An Empirical Analysis of the Cost of Borrowing*

Miguel Faria-e-Castro | Samuel Jordan-Wood | Julian Kozlowski
FRB of St. Louis | FRB of St. Louis | FRB of St. Louis

PRELIMINARY AND INCOMPLETE PLEASE DO NOT CIRCULATE

NOTE FOR THE SED COMMITTEE: This work uses confidential data; the results in the current version have been approved. We have made a lot of progress that is not reflected in this draft as the data is embargoed until early March. We will update the draft at www.juliankozlowski.com/papers/FJK_2024.pdf and notify the scientific committee.

Abstract

This paper studies the cost of borrowing of firms using a novel security-level database of US firms that includes both bank loans and corporate bonds. Our findings reveal significant within-firm dispersion, with firms issuing various securities at different interest rates within each quarter. For the average firm, there is about 70 basis points gap between the highest and average interest rates paid on new originations. Within-firm dispersion explains over 25% of the total variance in interest rates across the dataset, rising to 60% for large firms that issue both bank loans and corporate bonds. After controlling for observable characteristics, we find that bank loans are 100 bps cheaper than corporate bonds on average, with the bond-loan spread widening for firms with high default probability. We build a dynamic corporate finance model with secured (loans) and unsecured (bonds) debt. Secured debt is subject to a collateral constraint, but firms can also issue unsecured debt once the collateral constraint becomes binding. As a result, there is equilibrium default for both secured and unsecured debt. We find that the unsecured nature of corporate bonds can explain about 25 percent of the bond-loan spread. The model is also consistent with the default elasticity of bond-loan spreads. Finally, we use the model to study counterfactual economies to understand the role of limited liability, bank, and market lending.

*The views expressed here are those of the authors and do not necessarily reflect official positions of the Federal Reserve Bank of St. Louis, the Federal Reserve System, or its Board of Governors.

JEL Classification: E6, G01 H00

Keywords: Credit Spreads, Bonds, Loans, Macrofinance

1 Introduction

We compile a new security-level database of US firms issuing both bank loans and corporate bonds. Our analysis use two main data sources. We start with the Federal Reserve's FR Y-14Q, schedule H.1 which contains information for loan facilities and firm balance sheet data. We then merge this with the Mergent Fixed Income Securities Database (FISD), which provides us with information on corporate bonds. The final output is a quarterly, security-level database with information of bank loans, corporate bonds, and firms' financial information. The final database has 6.48 million observations of 284 thousand firms, for a total of 818 thousand loans and about 25.4 thousand bonds.

We define the *bond-loan spread* as the difference in the interest rate between bonds and loans for the same borrower. First, to estimate the bond-loan spread we perform a within-firm estimation and find that loans are, on average, 208 basis points (bps) cheaper than bonds, after we control for many confounding factors. This estimate has firm-time fixed effects as well as security-level controls such as the maturity, the size of the issuance, and the default probability. This result is robust to several alternative specifications and controls (such as splitting the securities by loan or bond types, for example). Second, we estimate a positive default elasticity for the bond-loan spread. This means that the bond-loan spread is larger for firms with higher default probability, and this result is robust to alternative measures of default and other controls in the estimation. Third, we study what firms are issuing bonds. We find that firms more likely to issue bonds have more assets, higher leverage, higher liquidity, a lower tangible share of assets, and more long-term debt.

Next, we build a macrofinancial model of the bond-loan spread. We study the dynamic problem of firm investment with a specific focus on firms' balance sheet items. The model has standard elements of macrofinance models as well as two types of debt: secured and unsecured borrowing. On the standard side, firms face capital adjustment costs and equity issuance costs. We augment this model by allowing firms to access two corporate debt markets: they can issue secured debt, called loans, which is subject to a collateral constraint. Additionally, the firm can also issue unsecured debt, called bonds. The firm may default in either type of debt, which gives rise to a price schedule that relates the price of debt to the firm's choices for both secured and unsecured debt.

Secured debt is subject to a collateral constraint, but firms can also issue unsecured debt once the collateral constraint becomes binding. As a result, there is equilibrium default for both secured and unsecured debt. The model allow us to explain the bond-loan spread and its default elasticity.

We calibrate the model to match data moments. We find that the unsecured nature of corporate bonds can explain about 25 percent of the bond-loan spread. The model is also consistent with the default elasticity of bond-loan spreads. Finally, we use the model to study counterfactual economies to understand the role of limited liability, bank, and market lending. We find the novel result that default probability is lower in a counterfactual economy where capital is less pledgable and has more unsecured debt.

2 Empirical Analysis

This section documents how firms borrow in different corporate debt markets. Specifically, we study the within-firm differences between borrowing from banks—with term loans or credit lines, or in the corporate bonds market. We also investigate the heterogeneity in borrowing across firm-level characteristics.

We build a novel security-level panel, from 2013Q1 to 2022Q3, with information on lending from large bank holding companies (BHC), corporate bonds, and firms' balance sheets. We use two main data sources: (i) the Federal Reserve's FR Y-14Q H.1 schedule, which contains information for loan facilities and firm balance sheet data, and (ii) Mergent Fixed Income Securities Database (FISD) which provides information on corporate bonds.

2.1 Data Sources

We obtain loan and firm financial data from the Federal Reserve's FR Y-14Q. More specifically, we use the H.1 schedule, which contains detailed data on commercial & industrial lending for large BHCs. All BHCs with more than \$50 billion in total consolidated assets prior to 2019, and \$100 billion after, are required to report detailed balance sheet data to the Fed for the purposes of stress testing. For most of our sample there are around 33 banks reporting. For each reporting BHC, we observe any loan facilities that have committed exposures of \$1 million or more.[1] Banks only report loan facilities on their balance sheets, so if a bank sells part or all of a loan we will only observe what is left on their balance sheet. We see quarterly loan facility level data on interest rates, maturity, seniority, facility type, committed and utilized exposure,

[1] A loan facility may be comprised of many separate loan types grouped into one facility.

collateral market value, loss given default (LGD), and syndicated status. Furthermore, we observe financial data at the firm level such as assets, liabilities, sales, income, and probability of default (PD). The Y-14 data started being collected in late 2011, after the Great Financial Crisis. However, we restrict to the start of 2013, since the early data is less standardized and contains many errors. Two major advantages of the Y-14 data are the size of data and the ability to see both small and large firms. Commonly used loan datasets like the Shared National Credit or Dealscan tend to contain only syndicated loans, which restricts the sample to larger firms.

For bond data, we use the Mergent Fixed Income Securities Database (FISD). The FISD covers a significant number of US corporate issuances, and provides information on bond issuance, offering amount, maturity, coupon, seniority, issuer, and a number of bond type flags (callable, putable, covenant, asset-backed, or rule 144a for example).

To define a firm, we use the S&P Business Entity Cross Reference Service (BECRS). The BECRS creates a linkage between firms and their ultimate parent, allowing us to identify subsidiaries and treat them as the same firm as their parent company. We create a firm id using the 6-digit firm CUSIP, grouping together CUSIPs with the same ultimate parent. Using CUSIPs, we merge the firm id to both the Y-14 and FISD. For firms in the Y-14 without a match to the BECRS data, we use the taxpayer identification number (TIN) as the firm id[2].

We clean the data as follows. First, we keep only US firms and exclude firms with NAICS in finance (52) and public administration (92). We keep only corporate bonds that are not convertible, and drop loan facilities to foreign and financial firms, and governments. We also download data from Bloomberg on securities that have been called. We use this to drop bonds that have been called after their call date. The Y-14 provides information on whether or not a loan facility is syndicated, and if so, what the reporting bank's participation interest is. We use information on the participation interest to scale-up the committed and utilized exposure of syndicated loans. To avoid double counting, we then search and remove portions of the same syndicate loan facilities reported by different banks.[3]

Table 1 describes the main variables used in the empirical analysis. The final dataset has about 6.48 million observations (at the security level), for 283,549 unique firms. We observe a larger number of bank loans (817,788 unique loans) than corporate bonds (25,374 unique bonds). At the aggregate level we observe that both the mean and the median interest rate and

[2]For more details on the definition of a firm, see A.3

[3]Appendixes A.1, A.3, and A.3 provide additional details on the cleaning and construction of the variables.

interest rate spread are larger for bonds than for loans. For example, the mean interest rate for bonds is 536 basis points (bps), while it is 346 bps for loans. Of course, there are many security and/or firm-level characteristics that might make interest rates for bonds or loans to different. In the next section we perform a within-firm estimate of the bond-loan spread and show that bonds are more expensive than loans after we control by observable security and firm characteristics.

Table 1: Summary Statistics

	mean	sd	p10	p50	p90
Bond					
Maturity (yrs)	15.96	12.13	5.02	10.04	30.05
Amount (mil$)	511.64	603.27	10.00	375.00	1,000.00
Interest Rate (bps)	535.79	204.02	265.00	537.50	800.00
Interest Rate Spread (bps)	335.53	225.57	54.06	329.82	643.91
Loan					
Maturity (yrs)	7.89	5.89	2.01	6.00	15.61
Amount (mil$)	41.72	770.54	0.79	2.52	48.73
Interest Rate (bps)	346.12	140.86	170.37	339.76	525.00
Interest Rate Spread (bps)	179.29	151.64	-2.84	173.67	363.75
N	6476797				
N Firms	283549				
N Loans	817788				
N Bonds	25375				

2.2 The bond-loan spread

We now set up a formal specification in order to study if interest rates are different across security types. We estimate the following panel regression:

$$y_{f,t,s} = \alpha_{f,t} + \sum_{i=l,b} \gamma_i \mathbb{I}(\text{security type}_{f,t,s} = i) + \Gamma X_{f,t,s} + \varepsilon_{f,t,s} \tag{1}$$

where $y_{f,t,s}$ is the interest rate paid by firm f in quarter t on security s, regressed on the security type (i.e., if it is a bond or a loan). $\alpha_{f,t}$ is a firm-quarter interacted fixed effect, and we include other controls $X_{f,t,s}$ (e.g. the maturity and amount borrowed of the security). The main coefficient of interest are γ_l and γ_b, which capture the differences in interest rate due to the security type.

Table 2 shows the main empirical estimates. Our benchmark specification in column (1) contains firm-quarter fixed effects, the maturity, and the amount of the credit facility. Contrary to existing literature, our results document that loans have a significantly lower interest rate than bonds—by 208.1 basis points in our benchmark. Column (2) controls for the collateral share: the market value of the pledged collateral divided by the size of the facility.[4] The coefficient is positive and significant, which may reflect selection. The important point is that controlling for the market value of collateral barely changes our main result, and if anything we find a slightly higher bond-loan spread, of 216 bps.

Next, we examine how the bond-loan spread changes with the default probability. Columns (3) and (4) of Table 2 include the default probability as an additional control variable. Since the default probability is measured at the firm level, we can no longer include the firm-quarter interacted fixed effect. Instead, we include firm and quarter fixed effects separately (i.e, not interacted). The results are consistent with the baseline and show that loans are between 199-206 bps cheaper than bonds—keeping all other variables constant. The estimated coefficient on default is of 97.5. Hence, an increase of the default probability of one standard deviation (which is 7.84%) implies an increase in the interest rate of about 764 basis points. Next, we evaluate how the bond-loan spread changes with the default probability.

[4]We directly observe collateral data for the Y-14 loans. We do not observe collateral data for bonds and, since most bonds are unsecured, we assume it is zero. While this is a strong assumption, it should work against us finding a significant difference in interest rates between bonds and loans.

Table 2: The Bond-Loan Spread

	(1)	(2)	(3)	(4)
Maturity	4.7528***	4.7301***	4.2357***	4.2161***
	(0.024)	(0.024)	(0.020)	(0.020)
Amount	-0.0029***	-0.0028***	-0.0023***	-0.0023***
	(0.000)	(0.000)	(0.000)	(0.000)
Loan	-208.1245***	-216.1415***	-199.0460***	-205.5836***
	(0.528)	(0.533)	(0.476)	(0.478)
Collateral Share		14.1530***		11.6811***
		(0.256)		(0.202)
Default Probability			97.4141***	97.5033***
			(0.943)	(0.944)
Constant	493.4904***	491.5268***	505.2322***	502.9894***
	(0.586)	(0.589)	(0.549)	(0.552)
Observations	3001118	3001118	4234959	4234959
Adjusted R^2	0.626	0.627	0.657	0.658
Firm-Time FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Time FE	No	No	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.3 The default elasticity of the bond-loan spread

We now evaluate how the bond-loan spread changes with the default probability of the firm. First, we repeat the estimation, but only on the subsets of firms with the lowest and highest 10% probability of default. Table 3 shows that firms in the bottom decile of the default probability, meaning they are less likely to default, have loans that cost 124 basis points less than bonds all else equal. Firms in the top decile have loans that are over 302 bps cheaper than bonds. Hence our results point to a positive elasticity of the bond-loan spread with respect to the probability of default.

We take this analysis further by formally estimating the bond-loan spread for each decile of the default probability. Specifically, we estimate

$$y_{f,t,s} = \alpha + \sum_{i=1}^{10} \beta_i \mathbb{I}(\mathrm{q}_{f,t} = i)\mathrm{maturity}_{f,t,s} + \sum_{i=1}^{10} \delta_i \mathbb{I}(\mathrm{q}_{f,t} = i)\mathrm{amount}_{f,t,s} \quad (2)$$
$$+ \sum_{i=1}^{10} \sum_{j=1}^{2} \gamma_{i,j} \mathbb{I}(\mathrm{q}_{f,t} = i)\mathbb{I}(\mathrm{s.t.}_{f,t} = j) + \varepsilon_{f,t,s}$$

where $q_{f,t}$ is the decile of the default probability distribution. Figure 1 shows for each decile

Table 3: The Default Elasticity of Bond-Loan Spreads

	(1)	(2)	(3)
Maturity	4.2357***	6.7166***	3.7603***
	(0.020)	(0.068)	(0.059)
Amount	-0.0023***	-0.0363***	-0.0006***
	(0.000)	(0.005)	(0.000)
Loan	-199.0460***	-124.0336***	-301.9200***
	(0.476)	(3.127)	(1.257)
Default Probability	97.4141***		
	(0.943)		
Constant	505.2322***	343.1024***	613.2469***
	(0.549)	(3.672)	(1.326)
Observations	4234959	248466	730199
Adjusted R^2	0.657	0.541	0.701
Firm-Time FE	No	Yes	Yes
Firm FE	Yes	No	No
Time FE	Yes	No	No
Prob. Default	Cont.	Below p10	Above p90

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the value of $\alpha + \gamma_{i,j}$ for both bonds and loans. This corresponds to the interest rate that firms pay for bonds and loans grouped by a firm's default probability. Similar to the result in Table 3, firms with lower default probability pay relatively similar rates for bonds and loans. The slope of the pricing for bonds is much steeper than the slope of pricing for loans. This implies that as a firm becomes more likely to default, the spread between borrowing with bonds or loans increases.[5]

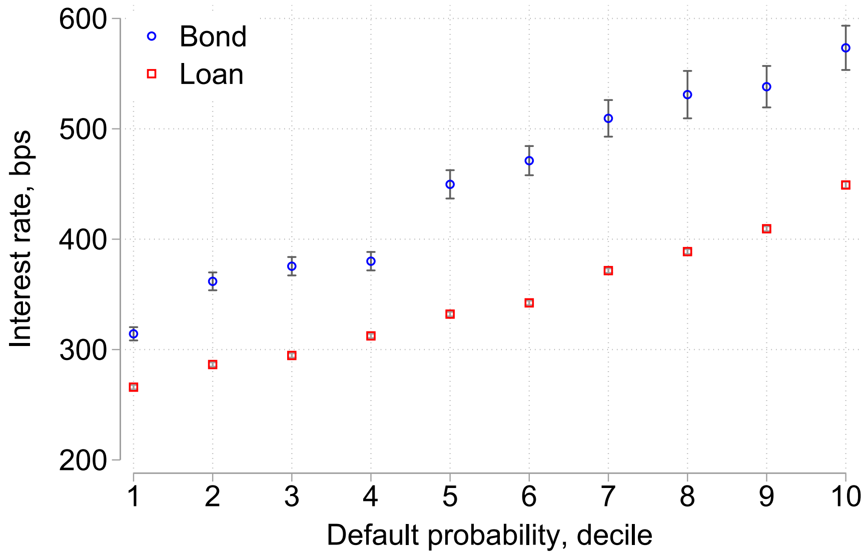
2.4 Robustness

We now briefly discuss the robustness of the previous two results, while Appendix A provides additional estimates.

At the date of origination One potential concern is that we are looking at all existing loans and bonds. To address this, we now consider only bonds and loans in the quarter of origination. The results are in Table 4. Naturally, we have fewer observations. For example, column (4) in this restricted sample includes about 203 thousand observations, versus over 4.24 million in our baseline results. The sign of the coefficients are the same, but the estimated coefficient for

[5]Besides the default probability, the Y-14 dataset also contains information on the the loss given default for loans. Appendix A.4 shows that we observe a similar pattern when considering this alternative measure.

Figure 1: The Default Elasticity of the bond-loan spreads



Notes: The Figure shows for each decile the value of $\alpha + \gamma_{i,j}$ for for each decile, both for bonds and loans, together with a one standard-error confidence interval.

loans is now a bit lower, while the coefficient for default probability is a bit larger.

Loan types: credit lines and syndicated loans There are different types of bank loans. Thus far we have considered all loans to be in the same category. Now, we relax this assumption and allow for different loan types. First, we distinguish term loans from credit lines. Second, we distinguish syndicated from non-syndicated loans.

Credit lines are a type of loan where the lender defines a borrowing limit (the so-called committed exposure) that can be fully or partially utilized by the borrower, potentially several times (depending on whether it is a revolving or non-revolving line of credit). We run our benchmark regressions with an indicator function, $\mathbb{I}(\mathrm{st}_{f,t,s} = i)$, that now distinguishes term loans, bonds, and credit lines. Table 5 shows both term loans as well as credit lines are cheaper than bonds. Moreover, credit lines are cheaper than term loans. Our dataset also gives us information on whether a loan facility is part of a syndicated loan or shared credit facility. As before, we split all loan facilities into two types: syndicated and non-syndicated. Table 5 shows results for the benchmark regression but with the indicator function now taking bonds, syndicated loans, and non-syndicated loans. Again, we find that loans are cheaper than bonds. Moreover, we find that syndicated loans are cheaper than non-syndicated ones.

Table 4: The Bond-Loan Spread at Origination

	(1)	(2)	(3)	(4)
Maturity	2.4333***	2.3883***	1.7683***	1.6844***
	(0.101)	(0.101)	(0.092)	(0.092)
Amount	-0.0011***	-0.0011***	-0.0008***	-0.0008***
	(0.000)	(0.000)	(0.000)	(0.000)
Loan	-140.2879***	-145.6905***	-121.4976***	-129.1849***
	(3.132)	(3.151)	(2.340)	(2.351)
Collateral Share		9.3692***		13.8665***
		(0.958)		(0.777)
Default Probability			198.1029***	197.9445***
			(6.815)	(6.812)
Constant	449.8341***	448.8885***	446.8119***	444.7404***
	(3.191)	(3.203)	(2.509)	(2.523)
Observations	153279	153279	202825	202825
Adjusted R^2	0.758	0.758	0.648	0.649
Firm-Time FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Time FE	No	No	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Bond types The final database has 25,374 unique bonds after all the cleaning described in Appendix A.2. We also run our benchmark regressions distinguishing bonds of different types. Now, $\mathbb{I}(\mathrm{st}_{f,t,s} = i)$ indicates loan, bond, and special type of bond. For brevity, we report only the coefficients of $\mathbb{I}(\mathrm{st}_{f,t,s} = i)$ for both loans and the type of bond. The results are summarized in Table 6. First we look at callable bonds, i.e. bonds in which the borrower has the option to prepay or redeem before the maturity date. Most of our bonds (84.8%) are callable, and the results are thus very similar to the benchmark, with loans being about 267 bps cheaper than regular bonds, and callable bonds being about 67 bps cheaper than regular ones. Second, we distinguish putable bonds, where the holder can demand early repayment (412 unique bonds), and asset-backed bonds (212 unique bonds), again with similar results for the loan coefficient. We also observe that a large number of bonds (15,956 bonds) have covenants, but discriminating them yields results that are very similar to those of the benchmark regressions, with covenants generating slightly higher bond-loan spreads.[6] Finally, we also distinguish 144A bonds, which can only be held by qualified institutional buyers, and find that they are more expensive than regular bonds (61 bps), with the bond-loan spread being slightly smaller (186 bps).

[6] We only observe a flag for having covenants, but we do not actually observe the covenant description.

Table 5: The Bond-Loan Spread: Credit Lines and Syndicated Loans

	(1)	(2)	(3)
Loan	-205.5836***		
	(0.478)		
Term Loan		-197.4364***	
		(0.486)	
Credit Line		-216.1840***	
		(0.477)	
Non-syndicated			-191.1850***
			(0.527)
Syndicated			-215.5527***
			(0.472)
Constant	502.9894***	502.4497***	495.7205***
	(0.552)	(0.550)	(0.564)
Maturity	4.2161***	4.2396***	4.2346***
	(0.020)	(0.020)	(0.020)
Amount	-0.0023***	-0.0022***	-0.0020***
	(0.000)	(0.000)	(0.000)
Default Probability	97.5033***	97.5788***	98.0871***
	(0.944)	(0.944)	(0.948)
Collateral Share	11.6811***	11.6417***	9.8471***
	(0.202)	(0.201)	(0.202)
Observations	4234959	4234959	4234959
Adjusted R^2	0.658	0.659	0.659
Firm-Time FE	No	No	No
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Interest rate spreads Results are very similar if we use interest rate spreads with respect to the risk-free rate as the dependent variable, instead of the level of the interest rate. We use nominal yield data from Gurkaynak et al. (2007) to calculate the interest rate spread.[7] We define the interest rate spread as the security's interest rate less the nominal yield with maturity equal to the maturity left on the security.[8]

2.5 Which firms issue bonds?

So far we have focused our analysis at the security level. Next, we analyze firm balance sheets and financial decisions. Starting with our security level dataset, we aggregate the value of all loans and bonds of a firm in a given quarter. Since our main source of firm financial

[7]Data available from the Federal Reserve Board here

[8]For demand loans and credit lines without a well-defined maturity date, we use the 30 year nominal yield

Table 6: Bond types

Bond Type	N	β Loan	β Bond
Callable	21519	-266.85	-66.86
		(1.18)	(1.13)
Putable	412	-206.25	-81.08
		(.48)	(2.6)
Asset Backed	212	-204.8	97.18
		(.48)	(3.63)
Covenants	15956	-242.88	-53.02
		(.71)	(.71)
Rule 144a	6817	-186.15	60.53
		(.53)	(.73)
Total	25375		

information is the Y-14, we only consider those loans and bonds that can ultimately be matched to Y-14 firm[9]. Now, we look at the data at the firm level to describe what are the firms that issue bonds.

Table 7 presents summary statistics for firm characteristics in two panels: (i) unweighted, and (ii) weighted by assets.[10] The table shows that only 5.2% of firms in our sample issue bonds, but this share becomes 63% when weighted by assets. This implies that bond issuers tend to be the largest firms in our sample. We define the loan share as the ratio of loans, l, to loans plus bonds, $l+b$. In the unweighted panel, we find a loan share of almost 97%, reinforcing the idea that very few firms ever issue bonds. Once we condition on firms that issue at least one bond, the loan share falls to 36%, meaning that firms finance themselves mostly using bonds once they start issuing them. When considering the weighted data, the total loan share predictably falls to 51%, while the loan share conditional on bond issuance also drops, to 22%. The leverage ratio (defined as total liabilities over total assets) is about 67% and this number does not change much regardless of whether we look at the unweighted or weighted samples. The loss given default (LGD) is about 29%. When weighted, the LGD is almost 36%, indicating that larger asset firms create larger potential losses for banks if they default. The tangible share of assets (tangible assets over total assets) is about 89%, and the weighted

[9]Most of the unmatched bonds are utilities, or bonds in which we have the firm matched for other CUSIPs, but not this bond's particular CUSIP.

[10]We do not necessarily observe firm financial information for every quarter.In this section we only consider the quarters for which we have financial data, resulting in just over 600k firm-quarter observations. As robustness we have also created a yearly median of financial data, and interpolated using prior year financial variables to get firm financials at the yearly level. This procedure generates very similar results.

tangible share of assets is only 77%. Thus, larger firms tend to have more intangible capital. Total assets show that our coverage of firms is wide and skewed right – the median firm has about 24 million in total assets, while the mean firm has 1.7 billion. The probability of default, at the firm level, is 2.5%. When weighted by assets the PD is smaller, only 1.35% – larger firms have smaller default probabilities.

Table 7: Firm Characteristics

	mean	sd	p10	p50	p90
Equal weight					
Share of Firms with Bonds	5.19	22.18	0.00	0.00	0.00
Loan Share, $l/(l+b)$	96.65	16.13	100.00	100.00	100.00
Loan Share given $b>0$	35.47	32.67	0.25	27.16	85.41
Leverage	67.16	25.58	34.71	67.30	95.37
Tangible Share of Assets	89.08	19.19	60.29	98.67	100.00
Total Assets ($ mil)	1,719.78	14,980.05	3.60	23.92	1,092.05
LGD	28.67	15.52	5.00	30.00	47.01
Probability of Default	2.50	7.87	0.16	0.78	4.05
Asset weight					
Share of Firms with Bonds	63.34	48.19	0.00	100.00	100.00
Loan Share, $l/(l+b)$	50.52	43.82	0.45	42.85	100.00
Loan Share given $b>0$	21.88	28.18	0.19	7.77	72.01
Leverage	66.75	18.15	44.45	68.95	88.28
Tangible Share of Assets	76.96	22.74	41.04	86.81	100.00
Total Assets ($ mil)	132,202.82	140,749.07	3,505.97	68,453.00	401,808.00
LGD	36.32	10.33	21.50	38.69	47.00
Probability of Default	1.35	6.24	0.06	0.29	2.01

To formally analyze the determinants of bond issuance, we estimate a linear probability model where the dependent variable is equal to 100 if the firm issues bonds, and the regressors are different types of firm characteristics.[11] Table 8 shows that bond issuers tend to be larger (have more assets), and have higher leverage ratios, higher liquidity ratios, lower shares of tangible assets, and more long-term debt. The return on assets is also significant, but the effect is extremely small so we omit it from the table.

3 A Macrofinance Model with Secured and Unsecured Debt

We study the dynamic problem of firm investment with a specific focus on firms' balance sheet items. Time is discrete and infinite and the economy is populated by ex-ante homogeneous firms. Our model has standard elements of macro-finance models as well as two type

[11] Results are robust to alternative model such as logit ones.

Table 8: Probability of Issuing Bonds

	(1)	(2)
Assets	5.1509***	4.6932***
	(0.023)	(0.025)
Leverage	6.8536***	7.0361***
	(0.244)	(0.331)
Liquidity Ratio	0.7604	1.0477
	(0.521)	(0.738)
Tangible / Total Assets	-2.3015***	-3.4520***
	(0.214)	(0.267)
Long Share of Debt	0.1414***	-0.2164***
	(0.038)	(0.048)
Constant	-87.6914***	-78.5879***
	(0.513)	(0.545)
Observations	621647	615726
Adjusted R^2	0.290	0.365
Time FE	Yes	No
Time-NAICS FE	No	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

of debts: secured and unsecured borrowing. On the standard side, firms face capital adjustment costs and equity issuance costs. We augment this model by allowing firms to access two corporate debt markets. First, they can issue *secured debt*, called loans, which is subject to a collateral constraint. Second, the firm can also issue *unsecured debt*, called bonds. Due to the presence of unsecured debt the firm might default. Hence we will have a price schedule as a function of firm's choices for both secured and unsecured debt.

Production and Investment The firm has access to a decreasing returns-to-scale production technology over capital k and labor n, with total factor productivity (TFP) z. Firms hire labor at market wage w. The labor choice solves the following static problem:

$$\pi(z,k) = \max_{n} \quad zk^{\alpha}n^{\eta} - wn - \gamma \tag{3}$$

where α, η are the capital and labor share, respectively, and γ is a fixed cost of operation. Static profits from production for a given level of capital k and productivity z are $\pi(z,k)$. The capital stock of the firm depreciates with rate $\delta \in (0,1)$. Capital accumulation is subject to convex adjustment costs:

$$\mathscr{A}^K(k',k) = \frac{\zeta}{2}\left(\frac{k'-k}{k}\right)^2 k \tag{4}$$

where $\zeta > 0$.

Finally, we assume that capital is the sum of tangible and intangibles, $k = k^T + k^I$. In the data we observe that firms with more assets have a larger share of intangibles. To replicate this fact we assume a reduced-form level of intangibles (see, for example, Lee and Paluszynski, 2022). In particular, we estimate the following specification

$$\frac{k^T}{k} = \min\left\{\max\left\{\beta_0 + \beta_1 \log k, 0\right\}, 1\right\} \tag{5}$$

with estimates being $\beta_0 = 79.82$ and $\beta_1 = -2.54$.

Secured debt The firm can issue secured debt, called loans l', which are subject to a collateral constraint:

$$l' \leq \phi_l k^{T'}. \tag{6}$$

The price schedule for loans is

$$q^l\left(z,k',l',b'\right) = \frac{\mathscr{P}\left(z,k',l',b'\right)}{1+r} + \frac{1-\mathscr{P}\left(z,k',l',b'\right)}{1+r}\psi^l \frac{\min\left\{k^{T'}, l'\right\}}{l'} \tag{7}$$

where $\mathscr{P}$ is the repayment probability, r is the lender's risk-free interest rate, and ψ^l captures the recovery given default.

Unsecured debt The firm can also issue unsecured debt, called bonds b'. The price schedule for bonds is

$$q^b\left(z,k',l',b'\right) = \frac{\mathscr{P}\left(z,k',l',b'\right)}{1+r} + \frac{1-\mathscr{P}\left(z,k',l',b'\right)}{1+r}\psi^b \frac{\min\left\{\max\left\{k^{T'}-l',0\right\}, b'\right\}}{b'} \tag{8}$$

where ψ^b captures the lost given default. Note that secured debt has priority in the case of default, so the recovery of the unsecured debt is over $\max\{k'-l',0\}$.

Costly Equity Issuance The firm is subject to costly equity issuance. Let *div* denote firm dividends:

$$div = \pi(z,k) + (1-\delta)k - k' - \mathscr{A}^K(k',k) - l + q^l(z,k',b',l')l' - b + q^b(z,k',b',l')b' \tag{9}$$

Dividends are equal to static profits $\pi(z,k)$ net of capital investment and borrowing in secured and unsecured debt. Firms with negative dividends are subject to convex equity issuance costs

$$\mathscr{A}^D(div) = \frac{\xi}{2}\max\{-div, 0\}^2 \tag{10}$$

where $\xi > 0$.

Default At the beginning of each period, the firm receives i.i.d. extreme-value preference shocks that induce some firms to default in equilibrium (Dvorkin et al., 2021). At the beginning of the period, the firm decides to repay its debt obligations or default:

$$V(z,k,l,b,\varepsilon^P,\varepsilon^D) = \max\left\{V^P(z,k,l,b) + \varepsilon^P, V^D(z,k,l,b) + \varepsilon^D\right\} \tag{11}$$

where V^P is the value of repayment given states (z,k,l,b) and V^D is the value of default, which we assume to be equal to zero for simplicity, $V^D = 0$. The preference shocks follow an extreme-value distribution, and so $\varepsilon = \varepsilon^P - \varepsilon^D$ has a mean-zero logistic distribution with scale parameter κ. The repayment probability can be written as

$$\mathscr{P}(z,k,l,b) = \frac{\exp[V^P(z,k,l,b)/\kappa]}{\exp[V^P(z,k,l,b)/\kappa] + \exp[V^D(z,k,l,b)/\kappa]}$$

The assumptions on these shocks also allow us to derive a closed-form expression for the expected value function. The expectation with respect to the extreme-value shocks is

$$\mathscr{V}(z,k,l,b) \equiv \mathbb{E}_\varepsilon[V(z,k,l,b,\varepsilon^P,\varepsilon^D)] \quad = \kappa \log\{\exp[V^P(z,k,l,b)/\kappa] + \exp[V^D(z,k,l,b)/\kappa]\}$$

Firm's Problem Conditional on not defaulting, the problem of the firm is

$$V(z,k,l,b) = \max_{k',l',b'} div - \mathscr{A}^D(div) + \beta \mathbb{E}\left[\mathscr{V}(z',k',l',b')\right] \tag{12}$$

subject to

$$div = \pi(z,k) + (1-\delta)k - k' + \mathscr{A}^k(k',k) - l - b + q^l(z,k',l',b')\,l' + q^b(z,k',l',b')\,b'$$
$$l' \leq \phi_l k^{T'}$$

where $\beta \in (0,1)$, and $\mathscr{V}, q, \mathscr{A}^K, \mathscr{A}^D$, q^l, and q^b are defined in the text above.

3.1 The bond-loan spread

Proposition 1 shows that if $\psi^l \geq \psi^b$, which is the empirically relevant case as we show later in the calibration, then $q^b < q^l$ so bonds are more expensive than loans.[12]

Proposition 1. *Assume that $\psi^l \geq \psi^b$. Then, bonds are more expensive than loans: $q^b(z,k',b',l') < q^l(z,k',b',l')$.*

As a result of Proposition 1 there is a pecking order. The firm first borrow in the secured debt market, and if the collateral constraint is binding then it also borrow in the unsecured debt market. As a consequence, we can reduce the dimensionality of the problem by keeping track of total debt $d = l + b$, and

$$l = \min\left\{\phi_l k^T, d\right\} \tag{13}$$
$$b = \max\{0, d - l\} \tag{14}$$

4 Quantitative Evaluation

We now solve the model globally using the equations derived in the previous section. First we calibrate the model. Second, we analyze the ability of the model to replicate the bond-loan spread and its default elasticity. Finally, we study the role of secured and unsecured debt through a series of counterfactual exercises.

[12] Appendix C contains the proof of the results.

4.1 Calibration

There are two sets of parameters, those that can be taken from the literature or data, and those that are internally calibrated from the simulation of the model. Table 9 describes the parameters. The first panel describes the parameters that we either took from the literature, the data, or we use as a normalization. Most of these parameters are standard. The recovery given default for loans is equal to 0.6895 which we took from the Y14 data. Finally, note that due to Proposition 1 only firms with a binding collateral constraint issue bonds. Hence, if $\phi_l \geq 1$ as long as $\psi_b < \psi_l$ any value of ψ_b generates the same equilibrium because there is no recovery for bonds after default. For normalization we assume $\psi_b = 0.0$.[13]

Table 9: Calibration

Description	Parameter	Value	Source
External			
Capital share	α	0.3000	Standard
Labor share	η	0.6000	Standard
Depreciation rate	δ	0.1200	Standard
Wage	w	1.0000	Normalization
Capital adjustment costs	ζ	2.0000	Cooper and Haltiwanger (2006)
Equity issuance cost	ξ	0.3900	Hennessy and Whited (2007)
Interest rate	r	0.0400	Standard
Productivity, persistence	ρ_z	0.7670	Standard
Productivity, volatility	σ_z	0.3000	Standard
Recovery given default, loans	ψ_l	0.6895	Y14 Data
Recovery given default, bonds	ψ_B	0.6895	Normalization
Preference shocks, scale	κ	0.1000	Normalization
Internal			
Average productivity	$\bar{z}$	1.1000	
Discount factor	β	0.9100	
Fixed costs	γ	0.0300	
Collateral constraint	ϕ_l	1.1000	

The second panel shows the parameters that we pick to match data moments. To calibrate these 4 parameters we target data moments, as described in Table 10. The data moments correspond to our final database as reported in Table 7. First, the average productivity $\bar{z}$ is closely related to the average capital of 1 and the average tangible share of 0.90. The average capital of one is an important normalization so the reduced-form expression in 5 for the tangible share of capital is consistent in the model and data.

[13] While the value of ψ_b does not affect the benchmark economy it will affect some of the counterfactual exercises.

Second, the discount factor β help us generate a leverage in the model consistent of the 68% in the data. Third, the fixed cost of operation γ will help us generate a default probability of about 3%.Finally, the collateral constraint parameter ϕ_l will help us generate that only 2% of the firms issue bonds

Table 10: Moments

	Data	Model
Average tangible share	0.90	0.83
Average capital	1.00	0.94
Leverage	0.68	0.67
Default probability	0.03	0.05
Share of firms with $b > 0$	0.02	0.02

4.2 The Bond-Loan Spread

The model generates a Bond-Loans Spread of 50 bps, while in the data, this spread is of 203 bps. Hence, the model can explain about 25 percent of the Bond-Loan Spread.

Moreover, the model also generates a qualitatively similar default elasticity of the bond-loan spread. Figure 2 shows the interest rates for bonds and loans as a function of the default probability. For low default probability both interest rates are equal to the lenders' discount, r. However, for firms with higher default probability, those in the 8th to 10th percentile of the default probability distribution, the bonds rate are higher than the loan rates. This results resembles the empirical finding in Figure A2. The reason is that, through the lens of the lenders, for higher default probabilities firms, loans are safer than bonds because they have lower loss given default.

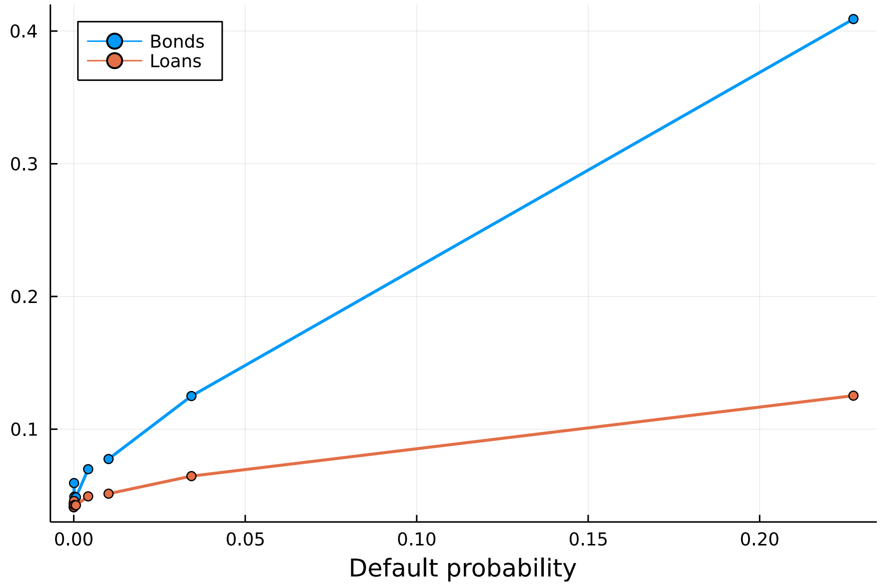
4.3 Role of Secured and Unsecured Debt

In this section we analyze the effects of secured and unsecured debt for the economy.

Specifically, we analyze the effect of reducing the collateral parameter by 50%, that is $\phi_l = 0.55$ instead of $\phi_l = 1.10$. Note that in this model the firm cares about the value of ψ_b, as $\phi_l < 1$. Table 11 considers the two polar cases: no recovery (i.e., $\phi_b = 0$) and same recovery (i.e., $\phi_b = \phi_l$).

We first consider the case of no recovery for bond holders after default. We find that the firm chooses to accumulate less capital. This is a natural result. In the counterfactual model, capital has lower effective return (its provides less value as collateral). Hence, firms have less

Figure 2: The Bond-Loan Spread



Notes: The Figure shows the interest rate for bonds and loans as a function of the default probability. We simulate the economy, and create 10 groups according to the deciles of the default probability. For each group we compute the average interest rates and default probability.

incentives to accumulate capital. Second, the firm also chooses to issue less debt as borrowing becomes more expensive. Firm leverage is reduced from 67 percent to 51 percent. We also find that firms substitute secured with unsecured debt. The share of firms issuing bonds increases from 2% to 77%, and the loan share decreases from 100% to 83%.

The novel result is that the default probability is one percent lower in the economy where capital is less pledgeable. The reason is that default is more costly in the counterfactual economy. As a result, the cost of debt increases, and firms decide to become less leveraged. This reduction in leverage contributes to the decrease in the default probability. Finally, the bond-loan spread reduces by 25 bps, mainly due to the reduction on the default probability.

Note that if instead $\phi_b = \phi_l$, then the moments are very similar to the benchmark economy, with a few exceptions. First, there are more firms issuing bonds, and the loan share decreases. Second, the bond-loan spread is almost zero. The main reason is that both loan and bond holders have the same recovery rate. While it is true that loan holders have priority in recovery, because the firm can only pledge 55% of their tangible capital as collateral, there are plenty of tangible assets to pay back the bond holders also.

Table 11: Role of Secured Debt

	Benchmark	$\phi_l = 0.55$	
		$\psi_b = 0$	$\psi_b = \psi_l$
Average capital	0.94	0.91	0.94
Leverage	0.67	0.51	0.67
Loan share, $l/(l+b)$	1.00	0.83	0.70
Share of firms with $b > 0$	0.02	0.77	0.06
Loan share, for firms with $b > 0$	0.88	0.80	0.69
Default probability	0.05	0.04	0.05
Bond-loan spread, bps	50.30	25.20	1.40

5 Conclusions

We build a new security-level database of US companies issuing both corporate bonds and bank loans. We show that bank loans are significantly less expensive than corporate bonds, and this bond-loan spread is greater for companies with higher default probabilities. We build a dynamic corporate finance model. Firms can issue both secured (loans) and unsecured (bonds) debt. Secured debt is subject to a collateral constraint, but firms can also issue unsecured debt once the collateral constraint becomes binding. As a result, there is equilibrium default in both secured and unsecured debt. We find that around 25% of the bond-loan spread can be explained by the unsecured nature of corporate bonds.

References

Cooper, R. W. and Haltiwanger, J. C. (2006). On the Nature of Capital Adjustment Costs. *Review of Economic Studies*, 73(3):611–633.

Dvorkin, M., Sánchez, J. M., Sapriza, H., and Yurdagul, E. (2021). Sovereign debt restructurings. *American Economic Journal: Macroeconomics*, 13(2):26–77.

Gurkaynak, R. S., Sack, B., and Wright, J. H. (2007). The u.s. treasury yield curve: 1961 to the present. *Journal of Monetary Economics*, 54(8):2291–2304.

Hennessy, C. A. and Whited, T. M. (2007). How costly is external financing? evidence from a structural estimation. *The Journal of Finance*, 62(4):1705–1745.

Lee, H. and Paluszynski, R. (2022). Intangible capital and shadow financing. *Unpublished manuscript*.

SCHWERT, M. (2020). Does borrowing from banks cost more than borrowing from the market? *The Journal of Finance*, 75(2):905–947.

Online Appendix

A Empirical Appendix

A.1 Data: Y14

This section explains the sample selection of the Y-14 data, the construction of the variables used in the empirical analysis.

Sample Selection Our sample selection criteria follow standard practice in the literature. We exclude all firm-quarters for which:

(i) Loans not in the U.S. (Field 6 Country is not U.S.)

(ii) Industry is financial or public administration (Field 8 IndustryCode is 52 or 92)

(iii) Committed Exposure is negative or zero (Field 24 CommittedExposure ≤ 0)

(iv) Utilized Exposure is negative (Field 25 UtilizedExposure < 0)

(v) Utilized exposure is higher than committed (Field 25 UtilizedExposure $>$ Field 24 CommittedExposure)

(vi) The date is after the maturity date (Field 0 D_DT, the date of observation, is after Field 19 MaturityDate)

(vii) The date is before the origination date (Field 0 D_DT is before Field 18 OriginationDate)

(viii) The loan is classified as municipal or foreign (Field 26 LineReportedOnFRY9C loan type is not 3, 4, 8, 9, or 10[14].)

Construction of variables We construct the key variables employed in the empirical analysis as follows. In the Y-14 we have two levels of analysis: security level and firm level. Therefore, we have two sets of variables The variables from collateral share up to probability of default are calculated at the security-quarter level. Starting at probability of default and going until

[14] 3 - Loans to finance agricultural production and other loans to farmers, 4 - Commercial and industrial loans to U.S. addresses, 8 - All other loans, excluding consumer loans, 9 - All other leases, excluding consumer leases, 10 - Loans secured by owner-occupied nonfarm nonresidential properties originated in domestic offices

coverage, the variables are calculated at the firm-quarter level. Variables at the security-quarter level:

(i) Collateral Share: ratio of loan collateral over amount utilized on the loan for loans with first or second lien. We cap collateral share at 1.

(ii) Maturity: The difference between maturity and origination dates (Field 19 MaturityDate - Field 18 OriginationDate).

(iii) Amount: The utilized exposure on a loan (Field 25 UtilizedExposure).

(iv) Default probability: We define the default probability at the firm-quarter level. For each firm-quarter, we take the median of the PD of all loans in that quarter (Field 88 ProbabilityOfDefault).

(v) Collateral share: The collateral market value divided by the utilized exposure of the loan. We cap the collateral share at 1 (Field 93 CollateralMarketValue divided by Field 25 UtilizedExposure).

(vi) Loan type: We use the credit facility type to create broad categories of revolving credit lines and term loans (Field 20 FacilityType - credit lines defined as 1-6, term loans defined as 7-13).

(vii) Syndicated loans: We use a participation flag to define if a loan is syndicated or not (Field 34 ParticipationFlag - 1 is not syndicated, 2-5 syndicated).

(viii) Interest rate: The interest rate on a loan (Field 38 InterestRate).

(ix) Interest rate spread: We calculate the interest rate spread using the nominal yields from Gurkaynak et al. (2007). For each loan, we calculate the maturity remaining to the nearest year, and subtract from the interest rate the nominal treasury yield with maturity equal to maturity remaining. (Field 38 InterestRate, nominal interest yields from the Board of Governors). We follow the same process for both loans and bonds, using (Issue coupon) as the initial interest rate for bonds.

(x) Lien Position: The possible lien positions of loans are first lien senior, second lien, senior unsecured, and contractually subordinated (Field 35 LienPosition).

Variables at the firm-quarter level:

(i) Probability of default: the median of a firm across observations (i.e., across different securities from potentially different banks) in a quarter.

(ii) Expected loss: We multiply PD and LGD together to calculate expected loss (Field 88 ProbabilityOfDefault * Field 89 LGD).

(iii) Total Assets: We use the log of total assets (Field 70 TotalAssetsCurrent).

(iv) ROA: We calculate return on assets as the net income divided by the total assets (Field 59 NetIncomeCurrent / Field 70 TotalAssetsCurrent).

(v) Leverage: We define leverage as total liabilities divided by total assets (Field 80 TotalLiabilities / Field 70 TotalAssetsCurrent).

(vi) Liquidity Ratio: We define the liquidity ratio as the difference between current assets and current liabilities divided by total assets ((Field 66 CurrentAssetsCurrent - Field 76 CurrentLiabilitiesCurrent) / Field 70 TotalAssetsCurrent).

(vii) Tangible / Total Assets: We define this as the ratio of tangible assets and total assets (Field 68 TangibleAssets / Field 70 TotalAssetsCurrent) .

(viii) Long Share of Debt: We define the long share of debt as the total observed amount utilized by a firm for both bonds and loans, with maturity of over a year, divided by the total observed borrowing.

(ix) Loan Share: We define the loan share as the total utilized value of loans divided by the total observed utilized value of loans and bonds. For firms with no bonds, the loan share will be $= 1$.

(x) Coverage: We define the coverage as the total utilized value of loans and bonds divided by a firm's total liabilities.

A.2 Data: FISD

This section explains the sample selection of the FISD data, the construction of the variables used in the empirical analysis.

Sample Selection Our sample selection criteria follow standard practice in the literature. Our final sample is 2013Q1 - 2022Q3, but we view the FISD bonds only at origination. Because of this, we start the "sample" – the bonds that we are viewing at origination – in 1990q1. Thus if a bond has a maturity of 20 years and originates in 2000q1, we will have this bond in our sample from 2013q1-2020q1. We exclude all firm-quarters for which:

(i) Industry is financial or public administration (Issuer NAICS_Code is 52 or 92)

(ii) Bond issuer or issue not in US (Issuer or Issue Country_Domicile not USA)

(iii) Issuer or issue industry was government (Issue industry_group is 4)

(iv) Currency is not USD (Currency not either USD or missing)

(v) Bond is not a corporate bond (Bond_type not CCOV, CCPI, CDEB, CLOC, CMTN, CMTZ, CP, CPAS, CPIK, CS, CUIT, CZ, RNT, UCID, or USBN)

(vi) Bond is not convertible (convertible not yes)

Further, we download data from Bloomberg on bonds that have been called, and the date they were called. We merge that data to FISD using the nine digit security level cusip, and drop bond observations that are in or after the quarter the bond was called.

Construction of variables We construct the key variables employed in the empirical analysis as follows.

(i) Maturity: Difference between maturity and origination dates (Issue Maturity - Issue Offering_date).

(ii) Amount: The offering amount of the loan (Issue Offering_amt).

(iii) Collateral share: We set it equal to zero.

(iv) Bond type: We have flags for a number of bond types. Specifically, if a bond is convertible, putable, callable, asset backed, rule 144a, or if it has a covenant (Issue convertible, putable, announced_call asset_backed, rule_144a, and covenants respectively).

(v) Interest rate: Issue coupon (Issue coupon_type) .

(vi) Lien position: The seniority level for bonds contain the following possibilities: none, junior, junior subordinate, subordinate, unsecured, senior, and senior secured. (Issue security_level).

Comparison to Flow of Funds To measure the aggregate coverage of our Y-14 FISD merged dataset, we compare our data to the U.S. flow of funds. Specifically, we compare the Y-14 loan data to fl104123005q non-financial corporate loans plus fl114123005q non-financial non-corporate loans. We compare the FISD bonds to fl103163003q non-financial corporate bonds. On average across our sample, the total loan and bond coverage is 74% and 115% of the flow of funds respectively.

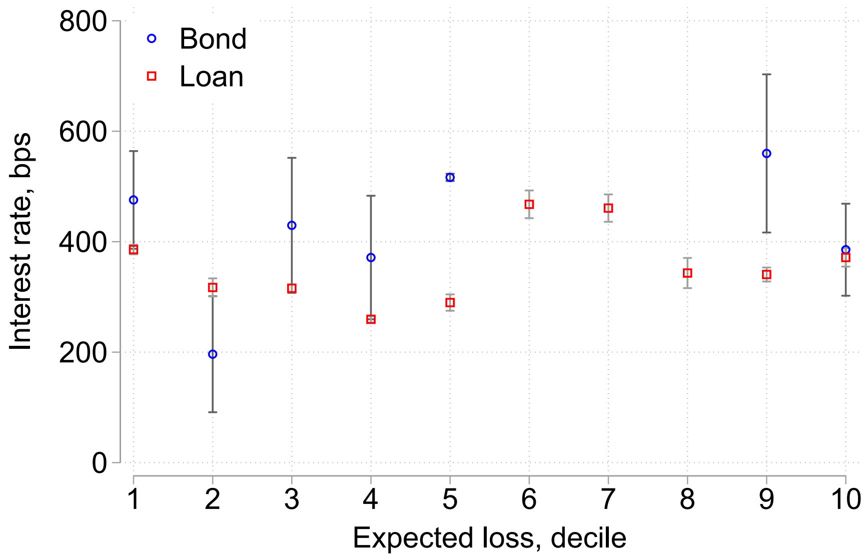
A.3 Firm-level data

This section explains how we create the final firm identifier, how we assign bonds and loans to this firm, and the calculation of the calibration targets. The Y-14's main firm identification variable is the tax identification number (TIN). To begin, we define a firm by grouping TINs. For any loans that are missing TINs, we define the firm by grouping loans that share an ObligorName, ZipCode, and IndustryCode. In order to merge the Y-14 and FISD, we use S&P's Business Entity Cross Reference Service (BECRS). The BECRS contains CUSIP level information, and contains the ultimate parent of each CUSIP. We create an ultimate id for a firm that contains the ultimate parent, and every CUSIP of that firm or their subsidiaries. Then, we merge the BECRS ultimate id to the Y-14 using the 6-digit firm CUSIP. After merging the BECRS to the Y-14, we carry forward the ultimate id by firm for any missing ultimate ids. To settle any within firm-quarter discrepancies (A Y-14 firm, as defined by TIN, with multiple CUSIPs in the same quarter, that point to different ultimate parents in the BECRS), we assign the ultimate id with the most observations in a firm-quarter to all observations in that firm-quarter. The FISD uses the firm CUSIP identifier, so we can simply merge with the BECRS.

A.4 Expected Loss

For most of the analysis, we use the variable probability of default to measure a firm's risk level in a given quarter. Expected loss is another possible measure of risk. We calculate expected loss as the probability of default multiplied by the loss given default. We run the regression in equation two using expected loss quantiles instead of probability of default. In Figure A1, we show that our result is robust. That is, firms that are less risky pay similar rates on loans and bonds, while more risky firms pay a premium on bonds that is increasing with respect to their riskiness – in this case expected loss.

Figure A1: The Expected Loss Elasticity of the bond-loan spreads



A.5 Interest Rate Spread

Table A1 and Figure A2 show that the results are robust to consider the interest rate spread with respect to the risk-free rate instead of the interest rate level.

A.6 Seniority of securities

Initially, we include all types of seniority in our sample. Below, we first show a breakdown of each of the seniority types – which are different for Y-14 and FISD.

Next, we run our benchmark regressions on a subset of our original sample containing only loans that are first-lien senior and bonds that are senior. Our results are provided in Table A2

A.7 Credit lines and syndicated loans

Table A3 describes the main variables used in the analysis.

A.8 Firms with Loans and Bonds

In this section, we run our benchmark regressions on a sample that contains only firm-quarters in which a firm has both loans and bonds. Our estimates of the Bond-Loan spread are slightly smaller for this sample, but remain close to 200 basis points.

Table A1: Interest Rate Spread

	(1)	(2)	(3)	(4)
Maturity	1.2685***	1.2282***	1.1494***	1.1124***
	(0.023)	(0.023)	(0.020)	(0.020)
Amount	-0.0031***	-0.0030***	-0.0023***	-0.0023***
	(0.000)	(0.000)	(0.000)	(0.000)
Loan	-202.0841***	-214.8617***	-194.2999***	-205.4690***
	(0.552)	(0.562)	(0.498)	(0.504)
Collateral Share		23.0201***		20.2783***
		(0.284)		(0.224)
Default Probability			104.6384***	104.7486***
			(1.025)	(1.026)
Constant	361.4243***	358.1706***	365.6466***	361.7331***
	(0.597)	(0.600)	(0.560)	(0.563)
Observations	3059549	3059549	4298093	4298093
Adjusted R^2	0.536	0.538	0.591	0.592
Firm-Time FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Time FE	No	No	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A2: The Bond-Loan Spread: First-Lien Senior Loans and Senior Bonds

	(1)	(2)	(3)	(4)
Maturity	4.6992***	4.7004***	4.1366***	4.1383***
	(0.027)	(0.027)	(0.022)	(0.022)
Amount	-0.0041***	-0.0041***	-0.0032***	-0.0032***
	(0.001)	(0.001)	(0.001)	(0.001)
Loan	-183.8354***	-175.9216***	-172.1142***	-163.7405***
	(0.704)	(0.794)	(0.616)	(0.693)
Collateral Share		-8.8746***		-9.5330***
		(0.453)		(0.384)
Default Probability			92.7939***	92.7076***
			(0.974)	(0.974)
Constant	480.7625***	481.1134***	488.6644***	489.2799***
	(0.754)	(0.756)	(0.681)	(0.683)
Observations	2319895	2319895	3475760	3475760
Adjusted R^2	0.616	0.616	0.656	0.656
Firm-Time FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Time FE	No	No	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Summary Statistics by Security, With Robustness

	mean	sd	p10	p50	p90
Bond					
Maturity (yrs)	15.96	12.13	5.02	10.04	30.05
Amount (mil$)	511.62	603.22	10.00	375.00	1,000.00
Interest Rate (bps)	535.79	204.02	265.00	537.50	800.00
Interest Rate Spread (bps)	335.53	225.57	54.06	329.82	643.91
Term Loan					
Maturity (yrs)	8.48	5.60	3.10	7.00	15.51
Amount (mil$)	35.44	498.36	1.06	2.31	25.50
Interest Rate (bps)	347.67	136.49	178.00	344.39	515.72
Interest Rate Spread (bps)	179.54	149.72	2.22	173.28	364.07
Credit Line					
Maturity (yrs)	7.06	6.18	1.08	5.00	15.76
Amount (mil$)	48.99	996.43	0.46	3.00	85.00
Interest Rate (bps)	344.33	145.73	166.00	331.39	530.52
Interest Rate Spread (bps)	179.01	153.82	-9.03	174.05	363.53
Non-syndicated Loans					
Maturity (yrs)	8.35	6.25	2.00	6.98	17.55
Amount (mil$)	5.55	18.65	0.65	2.00	11.16
Interest Rate (bps)	349.44	138.06	176.25	345.12	525.00
Interest Rate Spread (bps)	178.49	152.68	-11.48	176.91	361.55
Syndicated Loans					
Maturity (yrs)	5.84	3.12	3.01	5.00	9.28
Amount (mil$)	231.51	1,914.21	4.24	63.95	524.40
Interest Rate (bps)	329.76	152.89	155.50	310.00	536.00
Interest Rate Spread (bps)	183.31	146.21	30.46	157.17	378.35

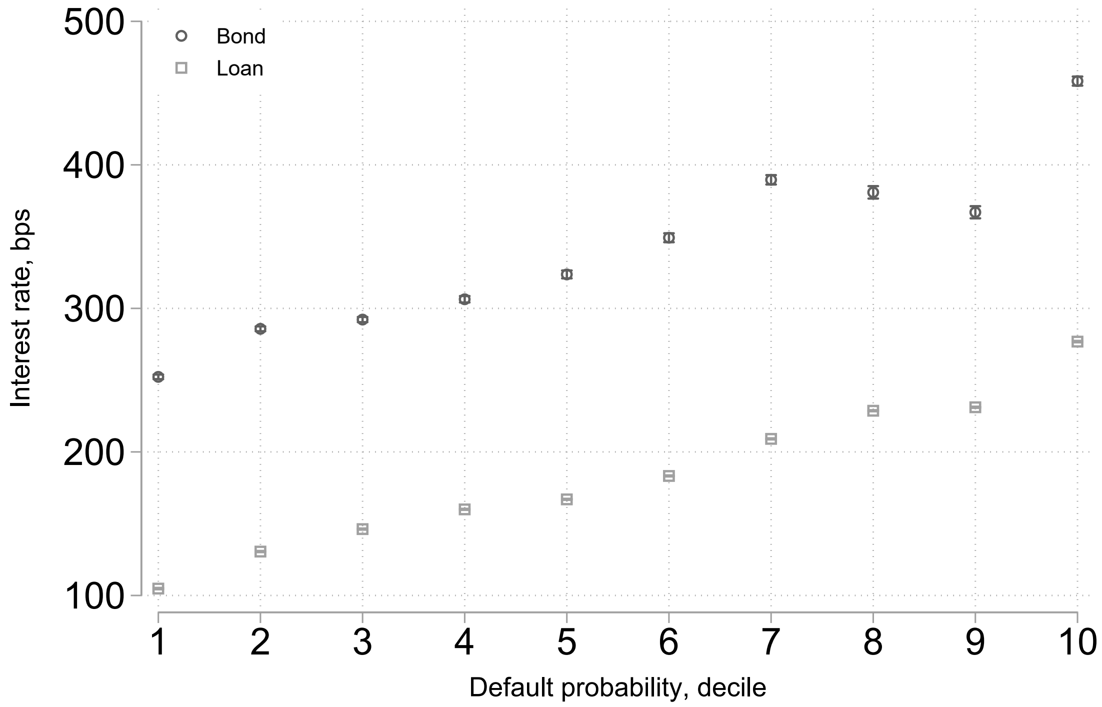


Figure A2: Probability of Default for Interest Rate Spread

A.9 Calibration of Tangible Assets

Here, we describe the cleaning and regression procedures used to estimate the regression for equation 5:

(i) For any observation of tangible or total assets that is zero, we change the observation to missing.

(ii) We then winsorize tangible and total assets at the .05% level.

(iii) We then generate the tangible share of assets, k^T/k, as tangible assets over total assets.

(iv) We change to missing any values of k^T/k that are less than zero or greater than 100.

(v) For each quarter, we calculate the mean of total assets.

(vi) We then normalize total assets using the values from the previous step.

(vii) We then take the log of the normalized total assets

(viii) We then regress k^T/k on a constant using a quarter fixed effect. We subtract the fixed effect from k^T/k to create a "clean" k^T/k

Table A4: The Bond-Loan Spread: Firms That Have b>0 in a Given Quarter

	(1)	(2)	(3)	(4)
Maturity	6.2476***	6.2452***	6.3608***	6.3569***
	(0.030)	(0.030)	(0.031)	(0.031)
Amount	-0.0094***	-0.0093***	-0.0088***	-0.0086***
	(0.001)	(0.001)	(0.001)	(0.001)
Loan	-192.4784***	-195.8147***	-179.3271***	-184.4263***
	(0.673)	(0.670)	(0.639)	(0.642)
Collateral Share		6.1417***		9.5273***
		(0.466)		(0.472)
Default Probability			105.1030***	105.2815***
			(2.829)	(2.833)
Constant	448.0050***	447.8373***	434.4117***	434.1169***
	(0.956)	(0.954)	(0.931)	(0.928)
Observations	950009	950009	832183	832183
Adjusted R^2	0.562	0.562	0.519	0.519
Firm-Time FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Time FE	No	No	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Our old Data	Our Data	Schwert
bond rate (bp)	497	535	231
loan rate (bp)	345	346	159
ratio	1.44	1.55	1.45

(ix) Finally, we regress the "clean" k^T/k from step 8 on the log normalized total assets from step 7.

B Comparison to SCHWERT (2020)

C Theoretical Results

Proof of Proposition 1. Note that

$$q^b\left(z,k',l',b'\right) - q^l\left(z,k',l',b'\right) = \frac{1-\mathscr{P}\left(z,k',l',b'\right)}{1+r}\left(\psi^b \frac{\min\left\{\max\left\{k^{T'}-l',0\right\},b'\right\}}{b'} - \psi^l \frac{\min\left\{k^{T'},l'\right\}}{l'}\right) \tag{15}$$

Hence, if $\psi^l \geq \psi^b$, which is the empirically relevant case as we show later in the calibration, then $q^b < q^l$ so bonds are more expensive than loans. $\square$