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The Valuation of Collateral in Bank Lending

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Abstract

We study the valuation of collateral by comparing spreads on loans by the same bank, to the same borrower, at the same origination date, but backed by different types of collateral. Pledging collateral reduces borrowing costs by 23 BPS on average. The effect varies across different types of collateral, with marketable securities being most valuable, and real estate and accounts receivables and inventory being more valuable than fixed assets and a blanket lien. Further, the rate reduction from pledging collateral is sensitive to the value of the underlying collateral, and collateral tends to be more valuable for smaller and private firms and for loans with longer maturity.

I. Introduction

A large body of theoretical work argues that collateral mitigates frictions in credit markets.[1] However, empirical research on the value of collateral has been hampered by the endogeneity of the decision to pledge collateral. For example, existing cross-sectional studies find loans secured with collateral carry higher spreads even after controlling for observable risk factors (see, e.g., Berger and Udell (1990), John, Lynch, and Puri (2003), Santos and Winton (2008), (2019), and Santos (2011)). Albeit recent progress in identifying and quantifying the causal effect of collateral on loan prices (see, e.g., Benmelech and Bergman (2009), Cerqueiro, Ongena, and Roszbach (2016)), fundamental questions remain the subject of debate: Which types of collateral are most common and most valuable

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[1]For example, collateral can alleviate credit rationing (Stiglitz and Weiss (1981)), signal borrowers' quality (Chan and Kanatas (1985)), solve under-investment problems (Stulz and Johnson (1985)), improve banks' monitoring incentives (Rajan and Winton (1995), Gorton and Kahn (2000)), reduce borrowers' risk-shifting incentives (Boot, Thakor, and Udell (1991)), and assign priority rights among creditors (Longhofer and Santos (2003)).

in bank-firm lending? Is the pricing of collateral sensitive to the value of the collateral pledged? For which types of firms is collateral most valuable?

In this article, we contribute to the understanding of these questions in two ways. First, we provide a set of key facts of how collateral is used in C&I lending by U.S. banks. Second, we study the effect of collateral on loan pricing by comparing secured loans with unsecured loans, looking at financial instruments of the same type, from the same firm, with the same bank, and the same origination date. Our empirical approach therefore allows us to control for observed and unobserved time-varying lender or borrower-specific drivers of loan prices. This approach gives us the opportunity to obtain a relatively precise estimate of the marginal valuation of pledging collateral for a given bank-firm pair.

We conduct our analysis using loan-level data from the Federal Reserve's Y-14 data collection. Starting in 2011, large banks with more than $50 billion in assets are required to report detailed information on most types of commercial and industrial (C&I) loans on their balance sheet with a commitment of $1 million or more. These data have several advantages over the data commonly used to study C&I lending. The data collection does not only cover publicly listed and large private borrowers, but also medium-sized businesses. Further, the Y-14 data provide relatively detailed information on the collateral used in each loan contract.[2] Finally, there is a large number of borrowers that receive multiple loans from the same bank at the same time, with some loans being unsecured and others being secured.

Our analysis reveals four key insights. First, we show that while 84% of all C&I loans are secured, there is large heterogeneity across the types of collateral used and the types of firms that pledge collateral. The most common types of assets pledged are accounts receivable and inventory (28%) and real estate (15%). Fixed assets other than real estate (8.3%) as well as cash and marketable securities (1.8%) are rather uncommon. Around 24% of all loans have a blanket lien. Further, there are also important differences in the types of collateral used across different types of firms such as private and public firms or smaller and large firms. For instance, while less than 10% of all loans from private firms are unsecured, around 45% of loans from public firms are unsecured. Similarly, while small firms (those with less than $50 million in assets) have less than 4% of their loans unsecured, 43% of loans to large firms (with more than 500$ million in assets) are unsecured.

Second, comparing loans taken by the same firm, of the same type, at the same time, from the same bank, we find that the spread on the secured loan is on average 23 BPS lower than the spread on the unsecured loan. In line with banks assigning higher valuations to more liquid and less borrower-specific assets, we find large variation in the price effect across collateral types. For instance, we find that marketable securities are by far the most valuable type of collateral and reduce the loan spread by more than 38 BPS. Accounts receivable and inventory or real estate are equally valuable and each reduce the spread by around 25 and 24 BPS, respectively. In contrast, fixed assets other than real estate are the least valuable and reduce the spread by only 14 BPS. A blanket lien is very similar to an unsecured loan.

[2]Both DealScan and Shared National Credit (SNC)—the most widely utilized databases on corporate loans in the USA—are dominated by large firms because they report information on syndicated loans. Moreover, DealScan reports only information on whether the borrower pledged collateral without specifying the type of collateral used, and that information is missing for more than 40% of the facilities.

Third, we show that loan pricing is sensitive to changes in the value of collateral pledged. Specifically, we find that the price effect of pledging real estate collateral becomes stronger if local housing prices are increasing or at a higher level, in line with the classic collateral channel (Bernanke and Gertler (1989), Kiyotaki and Moore (1997), and Brunnermeier and Sannikov (2014)). We estimate that a 1-percentage-point increase in the rate of housing price growth reduces the spread on loans collateralized by real estate by around 5 BPS. Moreover, we find a comparable pattern when firms pledge accounts receivable and inventory as collateral. If the value of a firm's accounts receivable and inventory increase by 0.1 relative to the amount borrowed backed by accounts receivables and inventory, the respective spread decreases by around 5 BPS.

Fourth, we find that the valuation of collateral varies with firm and loan characteristics in line with the insights from the theoretical literature. For instance, we find suggestive evidence that collateral is more valuable for riskier firms (in line with, e.g., Strahan (1999)). We find stronger price reductions when pledging collateral for smaller firms, private firms, firms with a higher leverage, and firms that are in an early stages of a bank-firm relationship experience. In contrast, collateral is of little value for large and publicly listed firms as well as firms with long-term bank-lending relationships, which tend to be safer and less informationally opaque. However, while the point estimates are indicating differences across all the dimensions considered above, it is important to note that the differences in the valuation of collateral by firm type are only statistically significant when considering firm size and whether firms are public or private but not firm leverage and bank-firm relationship status. Finally, we also find that collateral is more valuable in loans with longer maturity.

A key advantage of our within bank-firm pair identification strategy lies in its ability to deal with identification challenges that arise in cross-sectional studies. For instance, it alleviates concerns about the selection of risky borrowers into collateralized loan products and rules out that differences in market power drive results. However, focusing on within-firm variation implies that we are not able to identify the value of collateral that arises in the cross section such as when collateral is a signaling device (Bester (1985), Chan and Kanatas (1985), Besanko and Thakor (1987a), (1987b), and Chan and Thakor (1987)). Thus, our approach is best suited to quantify the value of collateral that results from an increased recovery value/decreased loss given default (Altman and Kalotay (2014), Carey and Gordy (2016)).

Further, our empirical strategy is subject to a set of identification concerns that need to be kept in mind when interpreting our findings. First, while it is common that firms take out more than one loan of the same type with the same bank at the same time – it happens in around 17% of all new originations – the question arises why firms pledge collateral in some loans, but not in others. Our preferred interpretation is that firms are either constrained and do not have sufficient collateral to cover the entire amount borrowed or have a preference for keeping assets unencumbered for future borrowing. Second, the degree of loan collateralization and loan prices are jointly determined and banks arguably understand that by reducing the amount of unencumbered assets, the value of the unsecured loan is reduced. Thus, it is important to keep in mind that our empirical strategy only identifies the *marginal* price reduction from collateralizing one additional unit of credit. That is, we identify the price effect of backing one additional unit of a claim with an encumbered asset that cannot written

down in bankruptcy. Third, our estimates on the valuation of specific types of collateral are by definition equilibrium outcomes, possibly giving rise to a selection problem that constrains the external validity of our findings. For instance, if only relatively risky firms pledge collateral, the estimated price effect of pledging collateral may be higher than it is for less risky firms that are not pledging collateral in equilibrium.

Our article is most closely related to Benmelech and Bergman (2009) and Cerqueiro et al. (2016).[3] Benmelech and Bergman (2009) investigate how loan pricing in the airline industry varies with the redeployability of collateral (airplanes). They find that debt tranches that are secured by more redeployable collateral carry lower credit spreads, higher credit ratings, and higher loan-to-value ratios, thereby confirming that pledging collateral is valuable. Cerqueiro et al. (2016) exploit a legal change in Sweden that reduced the eligible assets that creditholders could seize absent a court order declaring the debtor's bankruptcy. Using data on the loan exposures of one bank, they find that the bank reduced the assessed value of collateral and increased the interest rate on outstanding treated loans after the change in the law was implemented.

Our article extends these studies in several important directions. In contrast to Benmelech and Bergman (2009), we investigate the value of pledging collateral in a setting where we are able to distinguish between different types of collateral and that includes large and small firms, from a variety of different industries. Interestingly, we find that the magnitude of the price effect that results from pledging the most valuable type of collateral (marketable securities) is comparable to the price reduction an airline receives for pledging a highly redeployable airplane. In contrast to Cerqueiro et al. (2016), our data cover many banks and thus our estimates are not driven by the idiosyncrasies or market power of any single lender. Similarly, because we focus on new loans that were originated over several years, our findings are less likely to be confounded by time effects. Last, and most importantly, because our identification strategy is based on a within-firm comparison, concerns with the endogeneity of collateral pledging are somewhat mitigated, hence strengthening the findings of these studies.

Our article is also related to other recent studies that rely on within-firm strategies to identify the price effect of different forms of funding. Contemporaneous work by Benmelech, Kumar, and Rajan (2022) has a similar research objective as ours but relies on DealScan data. Given that the Y-14 data cover a wider set of borrowers than Dealscan, our analysis benefits from a larger sample of borrowers that take out multiple term loans or credit lines at the same time with some being secured and other not. Also, in contrast to Dealscan, our data allow us to investigate the relative importance of different types of collateral. Like us, Beyhaghi (2022) uses the Y-14 but his focus is on identifying the price effect of guarantees by U.S. government agencies. Giovanni, Kalemli-Ozcan, Ulu, and Baskaya (2021) use within-firm variation to study the role of collateral in a credit boom in an emerging economy and Schwert (2020) uses within-firm identification variation to compare spreads on bonds and bank loans originated at the same date to identify the cost difference between market-based an bank finance.

[3]Our article is also related to Booth and Booth (2006), who address the endogeneity problem of collateral pledging using a two-step procedure.

Additionally, our article is related to several other studies that have investigated various aspects of collateral in bank lending. Like Hester (1979), Berger and Udell (1995), and Berger, Frame, and Ioannidou (2011), (2016), we too find that riskier borrowers are more likely to pledge collateral.[4] In addition, like Ioannidou, Pavanini, and Peng (2022), our findings show that riskier borrowers benefit the most from pledging collateral. Like Ortiz-Molina and Penas (2008) and Berger et al. (2011), we too find that collateral is more valuable for longer-term loans, and our results show that this effect is more prevalent among small firms—in line with evidence in Greenwald, Krainer, and Paul (2020), Caglio, Darst, and Kalemli-Özcan (2021), and Chodorow-Reich, Darmouni, Luck, and Plosser (2021). Our finding that marketable securities are the most valuable type ofcollateral is in line with Benmelech et al. (2005) and Benmelech (2008), who find that collateral with higher liquidation values is associated with longer-term debt.

Finally, our article adds to those studies that have attempted to uncover supporting evidence for the collateral channel. Cvijanović (2014) and Nikolov, Schmid, and Steri (2018) show that corporate leverage increases together with collateral values, while Lin (2016) shows that firms take on more bank debt when collateral values rise. Gan (2007), Chaney, Sraer, and Thesmar (2012), Bahaj, Foulis, and Pinter (2020), and Lian and Ma (2021), in turn, document that rising real estate collateral values support corporate investment. Further, Cerqueiro, Ongena, and Roszbach (2020) show how the value of collateral affects corporate financing, investment, and performance. A common feature of this literature is the focus on publicly listed or large private firms.[5] Also, these studies do not investigate whether firms actually take advantage of higher collateral asset values by pledging them in secured contracts.[6] While we confirm the finding that large firms do not rely extensively on collateral (see, e.g., Lian and Ma (2021)), we do find in line with Bahaj et al. (2020) that collateral is most often used and very valuable for smaller and medium-sized borrowers and generally sensitive to changes in its value.

The rest of the article is organized as follows: Section II presents our data sources and methodology and describes our sample and establishes a set of stylized facts. Section III presents our main results on the pricing of collateral. Section IV explains how the value of collateral varies across different types of firms as well as with loan maturity. Finally, Section V concludes with some final remarks.

II. Data, Methodology, and Sample Characterization

A. Data

Our main data source is the FR Y-14Q data collection, which is maintained to assess bank capital adequacy and to support stress test models. The FR Y-14Q data contain detailed quarterly data on various asset classes, capital components, and

[4]This finding contrasts with research by Jiménez, Salas, and Saurina (2006), who present evidence that safer Spanish firms are more likely to pledge collateral.

[5]An important exception is Gopal (2021) who studies the role of lender specialization for small business credit access in the aftermath of the 2008 financial crisis.

[6]Campello, Connolly, Kankanhalli, and Steiner (2022) find that firms increase investment spending following a rise in the value of their real estate holdings, but do so using funds raised primarily from the issuance of unsecured bonds and notes.

categories of pre-provision net revenue for some bank holding companies (BHC) and intermediate holding companies (IHC). The respondent panel used in our analysis is comprised of any top-tier BHC or IHC that has $50 billion or more in total consolidated assets, and covers all banks that are or have ever been subject to the Federal Reserve's stress tests.[7]

We use the corporate loan schedule (H.1) which contains information on loans with a commitment of $1 million or more issued by the reporting bank. We include four types of loans, defined by their line numbers on schedule HC-C of the FR Y-9C reports filed by all BHCs: commercial and industrial (C&I) loans to U.S. addresses (Y-9C item 4.a), loans secured by owner-occupied nonfarm nonresidential properties (Y-9C item 1.e(1)), loans to finance agricultural production (Y-9C item 3), and other leases (Y-9C item 10.b). Overall, the loans reported in the data account for a little less than two-thirds of all C&I lending volume.

In comparison to other commonly used loan-level data sets (such as DealScan or the Shared National Credit (SNC) program), which are dominated by syndicated loans, the FR Y-14 includes both syndicated and nonsyndicated loans. This data source, therefore, provides an opportunity to study loans to small and medium-sized corporations.

In our main analysis, we focus on loans originated between 2012:Q3 and 2019:Q4 by a total of 33 unique banks.[8] Banks report a large set of characteristics for each loan, including its committed and utilized amount, interest rate, spread, whether the loan is floating or fixed rate, loan purpose, origination and renewal date, and the remaining maturity.[9] Banks also report the loan type, allowing us to distinguish between revolving credit lines, term loans, nonrevolving credit lines, capitalized lease obligations, and other loans. Most important for our purposes, banks report whether the loan is secured, and if so, the type of collateral the borrower pledged. If multiple types of collateral are pledged for a loan, banks report the predominant type of collateral. Banks distinguish between six categories of collateral pledged: real estate, cash and marketable securities, accounts receivable and inventory, fixed assets other than real estate, other collateral, blanket lien, and unsecured.

The FR Y-14 data also contain information on borrowers, including their location, industry, risk rating, and financial variables. Financial variables are reliably available for around two-thirds of firms and include total assets, total debt, operating income, interest expenses, accounts receivable and inventories, and sales. We use borrowers' tax identification numbers to link their loans across banks and over time. We hand-match the FR Y-14Q data with Compustat to distinguish

[7]The size cutoff is based on: i) the average of the firm's total consolidated assets in the four most recent quarters as reported quarterly on the firm's Consolidated Financial Statements for Holding Companies (FR Y-9C); or ii) if the firm has not filed an FR Y-9C for each of the most recent four quarters, then the average of the firm's total consolidated assets in the most recent consecutive quarters as reported quarterly on the firm's FR Y-9Cs. Since 2020:Q2, the respondent panel is comprised of any top-tier BHC or IHC with $100 billion or more in total consolidated assets. However, the sample used for our analysis ends in 2019:Q4.

[8]Given that the majority of banks only report data after 2012:Q3, we drop observations prior to 2012:Q3.

[9]Interest rates and spreads are only reported if the facility has positive drawdown rate. Given that our analysis focuses on the pricing of collateral, we exclude all undrawn commitments from our analysis.

publicly listed borrowers. Finally, we merge our loan data with county-level housing prices from CoreLogic to gather information on housing prices in the county where the borrower is located in to study the sensitivity of loan pricing to collateral values.

B. Collateral Usage in U.S. C&I Lending

To set the stage for our main analysis on the pricing effect of pledging collateral, we present a series of stylized facts on how collateral is used in bank-firm C&I lending in the U.S. between 2012 and 2019. Table 1 shows that only 16% of all loans reported are unsecured.[10] The most common types of assets pledged as collateral are accounts receivable and inventory (28%) and real estate (15%). Fixed assets other than real estate (8.3%) and cash and marketable securities (1.8%) are rather uncommon. Around 24% of all loans have a blanket lien.

Panels A1–A4 of Table 1 further show how the use of different types of collateral vary across different types of loans. We find that revolving credit lines are typically backed by accounts receivable and inventory (39%), see Panel A1. In contrast, Panels A2 and A3 show that term loans and nonrevolving credit lines are typically backed by real estate (36% and 25%, respectively). Further, the distribution of the different types of collateral used in term loans is generally quite similar to the distribution of collateral types used in nonrevolving credit lines, although the latter is somewhat more likely to be unsecured. Capitalized lease obligations are by definition typically linked to fixed assets that are not real estate.

A key advantage of the Y-14 data collection is that it not only contains loans to large corporations, but it also allows the study of loans to private as well as small and medium-sized enterprises. Indeed, there is a pronounced difference in collateral usage between private and public firms as well as large differences across firm size, see Panel B of Table 1.[11] In line with evidence documented in Greenwald et al. (2020) and Chodorow-Reich et al. (2021), secured loans are far less prevalent among publicly listed firms, the most studied segment of U.S. corporate sector market. For instance, around 17% of all loans to publicly listed firms have a blanket lien and around 45% are unsecured. These estimates are in line with the findings from Lian and Ma (2021) who show that most lending to large firms is typically cash-flow based rather than asset-based.[12] In contrast, among privately held firms only around 8.3% of outstanding loans are unsecured (or 34.3% when considering a blanket lien as unsecured).

There are also important differences in the types of collateral used across private and publicly listed firms. For example, less than 2% of publicly listed firms' loans are backed by real estate; in contrast, 18% of private firms' loans are secured by real estate. Similarly, while 20% of public firm loans are backed by accounts receivable, 32% of small firm loans use this type of collateral. Further, while 17% of

[10]This percentage is higher than the proportion of unsecured loans in Dealscan over the period of 2012 to 2018 (6.6%). However, 47.9% of the loans reported in DealScan over that time period are not classified as secured or unsecured.

[11]We identify a firm as publicly traded via merging our data with Compustat.

[12]The share of secured loans (collateral other than blanket lien) is only around 30% when considering volume-weighted shares.

TABLE 1

Distribution of Collateral Usage by Loan and Firm Type

Table 1 reports the fraction of loan commitments with the type of collateral indicated in the table header by loan type and firm type. The sample includes all outstanding loans in the FR Y-14 corporate loan schedule between 2012:Q3 and 2019:Q4.

Collateral Type	Real Estate	Cash and Mark. Sec.	AR and Inventory	Fixed Assets	Other	Blanket Lien	Unsecured	No. of Obs.
				All Firms				
Panel A. All Loan Types								
	0.15	0.018	0.28	0.083	0.055	0.24	0.16	3,542,509
Panel A1. Revolving Credit Lines								
	0.015	0.02	0.39	0.039	0.059	0.25	0.2	2,121,625
Panel A2. Term Loans								
	0.36	0.013	0.12	0.16	0.042	0.23	0.08	1,204,313
Panel A3. Nonrevolving Credit Lines								
	0.25	0.035	0.16	0.067	0.073	0.25	0.17	287,596
Panel A4. Capitalized Lease Obl.								
	0.0017	0.0011	0.065	0.83	0.029	0.0087	0.066	182,980
				Public Versus Private				
Panel B. All Loan Types								
Private	0.18	0.016	0.32	0.094	0.051	0.26	0.083	2,159,424
Public	0.019	0.032	0.2	0.057	0.078	0.17	0.45	492,291
Panel B1. Revolving Credit Lines								
Private	0.018	0.019	0.47	0.046	0.058	0.28	0.11	1,220,630
Public	0.0028	0.031	0.22	0.03	0.081	0.15	0.49	345,200
Panel B2. Term Loans/Nonrevolving Credit Lines/Capitalized Lease Obl.								
Private	0.39	0.012	0.12	0.16	0.043	0.23	0.049	938,794
Public	0.057	0.034	0.15	0.12	0.07	0.22	0.35	147,091
				By Assets (mil.)				
Panel C. All Loan Types								
0–50	0.22	0.011	0.35	0.065	0.038	0.28	0.036	1,387,922
50–500	0.12	0.021	0.3	0.16	0.065	0.25	0.097	590,643
500–	0.021	0.032	0.2	0.073	0.086	0.16	0.43	673,150
Panel C1. Revolving Credit Lines								
0–250	0.029	0.019	0.42	0.038	0.052	0.37	0.069	1,075,596
250–1,000	0.015	0.034	0.34	0.043	0.086	0.27	0.21	191,262
1,000–5,000	0.0071	0.033	0.27	0.039	0.099	0.16	0.38	238,430
5,000–	0.0031	0.02	0.1	0.017	0.074	0.063	0.72	208,289
Panel C2. Term Loans/Nonrevolving Credit Lines/Capitalized Lease Obl.								
0–250	0.42	0.014	0.11	0.13	0.043	0.25	0.032	955,239
250–1,000	0.14	0.023	0.17	0.28	0.069	0.23	0.098	100,638
1,000–5,000	0.068	0.027	0.15	0.15	0.11	0.18	0.32	90,841
5,000–	0.029	0.022	0.09	0.16	0.11	0.11	0.48	70,236

public firm loans have a blanket lien, 26% of private firm loans have a blanket lien. The difference between private and public firms is also pronounced in the case of other, less common types of collateral. For example, while 5.7% of public firm loans are backed by fixed assets, around 9.4% of private firm loans use fixed assets as collateral. Notably, the only type of collateral that is more common in loans from public firms are cash and marketable securities: 3.2% of public firm loans are backed by cash and marketable securities, but only 1.6% of private firm loans use this form of collateral.

Given that the majority of large firms are publicly listed, and most small firms are privately held, a similar pattern emerges when studying collateral use across the firm size distribution, see Panel C of Table 1. Firms with less than 50 million dollars

in assets, for instance, essentially never borrow unsecured (3.6% of their loans are unsecured). In contrast, firms with more than 500 million dollars in assets typically borrow unsecured (43% of their loans are unsecured).

C. Empirical Specification

Identifying and quantifying the effect of pledging collateral on loan prices empirically is challenging because whether collateral is pledged is endogenous. Economic theories predict that for any given firm, pledging collateral increases the probability of repayment and/or the recovery rate in case of default. This could be because collateral reduces borrowers' risk-shifting incentives (see, e.g., Berger and Udell (1990), Boot et al. (1991)) or because it improves banks' monitoring incentives (see, e.g., Rajan and Winton (1995), Gorton and Kahn (2000)). Hence, ceteris paribus, the effect of collateral on loan prices should be negative for any given firm. However, if collateral is more likely to be posted by riskier firms, the cross-sectional relationship between prices and collateral may be driven by this selection bias, and the correlation between collateral and prices becomes positive. Indeed, many existing studies of loan prices find that loans secured with collateral carry higher spreads even after controlling for observable risk factors (see, e.g., Berger and Udell (1990), John et al. (2003), Santos and Winton (2008), (2019), and Santos (2011)).

To illustrate the importance of this bias, we begin by estimating what we refer to as a "naive" regression model, in which the loan price is regressed on the loan terms at origination:

$$s_{\ell ibt} = \beta \times \text{SECURED}_{\ell ibt} + \theta X_{\ell t} + \gamma_b + \gamma_i + \gamma_L + \tau_t + \varepsilon_{\ell ibt}, \tag{1}$$

where $s_{\ell ibt}$ is the spread for loan ℓ from borrower i originated by bank b in quarter t. $\text{SECURED}_{\ell ibt}$ is a dummy variable equal to 1 if the borrower pledged collateral on that loan, and $\gamma_b, \gamma_i, \gamma_L, \tau_t$ are fixed effects for bank, firm, loan type, and time, respectively. $X_{\ell t}$ is a set of loan-level controls, including size and maturity.

To overcome the identification challenge stemming from the endogeneity of loan prices and loan terms, we conduct a within firm-bank-quarter and loan-type comparison to exploit instances when a firm borrows from the same bank, at the same time, using the same loan type but pledging collateral in one loan but not in the other. To that end, we estimate the following regression model:

$$s_{\ell ibt} = \beta \times \text{SECURED}_{\ell ibt} + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt}, \tag{2}$$

where all the terms are the same as in equation (1), but γ_{ibtL} are firm-bank-time-loan-type fixed effects. This specification allows us to eliminate variation stemming from observed and unobserved firm- or bank-specific drivers of loan prices. In this case, the effect of collateral on loan prices is identified by comparing two (or more) loans from the same firm, by the same bank, of the same type, and originated in the same quarter, but with one being secured and the other being unsecured.

We consider two loan types, L, distinguishing between revolving credit lines on the one hand, and term loans and nonrevolving lines of credit on the other.

We choose this classification because the use of collateral and the general contractual terms are quite similar for term loans and nonrevolving credit lines.[13] We exclude capitalized lease obligations from our analysis as they are relatively infrequent and almost always backed by fixed assets.

The regression model equation (2) allows us to estimate the average effect of collateral on loan prices, but masks possible underlying heterogeneity in the relative values of different types of collateral. However, banks plausibly place more value on assets that protect them from borrower risk-shifting as well as assets that are more liquid and thus have a higher value in the event of default Tirole (2005). Indeed, Degryse, Ioannidou, Liberti, and Sturgess (2020) provide evidence that collateral that is less redeployable or has faster depreciation rates exhibits lower recovery rates. Benmelech and Bergman (2008), in turn, provide evidence that airlines can successfully renegotiate their lease obligations downward when the liquidation value of their fleet deteriorates.

To investigate possible differences across different types of collateral, we estimate the following model:

$$
\begin{aligned}
(3) \qquad s_{\ell ibt} = {} & \beta_1 \times \text{REAL\_ESTATE}_{\ell ibt} + \beta_2 \times \text{AR} + \text{INVENTORY}_{\ell ibt} \\
& + \beta_3 \times \text{CASH} + \text{MARKETABLE\_SECURITIES}_{\ell ibt} \\
& + \beta_4 \times \text{FIXED\_ASSETS}_{\ell ibt} + \beta_5 \times \text{BLANKET\_LIEN}_{\ell ibt} \\
& + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt}.
\end{aligned}
$$

Equation (3) is a variant of model equation (2) in which we replace the dummy variable $\text{SECURED}_{\ell ibt}$ with five dummy variables, one for each type of collateral pledged by the borrower. Coefficients β_1 through β_5 are estimates of the marginal pricing of the different types of collateral relative to unsecured loans, the omitted group.

D. Theoretical Underpinning

To help interpret our model's estimates, we provide a simplified framework of loan pricing in this subsection. The framework is aimed at capturing the effect of collateral on loan pricing through its impact on the recovery value in the event of default when borrowers take out a secured and an unsecured loan from a given bank.

We assume that banks are risk-neutral, the risk-free interest rate is 0, and loans are priced competitively. Let I be a fixed amount some firm intends to borrow from a bank. Assume the firm will be able to repay the debt in full with probability p, but will default with probability $(1-p)$. Assume also the firm has assets in place worth C that can be pledged as collateral and transferred to the lender in case of default.

[13] The main reasoning behind the grouping is based is as follows: First, the contractual structure and nature of revolving credit is different as credit lines can be both drawn and repaid at any given point in time and are thus commonly used as a way to insure against liquidity shocks. Term loans and nonrevolving credit lines are in contrast more naturally used to finance capital investment. Second, as can be seen in tab: descriptives, nonrevolving credit line are—like term loans—more likely to be secured by real estate and accounts receivable and inventory are a less common type of collateral. Lastly, our results are robust to using a more granular fixed effects specification that treats nonrevolving lines of credit as its own loan type.

Suppose that $C<I$. Thus, the firm can only collateralize a fraction $\alpha \equiv C/I \in [0,1]$ of the loan.

In order to break even when lending an amount I, the bank needs to charge a gross interest $r(\alpha)$:

$$prI+(1-p)\alpha I = I \Leftrightarrow r(\alpha) = \frac{1-(1-p)\alpha}{p}.$$

Consider an instance comparable to our empirical setting in which the firm takes out two loans at the same time from the same bank with one being secured up to α and the other unsecured. In this case, the firm will pay the rate $r^s(\alpha) = \frac{1-(1-p)\alpha}{p}$ on the secured loan and the rate $r^u = \frac{1}{p}$ on the unsecured loan.

The difference between the rates on the unsecured and secured loan is given by

$$r^u - r^s = \frac{1-p}{p}\alpha,$$

which is increasing in the collateralized portion of the loan, α. Pledging one additional unit of collateral reduces the cost of borrowing relative to the unsecured loan by $\frac{1-p}{p}$, the odds ratio of default. Note that the collateral discount is decreasing in p, the firm's probability of repayment. In other words, riskier firms will benefit more from pledging collateral than safer firms.

According to our empirical approach described above, we compare two loans made by the same bank to the same firm at the same time (i.e., $X^u_{\ell t} = X^s_{\ell t}$), implying that

$$\begin{aligned} r^u - r^s &= \underbrace{E(r_{\ell ibt}|\text{SECURED}_{\ell ibt}=0)}_{E[\theta X_{\ell t}+\gamma_{ibtL}+\varepsilon_{\ell ibt}]} - \underbrace{E(r_{\ell ibt}|\text{SECURED}_{\ell ibt}=1)}_{E[\beta+\theta X_{\ell t}+\gamma_{ibtL}+\varepsilon_{\ell ibt}]} \\ &= -\widehat{\beta}. \end{aligned}$$

Consider the following three observations. First, note that if a firm cannot pledge sufficient collateral to cover the entire amount borrowed and takes out two loans, the estimates from equation (2) are equal to the marginal value of pledging an additional unit of collateral. Thus, the coefficients estimated in equation (2) are not estimates of the price reduction a firm would get for collateralizing *all* of its newly originated loans but estimates of the *marginal* price reduction from collateralizing one additional unit of credit. In other words, we estimate the price effect from having one additional unit of credit backed by an encumbered asset that cannot be written down in bankruptcy. In that sense, all of our estimates should be interpreted as the shadow value of collateral.

Second, our theoretical framework focuses on the importance of the recovery value of collateral in the event of default and abstracts away from other factors that could affect the difference between the interest rate a firm would pay on its unsecured and secured loans from the same bank. For instance, we assumed that the firm prefers to pledge the entire amount of collateral available. While plausible in a static model, the prediction could change in a dynamic model in which collateral is preserved for future use. The interpretation of our coefficient naturally changes if a firm chooses not to pledge its entire collateral as the recovery value of

the unsecured loan would be positive. In this case, the interest rates on the two loans taken out by the firm are not independent anymore. Arguably, banks consider that requiring borrowers to pledge more collateral on a loan reduces their stock of unencumbered assets, making any other unsecured loans potentially riskier – by reducing their recovery value.

Finally, our framework abstains from several important drivers of loan rates. For instance, we assumed that the firm had no outstanding debt. Similarly, we assumed that collateral pledging does not affect the probability of default p. Accounting for these drivers will affect the difference between the rates on the unsecured and secured loans, but it will not change the key insight from our framework on the value of pledging collateral.

E. Identification Challenges

While our data are rich and provide us with a unique empirical setting to determine the value of collateral, there is a set of remaining identification challenges and data limitations that warrant a discussion as they can impact the interpretation of our findings. First, is there enough variation in the data to allow us to estimate a model with such a demanding set of fixed effects? Note that around 17% of all newly originated loans are originated in instances in which one bank makes more than one loan to the same firm at the same time. This gives us a sample of almost 29,000 loans and 8,000 unique firms, each taking out more than one loan with the same bank at the same time sometime between 2012:Q3 and 2019:Q4.

Second, to the extent that we find that collateral reduces loan prices, the question arises: Why do firms that take out more than one loan at the same time with the same bank pledge collateral on one loan but not on the other? Data limitations have precluded an investigation of this question,[14] but a possible explanation is that when a firm applies for a new loan, the bank may ask to renegotiate the terms of existing loans. Another possibility is that the firm prefers to have two different loans because it does not have enough collateral to cover the entire amount borrowed or because it prefers to keep some of its collateral unencumbered for potential use at a later date.[15]

A third concern relates to two limitations of our data. Banks do not report the degree to which a loan is collateralized, but only the most common type of collateral the borrower pledged on the loan. Additionally, banks do not report information on loan covenants. To the extent that either of these vary across loans with different degrees of collateralization, it may bias our coefficients. For instance, if loans

[14]For example, the information on whether the loan is secured with collateral is missing for more than 40% of Dealscan facilities. Thus, previous work was not able to exploit these types of instances due to a low number of observations. Despite that, and in line with our findings, the loan spread is lower for the secured facilities than the unsecured ones in the deals containing both types of facilities.

[15]A complementary explanation is that more than one loan characteristic varies between the two loans (e.g., collateral *and* maturity). Varying more than one loan characteristic across loans may explain the instances of taking two loans from the same bank, but it also raises the concern that differences in the pricing may derive from other differences in loan terms. We control for other loan characteristics such as size and maturity, throughout our analysis. To further reduce these concerns, we also investigate the interaction between collateral usage and maturity in detail in Section IV.D.

backed by accounts receivable and inventory also have tighter (loose) covenants or a higher (lower) degree of collateralization than unsecured facilities, this may bias our estimates upward (downward).[16] While we do not have a way to fully address the latter concern, we do investigate whether the interest rate discount from collateral pledging varies with changes in the asset values borrowers pledge as collateral for loans in Section III.B.

A fourth concern is that our estimates on the valuation of specific types of collateral obtained in equation (3) are driven by a correlation between firm types and collateral types. For instance, safer firms may select to pledge different types of collateral than riskier firms. If the sensitivity of collateral prices is a function of firm riskiness, this collateral selection could affect our findings. For example, if only low-risk firms have a blanket lien, then we identify the value of a blanket lien for those low-risk firms, and therefore underestimate the value it would have for riskier firms. One way to alleviate concerns with the interplay between firm riskiness and collateral types is to study whether the variation in the price effect is different for more and less risky firms, which we study in Section IV.A. Nonetheless, one needs to be mindful of this limitation while interpreting our findings on the relative value of different types of collateral.

A final issue concerns the external validity of our methodology more generally. Firms that take out two loans at the same time may be different from firms that take out just one loan. Table 2 reports information on observable characteristics of loans and borrowers (at the time of loan origination) which take out only one new loan and the same information for borrowers that take out more than one loan at the same time from the same bank. Table 2 reveals that multi-loan firms tend to be larger, as measured by total assets and sales. They also tend to be riskier. For instance, they have higher leverage and a lower interest coverage at loan origination. Given that collateral is likely to be more valuable for risky firms, our estimates of the value of collateral may thus overstate the value of collateral.

III. The Valuation of Collateral

Column 1 in Table 3 shows results from estimating equation (1) for the entire set of newly originated loans between 2012:Q3 and 2019:Q4 contained in our sample when including time and loan-type fixed effects. In columns 2–7, we restrict the sample to new loans in which at least two loans of the same type are originated by the same bank to the same firm at the same time. Further, in columns 4–7, we change the type of fixed effects used.

Using the entire cross section of newly originated loans, columns 1–3 show that there is a positive correlation between pledging collateral and the loan price, with the spread on secured loans exceeding that on unsecured loans by almost 17–27 BPS on average, and the effect varying widely across different types of collateral. These results are in line with evidence from earlier studies that riskier

[16]Data limitations have also precluded an investigation of these questions. For example, Bradley and Roberts (2015) document a positive correlation between the presence of financial covenants and the pledging of collateral but because they rely on Dealscan they are unable to study how this correlation varies with the degree of collateralization or the type of assets pledged as collateral.

TABLE 2

Descriptive Statistics

Table 2 shows observable characteristics at both the firm and loan level for the sample of all newly originated loans ("Full Sample") as well as for instances in which one firm takes two loans of the same type, from the same bank, at the same time ("Multi-loan Sample"). The data are as reported in the FR Y-14 and restricted to loans newly originated between 2012:Q3 and 2019:Q4. Standard errors are clustered at the firm level.

	Full Sample					Multi-Loan Sample				
	Mean	p25	p75	Std. Dev.	No. of Obs.	Mean	p25	p75	Std. Dev.	No. of Obs.
Firm-Level Characteristics										
FIRM_SIZE (log(ASSETS))	10.68	8.95	11.92	2.35	68,765	12.12	10.04	14.13	2.59	8,239
FIRM_SIZE (log(SALES))	10.96	9.52	12.23	2.25	66,934	12.46	10.79	14.17	2.36	8,134
INTEREST_COVERAGE_RATIO	8.66	1.00	11.05	13.17	58,702	6.20	0.68	7.54	10.68	7,634
LEVERAGE (DEBT/ASSETS)	0.30	0.09	0.46	0.24	65,455	0.38	0.19	0.55	0.24	7,774
RATING	4.85	4.00	5.00	0.80	75,656	4.76	4.00	5.00	0.86	8,349
(AR + INVENTORY)/ASSETS	0.35	0.09	0.57	0.27	65,464	0.32	0.07	0.53	0.27	7,957
Loan-Level Characteristics										
SPREAD (in BPS)	138.95	50.00	225.00	303.07	166,557	131.09	50.00	225.00	151.02	28,932
LOAN_SIZE (log(COMMITTMENT))	8.52	7.31	9.52	1.41	166,557	9.00	7.82	9.95	1.51	28,932
MATURITY (in month)	57.79	21.00	61.00	56.97	159,894	50.33	24.00	60.00	36.51	26,328
DEMAND_LOAN	0.04	0.00	0.00	0.20	166,557	0.09	0.00	0.00	0.29	28,932
REAL_ESTATE	0.17	0.00	0.00	0.37	166,557	0.09	0.00	0.00	0.29	28,932
CASH + MARKETABLE_SECURITIES	0.04	0.00	0.00	0.20	166,557	0.03	0.00	0.00	0.17	28,932
AR + INVENTORY	0.21	0.00	0.00	0.41	166,557	0.29	0.00	1.00	0.45	28,932
FIXED_ASSETS	0.14	0.00	0.00	0.35	166,557	0.09	0.00	0.00	0.28	28,932
UNSECURED	0.17	0.00	0.00	0.38	166,557	0.25	0.00	0.00	0.43	28,932
BLANKET_LIEN	0.26	0.00	1.00	0.44	166,557	0.26	0.00	1.00	0.44	28,932

borrowers are more likely to pledge collateral (see, e.g., Berger and Udell (1990), John et al. (2003), and Santos and Winton (2008)).[17]

We next study how the estimate when changing the set of fixed effects. Adding fixed effects for banks and firms lowers the coefficient and indicates that the spread on secured loans is around 7.7 BPS lower, with the estimate becoming insignificant (column 4). Once we include fixed effects for banks and for firm-time-loan type, the sign of the coefficient flips and indicates that pledging collateral indeed reduces the spread by 17 BPS (column 5) with the coefficient being precisely estimated. This indicates that if a firm takes out more than one loan at the same time—possibly each loan originated by a different lender—the secured loan will carry an around 17 BPS lower interest. Finally, once we also consider borrower-specific variation on the supply side (i.e., include bank-firm-time-loan type fixed effects), we find that pledging collateral lowers loan spreads even more and by about 23.1 BPS (column 6). In other words, if a firm takes out two (or more) loans of the same type at the same time and with the same bank, the spread on the secured loan is 23.1 BPS lower than the spread it pays on its unsecured loan. Thus, considering only within bank-firm variation arguably allows to attenuate the selection issues associated with the naive cross-sectional estimates. Further, note that the difference between the estimates in columns 5 and 6 shows that arguably banks value collateral from the same firm differently, reinforcing the notion that the most credible estimates stem form studying variation within bank-firm pairs.

[17]For comparison, Santos and Winton (2019) find that, based on syndicated loans taken out by publicly listed firms between 1987 and 2007, spreads on secured loans are about 48 BPS higher than spreads on unsecured loans.

Altogether, the estimates discussed above show that collateral can reduce the cost of borrowing for a firm, although the average effect is only moderate. However, the estimates can only be obtained by conducting within bank-firm-pairs comparison as the cross-sectional variation is in part confounded.

A. Are All Types of Collateral Valued Equally?

We next study whether there is heterogeneity in the valuation of the different types of collateral by estimating equation (3). The results of this investigation are reported in column 7 in Table 3.

We find that the effect of collateral on prices varies significantly with respect to the type of collateral pledged when we include bank-firm-time-loan type fixed effects for the observed and unobserved time-varying risk characteristics of the

TABLE 3

The Valuation of Collateral

Table 3 shows results from estimating a model of the following type:

$$s_{\ell ibt} = \beta \times \text{SECURED}_{\ell ibt} + \theta X_{\ell t} + \text{FIXED\_EFFECTS} + \varepsilon_{\ell ibt},$$

where $s_{\ell ibt}$ is the spread on loan ℓ from bank b to firm i, originated at time t, and $\text{SECURED}_{\ell ibt}$ is a dummy whether loan ℓ is secured. We replace $\text{SECURED}_{\ell ibt}$ with a set of five dummies that indicate the type of collateral used in secured loans and report these coefficients in columns 3 and 7.

We vary the types of fixed effects as indicated in the table. In columns 1–3, we include time-fixed effects, τ_t, and loan-type fixed effect γ_L. In column 4, we further include bank fixed effects, γ_b, and firm fixed effects, γ_i. In column 5, we include bank fixed effects as well as firm-time-loantype fixed effects, γ_{itL}. Finally, in columns 6 and 7, we include bank-firm-time-loantype fixed effects, γ_{ibtL}. The data are as reported in the FR Y-14 and restricted to loans newly originated between 2012:Q3 and 2019:Q4. In columns 2–7, the sample is further restricted to bank-firm-time-loantype combinations with more than one observation per quarter. Robust standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable: SPREAD (in BPS)						
	1	2	3	4	5	6	7
SECURED	17.2**	27.9**		−7.3*	−17.0**	−23.1**	
	(1.8)	(1.8)		(3.2)	(3.6)	(4.3)	
CASH + MARKETABLE_SECURITIES			20.9**				−38.6**
			(4.2)				(7.3)
REAL_ESTATE			14.5**				−25.1**
			(2.8)				(5.6)
AR + INVENTORY			26.7**				−23.6**
			(2.0)				(5.9)
FIXED_ASSETS			9.5**				−14.3**
			(2.8)				(5.5)
BLANKET_LIEN			36.3**				−11.4
			(2.0)				(6.0)
−2_YEARS	0.0	−5.1	−5.5	−9.4**	−8.8**	−2.2	−2.1
	(2.4)	(2.9)	(2.9)	(3.1)	(3.1)	(3.3)	(5.0)
−4_YEARS	11.9**	5.5*	4.6	−7.3*	−3.5	13.0**	12.8*
	(2.4)	(2.6)	(2.6)	(2.9)	(3.0)	(3.2)	(5.3)
MORE_THAN_4_YEARS	16.1**	10.9**	10.7**	0.0	1.4	33.3**	33.0**
	(1.8)	(2.1)	(2.1)	(2.5)	(2.5)	(2.6)	(6.2)
Loan controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	No	No
Time FE	Yes	Yes	Yes	Yes	No	No	No
Firm FE	No	No	No	Yes	No	No	No
Firm-time-loantype FE	No	No	No	No	Yes	No	No
Bank-firm-time-loantype FE	No	No	No	No	No	Yes	Yes
No. of banks	33	33	33	33	33	33	33
No. of firms	79,425	8,359	8,359	8,359	8,359	8,359	8,359
No. of obs.	166,557	28,932	28,932	28,932	28,932	28,932	28,932
Effective no. of obs.	166,509	28,884	28,880	20,498	17,948	16,002	12,916
R^2	0.129	0.457	0.459	0.819	0.882	0.879	0.879

borrower. Cash and marketable securities are the most valuable type of collateral. They reduce loan spreads by around 38.6 BPS – an almost 75% larger reduction compared to the average price effect of 23 BPS. The magnitude of the effect is quite striking but also intuitive, as cash and marketable securities are liquid, low risk, and with a value independent of firms' own cash flows.

The second most valuable type of collateral is real estate. A firm that takes out two or more loans at the same time, one unsecured and one secured by real estate, enjoys a 25.1 BPS reduction in the spread on the secured loan. Almost equally valuable to real estate are accounts receivables and inventory. A firm benefits from a 23.6 BPS spread discount when it pledges accounts receivables and inventory. Pledging fixed assets other than real estate reduces loan spreads by around 14.3 BPS. All of the above estimates are statistically significant. The least valuable form of collateral is the blanket lien which reduces the spread by only about 11.4 BPS. However, the coefficient is not statistically significant at the 5% level or less, and we interpret a blanket lien being essentially equivalent to an unsecured loan.

We formally test whether the rank-ordering across the coefficients is statistically significant in Table 4. We find that cash is more valuable than all other types of collateral except real estate. While the difference is statistically significant for all types of collateral other than real estate, it is important to note that the difference to real estate has a *p*-value just above 5% and is not statistically significant Thus, even though our findings suggest that cash is most valuable, the delineation between cash and real estate is relatively weak.

We further find that real estate and accounts receivable and inventory are about equally valuable. The point estimate for the value of real estate is slightly higher than the point estimate for accounts receivable and inventory, but the difference is not statistically significant. Finally, both real estate and accounts receivable and inventory are more valuable than fixed assets and a blanket lien, but the difference between fixed assets and a blanket lien is again indistinguishable.

Our findings confirm that banks distinguish across the assets pledged as collateral and that they place greater value on those assets that are easier to resell. This insight is in line with evidence presented by Davydenko and Franks (2008), who show that country differences in the bankruptcy codes affecting banks' ability to realize value in default explain their collateral preferences. Our findings are also consistent with Benmelech and Bergman (2009), who find that debt tranches secured by airplanes that are easier to redeploy have lower credit spreads. The magnitude of the price effect that results from pledging the most valuable type of

TABLE 4

Rank-Ordering of Collateral Values

Table 4 reports the absolute the difference between coefficients retrieved from the estimation results presented in column 7 of Table 3. * and ** indicate whether the difference is statistically significant at the 5% and 1% levels, respectively.

	j = REAL_ESTATE	j = AR+INVENTORY	j = FIXED_ASSETS	j = BLANKET_LIEN
$\lvert\beta^{\text{CASH+MARK\_SEC}} - \beta^{j}\rvert = 0$	13.5	15*	24.3*	27.2**
$\lvert\beta^{\text{REAL\_ESTATE}} - \beta^{j}\rvert = 0$		1.5	10.8*	13.7**
$\lvert\beta^{\text{AR+INVENTORY}} - \beta^{j}\rvert = 0$			9.3	12.2
$\lvert\beta^{\text{FIXED\_ASSETS}} - \beta^{j}\rvert = 0$				2.9

collateral is "similar" to their estimate of the value of pledging a highly redeployable airplane.[18]

B. Is Loan Pricing Sensitive to the Value of Collateral?

Next, we investigate whether loan pricing is sensitive to the value of the underlying collateral. Toward that end, we study whether local housing prices affect the pricing of loans backed by real estate collateral and whether the value of a firm's accounts receivables and inventory or sales affect the price for loans backed by accounts receivables and inventory.

1. Housing Prices and the Pricing of Collateral

We start out by studying the effect of local housing prices on the pricing of loans backed by real estate. To that end, we merge county-level housing prices from CoreLogic with our loan-level data via the location of firms' headquarters. We assume that the value of a firm's real estate collateral is correlated with the local housing price index where the firm has its headquarters – a plausible assumption especially for relatively smaller firms which make most of our sample. Using this data, we test whether the interaction between the housing prices and real estate collateral is negative. Specifically, we investigate whether firms get a larger interest rate reduction when they pledge real estate collateral and are located in a county in which real estate prices have increased in the recent past or are at a relatively high level compared to other counties.

An obvious concern with that exercise is that housing prices may be correlated with local economic activity. Hence, an increase in real estate values may be correlated with the more general economic environment in which a firm is operating in. However, an attractive feature of our setup is that it allows us to test whether housing prices also affect the pricing of other types of collateral. By making a within-firm comparison, we can test whether real estate becomes cheaper vis-á-vis not only unsecured loans, but also loans in which other types of collateral are pledged.

To formally test whether real estate collateral is more valuable when housing prices are high or increasing, we estimate the following model:

$$\begin{aligned} s_{\ell ibt} = &[\beta_1 \times \text{REAL\_ESTATE}_{\ell ibt} + \beta_2 \times \text{OTHER\_COLLATERAL}_{\ell ibt}] \times \Delta\text{HPI} \\ &+ \beta_3 \times \text{REAL\_ESTATE}_{\ell ibt} + \beta_4 \times \text{OTHER\_COLLATERAL}_{\ell ibt} \\ &+ \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt}, \end{aligned}$$

where $\text{REAL\_ESTATE}_{\ell ibt}$ is as above a dummy that takes the value 1 if real estate collateral has been pledged for loan ℓ, and $\text{OTHER\_COLLATERAL}_{\ell ibt}$ is a dummy that takes the value 1 if any other type of collateral has been pledged in

[18] Our findings show that when a firm takes out a loan secured by marketable securities it benefits from a discount of 38.6 BPS, the equivalent of around 25% of the mean spread, when compared to a same-type loan it takes out at the same time from the same bank but which is unsecured. According to their findings, moving from the 25th percentile to the 75th percentile in their redeployability measures leads to a within-airline decrease in the spread of 52 and 64 BPS, which corresponds to a decrease of 26%–32% of the mean spread.

TABLE 5

Sensitivity of Collateral Pricing to Housing Prices, Accounts Receivables and Inventory, and Sales

Column 1 in Table 5 shows results from estimating the following model:

$$s_{\ell ibt} = \beta_1 \times \text{REAL\_ESTATE}_{\ell ibt} \times \Delta\text{HPI} + \beta_2 \times \text{OTHER\_COLLATERAL}_{\ell ibt} \times \Delta\text{HPI} + \beta_3 \times \text{REAL\_ESTATE}_{\ell ibt} + \beta_4 \times \text{OTHER\_COLLATERAL}_{\ell ibt} + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt},$$

where $s_{\ell ibt}$ is the spread on loan ℓ from bank b to firm i, originated at time t, γ_{ibtL} is a set of bank-firm-time-loantype fixed effects, $\text{REAL\_ESTATE}_{\ell ibt}$ is a dummy that takes the value one if loan ℓ is secured by real estate, $\text{OTHER\_COLLATERAL}_{\ell ibt}$ is an indicator whether the loan is secured with any type of collateral other than real estate, and ΔHPI is the change of the housing prices in the county in which the headquarter of firm i is located in the year before loan ℓ is originated.

In column 2, we replace the change in the housing price ΔHPI with the level of the housing price at time of origination in the county of a firm's headquarter. Further, in columns 3 and 4, we conduct a similar exercise but using indicators whether the loan is secured by accounts receivable or a different type of collateral and interact it with a firm's ratio of accounts receivable to total assets at time of origination (column 3) or growth in sales (column 4). The data are as reported in the FR Y-14 and restricted to loans newly originated between 2012:Q3 and 2019:Q4. Robust standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable: SPREAD (in ppt)			
	1	2	3	4
REAL_ESTATE × ΔHPI	−376.4			
	(223.8)			
OTHER_COLLATERAL × ΔHPI	201.0			
	(216.6)			
REAL_ESTATE × HPI		−319.8*		
		(154.8)		
OTHER_COLLATERAL × HPI		41.0		
		(106.8)		
SECURED_BY_AR + INVENTORY × $\frac{\text{AR+INVENTORY}}{\text{LOAN\_AMOUNT}}$			54.4**	
			(12.0)	
OTHER_COLLATERAL × $\frac{\text{AR+INVENTORY}}{\text{LOAN\_AMOUNT}}$			−3.7	
			(9.1)	
AR + INVENTORY × ΔSALES				−101.0**
				(22.7)
OTHER_COLLATERAL × ΔSALES				−17.5
				(19.3)
Loan controls	Yes	Yes	Yes	Yes
Bank-firm-time FE	Yes	Yes	Yes	Yes
No. of banks	32	32	33	32
No. of firms	5,697	6,696	7,943	5,538
No. of obs.	19,030	22,304	24,448	21,577
Effective no. of obs.	5,696	6,695	7,942	5,537
R^2	0.909	0.872	0.877	0.857

loan ℓ. ΔHPI is the change of the housing price index of the county in which firm i has its headquarters in the year preceding the loan origination. We also use a specification in which we interact the collateral dummy variables with the level as opposed to the change of the housing price index, referred to as HPI.

Columns 1 and 2 in Table 5 report the results. Consistent with existing evidence on the collateral channel that shows that increases in housing prices affect credit and investment, we find that credit becomes cheaper when real estate prices increase.[19] For a 1-standard-deviation increase in housing price growth, roughly equal to a 3.1-percentage-point higher growth rate, we find that the loan spread decreases by around

[19]See, for example, Gan (2007), Chaney et al. (2012), Cvijanović (2014), Lin (2016), Nikolov et al. (2018), and Lian and Ma (2021). For instance, Lian and Ma (2021) estimate that borrowing increases by 3–4 cents for a $1 increase in real estate value. Further, Chaney et al. (2012) estimate that firms invest 7 cents out of every $1 increase in the value of real estate collateral.

14 BPS. In other words, a 1-percentage-point increase in house prices growth implies a decrease in loan spreads of around 5 BPS.

Column 2 corroborates this finding and reveals that the correlation between the interaction of collateral and house prices with the spread is robust to using the level of house prices. A 1-standard-deviation increase in the housing price level is equivalent to 0.05 increase in the level. Thus, a 1-standard-deviation increase in the housing price index implies that the loan spread decreases by around 10 BPS more when real estate is pledged. The magnitude of the effect is thus slightly lower when we use the housing price level rather than the house price growth. This is likely driven by the effect that recent house price growth contains more information than house price levels about the prospects of the local housing market.

2. Accounts Receivable and Inventory, Sales, and the Pricing of Collateral

Next, we attempt to ascertain whether banks respond to changes in the asset values pledged as collateral by studying the importance of the value of a firms' accounts receivable and inventory and sales on the pricing of loans that are backed by accounts receivable.

Using the financial variables reported in the Y14 data, we compute the value of a firm's accounts receivables and inventory relative to the total amount borrowed in the loan backed by accounts receivables and inventory. A higher book value of a firm's accounts receivable relative to the size of the total loan should induce a higher recovery rate in case of default. Consequently, the loan price should fall when accounts receivables and inventory increase relative to the loan size. As an alternative, we consider the growth of a firm's sales as a share of total assets. Increasing sales as a share of a firm's total assets are likely to be associated with an increase in the value of a firm's accounts receivable and could thus make accounts receivable relatively more attractive as collateral.

As with our study of the effect of housing prices on the valuation of real estate collateral, a potential concern with considering increases in accounts receivable or sales is that they may be correlated with the general economic outlook a firm is facing. Thus, again studying the effect on the other types of collateral whose valuation is plausibly unaffected is an important placebo test to make sure we are identifying the sensitivity of loan rates to the valuation of collateral rather than to the firm value per se.

We estimate the following model:

$$s_{\ell ibt} = \left[\beta_1 \times \text{AR\&INVENTORY}_{\ell ibt} + \beta_2 \times \text{OTHER\_COLLATERAL}_{\ell ibt}\right] \times \frac{\text{AR\&INVENTORY}}{\text{LOAN\_AMOUNT}} + \beta_3 \times \text{AR\&INVENTORY}_{\ell ibt} + \beta_4 \times \text{OTHER\_COLLATERAL}_{\ell ibt} + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt},$$

where everything is as above and $\frac{\text{AR\&INVENTORY}}{\text{LOAN\_AMOUNT}}$ is the relative size of firm i's accounts receivable and inventory to the total amount borrowed in loan ℓ. In an alternative specification, we interact the collateral dummy variables with the

relative increase in a firm's sales, defined as $\Delta\text{SALES} = (\text{SALES}_t - \text{SALES}_{t-1})/\text{ASSETS}_{t-1}$.

Columns 3 and 4 in Table 5 report the results. Column 3 shows that pledging accounts receivable and inventory as collateral has a larger effect on the loan price when a firm's accounts receivable are more valuable relative to the total amount it borrowed against that type of collateral. If the relative size of accounts receivable increases by 0.1, the loan spread decreases by around 5 BPS. This is a considerable effect as for more than 95% of the facilities in our sample, the firm's accounts receivable exceeds the loan amount. Importantly, note that the value of other types of collateral is insensitive to the share of accounts receivable and inventory of the loan amount.

We find similar results when we consider the effect of an increase in sales. Whenever sales increase as a share of total assets in the year prior to the loan origination, accounts receivable become a more valuable type of collateral. For a 1-standard-deviation increase in share of accounts receivable, we find that the loan spread decreases by around 15 BPS. Further, as above, the same does not hold true for other types of collateral, alleviating concerns that an increase in sales affects the value of *all* types of collateral as it signals improved fundamentals.

Altogether, the results of our investigation of house prices and accounts receivable suggest that loan prices are sensitive to the value of the underlying asset pledged as collateral with relatively more valuable collateral being associated with a bigger interest rate discount.

IV. Is Collateral More Valuable for Riskier Borrowers?

In this section, we investigate the key insight from the literature that the value of collateral increases with risk building on proxies of risk related to the borrower (e.g., leverage, interest coverage, size), the bank-borrower relationship (e.g., length of their lending relationship), and the loan (e.g., maturity).

A. Firm Risk

We construct two measures from the borrowers' financial statements reported in the Y-14 to proxy for firm riskiness. First, we group firms by their leverage as measured by the debt-to-assets ratio at the date of the loan origination. We classify firms into three groups depending on whether their leverage ratio is: i) above 0.4, ii) between 0.4 and 0.15, and iii) below 0.15. These thresholds are approximately equal to the first and second terciles of the entire sample of firms in the Y-14. Second, we group firms by their interest coverage ratio (ICR) as measured by the operating income divided by interest expenses over the year prior to the loan origination. Again, we classify firms into three groups depending on whether their ICR is: i) below 1, ii) between 1 and 10, and iii) above 10. A firm with an ICR less than 1 is at the immediate risk of becoming delinquent while a firm with a high ICR seems to have abundant cash inflows to service its debt.

Table 6 reports the results of this investigation. Consistent with the insights derived from our stylized model in Section II.D, our results show that pledging collateral is most valuable for firms that banks perceive to be risky. For highly leveraged firms, pledging collateral reduces the spread by 30 BPS vis-á-vis the

TABLE 6

The Effect of Collateral on Loan Prices by Firm Type (High vs. Low Debt-to-Assets and High vs. Low-Interest Coverage)

All columns in Table 6 show results from estimating a model of the following type:

$$s_{\ell ibt} = \beta \times \text{SECURED}_{\ell ibt} + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt},$$

where $s_{\ell ibt}$ is the spread on loan ℓ from bank b to firm i, originated at time t, γ_{ibtL} is a set of bank-firm-time-loantype fixed effects, and $\text{SECURED}_{\ell ibt}$ is a dummy whether loan ℓ is secured. In columns 2, 4, 6, 8, and 10, we replace $\text{SECURED}_{\ell ibt}$ with a set of five dummies that indicate the type of collateral used in secured loans.

In columns 1–6, the sample is grouped by debt-to-assets ratios as indicated in the header; in columns 7 and 12, the sample is grouped by the interest coverage ratios as indicated in the header. The data are restricted to loans newly originated between 2012:Q3 and 2019:Q4. Robust standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable: SPREAD (in BPS)											
Sample	$0.4 > \frac{\text{DEBT}}{\text{ASSETS}}$		$0.15 < \frac{\text{DEBT}}{\text{ASSETS}} < 0.4$		$\frac{\text{DEBT}}{\text{ASSETS}} < 0.15$		ICR < 1		1 < ICR < 10		10 < ICR	
	1	2	3	4	5	6	7	8	9	10	11	12
SECURED	−28.4**		−4.7		−4.3		−24.2*		−25.7**		−9.2	
	(10.1)		(9.7)		(11.3)		(11.9)		(9.6)		(12.4)	
REAL_ESTATE		−26.6**		−7.6		−9.2		−33.3*		−16.3		−21.3
		(9.5)		(9.7)		(12.4)		(16.4)		(8.7)		(11.5)
CASH + MARKETABLE_SECURITIES		−46.1*		11.9		4.5		−27.7		−17.2		8.9
		(20.7)		(15.0)		(15.0)		(17.7)		(15.6)		(16.9)
AR + INVENTORY		−23.0*		−6.4		−11.6		−29.0*		−25.3**		−15.8
		(10.3)		(10.7)		(10.9)		(13.5)		(8.8)		(14.1)
FIXED_ASSETS		−21.0*		−4.5		6.8		−15.6		−15.7*		6.2
		(9.3)		(10.4)		(10.8)		(14.8)		(7.9)		(15.8)
BLANKET_LIEN		−15.9		−2.3		8.5		−28.3*		−8.4		−6.7
		(9.3)		(10.3)		(13.3)		(11.3)		(10.2)		(13.3)
Loan controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-firm-time-loantype FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks	31	31	31	31	33	33	31	31	31	31	32	32
No. of firms	2,139	2,139	2,104	2,104	1,906	1,906	1,641	1,641	3,504	3,504	1,559	1,559
No. of obs.	7,890	7,890	7,802	7,802	6,109	6,109	5,359	5,359	13,939	13,939	4,478	4,478
Effective no. of obs.	4,396	4,392	4,357	4,353	3,362	3,358	1,640	1,640	3,503	3,503	1,558	1,558
R^2	0.823	0.823	0.923	0.923	0.912	0.912	0.823	0.823	0.906	0.906	0.929	0.929

unsecured loan, as shown in column 1. In contrast, the spread falls by only 8 and 6 BPS for firms with a medium or low leverage, respectively, with the estimates being insignificant (columns 3 and 5). However, a simple *Z*-test[20] reveals that the difference between high and low debt-to-assets firms is only statistically significant at the 10% level. Given the relatively large effective number of observations, our findings with respect to observable firm riskiness are thus more suggestive than conclusive.

Columns 2, 4, and 6 in Table 6 show the results when we distinguish between different types of collateral. The rank ordering of the valuation of different types of collateral in our main findings in Table 3 is preserved among high debt-to-assets firms. Among these firms, cash and marketable securities are the most valuable type of collateral, real estate, and accounts receivables and inventory are slightly less valuable and fixed assets and the blanket lien are the least valuable. Pledging marketable securities as collateral reduces the spread for all types of firms by around 33 BPS, but by 47 BPS for risky firms. Similarly, on average, firms see their loan spread fall by 21 BPS when they pledge real estate, but the effect is stronger for highly leveraged firms which see their loan spread fall by more than 28 BPS. In contrast, low-risk firms only see a price reduction of 10 BPS with the estimate being insignificant. Likewise, the loan spread falls by around 25 BPS when a highly leveraged firm pledges accounts receivable and inventory, but only by 6 and 12 BPS when relatively lower leveraged firms pledge this type of collateral.

It is reassuring for our purposes that the rank ordering of the different types of collateral is preserved when we consider exclusively risky firms. This alleviates the concern discussed above that the valuation of different types of collateral identified in our setting could be driven between firm riskiness and their choice of collateral.

Our insights on the valuation of collateral persist when we proxy the firm's riskiness by its ICR instead of its leverage ratio (Table 6). As evidenced in columns 11 and 12, the pricing of loans for firms with a relatively high ICR—arguably the least likely to become delinquent—is insensitive to the pledging of collateral and the estimates albeit indicating that spreads decrease when collateral is pledged are insignificant. In contrast, the estimates in columns 7–10 show that collateral becomes valuable for a firm once the ICR falls below 10 and is especially valuable for firms with an ICR less than 1. Firms with an ICR between 1 and 10 see a 25 BPS lower spread when pledging collateral and the effect is especially pronounced when pledging real estate or accounts receivable and inventory. For firms with an ICR of less than 1, the spread falls on average by 30 BPS when pledging collateral, with marketable securities again the most valuable type of collateral (together with real estate) and inducing a 38 BPS reduction of the spread. However, it is again important to note that the difference in the coefficients between high and low ICR firms is not statistically significant. Thus, our findings on the value of collateral being higher for high ICR firms is at best suggestive and not conclusive.

B. Public Versus Private and Large Versus Small Firms

An alternative way to investigate the theoretical insight that collateral is more valuable for riskier firms is to study the effect of collateral on loan prices for private

[20]We calculate the *Z*-score as: $Z = \frac{\beta_1 - \beta_2}{\sqrt{SD\beta_1^2 + SD\beta_2^2}}$.

versus public firms, and for small versus large firms.[21] Private and small firms tend to be riskier than public and large firms, respectively. They also tend to be more informationally opaque, which will likely add to the importance of pledging collateral particularly when made of assets easy to value.

To test these hypotheses, we estimate equation (2) for different subsamples, private and public firms, as well as larger and smaller firms. The Y-14 data allow us to carry out these tests because, in contrast to DealScan which is dominated by larger corporations, it includes any loan that is larger than $1 million. As a result, it also captures credit to medium-sized businesses and thus covers a broader universe of US corporate borrowers. In order to distinguish between the different types of firms, we study publicly listed firms and private firms separately. Recall that Compustat—the data we use to identify publicly listed firms—mostly covers firms that take out syndicated loans. Hence, these firms are generally much larger and have access to a wider set of external sources of funding. We use the firms' total assets to classify firms by their size and study the valuation of collateral for small and large firms separately.

The results of this exercise are reported in Table 7. Columns 1 and 3 reveal that there is a strong contrast in the valuation of collateral between private and public firms. A public firm that takes out two or more loans at the same time from the same bank, is given a 6 BPS discount on the secured loan. However, the coefficient is not precisely estimated, possibly because public firms are less likely to pledge collateral, as documented in Table 1. In contrast, a private firm that pledges collateral receives on average a 43 BPS lower spread. Further, a *Z*-test indicates that the difference between the two coefficients is statistically significant. Thus, we find strong evidence that the valuation of collateral is higher for smaller firms than for large firms.

Columns 3 and 4 show the results when we estimate the more granular model that distinguishes between different types of collateral. The point estimates for different types of collateral are negative across the board for public firm, but once again they are not statistically significant. In contrast, a private firm that pledges marketable securities benefits from a 58 BPS discount vis-á-vis an unsecured loan, see column 2 of Table 7. Private firms that pledge real estate benefit from a 37 BPS discount while those that pledge accounts receivable and inventory benefit from a 40 BPS discount relative to their unsecured loans.

We also find that collateral is more valuable for riskier firms when we proxy risk by firm size. We split firm into small SMEs with less than $50 million in assets, large SMEs with $50 to $500 million in assets, and large firms with more than $500 million in assets. The smallest firms in our sample which are most likely to pledge collateral (see Table 1), and benefit the most from pledging collateral, obtaining a reduction of 75 BPS on their loan spreads when they pledge collateral. The effect is somewhat attenuated for large SMEs which receive a 34 BPS reduction in the spread when pledging collateral. Finally, the price effect is smallest for the largest

[21] The financials provided in the Y-14 are possibly noisy, with assets being the most precisely reported variable and interest expenses being among the least precise. Thus, studying the effects by size may be less direct but more precise.

TABLE 7

The Effect of Collateral on Loan Prices by Firm Type

All columns in Table 7 show results from estimating a model of the following type:

$$s_{\ell ibt} = \beta \times \text{SECURED}_{\ell ibt} + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt},$$

where $s_{\ell ibt}$ is the spread on loan ℓ from bank b to firm i, originated at time t, γ_{ibtL} is a set of bank-firm-time-loantype fixed effects, and $\text{SECURED}_{\ell ibt}$ is a dummy whether loan ℓ is secured. In columns 2, 4, 6, 8, and 10, we replace $\text{SECURED}_{\ell ibt}$ with a set of five dummies that indicate the type of collateral used in secured loans.

In columns 1–4, the sample is restricted to either public or private firms as indicated in the header; in columns 5 and 10, the sample grouped by firm size as measured by a firm's total assets reported in the Y-14 and as indicated in the header. The data are restricted to loans newly originated between 2012:Q3 and 2019:Q4. Robust standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable: SPREAD (in BPS)									
Sample	Private		Public		<50 M		50 M–0.5 B		>0.5 B	
	1	2	3	4	5	6	7	8	9	10
(lr)1_11_SECURED	−45.9**		−5.8		−75.2**		−31.9*		−13.4*	
	(8.6)		(8.5)		(20.5)		(14.8)		(6.0)	
REAL_ESTATE		−37.2**		2.6		−62.5**		−32.1*		−8.8
		(8.1)		(19.2)		(17.5)		(12.9)		(9.1)
CASH + MARKETABLE_SECURITIES		−62.9**		30.4		−79.8**		−68.4**		−22.8
		(10.1)		(28.0)		(21.9)		(23.2)		(12.3)
AR + INVENTORY		−40.2**		−6.2		−68.3**		−30.4*		−11.8
		(9.1)		(10.0)		(19.0)		(13.3)		(8.4)
FIXED_ASSETS		−19.9*		5.5		−43.6**		−16.9		4.9
		(7.8)		(11.3)		(16.3)		(12.4)		(6.7)
BLANKET_LIEN		−29.2**		−29.0*		−54.8**		−18.7		−32.6**
		(9.2)		(12.0)		(19.1)		(13.9)		(9.0)
Loan controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-firm-time-loantype FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks	32	32	32	32	28	28	29	29	33	33
No. of firms	5,259	5,259	1,093	1,093	2,262	2,262	1,575	1,575	2,518	2,518
No. of obs.	15,003	15,003	7,346	7,346	5,237	5,237	4,985	4,985	11,882	11,882
Effective no. of obs.	8,232	8,228	4,248	4,244	2,775	2,771	2,728	2,724	6,828	6,824
R^2	0.909	0.906	0.942	0.942	0.930	0.930	0.899	0.899	0.925	0.925

firms for which the spread only decreases by 9 BPS with the coefficients being imprecisely estimated. The difference between the largest and smallest firm is also statistically significant.

Note that the rank ordering of the types of collateral according to their value identified above holds among the smallest and mid-size firms, with cash and marketable securities being most valuable, followed by real estate and accounts receivable and inventory, followed by fixed assets. Among the largest firms, it is worth noting that even though pledging collateral on average only has a very small effect on loan prices, blanket liens by contrast appear to be valuable. A loan with a blanket lien has an around 28 BPS lower spread for large firms as compared to an unsecured loan. This is in line with the notion that a blanket lien is most valuable for a lender if a firm has pledged little or none of its assets as collateral to another lender. Given that most large firms borrow unsecured (see Table 1), it is thus plausible that a blanket line is particularly valuable for large firms.

Our evidence that collateral is more valuable for private firms as well as small firms is in line with our previous findings based on leverage and interest coverage and adds further support to the insight from the literature that collateral is more valuable for riskier firms. Our evidence from comparing the valuation of collateral within private and public firms also suggests that the precision of our estimates documented in Table 3 is driven by private firms rather than publicly listed firms.

C. Collateral and Relationship Lending

An alternative way to assess the interplay between collateral valuation and risk is to consider the depth of the relationship between the bank and the borrower at the time of the loan origination. Stronger ties between lenders and borrowers may imply that the bank has more information about the borrower and is better positioned to assess its risk (Rajan and Winton (1995), Boot (2000)). Thus, from the perspective of the bank a borrower that it knows better may be perceived as less "risky" and thus collateral may be less valuable. Alternatively, additional information may generate a hold-up problem (Sharpe (1990), Rajan (1992)) in which the bank exploits its relatively higher market power over the firm.

We consider the length of the relationship between the bank and the borrower at the time of the loan origination to investigate the interaction between collateral valuation and bank-firm relationships. To that end, we split our sample into two groups. We consider in one group the bank-firm pairs of firms that have no loan agreements of any type with the bank that are 3 years or older at the time of the origination. We refer to these as "weak relationship" pairs as the bank-firm relationship is relatively young. All other bank-firm pairs are reported as "strong relationships" as the firm has been obtaining funds from the same bank for more than 3 years. In other words, these pairs are associated with firms that have a long-term relationship with the bank. We then estimate our main specification, equation (2), for both samples separately.

The results are reported in Table 8. Column 1 reveals that pledging collateral reduces the spread by around 40 BPS when the firm and the bank have not yet developed a strong relationship. As before, the most valuable type of collateral is cash and marketable securities followed by real estate and account receivables, see

TABLE 8

The Effect of Collateral on Loan Prices by Relationships Length

All columns in Table 8 show results from estimating a model of the following type:

$$s_{\ell ibt} = \beta \times \text{SECURED}_{\ell ibt} + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt},$$

where $s_{\ell ibt}$ is the spread on loan ℓ from bank b to firm i, originated at time t, γ_{ibtL} is a set of bank-firm-time-loantype fixed effects, and $\text{SECURED}_{\ell ibt}$ is a dummy whether loan ℓ is secured. In columns 2 and 4, we replace $\text{SECURED}_{\ell ibt}$ with a set of five dummies that indicate the type of collateral used in secured loans.

In columns 1 and 2, the sample is restricted to firms that have not obtained a loan from the originating bank within the last 12 quarters ("Weak Relationship"); in columns 3 and 4, the sample is restricted to firms that have previously obtained a loan from the originating bank in the last 12 quarters ("Strong Relationship"). The data are restricted to loans newly originated between 2012:Q3 and 2019:Q4. Robust standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable: SPREAD (in BPS)			
Sample	Weak Relationships		Strong Relationship	
	1	2	3	4
SECURED	−29.6**		−15.9*	
	(8.4)		(6.2)	
REAL_ESTATE		−25.2**		−17.7*
		(8.1)		(8.2)
CASH + MARKETABLE_SECURITIES		−38.0**		−13.2
		(11.3)		(10.0)
AR + INVENTORY		−23.3**		−14.6
		(8.0)		(7.8)
BLANKET_LIEN		−7.3		−14.8
		(8.1)		(9.0)
FIXED_ASSETS		−15.8		−9.8
		(8.5)		(7.2)
Loan controls	Yes	Yes	Yes	Yes
Bank-firm-time-loantype FE	Yes	Yes	Yes	Yes
No. of banks	31	31	32	31
No. of firms	6,181	6,145	3,088	2,708
No. of obs.	16,252	16,134	12,822	11,117
Effective no. of obs.	6,180	6,144	3,087	2,707
R^2	0.866	0.867	0.929	0.927

column 2. By contrast, if the firm already has a long-term relationship with the bank, the price effect of pledging collateral is considerably weaker. The average effect is around 15 BPS, see column 3, with little noticeable variation across different types of collateral, column 4. However, note that even though the point estimates are quite different, the difference between weak and strong relationship firms is not statistically significant.

D. Collateral and Loan Maturity

Our final tests focuses on loan maturity. Given that maturity tends to correlate with risk then we should find that pledging collateral is more valuable on loans with longer maturity. In order to test for the interaction between collateral and maturity, we estimate the following model:

$$s_{\ell ibt} = \sum_{j=1}^{4} \beta_{1,j} \times \text{SECURED}_{\ell ibt} \times \mathbb{I}\left[\text{MATURITY}_{j\ell ibt} = j\right] + \beta_2 \times \text{SECURED}_{\ell ibt} + \sum_{j=1}^{4} \beta_{3,j} \mathbb{I}\left[\text{MATURITY}_{j\ell ibt} = j\right] + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt},$$

TABLE 9

The Joint Effect of Collateral and Maturity on Loan Prices

Table 9 shows results from estimating a model of the following type:

$$s_{\ell ibt} = \sum_{j=1}^{4} \beta_{1,j} \times \text{SECURED}_{\ell ibt} \times \mathbb{I}\left[\text{MATURITY}_{j\ell ibt} = j\right] + \beta_2 \times \text{SECURED}_{\ell ibt} + \sum_{j=1}^{4} \beta_{3,j} \mathbb{I}\left[\text{MATURITY}_{j\ell ibt} = j\right] + \theta X_{\ell t} + \gamma_{ibtL} + \varepsilon_{\ell ibt},$$

where $s_{\ell ibt}$ is the spread on loan ℓ from bank b to firm i, originated at time t, γ_{ibtL} is a set of bank-firm-time-loantype fixed effects, $\text{SECURED}_{\ell ibt}$ is a dummy whether loan ℓ is secured, and $\mathbb{I}\left[\text{MATURITY}_{j\ell ibt} = j\right]$ is an indicator for whether the loan has maturity of less than 1 year (including demand loans), between 1 and 2 years, between 2 and 4, and more than 4 years.

The data are restricted to loans newly originated between 2012:Q3 and 2019:Q4. Robust standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

	Dependent Variable: SPREAD (in BPS)
	1
SECURED	−16.5*
	(7.5)
1_2_YEARS	−0.8
	(2.5)
2_4_YEARS	5.7*
	(2.3)
MORE_THAN_4_YEARS	43.8**
	(2.3)
SECURED × 1_2_YEARS	−11.3
	(7.0)
SECURED × 2_4_YEARS	−7.7
	(7.0)
SECURED × MORE_THAN_4_YEARS	−20.7**
	(7.8)
Loan controls	Yes
Bank-firm-time-loantype FE	Yes
No. of banks	33
No. of firms	8,392
No. of obs.	29,025
Effective no. of obs.	16,049
R^2	0.874

where $\mathbb{I}\left[\text{MATURITY}_{j\ell ibt} = j\right]$ is a dummy variable, equal to 1 if loan ℓ is in loan maturity category j. We define four different loan maturity categories: maturity of less than 1 year (including demand loans), between 1 and 2 years, between 2 and 4, and more than 4 years.

Results are reported in Table 9. We estimate that in this specification, pledging collateral on average decreases the spread by around 16.5 BPS independent of a loan's maturity. Moreover, we estimate that increasing the maturity of a loan has very little effect on the price if the maturity varies between 0 and 2 years, but there is a weak price effect of the maturity exceeding 2 years and a much stronger price effect when the maturity exceeds 4 years. For instance, we find that spreads on loans with a maturity of 2–4 years are 5 BPS higher, on average, than spreads on loans with a maturity of less than 1 year. However, we find that choosing a maturity of more than 4 years increases the spread by around 22 BPS vis-á-vis a short-term loan with a maturity of less than 1 year. Further, the pricing of loans is more sensitive to changes in the maturity and there is a considerable degree of interaction between

collateral and maturity. Collateral reduces the spreads by about 22 BPS for loan contracts with more than 4 years of maturity. These results indicate that collateral is particularly valuable in longer-term loans, adding further support to our previous finding that collateral is more valuable for riskier loans.

V. Final Remarks

In this article, we capitalize on a rich loan-level data set and a novel identification strategy to overcome some of the challenges that studies of collateral have encountered. Estimating the effect of collateral on loan pricing by comparing secured loans with unsecured loans of the same type, from the same firm, with the same bank, and the same origination date allows us to address the problems emanating from the endogeneity of the collateral pledging decision. This endogeneity is important. While existing studies of loan prices find that loans secured with collateral carry higher spreads even after controlling for observable risk factors (see, e.g., Berger and Udell (1990), John et al. (2003), Santos and Winton (2008), (2019), and Santos (2011)), we find that securing a loan reduces the spread by 23 BPS on average.

While this finding is in of itself not surprising and in line with standard economic theory, our article broadens the findings of Benmelech and Bergman (2009) and Cerqueiro et al. (2016) both on the value of different types of collateral and the differences in the importance of collateral across firm types. Our results show that there is considerable variation in the price effect across different types of collateral, with marketable securities and real estate being the most valuable types of collateral and a blanket lien being the least valuable type of collateral. Further, we show that collateral is most valuable for smaller and private firms.

Our evidence that banks respond to changes in the value of the collateral pledged, in particular our finding that rates on loans backed by real estate are reduced when real estate prices go up, adds support to the thesis that collateral is valuable. That finding is also important because existing studies showing that firms' investment expenditures rise in response to increases in real estate values (e.g., Gan (2007), Chaney et al. (2012)) are not able to document how borrowers adjust their collateral policies in response to shocks to their pledgeable assets. Finally, our evidence that collateral is more important for smaller and privately held firms complements available evidence that large and publicly firms rely very little on collateral (Lian and Ma (2021)).

Our article suggests some fruitful areas for future research. Our findings show that the length of the bank-borrower relationship affects collateral valuation, but we did not investigate whether other bank-specific factors also play a role on collateral valuation. It would seem worthwhile to investigate to what extent the value of collateral depends on banks' expertise dealing with different types of collateral. Similarly, our findings show that there is a striking difference in collateral valuations for small/medium-sized firms versus large/publicly listed firms. It would seem important to investigate small firms' investment responses to shocks to their pledgeable assets and compare them with the existing findings, which are based on large/publicly listed firms.

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