade date to the logarithm of total debt. *Herfindahl* is the Herfindahl index of outstanding public bond issues. *Short-term debt* is the ratio of debt in current liabilities to total debt. *Public debt* is the ratio of public to total debt. *Norm. no. of shareholders* is ratio of the logarithm of the number of institutional shareholders to the logarithm of total market value of equity. *Leverage*, *Asset volatility*, *Log(Assets)*, *Risk-free rate*, and the intercept are also included in all specifications. Fama–MacBeth regressions with the Newey–West standard errors adjustment are estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings for each factor on a constant. Only one randomly selected observation per firm is included every month. N is the average number of observations in monthly regressions. Values of t-statistics are reported in parentheses. Coefficients marked *** and ** are significant at the 1% and 5% significance level, respectively.

Factor	Proxy	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Liquidation costs	*Nonfixed assets*	0.086***				0.148***	0.181***	0.086***	0.227***	0.123	0.111***
		(3.46)				(5.26)	(3.90)	(3.17)	(9.02)	(1.60)	(4.77)
	Market-to-book		1.31**								
			(2.56)								
	R&D			0.731***							
				(2.93)							
	Nonutility				21.4***						
					(13.54)						
Bargaining power	*CEO shareholding*	1.15***	1.15***	2.73***	1.04***			1.15***	1.03***	0.354	1.12***
		(7.56)	(7.12)	(7.39)	(6.64)			(7.59)	(6.82)	(0.62)	(6.98)
	Inst. shareholding					0.232***					
						(9.06)					
	CEO tenure						0.128				
							(0.81)				
Renegotiation frictions	*Norm. no. of issues*	−27.2***	−30.9***	−7.81	−23.5***	−36.6***	−52.5***				
		(−7.34)	(−8.70)	(−1.31)	(−6.67)	(−9.32)	(−4.81)				
	1 − Herfindahl index							−0.139***			
								(−3.99)			
	Short-term debt								−0.496***		
									(−26.79)		
	Public debt									−0.461***	
										(−4.90)	
	Norm. no. of shareholders										−90.1**
											(−2.30)
$\bar{R}^2$		33.8%	33.8%	39.2%	34.9%	35.3%	47.1%	33.8%	35.8%	45.0%	33.8%
N		170.8	168.9	93.3	170.8	190.4	58.6	170.8	170.8	107.0	170.8
		(72)	(72)	(72)	(72)	(72)	(71)	(72)	(72)	(48)	(72)

The results presented thus far confirm that higher liquidation costs and bargaining power of equity result in higher spreads. These results 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. However, 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 as reported by Schultz (2001).

The impact of liquidation costs and bargaining power on spreads is consistent with both the bargaining in default and the strategic default effects. To discriminate between the two competing explanations, we now turn to tests of Hypothesis 2, which is central to our study. This hypothesis states that if the influence of strategic actions on spreads is mostly due to the fact that recovery rates are determined in bargaining, then renegotiation frictions should unambiguously increase spreads. By contrast, if strategic default is important, then the resulting impact depends on which of the two effects dominates.

Table VI shows that spreads are significantly influenced by all our proxies for renegotiation frictions. The direction of the influence is consistent across the five proxies: Spreads are lower when renegotiation is difficult. This implies that in our sample the threat of strategic default dominates the benefits of avoiding liquidation costs in renegotiation, so that overall the possibility of renegotiation results in higher spreads. Thus, contingent claims models that allow for strategic debt service may indeed capture important features of debt markets ignored in models with exogenous default.

However, the magnitude of the effect reflected in the coefficient values for the whole sample is modest. A one-standard deviation increase in the *normalized number of issues* decreases spreads by 1 to 7 basis points, while the marginal impact of the *Herfindahl index* is 3 basis points and that of the proportions of *short-term debt* and *public debt* is 8 basis points each. The effect of the possibility of renegotiation on the average level of spreads can be estimated by multiplying the coefficients by the average value of the variables normalized so that their values of zero correspond to the case of no renegotiation.[17] This contribution is between 3 and 5 basis points for the *Herfindahl index* and *public debt*. Only for the *short-term debt* does the implied impact have a considerable magnitude of 41 basis points. However, the interpretation of the economic impact of this variable is unclear, since it is unlikely that when all debt is short term, it is renegotiation-proof.[18]

It should be pointed out that the quantitative impact of strategic factors may actually be higher than implied by the reported numbers, because our proxies are noisy measures of the underlying strategic variables. Moreover, our estimates may also be affected if the firm's leverage and other characteristics depend on the possibility of debt renegotiation, as discussed in Section IV.D.

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

[18] By contrast, dispersedly held public debt may well be renegotiation-proof (see Hege and Mella-Barral (2005)).

These caveats notwithstanding, the reported magnitudes of the effect of strategic default are certainly considerably less than those predicted for extreme cases in models such as Anderson and Sundaresan (1996) and Mella-Barral and Perraudin (1997), where all the bargaining power is assumed to belong to equity. Our findings are more consistent with the assumption that creditors have considerable bargaining power, resulting in a positive recovery effect that partially offsets the strategic default effect. These results suggest that while models of strategic debt service are relevant empirically, they cannot remedy the poor empirical performance of traditional models of credit risk.

D. The Sensitivity to Strategic Actions under Different Conditions

We proceed to establish the conditions under which the effect of strategic actions on spreads is likely to be relatively more pronounced, as discussed in Hypotheses 3–5. We test the hypotheses by studying interaction terms constructed from pairwise combinations of proxies for each of the three strategic factors (liquidation costs, bargaining power, and renegotiation frictions). The results of these tests are reported in Table VII. To avoid multicollinearity, proxies used in constructing a particular interaction term are not included in regressions with that term; alternative proxies for the same factors are employed instead. Toward this end, we use the *number of issues* and *short-term debt* for renegotiation frictions, and *market-to-book* and *nonfixed assets* for liquidation costs. Thus, the *Liquidation costs* × *Frictions* cross-term in regression (5) of Table VII equals *Market-to-book* ×*Short-term debt*. For bargaining power, however, the correlation between *CEO shareholding* and *institutional shareholding* is low, suggesting that they are noisy proxies reflecting different aspects of bargaining power. We deal with this problem by using *managerial shareholding*, estimated as the proportion of equity held by the five highest-paid executives, to construct the bargaining power interaction terms, and by using *CEO shareholding* as a control variable.

Hypothesis 3 states that the impact of strategic debt service should be higher when equity's bargaining power is high. This implies that the cross-term of equity's bargaining power and renegotiation frictions should be negatively related to spreads, since the negative strategic default effect increasingly dominates the positive recovery effect as equity's power increases. Columns (1) to (2) of Table VII confirm that this appears to be the case in our sample: The cross-terms of bargaining power and the two proxies for renegotiation frictions are negative and significant. Thus, the impact of renegotiation on debt value is more adverse when creditors lack bargaining power.

Hypothesis 4 predicts that the correlation of spreads with equity's bargaining power should become more positive as liquidation costs increase. This implies that the interaction term between liquidation costs and bargaining power is expected to be positive. Columns (3) to (4) of Table VII provide support for this prediction: The cross-terms are positive and significant. Higher liquidation costs appear to amplify the adverse impact of equity's bargaining power on spreads.

Finally, Hypothesis 5 predicts that since the importance of strategic actions increases with liquidation costs, the product of liquidation costs with

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. *Nonfixed assets* are one minus the ratio of net property, plant, and equipment to total assets. *Market-to-book* is the ratio of the quasi-market value of assets to their book value. *CEO shareholding* is the percentage of common equity owned by the CEO. *Norm. no. of issues* is the ratio of the logarithm of the number of bond issues outstanding on the trade date to the logarithm of total debt. *Short-term debt* is the ratio of debt in current liabilities to total debt. For each regression, the interaction term is a product of the two alternative proxies for the relevant factors not already included as the control variable in that regression (*Managerial shareholding*, estimated as the proportion of common equity owned by five highest-paid executives, is used as a proxy for bargaining power). *Leverage*, *Asset volatility*, *Log(Assets)*, *Risk-free rate*, and the intercept are also included in all specifications. Fama–MacBeth regressions with the Newey–West standard errors adjustment are estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings for each factor on a constant. Only one randomly selected observation per firm is included every month. N is the average number of observations in monthly regressions. Values of t-statistics are reported in parentheses. Coefficients marked *** and ** are significant at the 1% and 5% significance level, respectively.

		Hypothesis 3		Hypothesis 4		Hypothesis 5			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Liquidation costs	*Nonfixed assets*	0.077***	0.192***	0.048**		0.100***	0.203***		
		(3.15)	(7.34)	(2.06)		(4.08)	(8.62)		
	Market-to-book				1.05**			1.92***	2.09***
					(2.09)			(3.95)	(4.56)
Bargaining power	*CEO shareholding*	1.41***	2.10***	0.999***	1.03***	0.955***	0.870***	0.984***	0.937***
		(9.50)	(7.85)	(6.83)	(6.73)	(6.91)	(6.28)	(6.67)	(6.30)
Renegotiation frictions	*Norm. no. of issues*	−24.7***				−29.2***		−37.2***	
		(−6.47)				(−7.37)		(−9.81)	
	Short-term debt		−0.457***	0.025***	0.001***		−0.468***		−0.397***
			(−25.33)	(3.35)	(3.34)		(−26.57)		(−27.12)
Bargaining power × Frictions		−0.041**	−5.39***						
		(−2.35)	(−4.55)						
Liquidation costs × Bargain. power				0.025***	0.001***				
				(3.35)	(3.34)				
Liquidation costs × Frictions						−0.074***	−0.400	−0.005***	−0.066
						(−6.54)	(−0.23)	(−21.73)	(−1.19)
$\bar{R}^2$		0.33	0.35	0.33	0.33	0.33	0.35	0.34	0.34
N		167.5	167.5	165.7	165.7	165.9	165.9	165.9	165.9
		(72)	(72)	(72)	(72)	(72)	(72)	(72)	(72)

renegotiation frictions should be negatively correlated with spreads. Columns (5) to (8) of Table VII show that this appears to be the case in our sample. All four interaction terms between liquidation costs and renegotiation frictions are negative, and two of them are significant.

Overall, our tests indicate that the adverse effect of strategic default on debt spreads is higher when bondholders' bargaining position (bargaining power and the outside option) in potential renegotiations is likely to be weak. This is the case when managers have high equity stakes and when the proportion of tangible assets that cannot be easily destroyed if renegotiation fails is low. The presence of second-order effects manifested in our cross-term tests despite the use of noisy empirical proxies suggests that the effect of strategic actions on spreads is robust.

E. The Effect of Bond Ratings

Bond ratings reflect a variety of credit risk factors that are unlikely to be fully captured by our measures of leverage and volatility. In our tests in this subsection, we treat the firm's senior unsecured rating as a black-box summary of its credit risk, and study the effect of our strategic and nonstrategic variables for different rating groups. Admittedly, part of the credit risk captured in ratings, but not in the leverage/volatility-type variables, may be due to strategic default. We hope to capture the variation of the importance of strategic debt service within rating classes.

We first estimate regressions of spreads on nonstrategic variables when the sample is stratified by rating. The results of these regressions are shown in columns (4) to (7) of Table V. All variables have the same signs as in the whole sample and generally remain highly significant, despite controlling for credit risk by using rating groups. Apart from regression (4), where the number of observations in the Fama–MacBeth regressions is small, the coefficients on risk factors monotonically increase as ratings deteriorate. This suggests that default risk plays a greater role in explaining lower grade bond spreads, consistent with the findings of Huang and Huang (2003).

We proceed to estimate the effect of our strategic proxies on spreads for two groups of bonds, namely, those rated A and higher, and those rated A– and lower, where A– is the median bond rating in the sample.[19] Our expectation is that strategic debt service should not influence spreads greatly for high ratings, since default (including strategic default) is a relatively less important determinant of spreads for these bonds. However, conditional on a higher probability of default, the incentive to default strategically is higher (as equityholders have little to lose when default is imminent anyway) and the expected recovery rate is

[19] We combine bonds in this way because there are not enough observations to study lowest and highest rating classes separately in Fama–MacBeth regressions. We also estimate pooled regressions by rating groups instead of using the high-grade dummy, and find the same pattern as reported here.

more important. The latter may be especially true when default is unavoidable, in which case the introduction of renegotiation should lower spreads.

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 multiply this dummy by proxies for the three strategic factors. Table VIII presents the results of these tests. For all our strategic proxies, the effect documented above for all firms is in fact more pronounced for lower ratings, and, apart from bargaining power, the difference between rating classes is statistically significant. Moreover, the values of the coefficients suggest that while the strategic effect may be considerable for low-grade bonds, for high-grade bonds it is likely to be smaller in magnitude or even change sign. For example, the coefficient for the normalized number of issues in specification (1) is –37.0 for the low-grade subsample, but +9.4 for higher-grade bonds. Similar patterns obtain for other strategic variables. The only exception relates to the CEO and institutional shareholding proxies, for which the cross-term is insignificant, although their signs conform to the general pattern. Overall, strategic actions appear much more relevant for pricing of lower grade bonds than safer bonds.

IV. Robustness and Alternative Interpretations

A. Alternative Interpretations

One can argue that since our variables are noisy proxies for the strategic factors we want to study, their observed correlation with spreads may be spurious. It is difficult, for example, to find a perfect proxy for bargaining power. Fortunately, the quality of bargaining power proxies is not central in our analysis, as our major conclusions are based on the effect of renegotiation frictions. In contrast to bargaining power, which describes the hypothetical division of the renegotiation surplus, firm characteristics that make renegotiation difficult have been documented in a number of empirical and theoretical papers. The consistency of the effect that we find for our five very distinct proxies for renegotiation frictions on spreads provides confidence in the conclusions. Even so, one can think of alternative mechanisms unrelated to strategic actions that could cause the correlation of our proxies with spreads. Below we discuss a number of such potential alternative explanations, and argue that they are unlikely to be behind our findings.

Managerial shareholding (positive correlation with spreads): High share ownership by the CEO may change her attitude toward risk. If managers' individual wealth is nondiversified and largely invested in their firm's equity, the managers may have incentives 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. An alternative view is that CEOs with high equity stakes may want to *increase* the risk of the projects in order to maximize the value of their limited-liability option (Jensen and Meckling (1976)). This risk-shifting behavior could potentially produce the observed positive correlation between CEO shareholding and

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 one if the bond rating at the date of trade is A or above, and zero otherwise. *Nonfixed assets* are one minus the ratio of net property, plant, and equipment to total assets. *Market-to-book* is the ratio of the quasi-market value of assets to their book value. *CEO shareholding* and *Institutional shareholding* are the percentages of common equity owned by the CEO and institutional investors, respectively. *Norm. no. of issues* is the ratio of the logarithm of the number of bond issues outstanding on the trade date to the logarithm of total debt. *Short-term debt* is the ratio of debt in current liabilities to total debt. *Leverage*, *Asset volatility*, *Log(Assets)*, *Risk-free rate*, and their products with the *High grade* dummy, as well as the intercept, are also included in all specifications. Fama–MacBeth regressions with the Newey–West standard errors adjustment are estimated by running cross-sectional monthly regressions over the whole period (72 months) and then regressing loadings for each factor on a constant. Only one randomly selected observation per firm is included every month. N is the average number of observations in monthly regressions. Values of t-statistics are reported in parentheses. Coefficients marked *** and * are significant at the 1% and 10% significance level, respectively.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Liquidation costs	*Nonfixed assets*	0.072***		0.127***		0.101***		0.167***	
		(5.04)		(8.28)		(6.63)		(9.01)	
	Nonfixed assets ∗ High grade	−0.048		−0.085***		−0.102***		−0.136***	
		(−1.57)		(−2.63)		(−3.30)		(−4.00)	
	Market-to-book		3.45***		3.87***		3.99***		4.27***
			(6.66)		(7.80)		(7.64)		(8.52)
	Market-to-book ∗ High grade		−4.91***		−5.11***		−5.56***		−5.62***
			(−6.97)		(−6.89)		(−9.08)		(−8.87)
Bargaining power	*CEO shareholding*	0.506***	0.303	0.584***	0.381*				
		(2.75)	(1.54)	(3.18)	(1.95)				
	CEO shareholding ∗ High grade	−0.168	−0.021	−0.556	−0.304				
		(−0.36)	(−0.04)	(−1.09)	(−0.57)				
	Inst. shareholding					0.132***	0.143***	0.128***	0.152***
						(5.13)	(5.13)	(5.24)	(5.78)
	Inst. shareholding ∗ High grade					−0.016	−0.023	−0.047	−0.053
						(−0.43)	(−0.60)	(−1.23)	(−1.39)
Renegotiation frictions	*Norm. no. of issues*	−37.0***	−37.6***			−40.3***	−41.6***		
		(−8.12)	(−7.93)			(−8.59)	(−9.06)		
	Norm. no. of issues ∗ High grade	46.4***	41.5***			49.2***	46.9***		
		(7.34)	(6.32)			(7.35)	(6.94)		
	Short-term debt			−0.468***	−0.411***			−0.627***	−0.536***
				(−16.78)	(−15.07)			(−20.18)	(−18.61)
	Short-term debt ∗ High grade			0.327***	0.297***			0.490***	0.418***
				(8.40)	(8.53)			(11.62)	(11.12)
$\bar{R}^2$		0.37	0.36	0.37	0.37	0.37	0.37	0.38	0.38
N		168.83	166.94	168.83	166.94	187.47	184.93	187.47	184.93
		(72)	(72)	(72)	(72)	(72)	(72)	(72)	(72)

spreads. To account for this possibility, we control for risk-taking incentives using the number of the CEO's unexercised options with the firm (normalized by the number of outstanding shares). Since unexercised options affect risk-taking incentives but not bargaining power in default, controlling for the number of options should allow us to disentangle the two possible mechanisms through which CEO shareholding could be affecting spreads.[20] The results are reported in regression (1) of Table IX. Consistent with the risk-shifting hypothesis, the number of CEO's options is positively and significantly related to spreads. However, CEO shareholding remains strongly significant despite the presence of this control variable, suggesting that its impact cannot be explained by risk-shifting behavior.

Another possibility is that CEO share ownership affects spreads because of its disciplining role on the CEO (Jensen and Meckling (1976)). This conjecture cannot explain our finding either, since better corporate governance in firms with high managerial shareholding should, if anything, increase firm value and result in lower spreads.

Institutional shareholding (positive correlation with spreads): High institutional shareholding may imply lower risk, as some institutions cannot invest in very risky companies for regulatory reasons. However, in this case we would expect a negative correlation with spreads, which is contrary to what we find. Also note that while *institutional shareholding* (our proxy for bargaining power) is positively related to spreads, *the number of institutional shareholders* (our proxy for renegotiation frictions) exhibits a negative correlation. While consistent with the effect of strategic actions, these two findings are difficult to explain simultaneously by other mechanisms.

Number of bond issues / total debt (negative correlation with spreads): A high number of bond issues may imply a high number of protective covenants, which may increase the value of all bonds. In this case we would expect spreads to be negatively related to the number of issues. We control for the number of different covenant types recorded for outstanding bonds in the FISD database in regression (2) of Table IX, and find that firms with many covenants have high (rather than low) spreads. This result is likely due to the fact that risky firms have both more covenants and higher spreads than safe firms. For our purposes, the important finding is that the number of bond issues remains highly significant when we control for covenants, even though the coefficient becomes smaller.

An alternative source of spurious correlation of the number of bond issues with spreads could be due to bond liquidity. When there are many bond issues outstanding for a particular firm, all bonds may be more liquid, resulting in lower spreads. This liquidity effect might explain negative correlation of spreads with the number of bond issues. However, it is not clear why the *per dollar* number of issues that we use should be positively related to liquidity.

[20] We also construct an estimate of the Black–Scholes value of CEO options as a proportion of her total wealth tied to the company. While the significance of this variable is much higher, coefficients for CEO shareholding are unaffected. We report the number rather than the value of options, since the latter could be a nonlinear proxy for firm volatility.

Table IX

Robustness Regressions

Except for regressions (5) and (6), the dependent variable is the annualized credit spread in basis points relative to a cash flow-matched portfolio of STRIPS. In regressions (5) and (6) the dependent variable is the observed credit spread relative to a cash flow-matched portfolio of STRIPS, minus the spread predicted for the bond by the Merton (1974) model. *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 trade date. *Asset volatility* is the leverage-weighted average of the firm's 1-year historic equity volatility and average bond volatility for the same rating. *KMV volatility* is the volatility of the firm's assets estimated from the Merton (1974) model. *Time to maturity* is the remaining time to maturity at the trade date. *Log(Assets)* is the logarithm of the total book assets of the issuing firm in millions of dollars. *Risk-free rate* is the 5-year constant maturity Treasury rate. *Nonfixed assets* are one minus the ratio of net property, plant, and equipment to total assets. *CEO shareholding* is the percentage of common equity owned by the CEO. *Norm. no. of issues* is the ratio of the logarithm of the number of bond issues outstanding on the trade date to the logarithm of total debt. *Short-term debt* is the ratio of debt in current liabilities to total debt. *No. of covenants* is the number of different covenant types included in the indentures for the outstanding bonds. *CEO options* is the number of options (exercisable and nonexercisable) granted to the CEO divided by the number of shares owned by the CEO. *Debt trading volume* is the total volume of trade for all bonds of the issuer recorded in the NAIC database, divided by the book value of debt outstanding. Fama–MacBeth regressions with the Newey–West standard errors adjustment are estimated by running cross-sectional monthly ordinary least squares regressions (except for regression (7), which is an instrumental regression employing lagged leverage as an instrument for the firm's leverage) over the whole period (72 months) and then regressing loadings for each factor on a constant. Only one randomly selected observation per firm is included every month. N is the average number of observations in monthly regressions. Values of t-statistics are reported in parentheses. Coefficients marked ***, **, and * are significant at the 1%, 5%, and 10% significance level, respectively.

	Controls			Nonlinearity			IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Leverage	1.48***	1.50***	1.59***	1.58***	0.351***	0.325***	1.59***
	(20.12)	(24.88)	(24.08)	(25.41)	(3.47)	(3.19)	(23.95)
Asset volatility	70.2***	70.4***	75.6***		−23.8**	−28.2***	76.2***
	(11.67)	(12.99)	(13.15)		(−2.32)	(−2.72)	(13.17)
KMV volatility				180***			
				(14.41)			
Time to maturity	1.34***	1.40***	1.38***	1.30***	1.19***	1.18***	1.37***
	(17.56)	(17.59)	(7.04)	(16.19)	(14.28)	(14.56)	(16.73)
Log(Assets)	−10.9***	−9.89***	−10.3***	−9.37***	−7.37***	−6.43***	−10.4***
	(−18.64)	(−16.21)	(−17.38)	(−15.71)	(−17.64)	(−13.73)	(−17.20)
Risk-free rate	−0.143	−0.119	−0.108	−0.108	−0.117	−0.134	−0.110
	(−1.21)	(−1.04)	(−0.93)	(−0.94)	(−1.10)	(−1.27)	(−0.95)
Nonfixed assets	0.060***	0.078***	0.084***	0.050*	0.047*	0.138***	0.086***
	(2.89)	(3.11)	(3.33)	(1.82)	(1.77)	(4.97)	(3.46)
CEO shareholding	1.61***	1.18***	1.14***	1.09***	1.01***	0.857***	1.15***
	(10.03)	(8.08)	(7.51)	(7.26)	(6.49)	(5.58)	(7.56)
Norm. no. of issues	−22.8***	−12.0***	−27.2***	−23.7***	−4.92*		−27.2***
	(−4.76)	(−3.06)	(−7.34)	(−6.07)	(−1.73)		(−7.34)
Short-term debt						−0.369***	
						(−13.21)	
CEO options	1.02***						
	(6.02)						
No. of covenants		3.64***					
		(9.75)					
Debt trading volume			0.059				
			(0.61)				
Const.	201***	168**	176**	149**	199***	203***	179***
	(2.83)	(2.44)	(2.55)	(2.17)	(3.13)	(3.24)	(2.61)
$\bar{R}^2$	0.37	0.36	0.34	0.37	0.20	0.22	0.34
N	154.58	170.81	170.81	170.71	161.25	161.25	170.81
	(72)	(72)	(72)	(72)	(72)	(72)	(72)

We nevertheless explore this possibility by proxying for liquidity using the total volume of trades in the firm's bonds recorded in our NAIC transactions database. Regression (3) of Table IX shows that the trading volume normalized by total debt is not significant, and its presence only makes the effect of the number of bonds more pronounced. We obtain similar results when we use the number of bond trades instead of the volume, and when we normalize by other variables instead of the total debt. Thus, neither the number of covenants nor liquidity can account for the negative correlation between spreads and the number of bond issues.

Short-term / total debt (negative correlation with spreads): Higher short-term liabilities may imply a higher probability of liquidity shortages, 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. In addition, outside of bankruptcy short-term debt is effectively a more senior claim on the firm's assets than long-term debt, since it is repaid first (Gertner and Scharfstein (1991), Berglöf and von Thadden (1994)). Again contrary to what we find, this suggests that the value of long-term bonds should be lower when there is a lot of short-term debt.

Public / total debt (negative correlation with spreads): A higher proportion of privately held debt may result in more monitoring by sophisticated investors (Rajan (1992)), which should benefit all creditors and reduce bond spreads rather than increase them. Thus, monitoring cannot explain the negative correlation that we observe.

To conclude, alternative explanations are mostly incompatible with the strategic mechanism and they do not appear to explain our empirical findings. The overall consistency of our results across diverse proxies suggests that the effect of strategic factors dominates alternative channels of influence of our proxies on spreads. However, it should be noted that when the direction of influence due to strategic factors is the opposite of that due to alternative mechanisms, the quantitative impact of the purely strategic factors may be underestimated in our tests.

B. Controls for Nonlinear Effects

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

To control for possible nonlinear effects, we employ the following procedure. For every observation in our sample, we estimate the debt spread implied by the Merton (1974) model and subtract it from the actually recorded spread. We thus obtain the spread residual that is presumably uncorrelated with leverage and volatility, and we test whether strategic variables can explain this residual. While the degree of nonlinearity admittedly varies across existing models, no existing model is clearly superior. For this reason we follow other studies in using the Merton (1974) model, which is the simplest model available.

We apply the modified calibration approach used by the KMV Corporation, as outlined in Crosbie and Bohn (2001) and implemented by Vassalou and Xing (2004), to estimate the volatility of assets. As inputs, the procedure uses a year-long time series of equity values and debt outstanding, the latter taken to be the face value of debt in the Merton model. These inputs are used to find a time series of asset values that (1) make the Merton-predicted equity values consistent with the observed equity prices on each trading day for the last year, and (2) have the volatility that is assumed in these Merton equity value calculations. In regression (4) of Table IX we use KMV asset volatility estimates instead of our previous estimates. The only difference in results is that the coefficient for KMV volatility is higher and slightly more significant; strategic proxy coefficients are not materially affected.

Armed with the estimates of asset volatility from the KMV procedure, we calculate the residual spread unexplained by the Merton model. We estimate our strategic regressions using this residual as the left-hand side variable. Two examples of these tests are reported in columns (5) to (6) of Table IX. Consistent with our expectations, the significance of leverage is greatly reduced once the Merton spread is taken out. The coefficient for asset volatility actually changes its sign. This may be due to possible "overcompensation" by the Merton model, which is very sensitive to volatility estimates. Alternatively, the noise in historic volatility estimates may have resulted in similar noise in the estimated Merton spreads, implying a negatively correlated residual. The main finding for our purposes is that our main conclusions regarding the importance of strategic actions are essentially unaltered.

C. Robustness to Specification and Frequency of Variable Measurement

We test the robustness of our results by using different proxies for liquidity, volatility, maturity, and risk-free rates. We use other size measures instead of log-assets, duration instead of remaining maturity, and various short-term and longer-term risk-free interest rates as other proxies for the risk-free rate. Our results are unaffected by these changes. We also employ pooled instead of Fama–MacBeth regressions, and construct our data panel in different ways. In our main tests reported previously, we select one observation per firm to avoid a bias toward large firms with many trades. In so doing we may have introduced a "reverse bias" against firms with many bonds, and may have lost efficiency by considering only a subsample of the data. We repeat the analysis randomly selecting one bond (rather than firm) trade per month; in most cases the results are very close to those reported here. We find that in such random samples some weakly significant and insignificant coefficients in tests of Hypotheses 3–5 change signs and become insignificant/significant. Overall, our main results are unaltered.

Corporate spreads employed in our empirical analysis are recorded within a few days of the trade date. While some independent variables we use are also measured on the day of trade, a number of variables are based on Compustat data recorded on an annual basis.[21] We explore whether the quality of the explanatory variables is sufficient for our purposes by studying only trades executed within 4 months of the issuer's fiscal year-end, before annually reported variables become stale. The results again are very similar to the base case.

D. Endogeneity

A potential question about our inference is whether our renegotiation friction proxies could be determined endogenously, depending on credit spreads. One may argue, for example, that when credit spreads are consistently low the firm might want to increase its public debt issuance, and the number of bond issues would increase 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 that influence capital structure are also likely to affect spreads directly.[22] To explore the potential importance of such issues, we use lagged leverage as an instrument for current leverage, which may be endogenous to the cost of debt. Regression (7) of Table IX shows that the effect of strategic variables on spreads is unaltered. This result is consistent with capital structure studies that argue that leverage is a path-dependent variable that changes only infrequently (e.g., Leary and Roberts (2005)), implying that it is unlikely to be endogenous to the contemporaneous cost of debt. Nevertheless, we must stress that lagged leverage may also depend on the possibility of debt renegotiation, which may influence all capital structure decisions, including the target leverage level (if any) as well as the restructuring policy. As a result, this may affect our numerical estimates of the effect of strategic variables on credit spreads.

The possible effects of endogeneity of strategic proxies are likely to be mitigated by our use of normalized variables. For example, while lower credit spreads may result in higher public bond issuance and a higher number 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-term to total debt we expect the effect of endogeneity to work in the opposite direction to that actually found: If bond spreads are low, the firm would tend

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

[22] 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 attempt 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 a valid instrument, as even such robust determinants of spreads as leverage and volatility lose their significance in these tests.

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-term to total debt ratio. Finally, it is hard to think of a reason why managerial and institutional shareholding could be endogenous and positively related 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.

However, the magnitudes of the coefficients in spread regressions may be affected by the fact that our right-hand side variables could be optimally chosen in the presence of the possibility of strategic renegotiation. For example, Hackbarth et al. (2007) predict that the proportion of public debt (and potentially other proxies for renegotiation frictions) should be positively related to equityholders' bargaining power. If that is the case, then the effect of bargaining power on spreads comprises the direct strategic effect and the indirect effect due to its influence on the optimally chosen level of renegotiation frictions. The presence of the indirect effect may bias the estimated coefficients for bargaining power in spread regressions *downwards* without changing our conclusions qualitatively. To see this formally, suppose that the only indirect influence of bargaining power, η, on spreads, s, comes from the fact that renegotiation frictions, q, depend on η in the cross-section. Then the total effect can be decomposed as

$$\frac{ds}{d\eta} = \frac{\partial s}{\partial \eta} + \frac{\partial s}{\partial q}\frac{\partial q(\eta)}{\partial \eta}.$$

We are interested in the direct effect of bargaining power on spreads, $\partial s/\partial \eta$. Hackbarth et al. (2007) show that when equityholders' bargaining power is high, firms will optimally choose high public-to-private debt ratios to deter strategic renegotiation. Thus, renegotiation frictions should be increasing in η, so that $\frac{\partial q(\eta)}{\partial \eta} > 0$. Moreover, our tests in Section III show that spreads are negatively correlated with frictions, $\frac{\partial s}{\partial q} < 0$. Therefore, the second term on the right-hand side should be negative. At the same time, we find that the total effect of bargaining power on spreads is positive: $\frac{ds}{d\eta} > 0$. It follows that the direct effect should also be positive and greater than implied by our estimates. While it is difficult to ascertain the magnitude of the bias, it does not affect our conclusions regarding the direction and the significance of the influence of bargaining power on spreads.

V. Summary and Conclusions

Models of risky debt with strategic debt service suggest that strategic considerations may be an important determinant of corporate debt spreads. A large body of theoretical corporate finance research relates the valuation of corporate debt to renegotiation and bargaining in restructuring. The available empirical evidence, however, is limited to studies of the implications of ex post bargaining for recovery rates in default. This paper is the first to document empirically the influence that strategic behavior of borrowers has on ex ante corporate bond spreads.

We use variables related to debt structure complexity, equity ownership, and asset tangibility to proxy for renegotiation frictions, bargaining power, and liquidation costs. Our main finding is that corporate bond prices do appear to be affected by the possibility of strategic renegotiation, especially when (1) the costs of liquidation and equityholders' bargaining power are likely to be high, (2) the debt structure does not make renegotiation difficult, and (3) the credit quality of the issuer is relatively low. However, despite robust statistical significance of strategic factor proxies, their quantitative contribution to both the average level and the cross-sectional variation of spreads is below transactions costs. The evidence suggests that bondholders are likely to have significant bargaining power, which limits the adverse effect of opportunistic behavior by borrowers. Overall, we conclude that strategic default is not the main factor behind the poor empirical performance of traditional structural models of debt pricing.

Appendix A: Model and Hypothesis Derivation

We augment the Fan and Sundaresan (2000) model of strategic debt service by allowing for renegotiation frictions. Different levels of such frictions correspond to differences in how easy renegotiation is for different firms, allowing us to derive hypotheses regarding the influence of the *possibility* of renegotiation on spreads.

The Fan and Sundaresan (2000) model (FS) is based on the Leland (1994) model of risky infinite-maturity debt and incorporates strategic debt service with varying degrees of equityholders' bargaining power vìs-à-vìs creditors in renegotiations. While FS address a host of questions, the simplest version of their model is sufficient for our purposes. Consider a firm with a single defaultable infinite-maturity bond with an instantaneous coupon c. If the firm defaults on its debt and the claims are settled by the bankruptcy court, proportional liquidation costs of αV are incurred, where V is the value of the firm's assets at default. The balance of the firm's assets is then transferred to the creditors, leaving equityholders with nothing. In addition, costless renegotiation of the debt contract is allowed by means of a debt-for-equity swap, whereby the value of assets is split between equityholders and creditors according to their bargaining power.

Suppose that once renegotiation is initiated, it fails with probability q due to exogenous factors, in which case the claims are settled in bankruptcy according to the absolute priority rule at a cost αV. The parameter q measures various frictions that make renegotiation difficult. It is easiest to think of this setting as corresponding to an out-of-court workout that may fail with some probability, resulting in costly liquidation. Empirical studies document that firms often attempt informal workouts and exchange offers before resorting to formal bankruptcy. These workouts often fail in the presence of many stakeholders with divergent interests. However, the model's framework is not confined to out-of-court renegotiations. For instance, it is also applicable to Chapter 11 reorganizations, which may fail, resulting in a liquidation under Chapter 7. Even when renegotiation ultimately proves successful, frictions make the process costly, which affects the incentives to renegotiate ex ante.

Assume that there are no taxes, the interest rate r is constant, and the value of the firm's assets follows the log-normal diffusion process with a constant payout ratio β. Assume that in renegotiations equityholders and creditors play a Nash bargaining game with respective bargaining power η and $1-\eta$, and the court-administered outcome as the disagreement point. Under these assumptions equityholders' and creditors' payoffs in successful renegotiations are, respectively, $\eta\alpha V_R$ and $(1-\eta\alpha)V_R$, where V_R is the renegotiation-triggering value of assets. This implies that when renegotiation is initiated, the expected value of equity is $(1-q)\eta\alpha V_R$.

The value of equity $E(V)$ satisfies the differential equation

$$0.5\sigma^2 E_{VV} + (r-\beta)VE_V - rE + \beta V - c = 0$$

with the following boundary conditions:

$$\lim_{V\uparrow\infty} E(V) = V - c/r, \quad \lim_{V\downarrow V_R} E(V) = (1-q)\eta\alpha V_R, \quad \lim_{V\downarrow V_R} E_V(V) = (1-q)\eta\alpha.$$

The solution to the PDE is given by

$$E(V;\alpha,\eta,q) = V - (1-P_R)\frac{c}{r} - [1-(1-q)\eta\alpha]V_R P_R, \tag{A1}$$

where

$$V_R = \frac{1}{1-(1-q)\eta\alpha}\frac{-\lambda}{1-\lambda}\frac{c}{r}, \tag{A2}$$

is the renegotiation triggering point,

$$P_R = \left(\frac{V}{V_R}\right)^{\lambda} \tag{A3}$$

is the risk-neutral probability of default and renegotiation, and

$$\lambda = \left[\frac{1}{2} - \frac{r-\beta}{\sigma^2}\right] - \sqrt{\left[\frac{1}{2} - \frac{r-\beta}{\sigma^2}\right]^2 + \frac{2r}{\sigma^2}} < 0. \tag{A4}$$

Equation (A2) implies that the expected recovery for creditors in default is

$$R = (1-q)(1-\eta\alpha)V_R + q(1-\alpha)V_R = \left[1 - \frac{q\alpha}{1-(1-q)\eta\alpha}\right]\frac{-\lambda}{1-\lambda}\frac{c}{r}. \tag{A5}$$

These formulas extend the FS's results for the case of variable renegotiation frictions q. The value of the firm is the value of assets less the expected value of liquidation costs, $q\alpha V_R \times P_R$. The value of debt is therefore equal to

$$\begin{aligned} D(V;\alpha,\eta,q) &= V - q\alpha V_R P_R - E(V) \\ &= (1-P_R)\frac{c}{r} + [1-(1-q)\eta\alpha - q\alpha]V_R P_R \\ &= (1-P_R)\frac{c}{r} + R \times P_R. \end{aligned} \tag{A6}$$

Thus, the value of debt is the renegotiation-probability weighted average of the value of the perpetual coupon stream and the expected recovery rate. Substituting (A2) and (A3) into (A6), the value of debt can be rewritten as

$$D(V;\alpha,\eta,q) = \frac{c}{r} - h(\alpha,\eta,q)\frac{1}{1-\lambda}\left[\frac{1-\lambda}{-\lambda}\frac{r}{c}\right]^{\lambda}\frac{r}{c}V^{\lambda}, \tag{A7}$$

where

$$h(\alpha,\eta,q) = (1-(1-q)\eta\alpha - q\alpha\lambda)(1-(1-q)\eta\alpha)^{\lambda-1}. \tag{A8}$$

The interest rate spread $s = c/D$ depends on the parameters α, η, and q through the monotonic transformation $h(\alpha,\eta,q)$, where higher values of $h(\cdot)$ correspond to higher spreads. Hypotheses 1–5 in the main text are obtained by analyzing the derivatives of $h(\alpha,\eta,q)$, given α, η, and q all between 0 and 1 and $-\sqrt{2r/\sigma^2} \le \lambda < 0$.

First, we demonstrate that high liquidation costs α correspond to higher spreads. Indeed,

$$\frac{\partial h}{\partial \alpha} = -\lambda[q(1-\eta)+\eta(1-\alpha\eta)+q\alpha\eta^2(2-q)-q\alpha\eta\lambda(1-q)](1-(1-q)\eta\alpha)^{\lambda-2} > 0, \tag{A9}$$

implying that spreads are increasing in the liquidation cost parameter α.

HYPOTHESIS 1: *Differentiating h with respect to bargaining power, η, yields*

$$\frac{\partial h}{\partial \eta} = -\alpha\lambda(1-q)[1-\alpha\eta+q\alpha(1+\eta-\lambda)](1-(1-q)\eta\alpha)^{\lambda-2} > 0, \tag{A10}$$

implying that spreads are increasing in the bargaining power of equity. Both the strategic default effect and the recovery rate effect depress debt values for high values of η.

HYPOTHESIS 2: *The risk-neutral probability of default is decreasing in renegotiation frictions, as costly renegotiation discourages strategic default*

$$\frac{\partial P_R}{\partial q} = \frac{\lambda\eta\alpha}{1-(1-q)\eta\alpha}P_R < 0. \tag{A11}$$

However, creditors' expected recovery conditional on default is also lower when renegotiation is difficult

$$\frac{\partial R}{\partial q} = -\alpha \frac{1-\eta\alpha}{(1-(1-q)\eta\alpha)^2} \frac{-\lambda}{1-\lambda} \frac{c}{r} < 0. \tag{A12}$$

The net effect of q on spreads depends on the particular parameters and is given by the following expression:

$$\phi = \frac{\partial h}{\partial q} = -\alpha\lambda[(1-\eta)(1-\alpha\eta) - q\alpha\eta(\eta-\lambda)](1-(1-q)\eta\alpha)^{\lambda-2}. \tag{A13}$$

For low values of η this expression is positive, while for high values of η it is negative, implying that depending on the bargaining power, the possibility of renegotiation can either decrease or increase ex ante debt spreads.

Denote $m = (1-\eta)(1-\alpha\eta) - q\alpha\eta(\eta-\lambda)$. Notice that the sign of ϕ coincides with that of m.

HYPOTHESIS 3: *Differentiating ϕ with respect to bargaining power, η, yields*

$$\begin{aligned}\frac{\partial \phi}{\partial \eta} &= \alpha\lambda[(1-\alpha\eta(1-q))(1-\alpha(1-2q)(1-(1-\eta)\lambda) - q\alpha\eta\lambda) \\ &\quad + q\alpha^2\eta(1-q)(2-3\lambda+\lambda^2)] \times (1-(1-q)\eta\alpha)^{\lambda-3}.\end{aligned} \tag{A14}$$

This expression is always negative for $\eta = 1$. However, for some parameters it can turn positive for low values of η. If ϕ is a monotonic function of η, it must be that $\frac{\partial\phi}{\partial\eta} < 0$ throughout. Also, this expression is always negative when $\phi < 0$. To see this, rewrite it as

$$\frac{\partial \phi}{\partial \eta} = \phi \times \left(\frac{\alpha(1-q)(2-\lambda)}{1-(1-q)\eta\alpha} + \frac{(1-\alpha\eta)+\alpha(1-\eta)+q\alpha(2\eta-\lambda)}{-m}\right).$$

If $\phi < 0$, then necessarily $m < 0$ and the above equation implies $\frac{\partial\phi}{\partial\eta} < 0$. Thus, when the strategic effect dominates the recovery effect, the magnitude of the sensitivity of spreads to renegotiation increases with equity's bargaining power.

HYPOTHESIS 4: *The relevant second derivative of h is*

$$\begin{aligned}\frac{\partial^2 h}{\partial\alpha\partial\eta} &= -\lambda(1-q)[(1-\alpha\eta(1-q)+q\alpha(1-\lambda))(1-\alpha\eta\lambda(1-q)) \\ &\quad + q\alpha(1-\lambda)] \times (1-(1-q)\eta\alpha)^{\lambda-3} > 0.\end{aligned} \tag{A15}$$

Thus, the sensitivity of spreads to bargaining power increases with liquidation costs.

HYPOTHESIS 5: *Differentiating ϕ with respect to liquidation costs, α, yields*

$$\frac{\partial \phi}{\partial \alpha} = \phi \times \left(\frac{1}{\alpha} + \frac{\eta(1-q)(2-\lambda)}{1-(1-q)\eta\alpha} + \eta\frac{(1-\eta)+q(\eta-\lambda)}{-m}\right). \tag{A16}$$

If $\phi < 0$, then necessarily $m < 0$ and the above equation implies $\frac{\partial \phi}{\partial \alpha} < 0$. Thus, when the strategic effect dominates the recovery effect, the magnitude of the sensitivity of spreads to renegotiations increase with liquidation costs.

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 data set that we use (bond trades recorded by the National Association of Insurance Commissioners) is that insurance companies may themselves choose the date they record as the settlement day.[23] Therefore, some prices may be observed on trading days, and others on settlement days. Furthermore, 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 this practice 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, they become more important for very short maturity bonds with large coupons. We deal with this issue by excluding all bonds with time to maturity of less than 1 year at the date of trade.

In the first stage, we calculate the annual yield to maturity of each corporate bond trade using the invoice price of the bond (equal to the flat trade price from the database plus accrued interest) and its cash flow structure. In 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 the 15th of February, May, August, and November.[24] We replicate each cash flow using a linear approximation of yields. Discounting each cash flow by the resulting risk-free rate gives the price of the constructed government bond with matched cash flows. Using this invoice price, we estimate the yield to maturity using the same formula as for the corporate bond. Finally, subtracting the matched risk-free yield from the corporate bond yield gives the corporate bond spread.

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[23] This becomes apparent after comparing the calendar-accrued interest and the accrued interest recorded in the data set. We cannot use the latter since it is given only for buy transactions.

[24] The U.S. Treasury used to issue 30-year bonds quarterly; the issuance cycle was later changed to semi-annual. Therefore, for very long maturities the period between STRIPS maturities is 6 months, and for all others it is 3 months.

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