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"Is Borrowing from Banks More Expensive than Borrowing from the Market?"

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January 15, 2018

Abstract

This paper investigates the pricing of bank loans in a sample of new loans to firms with outstanding bonds. After accounting for seniority, banks earn an economically large interest rate premium relative to the price of credit risk in the bond market. To establish this result, I use intuition from a reduced-form model of credit risk to show that average loan spreads are three times higher than implied by bond spreads and relative losses in default. To quantify the premium at the loan level, I apply a structural model to a subsample of secured term loans and estimate an average loan premium of 240 bps. I rule out general mispricing of seniority, liquidity, fixed costs, and capital charges as drivers of the premium. My findings imply that firms place a high value on bank services other than the simple provision of debt capital.

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The two primary sources of debt for public corporations are private bank loans and bonds issued in the public debt markets. The academic literature offers a number of theories on the interaction of intermediated and public debt markets (e.g., Diamond (1991), Rajan (1992), Park (2000), Carey and Gordy (2016)) and empirical evidence on cross-sectional and time-series variation in quantities of loans and bonds issued (e.g., Faulkender and Petersen (2006), Rauh and Sufi (2010), Becker and Ivashina (2014)). However, there is less research on the pricing of bank loans and the relative pricing of private and public debt. This paper fills that gap by offering new evidence on the relative costs of bank and bond debt.

The central finding of this paper is that banks earn a substantial interest rate premium relative to the price of credit risk implied by the bond market, after accounting for seniority. I arrive at this finding by constructing a novel dataset consisting of new loan originations and secondary bond market quotes from the same firm on the same date. The benefit of this approach is that it controls for firm-time observable factors and the risk premium in the bond market.[1] I account for the firm's priority structure of debt using both reduced-form intuition and a structural model.

From a credit risk standpoint, the key difference between loans and bonds is that banks are senior to bondholders in bankruptcy.[2] Default is the only state in which creditors are not paid in full, so expected payoffs in default are a crucial determinant of the cost of credit. Table 1 presents evidence from Moody's Ultimate Recovery Database on bankruptcies of firms with both loans and bonds outstanding at the time of default from 1987 to 2014. The average recovery rate for loans is 80%, double the average recovery of 40% for bonds. This significant difference in exposure to default losses implies that loan credit spreads should be

[1] The sample consists of large firms with access to public debt markets, so it does not represent the population of corporate borrowers. Smaller firms outside of the sample likely have less bargaining power, without the outside option of the bond market, so I expect the loan premium is similar or even larger for these firms.

[2] Many loans are unsecured, which places the bank on equal footing with unsecured bondholders, but it is unusual for a firm to default on an unsecured loan. Table 1 shows that very few bank loans are unsecured at the time of default. Out of 1,448 loan observations in the Moody's Ultimate Recovery Database, only 106 (7.3%) are unsecured at the time of default. This likely stems from the ability of the bank to renegotiate loan terms after the firm violates financial covenants but before the firm defaults. During this renegotiation, the bank can secure the loan, making itself strictly senior to bondholders (Rauh and Sufi (2010)).

significantly smaller than bond credit spreads.

Table 1: Summary Statistics on Loan and Bond Recovery Rates

This table reports summary statistics on defaulted debt recovery rates from Moody's Ultimate Recovery Database. The sample includes cases involving firms rated by Moody's that filed for bankruptcy between 1987 and 2014 and had both loans and bonds outstanding at the time of default. The variable summarized is each debt instrument's court-determined recovery rate, based on Moody's suggested method (settlement value or trading price) and discounted from emergence to the default date by the instrument's interest rate. Recovery of 100% means the claimant was paid principal and accrued interest. Observations are at the instrument level.

	Mean	StDev	p5	p25	p50	p75	p95	Obs.
Loan	0.803	0.302	0.139	0.650	1.000	1.000	1.000	1,448
Revolving Facility	0.846	0.267	0.251	0.759	1.000	1.000	1.000	750
Secured by All Assets	0.858	0.260	0.245	0.798	1.000	1.000	1.000	444
Secured by Specific Assets	0.890	0.223	0.348	1.000	1.000	1.000	1.000	237
Unsecured	0.616	0.336	0.016	0.358	0.653	0.998	1.053	69
Term Loan	0.757	0.330	0.066	0.506	1.000	1.000	1.000	698
Secured by All Assets	0.801	0.289	0.158	0.652	1.000	1.000	1.000	466
Secured by Specific Assets	0.715	0.356	0.069	0.402	0.891	1.000	1.000	195
Unsecured	0.427	0.444	0	0	0.102	0.818	1.127	37
Bond	0.396	0.367	0	0.065	0.246	0.709	1.000	2,063
Senior Secured	0.625	0.350	0.114	0.209	0.674	1.000	1.000	468
Senior Unsecured	0.418	0.361	0	0.093	0.327	0.725	1.000	934
Senior Subordinated	0.224	0.294	0	0.008	0.099	0.315	0.837	382
Subordinated	0.192	0.255	0	0	0.102	0.245	0.725	227
Junior Subordinated	0.114	0.207	0	0	0.020	0.185	0.393	52

Duffie and Singleton (1999) develop a reduced-form default intensity model that serves as a useful benchmark. In their model, the credit spread on a risky zero-coupon bond equals the "risk-neutral mean-loss rate," or the probability of default times the expected loss given default. The probability of default is the same for all debt instruments issued by the same firm, assuming cross-default provisions are in place, so the relative spreads on bonds and loans depend only on the expected loss given default. Table 1 indicates that the expected loss given default for bonds is three times higher than the expected loss given default for loans. Therefore, the Duffie and Singleton (1999) model predicts that bond spreads should be approximately three times as large as loan spreads.[3]

[3]One issue with this prediction is that the loss given default in Duffie and Singleton (1999) is an ex-

Figure 1 visually summarizes the relative pricing of corporate bonds and loans, uncovering facts that to my knowledge have not been reported previously in the literature. The top panel plots bond and loan spreads relative to the LIBOR swap curve as non-parametric functions of distance-to-default (Bharath and Shumway (2008)) and the bottom panel plots the ratio of the spreads. The sample contains new loans and secondary bond market quotes from the same firm on the loan's origination date. In this figure, I exclude loan-bond pairs with a maturity difference over one year to mitigate the effect of maturity structure on the relative spreads (Bao and Hou (2017)).

On first glance, the plot in Panel A may appear intuitive. When the firm is close to default, bond spreads are significantly higher than loan spreads, reaching the bond-spread ratio of three-to-one predicted by the Duffie and Singleton (1999) model when the distance-to-default is zero. When the firm is far from default, the loan and bond spreads are similar, which seems consistent with most bank loans being unsecured when the firm is in good standing. However, Table 1 shows that the bank is rarely unsecured in the event of default, which likely results from the bank renegotiating loan terms as the firm's creditworthiness deteriorates (Roberts and Sufi (2009), Rauh and Sufi (2010)).

Accounting for the bank's senior position conditional on default, the similar pricing of loans and bonds for healthy firms is puzzling. Panel B of Figure 1 shows that when the firm is far from default, the credit spreads on bonds and loans are statistically indistinguishable. This stands in stark contrast with the prediction from the Duffie and Singleton (1999) model that loan spreads should be one-third as large as bond spreads. Assuming bonds are fairly priced, this implies that the bank earns a premium relative to the credit risk it bears.

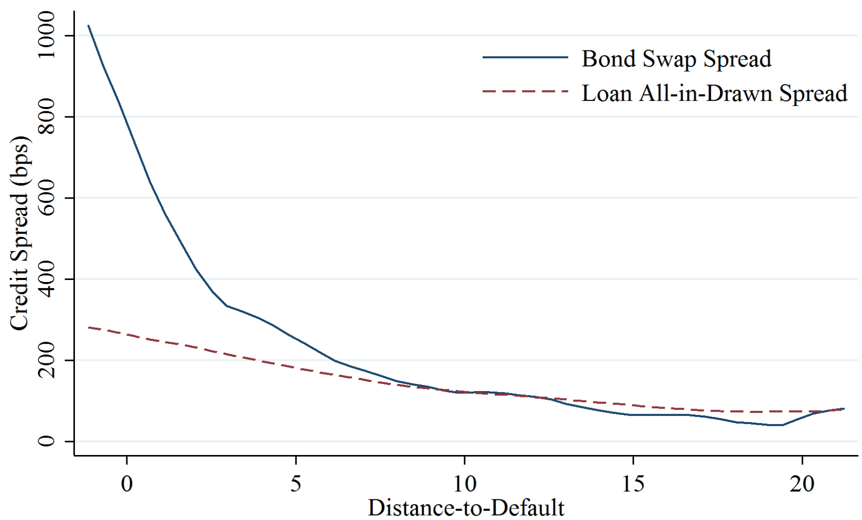
pectation under the risk-neutral measure, while the data in Table 1 provide an estimate of the expectation under the physical measure. This is an issue if there is a systematic component to the relative recoveries of loans and bonds. The Internet Appendix provides supplementary evidence indicating that loans recover significantly more than bonds in all market conditions and in the subset of bankruptcies in which absolute priority is violated. Thus, the mapping between physical and risk-neutral probabilities should not have a large effect on this reduced-form prediction.

Another issue is that loans are floating rate instruments and bonds are fixed rate instruments. Duffie and Liu (2001) show that when credit risk is uncorrelated with interest rates, the spread between floating and fixed rate credit spreads is on the order of one basis point. When credit and rates are correlated, the spread is larger, but not by enough to affect the interpretation of the magnitudes presented here.

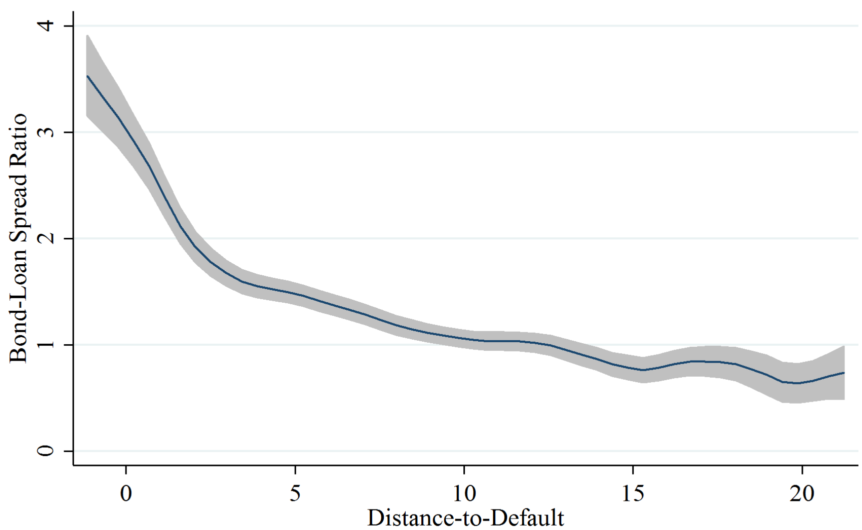
Figure 1: Non-Parametric Regressions of Credit Spreads on Distance-to-Default

This figure reports non-parametric regressions of bond and loan credit spreads on distance-to-default. The sample is restricted to absolute maturity differences of one year or less to mitigate the impact of maturity structure on the relative credit spreads. Panel A contains non-parametric regression estimates of bond and loan credit spreads on distance-to-default. *Bond Swap Spread* is the spread over the LIBOR swap curve after adjusting for embedded options, as provided by Bank of America Merrill Lynch. *Loan All-in-Drawn Spread* is the spread over LIBOR paid on drawn amounts plus the annual facility fee. *Distance-to-Default* is the naive distance-to-default from Bharath and Shumway (2008): $DtD = \left(\log(\frac{E+D}{D}) - (r - 0.5\sigma_A^2)T\right) / \left(\sigma_A\sqrt{T}\right)$, where E is market capitalization, D is short-term debt plus half of long-term debt, r is the trailing one-year stock return, σ_A is asset volatility, defined as $\sigma_A = \frac{E}{E+D}\sigma_E + \frac{D}{E+D}(0.05 + 0.25\sigma_E)$, with σ_E estimated with the standard deviation of the trailing one year of daily stock returns, and maturity $T = 1$. In my sample, the average distance-to-default for A-rated firms is 11.7, for BBB-rated firms it is 8.9, for BB-rated firms it is 6.1, for B-rated firms it is 3.6, for CCC-rated firms it is 1.2, and for CC-rated firms it is -0.7. Panel B reports a non-parametric regression of *Bond-Loan Spread Ratio*, the ratio of *Bond Swap Spread* to *Loan All-in-Drawn Spread*, on *Distance-to-Default*. The gray region around the regression estimate is the 95% confidence band.

Panel A: Bond and Loan Credit Spreads



Panel B: Bond-Loan Spread Ratio



To quantify the magnitude of the premium, I apply a structural model of credit risk that accounts for the priority structure of debt. This analysis focuses on a subsample of the data containing secured term loans and unsecured bonds, so there is no ambiguity about seniority and the impact of embedded options on the loan value is minimal. The model is an extension of the Merton (1974) model in which the firm's senior and junior debt claims are valued as options on the underlying assets. My empirical approach involves computing the underlying asset volatility implied by corporate bond prices under the model of junior debt, then using the model of senior debt to estimate counterfactual loan spreads that compensate the bank for bearing credit risk in the senior position of the priority structure. Importantly, the model prices corporate bonds accurately by construction, so my approach does not suffer from the "credit spread puzzle" (Huang and Huang (2012)) in which structural models underestimate corporate bond spreads.

The result of this estimation is that the average bond-implied loan spread for secured term loans is 48 basis points (bps), which is 240 bps lower than the average all-in-drawn spread of 288 bps in the subsample of secured term loans. The distribution of expected recoveries implied by the model closely matches the empirical distribution in Table 1, so the model adequately measures the bank's exposure to loss of principal in the default state. I extend the model to include two types of bankruptcy friction and find that bankruptcy costs must exceed 100% of firm value in many cases to reconcile the high level of loan spreads relative to bond spreads. Thus, it is unlikely that improper modeling of default exposure or bankruptcy costs are driving the finding of an economically large loan premium.

The results show that the bank earns a higher loan spread than implied by its risk exposure, but it is unclear whether this premium results from mispricing of seniority in general or something specific about bank debt. To address this issue, I analyze a separate sample of secured and unsecured bonds issued by the same firm. Interestingly, the relation between secured and unsecured bond spreads is very different than the relation between loan and bond spreads. The average ratio of the secured-to-unsecured spread is around

1.6 and does not depend on the firm's distance-to-default, conforming almost exactly to the prediction of the Duffie and Singleton (1999) model using information on secured bond recoveries from Table 1. The credit spread on secured bonds is almost always smaller than the credit spread on unsecured bonds. This finding is in stark contrast to the findings on bank loan spreads and suggests that the loan premium is specific to banks.

Why does the bank earn a premium relative to the market price of credit risk? There are a number of differences between loans and bonds that could be responsible for this finding. I cannot definitively identify the mechanism underlying the loan premium, but I am able to rule out several explanations, while supporting others. First, the estimated premium is not driven by a basis between fixed (bond) and floating (loan) rate credit spreads, which Duffie and Liu (2001) show to be on the order of one basis point. Second, the premium cannot be attributed to fixed costs of issuance, as the average up-front loan fee is 50 bps and the average bond underwriting spread is 150 bps for the BB and B-rated issuers in the sample of term loans. Amortizing these up-front costs over the 5-year maturity of the typical loan, the difference in fixed costs could explain at most 20 bps of the 240 bps loan premium.[4] Third, although the secondary market for loans is becoming more active (Gande and Saunders (2012)), loans are probably less liquid than corporate bonds. I use intuition from the Amihud and Mendelson (1986) model, along with secondary market bid-ask spreads for a subset of loans in my sample, to show that the loan premium is too large to be explained by illiquidity. Finally, I show that bank capital requirements are unlikely to drive the premium. Back-of-the-envelope calculations indicate that banks earn an attractive return on equity by lending to the firms in my sample.

Regression analysis of the loan premium shows that the firm's debt structure is the primary determinant of the difference between actual and model-implied spreads. Loan spreads are positively associated with total debt but uncorrelated with the amount of senior

[4]The typical bond has maturity longer than 5 years, so the per-year difference in up-front costs is less than 20 bps. Relatedly, Berg, Saunders, and Steffen (2016) show that fees are important component of the bank's compensation for a loan. If anything, the existence of fees in addition to the all-in-drawn spread means that I underestimate the magnitude of the loan premium.

debt, whereas model spreads depend only on senior debt, so the bank premium is larger for firms with less bank debt and more unsecured bond debt. One potential explanation for this finding is that the bank cares about the likelihood of the firm defaulting because it is costly to report non-performing loans to regulators, even if actual loss of principal is minimal. However, the model with bankruptcy costs casts doubt on this explanation, as these non-pecuniary costs of default would need to exceed 40% of the loan's principal to justify the pricing of the loan. The loan premium is smaller when more banks are in the syndicate, when the firm's relationship with the bank is stronger, and when the loan includes a performance pricing matrix, which provides support for ease of renegotiation (Roberts and Sufi (2009)) as an explanation of the loan premium. Surprisingly, there is no correlation between the bank premium and loan size, firm size, market-to-book, or asset tangibility, which casts doubt on fixed costs of screening and monitoring as the explanation for the premium.

The main implication of these findings is that firms are willing to pay a high cost to borrow from a bank, offering the bank a senior claim at a discount to the price implied by the bank's exposure to credit risk. By revealed preference, firms must place a high value on bank services other than the simple one-time provision of debt capital. To my knowledge, this paper is the first to quantify the value of bank "specialness" using the firm's willingness to pay for bank credit. The finding of a economically large loan premium contributes to the literature that uncovers the value of bank specialness indirectly (e.g., Fama (1985), James (1987)).[5] More work is necessary to pin down the sources of specialness and determine whether the bank is fairly compensated.

My results raise a new type of "credit spread puzzle" for corporate loans that is distinct from the well studied puzzle in the corporate bond market (Huang and Huang (2012)). The original credit spread puzzle is that structural models underestimate bond spreads when

[5] James (1987) shows that the stock market reaction to new loan announcements is positive. In the Internet Appendix, I show that the abnormal stock returns around loan originations in my sample are insignificantly positive. The firms in my sample are larger and less constrained than the typical bank borrower, so it is not surprising that the market reaction is muted. Consistent with James (1987), I find that the abnormal returns around new loans to firms without outstanding bonds are significantly positive.

calibrated with historical default rates or volatility from the equity market. My findings indicate that a structural model underestimates loan spreads when the model is set up to price bonds exactly. This puzzle appears to be specific to bank loans, as the relative pricing of secured and unsecured bonds is consistent with their priority ranking in default. The inability of the model to explain the level of loan spreads does not mean that loans are mispriced, but it does indicate that the bulk of corporate loan spreads are attributed to non-credit factors.[6]

This paper contributes to the literature on the pricing of corporate loans. Several earlier papers study the pricing effects of specific characteristics of the loan or the firm-bank relationship. Hubbard, Kuttner, and Palia (2002), Santos (2011), Lambertini and Mukherjee (2016), and Wallen (2017) focus on bank capital, Ivashina (2009) focuses on lead arranger skin-in-the-game, Santos and Winton (2008), Hale and Santos (2009), and Schenone (2010) study informational rents, Lim, Minton, and Weisbach (2014) focus on non-bank tranches, Murfin and Petersen (2016) study seasonality, and Botsch and Vanasco (2017) show that banks learn about borrower quality. In contrast to these papers, I focus on the pricing of new loans relative to outstanding bonds and find that banks earn high interest rates after accounting for their limited exposure to credit risk. My paper is also related to Dougal et al. (2015) and Murfin and Pratt (2017), who uncover mispricing due to overweighting information from past loans. Our approaches differ, in that I compare the pricing of loans to the pricing of the same firm's outstanding bonds on the same date, whereas these papers compare the pricing of loans made to the same firm in the past and similar firms in the same time period, respectively. In another related paper, Bao and Hou (2017) study the effects of maturity structure on corporate bond spreads. My paper builds on this work by showing that priority structure is priced as expected within the bond market, but senior loans earn a large premium relative to the rate implied by junior bonds.

[6]Interestingly, the regression analysis in Section 1.3 shows that observable credit risk variables explain over 70% of cross-sectional variation in loan spreads. Similar results hold for corporate bond spreads. Therefore, the relative pricing of loans depends heavily on credit risk, but the level of loan spreads is mostly due to non-credit factors.

Understanding the relative pricing of loans and bonds is essential for understanding the choice between public and private debt financing. This paper sheds light on previous research on this choice (e.g., Diamond (1991), Denis and Mihov (2003)) by showing that bank financing is significantly more expensive than bond financing, after accounting for differences in seniority. My results help explain the finding in Faulkender and Petersen (2006) that bank-dependent firms have significantly lower leverage than firms with access to the bond market, which is consistent with firms paying a higher cost to borrow from banks.

My findings also relate to the contracting literature that explains why the bank is typically senior to bondholders in the firm's debt structure (e.g., Diamond (1993), Welch (1997), Park (2000), Gornall (2017)). Although it may be optimal for the bank to be senior to resolve contracting frictions, my results indicate that banks earn higher returns than implied by their limited exposure to risk. Therefore, this contracting solution has real costs that are reflected in the firm's cost of debt capital. My sample contains firms that also borrow in the bond market, so a natural question is whether the cost of bond issuance is reduced by the presence of bank monitoring, as the aforementioned theories would predict, and the bank captures this surplus via the bank premium.[7]

Finally, my results relate to recent work by Begenau and Stafford (2017), who show that bank assets underperform passive investments in U.S. Treasury bond portfolios. In contrast, I find that banks earn significantly higher interest rates on corporate loans than they would earn in counterfactual corporate bond investments with equivalent seniority. Following the interpretation of Begenau and Stafford (2017), this implies that inefficiencies in other segments of the bank lead to the underperformance of bank assets. Interestingly, these findings conflict with the narrative of some practitioners that corporate lending is unprofitable and that banks need to earn fees from other services to profit from lending.

The remainder of the paper is organized as follows. Section 1 describes the construction

[7] In the Internet Appendix, I show that the difference in bond spreads for firms with and without bank debt is statistically insignificant after controlling for underlying credit. Unfortunately, endogenous selection into bank borrowing makes it difficult to interpret this finding. Specifically, it is likely that firms who benefit more from monitoring are more likely to borrow from banks.

of the sample. Section 2 outlines an extension of the Merton (1974) model and estimates counterfactual loan spreads under the model. Section 3 explores potential explanations for the loan premium. Section 4 concludes.

1 Data

1.1 Sample Construction

I construct a sample of loan originations merged with secondary market bond price data from the same firm on the origination date of the loan. In the absence of widely available secondary market prices for corporate loans, but with reliable daily quote data on a large panel of corporate bonds, this is the best approach to compare the pricing of bonds and loans in a way that controls for firm-time variation. The descriptive analysis in this section uses a sample of 2,342 loan originations by 658 firms from 1997 to 2016, with each loan matched with the outstanding bond of nearest maturity. The quantitative estimation in the next section uses a smaller sample of secured term loans with detailed data on debt structure, consisting 205 loans to 108 firms from 2003 to 2016.[8]

Table 2 summarizes the sample construction. I begin with data on loan originations from 1997 to 2016 in DealScan merged with firm characteristics from the quarter prior to origination from Compustat. I restrict the sample to observations with non-missing data on short-term and long-term debt from Compustat and market capitalization and equity volatility from CRSP.[9] I drop a very small number of subordinated loans. I require the

[8]The restricted sample for the quantitative analysis ensures the precision of the comparison between loans and bonds and the model adjustment for seniority by avoiding the effects of embedded options in lines of credit and ensuring a strict priority ordering in the event of default.

[9]I extend the Chava and Roberts (2008) DealScan-Compustat link table to the end of 2016 by adding Compustat identifiers for loans originated after August 21, 2012 by companies that are public and located in the U.S., as indicated by DealScan. For each DealScan BorrowerCompanyID in this set of loans, I use the last Compustat GVKEY in the Chava and Roberts (2008) table if the GVKEY is still active in the CRSP-Compustat link table, hand-checking that the company names still match. For the remaining companies in the DealScan data after August 21, 2012, I hand-match company names with the Compustat header file on WRDS, using web searches for each unmatched company to determine if it is a subsidiary or an alternative name for a public company. I drop the company if I cannot find its identifier in Compustat.

all-in-drawn spread be relative to London Interbank Offered Rate (LIBOR), which is the standard base rate for corporate loans. I restrict the sample to revolving credit facilities (including 364-day facilities) and term loans (bank and non-bank tranches, as well as bridge loans and delay draw term loans), dropping leases, letters of credit, and other loan types. I exclude commercial paper backup loans because they are rarely used. I exclude debtor-in-possession loans because their issuers are in default.

Table 2: Sample Construction

This table summarizes the construction of the sample. The starting point is the DealScan-Compustat sample from 1997 to 2016. The sample of loans is restricted to senior revolving credit facilities and term loans with an all-in-drawn spread relative to LIBOR, excluding commercial paper backup and debtor-in-possession loans. Each loan is matched with the closest senior unsecured bond by maturity in the Bank of America Merrill Lynch bond quote data, dropping bond-loan pairs with an absolute maturity difference over five years or a minimum maturity less than 11 months. To mitigate the influence of multiple originations on the same date, I select distinct firm-date observations with a preference for term loans, smaller maturity differences, larger loan facilities, and finally, larger facility identification numbers in DealScan. To closely match the assumptions in the quantitative model estimation, I select a restricted sample of secured term loans with good quality data in Capital IQ. Data quality is ensured by matching the sum of secured and unsecured debt to total debt in Capital IQ, and matching total debt in Capital IQ and Compustat.

Selection Criteria	Loans in Sample	Amount ($ Bil.)	Firms in Sample
DealScan-Compustat (1997 to 2016)	30,285	13,613	4,651
Non-missing CRSP-Compustat data	22,491	11,013	3,939
Senior loans with AISD, LIBOR base	19,099	9,681	3,479
Revolvers and term loans	18,520	8,866	3,466
Exclude CP backup and DIP loans	17,070	7,693	3,434
Closest senior unsecured bond	3,187	3,182	663
Loan and bond maturities $\geq$ 11 mo.	3,091	3,024	658
Distinct firm-date observations	2,342	2,452	658
Full bond-loan sample	2,342	2,452	658
Secured term loans	382	240.8	194
Capital IQ debt components sum	215	145.3	115
Compustat, Capital IQ debt match	205	136.6	108
Restricted sample for quantitative model	205	136.6	108

I merge corporate bond quote data from Bank of America Merill Lynch (BAML), which are available from 1997 to 2016, on the origination date of each loan.[10] This is accomplished by merging the leading six digits of the CUSIP (the issuer CUSIP) in the BAML data with

[10]These quote prices are the basis for Bank of America's bond indices. In academic research, these data are used by Schaefer and Strebulaev (2008) and Feldhutter and Schaefer (2017).

the same identifier in Compustat. For each loan, I match the senior unsecured bond with the smallest absolute maturity difference, dropping pairs with an absolute maturity difference greater than five years. To mitigate the impact of extremely short maturities on the results, I drop loans and bonds with less than 11 months to maturity.

Finally, I select distinct firm-date observations to mitigate the impact of large firms borrowing under multiple loan facilities in the same origination. If there is a term loan included in the loan package, I select it because term loans have fewer embedded options that complicate the comparison with bond credit spreads. After giving preference to term loans, I select the minimum absolute maturity difference among the bond-loan pairs on each origination date. If there remain multiple facilities in a firm-date observation, I select the largest facility and then the highest facility identification number in DealScan. The full bond-loan sample consists of 2,342 originations by 658 firms totaling $2.45 trillion in loan capacity.

Even though the evidence on ultimate recoveries indicates that unsecured loans have priority over unsecured bonds in a default, I restrict the sample to secured term loans for the quantitative model estimation to ensure that there is no ambiguity about the priority of debt and minimal impact of embedded options. I use data from Capital IQ from 2002 to 2016 to measure the firm's debt structure at the quarter-end immediately before the origination date, which drops the observations from years 1997 to 2001.[11] After restricting the sample to secured term loans and ensuring the quality of the Capital IQ data by requiring that secured and unsecured debt sum to total debt and that total debt in Capital IQ match total debt in Compustat, the restricted sample consists of 205 originations by 108 firms totaling $136.6 billion in loan volume.

[11]Although the Capital IQ data covers 2002 to 2016, there are no secured term loans with non-missing Capital IQ data in 2002, so the restricted sample for the quantitative analysis covers 2003 to 2016.

1.2 Sample Characteristics

Table 3 reports summary statistics on the sample. The firms in the sample all have access to the public debt markets, so they are generally large, profitable, and have substantial tangible assets. There is significant cross-sectional variation in capital structure and debt structure. Consistent with Rauh and Sufi's (2010) finding that firms with tiered debt structure tend to be medium-to-low quality, most of the firms are in the BBB and BB rating categories.

The median loan facility has $650 million capacity, a maturity of five years, and an all-in-drawn spread over LIBOR of 125 bps. Approximately 30% of the loans are secured and 30% are term loans. The median bond has $350 million in principal outstanding and five years to maturity, with a secondary market asset swap spread of 152 bps. The sample of bonds has greater variance in credit spreads and time to maturity than the sample of loans, but the maturities are well matched in the middle of the distribution, indicating that maturity structure should not have a significant impact on the analysis.

To assess external validity, the Internet Appendix compares the sample with the DealScan-Compustat universe. The main difference between the sample and the universe is that the sample is restricted to bond issuers, so the firms are larger, less volatile and less reliant on bank financing, and almost all have credit ratings. In contrast, nearly half of the firms in the DealScan universe are non-rated. Along these lines, the loans are larger and have slightly lower credit spreads than the typical loan in the universe. The bank syndicates include more lenders and the largest banks are more likely to serve as lead arranger or participate as lenders in the syndicate. The distribution of borrower industries in the sample is similar to the distribution in the universe. Overall, the firms in the full sample are more creditworthy and have less severe information asymmetry than the typical borrower in the syndicated loan market. When generalizing the results in this paper, it is worthwhile to keep these differences in mind.

Table 3: Summary Statistics: Full Bond-Loan Sample

This table reports summary statistics on the full bond-loan sample. The construction of the sample is described in Table 2. *Term Loan* is an indicator for term loans, including bridge loans and delay draw term loans. *Secured Loan* is an indicator for secured loans, with missing data in DealScan counted as unsecured. *Lead Arranger Count* and *Participant Count* report the respective numbers of lead arranger and participant banks in the syndicate. *LIBOR Swap Rate* is the maturity-matched rate from the LIBOR swap curve. *Quasi-Market Assets* equal the sum of book debt (short-term plus long-term) and equity market capitalization. *Quasi-Market Leverage* is the ratio of book debt to book debt plus equity market capitalization. *Asset Volatility* is unlevered volatility of the trailing year of daily stock returns. *Distance-to-Default* is the naive distance-to-default from Bharath and Shumway (2008). *Asset Market-to-Book* is the ratio of quasi-market assets to book assets. *Asset Tangibility* is the ratio of net property, plant, and equipment to book assets. *Profitability* is the ratio of operating income before depreciation to book assets. *Operating Leverage* is the ratio of selling, general, and administrative (SG&A) expense to the sum of SG&A expense and cost of goods sold. *Bank Debt/Total Debt* and *Secured Debt/Total Debt* are from Capital IQ and are only available for a subset of originations from 2002 onward. All variables are winsorized at the 1% level to mitigate the impact of outliers. The distribution of Standard & Poor's (S&P) long-term issuer credit ratings in the month of loan origination is reported in the second row from the bottom, with the AA category including AA and AAA ratings and the CCC category including CCC and CC ratings.

	Mean	StDev	p5	p25	p50	p75	p95	Obs.
Loan Characteristics								
Loan all-in-drawn spread (bps)	153.3	105.2	22.50	75.00	125.0	200.0	350.0	2,342
Facility amount ($MM)	1,047	1,492	100.0	300.0	650.0	1,250	3,000	2,342
Loan maturity	4.364	1.520	0.997	3.833	4.999	5.002	6.590	2,342
LIBOR swap rate (%)	2.820	1.827	0.798	1.360	1.875	4.419	6.055	2,342
Term loan	0.291	0.454	0	0	0	1	1	2,342
Secured loan	0.306	0.461	0	0	0	1	1	2,342
Lead arranger count	2.758	2.146	1	1	2	4	7	2,341
Participant count	9.726	8.693	0	4	8	14	25	2,341
Bond Characteristics								
Bond swap spread (bps)	231.5	248.1	13.00	66.00	152.0	313.0	697.0	2,342
Bond face value ($MM)	455.0	358.1	150.0	250.0	350.0	500.0	1,000	2,342
Bond maturity	5.016	1.929	1.652	3.789	4.978	6.268	8.455	2,342
LIBOR swap rate (%)	2.861	1.853	0.705	1.311	2.144	4.501	6.105	2,342
Firm Characteristics								
Quasi-market assets ($B)	21.70	41.53	0.960	3.491	8.284	20.88	87.19	2,342
Quasi-market leverage	0.310	0.198	0.069	0.156	0.267	0.412	0.717	2,342
Asset volatility	0.220	0.093	0.103	0.156	0.204	0.265	0.396	2,342
Distance-to-default	8.005	4.932	0.605	4.309	7.474	11.28	17.15	2,342
Asset market-to-book	1.408	0.784	0.581	0.883	1.194	1.702	2.949	2,342
Asset tangibility	0.342	0.253	0.037	0.130	0.279	0.518	0.853	2,302
Profitability	0.036	0.021	0.007	0.024	0.034	0.046	0.075	2,216
Operating leverage	0.240	0.176	0.035	0.107	0.197	0.324	0.619	2,105
Bank debt/total	0.138	0.192	0	0	0.034	0.221	0.562	1,366
Secured debt/total	0.142	0.217	0	0	0.016	0.217	0.624	1,366
	AA	A	BBB	BB	B	CCC	NR	
Credit rating (%)	2.610	18.53	39.03	24.12	14.30	0.850	0.560	2,342
Origination dates per firm	3.559	2.732	1	1	3	5	9	658

1.3 Determinants of Bond and Loan Credit Spreads

As a first step to understanding the relative pricing of corporate bonds and bank loans, I explore the determinants of their credit spreads. Table 4 reports regressions of loan and bond spreads on firm and loan characteristics related to credit risk. The left four columns consider loan spreads and the right four columns consider bond spreads. The leftmost column in each set considers the most basic observable credit risk variables: leverage, asset volatility, and maturity. These regressions also include the risk-free rate. Each column to the right adds more variables that are expected to correlate with credit spreads.

The coefficients on the basic credit variables are of the expected sign for both loans and bonds. These variables explain 48% and 57% of cross-sectional variation in loan and bond spreads, respectively. The addition of indicators for S&P long-term issuer ratings increases each R^2 by more than 20%, indicating that credit ratings contain pricing information not captured by capital structure and asset risk. Explanatory power is increased further by adding non-credit firm characteristics and indicators for secured loans and term loans.

Overall, the results in Table 4 indicate that observable credit risk, firm characteristics, and loan terms can explain 77% of cross-sectional variation in loan spreads and 84% of cross-sectional variation in bond spreads. Put differently, the relative pricing of loans originated in the same month can be explained largely by observable variables related to the borrower's creditworthiness. In light of the patterns shown in Figure 1 and the recovery data in Table 1, this is somewhat surprising. While the data indicate that the level of loan spreads is too high, the relative pricing of loans is largely explained by observables. In Section 2, I use a structural model to quantify the level of loan spreads that is implied by secondary market bond spreads, after accounting for bank seniority.

There are interesting differences in the correlations among credit spreads and other firm and loan characteristics. All-in-drawn loan spreads are uncorrelated with both firm size and profitability, while these are highly significant determinants of bond spreads. On the other hand, secured loans and term loans have significantly higher credit spreads, but these loan types are not associated with differences in bond spreads. The positive and significant correlation between secured loans and loan spreads is counterintuitive, but suggests that the choice to secure the loan is negatively associated with unobservable creditworthiness. The analysis in Section 2 mitigates this problem by focusing only on secured term loans.

Table 4: Determinants of Loan and Bond Credit Spreads

This table reports regressions of all-in-drawn loan spreads and bond swap spreads on firm, loan, and bond characteristics. Table 2 describes the sample construction and Table 3 contains variable definitions. *Bank Debt/Total Debt* and *Secured Debt/Total Debt* are from Capital IQ and are only available for a subset of originations from 2002 onward. *S&P Rating FEs* are based on the firm's long-term issuer rating. Firm Controls include asset market-to-book, asset tangibility, operating leverage, and 2-digit SIC dummies. Within R^2 represents the goodness of fit after accounting for month fixed effects (but not rating or industry effects). t-statistics based on standard errors clustered by firm and month are reported in brackets. * and ** denote p-values less than 0.05 and 0.01, respectively.

	Loans				Bonds			
Log(Swap Spread)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quasi-market leverage	2.470**	0.583**	0.506**	0.351*	3.984**	1.491**	1.528**	1.442**
	[20.3]	[5.12]	[3.89]	[2.34]	[28.5]	[10.2]	[9.31]	[7.71]
Asset volatility	2.957**	0.539**	0.564**	0.581*	4.547**	1.496**	1.345**	1.193**
	[11.7]	[2.72]	[2.82]	[2.31]	[15.3]	[7.02]	[5.68]	[4.14]
Maturity	0.096**	0.074**	0.050**	0.025	0.137**	0.096**	0.099**	0.108**
	[5.73]	[4.61]	[3.34]	[1.18]	[8.72]	[6.73]	[7.44]	[5.51]
Swap rate (%)	0.009	-0.070	-0.048	-0.009	0.017	-0.054	-0.082	-0.067
	[0.18]	[-1.59]	[-1.16]	[-0.14]	[0.26]	[-1.09]	[-1.70]	[-0.94]
Log(Assets)			0.006	-0.008			-0.119**	-0.139**
			[0.47]	[-0.58]			[-6.65]	[-6.90]
Profitability			-0.066	0.110			-2.572**	-2.074*
			[-0.12]	[0.15]			[-3.40]	[-2.60]
Secured loan			0.201**	0.125**			-0.063	-0.061
			[5.18]	[4.27]			[-1.69]	[-1.42]
Term loan			0.219**	0.150**			0.013	0.050
			[8.63]	[5.81]			[0.35]	[1.42]
Bank debt/total				0.067				-0.090
				[0.84]				[-0.82]
Sec. debt/total				-0.084				-0.194
				[-1.22]				[-1.87]
Month FEs	X	X	X	X	X	X	X	X
S&P rating FEs		X	X	X		X	X	X
Firm controls			X	X			X	X
Adj. R^2	0.619	0.781	0.811	0.846	0.659	0.802	0.821	0.868
Within R^2	0.481	0.705	0.756	0.773	0.572	0.754	0.786	0.835
Observations	1,961	1,961	1,961	1,125	1,961	1,961	1,961	1,125

Surprisingly, neither the ratio of bank debt to total debt nor the ratio of secured debt to total debt has a significant coefficient in either regression. The coefficient on secured debt to total debt is negative and marginally statistically significant in the bond regressions, indicating that a greater proportion of secured debt is associated with lower unsecured bond spreads. This is consistent with the reasoning in Carey and Gordy (2016), who present a model in which banks set the firm's default threshold, so a higher amount of secured bank debt implies a higher default threshold.[12]

The weak correlations between debt structure and loan spreads are puzzling, given the importance of seniority for determining payoffs in default. In both the Merton (1974) and Carey and Gordy (2016) models of risky debt, the value of senior debt depends on the amount of senior debt and does not depend on the amount of total debt. The intuition is that the payoff on the loan in default depends only on the value of the firm relative to the amount of the loan and not the amount of bonds outstanding, because the loan is paid in full before bondholders receive any recovery. In contrast, these results suggest that overall leverage is what matters for determining loan spreads at origination, while the relative proportions of bank and bond debt have no effect.[13]

2 Quantifying the Bank Premium

The evidence presented thus far indicates that seniority is not a key determinant of the relative credit spreads of corporate bonds and bank loans, in spite of strong evidence that banks are less exposed to the risk of loss of principal. In this section, I explore whether banks earn an interest rate premium by estimating counterfactual loan spreads in a structural model. First, I describe a version of the Merton (1974) model with senior and junior debt.

[12]Unreported results show that the insignificant coefficients on the debt structure variables remain if only one of the bank debt or secured debt ratios are included, or if other control variables are omitted from the regression.

[13]The Internet Appendix reports analogous regressions for the ratio of bond to loan credit spreads. The results are consistent with both Figure 1 and Table 4. The debt structure variables are insignificant, in spite of the association between priority structure and the relative recoveries of loans and bonds, which should drive the ratio of credit spreads, according to Duffie and Singleton (1999).

Second, I extend the model to include bankruptcy costs. Third, I describe my approach to estimating counterfactual loan spreads in the data, which involves backing out implied volatility from bond prices and calculating the loan value in the model. Finally, I describe and interpret the results of this exercise.

2.1 Merton Model with Senior and Junior Debt

Black and Cox (1976) and Bao and Hou (2016) outline an extension of the Merton (1974) model with senior and junior debt.[14] In the Merton (1974) model, the firm's value follows a geometric Brownian motion under the risk-neutral measure,

$$d\ln V_t = \left(r - \frac{1}{2}\sigma^2\right) dt + \sigma dW_t^Q. \tag{1}$$

Assume the firm has two zero-coupon debt issues outstanding, a senior loan with face value K_S and a junior bond with face value K_J, both maturing at time T. Senior debt is a risk-free bond plus a short put option struck at its face value, while the junior debt is a portfolio containing a long call option struck at the senior debt's principal and a short call option struck at the sum of the senior and junior face values. The value of senior debt is:

$$D_S = V - V\Phi(d_{1,S}) + K_S e^{-rT}\Phi(d_{2,S}), \tag{2}$$

where

$$d_{1,S} = \frac{\ln\left(V/K_S\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_{2,S} = d_{1,S} - \sigma\sqrt{T}.$$

The value of junior debt is:

$$D_J = V\Phi(d_{1,S}) - K_S e^{-rT}\Phi(d_{2,S}) - V\Phi(d_1) + (K_S + K_J)e^{-rT}\Phi(d_2), \tag{3}$$

[14]In their paper, Bao and Hou (2016) focus on the pricing of bonds maturing at different points in the firm's maturity structure, as they do not observe interesting variation in priority in their sample of corporate bonds, which does not include bank debt.

where

$$d_1 = \frac{\ln\left(V/(K_S + K_J)\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_2 = d_1 - \sigma\sqrt{T}.$$

The yields of the loan and bond can be expressed as $y_S = \frac{1}{T}\ln\left(K_S/D_S\right)$ and $y_J = \frac{1}{T}\ln\left(K_J/D_J\right)$, respectively, because they are zero-coupon securities.

This model makes several simplifying assumptions that merit explanation. Strict absolute priority is assumed to hold, so the senior debt is paid in full before junior debt receives any recovery in a bankruptcy. The evidence on loan and bond recoveries in Table 1 indicates that this assumption approximates reality. The firm can only default on the maturity date T, which is assumed to be the same for both types of debt. In reality, the firm can default at any time, but it is most likely to default when faced with a large principal repayment. I mitigate concerns over this assumption by using the closest bond-loan pair in the firm's maturity structure, but future versions of the paper may implement a more complex model of default. The firm's debt structure is assumed to be fixed between the valuation date and maturity. I confirm that changes in debt structure around origination do not affect my estimates by measuring debt structure both immediately before and immediately after origination. Finally, the debt in the model is zero-coupon but almost all corporate loans and bonds pay period interest, which introduces some basis between the par and zero-coupon credit spreads.

2.2 Expected Recoveries under the Merton Model

One potential concern about using the Merton (1974) model with senior and junior debt to estimate counterfactual loan spreads is that the model may not account for the bank's risk of losing its principal. In this section, I derive formulas for the probability of default and the expected recoveries for senior and junior debt conditional on default. These quantities are computed under the risk-neutral measure and cannot be directly compared with the recoveries in Table 1. Nevertheless, they are useful for showing that the model generates a reasonable distribution of loss given default that reflects the bank's exposure to default risk.

Under the Merton (1974) model, the value of the firm is distributed log-normally:

$$\ln V_T \sim N\left(\left(r - \frac{1}{2}\sigma_V^2\right)(T-t), \sigma_V^2(T-t)\right).$$

For ease of notation, let $\mu = \left(r - \frac{1}{2}\sigma_V^2\right)(T-t)$ and $\Sigma = \sigma_V\sqrt{T-t}$. The probability that the firm defaults on its debt at time T is:

$$P\left(V_T \leq K_S + K_J\right) = \Phi\left(\frac{\ln(K_S + K_J) - \mu}{\Sigma}\right), \tag{4}$$

the probability senior debt is impaired is:

$$P\left(V_T \leq K_S\right) = \Phi\left(\frac{\ln(K_S) - \mu}{\Sigma}\right),$$

and the probability the firm defaults but senior debt is made whole is:

$$P\left(K_S \leq V_T \leq K_S + K_J\right) = P\left(V_T \leq K_S + K_J\right) - P\left(V_T \leq K_S\right).$$

Conditional on the firm defaulting, the recovery on senior debt is $\min\left(1, \frac{V_T}{K_S}\right)$ and the recovery on junior debt is $\min\left(1, \max\left(0, \frac{V_T - K_S}{K_J}\right)\right)$. To make the derivation explicit and reduce the amount of notation in each equation, I break the expected recovery calculation into steps.

The expected payoff to senior debt, conditional on the firm defaulting and senior debt being impaired, is:

$$E\left[D_S | V_T \leq K_S\right] = \frac{e^{\mu + \frac{1}{2}\Sigma^2}\Phi\left(\frac{\ln(K_S) - \mu - \Sigma^2}{\Sigma}\right)}{P\left(V_T \leq K_S\right)}.$$

Then the expected payoff to senior debt, conditional on the firm defaulting, is:

$$E\left[D_S | V_T \leq K_S + K_J\right] = \frac{P\left(K_S \leq V_T \leq K_S + K_J\right) + P\left(V_T \leq K_S\right)E\left[D_S | V_T \leq K_S\right]}{P\left(V_T \leq K_S + K_J\right)}. \tag{5}$$

The first term in the numerator reflects the state in which the firm defaults and senior debt is paid in full and the second set of terms reflects the state in which the firm defaults and senior debt is impaired.

The expected payoff to junior debt, conditional on the firm defaulting and the senior debt being made whole, is:

$$E\left[D_J | K_S \leq V_T \leq K_S + K_J\right] = \frac{e^{\mu+\frac{1}{2}\Sigma^2}\left(\Phi\left(\frac{\ln(K_S+K_J)-\mu-\Sigma^2}{\Sigma}\right) - \Phi\left(\frac{\ln(K_S)-\mu-\Sigma^2}{\Sigma}\right)\right)}{P\left(K_S \leq V_T \leq K_S + K_J\right)} - K_S,$$

Then the expected payoff to junior debt, conditional on the firm defaulting, is:

$$E\left[D_J | V_T \leq K_S + K_J\right] = \frac{P\left(K_S \leq V_T \leq K_S + K_J\right) E\left[D_J | K_S \leq V_T \leq K_S + K_J\right]}{P\left(V_T \leq K_S + K_J\right)}. \qquad (6)$$

The numerator only contains one set of terms, reflecting the state in which the firm defaults and senior debt is paid in full, so there is a recovery for junior creditors.

2.3 Extension with Bankruptcy Costs

Bankruptcy costs are an important element missing from the Merton (1974) model that can affect the pricing of corporate debt. I use two extensions of the model to address the impact of bankruptcy frictions on the model output. The purpose of each extension is to compute the bankruptcy costs necessary to reconcile loan and bond credit spreads in the data.

In the main approach outlined above, I compute the asset volatility implied by bond spreads (one equation, one unknown) and use this parameter to calculate counterfactual loan spreads. In the models with bankruptcy costs, I compute the asset volatility and the bankruptcy cost parameter jointly from loan and bond spreads (two equations, two unknowns) and use the estimated bankruptcy cost to draw conclusions about the pricing of corporate debt.

In this section, I describe two extensions of the Merton (1974) model that explicitly account for bankruptcy costs. The first extension assumes the firm loses some fraction α_V of its value after filing for default, so the value split up among claimants is proportionally lower than it is under the original model. The second extension assumes the senior and junior claimants lose respective fractions α_S and α_J of their claims to bankruptcy costs, which could reflect the payment of legal fees or the loss of time value of money.

2.3.1 Case 1: Loss of Firm Value

Suppose the value of the firm drops from V_T to $(1-\alpha_V)V_T$ if the firm files for bankruptcy at time T, where α_V is between zero and one. The firm-level bankruptcy cost α_V could be interpreted as reflecting indirect costs of bankruptcy such as loss of customers and suppliers. Applying the Merton (1974) framework to the modified payoffs in the default state, the value of senior debt is:

$$D_S = (1-\alpha_V)V\left(1-\Phi\left(d_{1,S}\right)\right) + K_S e^{-rT}\Phi\left(d_{2,S}\right), \tag{7}$$

where

$$d_{1,S} = \frac{\ln\left(\frac{(1-\alpha_V)V}{K_S}\right) + \left(r+\frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_{2,S} = d_{1,S} - \sigma\sqrt{T}.$$

The value of junior debt is:

$$D_J = (1-\alpha_V)\left[V\left(\Phi(d_{1,S}) - \Phi(d_1)\right) - K_S e^{-rT}\left(\Phi(d_{2,S}) - \Phi(d_2)\right)\right] + K_J e^{-rT}\Phi(d_2), \tag{8}$$

where

$$d_{1,S} = \frac{\ln\left(\frac{(1-\alpha_V)V}{K_S}\right) + \left(r+\frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_{2,S} = d_{1,S} - \sigma\sqrt{T}.$$

and

$$d_1 = \frac{\ln\left(\frac{V}{K_S+K_J}\right) + \left(r+\frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_2 = d_1 - \sigma\sqrt{T}.$$

2.3.2 Case 2: Loss of Claim Value

Suppose that if the firm files for bankruptcy at time T, then the respective values of the senior and junior debt claims are reduced by fractions α_S and α_J. These claim-level bankruptcy costs could be interpreted as the costs to banks and bondholders of negotiating for their recoveries in bankruptcy. Applying the Merton (1974) framework to the modified payoffs in the default state, the value of senior debt is:

$$D_S = (1-\alpha_S)V\left(1-\Phi\left(d_{1,S}\right)\right) + K_S e^{-rT}\left((1-\alpha_S)\Phi\left(d_{2,S}\right) + \alpha_S\Phi\left(d_2\right)\right), \tag{9}$$

where

$$d_{1,S} = \frac{\ln\left(\frac{V}{K_S}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_{2,S} = d_{1,S} - \sigma\sqrt{T},$$

and

$$d_1 = \frac{\ln\left(\frac{V}{K_S+K_J}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_2 = d_1 - \sigma\sqrt{T}.$$

The value of junior debt is:

$$D_J = (1-\alpha_J)\left[V\left(\Phi(d_{1,S}) - \Phi(d_1)\right) - K_S e^{-rT}\left(\Phi(d_{2,S}) - \Phi(d_2)\right)\right] + K_J e^{-rT}\Phi(d_2) \tag{10}$$

where

$$d_{1,S} = \frac{\ln\left(\frac{V}{K_S}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_{2,S} = d_{1,S} - \sigma\sqrt{T},$$

and

$$d_1 = \frac{\ln\left(\frac{V}{K_S+K_J}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}, \quad d_2 = d_1 - \sigma\sqrt{T}.$$

When computing the parameters of this model in the data, I assume the bankruptcy cost for junior claims is $\alpha_J = 0.20$ and jointly estimate the asset volatility σ and the bankruptcy cost for senior claims α_S. The results are insensitive to assuming alternative values of α_J.

2.4 Numerical Computation of Model Parameters

I use the extensions of the Merton (1974) model outlined above to quantify the premium earned by the bank relative to the price of credit risk implied by the bond market. My approach to estimating counterfactual loan spreads involves computing the asset volatility implied by the bond swap spread and plugging this volatility into equation (2) to value the loan under the bond market's price of credit risk. As an alternative approach, I compute implied volatility from the all-in-drawn loan spread and use this volatility to obtain a counterfactual bond spread from equation (3). Equations (2) and (3) describe one-to-one relations between the value of debt and the underlying asset volatility, so the implied volatility is solved numerically by setting the difference between the observed credit spread and the zero-coupon spread in the model to zero.[15]

It is important to note that this approach does not suffer from the "credit spread puzzle" (Huang and Huang (2012), Feldhutter and Schaefer (2017)), the finding that structural models of credit risk consistently underestimate corporate bond spreads. This failure stems from researchers using equity-implied volatility to price corporate bonds, which may not account for the risk premium demanded by corporate bond investors. In my approach, the model prices corporate bonds correctly because the implied volatility is based on corporate bond prices. The bond-implied volatility includes information on both the expected volatility of the firm's assets as well as the risk premium. In the analysis below, I confirm that my approach accurately prices bonds other than the one used to compute implied volatility.

I use data from various sources to map the debt structures of firms with senior bank loans and junior bond debt outstanding. In this analysis, I focus on a sample of secured term loans and unsecured bonds to minimize the potential for mismeasurement of seniority and the influence of embedded options on the pricing of the loan. Table 2 describes the sample construction. The table below summarizes the data variables that I use to estimate

[15]This approach is similar to the one introduced by Kelly, Manzo, and Palhares (2016) to estimate credit-implied volatility from CDS spreads.

counterfactual loan spreads:

Parameter	Description	Data Variable	Source
K_S	Senior debt face value	Secured debt	Capital IQ
K_J	Junior debt face value	Unsecured debt	Capital IQ
V	Market value of assets	Quasi-market assets	Capital IQ, CRSP
T	Debt maturity	Loan and bond maturities	DealScan, BAML
r	Risk-free rate	LIBOR swap rate	Bloomberg
y	Debt yield	Swap spread plus swap rate	DealScan, BAML

The face values of senior and junior debt are measured as the amounts of outstanding secured and unsecured debt at the quarter-end prior to origination in Capital IQ. To mitigate concerns about changes in debt structure around loan origination, I report similar results using debt structure at the quarter-end after origination in the Internet Appendix. Quasi-market assets are the sum of total debt from Capital IQ and the equity market capitalization on the loan origination date. Loan and bond maturities are allowed to differ, with the respective values used in the implied volatility and counterfactual valuation steps. Risk-free rates are maturity-matched LIBOR swap rates and debt yields are the sum of swap rates and option-adjusted swap spreads.

Table 5 reports summary statistics for the restricted sample used to estimate counterfactual loan spreads.[16] The sample consists entirely of secured term loans, about one-third of which are secured by all the firm's assets. The most significant differences between the restricted sample and the full bond-loan sample are with respect to creditworthiness and the distribution of observations over time. Consistent with the notion that bank lenders are more likely to be secured after the firm's creditworthiness deteriorates (Rauh and Sufi (2010)), the firms in this sample are closer to default and receive smaller loans than the firms in the full sample.

[16] The Internet Appendix compares the restricted sample to the DealScan-Compustat universe. Aside from the differences noted here, there is a greater propensity for loans in the restricted sample to have investment banks like Goldman Sachs and Morgan Stanley as lead arrangers. The distribution of industries in the restricted sample is similar to the distributions in the universe and the full sample in this paper.

Table 5: Summary Statistics: Restricted Sample for Quantitative Model

This table reports summary statistics on the sample for quantitative model estimation. The sample is restricted to secured term loans with Capital IQ data on debt structure available prior to origination. The construction of the sample is described in Table 2. *Secured by All Assets* is an indicator for loans secured by all of the firm's assets. *Revolver in Package* is an indicator equal to one if the loan package includes a revolving credit facility. *Performance Pricing* is an indicator equal to one if the loan contract includes either interest-increasing or interest-decreasing performance pricing. *Lead Arranger Count* and *Participant Count* report the respective numbers of lead arranger and participant banks in the syndicate. *LIBOR Swap Rate* is the maturity-matched rate from the LIBOR swap curve. *Quasi-Market Assets* equal the sum of book debt (short-term plus long-term) and equity market capitalization. *Distance-to-Default* is the naive distance-to-default from Bharath and Shumway (2008). Firm characteristics are reported for the quarter-ends immediately before and after the loan origination. All variables are winsorized at the 1% level to mitigate the impact of outliers. The distribution of Standard & Poor's (S&P) long-term issuer credit ratings in the month of loan origination is reported in the bottom row, with the CCC category including CCC and CC ratings.

	Mean	StDev	p5	p25	p50	p75	p95	Obs.
Loan Characteristics								
Loan all-in-drawn spread (bps)	287.0	103.5	150.0	200.0	300.0	350.0	500.0	205
Facility amount ($MM)	666.4	831.6	85.00	250.0	422.0	794.6	1,800	205
Loan maturity	5.363	1.268	2.998	4.999	5.112	6.409	7.001	205
LIBOR swap rate (%)	2.081	1.242	0.815	1.275	1.691	2.324	5.017	205
Secured by all assets	0.337	0.474	0	0	0	1	1	205
Revolver in package	0.551	0.499	0	0	1	1	1	205
Performance pricing	0.229	0.421	0	0	0	0	1	205
Lead arranger count	3.328	2.342	1	2	3	4	8	204
Participant count	6.358	8.116	0	0	4	9	23	204
Bond Characteristics								
Bond swap spread (bps)	414.9	268.7	68.00	265.0	364.0	513.0	889.0	205
Bond face value ($MM)	480.2	292.2	150.0	250.0	400.0	600.0	1,000	205
Bond maturity	5.765	1.664	2.781	4.605	5.836	7.042	8.563	205
LIBOR swap rate (%)	2.063	1.262	0.770	1.204	1.720	2.376	5.071	205
Firm Characteristics								
Quasi-market assets ($B)	7.169	9.126	0.690	2.305	4.549	8.139	22.66	205
Quasi-market leverage	0.460	0.205	0.163	0.290	0.426	0.625	0.844	205
Secured/total debt	0.407	0.244	0	0.243	0.407	0.584	0.812	205
Distance-to-default	5.407	3.454	-0.244	3.217	4.939	7.558	11.60	205
	AA	A	BBB	BB	B	CCC	NR	
Credit rating (%)	0	0.490	1.460	58.05	36.59	2.440	0.980	205

Almost all of the firms in the restricted sample are rated BB or B. Three-quarters of the observations in the restricted sample are from the sub-period 2011 to 2016, whereas half of the full sample is from this sub-period.[17] The typical firm has a debt structure consisting of

[17]This is likely attributable to the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005, which made secured debt issuance more attractive by improving the ability of secured creditors to seize collateral and exercise control over the bankruptcy process.

41% secured and 59% unsecured debt prior to origination of the secured term loan. All but a few of the firms in the sample have secured debt outstanding prior to origination, so the senior debt of these firms is exposed to credit risk in the extended Merton (1974) model.[18]

2.5 Counterfactual Loan Spreads

Table 6 reports estimates of counterfactual loan and bond spreads, default probabilities and expected recoveries, and bankruptcy costs implied by loan and bond spreads. My main approach is to use corporate bond credit spreads to estimate implied volatility and counterfactual loan spreads, under the reasoning that corporate bonds are priced in a competitive market and their credit spreads primarily reflect credit risk.

The top two rows of Table 6 show that the implied asset volatility necessary to price corporate bonds in the Merton (1974) framework is about two times the asset volatility obtained from unlevering realized equity returns. These bond-implied volatility estimates are consistent with the existence of a risk premium in the corporate bond market. If bonds were priced in the model using asset volatility from unlevered stock returns, the model would return significantly lower credit spreads than observed in the data. This supports market segmentation, or a separate risk premium in the corporate bond market, as an explanation for the "credit spread puzzle" (Huang and Huang (2012)).

The next set of rows shows that when loans are priced according to Merton (1974) model with volatility implied by the bond market, their credit spreads are substantially lower than the credit spreads observed in new loan originations. The mean and median bond-implied loan spreads are 47.6 and 32.8 bps, respectively, compared with observed all-in-drawn

[18]Firm characteristics in Table 5 are from the quarter-end prior to the loan origination date. One problem with this approach is that the new loan may add secured debt, resulting in mismeasurement of the firm's debt structure at origination. Some observations are lost because the firm had zero secured debt prior to origination, which prevents estimation of loan value using equation (2). Another concern is that the loan changes the firm's debt structure in predictable ways, so the model is missing information that the bank possesses when it prices the loan. Finally, many loans are packaged with revolving credit facilities that may be drawn after origination. In the Internet Appendix, I address these concerns by showing that the model estimates are quantitatively similar if I measure debt structure at the quarter-end after origination. This approach assumes that the bank and bond investors can forecast the firm's debt structure in the near future.

spreads of 288 and 300 bps, respectively. Relative to the credit spread on a counterfactual senior secured bond, the bank earns an economically large and highly statistically significant premium of 240 bps on average.[19] In terms of proportions, 16% of the average loan spread is attributable to credit risk and the remaining 84% is a premium above the market price of credit risk. There is substantial variation in this premium, but even the 130 bp premium in the 10th percentile reflects substantial compensation relative to the credit risk borne by the bank.[20]

By construction, the model correctly prices the corporate bond used to compute the implied asset volatility. To confirm that the model is capable of pricing the firm's other outstanding debt securities, I compare the quoted asset swap spread and the model-implied spread for the next closest outstanding unsecured bond by time to maturity. The results indicate that on average, the difference in actual and predicted credit spreads is negligible, although there are significant differences in the tails. The near-zero average estimation error supports the notion that the large bank premium is not a result of mispricing by the model.

The intuition for the finding of a substantial bank premium is that the bank occupies a strictly senior position in the firm's debt structure, so it is paid in full before junior creditors receive any recovery in a default scenario. One potential concern with this analysis is that the Merton (1974) model may overestimate the recovery of bank creditors in default, possibly due to the distributional assumptions underlying the firm value process. Following the exposition in section 2.2, I compute the expected loan and bond recoveries conditional on default implied by the model. The distributions of expected recoveries closely match the distributions of recoveries for secured loans and unsecured bonds in Table 1, indicating that

[19]There is little discernible time-series variation in the loan premium. Three-quarters of the observations in the restricted sample are from the sub-period 2011 to 2016. In each of these years, the average premium is between 220 and 280 bps. Prior to 2010, the average premium is 247 bps. Note that very few loans are originated during the financial crisis and I do not have access to secondary market loan data before 2010, so it is difficult to examine the behavior of loan spreads in the crisis.

[20]Bao and Hou (2017) show that maturity structure is an important determinant of corporate bond credit spreads. Unreported, I find that in the 35% of loan-bond pairs with loan maturity longer than bond maturity, the average bank premium is actually slightly larger at 256 bps, so maturity structure does not seem to affect the results.

the model accurately captures the bank's risk of losing its principal.

Table 6: Counterfactual Credit Spreads from the Quantitative Model

This table reports numerical estimates from the Merton model with junior and senior debt. The sample is restricted to secured term loans with Capital IQ data on debt structure available prior to origination. The construction of the sample is described in Table 2. Model estimates are generated by numerically estimating implied asset volatility using either bond or loan credit spreads as zero-coupon credit spreads in the Merton model, then using that asset volatility to compute the zero-coupon credit spread for the other debt type. Other bond swap spread is the next closest maturity among outstanding senior unsecured bonds on the loan origination date and tests the model's ability to price bonds accurately. Difference (level) is the difference between the observed and model spread. Difference (fraction) is the level difference divided by the observed spread. t-statistics for differences in means are based on standard errors clustered by firm and year.

	Mean	StDev	p10	p50	p90	Obs.	t-stat
Model Estimates Based on Bond Spreads							
Bond-implied asset volatility	0.405	0.117	0.271	0.405	0.555	205	
Unlevered asset volatility	0.197	0.078	0.111	0.185	0.296	205	
Loan all-in-drawn spread (bps)	288.2	104.8	175.0	300.0	450.0	194	
Bond-implied loan spread (bps)	47.62	53.60	0.455	32.84	107.3	194	
Difference (level)	240.6	95.69	129.5	242.4	374.8	194	[23.4]
Difference (fraction)	0.841	0.151	0.685	0.871	0.997	194	[54.5]
Other bond swap spread (bps)	426.8	385.7	132.0	343.0	806.0	105	
Bond-implied spread (bps)	423.9	382.7	73.2	337.4	843.8	105	
Difference (level)	2.806	207.4	-181.0	16.19	245.1	105	[0.12]
Difference (fraction)	-0.035	1.342	-0.393	0.046	0.546	105	[-0.23]
Other bond maturity diff.	-0.750	8.553	-2.745	-0.205	3.000	105	[-0.85]
Expected loan recovery	0.901	0.089	0.769	0.926	0.998	192	
Expected bond recovery	0.371	0.163	0.178	0.353	0.563	194	
Model Estimates Based on Loan Spreads							
Loan-implied asset volatility	0.576	0.159	0.398	0.590	0.774	194	
Bond swap spread (bps)	424.6	269.8	148.0	369.0	751.0	194	
Loan-implied spread (bps)	981.7	486.0	505.2	944.8	1,646	194	
Difference (level)	-557.2	421.0	-1,017	-544.3	-206.7	194	[-17.8]
Difference (fraction)	-1.771	6.845	-3.557	-1.460	-0.282	193	[-3.82]
Expected loan recovery	0.719	0.124	0.574	0.703	0.909	189	
Expected bond recovery	0.230	0.195	0.102	0.175	0.363	194	
Bankruptcy Costs Required to Reconcile Bond and Loan Spreads							
Loss of firm value	0.815	0.100	0.679	0.837	0.927	62	
Loss of claim value	0.447	0.172	0.225	0.439	0.649	165	

As an alternative approach to showing the divergence between loan and bond credit spreads after accounting for seniority, I estimate implied volatility from loan spreads according to equation (2) and compute counterfactual bond spreads using equation (3). The loan-implied volatility is significantly higher than the bond-implied volatility. The higher implied volatility translates to a loan-implied bond spread that is 520 bps higher than the observed bond spread on average. This evidence is consistent with loans have higher spreads than bonds after accounting for seniority, but does not necessarily imply that loan spreads are too high in absolute terms. These estimates are also useful for understanding whether differences between secondary market bond yields, which I rely on for this analysis, and primary market (new issuance) yields could explain the loan premium. In this light, the loan-implied bond spreads imply that a wedge of 520 bps between primary and secondary market yields is necessary to justify the joint pricing of bonds and loans.

The distribution of expected recoveries under the loan-implied volatility provides some indication that the loan spreads are too high to be justified by default risk, while the bonds are properly priced. The mean and median loan recoveries are significantly lower than the observed recoveries in Table 1, especially after accounting for the longer left tail in the Moody's data. Bond recoveries implied by loan spreads are about half of the recoveries to senior unsecured bonds in the data.

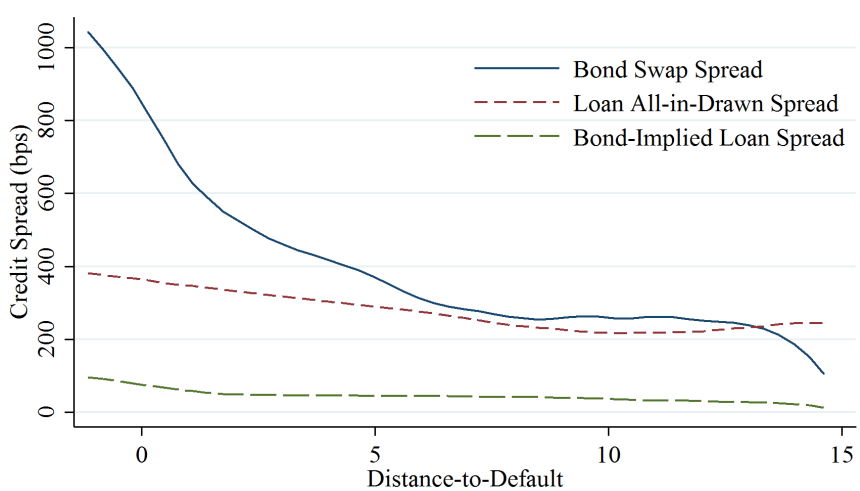
Finally, I use the models with bankruptcy costs described in section 2.3 to determine whether deadweight costs of bankruptcy could explain the low counterfactual loan spreads. When the loss of firm value approach is applied, the model is unable to jointly match loan and bond spreads for more than two-thirds of the observations with a bankruptcy cost between zero and one. When the model is able to reconcile the two credit spreads, the average estimated bankruptcy cost is 81%, which is implausibly high.

The model with loss of claim value performs better, but is still unable to reconcile spreads for almost one-fifth of observations and the average bankruptcy cost is 45% when the model can reconcile the spreads. If the bankruptcy cost α_S is interpreted as a direct cost, it contradicts the observed recoveries on secured term loans in Table 1, which imply a maximum bankruptcy cost of 20%. If this cost is interpreted as an indirect cost, such as effort and negotiation required by the bank to obtain its full recovery in bankruptcy, it is still implausibly high. Ultimately, it seems unlikely that deadweight costs of bankruptcy can explain the different pricing of bonds and loans.

For comparison with the motivating plots in Figure 1, I plot the observed bond and loan spreads along with and counterfactual loan spreads from the quantitative model against distance-to-default in Figure 2. Although the sample is restricted to secured term loans, the relative pricing of bonds and loans is quite similar to the pattern in Figure 1. When the firm is close to default, the bond spread is significantly higher than the loan spread, but when the firm is in good financial condition, the two spreads are very close. The dashed green line is the counterfactual loan spread estimated using bond-implied volatility in the Merton (1974) model. As shown in Table 6, the bond-implied loan spread is significantly lower than the bond spread and the observed loan spread at origination regardless of the firm's financial condition. This reflects the strict priority of the secured bank loan and is consistent with the high recoveries enjoyed by secured bank creditors shown in Table 1.

Figure 2: Non-Parametric Regressions of Bond-Implied Loan Spreads on Distance-to-Default

This figure reports non-parametric regressions of bond-implied loan spreads on distance-to-default. The sample is restricted to secured term loans with Capital IQ data on debt structure available prior to origination. The construction of the sample is described in Table 2. *Bond Swap Spread* is the spread over the LIBOR swap curve after adjusting for embedded options, as provided by Bank of America Merrill Lynch. *Loan All-in-Drawn Spread* is the spread over LIBOR paid on drawn amounts plus the annual facility fee. *Bond-Implied Loan Spread* is the counterfactual loan spread estimated under the Merton model with implied volatility calculated using the bond swap spread. *Distance-to-Default* is the naive distance-to-default from Bharath and Shumway (2008), defined in the caption of Figure 1.



Overall, the evidence indicates that banks earn a significant interest rate premium above the market price of credit risk implied by corporate bonds. Using the Merton (1974) model to compute bond-implied volatility and a counterfactual loan spread results in a significantly lower loan spread than observed in the data and an empirically reasonable distribution of expected loan and bond recoveries, whereas using the same approach with loan-implied volatility results in extremely high bond spreads and expected recoveries that are too low.

3 Interpreting the Bank Premium

In this section, I explore potential explanations for the high level of loan spreads relative to the credit spreads on corporate bonds. First, I use data on secured bonds to determine whether the findings are due to general mispricing of seniority in credit markets. Second, I use intuition from Amihud and Mendelson (1986) to gauge whether differences in liquidity could explain the level of loan spreads. Third, I use regulatory capital requirements to assess whether banks are passing along their cost of capital to corporate borrowers. After concluding that the loan premium is specific to banks and that liquidity and capital charges cannot explain it, I explore the determinants of the loan premium by estimating cross-sectional regressions of the premium on firm and loan characteristics.

3.1 Is This about Banks or Seniority?

The results presented thus far indicate that banks earn significantly higher credit spreads on new loan originations than implied by their position in the firm's priority structure of debt and the pricing of credit risk in the corporate bond market. However, it is unclear from the preceding analysis whether this puzzling finding results from mispricing of seniority in the market or whether this premium is specific to banks. In this section, I construct a separate sample of secured and unsecured bonds from the same issuer to investigate how seniority is priced in the bond market.

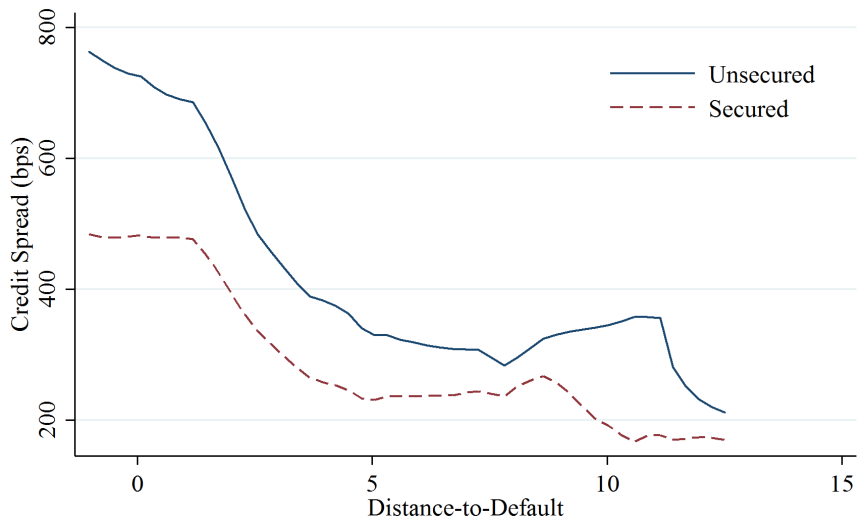
The sample of secured bonds is from the same Bank of America Merrill Lynch quote data that form the bond component of the sample in the preceding analysis, without conditioning on whether the firm has an outstanding bank loan. For each secured bond-month observation, I select the nearest unsecured bond by maturity from the same firm in the same month. Using data from Mergent FISD, I confirm that the secured bond is senior secured and the unsecured bond is senior unsecured. I ensure data quality by requiring that secured and unsecured debt in Capital IQ sum to total debt and that total debt in Capital IQ match total debt in Compustat. Finally, I exclude bonds with less than 11 months to maturity and observations with distance-to-default less than -1.147 (the minimum distance-to-default in the loan-bond sample). The resulting bond-month panel includes 2,115 observations from 2000 to 2016. The distribution of observations is skewed heavily towards the latter part of the sample, with 98% of observations occurring between 2009 and 2016, likely due to improved secured creditor rights after the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005.

Figure 3 contains plots analogous to Figure 1 for secured and unsecured bonds. Secured bond issuers are of poor credit quality, with almost all of the borrowers rated B or CCC in this sample. Nevertheless, these plots indicate a relation between secured and unsecured bonds that starkly contrasts the relation between secured loan and unsecured bond spreads. The unsecured bond spread is strictly higher than the secured bond spread for both healthy and unhealthy firms. Panel B indicates that the secured-to-unsecured bond spread ratio is around the unconditional average of 1.58 for all firm types and always significantly higher than one.

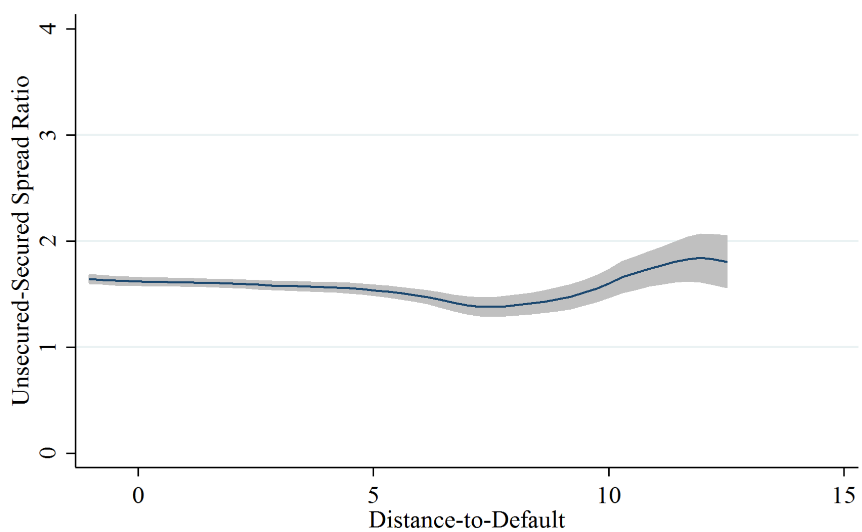
Figure 3: Non-Parametric Regressions of Bond Credit Spreads on Distance-to-Default

This figure reports non-parametric regressions of secured and unsecured bond credit spreads on distance-to-default. The sample is a monthly panel of secured bonds paired with the nearest unsecured bond by maturity from the same firm in the same month, excluding observations with distance-to-default less than -1.147 (the minimum distance-to-default in the full loan-bond sample in the paper). There are 2,115 observations in the sample. Panel A contains non-parametric regression estimates of secured and unsecured credit spreads on distance-to-default. *Bond Swap Spread* is the spread over the LIBOR swap curve after adjusting for embedded options, as provided by Bank of America Merrill Lynch. *Distance-to-Default* is the naive distance-to-default from Bharath and Shumway (2008). Panel B reports a non-parametric regression of *Unsecured-Secured Spread Ratio*, the ratio of the unsecured bond swap spread to the secured bond swap spread, on *Distance-to-Default*. The gray region around the regression estimate is the 95% confidence band. For comparison, Panel B has the same scale as Panel B in Figure 1 in the paper.

Panel A: Unsecured and Secured Bond Credit Spreads



Panel B: Unsecured-Secured Bond Spread Ratio



The findings in Figure 3 are consistent with the relative priority of secured and unsecured bonds in default. Table 1 shows that the average recoveries for secured and unsecured bonds are 62.5% and 41.8%, respectively. Under the reduced-form model in Duffie and Singleton (1999), in which the credit spread equals the risk-neutral probability of default times the expected loss given default, the predicted ratio of secured-to-unsecured spreads is 58.2/37.5 = 1.55, which is extremely close to the ratio observed in the data. In contrast, the recoveries to bank debt are significantly higher conditional on default, but the loan-to-bond spread ratio is close to one for healthy firms.[21]

These results suggest that the finding of a bank loan premium does not result from general mispricing of seniority in the corporate credit markets, as the relative pricing of secured and unsecured bonds is consistent with the predictions of the reduced-form model in Duffie and Singleton (1999). Thus, the significant loan premium identified in the preceding analysis is specific to banks.

3.2 Can Liquidity Explain the Bank Premium?

Liquidity is an important factor in the pricing of corporate bonds due to several market frictions, including over-the-counter trading and idiosyncratic contract details.[22] While the secondary market for syndicated loans has become more active in recent years (Gande and Saunders (2012)), trading activity is lighter and pricing is less transparent than in the corporate bond market.[23] Thus, it is possible that differences in liquidity between loans and bonds are responsible for part or all of the differences in pricing identified in this paper.

Without comprehensive transaction data on syndicated loans, it is difficult to quantify

[21] Results in the Internet Appendix further corroborate the idea that the pricing of secured and unsecured bonds is consistent with their relative seniority. Regressions analogous to those in Table 4 indicate that secured bond spreads depend strongly on the ratio of secured debt to total debt and less strongly on the firm's total leverage ratio. I conduct the same counterfactual spread estimation for secured bonds as for secured term loans, but the results are difficult to interpret in light of the model assumption that secured bonds are strictly senior to unsecured bonds, which contradicts the empirical facts from the recovery data that secured bonds experience significant impairment at the same time unsecured bonds obtain a non-zero recovery.

[22] For evidence, see Longstaff, Mithal, and Neis (2005) and Dick-Nielsen, Feldhutter, and Lando (2012).

[23] If liquidity is an important factor, then the increase in secondary market activity would imply a declining bank premium over time. On the contrary, the bank premium is only 8.6 bps lower on average after 2010 than it was before 2010. This difference is statistically insignificant ($t = 0.3$).

differences in liquidity and the effect on pricing. As an alternative approach, I use intuition from the simple model of Amihud and Mendelson (1986) to estimate the difference in transaction costs necessary to reconcile loan and bond spreads. In this exercise, I consider only the relative liquidity of loans and bonds, assuming that the market for corporate bonds is liquid. Since the corporate bond market is not perfectly liquid (see the literature cited above), this sets a floor on the implied illiquidity of loans.

In the Amihud and Mendelson (1986) framework, the expected return on an illiquid asset equals the expected return on a perfectly liquid asset with similar risk plus the product of the risk-neutral probability of liquidation and the expected liquidation cost.[24] Suppose that syndicated loans are priced to reflect credit risk, as priced in the bond market, and illiquidity relative to the bond market. Then if the annual risk-neutral probability of liquidation is 20%, the average loan premium estimate of 240 bps in Table 6 implies a risk-neutral expected transaction cost of 12%. If the probability is 10%, then the liquidation cost is 24%.

While data on trading activity in syndicated loans are not publicly available, it seems unlikely that the typical bank plans to sell off one in five, or even one in ten, of the loans in which it participates. The liquidation costs implied by the loan premium and even a high probability of liquidation are almost as large as the bank's expected loss conditional on default. Therefore, liquidity is not a plausible explanation for the entirety or even the bulk of the loan premium.

For an alternative approach, based on observed transaction costs, consider the liquidation probability implied by loan spreads. According to quote data from Thomson-Reuters LSTA for a subset of the term loans originated between 2010 and 2016, the mean (median) bid-ask spread is $0.64 ($0.57) per $100 face value. Among the 83 term loans with pricing data, the least liquid loan averaged a bid-ask spread of $2 per $100 face value over its life. Applying the maximum liquidation cost and ignoring the mapping between the physical and risk-neutral

[24]For the purposes of this exercise, I assume that the loan spread is a good approximation of the loan's expected return in excess of the risk-free rate. In reality, the expected return of risky debt is strictly lower than yield, but the evidence in Table 1 indicates that this difference is not large for secured loans, as there are few states of the world in which the bank is not paid in full.

measures, the average loan premium in Table 1 implies a liquidation probability of 120%. Under the risk-neutral measure, the expected liquidation cost may be higher and the implied liquidation probability lower, but the interpretation of this calculation is the same as the last: the loan premium is too large to be driven by liquidity.

3.3 Capital Requirements and the Cost of Credit

Another potentially important difference between the bond and loan markets regards the funding costs of their respective investors. Banks are subject to capital regulation that requires a minimum amount of equity funding for corporate loan exposures. [25] In this section, I estimate the return on equity implied by loan spreads, assuming banks break even on syndicated lending and capital requirements are binding on each loan.[26]

Under Basel I, the regulation governing bank capital for most of my sample period, corporate credit exposures were assigned a risk-weight of 100% in the standardized approach. This implies a capital charge of 8% under the minimum risk-weighted Tier 1 capital ratio.[27] Assuming this constraint is binding and the bank breaks even on each loan, the following equation holds:

$$r_L = 0.08 r_E + 0.92 r_D, \tag{11}$$

where r_L is the expected return on the loan and r_E and r_D are the bank's equity and debt cost of capital, respectively. The expected return on the loan is approximated by its yield,

[25] Insurance companies, the largest single class of investor in the corporate bond market, also face risk-based capital charges based on the bond's credit quality. According to Becker and Ivashina (2015), the capital charges for BB and B rated bonds are 3.39% and 7.38%, respectively. At the end of 2016, insurance companies held \$3.05 trillion in corporate and foreign bonds, while mutual funds and ETFs held \$2.44 trillion and pensions held \$1.34 trillion. Aggregate ownership data are from the Federal Reserve Flow of Funds Z.1, Table L.213, dated September 21, 2017.

[26] The latter assumption is unlikely to hold, but without knowledge of banks' approaches to capital allocation, it is a necessary starting point. The assumption is most likely to fail for relatively safe loans made by banks with capital in excess of the required minimum.

[27] Since the financial crisis, the U.S. has worked towards adopting new banking regulations in line with Basel III. Several of the banks in my sample began using the advanced approach, which allows them to assign risk-weights under 100% to safe corporate exposures, midway through the sample. Determining each bank's capital allocation for each loan type is beyond the scope of this paper and potentially impossible given public information, so I apply the Basel I approach in this exercise.

equal to the all-in-drawn spread plus the maturity-matched swap rate. I approximate r_D with the 3-month LIBOR rate, which is likely an underestimate of the bank's true cost of debt.

Rearranging, the bank's implied return on equity (RoE) is:

$$r_E = \frac{y_S - 0.92 r_D}{0.08}. \tag{12}$$

Applying this equation to the loan premium estimates in Table 6, the mean (median) loan offers RoE of 50% (48%). The minimum implied RoE in the sample of secured term loans is 20%. These estimates are substantially higher than the equity cost of capital implied by the CAPM using estimates of bank equity betas between one and two and a reasonable market risk premium. The implied RoE is sensitive to the assumptions about bank capital structure and the cost of debt capital, but the same qualitative conclusion holds under alternative specifications. Assuming a capital ratio of 4% leads to mean RoE of 100%, while a capital ratio of 16% leads to mean RoE of 25%. Assuming the cost of bank debt is 100 bps higher than LIBOR leads to mean RoE of 39%, while a premium of 200 bps leads to mean RoE of 27%.[28]

Overall, these back-of-the-envelope calculations indicate that the return to syndicated lending to the low quality firms in the restricted sample is attractive for banks. These results do not imply that syndicated lending is always profitable, as the credit spreads on safer loans are lower but the capital charges are similar.[29] However, they do suggest that the bank's cost of capital does not fully account for the high level of syndicated loan spreads relative to the bond-implied price of credit risk.[30]

[28]Note that these calculations take no stand on whether the assumptions of Modigliani and Miller (1958) hold for banks. They rely only on assumptions about the allocation of bank capital to loans and the association of observed bank equity betas with the assumed capital allocation.

[29]The calculations here cannot be applied to the full sample without a model of drawdown activity for revolving lines of credit. An implicit assumption here is that the prepayment option embedded in each term loan does not have a large effect on the expected return.

[30]A related cross-sectional prediction stemming from capital requirements is that the loan premium should be higher for low risk loans, since the model spread is more sensitive to risk than the actual loan spread, which must exceed the bank's hurdle rate. The results in Table 7 are inconsistent with this prediction, as

3.4 Cross-Sectional Determinants of the Bank Premium

The results in the previous sections indicate that the loan premium is not a more general characteristic of senior debt and that it is unlikely that illiquidity or bank capital charges drive the premium. However, there are a number of other differences between bank loans and bonds that could explain the loan premium. Banks overcome information asymmetry by screening firms before providing credit and monitoring borrowers to ensure repayment. Banks also provide valuable flexibility to firms through revolving lines of credit and the ability to renegotiate loan terms at relatively low cost in the event of financial distress. In this section, I assess the ability of these differences to explain the bank premium by associating the bank premium with firm and loan characteristics, including proxies for information asymmetry and contractual flexibility.

Table 7 reports regressions of all-in-drawn spreads, bond-implied loan spreads under the Merton (1974) model, and the bank premium on firm and loan characteristics. All three credit spreads are increasing in the volatility of the firm's asset value, but there are interesting differences in their respective exposures to the firm's capital structure. While the all-in-drawn spread is strongly increasing in total leverage and unrelated to the ratio of secured to total debt, the bond-implied loan spread is weakly increasing in total leverage and strongly increasing in the secured to total debt ratio.

Observed loan spreads reflect only the probability of the firm defaulting and not the impact of debt structure on expected recoveries. In contrast, the model spreads depend only on the bank's exposure to loss of principal. The net effect is that the premium earned by the bank relative to the bond-implied price of credit risk is increasing in total leverage and decreasing in the ratio of secured debt to total debt. In other words, the bank earns higher risk-adjusted profits when the firm's default probability is higher and when there is more unsecured debt in the firm's debt structure. The latter correlation implies that the bank is compensated more for monitoring when there are more bondholders to free-ride on its

riskier firms, measured by leverage and volatility, actually pay a higher premium to the bank.

efforts.

Interestingly, the size of the firm, the asset market-to-book ratio, and asset tangibility are all uncorrelated with the bank premium. This does not support compensation for screening and monitoring as an explanation for the premium, as the bank should earn a higher premium when informational frictions are more prevalent.[31] The size of the facility is also uncorrelated with the bank premium, which casts doubt on fixed costs of origination as a factor in loan pricing. Additionally, there is no difference in the pricing of term loans with and without attached revolving credit facilities, which indicates that the bank premium is not compensation for the bank providing valuable flexibility in the firm's capital structure. This is not necessarily surprising, as the firm pays separate fees for lines of credit and draw-downs are associated with a separate credit spread.

The bank premium is higher when there are fewer lenders in the syndicate, which could be interpreted in a few ways. One interpretation is that a loan with fewer lenders in the syndicate is less liquid, so the banks receive compensation for potential exposure to future liquidation costs. I examine the plausibility of this explanation in the next section. Another interpretation is that the firm pays for ease of future renegotiation, which is associated with a more concentrated syndicate. Consistent with this interpretation, the bank premium is smaller when the firm has a stronger relationship with the lead arrangers, measured by the proportion of borrowing volume from the same bank over the past five years (Bharath et al. (2007)).[32] The premium is also smaller when the loan has a performance pricing matrix, which reduces renegotiation costs for the bank by increasing the interest rate when the firm's condition deteriorates (Asquith, Beatty, and Weber (2005)).

[31]The Internet Appendix shows that in the universe of unsecured corporate bond credit spreads, the spreads of bank and non-bank borrowers are statistically indistinguishable after conditioning on credit risk, which could be interpreted as monitoring providing little value for firms large enough to issue public bonds. Unfortunately, endogenous selection into bank borrowing makes it difficult to interpret this finding. Specifically, it is likely that firms who benefit more from monitoring are more likely to borrow from banks.

[32]The negative correlation between the bank premium and relationship strength is inconsistent with the hypothesis that banks hold up their relationship borrowers (Rajan (1992)). This is unsurprising for the firms in my sample, which have access to public debt markets.

Table 7: Determinants of the Bank Premium

This table reports regressions of all-in-drawn loan spreads, bond-implied loan spreads under the Merton (1974) model, and estimates of the bank premium on firm and loan characteristics. Table 2 describes the sample construction and Table 3 contains variable definitions. *Revolver in Package* is an indicator equal to one if the loan package includes a revolving credit facility. *Performance Pricing* is an indicator equal to one if the loan contract includes either interest-increasing or interest-decreasing performance pricing. *Relationship Strength* is the ratio of lending volume between the borrower and the current bank to total lending volume to the borrower over the past five years, as defined in Bharath et al. (2007). *Log(Lender Count)* is the logarithm of one plus the number of lenders in the loan syndicate. Within R^2 represents the goodness of fit after accounting for year fixed effects. t-statistics based on standard errors clustered by firm and month are reported in brackets. * and ** denote p-values less than 0.05 and 0.01, respectively.

	Log(All-in-Drawn)	Log(Model Spread)	Log(Bank Premium)
Quasi-market leverage	1.068**	1.576**	0.974**
	[7.70]	[2.83]	[7.26]
Secured debt/total	-0.086	3.726**	-0.498**
	[-0.93]	[9.08]	[-4.44]
Asset volatility	1.296**	3.336*	1.056**
	[3.89]	[2.59]	[2.84]
Maturity	-0.005	0.336**	-0.031
	[-0.21]	[3.77]	[-1.22]
Swap rate (%)	0.089	0.180	0.117
	[1.34]	[0.75]	[1.61]
Log(Assets)	-0.070*	-0.049	-0.014
	[-2.41]	[-0.48]	[-0.36]
Asset market-to-book	0.125*	0.161	0.016
	[2.15]	[0.71]	[0.22]
Asset tangibility	0.203*	1.261**	-0.062
	[2.07]	[3.28]	[-0.47]
Log(Facility amount)	0.036	-0.218	0.032
	[1.35]	[-1.84]	[0.98]
Revolver in package	-0.048	-0.162	-0.014
	[-1.01]	[-0.88]	[-0.22]
Log(Lender count)	-0.060	0.338*	-0.105*
	[-1.70]	[2.47]	[-2.34]
Relationship strength	-0.198**	0.286	-0.338**
	[-3.20]	[1.19]	[-4.19]
Performance pricing	-0.157**	-0.128	-0.185**
	[-3.02]	[-0.63]	[-3.05]
Year FEs	X	X	X
Adj. R^2	0.607	0.559	0.488
Within R^2	0.579	0.522	0.496
Observations	192	192	192

4 Conclusion

This paper shows that credit spreads in the syndicated loan market are significantly higher than implied by the credit risk borne by bank lenders. I draw this conclusion in a sample of new loans to firms with bonds outstanding using two complementary approaches. First, I show that banks lose only one-third as much principal as bondholders in the average default, which leads to the prediction that loan spreads should be one-third as large as bond spreads under the Duffie and Singleton (1999) model. However, Figure 1 shows that loan and bond spreads are indistinguishable for healthy firms, which indicates that banks earn a higher rate than justified by their risk exposure. Next, I estimate the premium earned by banks in a structural model that extends Merton (1974). The model is set up to price bonds correctly and it successfully matches the distribution of loan recoveries conditional on default, but predicts loan spreads significantly lower than observed in the data. The main finding of this analysis is that banks earn a premium of 240 bps on the average secured term loan, or that 84% of the loan spread is due to non-credit factors.

The sample in this paper, which to my knowledge is the first of its kind, consists of new loans to firms with secondary bond quotes available on the origination date. The benefit of this sample construction is that it allows me to control for unobservable firm-time factors affecting the pricing of credit, including the bond market risk premium. The downside is that the sample consists of large firms with access to public debt markets, so it does not represent the population of corporate borrowers. However, considering that the firms in the sample have less severe information asymmetry and greater bargaining power than firms without access to the bond market, I expect that smaller firms of similar creditworthiness to those in my sample would pay an even larger premium to borrow from a bank. An implicit assumption of my analysis is that the firm could issue a new bond at the secondary market credit spread of its outstanding bonds. To the extent that new issues sell at higher or lower yields than outstanding bonds, my results may be over- or under-stated.

There are numerous differences between bank and bond debt that could drive the loan premium, but I cast doubt on several of them. I extend the Merton (1974) model to incorporate bankruptcy costs, finding that even implausibly high costs of financial distress could not reconcile loan and bond spreads. In a separate sample of secured bonds, I show that seniority in the bond market is priced according to the Duffie and Singleton (1999) model, so the loan premium must be specific to banks. Using intuition from Amihud and Mendelson (1986), I conclude that transaction costs in the secondary market for loans would need to be incredibly high to justify the loan premium. Finally, I show that banks earn a high return on equity by providing term loans to risky firms, indicating that capital requirements do not fully explain the high cost of intermediated credit. Capital requirements are only one form of bank regulation, and it is possible that other forms of regulation play a role in the pricing of loans. For example, the regulatory costs of having non-performing loans may cause banks to demand higher rates from risky borrowers than implied by their actual expected losses.

The main implication of these findings is that firms are willing to pay a high cost to borrow from a bank, offering the bank a senior claim at a discount to the price implied by the bond market. Therefore, firms must place a high value on bank services other than the simple provision of debt capital. More work is necessary to pin down the sources of specialness and determine whether the bank is fairly compensated, but the evidence presented here indicates that ease of renegotiation is an important factor, while screening and monitoring are less important, at least in this sample of borrowers.

The findings in this paper should encourage additional research on the relative pricing of bonds and loans. One question unexplored in this paper relates to the dynamics of loan pricing as the borrower's creditworthiness deteriorates. Figure 1 shows a pronounced divergence between bond and loan spreads as the firm moves towards default. This pattern could be driven by renegotiation of loan terms after the violation of financial covenants, which often improves the bank's seniority by securing the loan (Rauh and Sufi (2010)).

The evidence here also raises the question of whether corporate lending is profitable for banks. This question relates to the matter of competition in banking markets, which is recently explored by Hatfield et al. (2017) in a theory of collusion in syndication markets. Back-of-the-envelope calculations based on capital requirements imply that lending to risky firms offers a high return on equity. It would be speculative to conclude that anti-competitive behavior drives the loan premium identified in this paper, but more work is necessary to conclude whether banks are fairly compensated for the services they provide in addition to the provision of debt financing.

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