Kose John
New York University

Anthony W. Lynch
New York University and National Bureau of Economic Research

Manju Puri
Stanford University and National Bureau of Economic Research

Credit Ratings, Collateral, and Loan Characteristics: Implications for Yield*

I. Introduction

Collateral is an important part of more than 70% of all commercial and industrial loans made in the United States (see Berger and Udell 1990), but the academic literature addressing its role is small. Ceteris paribus, collateral decreases the riskiness of a given loan, since it gives the lender a specific claim on an asset without reducing her general claim against the borrower. However, using a large data set on secured and unsecured loans, this article finds that yields on collateralized debt issues are higher than on general debt issues after controlling for credit rating. An explanation for this puzzling result is proposed that recognizes the effect of agency problems between managers and claim holders, and imperfections in the rating process. We then test a number of the model's predictions con-

This article studies how collateral affects bond yields. Using a large data set of public bonds, we document that collateralized debt has higher yield than general debt, after controlling for credit rating. Our model of agency problems between managers and claim holders explains this puzzling result by recognizing imperfections in the rating process. We test the model's implications. Consistent with our model and in results new to the literature, we find the yield differential between secured and unsecured debt, after controlling for credit rating, is larger for low credit rating, nonmortgage assets, longer maturity, and with proxies for lower levels of monitoring.

cerning the ability of loan and collateral characteristics to explain cross-sectional variation in yields and find that they are supported in the data. In particular, we find that the yield differential between secured and unsecured debt, after controlling for credit rating, is larger for low credit rating, nonmortgage assets, longer maturity, and with proxies for lower levels of monitoring.

Jensen and Meckling (1976) argue that corporate insiders owning only a fraction of the firm's equity have incentives to consume perquisites beyond optimal levels. The same intuition continues to apply when some of the debt is collateralized. We model a scenario in which the corporate insiders own a fraction of the equity of the firm. The firm has general and collateralized debt, and the collateralized asset has a less volatile value than the remaining assets of the firm. Our theoretical analysis shows that the resulting agency problems affect the value of the collateralized assets more than the general assets. We then show that if credit rating fails to fully reflect the impact of agency problems on credit quality, then secured debt has higher yields after controlling for credit rating than unsecured debt.

The model is then used to generate some additional implications for the yield differential between secured and unsecured debt issues after controlling for credit rating. The goal is to identify important collateral and loan characteristics that can affect yield. First, the nature of the collateral can be important since there are some assets whose values are difficult to erode—for example, land and buildings. Hence, we expect the yield differential for mortgages relative to unsecured issues to be small but expect yield differentials for nonmortagage secured issues relative to unsecured issues to be higher. Second, we show that the yield differential between secured and general debt is increasing in the probability of default, which can be proxied by credit rating. Third, the yield differential is shown to be an increasing function of the volatility of the general asset value, which can be proxied by debt maturity. Fourth, the yield differential is also shown to be a decreasing function of monitoring intensity. Proxies for monitoring intensity are developed: for example, monitoring intensity is likely to be lower for new than seasoned issues and higher in the presence of debt covenants.

We gather a large data set from Securities Data Corporation (SDC), on all fixed-rate, straight debt public issues made in the period January 1, 1993, to March 31, 1995. We examine the yield differential between secured and unsecured debt after controlling for credit rating both on an aggregate level and on a disaggregate level, based on loan and collateral characteristics. Consistent with our story, we find that the yield differential between secured and unsecured debt, after controlling for credit rating, is positive. We then use the implications of our model to help guide us in investigating how yields are affected by collateral and loan characteristics. These include the nature of collateral, credit rating, maturity, whether a new or seasoned issue, and the presence of covenants.

Our empirical results can be summarized as follows. After controlling for

credit rating, (i) the yield differential between secured and unsecured debt is positive. (ii) The yield differential between secured and unsecured debt is largely driven by nonmortgage secured assets and is robust to controlling for cross-firm differences in risk. Mortgaged assets, such as land and buildings, do not exhibit a yield differential as compared to unsecured debt. (iii) The yield differential between secured and unsecured debt is higher for low credit-rated issues as compared to high credit-rated issues. (iv) The yield differential between secured and unsecured debt is higher for long maturity issues as compared to short maturity issues. (v) The yield differential between secured and unsecured debt is higher for new issues as compared to seasoned issues. (vi) Finally, the presence of covenants is found to reduce the yield on collateralized debt more than on unsecured debt, particularly for low credit-rated issues.

We believe that ours is the first empirical investigation of how the nature of collateral and issue characteristics can affect yields, after controlling for credit rating. The six results put together are consistent with our agency-cost explanation for the higher yields on collateralized debt after controlling for credit rating. While there may be alternate explanations that could explain some of the individual results, it is difficult to find an alternative explanation that is consistent with all six findings. Further, our results suggest that, even after taking credit rating into account, the nature of collateral, issue characteristics, and the level of monitoring intensity, among other things, are important determinants of yield.

The rest of the article is organized as follows. Section II has a literature review. Section III describes the data and gives a discussion of the credit rating process. Section IV contains the theoretical model, while Section V examines and presents the empirical results. Section VI concludes.

II. Literature Review

Much of the theoretical literature on the role of the collateral has focused on the scenario where there is private information about risk known only to borrowers. Further, the collateral is "outside collateral" where the owners pledge assets not owned by the firm. In an environment where lenders are not as well informed as borrowers regarding their default risk, it may be optimal for lenders to ration credit (see, e.g., Jaffee and Russell 1976; Stiglitz and Weiss 1981). However, Bester (1985) and Besanko and Thakor (1987a) show that, when borrower risk is private information, collateral may mitigate the credit rationing problem. A number of papers have elaborated on the role of collateral in the presence of information asymmetry (see, e.g., Chan and Kanatas 1985; Besanko and Thakor 1987b; and Chan and Thakor 1987). The common prediction of these models is that lower-risk borrowers pledge more collateral. This prediction seems to be at variance with the conventional wisdom in the banking community, which associates the use of collateral with observably risky borrowers. As a part of the preloan credit analysis, com-

mercial lenders assess the riskiness of the prospective borrowers and require the observably risky borrowers to pledge more collateral (Morsman 1986; Hempel, Coleman, and Simonson 1986).

This prediction is also at odds with the small amount of empirical work addressing the issue of collateralization and its effect on loan quality. Orgler (1970) compiled a database on individual loans from bank examination files and distinguished good from bad loans on the basis of whether the loans were eventually criticized by the bank examiners. He regressed a good/bad dummy variable on a secured/unsecured dummy variable and several control variables and found secured loans to be riskier. Hester (1979), using data from a 1972 survey, regressed a secured/unsecured dummy variable on six accounting proxies for risk and found that riskier borrowers pledge collateral. Berger and Udell (1990) use the Federal Reserve's Survey of Terms of Bank Lending data and document a positive relationship between collateral and risk. Klapper (1999) investigates the use of accounts receivable and inventory as collateral by larger firms, while Carey, Post, and Sharpe (1998) find that commercial finance companies who specialize in asset-based lending (collateralized lending) tend to lend to riskier firms than do commercial banks. Finally, Berger and Udell (1995) examine inside collateral in small business lines of credit in the United States, while Harhoff and Korting (1998) examine collateral use in small business lending in Germany. Both papers find a positive relation between collateral and risk in the context of small business loans.

The only theoretical paper to obtain a positive relation between borrower risk and collateral pledged is by Boot, Thakor, and Udell (1991), who examine collateral in the presence of both moral hazard and adverse selection. In contrast to our article, Boot et al. (1991) focus on outside rather than inside collateral. Several papers have considered the effects of moral hazard alone in the presence of inside collateral. Smith and Warner (1979) argue that inside collateral may be useful in solving the asset-substitution problem (e.g., raised in Jensen and Meckling 1976). Stulz and Johnson (1985) analyze the role of secured debt in solving Myers's (1977) underinvestment problem. More generally, James (1988) shows that the underinvestment problem can be solved by a range of securities with payoff characteristics similar to secured debt. However, none of these papers study how agency problems affect the yields of secured loans relative to unsecured loans.

The emphasis of most of the prior work—both theoretical and empirical—has been on the relation between the use of collateral and loan riskiness. Little attention has been paid to differences between secured and unsecured debt yields after controlling for credit rating. In particular, the papers to date do not examine how the nature of the collateral posted and the associated loan characteristics can affect yields. Further, none of these papers provide any guidance on the important characteristics that one should investigate in the first place.

To begin, we first ask whether collateral affects the yields of bonds, after

taking credit rating into account. For this purpose we put together a large data set of public debt issues, described below.

III. Data Description

We start out with all fixed-rate, straight debt public issues made in the period January 1, 1993, to March 31, 1995. This data are gathered from Securities Data Corporation. We use the U.S. domestic public new issues database of SDC, which SDC compiles from regulatory filings, news sources, company press releases, and prospectuses. In creating our sample we exclude issues in the financial industry (SIC code 6), as debt issues in this industry have often involved securitization of assets such as packaging of credit card receivables as the underlying collateral for debt issues. We also exclude all issues where the debt is guaranteed either by the government or by an affiliated company. Our final sample consists of 1,327 issues.

We want to control for the issue's credit rating and would expect that higher credit-rated issues have lower yield spreads than lower credit-rated issues. It is also important to control for other variables that may influence yield, such as size of the issue, purpose of the issue, reputation of the underwriter, maturity, and term structure of risk-free (treasury) yields. We now discuss the variables likely to influence yield spreads and then define how they are used in this article. Size of an issue is important, as larger issues are likely to be associated with less uncertainty, to be more liquid, and to have more public information available about them than smaller offerings. Hence, we would expect larger issues to have lower yields. A new debt issue is potentially associated with greater uncertainty than a seasoned issue and should result in relatively higher spreads. The purpose of the issue or the use of the funds raised can also potentially affect yield spread. In particular, if the purpose of the issue is to refinance existing bank debt, this can increase yield spreads. Maturity can also potentially affect yield spreads. There is more information available about exchange-listed firms, and one would expect debt issues of such firms to have lower yield spreads. Underwriter reputation is also potentially important, and one would expect high reputation of the underwriter to reduce yield spreads.

Information on these variables was obtained from SDC's new issue database. The variables used are defined below. Appendix B details how each variable was constructed from the SDC new issue database. Appendix C gives summary statistics.

BPS: The basis point spread over the treasury rate of comparable maturity.

CREDIT RATING: A set of seven credit-rating dummy variables, CR0–CR6, that correspond to Moody's Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, and Aaa categories.

MATURITY: Three dummy variables are constructed based on the maturity of the debt issue.

LOWMAT, MEDMAT, and HIMAT: LOWMAT is one if the security ma-

tures in less than 5 years, MEDMAT is one if it matures between 5 and 15 years, and HIMAT is one if the maturity is greater than 15 years. All dummy variables are zero otherwise.

LN(AMOUNT): The natural log of the issue amount in millions of dollars.

SECURED: A dummy variable that takes the value of one if the issue is secured, zero otherwise.

PRESTIGIOUS: A dummy variable created based on market share rank of dollar volume of underwritings of debt issues. PRESTIGIOUS is a dummy variable that is one if the underwriter is one of the top five underwriters, based on market share, zero otherwise.

REF BK DEBT: A dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt, zero otherwise.

NEW ISSUE: A dummy variable that is one if the debt issue is a new one, zero otherwise. In order to construct this variable we searched the SDC database to check if the firm had a debt issue in the last 20 years. If it did, then we take the issue to be a seasoned issue; if not, then we take it to be a new issue.

EXCHANGE: A dummy variable that takes the value of one if the firm is listed on an exchange, zero otherwise.

INDUSTRY: A number of industry dummy variables are constructed based on one-digit SIC codes. All industries save for financial firms are included in the sample and a dummy variable constructed for each one.

A. Does Credit Rating Capture It All?

We now regress the yield premium of the bond on credit rating as well as the other variables described above. We find that credit ratings do indeed play a very major role in determining yields.[1] The credit-rating dummies are highly significant both economically and statistically. Hence, the higher the credit rating, the better the prices (and the lower the yields). Thus, for example, if the credit rating is Caa–C, it increases yield by 544 basis points, whereas if the credit rating is Baa1–Baa3, it increases yields by 58 basis points only. An interesting finding, however, is that other variables matter in determining yields, even after controlling for credit rating. Table 1 shows us that other variables that are significant are collateral, maturity, purpose, and whether it is a new issue. Clearly, credit rating is not a sufficient statistic for determining yields. Further, collateral increases yield (lowers price) by 11 basis points, after controlling for credit rating.

This is an interesting but puzzling result. There is little in the prior theoretical or empirical literature to guide us on this finding. One possible explanation that we present is that there are imperfections in the rating process. These imperfections impart biases in ratings whose magnitudes depend on

1. The importance of credit ratings for investors is intuitive and consistent with prior literature, e.g., Crabbe and Post (1993) and Gande et al. (1997).

TABLE 1   **Effect of Secured on Full Data**

Variable	Coefficient	t-Ratio
Constant	43.70	4.96*
CR0	544.73	13.68*
CR1	399.24	38.57*
CR2	235.24	18.75*
CR3	58.49	9.38*
CR4	15.62	2.76*
CR5	.49	.09
LOWMAT	−11.82	−3.14*
HIMAT	25.94	10.29*
LN(AMOUNT)	−1.84	−1.26
SECURED	11.00	2.99*
PRESTIGIOUS	.81	.25
REF BK DEBT	7.21	1.66***
NEW ISSUE	18.68	2.92*
EXCHANGE	−4.75	−1.18
Observations	1,327	
Adjusted R^2	.86	

NOTE.—The table gives the OLS estimates of the following equation:

$$BPS = \beta_0 + \beta_{CR}\ CREDIT\ RATING + \beta_{MAT}\ MATURITY + \beta_A\ LN(AMOUNT)$$

$$+ \beta_S\ SECURED + \beta_P\ PRESTIGIOUS + \beta_R\ REF\ BK\ DEBT$$

$$+ \beta_N\ NEW\ ISSUE + \beta_I\ INDUSTRY + \beta_E\ EXCHANGE.$$

The dependent variable for basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points. The independent variables are as follows: CR (CREDIT RATING): set of credit rating dummy variables CR0–CR6 that correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa; MATURITY: dummy variables constructed based on the maturity of a debt issue; LOWMAT: value of one if the security matures in less than 5 years; HIMAT: value of one if the maturity is greater than 15 years; LN(AMOUNT): natural log of the issue amount in millions of dollars; SECURED: dummy variable that takes the value of one if the issue is secured; PRESTIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; NEW ISSUE: dummy variable that is one if the debt issue is a new one; EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange. All dummy variables are zero otherwise. INDUSTRY dummy variables are not reported in the table. The t-ratios are computed using White heteroskedasticity corrected standard errors (White 1980).
  * Significant at the 1% level.
  *** Significant at the 10% level.

loan characteristics like the nature of the collateral. In particular, the bias is shown to depend on whether the issue is collateralized or not. An alternative explanation is a risk story that relies on ratings imperfectly correcting for risk differences between collateralized and uncollateralized issues. This risk story recognizes that collateralized debt issues are riskier empirically and argues that the resulting higher mean yield translates into a higher mean for rating-adjusted yield because of the coarseness of the ratings bins.[2] In the empirical

2. We thank the referee for suggesting this alternative story. Although the risk story does not hold for any arbitrary distribution for the yields on collateralized and uncollateralized debt issues, such a result can hold for quite reasonable distributional assumptions for the yields on the two types of issues. Consequently, it provides an important alternative to our story that we subject to careful empirical testing in Sec. V.

testing, we develop tests to ascertain whether there is a role for our story after controlling for across-firm differences in risk. We also present a range of tests that allow us to distinguish between the two stories.

Since our story relies on imperfections in the rating process, we next go through the criteria for determining credit rating and ask whether omissions by the rating agencies can create biases in ratings across collateralized and uncollateralized debt issues. More generally, we are interested in how these biases vary as a function of the nature of collateral and associated loan characteristics. Answering this question is important, since it establishes a basis for empirical testing.

B.   The Credit Rating Process

Our empirical results about collateral suggest that despite Moody's claims, their credit ratings may not provide unbiased assessments of expected recovery rates. As a consequence, it would be useful to document in more detail the process used by Moody's to determine their credit ratings. For this purpose we went through the documentation provided by Moody's (see, e.g., Moody's Investors Services Web site) and also had detailed discussions with personnel actually involved in doing the credit ratings as well as academic experts who guide and consult for the credit rating agencies (such as Edward Altman).

Moody's claims to use an expected loss framework for assigning ratings. Moreover, Moody's uses the practice of "notching" to make rating distinctions among different liabilities of a firm. In the investment-grade sector, Moody's first assigns a rating to a firm's most important liability class, its senior unsecured debt. In the speculative grade sector, the first step is to assign a "senior implied" rating, which is the rating that would be assigned if the firm had a single class of debt. The second step in each case is to decide how to rate the firm's various debt instruments in relation to this initial rating.

Moody's "notching" guidelines for implementing the second step depend on whether the firm is speculative grade or investment grade. For investment-grade firms, Moody's typically applies the same "notching" guidelines to all firms with little regard to firm-specific information about expected recovery rates across the firm's issues. In particular, secured debt is generally rated one notch above the firm's senior unsecured debt rating, while subordinated debt, including junior and senior subordinated debt, is rated one notch below. For speculative-grade firms, Moody's analyses each firm's capital structure and bond covenants and then uses expected loss as a framework to determine notching adjustments. The result is often large differences in notching for relative seniority from one firm to another.

While Moody's attempts to assign ratings on the basis of expected loss, there are several reasons to believe that in practice Moody's ratings may not be unbiased measures of expected loss. First, with investment-grade firms, Moody's itself acknowledges that its rule-of-thumb guidelines for notching are likely to lead to undernotching of subordinated issues for firms in the

highest (Aaa and Aa) ratings classes (see Priority of Claim Standing Committee and Ratings Symbols and Definitions Standing Committee 2000). Second, with speculative-grade firms, Moody's analysts have discretion to notch based on firm-specific information about relative recovery rates. This discretion could be employed in a manner that imparts biases as a function of whether the issue is collateralized or not. For example, while classes of debt are broken down into secured and unsecured, Moody's analysts may fail to consider the kind of security pledged when notching secured issues. Moreover, Moody's itself also recognizes that assigning ratings is inherently a subjective process: "There is no 'one size fits all' solution. The notching debate must be a dynamic analysis that considers corporate governance, collateral value, structure, and size of the issue in relation to total capitalization. . . . The lack of a specific rule set recognizes that evaluation of credit quality and expected loss is more an art than a rigid science" (Rowan 1999, pp. 1, 6; Cantor and Fons 1999).

In summary, our discussion of Moody's rating process suggests that its ratings do not fully account for some important issues that can arise because of collateral. In particular, if the kind of assets being collateralized is not taken into account, credit ratings will not reflect any incremental impact on asset values arising from managerial incentives for the differential care of certain kinds of collateralized and uncollateralized assets. Under this scenario, the part of the yield differential between certain kinds of collateralized and uncollateralized debt that is not captured by credit rating can be explained by examining carefully managerial incentives to maintain the assets of the firm. More generally, the inherent subjectivity of the notching process, particularly for speculative-grade issues, suggests that Moody's may systematically fail to fully incorporate managerial incentives for perquisite consumption when assigning ratings. In the next section, we present a model to study how managerial incentives to maintain these assets affect the yield differential between collateralized and uncollateralized debt.

IV. The Model

We first explain why managers typically have an incentive to consume more perquisites out of the secured than the unsecured assets.[3] We then analyze how this pattern of consumption or neglect by managers can increase the yield of collateralized debt more than the yield of uncollateralized debt. Finally, the model is extended to show that these results hold more generally.

3. Although we explicitly model incentives for perquisites consumption, their interpretation is quite broad. They include not just incentives for managerial perk consumption but also incentives to underinvest in any discretionary managerial activities that preserve the value of the assets. Managerial effort and other resources expended to maintain asset value are often discretionary. For example, the adequacy of the insurance on the assets and the frequency and quality of periodic maintenance are often not contractually stipulated and are thus under the discretion of the manager. We show that managers expend less effort and resources in maintaining the value of the secured assets than the unsecured assets.

This general model allows us to identify the collateral and loan characteristics that have a systematic impact on expected payoffs and associated yields.

Jensen and Meckling (1976) argue that when corporate insiders own only a fraction of the equity of the firm, they have incentives to consume perquisites beyond optimal levels. Similar intuition would apply to when the assets of the firm are collateralized, causing them to have incentives to care less about these assets, which can be reflected either in reducing the maintenance of the assets or in increased managerial perk consumption from such assets.

Collateralization of some assets alters the structure of managerial "ownership" in these assets compared to that in the remaining uncollateralized assets. This in turn leads to managerial incentives to consume more perquisites out of the secured than the unsecured assets.

A.   Why Managers Consume More from the Secured Than the Unsecured Assets

We first show that managers typically consume (or neglect) more the secured asset as compared to the unsecured asset. In the next section we then show how such neglect, or perk consumption, translates into differential yields.

We use a simple model that forms the basis for our theory. Consider a firm with two assets, C and U, and three claims on these assets: an equity claim and two debt claims. The first debt claim, debt U, has a promised payment of F and has a general claim to both the assets of the firm. The second debt claim, debt C, is collateralized on asset C and also has a promised payment equal to F. Debt C's claim to asset C ranks before that of debt U, but if asset C is not sufficiently valuable to payoff F, the unpaid balance of debt C ranks equally with debt U as a claim on asset U. The equity claim receives any residual after the two debt claims have been paid off. While the model in this section treats the firm's capital structure as exogenous, Section IVD endogenizes the decision to collateralize a portion of the debt and shows that the least risky assets will be used as the collateral.

The firm has two possible states, good (G) and bad (B). Default is only an issue in the bad state, whose probability of occurring is ϕ_B. Once in the bad state, there is a ϕ_R chance that the firm leaves the bad state and enters the recovery state (R). Let v_C be the value of the collateralized asset in the bad state and v_U be the value of the uncollateralized asset in the bad state both normalized by the promised payment F. We take v_C to be one, for simplicity, and v_U to be less than one to insure that the firm is in default in the bad state. In the absence of any neglect by the manager, the payoffs on the secured and unsecured debt are one and v_U, respectively. If the firm enters the recovery state, the value of the uncollateralized asset increases by a factor of λ_U, where $\lambda_U \gg 1$, while the value of the collateralized asset increases by a factor of λ_C, where λ_C is set equal to one. These values for λ_U and λ_C capture the notion that recovery is good for the firm and that, typically, collateralized assets are the least risky assets of the firm.

Turning to the manager, she holds α of the firm's equity and has a utility function $u(.)$ that is increasing and concave in its argument. Given an asset value of A_i and a fraction f_i consumed from asset i, the manager receives utility in dollar terms of $A_i u(f_i)$. It is assumed that this utility specification holds for both the collateralized and uncollateralized assets. This parameterization means that the manager's utility is proportional to the asset's value: doubling the asset value therefore doubles the dollar value of consumption. Further, the dollar value of the asset being consumed is important, rather than the number of assets from which the manager consumes, hence, the manager consumes the same dollar amount from a hundred dollars' worth of assets, irrespective of whether it is one asset or two assets. For this subsection, we take the utility function to be quadratic: $u(f_i) = f_i - \frac{1}{2}f_i^2$. In the next section we show how the results hold in a more general setting.

The manager's objective function (normalized by dividing through by F) can be written as

$$u(f_C) + v_U u(f_U) + \phi_R \alpha \max\left[0, (1 - f_C) + v_U(1 - f_U)\lambda_U - 2\right], \qquad (1)$$

where f_C and f_U are the manager's choice variables and are defined as above. The first two terms are the dollar utilities from consuming out of the collateralized and uncollateralized assets, respectively, while the third term is the expected payoff from the manager's equity holding. Note that the probability of entering the bad state (ϕ_B) has no effect on the manager's consumption decisions, since these are made only after the firm has arrived in the bad state. The manager's optimal consumption choice can be characterized as follows:

$$f_C^* = 1 - \alpha\phi_R \qquad (2)$$

and

$$f_U^* = 1 - \alpha\phi_R\lambda_U \qquad (3)$$

for v_U sufficiently large.[4]

Since $\lambda_U > 1$, these first-order conditions immediately imply that the manager consumes a greater fraction of the collateralized than the uncollateralized asset. To see the intuition for why, consider reducing the value of either asset in the bad state by 1%. This reduces the general asset's value by $\lambda_U\%$ in the recovery state but the collateralized asset's value by only 1%. Since collateralized assets tend to be the least risky assets, the greater volatility of the general asset's value means a greater reduction in its recovery-state value. Hence, since the manager gets α of the equity that has a positive value in the recovery state, she has a greater incentive to consume from the secured than the unsecured asset. Further, the value of the unsecured asset in the bad state ($v_U < 1$) is less than that for the secured asset ($v_C = 1$), which makes the dollar

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4. If v_U is sufficiently small, the manager is better off consuming everything, i.e., $f_C = f_U = 1$.

value of the consumption from the general assets even smaller relative to that from the secured assets.[5]

Another way to see the intuition is in terms of the familiar risk-shifting strategy in the presence of risky debt (which can arise even if there is no change in the total net present value of the assets). Shifting a certain amount, say Δ, of perk consumption from the uncollateralized asset to the collateralized asset is tantamount to an incremental investment of Δ in the riskier, uncollateralized asset. If the consumption fractions from the two assets were the same, this shift would leave the utility from the perk consumption unchanged. At the same time, the induced greater investment in the riskier general asset causes equity value to be higher. This leads to an optimum involving higher perk consumption from the collateralized asset.

B.   How Neglect (or Perk Consumption) Can Increase the Yield of Collateralized Debt More Than the Yield of Uncollateralized Debt

The previous section shows that the manager has incentives to consume more from the secured than the unsecured assets. This section characterizes how such perk consumption (or neglect) by the manager affects the yields on the secured and unsecured debt. Even though we use perk consumption for concreteness, the analysis can apply more broadly to agency problems such as underinvestment in the maintenance (managerial neglect) of the collateralized assets.

Collateralized debt has a senior claim on the collateral and so must recover more in the event of default. As a result, collateralized debt should have higher prices (lower yields) than uncollateralized debt. However, when we examine the impact of agency problems, we are examining their incremental impact on the yield of collateralized debt relative to their incremental impact on the yield of uncollateralized debt. In what follows below we show that the erosion in asset values caused by agency problems can result in a larger yield increase for collateralized than for general debt. As expected, this is particularly true when the manager consumes more from the secured than from the general assets, as was established in the previous subsection. In addition, the reduction in the collateralized asset's value as a result of agency problems forces the collateralized debt holder to recover from the general pool that typically has a lower recovery rate. The result can be a larger increase in the collateralized debt yield than in the general debt yield.

We use the model from the previous section to make these ideas more concrete, treating the bad (B) state as the firm's only default state. Note that we focus on payoff, but since payoff is inversely related to yield holding expected bond return constant, our results are equally applicable to yield.

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5. Our results can be generalized to a setting where the volatility of the collateralized asset is higher or lower than the uncollateralized asset and the managerial compensation structure is endogenized to include a fraction of the uncollateralized debt in addition to the equity. This structure of managerial compensation can be shown to be optimal in the presence of risk-shifting incentives in a variety of settings (see John, Saunders, and Senbet 1999).

Recall that in the absence of any neglect by the manager, the payoffs on the secured and unsecured debt in the bad state are one and v_U, respectively. Now suppose the manager consumes κ_C from the collateralized asset and κ_U from the uncollateralized asset, where each is expressed as a fraction of the promised payment F. Note that in terms of the terminology of the previous section, $\kappa_i = f_i A_i / F$. The values of asset C and U are now $(1 - \kappa_C)$ and $(v_U - \kappa_U)$, and the collateralized asset is no longer sufficient to meet the collateralized debt obligation. Instead, κ_C of the promised payment on the collateralized debt falls into the general pool. The uncollateralized asset is shared between the two debt holders pro rata based on promised payment, so the collateralized debt receives $\kappa_C/[\kappa_C + 1]$ of the value of the uncollateralized asset. The payoff on the collateralized debt becomes

$$(1 - \kappa_C) + \frac{\kappa_C}{1 + \kappa_C}(v_U - \kappa_U), \tag{4}$$

where the first term is the payoff from the collateralized asset while the second term is the payoff from the general pool. The payoff for the general debt can be obtained similarly:

$$\frac{1}{1 + \kappa_C}(v_U - \kappa_U). \tag{5}$$

The payoff on the collateralized debt must exceed that on the general debt, and this follows easily from equations (4) and (5).

We are interested in the reduction in payoff on each type of debt due to perk consumption. In particular, we want to compare the reduction for collateralized debt to that for general debt since this drives the yield differential between secured and unsecured debt after controlling for credit rating. We refer to this comparison as the incremental payoff differential in the bad state. Subtracting the reduction in payoff for collateralized debt from that for uncollateralized debt gives

$$\left\{1 - \left[(1 - \kappa_C) + \frac{\kappa_C}{1 + \kappa_C}(v_U - \kappa_U)\right]\right\} - \left\{v_U - \left[\frac{\kappa_C}{1 + \kappa_C}(v_U - \kappa_U)\right]\right\}, \tag{6}$$

where the first term is the reduction in the payoff on the collateralized debt and the second term is the reduction in the payoff on the uncollateralized debt. Rearranging equation (6), we obtain

$$\frac{2\kappa_C(1 - v_U) - (1 - \kappa_C)(\kappa_C + \kappa_U)}{1 + \kappa_C}, \tag{7}$$

which is easy to evaluate. First note that equation (7) is decreasing in both v_U and κ_U. This means that the incremental payoff differential is decreasing in the value of the general assets in the bad state and in the extent of perk consumption (as a fraction of promised payment) out of the general assets.

The implication is that the differential is more likely to be positive when either of these is small.

We would like to more fully characterize the $\{v_U, \kappa_U, \kappa_C\}$ combinations that cause this differential to be positive. Since this differential is decreasing in κ_U, we can define $\kappa_U^*(v_U, \kappa_C)$ to be the κ_U value that makes equation (7) equal to zero, given v_U and κ_C. Setting equation (7) equal to zero and rearranging gives the following expression:

$$\kappa_U^*(v_U, \kappa_C) = \frac{\kappa_C(1 - 2v_U + \kappa_C)}{1 - \kappa_C}. \tag{8}$$

Given v_U and κ_C, any κ_U value less than $\kappa_U^*(v_U, \kappa_C)$ results in a positive incremental payoff differential. Thus, $\kappa_U^*(v_U, \kappa_C)$ must be positive for there to exist values of κ_U that result in a positive incremental payoff differential. From equation (8), it follows that $\kappa_C \geq 2v_U - 1$ is equivalent to $\kappa_U^*(v_U, \kappa_C) > 0$. Thus, if perk consumption from the collateralized asset (κ_C) is sufficiently large relative to the value of the general asset (v_U), then the incremental payoff differential can be positive for a range of κ_U values from zero to $\kappa_U^*(v_U, \kappa_C)$.

For example, if the recovery rate on the general assets is 76% of the face value of the general debt and the perk consumption from the collateralized asset is 90% of the face value of the collateralized debt, then so long as the perk consumption from the general assets is less than $0.9(1 - 2 \times 0.76 + 0.9)/(1 - 0.9) = 3.42$, the incremental payoff differential is positive. Since the perk consumption from the general assets can be no more than 0.76 (the value of the general assets), the implication is that the differential is positive for any level of perk consumption from the general assets.

This analysis can also be used to illustrate a number of other results about the impact of agency problems on collateralized and uncollateralized debt yields. For example, how might yields be affected by recovery rates in the event of default? The larger reduction in expected payoff for collateralized than uncollateralized debt yields depends crucially on the general pool having a low recovery rate. Consistent with this intuition, we used equation (7) to show that the incremental payoff differential becomes smaller as the value of the uncollateralized asset in the bad state increases.

The nature of the collateralized asset can be important. Some collateralized assets have values that are largely unaffected by managerial actions and inactions, including neglect. For example, land and buildings may be affected very little by managerial inaction or neglect and are relatively insensitive to agency problems. We can examine the case in which the manager finds it so difficult to consume from the collateralized asset that the chosen of consumption is zero ($\kappa_C = 0$). From equation (7) we see that the incremental payoff differential is nonpositive when $\kappa_C = 0$. Thus, as expected, the incremental payoff differential is negative when it is difficult to consume perks from the collateralized asset.

Is there a differential effect for lower quality debt issues? We saw above

that the optimal perk consumption choices in the bad state are unaffected by the firm's probability of entering the bad state. However, the absolute value of the incremental payoff differential is increasing in this probability. Thus, the incremental payoff differential is larger for lower quality debt issues.

Finally, if agency problems are important, monitoring should help in limiting these problems. In the next section, we superimpose a monitoring technology similar to that in Rajan and Winton (1995). As a result of the monitoring in place, there is a probability γ that the manager's consumption in the bad state is detected. However, as γ increases, the likelihood of zero consumption by the manager increases, and the absolute value of the incremental payoff differential decreases. Thus, greater monitoring causes agency problems to have a smaller impact on debt yields.

C. The General Model

This subsection shows that agency problems induce the manager to consume more from secured than the unsecured assets in such a way that incremental payoff differentials are generally positive. This is done by extending the analysis above to a general utility function with fewer restrictions on the asset values in the bad state (v_C and v_U) and on the growth in asset values going from the bad to the recovery states (λ_C and λ_U). Instead of $v_C = 1$ and $v_U < 1$, we only restrict v_C to be less than or equal to one and v_U to be less than or equal to $(2 - v_C)$. The latter restriction insures that the firm will be in default if the firm stays in the bad state. The former restriction allows the firm to default on the secured debt in the bad state even in the absence of any value destruction.[6] We allow λ_C to be greater than one but maintain the assumption that $\lambda_C \leq \lambda_U$, since this captures the idea that the collateralized assets are the least risky assets of the firm.

In addition, we superimpose a monitoring technology as described in the previous subsection, with intensity parameter γ. With this technology, detection occurs with probability γ and results in the manager returning any stolen asset value to the firm. Finally, we can introduce a parameter ξ that measures the ease with which the manager consumes from the collateralized asset. When ξ is set equal to one, the manager finds it equally easy to consume from the collateralized and uncollateralized assets. On the other hand, a value for ξ of zero implies that the manager bears an infinite cost by consuming out of the collateralized asset. In what follows, ξ is set equal to one except when assessing how the nature of the collateral affects the incremental payoff differential.

The manager's objective function (normalized by dividing through by F)

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6. The yield effects that we focus on would be ameliorated if the asset values were larger fractions of the debt face values so that recovery rates in default were closer to one. However, on the flip side, we know that firms do default and that recovery rates are usually less than one, even for secured debt issues. So the effects that we focus on are likely to have some impact empirically.

can be written as

$$(1 - \gamma)\{v_C \xi u(f_C) + v_U u(f_U) + \phi_R \alpha \max [0, v_C(1 - f_C)\kappa_C$$

$$+ v_U(1 - f_U)\kappa_U - 2]\} \equiv V(f_C, f_U; v_U), \tag{9}$$

where f_C and f_U are the manager's choice variables and are defined as above. Since γ only enters this function through the scalar multiple $(1 - \gamma)$, the solution is invariant to γ, just as it is invariant to the probability of entering the bad state (ϕ_B). The manager's optimal consumption is completely characterized in appendix A, Section I, and is a generalization of optimal consumption formulas in equations (2) and (3).

Since we care about the incremental impact of managerial self-interest on the expected payoffs on debt C and debt U, we define $\Delta_d(f_C, f_U)$ to be $[P_d(0, 0) - P_d(f_C, f_U)]$ for $d = C$ and U. Thus, $\Delta_d(f_C, f_U)$ measures the incremental impact of perk consumption on the expected payoff on debt d as a fraction of its promised payment. Our particular interest is the differential between $\Delta_C(f_C, f_U)$ and $\Delta_U(f_C, f_U)$, and so we define $p(f_C, f_U)$ to be the incremental payoff differential. Section III of appendix A provides additional intuition for why this variable is proxied by the difference in yield (after controlling for credit rating) between secured and unsecured debt.

First, letting (f_C^*, f_U^*) be the manager's optimal consumption and $p^* \equiv p(f_C^*, f_U^*)$, we want to show that the manager endogenously chooses (f_C^*, f_U^*) in such a way that p^* can be positive for v_U sufficiently small. The following proposition establishes this result.[7]

PROPOSITION 1.   Incremental payoff differential for collateralized versus uncollateralized debt. There exists a v^0 such that $p^* > 0$ any for $v_U < v^0$.

This result is consistent with the notion that the manager's value-reducing activities force collateralized claim holders with an otherwise high recovery rate into the general pool that has a low recovery rate in the bad state.

Our second result concerns the nature of the collateralized assets. For some assets managerial perk consumption is difficult, or neglect (inaction) has little impact. Setting the parameter ξ to zero implies that the collateralized asset is difficult to consume from and that the chosen consumption level is zero. The following proposition shows that the incremental payoff differential is negative when $\xi = 0$.

PROPOSITION 2.   Incremental payoff differential when it is difficult to consume from the collateralized asset. When $\xi = 0$, $f_C^* = 0$, and so $p^* \leq 0$.

Thus, when the collateralized debt is secured on an asset whose value is difficult to destroy, agency problems reduce the expected payoff on general debt more than the payoff on the collateralized debt. This result is intuitive

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7. An expression for $p(f_C, f_U)$ can be obtained from its definition and eqq. (A4) and (A5) in app. A, Sec. II. It is a generalization of eq. (6). All propositions follow almost immediately from this expression.

since the incremental effect of agency problems on collateralized debt recovery rates will be low if the value of that asset is unaffected by the manager's self-interested behavior.

Our next result concerns the probability of arriving in the bad state and its effect on debt yields. Increasing this probability magnifies the impact of agency problems on collateralized and uncollateralized debt yields. As a consequence, any incremental payoff differential is also magnified by an increase in this probability. The following proposition establishes this result.

PROPOSITION 3. Incremental payoff differential as a function of the default probability:

$$\frac{d|p^*|}{d\phi_B} > 0.$$

Thus, a positive incremental payoff differential is increasing in the probability of arriving in the bad state (default probability), while a negative differential becomes more negative.

Next, we examine the effect of changing the value of the uncollateralized asset in the bad state. This value is likely to be important since it determines the recovery rate for the general debt pool. In particular, a lower general asset value reduces the recovery rate for the general pool that makes the collateralized debt's recovery rate more sensitive to managerial actions that reduce the collateralized asset's value. This is captured in the following proposition.

PROPOSITION 4 Incremental payoff differential as a function of the recovery rate for the general debt: $(dp^*/dv_U) < 0$.

Hence, any factor that reduces the general debt's recovery rate in the bad state will result in higher differential payoffs for collateralized and uncollateralized debt. Examples include lower expected payoff and higher volatility for the unsecured asset.

Finally, a higher monitoring intensity (γ) would be expected to reduce the absolute magnitude of any incremental payoff differential ($|p^*|$). The reason is as follows. Insofar as the level of monitoring increases, the likelihood that the manager's consumption is detected also increases, which leads to a decrease in the incremental payoff differential. Turning to a second result, the impact of monitoring on the incremental payoff differential is increasing in the likelihood of entering the bad state. If entering the bad state is a high probability event, the impact of perquisite consumption on expected payoffs is high. Consequently, varying the monitoring intensity has a large effect on expected debt payoffs. The following proposition confirms these two intuitions.

PROPOSITION 5. Effect of monitoring intensity on the incremental payoff differential:

$$a) \quad \frac{d|p^*|}{d\gamma} < 0.$$

$$b) \quad \frac{d\left|\left[\frac{d|p^*|}{d\gamma}\right]\right|}{d\phi_B} > 0.$$

On a slightly different dimension, monitoring intensity also affects the extent to which agency problems reduce the collateralized debt's expected payoff, $\Delta_C(f_C^*, f_U^*)$.

PROPOSITION 6.   Effect of monitoring intensity on the incremental payoff to the collateralized debt:

$$a) \quad \frac{d\,\Delta_C(f_C^*, f_U^*)}{d\gamma} < 0.$$

$$b) \quad \frac{d\left|\left[\frac{d\,\Delta_C(f_C^*, f_U^*)}{d\gamma}\right]\right|}{d\phi_B} > 0.$$

The size of the reduction in the expected payoff is decreasing in monitoring intensity. Further, the impact of monitoring on $\Delta_C(f_C, f_U)$ is increasing in the likelihood of entering the bad state. The reasons for these results are similar to those given above to explain the analogous results in proposition 5. The next subsection explains how bankruptcy costs can explain both why firms use collateralized debt and why they use their less risky assets as the collateral.

D.   Bankruptcy Costs as a Motivation for Using Collateralized Debt

In the model of the previous subsection, we take the existence of collateralized debt as given and examine the incentive effects of such debt and its implications for yields. In this section, we endogenize the management's decision to collateralize a subset of the assets and the nature (risk characteristics) of the collateral chosen, based on a simple characterization of the bankruptcy costs facing the firm. While many factors influence a firm's decision to use collateral, bankruptcy costs are likely to be one of the most important.[8]

Consider a bankruptcy cost function per dollar of face value that is a concave function of the loss rate. Concave bankruptcy costs follow naturally from a number of plausible assumptions about the destruction of asset value in financial distress. One assumption that is particularly simple and appealing can be described as follows. Fixed legal fees per dollar of face value are incurred upon default of a debt issue. In addition, a constant fraction of asset value is destroyed during the bankruptcy process. Several theoretical and empirical papers (see, e.g., Mello and Parsons 1992; Leland 1998; and Parrino, Poteshman, and Weisbach 2001) characterize bankruptcy costs as a fixed fraction

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8. Boot et al. (1991) endogenize the use of outside collateral in a model with moral hazard and adverse selection, while a number of papers have elaborated on the role of collateral in the presence of information asymmetry (see, e.g., Chan and Kanatas 1985; Besanko and Thakor 1987b; and Chan and Thakor 1987).

of asset value in default. Leland (1998) examines capital structure in the presence of agency and bankruptcy costs and models the bankruptcy cost as a fixed fraction of asset value. Mello and Parsons (1992) examine agency costs of debt in a framework that allows an asset's value in default to be a given fraction of its first best value. Recently, Parrino et al. (2001) use such a model of bankruptcy costs in their calibration of the agency costs associated with investment decision making.

This simple assumption causes the cost function per dollar of face value to be strictly concave at a zero loss rate. While the cost function is linear elsewhere, the function's concavity at a zero loss rate is enough for the analysis below to go through. However, the safe asset's value must exceed the collateralized debt's face value with positive probability in the firm's default state. More elaborate assumptions can produce a bankruptcy cost function that is strictly concave everywhere.[9] For simplicity, the following analysis assumes that the cost function is strictly concave everywhere. Further, default only occurs in the bad state, and the firm either issues general and secured debt each with the same face value (F) or issues general debt with a face value of $2F$. Finally, the analysis in this subsection abstracts from agency cost considerations by exogenously specifying asset values in the default state.[10]

We demonstrate that the use of secured debt in the presence of default-state differences in coverage rates across the two assets (as a fraction of F) leads to a reduction in expected bankruptcy costs. Secured debt concentrates losses in the unsecured debt, leading to lower bankruptcy costs because of the concave cost function. Moreover, bankruptcy costs are minimized by using the asset with the lower default-state coverage rate as the collateral for the secured debt. The reasoning is as follows: for a given average loss rate over all the firm's debt, the benefit of collateralizing a particular fraction of the debt is increasing in the difference between the average loss rates across the two classes of debt. Since the loss rate for collateralized debt is always higher than the coverage rate of the collateral, the loss-rate difference is maximized by using the asset with the higher coverage rate in the default state as the

9. For example, the value destruction associated with default, expressed as a percentage of asset value, is assumed to be increasing and concave in the loss rate. Such an assumption is plausible since monitoring of third parties is likely to be declining in the loss rate. Letting ℓ denote the loss rate per dollar of face value, the asset value available to be destroyed per dollar of face value is $(1 - \ell)$. Suppose first that value destruction as a fraction of asset value available is an increasing linear function of the loss rate $\ell : b\ell$, where $b > 0$. So value destruction per dollar of face value as a function of the loss rate ℓ is given by $D(\ell) = b\ell(1 - \ell)$. It is easy to see that $D(.)$ is a concave function. More generally, suppose that value destruction as a fraction of asset value available is an increasing function of the loss rate $\ell : b(\ell)$. So value destruction per dollar of face value as a function of the loss rate ℓ is now given by $D(\ell) = b(\ell)(1 - \ell)$. It is easy to show that $D''(\ell) = -2b'(\ell) + b''(\ell)(1 - \ell)$. Thus, more generally, the function $D(.)$ is a concave so long as $b(.)$ is increasing and not too convex.

10. We could easily extend the analysis to allow agency problems and bankruptcy costs to coexist. The effects of concave bankruptcy costs on the collateral decision as well as the incentive effects of the debt structure with collateral would be the same as those developed in the section.

collateral. This condition is equivalent to saying that the less risky asset is used as collateral. These results provide a rationale for the use of collateralized debt and for using the firm's less volatile assets as the collateral.

More formally, let $B(.)$ be the bankruptcy cost function per dollar of face value that is a concave function of the loss rate on the issue in the default state. An issue with a face value of $\hat{F}$ and a loss rate of ℓ incurs total bankruptcy costs in the bad state of $\hat{F}B(\ell)$. The firm has two assets, one and two, with values $v_1 F$ and $v_2 F$, respectively, in the default state. Let $v_1 > v_2$ and assume $v_1 + v_2 < 2$, so default occurs in the bad state. If the firm issues general debt with a face value of $2F$, the bankruptcy cost incurred by the firm in the default state is given by

$$B\left(\frac{2 - (v_1 + v_2)}{2}\right)2F = B\left(1 - \frac{v_1 + v_2}{2}\right)2F = B(\ell_G)2F, \qquad (10)$$

where ℓ_G is the debt loss rate when only general debt is issued. If the firm issues collateralized and uncollateralized debt each with a face value of F, the total bankruptcy cost incurred by the firm in the default state is given by

$$B\left(1 - \left[v_C + \frac{1 - v_C}{2 - v_C}v_U\right]\right)F$$

$$+ B\left(1 - \left[\frac{1}{2 - v_C}v_U\right]\right)F = B(\ell_C)F + B(\ell_U)F, \qquad (11)$$

where v_C is the collateralized asset value in the default state as a fraction of F, v_U is the uncollateralized asset value in the default state as a fraction of F, ℓ_C is the debt loss rate for the collateralized debt, and ℓ_U is the debt loss rate for the uncollateralized debt. Note that by construction, since the asset values are given, a weighted average of the debt loss rates in equation (11) must equal the loss rate for the general debt in equation (10). The weights are based on face values, so here the weights are 0.5 for each debt class:

$$\ell_G = \frac{F}{2F}\ell_C + \frac{F}{2F}\ell_U = \frac{1}{2}\ell_C + \frac{1}{2}\ell_U. \qquad (12)$$

This result holds irrespective of whether asset 1 or asset 2 is the collateralized asset. By Jensen's inequality, it follows that

$$B(\ell_G)F > \frac{1}{2}B(\ell_C)F + \frac{1}{2}B(\ell_U)F, \qquad (13)$$

so long as $\ell_C \neq \ell_U$. Thus, we have the first result that the use of collateralized debt reduces bankruptcy costs. The second result follows from noting that for a fixed ℓ_G, the bankruptcy cost advantage of collateralized debt is increasing in $|\ell_U - \ell_C|$. Since the loss rate on the collateralized debt must be greater than that on the uncollateralized debt, bankruptcy costs are minimized by

collateralizing the asset (either asset 1 or 2) that maximizes $\ell_U - \ell_C$. It is relative easy to show that

$$\ell_U - \ell_C = v_C \frac{2\ell_G}{2 - v_C}, \tag{14}$$

which is increasing in v_C. Thus, bankruptcy costs are minimized by collateralizing the asset with the highest default-state value as a fraction of F: here it is asset 1, since $v_1 > v_2$. This is the second result.

It is worth noting that the bankruptcy costs incurred depend on asset values in the firm's default state. Thus, an asset could have a volatile value and be preferred as collateral so long as its high values are in the firm's default states. Such an asset would also be an attractive source of perk consumption to a manager in much the same way as a low volatility asset. The reason is that such an asset has a low value in nondefault states, which are the only states that the manager cares about.

Alternatively, an asset's value may be volatile but have a lower bound irrespective of the firm's state. By using this asset as collateral to issue debt with a face value equal to that lower bound, the effect is to issue debt collateralized on the riskless portion of the asset's value. The bankruptcy cost argument could explain this type of collateralizing if the firm's other assets have zero values in the firm's default states. Moreover, firms often use assets such as inventory as collateral but for loans whose face values are only a small fraction of current inventory value. In fact, very often the fraction of an asset's value that can be borrowed using the asset as collateral seems to depend on its lower bound. For example, the lower bound is typically much larger as a fraction of current value for accounts receivable than for inventory. At the same time, a much larger fraction of current value can be borrowed using accounts receivable rather than inventory as collateral.

The next section presents proxies for the variables in the model and uses the above propositions and the proxies to develop testable implications.

V. Collateral and Loan Characteristics and How They Influence Yield

This section develops proxies for the model's parameters and generates testable predictions in terms of these proxies using the propositions developed in Section IV. Throughout, the correspondence between bond yields after controlling for credit rating and the incremental impact of agency problems on expected bond payoffs is used to present the predictions in terms of yields after controlling for credit rating. In particular, the yield differential between collateralized and uncollateralized debt after controlling for credit rating (henceforth referred to as the yield differential) can be viewed as a proxy for the incremental payoff differential from the previous section. While the patterns of results that we document are consistent with our story, it is difficult

to explain all of them using the risk story described earlier. Moreover, we explicitly control for cross-firm differences in risk by examining a matched sample of collateralized and uncollateralized issues by the same firms. For this sample, we still find a larger rating-corrected yield for collateralized than uncollateralized issues, as our theory predicts. In the process of testing implications of our theory, we are able to isolate a number of important characteristics relating to the nature of collateral, monitoring intensity, and default probability that can influence yields and that are important and interesting in their own right.

A.   *Secured versus Unsecured Debt*

After controlling for credit rating, secured debt will have higher yields than unsecured debt (proposition 1). Our model predicts this under fairly intuitive conditions, that is, when the value of the general asset in the bad state is low relative to the promised payment on the general debt (which is generally likely to be true). This is consistent with table 1, where the coefficient on the secured-debt dummy variable is positive and significant. However, the general result that secured debt has higher yields than unsecured debt could be consistent with alternative explanations: in particular, the risk story presented earlier. Hence, we test additional predictions based on the nature of the collateralized assets, the value of the uncollateralized assets in the event of default, the issuer's probability of defaulting, and the intensity of monitoring.

B.   *Mortgaged versus Nonmortgaged Secured Debt*

Does the type of collateral being posted matter? To our knowledge there is no theoretical or empirical work addressing this question. A natural dichotomy in the nature of assets (and the only one available in the data) is the dichotomy between mortgage and nonmortgage assets. Mortgages are typically land and buildings. Perk consumption or neglect of these assets cause relatively little damage (in terms of decreasing the value of the assets). Our model formalizes one way of examining the dichotomy between mortgage and nonmortgage assets (proposition 2). Two testable propositions emerge. First, the yield differential for collateralized debt relative to general debt should be higher when mortgage debt is excluded from the collateralized category. Second, yield after controlling for credit rating should be higher for nonmortgage secured debt than for mortgage debt.

Since the nature of the underlying collateral is an important component of our tests, we augmented our data collection going beyond the SDC New Issues Database to collect additional data on collateral as well as data on covenants. In the SDC New Issues Database, in their field for security, if the word *mortgage* appears, we take the bond to be secured by a mortgage, and other secured issues to be nonmortgage secured. There were 114 nonmortgage secured issues based on this classification. We took these 114 issues and examined four additional sources to see if any further details were given on the

collateral. The four sources checked were (i) Compact Disclosure, which has information extracted from registration statements, amendments, prospectuses, and supplements filed with the Securities Exchange Commission (SEC); (ii) the SEC Edgar Database and, for issues not found in Edgar, filings in the SEC library; (iii) Moody's Manuals; and (iv) Standard and Poor's Corporation Records. After going through these records we found that there were mortgages underlying some of these issues. We reclassified the issues accordingly. At the end of this exercise we were left with 93 nonmortgage secured issues. We define two additional variables:

MORTGAGE: A dummy variable that takes the value of one if the issue has a mortgage as the underlying collateral, zero otherwise.
NONMORTGAGE: A dummy variable that takes the value of one if the issue is secured but does not specifically have a mortgage as the underlying collateral, zero otherwise.

Our results for mortgaged versus nonmortgaged debt are reported in tables 2 and 3. Table 2 documents that the yield differential is strengthened when we examine nonmortgages as distinct from mortgage secured issues. Accordingly, nonmortgaged collateral raises yields by 44 basis points, which is significant at 1%, while mortgage collateral has an insignificant effect. Table 3 demonstrates that within the secured debt issues in our sample, mortgages have significantly lower yields after controlling for credit rating. The effect is large economically (38 basis points) as well as being statistically significant at 1%. This result is also consistent with the risk story, since real estate values are likely to be much less correlated with firm value than the values of other assets. However, credit ratings would still have to imperfectly risk-adjust for the consequent differences in risk between mortgage and nonmortgage secured debt issues to affect rating-adjusted yields.

With this in mind, a natural and interesting test would be to examine the relative pricing of uncollateralized versus nonmortgage secured debt for firms that issue both kinds of debt. We examine all firms in our sample that issue both kinds of debt and find 14 such firms. Using this sample, we can check whether our result concerning the yield differential between unsecured and nonmortgage secured debt continues to hold when the same firm issues both types of debt. In the full sample, we find that the rating-adjusted yield is higher for nonmortgage secured issues than for unsecured issues. Since riskier firms are more likely to use collateral, the risk story says that cross-firm differences in risk not captured by credit rating may be an explanation for our result. While a firm's unsecured and secured debt issues can have very different recovery rates, the firm risk of bankruptcy is common to all the firm's debt issues. Hence, the nonmortgage secured dummy in the matched sample is much less likely to be picking up risk differences not captured by credit rating, because each observation is a pair of unsecured and nonmortgage secured issues for the same firm.

We are interested in whether unsecured and nonmortgage secured debt

TABLE 2   Effect of Mortgage and Nonmortgage Secured on Full Data

Variable	Coefficient	t-Ratio
Constant	39.01	4.57*
CR0	543.05	13.88*
CR1	397.72	38.60*
CR2	234.68	18.98*
CR3	59.40	9.68*
CR4	18.33	3.30*
CR5	4.18	.78
LOWMAT	−16.20	−4.25*
HIMAT	24.42	10.46*
LN(AMOUNT)	.11	.08
MORTGAGE	.57	.17
NONMORTGAGE	44.51	5.90*
PRESTIGIOUS	−2.66	−.83
REF BK DEBT	6.64	1.55
NEW ISSUE	18.52	2.91*
EXCHANGE	−5.61	−1.42
Observations	1,327	
Adjusted R^2	.87	

NOTE.—The table gives the OLS estimates of the following equation:

$$\text{BPS} = \beta_0 + \beta_{\text{CR}} \text{ CREDIT RATING} + \beta_{\text{MAT}} \text{ MATURITY} + \beta_{\text{A}} \text{ LN(AMOUNT)}$$

$$+ \beta_{\text{M}} \text{ MORTGAGE} + \beta_{\text{NM}} \text{ NONMORTGAGE} + \beta_{\text{P}} \text{ PRESTIGIOUS} + \beta_{\text{R}} \text{ REF BK DEBT}$$

$$+ \beta_{\text{N}} \text{ NEW ISSUE} + \beta_{\text{I}} \text{ INDUSTRY} + \beta_{\text{E}} \text{ EXCHANGE}.$$

The dependent variable for basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points. The independent variables are as follows: CR (CREDIT RATING): set of credit rating dummy variables CR0–CR6 that correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa; MATURITY: dummy variables constructed based on the maturity of a debt issue; LOWMAT: value of one if the security matures in less than 5 years; HIMAT: value of one if the maturity is greater than 15 years; LN(AMOUNT): natural log of the issue amount in millions of dollars; MORTGAGE: dummy variable that is one if the underlying security is a mortgage; NONMORTGAGE: dummy variable that is one if the issue is secured but not by a mortgage; PRESTIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; NEW ISSUE: dummy variable that is one if the debt issue is a new one; EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange. All dummy variables are zero otherwise. INDUSTRY dummy variables are included but not reported in the tables. The t-ratios are computed using White heteroskedasticity corrected standard errors (White 1980).
  * Significant at the 1% level.

issued by the same firm has the same rating-adjusted yields. To assess this, we conduct the following test. For the full sample, we run the regression of yield spreads on credit rating, maturity, log amount, underwriter reputation, whether the purpose is to refinance bank debt, whether it is a new issue, and whether it is listed on an exchange. We then take the fitted values of this regression for each debt issues for our 14 firms and subtract the fitted values from the actual yield spread. The mean of the residuals for the unsecured debt is 53.02 basis points; for nonmortgage secured debt, it is 68.62 basis points, with the difference between the two being significant at 1%. These results are consistent with and support our earlier tests using the larger sample of firms issuing different kinds of debt, suggesting that nonmortgage secured

TABLE 3   Effect of Mortgage within Secured Category

Variable	Coefficient	t-Ratio
Constant	584.65	20.33*
CR1	−176.42	−9.07*
CR2	−325.48	−9.85*
CR3	−564.84	−27.52*
CR4	−604.82	−30.44*
CR5	−616.49	−30.51*
LOWMAT	−24.50	−3.35*
HIMAT	30.23	9.74*
LN(AMOUNT)	.11	.04
MORTGAGE	−38.15	−4.85*
PRESTIGIOUS	1.52	.54
REF BK DEBT	.70	.09
NEW ISSUE	13.90	1.27
EXCHANGE	3.41	.97
Observations	468	
Adjusted R^2	.89	

Note.—The table gives the OLS estimates of the following equation:

$$BPS = \beta_0 + \beta_{CR} \text{ CREDIT RATING} + \beta_{MAT} \text{ MATURITY} + \beta_A \text{ LN(AMOUNT)}$$

$$+ \beta_M \text{ MORTGAGE} + \beta_P \text{ PRESTIGIOUS} + \beta_R \text{ REF BK DEBT}$$

$$+ \beta_N \text{ NEW ISSUE} + \beta_I \text{ INDUSTRY} + \beta_E \text{ EXCHANGE.}$$

The dependent variable for basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points. The independent variables are as follows: CR (CREDIT RATING): set of credit rating dummy variables CR0–CR6 that correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa; MATURITY: dummy variables constructed based on the maturity of a debt issue; LOWMAT: value of one if the security matures in less than 5 years; HIMAT: value of one if the maturity is greater than 15 years; LN(AMOUNT): natural log of the issue amount in millions of dollars; MORTGAGE: dummy variable that is one if the underlying security is a mortgage; PRESTIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; NEW ISSUE: dummy variable that is one if the debt issue is a new one; EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange. All dummy variables are zero otherwise. INDUSTRY dummy variables are included but not reported in the table. The regressions are run for the subsample of debt issues that are secured. The t-ratios are computed using White heteroskedasticity corrected standard errors (White 1980).
  * Significant at the 1% level.

debt has higher yields than unsecured debt after controlling for credit ratings. Since our propositions and predictions do not apply to secured issues whose collateral is difficult to erode, the remaining tables examine the yield differential for nonmortgage secured loans rather than for all secured loans.

C.   Low versus High Credit Rating

As discussed above, credit ratings are determined based on the likelihood of default of the issuer (corporate credit rating) and the recovery rate in the event of default (notching adjustment). The most important determinant of the firm's default probability is the likelihood of entering the bad state, ϕ_B. Thus, credit rating provides a convenient, though noisy, proxy for ϕ_B. From proposition 3, the yield differential is predicted to be large when the likelihood of the issuer entering the bad state is high. This implies that the yield differential

TABLE 4   Effect on High and Low Credit Issues

Variable	Prime Credit Rating (A and Above)		Nonprime Credit Rating	
	Coefficient	t-Ratio	Coefficient	t-Ratio
Constant	73.52	12.95*	93.76	4.21*
CR0	a	a	476.97	13.27*
CR1	a	a	333.93	31.33*
CR2	a	a	176.11	15.33*
CR5	−12.80	−9.58*	a	a
CR6	−25.47	−8.88*	a	a
LOWMAT	−16.10	−7.60*	−19.47	−1.71***
HIMAT	23.13	17.29*	25.19	4.32*
LN(AMOUNT)	−.313	−.41	1.62	.48
NONMORTGAGE	12.98	2.75*	66.72	5.67*
PRESTIGIOUS	−.20	−.16	−1.65	−.25
REF BK DEBT	−1.85	−1.19	13.48	1.88***
NEW ISSUE	3.18	1.08	22.99	2.69*
EXCHANGE	4.95	3.48*	−15.42	−2.02**
Observations	712		615	
Adjusted R^2	.48		.810	

NOTE.—The table gives the OLS estimates of the following equation:

$$BPS = \beta_0 + \beta_{CR} \text{ CREDIT RATING} + \beta_{MAT} \text{ MATURITY} + \beta_A \text{ LN(AMOUNT)}$$

$$+ \beta_{NM} \text{ NONMORTGAGE} + \beta_P \text{ PRESTIGIOUS} + \beta_R \text{ REF BK DEBT}$$

$$+ \beta_N \text{ NEW ISSUE} + \beta_I \text{ INDUSTRY} + \beta_E \text{ EXCHANGE}.$$

The dependent variable for basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points. The independent variables are as follows: CR (CREDIT RATING): set of credit rating dummy variables CR0–CR6 that correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa; MATURITY: dummy variables constructed based on the maturity of a debt issue; LOWMAT: value of one if the security matures in less than 5 years; HIMAT: value of one if the maturity is greater than 15 years; LN(AMOUNT): natural log of the issue amount in millions of dollars; NONMORTGAGE: dummy variable that is one if the issue is secured but not by a mortgage; PRES-TIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; NEW ISSUE: dummy variable that is one if the debt issue is a new one; EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange. All dummy variables are zero otherwise. INDUSTRY dummy variables are included but not reported in the table. The t-ratios are computed using the White heteroskedasticity corrected standard errors (White 1980). The t-test for the difference in nonmortgage secured for high and low credit rating = 4.24.
  a No issues in these categories exist for these subdivisions.
  * Significant at the 1% level.
  ** Significant at the 5% level.
  *** Significant at the 10% level.

on secured debt (excluding mortgages whose collateralized assets are difficult to consume from) should be higher within low-rated than within high-rated debt categories.

   Table 4 reports results for low versus high credit ratings. Our prediction is that the yield differential for collateralized debt is higher for low-rated debt than high-rated debt. Hence, we split the sample into two: the top two credit ratings and the remaining. After controlling for other factors, we see that the effect of securing is significantly higher in the low-rated debt category. Thus, securing debt with nonmortgage collateral raises yields by 54 basis points

TABLE 5   Effect on Short and Long Maturity Issues

Variable	Short Maturity		Long Maturity	
	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Constant	12.14	.95	75.51	5.25*
CR1	a	a	246.49	29.37*
CR2	344.94	16.30*	188.07	8.37*
CR3	51.67	5.01*	70.98	10.81*
CR4	12.33	1.02	20.77	4.37*
CR5	−2.70	−.34	5.28	1.02
LN(AMOUNT)	1.54	.54	−.51	−.23
NONMORTGAGE	4.39	.49	53.87	4.29*
PRESTIGIOUS	.59	.12	.89	.36
REF BK DEBT	−3.77	−.79	−.40	−.09
NEW ISSUE	−13.10	−1.62	4.63	.65
EXCHANGE	−5.49	−.45	−.02	−.00
Observations	101		410	
Adjusted R^2	.72		.58	

Note.—The table below gives the OLS estimates of the following equation:

$$BPS = \beta_0 + \beta_{CR} \text{ CREDIT RATING} + \beta_A \text{ LN(AMOUNT)} + \beta_{NM} \text{ NONMORTGAGE}$$

$$+ \beta_P \text{ PRESTIGIOUS} + \beta_R \text{ REF BK DEBT}$$

$$+ \beta_N \text{ NEW ISSUE} + \beta_I \text{ INDUSTRY} + \beta_E \text{ EXCHANGE}.$$

The dependent variable for basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points. The independent variables are as follows: CR (CREDIT RATING): set of credit rating dummy variables CR0–CR6 that correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa; LN(AMOUNT): natural log of the issue amount in millions of dollars; NONMORTGAGE: dummy variable that is one if the issue is secured but not by a mortgage; PRESTIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; NEW ISSUE: dummy variable that is one if the debt issue is a new one; EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange. All dummy variables are zero otherwise. INDUSTRY dummy variables are included but not reported in the table. We run the regressions for subsamples of short maturity issues (with maturity less than 5 years) and long maturity issues (with maturity greater than 15 years). The *t*-ratios are computed using the White heteroskedasticity corrected standard errors (White 1980). The *t*-test for difference in nonmortgage secured for short and long maturity = 3.2.
   [a] None of the issues are of the CR1 category.
   * Significant at the 1% level.

more for low credit-rated issues as compared to high credit-rated issues, and this difference is significant at 1% (*t*-statistic = 4.24).

D.   *Short versus Long Maturity*

Proposition 4 predicts that the incremental payoff differential is decreasing in the value of the general assets in the bad state. What determines the value of the general assets in the bad state is the volatility of their value. If the asset value is more volatile, then the value of the assets is lower in the bad state. The volatility of the general asset value over the life of the debt increases with its maturity. Thus, the proposition implies that the yield differential (between nonmortgage secured and unsecured) is larger for longer maturity debt than for shorter maturity debt.

   Table 5 reports the effect of nonortgage collateral for short and long maturity

debt. It shows that the effect of nonmortgage collateralization on yields is significantly higher for long maturity issues as predicted by the model (proposition 4). In particular, the presence of nonmortgage collateral increases yields on long maturity issues by 49 basis points more than on short maturity issues with this difference being significant at 1% (t-statistic $=$ 3.2).

E.   New versus Seasoned Issues

An increase in monitoring reduces the incidence of managerial behavior that destroys firm value. Thus, an increased monitoring intensity reduces the expected payoff differential (proposition 5a). One proxy for monitoring intensity is whether the issue is new or seasoned. Seasoned issues are, in general, characterized by a large analyst following and continuous production of information and thus are likely to be characterized by more monitoring than new issues. Hence, the yield differential (between nonortgage secured and unsecured) should be higher for new issues as compared to seasoned issues. Table 6 reports the results concerning yields on new versus seasoned issues (t-statistic $=$ 1.09) and is positive for both subsamples.

F.   The Effect of Covenants

Another, more direct, proxy for monitoring intensity is the presence of covenants in the debt agreement (see, e.g., Smith and Warner 1979; Booth 1992). Proposition 6 says that a greater monitoring intensity reduces collateralized debt yield after controlling for credit rating and that this reduction is larger when the probability of entering the bad state is high. Thus, the prediction has two parts. First, within nonmortgage secured debt issues, yield after controlling for credit rating is lower for issues with covenants. Second, the reduction in yield (after controlling for credit rating) due to covenants is larger for low credit-rated issues than for high credit-rated issues.

Proposition 5 says that a positive yield differential (between nonmortgage secured and unsecured after controlling for credit rating) is lower for covenant debt (high monitoring intensity) than for noncovenant debt (low monitoring intensity). Further, the difference is largest when the debt issues are low grade. For any sample of bonds, the impact of covenants on the yield differential (between nonmortgage secured and unsecured debt) is exactly equal to the difference between the covenant impact on the nonmortgage secured debt and on the general debt. Thus, proposition 5 predicts that the impact of covenants on yields is more negative for nonmortgage secured debt than for unsecured debt, especially for debt issues with nonprime ratings.

In order to conduct these tests we collected covenant information on the nonmortgage secured issues using SEC Edgar, SEC filings and Compact Disclosure (SEC/Disclosure). For each issue, we searched if it could be found on any of these data sources and, if so, noted whether there were covenants associated with the issue or not. However, to test proposition 5, we also need covenant information on unsecured issues. For this purpose we created a

TABLE 6   Effect on Seasoned and New Issues

Variable	New Issue		Seasoned Issue	
	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Constant	140.33	2.27**	29.86	3.65*
CR0	556.31	14.09*	379.13	51.12*
CR1	392.33	12.24*	382.51	26.73*
CR2	245.09	7.77	217.96	13.44*
CR3	48.76	1.82***	57.34	9.81*
CR4	4.22	.16	14.03	2.70*
CR5	−30.88	−.94	1.30	.26
LOWMAT	−36.78	−2.35**	−14.80	−3.96*
HIMAT	13.76	1.06	24.99	11.33*
LN(AMOUNT)	−15.19	−1.891***	1.68	1.23
NONMORTGAGE	66.36	2.99*	40.87	5.63*
PRESTIGIOUS	−8.12	−.69	−1.01	−.35
REF BK DEBT	5.95	.51	5.77	1.44
EXCHANGE	−25.97	−1.73***	1.58	.45
Observations	238		1,089	
Adjusted R^2	.81		.83	

NOTE.—The table below gives the OLS estimates of the following equation:

$$BPS = \beta_0 + \beta_{CR} \text{ CREDIT RATING} + \beta_{MAT}\text{MATURITY} + \beta_A \text{ LN(AMOUNT)}$$

$$+ \beta_{NM} \text{ NONMORTGAGE} + \beta_P \text{ PRESTIGIOUS} + \beta_R \text{ REF BK DEBT}$$

$$+ \beta_I \text{ INDUSTRY} + \beta_E \text{ EXCHANGE}.$$

The dependent variable for basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points. The independent variables are as follows: CR (CREDIT RATING): set of credit rating dummy variables CR0–CR6 that correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa; MATURITY: dummy variables constructed based on the maturity of a debt issue; LOWMAT: value of one if the security matures in less than 5 years; HIMAT: value of one if the maturity is greater than 15 years; LN(AMOUNT): natural log of the issue amount in millions of dollars; NONMORTGAGE: dummy variable that is one if the issue is secured but not by a mortgage; PRES-TIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange. All dummy variables are zero otherwise. INDUSTRY dummy variables are included but not reported in the table. The *t*-ratios are computed using the White heteroskedasticity corrected standard errors (White 1980). The *t*-test for difference in nonmortgage secured for new and seasoned issues = 1.09.
  * Significant at the 1% level.
  ** Significant at the 5% level.
  *** Significant at the 10% level.

matched sample of 93 unsecured issues.[11] We then found covenant information for the unsecured control sample using the procedure described above. This data allowed us to construct a covenant variable called COVENANT, which is a dummy variable that takes the value of one if the debt issue has a covenant, zero otherwise.

Our results for the effect of covenants is given in table 7. We run two separate tests. First, within nonmortgage secured issues, we examine the im-

11. The prime matching criteria was the credit rating, and this was matched exactly for all 93 issues. The next matching critera used was the timing of the issue. Ninety of the 93 issues of the control sample were matched within 3 months of the nonmortgage secured sample, with the remaining three issues being matched within a 5-month window. Finally, wherever possible, issues with the closest issue size to the nonmortgage secured sample were chosen.

TABLE 7 **Effect of Covenants**

| Variable | Nonmortgage Secured Credit Rating | | | | Unsecured Control Sample Credit Rating | | | |
| | Prime Rating | | Nonprime Rating | | Prime Rating | | Nonprime rating | |
	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio
Constant	33.17	.78	24.11	.320	68.77	5.13*	291.39	4.96*
CR0	a	a	532.01	11.79*	a	a	a	a
CR1	a	a	363.95	8.10*	a	a	341.07	16.81*
CR2	a	a	390.91	12.76*	a	a	142.72	5.53*
CR5	−36.54	−4.01*	a	a	−22.80	−3.99*	a	a
LOWMAT	−28.16	−2.61**	−91.16	−2.30**	−6.78	−.92	26.08	.89
HIMAT	8.12	.65	85.73	4.35*	13.91	2.79*	33.82	2.21**
LN(AMOUNT)	16.08	2.80*	−28.79	−2.40**	−1.50	−.50	2.18	.23
PRESTIGIOUS	44.13	2.43**	20.62	1.38	8.491	1.29	2.14	.13
REF BK DEBT	−15.80	1.71	150.99	5.60*	−4.81	−.98	3.00	.24
NEW ISSUE	−10.73	−1.26	138.71	5.34*	1.92	.29	34.17	1.91***
EXCHANGE	25.57	2.30**	36.56	2.16**	15.69	2.80*	−56.32	−2.41**
COVENANT	−26.47	−1.77***	−164.35	−4.70*	−15.41	−3.11*	−30.02	−1.53
Observations	41		52		41		52	
Adjusted R^2		.62		.90		.62		.89

Note.—The table gives the OLS estimates of the following equation:

$$\text{BPS} = \beta_0 + \beta_{CR}\ \text{CREDIT RATING} + \beta_{MAT}\text{MATURITY} + \beta_A\ \text{LN(AMOUNT)}$$

$$+ \beta_P\ \text{PRESTIGIOUS} + \beta_R\ \text{REF BK DEBT} + \beta_N\ \text{NEW ISSUE}$$

$$+ \beta_I\ \text{INDUSTRY} + \beta_E\ \text{EXCHANGE} + \beta_C\ \text{COVENANT}.$$

The dependent variable for basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points. The independent variables are as follows: CR (CREDIT RATING): set of credit rating dummy variables CR0–CR6 that correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa; MATURITY: dummy variables constructed based on the maturity of a debt issue; LOWMAT: value of one if the security matures in less than 5 years; HIMAT: value of one if the maturity is greater than 15 years; LN(AMOUNT): natural log of the issue amount in millions of dollars; PRESTIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; NEW ISSUE: dummy variable that is one if the debt issue is a new one; EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange; COVENANT: dummy variable that is one if there are covenants associated with the issue. All dummy variables are zero otherwise. INDUSTRY dummy variables are included but not reported in the table. The *t*-ratios are computed using the White heteroskedasticity corrected standard errors (White 1980). The *t*-test for difference in the COVENANT coefficient for prime and nonprime issues in nonmortgage secured issue = 3.62. The *t*-test for difference in the COVENANT coefficient for nonprime issues in nonmortgage secured issues and unsecured = 3.35.

[a] No issues in these categories exist for these subdivisions.

* Significant at the 1% level.

** Significant at the 5% level.

*** Significant at the 10% level.

pact of covenants on yields for issues with prime credit ratings and for issues with nonprime credit ratings. We find that within the nonmortgage secured sample, covenants are associated with lower yield for both prime and nonprime credit-rated issues. However, consistent with proposition 6, the differential impact of covenants is larger for nonprime credit-rated issues, and this difference is significant at 1%.

Second, as a test of proposition 5, we compare the effect of covenants in the nonmortgage secured sample with the effect of covenants in a matched sample of unsecured issues. While covenants are negatively associated with yields in the unsecured sample, two things are worthy of note. First, the differential effect of covenants for prime and nonprime rated issues is not significant in the unsecured sample. Second, the differential impact of covenants for nonprime credit-rated issues is higher in the nonmortgage secured sample than the matched unsecured sample, and this difference is significant at 1%. This is consistent with proposition 5.

Finally, insofar as all issues were not found on SEC or Disclosure, and only issues on SEC/Disclosure had covenant information, it is possible that our results on covenants are being driven by a sample selection bias. In particular, all issues not on SEC or Disclosure are being classified as noncovenant even though some would be classified as covenant if such information were available. These misclassifications could be driving the smaller impact of covenants in the unsecured control sample if there are fewer issues found on SEC/Disclosure for this sample than the nonmortgage secured sample. However, we find that for nonprime issues, where our significant results lie, in the nonmortgage secured issues 41 nonprime issues are found on SEC/Disclosure, as compared to 44 such issues for the unsecured control sample. Hence, the bias we were concerned about is unlikely to be driving our results. Further, when we rerun our regressions for both the nonmortgage and unsecured control nonprime samples using only those issues found on SEC/Disclosure, we find qualitatively similar results to those reported.

To summarize, all six results are consistent with the propositions and, in the context of the model, with each other. The results provide support for the hypothesis that agency problems between managers and claim holders increase yields on secured debt to a greater extent than on unsecured debt. The yield differential (between secured and unsecured loans after controlling for credit rating) is positive and higher for low credit rating, nonmortgage collateralized assets, longer maturity issues, and with proxies for lower levels of monitoring.

VI.   Conclusions

The effect of collateral on yield spreads has been a matter of debate in the literature. Much of the literature of collateral (particularly the empirical literature) has focused on the relationship between collateral and the riskiness of the underlying firm. Little is known about how and why yields net of credit rating vary with collateral and loan characteristics. This article fills this gap

in the literature along both theoretical and empirical dimensions. We first document a positive yield differential (after controlling for credit rating) between secured and unsecured debt, using a large database on all fixed-rate public debt issues made in the period January 1, 1993, to March 31, 1995. We then provide an explanation for this puzzling result based on agency problems between insiders and claim holders. The intuition is twofold. First, ratings agencies fail to fully incorporate the effects of these agency problems when determining credit ratings for debt. Second, these agency problems have a larger incremental impact on the yields of collateralized than general debt issues.

The model also provides predictions about how collateral and loan characteristics affect the yield differential between secured and unsecured debt after controlling for credit rating. In particular, the model predicts that the yield differential depends on the default likelihood, the nature of the secured assets, the volatility of the general assets, and the intensity of monitoring. We use these predictions as a guide for our cross-sectional tests. Consistent with our model, we find that the yield differential, after controlling for credit rating, between secured and unsecured debt is found to be larger for low credit rating, nonmortgage assets, longer maturity, and with proxies for lower levels of monitoring, such as the absence of covenants.

To our knowledge, ours is the first study to empirically examine the nature of the yield differential on a disaggregate level based on collateral and loan characteristics. Hence, the empirical results are of interest in their own right. Our results suggest that the nature of collateral and associated loan characteristics are important determinants of yields and raise a number of questions for future research.

Appendix A

I.   Manager's Optimal Consumption

The manager's optimal consumption can be completely characterized as follows:

$$f_C^* = u'^{-1}(\alpha \phi_R \lambda_C / \xi) \quad \text{for } v_U \geq v^\#$$

$$= 1 \quad \text{for } v_U < v^\#, \tag{A1}$$

and

$$f_U^* = u'^{-1}(\alpha \phi_R \lambda_U) \quad \text{for } v_U \geq v^\#$$

$$= 1 \quad \text{for } v_U < v^\#, \tag{A2}$$

where $v^\#$ is nonnegative and satisfies

$$V(u'^{-1}(\alpha \phi_R \lambda_C), \ u'^{-1}(\alpha \phi_R \lambda_U); \ v^\#) = V(1, 1; v^\#), \tag{A3}$$

or else is equal to zero. Notice that $\lambda_U > \lambda_C$ and $\xi = 1$ implies that the manager consumes a greater fraction of the collateralized than the uncollateralized asset. To

see why, consider reducing the value of either asset in the bad state by 1%. The greater volatility of the general asset's value means a greater reduction in its recovery-state value than in the collateralized asset's recovery value.

II.   Impact on Expected Payoffs

Having characterized the manager's behavior, we now turn to its impact on expected debt payoffs. Since the expected debt payoffs depend on the levels of perk consumption, we define $P_C(f_C, f_U)$ and $P_U(f_C, f_U)$ to be the expected payoffs on the collateralized and uncollateralized debt respectively, each expressed as a fraction of the promised payment F. If the firm is not in default, then the recovery rate on the collateralized debt is 100%. The firm is in default in the bad state and possibly in the recovery state. Thus, defining the functions $c(v) = \min\{v, 1\}$ and $\hat{v}_d(f) = v_d[1 - f]$ for $d = C$ or U, $P_C(f_C, f_U)$ can be written

$$P_C(f_C, f_U) = (1 - \phi_B) + \phi_B\gamma + \phi_B(1 - \gamma)(1 - \phi_R)\left\{\hat{v}_C(f_C) + \frac{1 - \hat{v}_C(f_C)}{2 - \hat{v}_C(f_C)}\hat{v}_U(f_U)\right\}$$

$$+ \phi_B(1 - \gamma)\phi_R\min\left[1, c(\kappa_C\hat{v}_C(f_C)) + \frac{1 - c(\kappa_C\hat{v}_C(f_C))}{2 - c(\kappa_C\hat{v}_C(f_C))}\right.$$

$$\left.[\kappa_U\hat{v}_U(f_U) + \kappa_C\hat{v}_C(f_C) - c(\kappa_C\hat{v}_C(f_C))]\right].$$

(A4)

The first two terms on the right-hand side reflect the 100% recovery rate in the good state and when stealing is detected with probability γ in the bad and recovery states. The curly-bracketed expression in the third term and the minimum in the fourth term are the recovery rates in the bad and recovery states, respectively, when the manager's stealing goes undetected. Similarly, the expected payoff to debt U is given by

$$P_U(f_C, f_U) = (1 - \phi_B) + \phi_B\gamma + \phi_B(1 - \gamma)(1 - \phi_R)$$

$$\left\{\frac{1}{2 - \hat{v}_C(f_C)}\hat{v}_U(f_U)\right\} + \phi_B(1 - \gamma)\phi_R$$

$$\min\left\{1, \frac{1}{2 - c(\kappa_C\hat{v}_C(f_C))}[\kappa_U\hat{v}_U(f_U)\right. \tag{A5}$$

$$\left. + \kappa_C\hat{v}_C(f_C) - c(\kappa_C\hat{v}_C(f_C))]\right\}.$$

III.   Yield as a Proxy for Expected Payoff

In Section IV, we generated some theoretical predictions about $p(f_C, f_C)$, the differential between secured versus unsecured debt's incremental expected payoff (as a fraction of promised payoff) due to agency problems between managers and owners. In the empirical work, we use the yield differential between the collateralized and uncollateralized debt after controlling for differences in credit rating (the yield differential).

Since debt rating does not incorporate the impact of perquisite consumption on recovery rates in default, the yield differential is equal to the incremental impact of perquisite consumption on the collateralized debt's yield less the incremental impact of perquisite consumption on the uncollateralized debt's yield. Letting $Y_C(f_C, f_U)$ be the yield on the collateralized debt, $Y_U(f_C, f_U)$ be the yield on the general debt and $y(f_C, f_U)$ be the yield differential, $y(f_C, f_U)$ can be written

$$y(f_C, f_U) = [Y_C(f_C, f_U) - Y_C(0, 0)] - [Y_U(f_C, f_U) - Y_U(0, 0)]. \tag{A6}$$

This expression is closely approximated by

$$\left[\frac{1}{1 + Y_C(0,0)} - \frac{1}{1 + Y_C(f_C, f_U)} \right] - \left[\frac{1}{1 + Y_U(0,0)} - \frac{1}{1 + Y_U(f_C, f_U)} \right], \tag{A7}$$

which can be shown to be proportional to $p(f_C, f_U)$. So the yield differential used in the empirical work is a proxy for the $p(f_C, f_U)$ variable used in the propositions.

Appendix B

Description of the Data

The sample consists of fixed-rate U.S. nonconvertible debt issues of nonfinancial firms. The sample consists of 1,327 debt issues for which all the required data were available (e.g., no missing price information, no missing information on yield of comparable treasury, etc.). The construction of the variables from the SDC data variables is explained below.

  BPS: basis point spread over the treasury rate of comparable maturity. It is the same as SDC variable BPS.

  CREDIT RATING: a set of dummy variables CR0–CR6 created from SDC variable MDY (Moody's credit rating).

  CR0: a dummy variable that is one if MDY is Caa–C.

  CR1: a dummy variable that is one if MDY is B1–B3.

  CR2: a dummy variable that is one if MDY is Ba1–Ba3.

  CR3: a dummy variable that is one if MDY is Baa1–Baa3.

  CR4: a dummy variable that is one if MDY is A1–A3.

  CR5: a dummy variable that is one if MDY is Aa1–Aa3.

  CR6: a dummy variable that is one if MDY is Aaa. All dummy variables are zero otherwise.

  MATURITY: three dummy variables are constructed based on SDC variable YTOFM (number of years from offer date to final maturity). LOWMAT is one if YTOFM is less than 5 years. MEDMAT is one if YTOFM is between (and including) 5 and 15 years. HIMAT is one if YTOFM is greater than 15 years. All dummy variables are zero otherwise.

  LN(AMOUNT): the natural log of the issue amount in millions of dollars. It is constructed by taking the natural log of SDC variable AMT.

  SECURED: a dummy variable that takes the value of one if the issue is secured, zero otherwise. To construct this variable we use the SDC variable SECURL as the primary source. If the words "collateralized," "mortgage," "guaranteed," or "secured" appear in SECURL; the debt issue is classified as a secured issue. We

also cross-check the description of the security with Fabozzi and Fabozzi (1985) to infer if a particular issue can be classified as secured. For example, equipment trust certificates are considered to be secured. The secondary source is the SDC variable ENH. A debt issue is upgraded to be secured based on information in this field. For example, if ENH is *C*, it implies a collateralized credit enhancement and the debt issue taken to be secured.

MORTGAGE: a dummy variable that takes the value of one if the issue has a mortgage as the underlying collateral, zero otherwise. This is constructed using SDC variable SECURL. If the word "mortgage" appears in SECURL, then the underlying collateral is taken to be a mortgage.

NONMORTGAGE: a dummy variable that takes the value of one if the issue is secured but does not have a mortgage as the underlying collateral, zero otherwise. This is constructed by taking the variable SECURED and netting out those issues for which MORTGAGE is positive. These issues are then checked against four additional databases: (i) Compact Disclosure, (ii) SEC Edgar Database and SEC filings, (iii) Moody's Manuals, (iv) Standard and Poor's Corporation Records. Issues are classified as nonmortgage secured if they are not found to be mortgage secured in any of these databases.

PRESTIGIOUS: a dummy variable that is one if the underwriter is one of the top five underwriters, based on market share rank of dollar volume of underwritings of debt issues, and zero otherwise.

REF BK DEBT: a dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt. It is constructed to be one if the SDC variable UOPCODE has a value of 10, zero otherwise.

NEW ISSUE: a dummy variable that is one if the debt issue is a new one, zero otherwise. In order to construct this variable we search the SDC database to check if the firm had a debt issue in the last 20 years. If it did, then we take the issue to be a seasoned issue; if not, then we take it to be a new issue.

EXCHANGE: a dummy variable that takes the value of one if the firm is listed on an exchange, zero otherwise.

INDUSTRY: industry dummy variables are constructed based on one-digit SIC codes. All industries save for financial firms are included in the sample and a dummy variable given for each one.

Appendix C

Summary Statistics

TABLE C1   Continuous Variable Statistics

Variable	Mean	Minimum	Maximum	SD	Covariance
BPS	137.672	3.000	748.000	146.880	730.120
AMOUNT	152.229	.700	1,250.000	134.302	

NOTE.—The basis point spread (BPS) is the premium of the ex ante yield of a security over the ex ante yield of a treasury of comparable maturity in basis points; AMOUNT is the issue amount in millions of dollars.

TABLE C2   Dummy Variable Frequencies (%)

Variable	CR0	CR1	CR2	CR3	CR4	CR5	CR6	LOWMAT	HIMAT	SECURED	MORTGAGE	NONMORTGAGE	PRESTIGIOUS	REF BK DEBT	NEW ISSUE	EXCHANGE
CR0	.4	.0	.0	.0	.0	.0	.0	.0	.0	.2	.1	.1	.3	.2	.3	.1
CR1	86.9	12.7	.0	.0	.0	.0	.0	.0	.1	1.5	.7	.8	5.4	7.4	8.2	7.0
CR2	93.7	81.3	6.0	.0	.0	.0	.0	.1	.7	.7	.3	.4	3.7	2.9	2.6	5.4
CR3	72.3	60.0	66.8	27.3	.0	.0	.0	1.9	9.0	10.3	7.7	2.6	19.4	8.5	4.1	19.6
CR4	64.0	51.6	58.4	37.1	35.6	.0	.0	3.8	14.0	15.1	12.8	2.3	20.9	6.9	2.0	25.8
CR5	85.8	73.5	80.3	58.9	50.6	13.8	.0	.6	5.6	7.5	6.7	.8	10.4	2.0	.3	7.5
CR6	95.4	83.0	89.8	68.5	60.1	82.0	4.2	1.3	1.5	.0	.0	.0	3.4	.5	.3	.5
LOWMAT	92.0	79.7	86.5	67.0	60.5	79.2	89.4	7.6	.0	2.0	.8	1.2	5.8	1.2	.3	4.1
HIMAT	68.7	56.4	63.8	50.9	47.5	60.9	66.4	61.5	30.9	14.2	11.6	2.6	21.5	6.6	2.0	20.6
SECURED	64.5	53.5	59.5	47.8	44.2	58.4	60.5	59.1	48.1	35.3	28.3	7.0	23.2	4.1	2.8	19.9
MORTGAGE	71.4	59.7	66.1	52.1	48.9	64.7	67.5	64.9	52.4	64.7	28.3	.0	17.3	2.9	1.7	15.5
NONMORTGAGE	92.7	81.1	87.4	68.3	59.7	80.0	88.8	86.6	64.7	64.7	64.7	7.0	6.0	1.1	1.1	4.4
PRESTIGIOUS	36.5	29.2	34.4	28.7	21.9	33.2	35.8	34.8	27.2	24.6	25.6	35.6	63.4	17.0	8.9	40.3
REF BK DEBT	71.4	66.3	68.7	52.9	42.9	59.9	67.9	65.3	47.3	40.5	46.3	65.8	25.3	28.3	10.2	20.9
NEW ISSUE	82.0	77.5	78.7	58.9	48.5	68.6	78.1	74.8	53.2	49.6	55.5	76.1	27.6	64.0	17.9	11.8
EXCHANGE	33.8	28.3	33.5	26.4	24.2	27.8	30.4	30.5	23.7	18.7	21.3	31.4	11.0	26.6	28.0	65.9

NOTE.—CR0–CR6 stand for credit ratings and correspond to Caa–C, B1–B3, Ba1–Ba3, Baa1–Baa3, A1–A3, Aa1–Aa3, Aaa. The table reports descriptive statistics for the continuous variables. LOWMAT: value of one if the security matures in less than 5 years; HIMAT: value of one if the maturity is greater than 15 years; SECURED: dummy variable that takes the value of one if the issue is secured; MORTGAGE: dummy variable that is one if the underlying security is a mortgage; NONMORTGAGE: dummy variable that is one if the issue is secured but not by a mortgage; PRESTIGIOUS: dummy variable that is one if the underwriter is ranked in the top five of underwriters based on market share; REF BK DEBT: dummy variable that takes the value of one if the purpose of the issue is to refinance bank debt; NEW ISSUE: dummy variable that is one if the debt issue is a new one. EXCHANGE: dummy variable that takes the value of one if the firm is listed on an exchange. All dummy variables are zero otherwise. The table gives some descriptive statistics for the dummy variables. Each diagonal (i, i) element gives the frequency of occurrence for the ith variable. Above the diagonal, the (i, j) element gives the frequency with which the ith row and jth column variables are both one. Below the diagonal, the (i, j) element gives the frequency with which the ith row and jth column variables are both zero.

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