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CONTENTS

(contents continued on outside back cover)

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Takeover risk and the correlation between stocks and bonds

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ABSTRACT

Existing research suggests that, for a given firm, stock returns and bond prices are positively related, and this implies a negative relation between stock returns and bond spreads. In this paper, we show how takeover risk influences this relation. Bondholders of high-rated firms can suffer losses in a takeover, particularly if the takeover is largely funded with debt, resulting in a more positive (or less negative) correlation between stock returns and bond spread changes. Consistent with this notion and based on a large sample of data covering the period from 1980 to 2000, we find that high-rated firms which are likely to be taken over have a more positive correlation between stock returns and bond spread changes, while target firms with a poison put or an indebtedness covenant have a more negative correlation. Overall, our findings have implications for the pricing and hedging of bonds and default risk based financial products such as credit default swaps.

1. Introduction

The relation between the value of a firm's debt and its equity is studied extensively in the finance literature, starting with the seminal work of Black and Scholes (1973) and Merton (1974). According to this theory, an increase in investor expectations of a firm's profitability results in an increase in the firm's equity value as well as a decrease in the firm's probability of default (and therefore an increase in its bond value). Thus, in this standard asset pricing framework, the return on a firm's stock and the price of the bond are positively related. As bond spreads are inversely related with bond prices, the relation between a firm's stock returns and changes in its bond spread is negatively related.[1] While a number of papers address the manner in which macroeconomic variables influence the stock/bond relation at the aggregate level (Keim and Stambaugh, 1986; Campbell, 1987; Campbell and Ammer, 1993) and also examine the determinants of the average stock and bond spreads at the firm level (Kwan, 1996), no prior literature examines how takeover risk affects this relation. Takeovers increase the value of target firms' equity (Jensen and Ruback, 1983; Moeller et al., 2004) and can also decrease the value of the target firm's debt (Asquith and Wizman, 1990). Thus, the dissimilar impact of takeovers on the firm's stocks and bonds implies a distinct change in the typical negative stock/bond correlation.

We extend the literature by examining how takeover risk impacts the stock/bond correlation. For a firm subject to the possibility of a takeover, the firm's bond spread is a function of its yield in the absence of takeover plus the impact on its yield if the firm is acquired. Because firms that acquire other firms often take on more debt, the bond yield of highly rated target firms is expected to increase when the takeover occurs (Ghosh and Jain, 2000; Furfine and Rosen, 2006). Moreover, even when target firms

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[1] In our analysis, we use the variables stock returns and changes in bond spreads. The bond spread is defined as the yield-to-maturity (YTM) on corporate debt less the YTM on the duration-equivalent Treasury security. A positive excess return on a bond implies a reduction in its bond spread. While our primary empirical measure is a regression coefficient, informally, we refer to the relation between these variables as the stock/bond correlation.

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successfully fend off a takeover attempt these firms often significantly increase their leverage (Safieddine and Titman, 1999). Therefore, for highly rated firms (i.e., those with minimal credit risk or low default probability), as takeover risk increases, the relation between stock returns and changes in bond spread becomes less negative (or more positive).[2] Alternatively, if the target firm already has a low credit rating, a takeover may benefit the existing bond holders and therefore the impact is reversed for low rated targets. These results are consistent with the findings of Billett et al. (2004) who document that bondholders of non-investment grade (or high yield) firms benefit from acquisitions while those of investment grade firms suffer statistically significant negative returns.

Besides the differential impact of takeovers themselves, the risk of takeovers has also been examined in studies that consider antitakeover provisions. For example, Gompers et al. (2003) suggest that portfolios of firms with high takeover vulnerability, proxied by the absence of antitakeover provisions, exhibit higher stock valuations than those with low takeover vulnerability. They interpret this finding as consistent with managers using antitakeover defenses to insulate themselves from the discipline of the market for corporate control. In contrast, Cremers et al. (2007a,b) interpret the higher returns for firms that are more likely to be taken over as reflecting differences in their risk. From a bondholder perspective, there is evidence that an increase in takeover risk is associated with lower bondholder value. Klock et al. (2005) find that when the firm is exposed to takeover threat, managers may take actions that are value decreasing to bondholders (e.g., recapitalize the firm, increase the payout to shareholders, pay out the excess liquid assets, or focus the firm). Cook and Easterwood (1994) show that poison puts protect bondholders as well as entrenched managers from takeover risk at the expense of shareholders. Overall, the results suggest that while the presence of a takeover threat has a positive impact on stockholders, it has a negative impact on bondholders.

To test our hypotheses, we conduct empirical tests in a multi-step procedure. First, we estimate the relation between stock returns and changes in bond spreads for a panel of firms by year. Second, we estimate the probability of a takeover occurring for a firm in a given year. Third, we explain how our estimate of the stock/bond correlation varies with takeover risk. In our analysis, we use several models of takeover probability and control for firm and security-specific characteristics as well as macroeconomic effects. We also consider whether debt covenants such as poison puts or restrictions on debt impact the stock/bond correlation. Based on our hypotheses, we expect that firms with poison put bonds or leverage restrictions that are at risk of takeovers have a more negative stock/bond correlation.

Using a panel of U.S. firms covering the period from 1980 to 2000, we find evidence consistent with our theoretical predictions. Specifically, we find that firms with high ratings and a higher probability of takeover have less negative (or more positive) stock/bond correlations. For instance, for an average AA rated firm, a one standard deviation increase in takeover risk implies an increase in stock/bond correlation from −0.5 to approximately 0. Further, our results show that firms with poison put covenants are associated with significantly more negative stock/bond correlations for high takeover probability firms. These findings have practical implications for hedging and pricing credit related instruments and for fund managers that hold risky bonds.[3] Often, traders in the $26 trillion market for credit risk based financial products protect their credit exposures in a firm by taking opposing positions in the firm's stock. The stock position necessary to hedge credit exposures is critically dependent on the correlation between the firm's stock and bond spreads. As we demonstrate below, whereas the typical hedge for a credit position in a firm would involve a short equity position, in cases with strong ratings and high takeover risk, the stock position would be either zero or positive. A recent example of how takeover risk impacts the firm's stock/bond correlation took place in early 2005. A number of hedge funds suffered large losses when Kirk Kerkorian offered to buy General Motors (GM). The value of GM's stock rose on the announcement while GM's debt was downgraded (see e.g., Zuckerman, 2005; Ng, 2006).

The remainder of the paper is organized as follows. Section 2 motivates our research on takeover risk and the correlation between stock and bonds. Section 3 details the empirical method used in the study. Section 4 describes our data, variables, and control measures, and provides our descriptive statistics. Section 5 provides our empirical results, and Section 6 concludes.

2. Takeover risk and the relation between stocks and bonds

2.1. Motivation

The correlation between debt and equity values is, in general, positive because an increase in the value of the firm increases debt values, and this benefits equity holders at the same time. Thus, the correlation between debt value changes and equity price changes is typically positive. Because of the inverse relation between yields and bond prices, a negative correlation between changes in bond yields and stock returns exists (Merton (1974)). However, this correlation between debt yields and equity returns becomes less negative (or more positive) as firm value increases. That is, as the value of the firm increases, the probability of bankruptcy decreases and consequently the value of the debt approaches the risk free bond price. Thus, as firm value increases, the probability of default and the sensitivity of debt values to firm shocks decline (Leland (1994)).

[2] The discussion above is augmented by anecdotal evidence. A research report dated June 15, 2006, by UBS securities examines the impact of the latest takeover wave on security returns. It suggests that overall widening credit spreads may partly be related to a surge in leveraged buyouts. Firms that are attractive targets have seen their stock prices bid up and credit spreads increase in expectation of higher debt levels after the buyout. For example, in early 2007, on the announcement of a private equity takeover, Texas Utility's stock surged 13% while its debt was downgraded two notches by Fitch Ratings.

[3] Recent anecdotal evidence suggests that fund managers have increased their scrutiny of the impact of takeovers on the firm's bonds and stocks. For example, see "PIMCO and Advantus push bondholder protection against Kravis," in Bloomberg, 2006. Additionally, takeover risk has recently been added to the evaluations provided by credit rating agencies (see e.g., Wall Street Journal, 2006).

This also implies that the extent of the differential in the equity and debt value's response to shocks in firm value depends primarily on whether an increase in firm value significantly decreases the likelihood of default. The probability of default as well as its sensitivity to firm value depends, among other parameters, on the amount of debt (coupon payments) relative to the value of the firm. The response of equity and bond values when there is a change in the value of a firm is also intimately dependent on the volatility of corporate profits. An increase in the volatility of firm profits has an opposite effect on bondholders and equity holders because of its impact on the likelihood of default. An increase in volatility would drive down corporate debt prices (or increase bond yield spreads), while potentially increasing equity prices at the expense of bond holders. The net effect of an increase in volatility is to make the correlation between spreads and returns more positive (or less negative) (e.g., Longstaff and Scwartz (1995), Leland (1994)). In summary, the correlation between corporate bond spreads and equity returns for a firm is:

(a) More positive with a higher volatility of assets.
(b) More negative if the firm value is closer to bankruptcy.

2.2. Equity/debt relation in the presence of takeover risk

Our next objective is to motivate how the relation between equity and bond value changes when a firm is subject to the possibility of a takeover. The value of the firm's debt subject to a takeover is determined by the probability that the firm is acquired and by the leverage of the combined firm. Similarly, the equity value of the target firm's equity depends on the probability of takeover and the premium paid if an acquisition occurs.

Because equity holders of a target will not approve a deal unless they are adequately compensated in the takeover, the change in equity prices due to potentially being targeted for a takeover is positive (Bradley et al., 1988). However, in many instances, bondholders will not accrue gains from an increase in the value of the target firm (Billett et al., 2004). This is especially true if the target firm has a high credit rating, and therefore its debt has little upside rating potential. If the acquiring firm has to take on more leverage, the total debt service ratio would be higher than its current level. Debt holders of the target firm often perceive that the combined firms may be associated with a higher interest burden after a takeover, while equity holders of the target firm are paid a premium during the acquisition (Ghosh and Jain, 2000; Furfine and Rosen, 2006). A higher takeover risk could therefore result in a less negative (or even positive) correlation between equity returns and debt yield spreads because the increased takeover risk could imply a lower value of debt as well as a higher value of equity if a takeover occurs. Thus, the correlation is less negative (or more positive) than what it would be if debt holders were assured that their claim in the combined entity would preserve the current valuations. Alternately, if the target has a low credit rating, the possibility of a takeover could increase the value of debt, and the correlation is likely to be positive. Thus, for poorly rated firms, the correlation between debt spreads and equity returns may decrease with a possibility of a takeover. We consider the interaction between takeover risk and firm ratings to capture this effect below.

Bondholders sometimes attempt to protect themselves from losses in the event of a takeover using restrictive covenants. For example, a poison put limits losses to bondholders from value-reducing acquisitions (see e.g., Cook and Easterwood, 1994).[4] Because poison puts limit the losses to bondholders, the change in debt value due to a potential takeover may not be negative. If a poison put reduces the probability of a loss, it makes the correlation between bond yields and equity returns more negative, thereby reducing the increasing effect of takeover risk on equity values and bond spreads. Other debt covenants including restrictions on the issuance of additional debt, on secured debt, or on maintaining a minimum net worth may also diminish the value-reducing impact of takeovers. We examine how these covenants interact with takeover risk below.

Based on the above, our hypotheses are:

(a) The correlation between equity returns and bond spread changes is less negative (or more positive) when takeover risk increases for highly rated firms and vice versa.
(b) The correlation between equity returns and bond spread changes is more negative when takeover risk increases if the firm has a poison put.
(c) The correlation between equity returns and bond spread changes is more negative when takeover risk increases if the firm has other covenants restricting total debt.

In our empirical tests, we first estimate the relation between equity returns and bond spread changes for firms. We use the regression coefficient of stock returns on changes in bond spreads as our primary measure of correlation. This regression coefficient is our measure of the stock/bond correlation mentioned above. In the second step of the empirical analysis, we estimate takeover risk and relate it to this correlation between stocks and bonds. The empirical analysis in the following sections shows that as takeover risk increases, the correlation between bond spread changes and equity value changes becomes less negative (or more positive) for highly rated firms. This is consistent with the perception that bond holders of highly rated firms view acquisitions as value decreasing while equity holders view them as value increasing. Additionally, we find that firms with poison puts or indebtedness covenants have more negative stock/bond correlations for a given level of takeover risk.

[4] Poison put covenants are instruments designed to guard bondholders against event risks (e.g., a significant decline in the bond's rating, deterioration in firm performance, leveraged buyouts, and mergers and acquisitions) by giving them rights to redeem bonds, usually at par value, when these triggering events occur.

3. Empirical method

We use a multi-stage procedure to analyze the effect of takeovers on the relation between stock returns and bond spread changes. We first estimate the correlation between stock returns and bond spread changes for a panel of firms. We then estimate the probability of takeover in any given year and consider the relation between these variables.

Specifically, in the first stage, we regress the firm's stock returns on the changes in the bond spread while controlling for Fama and French (1993) market factors for each firm/year using monthly data. These include: Excess Return on the market (MKTRF), calculated as the value-weighted return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) minus the one-month Treasury bill rate (from Ibbotson Associates); Small Minus Big (SMB), or the average return on the three small portfolios minus the average return on the three big portfolios; High Minus Low (HML), or the average return on the two value portfolios minus the average return on the two growth portfolios. This regression gives us the relation between stock returns and bond spread changes for a firm in a given year. We choose stock returns as the dependent variable in the analysis because stock returns are noisier than bond spread changes, and thus this formulation reduces the error-in-variables problem. Our first-stage regression is

$$r_{i,t,m} = \alpha_{i,t} + \beta^1_{i,t}\Delta Spread_{i,t,m} + \beta^2_{i,t}MKTRF_{i,t} + \beta^3_{i,t}SMB_{i,t} + \beta^4_{i,t}HML_{i,t} \quad (1)$$

where $r_{i,t,m}$ and $\Delta\text{Spread}_{i,t,m}$ refer to the percentage stock return and the contemporaneous change in bond spread for firm i in year t and month m, respectively. This specification allows us to estimate a panel of $\beta^1_{i,t}$, our measure of the stock/bond relation, for the firms in our sample for different years. We restrict our sample to only those years where we have at least 10 observations available for the estimation. We estimate separate parameters for each firm/year and winsorize the upper and lower 0.5% of the estimated betas (although the results are similar regardless of how we control for outliers).[5]

In the next step, we estimate the probability of takeover for each firm-year. We use probit regressions on whether or not a merger or acquisition occurred in a given year as our dependent variable, and one year lagged firm characteristics, as well as year and industry dummies as independent variables (Palepu, 1986; Comment and Schwert, 1995). From this probit regression, we are able to estimate a predicted value for takeover probability. We also include the lags of institutional ownership, profitability, and firm volatility as additional explanatory variables in the probit regressions since they have been found to impact takeover probability (Cremers et al., 2007a,b).[6] We detail the results of this estimation procedure in the following section.

In the last stage, we regress the estimated $\beta^1_{i,t}$ from Eq. (1) on the estimated takeover probability and various controls. Our primary specification for the second stage regressions is

$$\beta^1_{i,t} = a + b_1 Pr(Takeover) + b_2 Poison\,Put + b_3 Poison\,Put\ Pr(Takeover) + b_{4-17}(Firm_S pecific)_{i,t} + b_{18-27}(Ind_D um_{1-8}) + b_{28-47}(Yr_D um_{1-20}) + \varepsilon_{i,t} \quad (2)$$

where PoisonPut Pr(Takeover) represents the interaction between the poison put covenant and probability of takeover. Our firm-specific variables include: leverage test covenant, institutional ownership, leverage, credit rating, log of total debt, firm volatility, log of total assets, market-to-book ratio, profitability, log of debt age, tangibility, and weighted average debt duration and convexity. We further include the interaction between rating and takeover probability and indebtedness covenant and takeover probability. As the first stage $\beta_{i,t}$ regressions also provide us with a variance for this estimated parameter, we weight our regression in Eq. (2) by the degree of precision with which these $\beta_{i,t}$ are estimated. This provides a simple but more efficient procedure for estimating the parameters in Eq. (2).[7]

Since the probability of takeover is also estimated from a prior regression, we correct our standard errors for the prior estimation of an independent variable (Newey, 1984). We calculate standard errors for the parameters using a bootstrap of 1000 random draws, where we re-estimate the probability of takeover and the betas in Eq. (2) with each draw.[8] One possible concern is that the number of observations with non-missing values for which Eq. (2) can be estimated is significantly smaller than the number of observations for which the probit can be estimated. Therefore, we stratify the random draw so as to keep the proportion of observations necessary to estimate Eq. (2) equal. A second issue is that the residuals may be autocorrelated. Therefore, we cluster our draws by firm in order to capture the effects of firm-level autocorrelation. That is, if a firm is included in a given draw, all of the observations for that firm are kept. This retains the pattern of correlation across time (and also greatly increases the estimated standard errors). A third concern is that the actual distribution of the estimated betas may be non-normal; in this case, reporting a t-statistic based on normal standard errors may over- or understate the actual p-values. However, empirically we find that bias corrected p-values are almost identical to those implied by regular t-statistics, and thus we report the more common t-statistics.

[5] We also consider a simpler specification where we consider only the stock/bond correlation without controlling for the Fama–French factors, and we find qualitatively similar results for our primary variables of interest.

[6] We also consider regressions with specific governance variables as in Bates et al. (2008). However, the gain in explanatory power from using these variables is offset by the more limited sample size.

[7] Alternatively, we can use a feasible generalized least square model. However, almost all the explanatory power in the variance is captured by the precision from the first-stage regression.

[8] Empirically, bootstrapping significantly increases the standard errors of our estimated coefficients.

In Section 3, we hypothesize that the stock/bond correlation should be less negative (or more positive) for highly rated firms with high takeover risk and more negative when bond values are protected by poison puts or other covenants. In our tests we use two closely related measures of the firm's debt risk: (i) the market value leverage and (ii) the bond credit rating. We expect the rating variable to capture both the level of debt and the expected volatility of the firm's assets. Our other firm-level controls, including measures of the size of the firm and the total debt, may also be related to the firm's volatility.

4. Data

4.1. Data sources

We utilize seven databases in our empirical analysis. These include: (i) Lehman Brothers Fixed Income (LBFI) database, (ii) Center of Research in Security Prices (CRSP) database, (iii) RiskMetrics (formally Investor Responsibility Research Center) corporate governance database, (iv) COMPUSTAT Industrial Annual database, (v) Thomson Financial SDC database, (vi) Thomson Financial Institutional Ownership database, and (vii) Mergent's Fixed Income Securities database (FISD). For a firm-year observation to be included in our analysis, firms must have a fixed-rate (non-zero coupon) debt issue that is present in the LBFI dataset. We use the COMPUSTAT and CRSP databases to garner any firm-specific and stock return information not already included in the LBFI database. Additional information on institutional ownership and debt covenants are extracted from Thomson Financial and Mergent (formally Moody's manuals) databases, respectively. This yields a sample of 144,439 firm-year observations on 1985 firms for the period from 1980 to 2000. Descriptive statistics on the variables used in the analysis are presented in Section 5.1 below.

In our initial analysis, we use monthly data on stock returns from CRSP matched by-month to changes in bond yield spreads from the LBFI. This dataset is available until 1998 and we manually collect monthly data for the years 1999 and 2000 from the Mergent database.

4.2. Measuring the cost of debt financing and stock returns

We use the LBFI database to measure the yield on corporate debt. The LBFI data contain month-end security-specific information such as bid price, coupon, yield, credit ratings from Moody's and S&P, duration, convexity, and issue and maturity dates on nonconvertible bonds that are used in the Lehman Brothers Bond Indexes. Securities are included in various Lehman Brothers Bond Indexes based on firm size, liquidity, credit ratings, maturity, and trading frequency. The LBFI covers the period from January 1973 to 1998, and is commonly used in the fixed income literature (Billett et al., 2004; Klock et al., 2005). While the LBFI does not contain the universe of fixed income securities, we have no reason to suspect any systematic bias in this database.

Our primary measure of the cost of debt financing is the bond yield spread or risk premium. The yield spread is defined as the difference between the yield to maturity on a corporate bond and the yield to maturity on its duration-equivalent Treasury security. The yield to maturity on a corporate bond is the discount rate that equates the present value of its future cash flows to its current price. The yield to maturity on a Treasury security is the yield on the constant maturity series obtained from the Federal Reserve Bank in its H15 release based on a par bond.[9] For firms with multiple observations in the sample, a weighted average yield spread is computed, with the weight being the amount outstanding for each security divided by the total amount outstanding for all available publicly traded debt. In the cases where no corresponding Treasury yield is available for a given maturity, the yield spread is calculated using interpolation based on the Nelson and Siegel (1987) exponential functional form.[10]

We extract stock returns from the CRSP database. Our measure in the first-stage analysis is the monthly holding period returns for each firm for which bond information is available.

4.3. Measuring takeover risk

In our tests, we estimate two probit models for the likelihood of a takeover. We consider acquisitions and mergers with similar filters as described in Masulis et al. (2007). That is, for the acquisition to be completed, the acquirer must hold less than 50% of the target before the acquisition and 100% after the acquisition, the deal must be worth at least $1 million, and the data must be available from COMPUSTAT and CRSP. We estimate the probability of the firm being a takeover target using lagged firm characteristics, year and industry controls. Our second takeover model also includes stock volatility and institutional ownership. These variables help predict takeover probability but increase the number of missing values.

4.4. Firm-specific and security-specific controls

We use a number of firm-level control variables from COMPUSTAT to explain the stock/bond correlations. The choice of these variables is motivated by Collin-Dufresne et al. (2001) and Eom et al. (2004). These variables include: log of debt, firm leverage, firm size, idiosyncratic volatility, market-to-book ratio, firm profitability, tangibility ratio, and institutional ownership. The log of debt, a proxy for the level of firm liabilities, includes both short-term and long-term debts. Firm financial leverage, a proxy for firm

[9] H15 is a weekly publication of the United States Federal Reserve Statistical release (with daily updates) for selected market interest rates.

[10] Jordan and Mansi (2003) provide evidence that Nelson and Siegel's (1987) functional form produces the least pricing errors when compared to other interpolation functions.

financial health, is computed as the ratio of total debt divided by total assets. Firm size is computed as the log of the firm's market value of equity plus the book value of debt deflated to 1983 dollars. Stock return volatility, a measure of idiosyncratic risk, is computed using the Campbell and Taksler (2003) approach. Volatility in this case is computed as the standard deviation of the firm's excess return over the market portfolio using the prior 255 trading days, which we multiply by ten for scaling purposes. The market-to-book ratio, a proxy for growth opportunities, is computed as the market value of equity plus the book value of debt divided by total assets. Firm profitability, a proxy for financial performance, is computed as the ratio of the firm's EBITDA divided by total assets. The tangibility ratio is computed as the ratio of net property, plant, and equipment of the firm divided by total assets. Institutional ownership, a proxy for outside monitoring, is computed as the ratio of share owned by institutional investors to total common shares outstanding. To reduce the impact of outliers, we winsorize our continuous variables at the upper and lower 0.5% of the distribution.

We also include debt specific control variables in our analysis. These include: firm credit ratings (Ratings), whether the debt has a poison put, log of debt age (Age), duration, and convexity. Credit rating is the average of the S&P and Moody's bond ratings for the firm (a measure that largely depends on the volatility of the firm's assets and the amount of debt). Numerical bond ratings are computed using a conversion process where AAA rated bonds are assigned a value of 22 and D rated bonds receive a value of one. For example, a firm with an “A1” rating from Moody's and an “A+” from S&P would receive an average score of 18. The conversion numbers for both Moody's and S&P ratings are provided in the Appendix. To estimate debt liquidity, we use the log of the weighted age of the outstanding debt, with the weight being the amount of debt outstanding for the individual debt issue divided by the total amount outstanding for all traded debt. Beim (1992) finds that liquidity is positively priced in the debt market and that more recently issued bonds are more liquid than older bonds. Finally, we include weighted debt duration and convexity to capture any linear and non-linear effects in the terms structure of interest rates as well as maturity differences.

To test for the impact of antitakeover covenants, we use data from Mergent's FISD database. We consider regressions which control for poison put covenants, ratings decline triggers put covenants,[11] and general consolidation or merger restriction. The consolidation or merger restriction actually comprises a number of related statements. This restriction is relatively common in debt covenants occurring in about 88% of the data according to Qi and Wald (2008) and is typically considered to have only a minor effect in dissuading firm takeovers. Rating put covenants are considered more effective in protecting bondholders (Kahan and Klausner, 1993), but these occur in very few debt issues (about 2% of issues include this covenant). In practice, we find that of the antitakeover covenants, only the poison put provision is significant in our analyses. Thus, we do not report regressions with the consolidation/merger and rating put covenants. The poison put covenant appears in about 23% of public bond issues after 1990, and about 41% of the firms in our sample include this protection on one of their bond issues in a given year. The number of firm/years with poison put protection is higher than the fraction of bonds as some firms have issues with poison puts outstanding for a number of years. Additionally, we consider whether the Gompers et al. (2003) antitakeover index (GIndex) may impact stock/bond correlations. Cremers et al. (2007a,b) also suggest that interactions between this index and institutional ownership also impact the cost of debt. We find that neither the GIndex nor its interaction with institutional ownership impacts stock/bond correlations in our sample.

Further, we test the impact of other debt related covenants, including negative pledge, indebtedness, subsidiary indebtedness, leverage test, and maintenance net worth covenants.[12] While these covenants do not protect against takeovers directly, they can provide bondholder protection against the additional debt which may be taken on during a takeover (Cremers et al., 2007a,b). We find that the net worth and negative pledge covenants are not significant in any specification, either alone or interacted with the probability of takeover, and thus we do not include these restrictions in our final analysis. The subsidiary indebtedness covenant has a similar impact to the indebtedness covenant when interacted with the probability of takeover due to the high correlation between these restrictions (about 88% of firms with a covenant restricting subsidiary debt also have the indebtedness covenant).

5. Empirical results

5.1. Descriptive statistics

Table 1a provides summary statistics for our sample. Included are the mean, median, standard deviation and number of observations available for each variable. We divide the table into four sections: stock–bond correlation related variables, firm-specific related variables, takeover related variables, and bond-specific related variables. For the correlation variables, the means (medians) monthly stock return and yield spread for the complete sample from 1980 to 2000 are 1.2% (0.85%) and 304 (174) basis points, respectively. There is considerable variation in stock returns and bond spreads over the sample period (standard deviations of 12.2% and 804 basis points for stocks and bonds, respectively). A regression of stock returns on bond spread changes for the 1980 to 2000 period gives an average beta estimate of −0.476, and this estimate is consistent with the theory that mean returns and yield spread changes are negatively correlated.[13] The average firm-year *R*-squared in the first-stage estimate is 52% with a

[11] A decline in the credit rating of the issuer (or issue) triggers a bondholder put provision.

[12] The negative pledge covenant restricts the issuance of additional secured debt unless existing debt is also secured on a pari passu basis. The indebtedness covenants restrict the issuer from incurring additional debt with limits on absolute dollar amount of debt outstanding or percentage total capital. The subsidiary indebtedness covenant places similar limits on the debt of the subsidiary. A leverage test restricts the total debt of the issuer, and a maintenance net worth covenant requires that the issuer sustains a minimum specified net worth.

[13] Without correcting for market, SMB, and HML factors, this beta is about five times more negative at approximately −2.4.

Table 1a
Descriptive statistics.

Variable	Mean	Median	Standard deviation	Observations
Stock–bond correlation variables				
Stock returns (%)	1.194	0.850	12.243	144,556
Yield spread (bp)	303.644	173.500	803.777	144,556
SMB	−0.0002	−0.002	0.032	144,556
HML	0.002	0.003	0.030	144,556
MKTRF	0.007	0.010	0.041	144,556
OLS beta (×100)	−0.476	−0.353	10.300	8,625
Adjusted *R*-squared	0.519	0.530	0.212	8,625
Firm-specific variables				
Size	1,135.423	66.982	6,926.989	141,894
Leverage	0.286	0.218	0.267	141,892
Market-to-book	1.855	1.007	3.218	141,794
Profitability	0.057	0.092	0.201	138,845
Tangibility	0.316	0.185	0.362	139,728
Abnormal return	0.001	0.000	0.052	130,684
Volatility	0.032	0.020	0.025	111,058
Inst-own	0.261	0.200	0.230	104,560
Takeover measures				
Pr(Takeover) − model 1	0.026	0.018	0.026	117,110
Pr(Takeover) − model 2	0.027	0.018	0.028	90,030
Bond-specific variables				
S&P rating	BBB	BBB+	AA−/B+	14,413
Poison put	0.407	0.000	0.491	14,719
Indebtedness	0.289	0.000	0.453	14,719
Subsidiary indebtedness	0.276	0.000	0.447	14,719
Leverage test	0.004	0.000	0.059	14,719
Maintenance	0.015	0.000	0.123	14,719
Negative pledge	0.496	0.000	0.500	14,719
Bond age	5.300	3.630	6.197	14,413
Duration	5.874	5.840	2.048	14,413
Convexity	0.564	0.450	0.424	14,413

Note: We use monthly stock returns and bond spreads from 1980 through 2000 in the first-stage of the analysis. Yield spreads are reported in basis points over duration-equivalent Treasury securities. The OLS beta is the coefficient estimated from regressing stock returns on changes in bond spreads. The adjusted *R*-squared is the goodness of fit measure from that regression. The variables small minus big (SMB), high minus low (HML), and excess return (MKTRF) are Fama and French market factors. Firm-specific variables include: sum of total debt plus market value of equity adjusted for inflation to 1983 dollars (Size), total debt divided by the summation of total debt and market value of equity (Leverage), market value divided by the total assets (Market-to-book), EBITDA divided by total market value (Profitability), ratio of net property, plant, and equipment of the firm divided by total assets (Tangibility), yearly average of the excess return over the return on the value-weighted market portfolio (Abnormal returns), standard deviation of the firm's excess returns over the prior 255 trading days as in Campbell and Taksler (2003) (Volatility), and ratio of institutional equity ownership to total common stock outstanding (Inst-own). Takeover measures include: Pr(Takeover) for models 1 and 2, refers to the predicted values from the probit regressions in Table 2. Security-specific variables include: average of the S&P and Moody's bond ratings for the firm (S&P ratings), dummy variable that takes on a value of one if the firm's debt has a poison put (Poison put), dummy variable equal to one if the firm has a covenant restricting debt (Indebtedness), dummy equal to one if the firm has a covenant restricting the debt of the subsidiary (Subsidiary indebtedness), dummy equal to one if the firm has a leverage restriction covenant (Leverage test), dummy variable equal to one if the firm has a covenant requiring the maintenance of net worth (Maintenance), dummy variable equal to one if the firm has a negative pledge covenant requiring that any secured debt cannot be issued unless the current debt is also secured (Negative pledge), weighted average of debt age of all available traded debt securities (Debt age), weighted average of debt durations of all available traded debt securities (Duration), and weighted average of debt convexities of all available debt securities (Convexity). The weight in all cases is the ratio of the market value of the individual security divided by the market values of all traded debt securities for the firm.

standard deviation of 21%. Finally, the Fama–French market control variables (SMB, HML, and MKTRF) have median values of −0.002, 0.003, and 0.01 with standard deviations of 0.032, 0.030, and 0.041, respectively.

The remaining variables are firm and security-specific. In terms of firm-specific variables, firm size has mean, median, and standard deviation of $1.1 billion, $66 million, and $6.9 billion, respectively. The median leverage (short-term plus long-term debt) ratio is 21.8% with a standard deviation of 26.7%, which suggests that a large portion of the sample consists of firms that have significant liabilities in their capital structure. The firms are, on average, profitable with a mean and median profitability of about 5.7% and 9.2%, have an average market to book ratio of about 1.86, a mean (median) ratio of property, plant, and equipment to total assets of about 31.6% (18.5%), and a mean daily volatility of about 3.2%. Institutions, on average, owned about 26% of the shares outstanding with a standard deviation of 23%.

In terms of debt variables, the mean (median) bond rating variable roughly equates to S&P ratings of “BBB” (“BBB+”) with a standard deviation of “AA−/B+”, which indicates that the sample contains investment as well as non-investment grade debt. On average, debt has been outstanding for 5.3 years with a duration and convexity of 5.9 years and 0.564, respectively. Poison puts are found in 41% of the sample observations, indebtedness in 29%, subsidiary indebtedness in 28%, leverage restrictions in 0.4%, and maintenance net worth in 1.5%. Finally, the probability of takeovers in our models has mean and median values of about 0.026 and 0.018, respectively. That is, takeover bids occur in just over 2.5% of firm-years on average.

Table 1b provides a breakdown of the number of firm-year observations based on Standard Industry Classification codes. Industries in the sample include: agriculture, forestry and fishing, mining and construction, manufacturing (food–petroleum and

Table 1b
Industry data.

SIC code	Title of industry	Obs.	Percent
0	Agriculture and Forestry	19	0.22
1	Mining and Construction	621	7.20
2	Manufacturing (food–petroleum)	1,848	21.43
3	Manufacturing (plastics–electronics)	2,027	23.50
4	Transportation and Communication	1,114	12.92
5	Wholesale Trade and Retail Trade	765	8.87
6	Finance, Insurance, and Real Estate	1,634	18.94
7	Services (hotels–recreation)	435	5.04
8	Services (health–private household)	113	1.31
9	Public Administration	49	0.57
Total		8625	100

Note: This panel provides industry data for the sample without missing stock/bond betas presented in number of observations for each SIC code and in percentages. The dataset is comprised of observations covering the period from 1980 through 2000.

plastics–electronics), transportation and communication, wholesale trade and retail trade, public administration, and services (hotels–recreation and health–private household). The majority of the sample is represented in manufacturing (45%), transportation and communication (13%), finance, insurance and real estate (19%), wholesale and retail trade (9%), and services (6%).

Table 1c provides correlation coefficients between the stock/bond beta, takeover probabilities from models 1 and 2, credit ratings, firm leverage, log of debt, volatility, firm size, market-to-book, and profitability. The variables bond rating, firm size, market-to-book, and profitability are positively correlated with the OLS beta coefficient, while takeover probabilities from models 1 and 2, firm leverage, log of total debt, and stock volatility are negatively correlated. Most of the variables are statistically significant at the 1% level and have their expected signs. Because of possible confounding year and other effects, we use a multivariate framework below to further explore our hypotheses.

5.2. Relation between stock returns and bond yield spreads

While our primary analysis focuses on the determinants of stock/bond correlations, we consider briefly the first-stage results. The results provided in the analysis show that the average beta estimated using the relation between stock returns and changes in bond yield spread is −0.476, evidence consistent with the findings in Kwan (1996). The estimate implies that, on average, a one basis point decrease in spreads is associated with a about half a basis point increase in stock values after correcting for general market movements.

Table 2 provides the estimated parameters of takeover probability from probit regressions using robust standard errors with clustering by firm. We present two specifications. Model 1 includes firm size measured as the logarithm of both market value and total assets, market-to-book ratio, abnormal returns over the value-weighted market portfolio, measures of R&D, tangibility, profitability, leverage, and year and industry dummies. Model 2 uses the same specification as model 1 but adds institutional ownership and stock volatility as additional control variables. The results from both models suggest that firm-specific variables such as size, abnormal returns, R&D, tangibility, profitability along with institutional ownership and volatility contribute significantly to takeover probability. This concurs with prior research on takeover probability (see e.g., Bates et al., 2008). We find

Table 1c
Selected correlations.

	Beta	Model 1	Model 2	Rating	Leverage	Log (bond)	Volatility	Size	Market-to-book
Pr(Takeover) Model 1	**−0.027**								
Pr(Takeover) Model 2	**−0.035**	**0.984**							
Rating	**0.082**	**−0.048**	**−0.037**						
Leverage	**−0.067**	**0.057**	**0.062**	**−0.404**					
Log(Debt)	**−0.030**	**0.198**	**0.203**	**0.035**	**−0.063**				
Volatility	**−0.069**	**0.094**	**0.043**	**−0.537**	**−0.019**	−0.018			
Size	0.011	**0.019**	**0.034**	**0.619**	**0.120**	**0.593**	**−0.470**		
Market-to-book	0.013	**−0.120**	**−0.078**	**0.030**	**−0.290**	**0.163**	**0.128**	**−0.043**	
Profitability	**0.042**	**−0.022**	**−0.088**	**0.164**	**0.097**	**−0.103**	**−0.391**	**0.330**	**−0.154**

Note: This panel provides Pearson correlation coefficients for selected variables. The OLS beta is the coefficient estimated from regressing stock returns on changes in bond spreads. Selected correlation variables include: Pr(Takeover) for models 1 and 2 refers to the predicted values from the probit regressions in Table 2, Rating is the average of the S&P and Moody's bond ratings for the firm, Leverage is total debt divided by the summation of total debt and market value of equity, log(Debt) is the log of short- and long-term debts, Volatility is the standard deviation of the firm's excess returns over the prior 255 trading days as in Campbell and Taksler (2003), Size is the log of the market value of equity plus book value of debt, Market-to-book is the firm's market value divided by the total assets, and Firm profitability is the firm's EBITDA divided by total market value. Correlation coefficients in bold represent significance at the 1% level.

Table 2
Probit regressions on whether a merger or acquisition occurs.

Variables	Takeover model 1	Takeover model 2
	(1)	(2)
$Size_{(t-1)}$	−0.112[c]	−0.094[c]
	(−7.149)	(−4.891)
$Log(TA)_{(t-1)}$	0.121[c]	0.117[c]
	(7.569)	(6.165)
$Market\text{-}to\text{-}book_{(t-1)}$	−0.001	0.010
	(−0.095)	(1.508)
$Abnormal\ returns_{(t-1)}$	4.528[c]	4.832[c]
	(27.994)	(24.537)
$R\&D_{(t-1)}$	0.407[c]	0.292[c]
	(4.450)	(2.801)
$Tangibility_{(t-1)}$	−0.195[c]	−0.164[c]
	(−5.982)	(−4.149)
$Profitability_{(t-1)}$	0.175[c]	0.027
	(3.177)	(0.417)
$Leverage_{(t-1)}$	−0.019	−0.023
	(−0.522)	(−0.528)
$Inst\text{-}own_{(t-1)}$		−0.221[c]
		(−4.063)
$Volatility_{(t-1)}$		−1.823[c]
		(−3.505)
Pseudo R-squared	0.080	0.087
Observations	117,110	90,030
Firms	16,426	12,825

Note: This table presents estimated coefficients and t-statistics calculated from robust standard errors with clustering using probit regressions in which the dependent variable equals one if the firm is the target of a merger or acquisition in the given year. The data covers the years from 1980 through 2000. All independent variables are lagged one year. The firm's Size equals the book value of debt plus the market value of equity, Log(TA) is the log of the firm's total assets, Market-to-book is the market value of the firm divided by the book value, Abnormal returns are defined as the yearly average of the excess return over the return on the value-weighted market portfolio, R&D is the ratio of research and development expenditures to total sales, Tangibility is the ratio of net property, plant, and equipment of the firm divided by total assets, Profitability is the firm's EBITDA divided by total market value, Leverage is the book value of short-term plus long-term debt divided by total assets, institutional ownership (Inst-own) is the ratio of institutional equity ownership to total common stock outstanding, and Volatility is the standard deviation of the firm's excess returns over the market portfolio over the prior 255 trading days. All variables are winsorized at the upper and lower 0.5% levels. Year and one-digit industry dummies are included in all regressions. Significance at the 10%, 5%, and 1% levels is denoted by a, b, and c, respectively.

that model 2 has a slightly higher pseudo R-squared but with 23% fewer observations. We also find that the fitted values from both models are highly skewed. Fig. 1 depicts the fitted probability density of takeover for model 1.

In unreported regressions, we add several governance-related variables as in Bates et al. (2008). However, these variables are only available for a limited number of firms after 1990. Additionally, most governance variables such as the various components of the Gompers et al. (2003) index of takeover provisions are not significant in the takeover regression. This evidence is consistent with the findings in Comment and Schwert (1995) that these variables have little impact on takeover probability. Additionally, we consider whether the firm has a poison put as an additional explanatory in these specifications and find that poison puts are not significant in predicting takeovers. Therefore, we exclude poison puts from this portion of the analysis. We consider the lagged

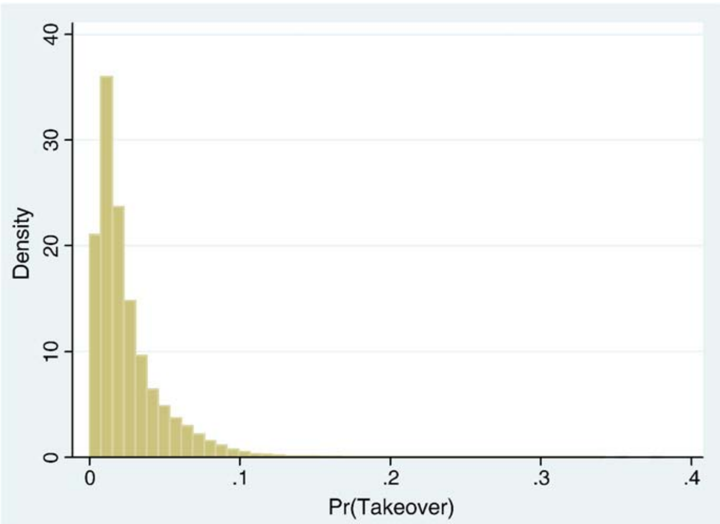

Fig. 1. Density of fitted probability of takeover (model 1).

stock/bond correlation as another possible explanatory variable in the takeover regression, but we also find the coefficient on this variable to be insignificant.

5.3. Explaining the stock/bond correlation

Table 3 presents the results from regressing the estimated betas in the first stage of the analysis on the probability of takeover provided from Table 2, on whether the firm has a poison put, indebtedness, and leverage restriction covenants, along with firm and

Table 3
Explaining the stock/bond correlation.

	Takeover model 1			Takeover model 2		
	(1)	(2)	(3)	(4)	(5)	(6)
Prob (Takeover)$_{(t-1)}$	9.623	−23.826[c]	15.060[b]	8.402	−20.051[c]	13.640[b]
	(1.393)	(−2.788)	(2.211)	(1.324)	(−2.817)	(2.097)
Poison Put$_{(t-1)}$	0.075	−0.319	−0.265	0.029	−0.316	−0.261
	(0.228)	(−1.175)	(−0.966)	(0.092)	(−1.206)	(−0.987)
Poison Put Pr(Takeover)	−17.809[b]			−15.440[b]		
	(−2.515)			(−2.276)		
Rating$_{(t-1)}$	0.064	0.003	0.064	0.064[a]	0.011	0.065[a]
	(1.604)	(0.072)	(1.600)	(1.680)	(0.249)	(1.701)
Rating Pr(Takeover)		2.499[c]			2.058[b]	
		(2.589)			(2.435)	
Indebtedness$_{(t-1)}$	−0.395	−0.420	0.208	−0.399	−0.434	0.157
	(−1.195)	(−1.280)	(0.517)	(−1.282)	(−1.412)	(0.419)
Indebtedness Pr(Takeover)			−24.731[c]			−22.134[c]
			(−3.451)			(−3.198)
Leverage Test$_{(t-1)}$	−4.919	−5.225[a]	−4.879[a]	−4.998	−5.255[a]	−4.991
	(−1.635)	(−1.706)	(−1.646)	(−1.612)	(−1.676)	(−1.641)
Inst-Own$_{(t-1)}$	0.729	0.726	0.786	0.728	0.781	0.816
	(1.291)	(1.297)	(1.387)	(1.257)	(1.342)	(1.399)
Leverage$_{(t-1)}$	−1.269[a]	−1.278[a]	−1.232[a]	−1.283[a]	−1.280[a]	−1.250[a]
	(−1.829)	(−1.848)	(−1.773)	(−1.864)	(−1.872)	(−1.814)
Log(Debt)$_{(t-1)}$	−0.380[b]	−0.386[b]	−0.392[b]	−0.372[b]	−0.374[b]	−0.384[b]
	(−2.042)	(−2.104)	(−2.089)	(−1.976)	(−2.012)	(−2.033)
Volatility$_{(t-1)}$	3.366	5.937	2.007	3.290	5.248	2.055
	(0.566)	(0.981)	(0.338)	(0.562)	(0.863)	(0.350)
Size$_{(t-1)}$	−0.184	−0.173	−0.190	−0.188	−0.183	−0.198
	(−1.379)	(−1.304)	(−1.428)	(−1.456)	(−1.420)	(−1.539)
Market-to-book$_{(t-1)}$	0.024	0.055	0.049	0.022	0.040	0.044
	(0.112)	(0.257)	(0.234)	(0.102)	(0.188)	(0.206)
Profitability$_{(t-1)}$	1.499[a]	1.640[a]	1.420[a]	1.502[a]	1.595[a]	1.427[a]
	(1.839)	(1.939)	(1.730)	(1.830)	(1.908)	(1.720)
Log(age)$_{(t-1)}$	−0.096	−0.084	−0.085	−0.095	−0.089	−0.084
	(−0.431)	(−0.377)	(−0.380)	(−0.430)	(−0.406)	(−0.379)
Tangibility$_{(t-1)}$	0.318	0.330	0.346	0.310	0.321	0.329
	(0.887)	(0.895)	(0.964)	(0.889)	(0.901)	(0.948)
Duration$_{(t-1)}$	−0.148	−0.132	−0.142	−0.150	−0.130	−0.144
	(−0.998)	(−0.890)	(−0.970)	(−1.040)	(−0.901)	(−1.001)
Convexity$_{(t-1)}$	0.477	0.428	0.458	0.481	0.413	0.459
	(0.677)	(0.607)	(0.654)	(0.684)	(0.587)	(0.654)
Adjusted *R*-squared	0.040	0.041	0.041	0.040	0.040	0.041
Observations	4,715	4,715	4,715	4,715	4,715	4,715
Firms	912	912	912	912	912	912

Note: The table provides estimated coefficients and *t*-statistics from regressions where the dependent variable is our measure of the stock/bond correlation (OLS beta), estimated from regressing stock returns on changes in bond spreads for a given firm-year. All independent variables are lagged one year. Prob(Takeover) is the fitted value from the probit regressions in Table 2. Poison put is a dummy variable that takes the value of one if any of the firm's bonds have a poison put, and Indebtedness is a dummy variable that takes the value of one if any of the firm's bonds have an indebtedness covenant restriction. Firm-specific variables include: institutional ownership (Inst-own) is the ratio of institutional equity ownership to total common stock outstanding, Leverage is the book value of short-term plus long-term debt divided by total assets, Log(Debt) is the log of the short-term plus long-term debt, Volatility is the standard deviation of the firm's excess returns over the market portfolio over the prior 255 trading days as in Campbell and Taksler (2003), Size is the log of the book value of debt plus the market value of equity, Market-to-book is the market value of the firm divided by the book value, Profitability is the firm's EBITDA divided by total market value, and Tangibility is the ratio of net property, plant, and equipment of the firm divided by total assets. Debt specific variables include: Rating is the average of the S&P and Moody's bond ratings for the firm, Log(age) is the log of one plus the average age of the debt, Duration is the weighted average of debt durations of all available traded debt securities,, and Convexity is the weighted average of debt convexities of all available traded debt securities. The weight in all cases is the ratio of the market value of the individual security divided by the market values of all traded debt securities for the firm. Industry and year dummies are included in all regressions. Bootstrapped *p*-values are reported in parentheses and adjusted for clustering by firm and for the fact that the probability of takeover is estimated in a prior stage. To improve estimation efficiency, regression estimates are weighted by the estimated variance of the dependent variable. Significance at the 10%, 5%, and 1% levels is denoted by a, b, and c, respectively.

security-specific characteristics. We also include the interactions between the probability of takeover and poison put covenants, indebtedness covenants, and credit ratings. All regressions include year and one-digit industry dummies to capture any macroeconomic effects. Models 1, 2, and 3 provide regression results using the probability of takeovers from the first model in Table 2 while models 4, 5, and 6 use the probability of takeover from the second model in Table 2.

Given our theoretical predictions, we expect firms with poison put covenants to have more negative stock/bond correlations. In our primary specifications, models 1 and 4, which include the interaction between poison put and takeover risk have negative and significant coefficients (at the 5% level) on the interaction variable. Thus, poison put covenants help reduce the stock/bond correlation; however, this effect is primarily visible for high probability of takeover firms. In models 2 and 5, we include the interaction between bond rating and the probability of takeover and find this variable to be significant at the 1% and 5% levels, depending on the specification. The results suggest that highly rated firms have less negative (or more positive) stock/bond correlations if they are at risk of being taken over.[14] In models 3 and 6 we consider the interaction between the indebtedness covenant and the probability of takeover. We find that the estimated coefficients on this interaction term to be negative and significant at the 1% level, suggesting that this covenant also protects bondholders of firms from the risk of takeovers.[15]

Following our discussion in Section 2, we expect a more negative correlation for firms with more default risk. We use four variables that capture some aspect of default risk: credit rating, debt to market value (leverage), log of total debt, and equity volatility. Note that because debt rating is inversely related to default risk, this hypothesis implies a positive coefficient on rating. While most of the estimated coefficients are consistent with the theory, only the coefficients on log(Debt) are significantly different from zero at the 5% level. Leverage and ratings are marginally significant in certain specifications, while volatility is not significant in all models. Additionally, the coefficients on market-to-book and profitability may also reflect some aspect of default risk, and we find marginally significant positive coefficients but only for firm profitability. Further, we find insignificant coefficients on both firm size and tangibility in all the regressions. In terms of debt related variables, all variables (log of debt age, duration, and convexity) have their expected signs but are insignificant in all models.[16]

The economic significance of our findings can be understood more easily with the following example. Our estimate for the sensitivity of stock returns to the bond spread changes implies that a one basis point increase in the spread is associated with about a 0.5 basis point decline in stock prices after correcting for market factors. A one basis point spread increase translates into 0.1% decline in the bond price, if the duration is 10 years. Suppose a bank is concerned with hedging returns on a 10-year duration bond. For every $1 million worth of bonds, a one basis point increase in spreads will result in a loss of $1000. To offset such a loss the bank would need to short sell stocks in the firm so that the gain on stocks is equal to the potential loss on bonds. Given the average stock/bond correlation of approximately -0.5, $0.005 \times S = 1000$. This gives the dollar value of stocks to be sold as $200,000.

To see how these results are influenced by takeover risk, consider a firm with an average probability of takeover that may or may not include a poison put covenant. For instance, the mean probability of takeover is 0.026, and the mean of poison put is 0.407. If the firm includes a poison put covenant, that implies a change in the beta (stock/bond correlation) of $-17.81\ (1-0.407)\ 0.026$ versus $-17.81\ \ -0.407\ \ 0.026$, or a net difference of 0.46 in the stock/bond correlation. The difference in the poison put settings of $(1-0.407)$ and -0.407 is exactly 1. Thus, without a poison put, the firm should short $320,513 of the stock to hedge its bond position, but if the bonds are protected with a poison put the firm should short $129,100. That is, if we consider a firm with a poison put, we want to compare its beta against the average beta of the sample, and that average beta corresponds to a 0.407 average value on poison put for the sample as a whole.

Alternatively, consider an otherwise average firm with an above average AA rating. Given the fit in model 2 of Table 3, this rating implies an increase of $2.5\ (20-13.76)\ 0.026$, or 0.41 in the estimated beta to -0.094. Thus, the firm should now hedge its bond position by shorting over $1,000,000 in stock. If the firm were both highly rated and at a more than average risk of takeover, the firm would want to go long the stock in order to hedge the bond position. For instance, the 90th percentile of takeover risk equals 0.056, and the 95th percentile equals 0.074, and these estimates imply positive stock/bond correlations for highly rated firms. Note also that the impact of takeover risk can flip if the firm's debt is rated low enough. For an otherwise average firm, if the firm is rated at approximately B+ or lower, a higher probability of takeover would decrease the stock/bond correlation.

The examples above are also relevant for the hedging of credit risk related products such as credit spread swaps and credit default swaps. In the case of a credit spread swap, the buyer of the swap is paid an amount that depends on the yield spread of a reference bond over the risk-free rate, and in return the buyer pays the seller a fixed fee each period (e.g., Chen and Sopranzetti, 2003). For example, if the yield spread is 2% and the face value (FV) equals $1 million the buyer will receive $20,000 for this period. If the spread decreases to 1.5%, the buyer will receive $15,000. Thus, the value of the swap is intimately linked to the yield spread changes of the bond. Banks will often sell such products and then protect themselves against losses by selling stocks in the firm. The value of stocks sold depends on the sensitivity of the stock return to changes in the value of the yield spread. Our estimate for the average sensitivity of stock returns to yield spread changes implies that a one basis point increase in the spread is associated with a 0.5% decline in stock prices. Hence to hedge the risk of a credit spread swap with a face value *FV*, it must be the case that the bank should sell shares worth $*S* so that $0.0001 \times FV = .005 \times S$. An increase in the beta from -0.5 to a more positive number will

[14] Note that ratings and spreads are closely correlated. Replacing the lagged rating variable with the lagged spread provides similar results, although with opposite sign as ratings and spreads are negatively correlated.

[15] Additionally, we consider a number of other debt related covenants, such as negative pledge, maintenance net worth, and a leverage test covenant. Of these, only the leverage test covenant is marginally significant in some specifications. Moreover, as this covenant only appears in 0.4% of our sample these results should be interpreted with caution.

[16] In unreported regressions, we add an interaction term between duration and takeover risk to our regressions, and find that the coefficient on this variable is insignificant.

increase the number of shares that must be sold. For cases with particularly high takeover exposure, either the stock does not provide an appropriate hedge (if the beta is close to zero), or beyond that the bank would want to buy shares of equity to hedge its swap position.

To measure the impact of takeover risk and covenants on a bond hedge, we redo our regressions predicting stock/bond correlations without year dummies, covenants, ratings, or takeover risk. The coefficients on year dummies are often significant, yet ex ante, they could not be predicted. Note that our other coefficients are estimated with lagged independent variables and therefore they measure how much of the correlation could be predicted. When we exclude year dummies, covenants, ratings, and takeover risk, the *R*-squared in the stock/bond correlation regressions drops to 1.63%. Adding back the covenant and rating information increases the *R*-squared to 2.84%. If we include takeover risk and its interactions (as in models 1, 2, and 3 of Table 3) the *R*-squared further increases to 2.97%, 2.98%, or 3.02%. Thus, while the explanatory power for these regressions, and therefore the ability to hedge any particular bond, is relatively low, the marginal impact of correcting for takeover risk, ratings, and covenants is relatively large.

6. Conclusion

We provide empirical evidence on the relation between stock returns and bond spread changes, and show how this relation is impacted by takeover risk and firm-specific factors. Takeover risk subjects firms to shocks, which are typically positive for stockholders but negative for bondholders if the firm is highly rated. Well rated firms that are more at risk of a takeover, such as those in industries with active takeover markets and with few takeover protections, have a less negative (or more positive) relation between stock returns and bond spread changes. Conversely, firms with more takeover protection or with restriction on debt issuance, including firms with poison puts and indebtedness covenants, have a more negative relation between stock returns and bond yields. Our empirical tests strongly confirm these results. Additionally, our theory suggests, and our empirical results confirm, that firms with riskier debt will have a more negative relation between stock returns and bond spread changes.

Overall, our results have significant implications for a variety of market participants. For credit–market products, our results imply that takeover risk is directly related to increases in default risk. Takeover risk must be accounted for to properly hedge the risk of such credit securities using stocks. In particular, the debt of highly rated firms with especially high takeover risk should actually be hedged by long, rather than short, equity positions.

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Appendix A

Bond rating numerical conversions.

Conversion Number	Moody's ratings	S&P ratings
22	Aaa	AAA
21	Aa1	AA+
20	Aa2	AA
19	Aa3	AA−
18	A1	A+
17	A2	A
16	A3	A−
15	Baa1	BBB+
14	Baa2	BBB
13	Baa3	BBB−
12	Ba1	BB+
11	Ba2	BB
10	Ba3	BB−
9	B1	B+
8	B2	B
7	B3	B−
6	Caa1	CCC+
5	Caa2	CCC
4	Caa3	CCC−
3	Ca	CC
2	C	C
1	D	D

This appendix provides bond rating conversion codes for Moody's and S&P ratings used in the analysis. Moody's and S&P ratings of 13 and above are considered investment grade, while those below 13 are non-investment grade. The data covers the period from 1990 to 2000.

References

Asquith, P., Wizman, T., 1990. Event risk, covenants and bondholder returns in leveraged buyouts. Journal of Financial Economics 27, 195–213.
Bates, T., Becher, D., Lemmon, M., 2008. Board classification and managerial entrenchment: evidence from the market for corporate control. Journal of Financial Economics 87, 656–677.
Beim, D., 1992. Estimating bond liquidity. Unpublished working paper, Columbia University.
Billett, M., King, D., Mauer, D., 2004. Bondholders wealth effects in mergers and acquisitions: new evidence from the 1980s and 1990s. Journal of Finance 59, 107–135.
Black, F., Scholes, M., 1973. The pricing of options and corporate liabilities. Journal of Political Economy 637–654.
Bradley, M., Desai, A., Kim, E.H., 1988. Synergistic gains from corporate acquisitions and their division between stockholders of target and acquiring firms. Journal of Financial Economics 21, 3–40.
Campbell, J., 1987. Stock returns and the term structure. Journal of Financial Economics 18, 373–399.
Campbell, J., Ammer, J., 1993. What moves the stock and bond markets? A variance decomposition for long-term asset returns. Journal of Finance 48, 3–37.
Campbell, J., Taksler, G., 2003. Equity volatility and corporate bond yields. Journal of Finance 58, 2321–2349.
Chen, R.R., Sopranzetti, B.J., 2003. The valuation of default-triggered credit derivatives. Journal of Financial and Quantitative Analysis 38, 359–382.
Collin-Dufresne, P., Goldstein, R., Martin, J.S., 2001. The determinants of credit spread changes. Journal of Finance 56, 2177–2207.
Comment, R., Schwert, G., 1995. Poison or placebo? Evidence on the deterrence and wealth effects of modern antitakeover measures. Journal of Financial Economics 39, 3–43.
Cook, D., Easterwood, J., 1994. Poison put bonds: an analysis of their economic role. Journal of Finance 49, 1905–1920.
Cremers, M., V. Nair, and K. John, 2007. Takeovers and the cross-section of returns. Yale University Working paper.
Cremers, M., Nair, V., Wei, C., 2007a. Governance mechanisms and bond prices. Review of Financial Studies 20, 1359–1388.
Eom, Y., Helwege, J., Huang, J., 2004. Structural models of corporate bond pricing: an empirical analysis. Review of Financial Studies 17, 499–544.
Fama, Eugene F., French, Kenneth R., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3–56.
Furfine, C. and R. Rosen, 2006. Mergers and risk. Federal Reserve Bank of Chicago Working paper, No. 2006-09.
Ghosh, A., Jain, P., 2000. Financial leverage changes associated with corporate mergers. Journal of Corporate Finance 6, 377–402.
Gompers, P., Ishii, J., Metrick, A., 2003. Corporate governance and stock prices. Quarterly Journal of Economics 118, 107–155.
Jensen, M., Ruback, R., 1983. The market for corporate control. Journal of Financial Economics 11, 5–50.
Jordan, J., Mansi, S., 2003. Term structure estimation from on-the-run Treasuries. Journal of Banking and Finance 27, 1487–1509.
Kahan, M., Klausner, M., 1993. Antitakeover provisions in bonds: bondholder protection or management entrenchment? UCLA Law Review 40, 948–950.
Keim, S., Stambaugh, R., 1986. Predicting returns in the stock and bond market. Journal of Financial Economics 17, 357–390.
Klock, M., Mansi, S., Maxwell, W., 2005. Does corporate governance matter to bondholders? Journal of Financial and Quantitative Analysis 40, 693–720.
Kwan, S., 1996. Firm specific information and the correlation between individual stocks and bonds. Journal of Financial Economics 40, 63–80.
Leland, H., 1994. Corporate debt value, bond covenants, and optimal capital structure. Journal of Finance 49, 1231–1252.
Longstaff, F.A., Scwartz, E.S., 1995. A simple approach to valuing risky fixed and floating rate debt. Journal of Finance 50, 789–819.
Masulis, R., Wang, C., Xie, F., 2007. Corporate governance and acquirer returns. Journal of Finance 62, 1851–1889.
Merton, R., 1974. On the pricing of corporate debt: the risk structure of interest rates. Journal of Finance 29, 449–470.
Moeller, S., Schlingemann, F., Stulz, R., 2004. Firm size and the gains from acquisitions. Journal of Financial Economics 73, 201–228.
Nelson, C., Siegel, A., 1987. Parsimonious modeling of yield curves. Journal of Business 6, 473–489.
Newey, W., 1984. A method of moments interpretation of sequential estimators. Economics Letters 14, 201–206.
Ng, S., 2006. Investors fret buyout-induced risk: some money managers fear surge in leveraged deals stretches corporate finances. Wall Street Journal: July 18, 2006, Section C4.
Palepu, K., 1986. Predicting takeover targets: a methodological and empirical analysis. Journal of Accounting and Economics 8, 3–35.
Qi, Y., Wald, J., 2008. State laws and debt covenants. Journal of Law and Economics 51, 179–192.
Safieddine, A., Titman, S., 1999. Leverage and corporate performance: evidence from unsuccessful takeovers. Journal of Finance 54, 547–580.
Wall Street Journal, September 14th 2006. Moody's to expand debt evaluation. Section C1.
Zuckerman, G., 2005. Hedge funds stumble even when walking; 'Conservative' wagers turn sour, leading to fears of a shakeout: A one–two punch on a GM bet. Wall Street Journal: May 18, 2005, Section C1.