Observed risk and loss reduction effects of collateral on loan pricing

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Abstract

This paper tests the relationship between collateral and loan pricing. When all else is equal, offering collateral should reduce the cost of borrowing; however, the effect of collateral is not so straightforward. Specifically, it separates two effects of collateral. Collateral mitigates the bank's loss in the event of default and thus should reduce loan pricing; however, banks require collateral from riskier borrower who pay higher loan costs (known as the observed risk effect). Past studies showing the expected negative relationship between loan pricing and collateral have used samples limited to specific industries or unique and limited datasets. This paper empirically demonstrates the interest-decreasing effect of collateral while teasing out borrowing risk consideration in a general setting that is applicable across industries and borrowers. When we control for the observed risk effect, the relationship between collateral and loan pricing is significantly negative in the main analysis and in the model including the control for endogeneity. To control for the observed risk effect, the collateral variable is interacted with the borrower's credit rating and we find a significant and positive relationship with loan pricing. Taken as a whole, this paper provides a generalizable model where these two diverging theoretical forces are both empirically supported.

1. INTRODUCTION

Bank loans are a primary source of funding for many firms and understanding how the terms of those loans, such as pricing, maturity, principle amounts, covenants, and the requirement (or not) of collateral, is an important area of research. We focus on the pricing effect of loans with collateral and to test this effect, we consider the reason(s) that collateral is required. Two main arguments are information asymmetry and observed risk; the information asymmetry theory states that low-risk borrowers choose to pledge collateral to signal their private knowledge of their credit worthiness to banks while the observed risk theory states that banks observe borrowers' riskiness and require collateral from more risky borrowers (Berger & Udell, 1990). Another purpose of collateral not directly captured in those theories is that it reduces a bank's loss if the borrower defaults on the loan (Blazy & Weill, 2013; Gonas, Highfield, & Mullineaux, 2004). Our design allows us to separate the loss reduction effect from the observed risk effect. With the effects separated, the unconditional effect of collateral (the loss reduction effect) is to lower loan spreads while the conditional effect of requiring collateral for borrowers the bank observes to be more risk (observed risk effect) is to increase loan spreads.

While the borrower information asymmetry theory is popular with theorists (Athavale & Edmister, 2004), empirical results do not support theories that borrowers choose to pledge collateral as a signal of their credit worthiness (Blazy & Weill, 2013; Gonas et al., 2004). Empirical results typically support the observed risk theory and find that loan spreads are positively related to a loan being secured (Berger & Udell, 1990; Inderst & Mueller, 2007).

Not all empirical results are consistent with the observed risk behavior. A study using the airline industry as its setting finds that when collateral is more re-deployable (easily sold once seized), the relationship between collateral and loan spreads is negative (Benmelech & Bergman, 2009). Another study that uses data that is an aggregation of loan terms (rather than individual loans) and includes a bank's private credit rating finds that including the private credit rating information leads to a negative relationship between collateral and loan spreads (English & Nelson, 1990).

The ease with which a bank can claim title (take possession) of collateral is also important. In Sweden, changed a law regarding floating lied collateral; prior to 2004, banks could claim such collateral outside of bankruptcy (they had 'special priority' and were senior to general and ordinary priority claims, both of which required a debtor to file bankruptcy prior to enforcement of the claim). With the change, the floating lien claims became general priority claims (Berger et al, 2016). Using the full loan files of a particular Swedish bank, including that bank's private assessment of collateral values, credit worthiness, and other important credit-decisioning factors, it is shown that once the special priority was lost, the bank lowered is assessment of the value of the collateral (Berger et al, 2016). Prior papers utilize isolated and localized collateral shocks to infer the impact of collateral on loan pricing and investment decisions (Gan, 2007); (Lin, 2016). These studies are informative but perhaps less generalizable due to sample restrictions or unique data sets. Our method separates the loss mitigation and observed risk effects of collateral in a more generalizable setting. Also, Lin (2016) considers the choice between public and private debt; we are specifically not examining this choice. We use the long-term S&P issuer rating as a measure of public credit worthiness.

We infer a bank's unique (and requisite) ability to collect private information about their borrowers. When determining credit worthiness (probability of default), banks have this private information in addition to public information for their assessment. By separating the function of collateral as a proxy of observed risk, we can evaluate the effect of collateral as a mitigation of loss given loan default. If collateral is simply a proxy for credit risk, we would not expect to find results in our loss given default tests. However, when we separate the risk proxy effect that collateral does mitigate loss given default as evidenced by the significant, negative effect of collateral on loan spreads. We also find that collateral can also proxy for the privately observed risk of the borrower. Our results are consistent when we control for potential endogeneity in the choice of securing a loan.

Our paper contributes to the debt contracting literature by expanding the understanding of the role of collateral in commercial loans. While the numerous studies using unique or proprietary data or other specialized jurisdictional or industry-specific settings have greatly advanced our understanding of the role of collateral in debt contracting, having a more generalizable understanding of that role is highly useful and desirable. We use a sample of syndicated loans without restricting our data to a specific industry or set of aggregated loan data, giving a more general result that is applicable across debt contracts. We also contribute to the growing evidence that the asymmetric information theory of collateral, that low-risk borrowers choose to pledge collateral to signal their low risk, is most likely not a reason that loans are secured.

The rest of the paper is organized as follows: Section 2 is the literature review and hypothesis development, Section 3 discusses the data and research design, Section 4 presents the results, and Section 5 provides a summary and conclusion.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Private lending (bank loans) is a key source of capital for firms and understanding the structure of loan contracts has been and continues to be important to regulators, market participants, and scholars. It has been shown that firms with lower accounting quality are more likely to choose bank debt rather than public debt (bonds) (Bharath, Sreedhar T., Sunder, & Sunder, 2008). This is consistent with findings that banks rely more on their privately acquired information than public information when developing loan contracts (Beatty, Liao, & Weber, 2010). Banks acquire private information because of the close, proprietary relationship they have with their borrowers (Diamond, 1984; Li, Saunders, & Shao, 2015). This private information affects loan pricing (Asquith, Beatty, & Weber, 2005; Beatty, Ramesh, & Weber, 2002) as well whether to secure a loan (Fang, Li, Xin, & Zhang, 2016; Hainz, Weill, & Godlewski, 2013). We focus on the pricing effect of having security for a loan.

A loan is ‘secured’ when the borrower has pledged collateral; collateral consists of borrower assets that may be claimed by the lender under certain conditions as stipulated in the loan contract. Borrowers can be in technical default or actual default. Violating a covenant is a technical default and such defaults occur frequently with lenders using covenants as tripwires (Dichev & Skinner, 2002). Technical defaults usually lead to a waiver, warning, or renegotiation between borrower and lender but rarely lead to acceleration (demand for early repayment) of the loan or seizure of collateral. Borrowers are shown to use tight financial covenants to convey information about the underlying items measured for those covenants (Demiroglu & James, 2010). Missing an interest or principle payment is an actual default and the consequences are more severe for the borrower. Actual default is an event that is more likely to cause the bank to seize collateral (Dichev & Skinner, 2002). Therefore, securing the loan allows the bank to mitigate losses if the borrower defaults on payments.

There are two primary arguments about why borrowers agree to provide collateral: one is an asymmetric information theory: the borrower has private knowledge that they are more credit worthy (less risky to the bank) and pledge collateral to signal their lower risk; the other is the observed risk theory: the bank requires collateral from the borrower based on the banks assessment of the riskiness of the loan to the borrower (Berger & Udell, 1990). The private information argument has been long touted in the debt contracting theoretical literature (Besanko & Thakor, 1987; Chan & Kanatas, 1985). However, most empirical evidence has supported the observed risk theory; banks require collateral from borrowers that the bank believes to be riskier borrowers. Securitization is a common control variable in debt contracting literature and almost without fail it is positively related to the cost of debt, as measured by all-in-spreads for the loans. This supports the argument that riskier borrowers are required to pledge collateral; the presence of collateral seems to proxy for being a risky borrower. However, collateral also reduces risk to the lender if the borrower does default. Under observed risk, collateral could be a proxy for observed borrower riskiness, a mitigation of loss given default, or some combination of the two. A secured loan allows the lender some relief in the event of default; if the models for debt pricing successfully control for borrower riskiness without using the presence of collateral as that proxy, then the effect of the collateral value itself can be disentangled from its effect as a proxy for riskiness.

The nature of the collateral, especially its liquidity, is important when considering its value to mediate borrower riskiness. Collateral that cannot be liquidated does little to make the lender whole. This issue has been addressed in the literature in specific industries and settings. Commercial aircraft as collateral are more valuable to the lender as the aircraft are easier to liquidate (Bo, 2019; Benmelech & Bergman, 2011). One study found that aircraft with deep market penetration (popular among the largest commercial airline firms) are more useful as collateral to the bank; a measure of the expected ease of re-selling seized aircraft is used (called re-deployability) and the study finds loan spreads are decreasing as the aircraft (the collateral) is expected to be more easily re-sold (Benmelech & Bergman, 2009).

The relationship between collateral and loan pricing has been shown to vary along collateral characteristics (liquidity and type of collateral, for instance) (Berger et al 2016). In their study, Berger et al (2016) have access to the Bolivian credit registry related to 13 large Bolivian banks and financial institutions. The credit registry is the most reliable source of financial data about the borrowers as well as highly detailed loan contract information according to the authors. Their sample borrowers are some of the largest firms in Bolivia and of the firms in their sample, only 0.3% had a prior default occurrence (Berger et al, 2016). They do show that the relationship between collateral and loan pricing is sensitive to both the liquidity in general and the type of collateral specifically.

The importance of the value and liquidity of collateral is evidenced in Cerquerio et al (2016). Those authors utilized a unique data set from a major Swedish bank; they have the complete monthly loan files for each of the bank's borrowers for 33 months commencing in January 2003 with highly granular detail regarding loan types, terms, collateral, loan approval process, et cetera. They further consider a law change in Sweden that restricted a banks' claim on certain types of collateral of their borrowers. For loans where the collateral was affected, loan pricing increased more than for loans with unaffected collateral; the change in the bank's private assessment of collateral value (which includes not only the economic value of the collateral, but also the bank's ease of exercising their claim) (Cerquerio et al, 2016).

Loans, as private debt from private lenders, enjoy an advantage over public debt such as bonds. Banks obtain private, even proprietary, information about their borrowers. Banks are allowed, and expected, to collect private information about potential and existing borrowers to ensure well-informed lending decisions; the lenders know information that only borrower managers or owners know (Diamond, 1984). Directly testing the effect of private, proprietary information without having the actual information is not possible. However, one study using a small sample from a specific bank considers sequential lending; they find that sequential loans to a borrower have lower rates than the initial loan to that borrower. The rate reduction is attributed to the bank obtaining more private information as the relationship with the borrower continues (Athavale & Edmister, 1999; Athavale & Edmister, 2004). Their findings and conclusions are consistent with Diamond (1984)'s assertion that banks acquire private information about their borrowers. Given their limited sample, generalizing from their study may be problematic, but it does show that the collateral effect is not as universal as it may seem.

Banks use the private information mainly to determine credit worthiness and without accounting for the bank's private knowledge, one cannot adequately assess that credit worthiness in the same fashion. Banks do issue their own credit ratings for borrowers at times; such a rating impounds all information the bank considers when determining credit worthiness. The Federal Reserve compiles the Survey of Terms of Bank Loans (STBL) from banks; the banks are asked to include a credit rating for their borrowers. If the bank does not rate their borrower, the STBL provides guidelines to create a rating; the guidelines also provide instruction for banks that do rate borrowers to translate that rating to a consistent 1 to 5 integer rating for the STBL report. When bank risk ratings are included as a control in a model of loan pricing, collateralization is significantly, negatively related to pricing. When the risk ratings are excluded, collateral is significantly, positively related to pricing (English & Nelson, 1998). In other words, once the borrower risk was appropriately controlled for, the effect of collateral was disentangled from its potential as proxy for that same risk. While English & Nelson (1998) finds this, the study is limited. The STBL is an aggregation of survey information from a sample of commercial banks. It is not a loan-specific study or measure.

Collateral has been positively related to loan pricing in much of the empirical literature, supporting the argument that collateral signals a riskier borrower that is charged a higher interest rate. However, collateral also lessens the bank's potential loss given a defaulted loan. Existing studies supporting this characteristic of collateral have been setting-specific and, while crucial to advancing our understanding of the role of collateral, they were not designed to be generalizable to the entire loan market. English & Nelson (1998) find that, when the bank's assessment of credit worthiness (via an internally generated credit score) is included in loan pricing models, the presence of collateral is negatively related to the price of the loan. Conversely, when the rating is absent, there is a positive relationship between loan pricing and collateral. Cerqueiro et al (2016) has shown the importance of a bank's private information in determining the effect of collateral on loan pricing. Based on these past studies, we hypothesize:

H1: Provided that default risk of collateral is appropriately controlled for, loan pricing is negatively related to the pledging of collateral.

Controlling for default risk aspect of collateral means to separate the credit worthiness signal of pledging collateral from the reduction of risk for the bank when collateral is pledged. If the asymmetric information theory that borrowers pledge collateral to indicate their private information about being credit worthy drives secured loans, then one would expect the interaction to be negatively related to loan pricing (Berger & Udell, 1990). This information asymmetry theory is supported neither in the literature nor anecdotal evidence (Blazy & Weill, 2013; Gonas et al., 2004).[1] The other theory in Berger and Udell (1990) is the observed risk theory; banks require collateral from riskier borrowers. While higher S&P ratings indicate less risk for the bank, the publicly available rating is not the only information banks use in determining borrower riskiness.[2]

Banks have access to private information about their borrowers and can use that information when determining credit worthiness (English & Nelson, 1998; Diamond 1984). In addition to confidential information that is part of the loan application, banks and borrowers typically have multiple loan and other banking relationships over time and these relationships strengthen the bank's private information about their borrower (Athavale & Edmister, 1999; Athavale & Edmister, 2004; Norden & Weber, 2010). The borrower benefits from using the same bank since the additional loans are more likely to be approved and will have lower interest rates (Bharath, Sreedhar, Dahiya, Saunders, & Srinivasan, 2007; Bharath, Sreedhar, Dahiya, Saunders, & Srinivasan, 2011). Banks develop industry expertise as well via repeated transactions with multiple firms of an industry as well as the support firms (suppliers, customers, etc.) for those firms (Stomper, 2006). In addition to sequential loan transactions, banks usually have deposit relationships, checking relationships, and other financing relationships with their borrowers. The complex relationship between borrower and bank is key in the bank's acquisition of private information about the borrower (Mester, Nakamura, & Renault, 2007; Norden & Weber, 2010). It has also been shown that banks' private information is more useful to the bank in assessing credit risk of the borrower and the loan(s) being offered (Beatty et al., 2010).

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[1] In addition to Blazy & Weill (2013)'s findings, in his time as a commercial credit analyst, author Meder experienced that no borrower believing themselves to be highly credit worthy chose to pledge collateral and, in fact, were quite upset and even offended when asked to do so.

[2] We use the long-term issuer S&P rating as a measure of borrower credit worthiness via public information. We considered the idea of investment grades; however, that is an issue-specific measure rather than an issuer measure.

The private information augments the public credit rating of the banks' borrowers. If the private information about credit worthiness simply corroborates the public information, securing loans for firms with high S&P ratings should further reduce the cost of borrowing. We do not have access the banks' private information about their borrowers; we argue that when a bank requires collateral for borrowers and loans where the public information indicates a lower risk of default (via a higher S&P rating) one can infer that the bank has privately assessed a higher risk of default than indicated by public ratings. Therefore, we hypothesize:

H2: The requirement of collateral by apparently less risky borrowers is positively related to loan pricing.

3. DATA AND RESEARCH DESIGN

3.1 Data

We use syndicated loans from the DealScan database initiated from 1998 to 2015. We obtain borrower financial characteristics from Compustat, including the long-term issuer S&P rating. The initial number of loans in our period is approximately 39,900 but we exclude bonds, bond-style facilities, letters of credit, and leases that are present in the data. The loans in our sample include term loans, mortgages, and lines of credit (short-term and long-term). We further restrict our sample by requiring all observations have all the information necessary for our regression tests. After imposing these restrictions and requirements, our sample consists of 7,512 syndicated loans with the requisite data.

3.2 Research Design

We are deliberately not trying to determine private versus public debt pricing for a particular credit instrument; we consider private debt only. Our variables of interest are *Secured* and *Secured*S&P*. *Secured* is a dichotomous variable that equals 1 for loans with pledged collateral and 0 otherwise.

We use the interaction of *Secured*S&P* to operationalize separating the two key functions of pledging collateral. The stand-alone *Secured* captures the effect of the reduction of loss given default function of pledging collateral. The interaction *Secured*S&P* captures the private credit risk knowledge of the bank. With the all-in spread (*AIS*) as our dependent variables and controlling for firm fixed effects, we regress our variables of interest as well as control variables in the following fully interacted regression:

$$AIS = \beta_0 + B_1{*}Secured + B_2{*}S\&P + B_3{*}Secured{*}S\&P + B_4{*}TIE + B_5{*}TIE{*}S\&P + B_5{*}Size + B_6{*}Size{*}S\&P + B_7{*}Leverage + B_8{*}Leverage{*}S\&P + B_9{*}LoanAmt + B_{10}{*}LoanAmt{*}S\&P + B_{11}{*}Maturity + B_{12}{*}Maturity{*}S\&P + \varepsilon \quad (1)$$

Under our first hypothesis, we expect the coefficient B_1 to be negative, consistent with the expectation that collateral mitigates the bank's loss in the event of default, provided we have separated the default risk indication effect of requiring collateral. The interaction *Secured*S&P* allows us to separate the effect of collateral as an indicator of a riskier borrower. We expect B_3 to be positive in support of our second hypothesis; if the bank requires collateral of a seemingly low default risk borrower (as indicated by a high S&P rating), that is indicative of the bank having private information that the borrower is riskier than the public information reveals. We include additional variables to control for the borrower's ability to repay the loan, their current indebtedness, and additional borrower and loan characteristics that could affect the pricing of the loan as well as the decision to require collateral. The variables are defined as follows:

AIS: All-in-spread, the amount (in basis points) that a loan's interest rate exceeds LIBOR
Secured: A dichotomous variable that equals 1 for loans with collateral and 0 otherwise
S&P: Long-term issuer credit rating. The rating is converted to a numeric scale (AAA=22,

AA+=21, AA=20, …, D=1). The natural logarithm of that value is used.

TIE: Times-interest-earned measured as EBITDA / Interest Expense

Size: The natural logarithm of the borrower's market value of equity

Leverage: A measure of the borrower's indebtedness as (Long-term debt+Current portion of long-term debt) / total assets

LoanAmt: The natural logarithm of the loan amount, or the maximum availability of a line of credit

Maturity: The maturity of the loan measured in months

We expect that *TIE, Size,* and *S&P* will be negatively related to loan spread (*AIS*). *TIE* is a measure of the borrower's ability to service their debt (to make the interest payments and, at maturity, repay the principle). Larger firms have more resources for raising capital as well as for satisfying their obligations and a stronger long-term issuer S&P rating indicates a borrower with a lower default probability. *Leverage* should be positively related to loan spreads; borrowers with higher debt are riskier since there are more claims on the borrower's assets as well as a higher amount of periodic interest expense. *Maturity* and *LoanAmt* are expected to be negatively related to loan spreads, consistent with prior literature. Longer loans with higher principle amounts are typically provided to lower risk borrowers.

4. RESULTS AND ANALYSIS

4.1 Descriptive statistics

Table 1 provides a summary of the descriptive statistics of our sample. Over our sample period (1998-2015), we have a total of 7,512 loans. Of those, 4,268 are secured and 3,244 are not. The first column of Table 1 shows the means and standard deviations for our regression variables (as well as the instrument *AvColl*). Our average loan has an all-in-spread of 194 basis points over LIBOR at the time of the loan and the average borrower has a 35.6% leverage ratio.

We separate our sample into secured and unsecured loans to compare the descriptive statistics. We see that secured and unsecured loans are observably different on all variables and that difference is statistically significant. For this reason, we include additional tests controlling for the potential endogeneity of securing a loan. The differences in means are as expected; borrowers with secured loans are more leveraged, smaller, pay higher interest rates, and have a lower times-interest-earned ratio. The loans have lower principle but, interestingly, have a longer maturity by about five and half months; the difference is statistically significant.

APPROXIMATE PLACEMENT TABLE 1

Table 2 presents the Pearson correlations between the variables for the observations used in our tests. The correlations are mostly as one would expect; loan spreads are negatively correlated with S&P rating, times-interest-earned, borrower size, and available collateral. The negative correlation with loan amount and maturity may not be as intuitive; however, longer and larger loans tend to go to borrowers who are more credit worthy and those borrowers also have lower interest rates. The positive correlations between loan amount and maturity with S&P rating support this idea. The negative correlation between *S&P* and *Secured* show that borrowers of lower risk as measured by publicly available ratings are less likely to be required to pledge collateral. We also have the usual caveat that these are univariate statistics and the multi-regression will be more informative.

APPROXIMATE PLACEMENT TABLE 2

4.2 Multivariable results

4.2.1 Full sample regression results

We test our hypotheses on the full sample of loan data which includes mortgages, other term loans, long-term lines of credit (maturities equal to and exceeding 1 year), and short-term lines of credit (maturities of less than one year). We estimate the regression of equation 1 over the full sample of 7,512 observations and report the results in Table 3.

To test *H1,* we consider the coefficient on the independent variable *Secured*, which equals one for secured loans and zero otherwise. We expect a negative and statistically significant coefficient. We find that the coefficient is -370.56 with a t-statistic of -6.76, which is statistically significant at less than 0.1%. We have support for *H1;* our test indicates that, once the effect of collateral as a proxy for credit worthiness has been controlled, collateral is negatively associated with the cost of debt as represented by the all-in-spread (*AIS*).

For *H2*, we consider the interactive term *S&P*Secured,* which represents the effect of pledging collateral coincidental with the borrower's credit worthiness. If the test supports *H2*, we expect the coefficient on the interaction to be positive and statistically significant. This would signify that the bank's private assessment of credit worthiness indicates a riskier borrower and that the bank requires collateral from the riskier borrower. We find a coefficient of 172.51 with a t-statistic of 8.15, significant at less than 0.1%, in clear support of *H2.*

APPROXIMATE PLACEMENT TABLE 3

We have support for both *H1* and *H2.* For this test, we utilized the entire sample including term loans and mortgages. Mortgages are almost always secured by the real property that is financed. Similarly, term loans are usually used for real or personal property and the property obtained is very often required as collateral as part of the loan contract by design. Therefore, we repeat our tests using the subsample of short-term lines of credit.

4.2.2 Results of regression on the short-term line of credit subsample

Our sample now consists of lines of credit with a maturity of less than one year. Unlike term loans and mortgages which typically have an associated, specific asset being financed, lines of credit often are for ‘working capital’ or ‘operating purposes’ and not a specific asset. They do not have that specificity of collateral choice and are less likely to be secured, on average. When collateral is required of lines of credit, it is less likely to be due to ‘standard practice’ of the bank. We have 1,012 observations and we estimate the equation 1 regression using this subsample and report the results in Table 4.

As before, we consider the coefficient on *Secured* for testing *H1*. We expect the coefficient to be statistically significant and negative. Such a finding would support *H1* by indicating the negative relationship between pledging collateral and loan pricing when the credit worthiness indication function of collateral is controlled. Our results, reported in Table 4, do support *H1*. We find a coefficient on *Secured* of -250.563 with a t-statistic of -2.05 which is statistically significant at less than the 5% level.

For *H2*, we again consider the interactive term *S&P*Secured*, which represents the effect of pledging collateral coincidental with the borrower’s credit worthiness. If the test supports *H2*, we expect the coefficient on the interaction to be positive and statistically significant. This would signify that the bank’s assessment of credit worthiness indicates a riskier borrower and collateral signals that risk. *H2* is supported with a coefficient of 113.79 on *S&P*Secured* and a t-statistic of 2.44 indicating significance at the less than 1% level.

APPROXIMATE PLACEMENT TABLE 4

4.3 Regression analysis including control for potential endogeneity

4.3.1 Probit model and results

Our main tests do not account for potential endogeneity concerns; secured borrowers may, by nature, have higher loan spreads. If this is so, our findings may not wholly be attributed to the effect of collateral but reflect the characteristics of secured borrowers. To address this issue, we employ the Heckman selection method (Heckman, 1979). We evaluate the following probit equation with *Secured* as the dependent variable.

$$Secured = \Gamma_0 + \Gamma_1 {*} AvColl + \Gamma_2 {*} AIS + \Gamma_3 {*} S\&P + \Gamma_4 {*} TIE + \Gamma_5 {*} Size + \Gamma_6 {*} Leverage + \Gamma_7 {*} LoanAmt + \Gamma_8 {*} Maturity + \delta \quad (2)$$

We then derive the inverse mills ratio to include in equation (1) while we repeat our tests.

The instrument, *AvColl*, is available collateral calculated as Book Equity/Total assets. Collateral is valuable if the lender can claim title in the event of default. In default, unsecured lenders are last to be made whole while secured lenders have priority; the secured lenders are ordered by loan date (earlier loans having seniority) (Schwartz, 1989). However, purchase money priority provides that a lender providing funds for specific items has first rights to that item and/or the benefits derived from that item (Schwartz, 1989). In other words, a firm's supplier has first rights to the inventory for which it has not been paid as well as any receivables outstanding from the sale of the items that supplier provided. Therefore, the authors use the net book equity scaled by total assets as a measure of available collateral to ensure the current lender will have senior rights to the collateral should the need to seize the collateral arise.[3]

The results of the probit model are reported in Table 5. The coefficient on *AvColl* is positive and significant at the less than 0.1% level. Loan spread, leverage and maturity are all positively associated with a collateralized borrower while size, S&P rating, and loan amount are negatively associated. Times-interest-earned is not significantly related to the presence of collateral. The Psuedo-R^2 is 0.4834. We derive the inverse mills ratio from this model and include it in our main regression equations (Greene, 2008).

APPROXIMATE PLACEMENT OF TABLE 5

[3] Qualitatively similar results are obtained when other tangibility and available collateral measures are used.

4.3.1 Full sample regression including the IMR

Table 6 presents the results of the main test on the whole sample with the *IMR* variable included. The significant, negative coefficient on *IMR* indicates likely endogeneity. In this model, when controlling for that endogeneity, we still support both *H1* and *H2.* The coefficient on *Secured* is negative and significant at less than the 0.1% level (coefficient = -533.48 with a t-stat of -7.46). For *H2*, the coefficient of the interaction *Secured*S&P* is positive and significant at less than the 0.1% (coefficient = 237.57 and t-stat 8.36). The consistence of our findings when controlling for endogeneity strengthens the support for both of our hypotheses.

Having controlled for selection concerns, we find that loan interest rates are lower in the presence of collateral consistent with the theory that banks use collateral to make the loan less risky by reducing potential loss given default. We accomplish this by separating the observed risk theory of collateral which states banks require collateral from risky borrowers. Evidence of that separation is that we find that when banks require collateral of apparently less risky borrowers, those borrowers' loans have higher interest rates. This is consistent with the observed risk theory and not the information asymmetry theory that posits borrowers choose to pledge collateral to indicate their higher credit worthiness.

APPROXIMATE PLACEMENT OF TABLE 6

4.3.2 Short-term line of credit subsample including the IMR

We repeat our second test using just the short-term lines of credit; those results are reported in Table 7. Similar to the full-sample tests including the *IMR*, our findings are consistent and support both *H1* and *H2.* The coefficient on *Secured* is -381.72 with a t-statistic of -2.51 which is significant at less than the 1% level. On the interaction *Secured*S&P*, we have a coefficient of 173.73 and a t-statistic of 2.72, significant at less than the 1% level. For both the full sample and the short-term line of credit subsample, we have found consistent results while controlling for the potential endogeneity of requiring collateral.

APPROXIMATE PLAEMENT OF TABLE 7

5. SUMMARY AND CONCLUSIONS

Collateral serves more than one function in a bank loan. By requiring the collateral, the bank has placed some control and constraint on the borrower. If the borrower defaults, the collateral pledged on secured loans may be seized by the bank. If the bank observes a risky borrower, the bank may require collateral. In that case, the collateral could proxy for general riskiness of the borrower and, since risky borrowers generally pay higher interest rates, collateral could be positively associated with loan spreads. This positive relationship is the one most often found in the literature. However, there are also findings of collateral and loan spreads being negatively related. Those studies typically were of specific industries (i.e. airlines), used small samples of some private information, or had other restrictions that could limit the generalizability of their findings. We develop a test that returns more generalizable results; we attempt to separate the observed risk effect of collateral from a second effect. Collateral also reduces the bank's loss in the event of borrower default. When the borrower defaults, the bank seizes the collateral as part of satisfying the remaining debt that is owed. We separate the observed risk effect from the mitigation of loss given default in a general sample of syndicated loans and find a consistent negative relationship between collateral and loan spreads.

In addition to that contribution to the debt contracting literature, our observed risk measure adds to the understanding of why firms agree to pledge collateral. The theoretical debate has been between the information asymmetry theory and the observed risk theory. In both theories, private information plays a role; in the first, it is the borrower who has private information and pledges collateral to signal their status as a low-risk borrower. In the second, the bank has private information that allows them to assess the borrower's risk. We cannot know the private information in a generalized setting using public data, but we use the public data to infer the private information. We find that when firms with publicly high credit ratings have loans with collateral, the collateral is positively associated with loan spreads. This is consistent with the observed risk theory; the private information of the bank leads them to require collateral despite the high pubic credit rating. The bank has privately observed risk in the borrower. Our paper separates the mitigation of loss in default effect from the proxy for riskiness effect of collateral and shows that collateral independently is negatively related to loan spreads. We also contribute to the growing evidence that borrowers do not choose to provide collateral as a signal of their credit worthiness.

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TABLE 1: Descriptive statistics

	Full Sample, N=7,512		Unsecured, N=3,244		Secured, N=4,268		1998-2015
Variable	**Mean**	**Std. Dev**	**Mean (A)**	**Std. Dev**	**Mean (B)**	**Std. Dev.**	**Difference: (B) – (A)**
AIS	194.07	129.24	109.60	86.67	258.28	118.92	148.69***
Secured	0.568	0.495	N/A	N/A	N/A	N/A	N/A
S&P	2.365	0.533	2.650	0.227	2.148	0.594	-0.502***
TIE	10.412	24.921	14.031	25.250	7.662	24.314	-6.370***
Size	7.466	2.08	8.710	1.300	6.520	2.007	-2.19***
Leverage	0.356	0.214	0.289	0.159	0.406	0.236	0.117***
LoanAmt	5.661	1.353	6.406	1.069	5.095	1.269	-1.311***
Maturity	45.550	20.901	42.369	21.780	47.960	19.874	5.592***
AvColl	0.330	0.169	0.367	0.150	0.302	0.177	-0.066***

AIS—the all-in-spread as the amount the interest rate exceeds LIBOR measured in basis points, *Secured* –dichotomous and equals 1 if the loan is secured and 0 otherwise, *S&P* –the log transform of borrower's S&P rating first translated to an integer (AAA=22, AA+=21, …, D=1), *TIE* –times-interest-earned as EBITDA/interest expense, *Size* log of the market value of equity, *Leverage*—borrower's debt load as (Current portion of long-term debt + long term debt) / total assets, *LoanAmt* –log of the total amount of the loan or the maximum availability of a line of credit, *Maturity* –time until the loan matures measured in months, *AvColl* –value of available collateral as book value of equity / total assets.

TABLE 2: Pearson Correlations

	AIS	Secured	S&P	TIE	Size	Leverage	LoanAmt	Maturity	AvColl
AIS	1								
Secured	0.5699*	1							
S&P	-0.4646*	-0.4659*	1						
TIE	-0.1461*	-0.1266*	0.1181*	1					
Size	-0.5151*	-0.5296*	0.6441*	0.1781*	1				
Leverage	0.3103*	0.2701*	-0.1726*	-0.3191*	-0.3060*	1			
LoanAmt	-0.4419*	-0.4800*	0.3348*	0.0799*	0.6165*	-0.2045*	1		
Maturity	-0.0340*	0.1325*	0.0013	0.0397*	0.0660*	-0.0059	0.0484*	1	
AvColl	-0.3017*	-0.1927*	0.2811*	0.2972*	0.3213*	-0.5721*	0.1565*	0.1241*	1

AIS—the all-in-spread as the amount the interest rate exceeds LIBOR measured in basis points, *Secured* –dichotomous and equals 1 if the loan is secured and 0 otherwise, *S&P* –the log transform of borrower's S&P rating first translated to an integer (AAA=22, AA+=21, …, D=1), *TIE* –times-interest-earned as EBITDA/interest expense, *Size* log of the market value of equity, *Leverage*—borrower's debt load as (Current portion of long-term debt + long term debt) / total assets, *LoanAmt* –log of the total amount of the loan or the maximum availability of a line of credit, *Maturity* –time until the loan matures measured in months, *AvColl* –value of available collateral as book value of equity / total assets

TABLE 3: Full sample with *AIS* as the dependent variable

VARIABLES	
Secured	-370.556***
	(-6.76)
S&P	-247.984***
	(-8.71)
Secured*S&P	172.512***
	(8.15)
TIE	-2.088***
	(-5.53)
TIE*S&P	0.803***
	(5.27)
Size	-9.232***
	(-2.72)
Size*S&P	-3.556**
	(-2.15)
Leverage	48.560
	(1.51)
Leverage*S&P	15.133
	(1.04)
LoanAmt	-32.949***
	(-4.03)
LoanAmt*S&P	9.748***
	(3.03)
Maturity	-1.089***
	(-5.01)
Maturity*S&P	9.197***
	(3.76)
Constant	909.774***
	(12.67)
Observations	7,512
Adjusted R-squared	0.6128
Including firm fixed effects	

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

AIS—the all-in-spread as the amount the interest rate exceeds LIBOR measured in basis points, *Secured* –dichotomous and equals 1 if the loan is secured and 0 otherwise, *S&P* –the log transform of borrower's S&P rating first translated to an integer (AAA=22, AA+=21, …, D=1), *TIE* –times-interest-earned as EBITDA/interest expense, *Size* log of the market value of equity, *Leverage*—borrower's debt load as (Current portion of long-term debt + long term debt) / total assets, *LoanAmt* –log of the total amount of the loan or the maximum availability of a line of credit, *Maturity* –time until the loan matures measured in months.

TABLE 4: Sample restricted to short-term lines of credit with *AIS* as the dependent variable

VARIABLES	
Secured	-250.563**
	(-2.05)
S&P	-37.319
	(-0.57)
Secured*S&P	113.790**
	(2.44)
TIE	-3.688***
	(-2.79)
TIE*S&P	1.274***
	(2.76)
Size	21.020
	(1.17)
Size*S&P	-8.463
	(-1.27)
Leverage	-271.672
	(-1.00)
Leverage*S&P	99.839
	(1.02)
LoanAmt	28.447
	(0.95)
LoanAmt*S&P	-15.453
	(-1.35)
Maturity	-1.735
	(-0.80)
Maturity*S&P	-0.350
	(-0.05)
Constant	340.715**
	(2.08)
Observations	1,012
Adjusted R-squared	0.8412
Including firm fixed effects	

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

AIS—the all-in-spread as the amount the interest rate exceeds LIBOR measured in basis points, *Secured* –dichotomous and equals 1 if the loan is secured and 0 otherwise, *S&P* –the log transform of borrower's S&P rating first translated to an integer (AAA=22, AA+=21, …, D=1), *TIE* –times-interest-earned as EBITDA/interest expense, *Size* log of the market value of equity, *Leverage*—borrower's debt load as (Current portion of long-term debt + long term debt) / total assets, *LoanAmt* –log of the total amount of the loan or the maximum availability of a line of credit, *Maturity* –time until the loan matures measured in months

TABLE 5: Probit model determining the presence of collateral. Dependent variable is *Secured*

VARIABLES	(1)
AvColl	0.693***
	(4.60)
AIS	0.005***
	(22.49)
S&P	-1.499***
	(-17.43)
TIE	-0.001
	(-0.77)
Size	-0.123***
	(-6.98)
Leverage	1.038***
	(7.62)
LoanAmt	-0.353***
	(-16.98)
Maturity	0.014***
	(13.54)
Constant	4.797***
	(18.93)
Observations	7,512
Pseudo R^2	0.4834

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

AIS—the all-in-spread as the amount the interest rate exceeds LIBOR measured in basis points, *Secured* –dichotomous and equals 1 if the loan is secured and 0 otherwise, *S&P* –the log transform of borrower's S&P rating first translated to an integer (AAA=22, AA+=21, …, D=1), *TIE* –times-interest-earned as EBITDA/interest expense, *Size* log of the market value of equity, *Leverage*—borrower's debt load as (Current portion of long-term debt + long term debt) / total assets, *LoanAmt* –log of the total amount of the loan or the maximum availability of a line of credit, *Maturity* –time until the loan matures measured in months, *AvColl* –value of available collateral as book value of equity / total assets

TABLE 6: Full sample tests including the *IMR* control. *AIS* is the dependent variable

VARIABLES	AIS
Secured	-533.478***
	(-7.46)
S&P	-315.585***
	(-9.11)
Secured*S&P	237.572***
	(8.36)
TIE	-2.370***
	(-5.45)
TIE*S&P	0.919***
	(5.25)
Size	-10.171***
	(-2.94)
Size*S&P	-2.691
	(-1.60)
Leverage	44.712
	(1.37)
Leverage*S&P	14.760
	(1.01)
LoanAmt	-33.190***
	(-4.02)
LoanAmt*S&P	10.358***
	(3.19)
Maturity	-1.135***
	(-5.08)
Maturity*S&P	9.361***
	(3.73)
IMR	-30.350***
	(-3.63)
Constant	1,081.105***
	(12.39)
Observations	7,512
Adjusted R-squared	0.6166
Including firm fixed effects	

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

AIS—the all-in-spread as the amount the interest rate exceeds LIBOR measured in basis points, *Secured* –dichotomous and equals 1 if the loan is secured and 0 otherwise, *S&P* –the log transform of borrower's S&P rating first translated to an integer (AAA=22, AA+=21, …, D=1), *TIE* –times-interest-earned as EBITDA/interest expense, *Size* log of the market value of equity, *Leverage*—borrower's debt load as (Current portion of long-term debt + long term debt) / total assets, *LoanAmt* –log of the total amount of the loan or the maximum availability of a line of credit, *Maturity* –time until the loan matures measured in months, *IMR* –inverse mills ratio developed from the probit model reported in Table 5

TABLE 7: Results from the subsample of short-term lines of credit including the *IMR* control. *AIS* is the dependent variable.

VARIABLES	
Secured	-381.724**
	(-2.51)
S&P	-97.212
	(-1.17)
Secured*S&P	173.731***
	(2.72)
TIE	-3.368**
	(-2.42)
TIE*S&P	1.162**
	(2.39)
Size	15.307
	(0.89)
Size*S&P	-5.993
	(-0.90)
Leverage	-292.524
	(-1.12)
Leverage*S&P	108.140
	(1.14)
LoanAmt	30.090
	(1.03)
LoanAmt*S&P	-15.814
	(-1.43)
Maturity	-1.430
	(-0.69)
Maturity*S&P	-1.651
	(-0.23)
IMR	-27.534
	(-1.12)
Constant	498.425**
	(2.43)
Observations	1,012
Adjusted R-squared	0.8430
Including firm fixed effects	

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

AIS—the all-in-spread as the amount the interest rate exceeds LIBOR measured in basis points, *Secured* –dichotomous and equals 1 if the loan is secured and 0 otherwise, *S&P* –the log transform of borrower's S&P rating first translated to an integer (AAA=22, AA+=21, …, D=1), *TIE* –times-interest-earned as EBITDA/interest expense, *Size* log of the market value of equity, *Leverage*—borrower's debt load as (Current portion of long-term debt + long term debt) / total assets, *LoanAmt* –log of the total amount of the loan or the maximum availability of a line of credit, *Maturity* –time until the loan matures measured in months, *IMR* –inverse mills ratio developed from the probit model reported in Table 5