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Risk-Taking and Monetary Policy Transmission: Evidence from Loans to SMEs and Large Firms

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ABSTRACT

Using administrative firm-bank-loan level data from the U.S., we document four new facts about the credit market. First, private firms' (SMEs') borrowing from banks comprises their entire balance sheet debt, compared to large publicly listed firms who can switch between bond markets and drawing from their credit lines. Second, SMEs borrow shorter maturity and pay higher interest rates relative to large listed firms. Third, SMEs mostly use their enterprise's continuation value as collateral rather than fixed assets and real estate. Fourth, the relation between collateral and risk—where risk is measured by the loan spread—is positive for large listed firms but negative for SMEs. Based on these facts, we show that monetary policy transmission and risk-taking differ across SMEs and large listed firms. When monetary policy is expansionary, credit demand of SMEs with high leverage increases more. SMEs' borrowing capacity expands more given their frequent use of earnings and operations-based collateral. We find no evidence of risk-taking by banks as they lend less to firms who defaulted before and likely to default in the future. Our results from the sample of all U.S. firms mimic those of SMEs and imply that the aggregate effects of monetary policy might depend on the size distribution of firms and the type of collateral used. Since SMEs cover 99 percent of all firms and over 50 percent of U.S. employment and output, our results also have important implications for aggregate boom-bust cycles.

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1 Introduction

Many argue that "too low for too long" interest rates might lead to low productivity and threaten financial stability, because low interest rates not only lead to more borrowing, they also affect the quality of that borrowing via allocation of credit across firms (e.g Borio and Zhu, 2012; Adrian and Shin, 2009; Gopinath, Kalemli-Ozcan, Karabarbounis, and Villegas-Sanchez, 2017; Acharya and Naqvi, 2012). Banks might extend loans to riskier and/or low productivity firms especially when monetary policy is accommodating. If risky firms subsequently default on these loans, then banks will experience a negative shock to their net worth, increasing systemic risk. Thus, expansionary monetary policy implies not only higher credit growth, investment, and output today, but also corporate debt overhang and increased default risk that might trigger a financial crisis and hold back investment in the future.

In order to quantify monetary policy transmission in an economy with heterogeneous agents with "risk-taking," we need a representative sample of lenders and borrowers. In particular, there can be heterogeneity in taking risk when rates are low that is based on either lender and borrower size or the type of financial contract. Therefore, results based on a select sample of large borrowers and/or lenders participating only in certain types of financial markets can be incomplete. There is an extensive theoretical literature studying monetary policy transmission in heterogeneous agents macro models focusing on household heterogeneity for consumption channel (e.g McKay, Nakamura, and Steinsson, 2016; Kaplan, Moll, and Violante, 2018; Auclert, 2019; Wong, 2019) and firm heterogeneity for investment channel (e.g Ottonello and Winberry, 2020). To date, it has been proven difficult to bring firm-side models to the data in the U.S. because only large publicly listed firms are required to report their financing sources.

We use a new confidential supervisory data set that includes a much more representative set of U.S. firms than all other available U.S. firm-level data sets that report firms' financing sources. The data also contains all large U.S. bank holding companies and covers the universe of systemically important banks. We combine our quarterly data with the standard measures of monetary policy surprise shocks, obtained through high frequency identification and ask: during episodes of expansionary monetary policy, do *high leverage banks* knowingly take risk by lending to firms who are more likely to default (*high leverage and/or low collateral firms*) or is it simply that low rates cause small firms to increase their demand for credit due to improved continuation values and higher ability to repay debt?

Our data comes from the Capital Assessments and Stress Testing Report (FR Y-14Q report) and is collected by the Federal Reserve as part of the Comprehensive Capital Anal-

ysis and Review (CCAR) process for bank holding companies, U.S. Intermediate Holding Companies of foreign banking organizations. The stress testing exercise covers all financial institutions with $50 billion or more in total consolidated assets.[1] The data covers approximately 70% of Corporate and Industrial (C&I) loans in the U.S. from Q3:2012 to Q4:2019. During this period, the federal funds rate was at the effective zero lower bound from 2012-2015, and remained beneath 1 percent until 2017Q2.

There are several advantages of our data set. First, this data is at the firm-bank-loan-quarter level, where we observe firms' and banks' balance sheets. Second, in addition to the loan quantity, which is generally the only variable available in other advanced country credit registries, we observe the interest rates (spreads) as well as the type and amount of collateral posted, both at the loan level.[2] This allows us to evaluate whether risk-taking operates through credit supply (bank) or credit demand (firm), and if other dimensions of heterogeneity, such as collateral type and financial constraints at the firm and/or loan level affect monetary policy transmission and/or allocation of credit across firms. Third, as we show below, our Y-14 data covers a much higher fraction of aggregate U.S. corporate sector debt and U.S. gross output compared to other available data sources that also contain information on U.S. on firm financing.

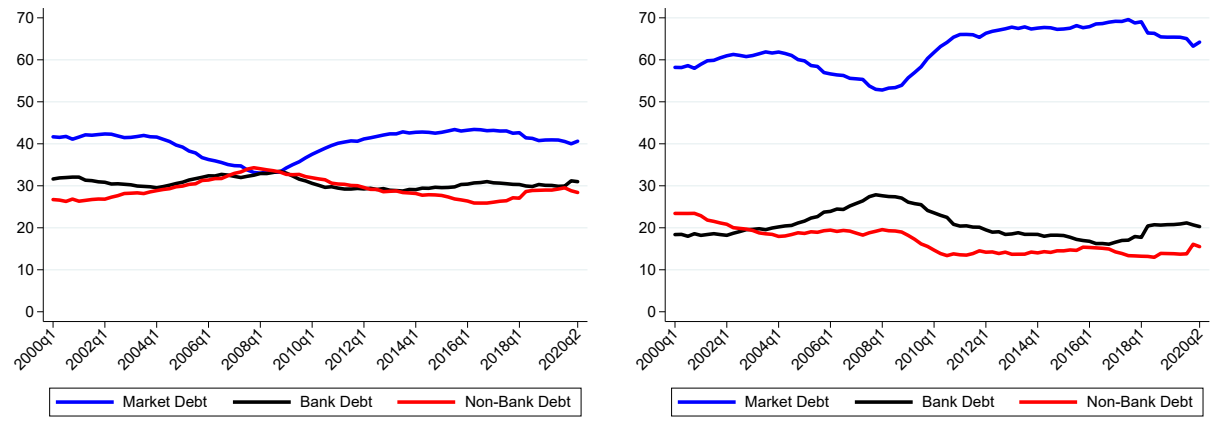
Figure 1 plots official aggregate data for the non-financial business sector from the Financial Accounts of the United States in the Flow of Funds (FoF). Panel (b) shows the debt share for publicly listed and large private firms (C and S corporations), known as "non-financial corporate businesses" in FoF data. The share of bank finance, shown by the line "Bank Debt" is small for these companies, around 20 percent on average. In Panel (a), which includes not only publicly listed firms, large private C and S corporations, but also other smaller private firms, known as "non-financial businesses," the share goes up to 30 percent. In addition, market debt declines sharply in Panel (a).[3] This difference indicates the importance of bank financing for small and medium size enterprises (SMEs), as including these firms increases the share of bank finance and decreases that of market finance. As the data depicted in

[1]The asset threshold has changed to $100 billion in 2019. The appendix provides a list of the financial institutions that report information for the CCAR process.

[2]The only other credit registry with this information, to the best of our knowledge is from an emerging market, Turkey, see di Giovanni, Kalemli-Ozcan, Ulu, and Baskaya (2019).

[3]The private firms included in the non-financial business series that are excluded from the non-financial corporate business series include, among others, partnerships and sole-proprietorships. In the Financial Accounts of the United States liabilities for private firms both under "non-financial corporate" and "non-financial businesses" are not built from the bottom up. They are "estimates" apportioned into categories from sources than can be identified. For example, the loan liabilities in the "non-financial business" category are derived from tax data from the IRS-SOI year end bulletin, and an estimate of loan shares from FRB 2003 Survey of Small Business Finance, a survey that is discontinued.

Figure 1: Non-financial Firms' Financing in the Financial Accounts of the United States



(a) Non-financial Business

(b) Non-financial Corporate Businesses

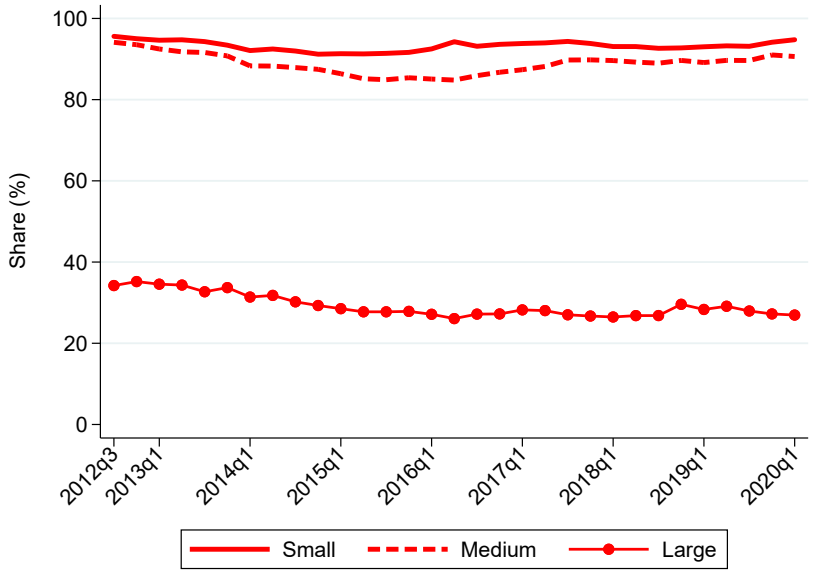
Note: The panel on the left represents the debt share for all "non-financial businesses" in the U.S. The panel on the right represents the debt share for the "non-financial corporate businesses" in the U.S. The "Bank Debt" include Corporate and Industrial (C&I) loans and non-residential mortgages held by banks. "Non-bank Debt" includes, among others, syndicated loans held by non-banks, non-residential mortgages held by non-banks, and finance company loans. "Market Debt" comprises corporate bonds, commercial paper, and industrial revenue bonds. Source: Financial Accounts of the United States, FOF.

panel (b) is widely used by researchers and dominated by large listed firms, it led to a false narrative in the literature that bank financing is not important for firms in the U.S.

Our data from FR Y-14 filings shown in Figure 2 paints a drastically different picture. We plot only firm financing among private firms to highlight the stark difference from the aggregate data that is dominated by listed firms. For large private firms, defined as firms in the upper quartile of the asset distribution, the red dotted line shows that we match the narrative of the aggregate data of Figure 1 (a) as only 30 percent of their financing is from bank lending. Interestingly, for the rest of the private firms, financing is almost exclusively from banks. These private firms that are below the 75th percentile of the asset distribution are firms with assets less than $43 million, and revenue less than $86 million. The median firm has $12 million in assets and $28 million in sales. Hence most of our Y-14 private firms, including the median firm, are SMEs.[4] It is important to understand borrowing and lending patterns of SMEs in the U.S., as SMEs account for 99.8 percent of all firms, 52 percent of

[4]In U.S., SMEs are defined as firms with less than 500 employees. There is not a well established asset and/or revenue cut-off to define SMEs. Since Y-14 data does not cover employment, we follow the OECD definition of SMEs as firms with assets less than $10 million, and/or revenue less than $50 million, and/or employees less than 250.

Figure 2: Non-financial Private Firms' Financing in FR Y-14



Note: The figures plots the median loan commitment as share of total balance sheet debt for various points in the asset-size distribution among private borrowers. Source: FR-Y14Q H.1

private sector employment and 48 percent of private sector gross output.[5] We argue that understanding the differences between SME and large firm financing is key to understanding monetary policy transmission in the aggregate U.S. economy.

Our identification methodology is via difference-in-differences regressions. We regress credit volume and price at the firm-bank-loan level on measures of bank and firm "riskiness" interacted with the monetary policy surprises measured by Gürkaynak, Sack, and Swanson (2005) (GSS). In the presence of financial frictions, the response of credit outcomes to monetary policy may in part reflect movements in risk spreads (e.g Gertler and Karadi, 2015). We investigate how credit outcomes (both spreads and quantities) for risky and non-risky firms and banks respond from quarter q to $q+1$ to a monetary policy surprise in quarter q. We interact the monetary policy surprises with "ex-ante risk" measures for firms and banks with the idea that "ex-ante risky" firms and banks will respond differently to monetary policy surprises. To highlight the importance of heterogeneity, we use all firms first and then show separate results for private/public firms and SMEs and large firms. We use ex-ante leverage, measured before the monetary policy surprise, as a proxy for ex-ante firm and bank risk. As an additional risk measure for banks, we also use ex-ante accumulated "charge-offs" on their

[5] See www.census.gov

balance sheets for non-performing loans.

Our results show that risk-taking in the U.S. operates through private firm/SME credit demand; that is, when interest rates are low, ex-ante risky (high leverage) firms demand more credit, increasing the loan amount and loan price. This result does not hold for publicly listed firms. The channel operates through credit demand because we condition on credit supply with bank×quarter fixed effects and show that both prices and quantities increase in tandem. Identification in this specification comes from the same bank lending to different firms and hence captures different firm credit demand among high and low leverage firms. When we investigate the credit supply side, using firm×quarter fixed effects focusing on firms borrowing from multiple banks instead, we find no evidence of risk-taking by banks. Highly levered banks lend *less* to SMEs during expansionary policy. Banks also lend *less* in general to firms who had non-performing loans (NPLs) in the past. Similarly to the results for credit demand, these credit supply results also hold in the all and SME/private firm samples, but they do not hold for the sample of publicly listed firms.

To understand the type of financial friction driving these results and how this friction relaxes/tightens with monetary policy changes, we undertake a granular investigation of the credit market in the U.S. and document new important facts. SMEs not only borrow solely from banks as we show before, they also borrow shorter maturity and pay higher interest rates relative to large publicly listed firms. Moreover, the value of the collateral they use to obtain credit is mostly tied to firm operations and enterprise continuation values rather than the market value of fixed assets and real estate. To dig deeper into the relation between the collateral pledged and credit outcomes both before and after the monetary policy changes, we run another difference-in-differences regression where credit outcomes are regressed on pledged collateral interacted with monetary policy surprises. We find that, in normal times, SMEs who pledge more collateral borrow more and pay a lower interest rate. For large publicly listed firms, the result is the exact opposite: large public firms who post more collateral obtain less credit and pay higher interest rates. Hence, pledging collateral reduces spreads for SMEs capturing access to finance, but increases them for large listed firms, capturing "default risk" as argued by an extensive literature (e.g Holmstrom and Tirole, 1997; Kiyotaki and Moore, 1997; Geanakoplos, 1996).

Why do leveraged SMEs borrow more when monetary policy is accommodating? We show that the answer to this question depends both on if and what type of collateral is pledged. SME loans are mostly secured by blanket liens and accounts receivable/inventory (AR&I) rather than fixed assets and real estate. By contrast, large public firms generally borrow unsecured and do not pledge any collateral. Blanket liens and AR&I collateral derive their

value from firm operations and the enterprise value of the firm through accumulated earnings. With easy monetary policy, the standard channel operates the collateral constraint on fixed assets relaxes (e.g Kiyotaki and Moore, 1997). In addition, the earnings and operations based collateral constraint also relaxes, adding to the borrowing power of SMEs who do not have a lot of fixed assets to use as collateral to begin with. These results are consistent with the recent work emphasizing earnings based constraints for "smaller firms" among the publicly listed firms (e.g Lian and Ma, 2020; Ivashina, Laeven, and Moral-Benito, 2020; Drechsel, 2019).[6] Our new finding is that such constraints are even more important for SMEs based on new granular data on pledged collateral of different types, where "operational collateral" is most important. We also show that pledging collateral can capture both riskiness and access to finance, and this difference can only be sorted out via representative variation in firm size.

We proceed as follows. Section 2 summarizes the literature. Section 3 describes the data in detail. Section 4 presents stylized facts on firms' borrowing, banks' lending and loan types and collateral used highlighting the heterogeneity on several dimensions of financial contracts. Section 5 presents results on monetary policy transmission. Section 6 concludes.

2 Literature

Our paper contributes to several strands of the literature.

The first strand studies the impact of monetary policy on financial frictions and their impact on the aggregate economy. Starting with Bernanke and Gertler (1989) and Bernanke, Gertler, and Gilchrist (1996, 1999), this literature focuses on the financial accelerator channel in representative agent new Keynesian models with abundant evidence on the empirical side showing the importance of heterogeneity. Expansionary monetary policy improves net work and reduces agency frictions, which allows low net worth (risky) borrowers to increase borrowing. On the lender side, low interest rates induce "search-for-yield" behavior among intermediaries that reallocate their portfolio toward risky lending (e.g Rajan, 2005). Alternatively, if low interest rates reduce funding costs to entrepreneurs and reduce the incentive to produce risky projects, then risky borrowers are not risky anymore (e.g Stiglitz and Weiss, 1981).

[6] This literature relies on data for large listed firms and firms who have access to bond markets and are not SMEs. Our FR Y-14 data shows that smallest firms among the large listed firms use blanket liens and AR&I as collateral, consistent with these papers that use different data to capture earnings based constraints rather than pledged collateral as we do.

The literature focusing on the lender side highlights the importance of heterogeneity in risk bearing/taking capacity, where large, well-capitalized banks (e.g Adrian and Shin, 2009) can take more risk, meaning high leverage banks will extend less credit during monetary expansions and/or after financial shocks. Consistent with this view, the empirical literature using bank-level data shows that riskiness of the banks' portfolio increases for the *high capital-low leverage* banks (e.g Dell'Ariccia, Laeven, and Suarez, 2017) and these banks charge lower spreads on syndicated loans, during expansionary policy (e.g Paligorova and Santos, 2017). Using borrower level data, some papers find that banks with *low capital-high leverage* lend to "riskier" borrowers who have defaulted more before (e.g Jiménez, Ongena, Peydró, and Saurina, 2014; Ioannidou, Ongena, and Peydró, 2014).

The second strand to which we relate studies heterogeneity in monetary policy transmission across firms by focusing firm size and financial frictions. Our contribution here is twofold. Since leverage and collateral capture both default risk and access to finance, we employ granular data on collateral type and loan spreads combined with firm size to sort this out. Different studies argue that firm-level responses to monetary policy changes depend on size, age, and leverage (e.g Gertler and Gilchrist, 1994; Jeenas, 2019; Cloyne, Ferreira, Froemel, and Surico, 2018; Ottonello and Winberry, 2020; Greenwald, Krainer, and Paul, 2020). Our specifications include firm and time fixed effects to control explicitly for age, and we investigate the role of leverage and size in detail. Consistent with the papers above, we show that large firms will not respond to monetary policy shocks as a function of their leverage as these firms are not financially constrained. By contrast, leveraged SMEs will respond more due to the relaxation of their earnings and operations based collateral constraints.[7]

The third strand of the literature we relate to is the importance of financial contracts in transmitting shocks to the aggregate economy via the relation between collateral, spreads, and debt. In the models developed by Kiyotaki and Moore (1997) and Kiyotaki, Moore, and Zhang (2021), entrepreneurs borrow against fixed assets and real estate (trees). If a firm uses these assets as collateral and defaults, the assets will be confiscated by lenders and sold to other firms to use. Hence, the collateral value of these assets is generally given by the market value (liquidation value) of the asset when the debts are due. In these models, entrepreneurs use the collateral to generate output (fruit) but cannot borrow against future output. However, in our data, SMEs loans are most frequently secured by AR&I collateral

[7] Our results are fully consistent with Ottonello and Winberry (2020) who investigate the effect of monetary policy shocks on investment. In our sample of public firms, which is the basis for their work, we show that high versus low leverage firms do not differ in their responses if leverage is measured with short term debt. When we measure leverage with total debt, we find their exact result: high leveraged public firms respond less by borrowing less during expansionary policy.

and blanket liens; that is they pledge the *current* fruit whose liquidation value depends on current firm current operations and continuation values. Put differently, the sales that firms generate combine ideas, intangible capital, marketing of products, etc. and get embedded into the value of the fruit they produce and become capitalized on the balance sheet and pledgeable as AR&I.

It turns out that collateral type is important for monetary policy transmission in our empirical exercise because monetary policy not only changes the relative price of assets as in traditional models, it also impacts firms' ability to produce its own assets that are used as collateral (fruit). Benmelech and Bergman (2012) argue that monetary policy, through the general equilibrium impact on aggregate demand, increases firm sales (and accounts receivable), which increases borrowing capacity. By contrast, Kiyotaki, Moore, and Zhang (2021) argue that, even with some pledgeability of future cash flows, lower interest rates may lower the borrowing capacity as the horizon of cash flow returns to the lender is shorter than the maintenance costs of fixed assets, which limits the returns to savers and the value of the fixed assets as collateral. This mechanism rests on the assumption that the value of the collateral used by entrepreneurs to borrow (the machine) is derived from its competitive resale value in the spot market or what savers are willing to pay. This is the right mechanism for tangible fixed assets and real estate collateral but not for "operational collateral" like AR&I and blankets lien that are produced by the firm rather than purchased in the spot market.

Our work is consistent with the new literature that draws a distinction between debt secured by assets (asset based loans or ABLs) and debt tied to firm cash-flows and earnings (earnings-based or going concern debt) (e.g Lian and Ma, 2020; Kermani and Ma, 2021). According to industry and legal language, loans secured by fixed assets, real estate, AR&I, cash, and marketable securities are considered ABLs whose value is determined by liquidation values; blanket liens and unsecured debt fall under earnings-based debt since their value derives from the firm cash-flows. We will use a more granular grouping reflecting the rich heterogeneity in our unique "pledged collateral" data. We draw a further distinction between tangible-fixed assets and real estate with AR&I as the book value of AR&I collateral only exists because of firm operations and its ability to create sales that generate the receivables and inventory. The distinction is that the firm itself *creates* its own collateral value through production rather than purchasing it as it does with land or machines that are used for production. Therefore, the very attributes of the firm that are generally taken to be going-concern value are in fact embedded in value of AR&I collateral despite the fact it is booked on the balance sheet just like other tangible fixed assets. The inability to separate the liquidation value of AR&I from the going-concern value embedded in blanket liens

is particularly important for SMEs who do not have large amounts of tangible fixed assets to pledge. Our results on monetary policy transmission also show that these two types of collateral, AR&I and blanket liens, work in the same way in the data as their values derive from firm operations and continuation values.

In terms of the relation between collateral and spreads, the existing empirical literature finds mixed results due to using different and select samples of firms and banks. Berger and Udell (1990) use bank-level data and show that collateralized loans have higher interest rates, opposite of our SME result.[8] Luck and Santos (2019), also using FR Y-14 data, focus on a small sample of new loan organizations from multiple banks and find that smaller firms who post collateral pay lower rates, consistent with our result.

Rauh and Sufi (2010) and Benmelech, Kumar, and Rajan (2020), all study the relationship between collateral and risk among large public borrowers. Similarly to Rauh and Sufi (2010), we show that there is a positive relation between collateral and risk for large listed firms. Public firms post collateral when they are in distress or if they are low quality firms. However, Benmelech, Kumar, and Rajan (2020) find a different result where collaterized debt has lower spreads relative to unsecured debt among large listed firms. Rampini and Vishwanathan (2020) argues that both secured and unsecured debt have some sort of collateral backing. From the lens of their model, more financially constrained firms will switch to secured debt. Less financially constrained large listed firms decrease use of secured debt over time. Thus, these composition effects might be driving the Benmelech, Kumar, and Rajan (2020) results.[9]

The fourth strand of the literature that we contribute to argues that monetary policy can be less effective or less powerful during recessions and/or during a low interest rate environment, and low rates can threaten financial stability. Tenreyro and Thwaites (2016) find that monetary policy shocks have a smaller impact on real economic activity in recessions than in normal times. Kiyotaki, Moore, and Zhang (2021) shows how low rates in a liquidity trap can reduce borrowing capacity through low returns to savers. Ottonello and Winberry (2020) shows that the power of monetary policy will depend on the distribution of default risk in the economy. Our contribution to this literature is to show that the power of monetary policy will depend on the firm size distribution and the collateral type used to secure loans. We also show a hidden financial stability risk; leveraged SMEs borrow more with low rates

[8] Berger, Frame, and Ioannidou (2016) using large firms from Bolivia also finds a positive relation between collateral and spread, whereas di Giovanni, Kalemli-Ozcan, Ulu, and Baskaya (2019) using universe of firms from Turkey finds a negative relation between collateral and spread.

[9] Very small private firms who lack collateral cannot access credit as they are screened out of the market as in Darst, Refayet, and Vardoulakis (2020). Although we do not observe this extensive margin, as our data is on firms who borrow, our results show that the same intuition works at the intensive margin.

and are more likely to default in the future.

Finally, we contribute to a growing literature using the FR Y-14 data. This data are used to study various other issues including CDS use by banks on borrower credit risk (Caglio, Darst, and Parolin, 2019), the relationship between U.S. exchange rates and banks credit supply to foreign firms (Niepmann and Schmidt-Eisenlohr, 2018), how banks re-balance their portfolios due to losses (Bidder, Krainer, and Shapiro, 2018), how monetary policy transmits differently through credit lines versus terms loans (Greenwald, Krainer, and Paul, 2020), the effects of COVID on credit line draw downs stemming from the differences between small and large firms in terms of their financing (Chodorow-Reich, Darmouni, Luck, and Plosser, 2020), the effect of corporate taxes on leverage (Ivanov, Pettit, and Whited, 2020), estimating the value of collateral in new loan originations (Luck and Santos, 2019), and the real effects of quantitative easing (Luck and Zimmermann, 2020).[10]

3 Data

3.1 FR Y-14Q Schedule H.1

The FR Y-14Q report collects detailed information on bank holding companies' (BHCs), savings and loan holding companies' (SLHCs), and U.S. intermediate holding companies' (IHCs) of foreign bank organizations (FBOs) on a quarterly basis. The data are collected as part of the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR) for BHCs, SLHCs and IHCs with at least $50 billion ($100 billion starting from 2019) in total assets.[11] The banks that submit FR Y-14Q data since 2012 comprise over 85% of the total assets in the U.S. banking sector.

For our study, we use the Wholesale Risk Schedule, or H.1. Schedule, which collects loan level data on corporate loans and leases together with corporates' balance sheets. The H.1 Schedule had two sections: (1) Loan and Obligor Description section, which collects information related to the firm and the loan itself; and (2) Obligor Financial Data section, which collects data related to the financial health (balance sheet and income statement) of the firm. Hence we also have time varying information on bank and firm balance sheets.

Banks report details on corporate loans and leases that are either held-for-investment (HFI) or held-for-sale (HFS) in the loan book at each quarter end. Loans and leases with HFI

[10]Note that Chodorow-Reich, Darmouni, Luck, and Plosser (2020) shows similar facts to us in terms of SMEs borrowing at higher rates and shorter maturities from banks.

[11]The assessment is conducted annually and consists of two related programs: Comprehensive Capital Analysis and Review and Dodd-Frank Act stress testing (DFAST).

designation are those that the bank has the "intent and ability to hold until the foreseeable future or until maturity or payoff." Loans and leases that are HFS are those that the bank intends or expects to sell at some indefinite date in the future. Both HFI and HFS loans and leases are categorically distinct from those that are reported as trading assets. Trading assets of banks are not reported on FR Y-14 Schedule H.1 and are instead reported on Schedule B (Securities Schedule). The vast majority of loans in the FR Y-14 data (on average 98% by dollar amount) are designated as HFI. The appendix contains additional information on how different assets are classified in the FR Y-14 schedules.

The population of loans is reported at the credit facility level (loan level) and is limited to commercial and industrial loans with a committed balance greater than or equal to $1 million.[12] Each facility is reported separately when borrowers have multiple facilities from the same bank. The facility level information includes total committed and utilized amounts, pricing and spread information, origination and maturity dates, and information on the value and type of underlying collateral. We will call each facility a loan in the remainder of the paper.

The total committed value of the loans reported on the H.1 Schedule as of 2019Q4 is nearly $3.3 trillion.[13] To get a sense for what fraction of total U.S. C&I lending our data comprise, we compare it to what is reported by the universe of BHCs, in the aggregate form, on the FR Y-9C (schedules HC-C and HC-L). BHCs commitments in the FR Y-9C total nearly $4.6 trillion. Thus, our data from the FR Y-14Q accounts for nearly 70 percent of all C&I equivalent lending in the U.S.[14]

The FR Y-14Q information on the financial health of the borrowers (firm balance sheet and income statement variables) is an invaluable source of information for private firms in the U.S. as this information does not exist anywhere else.[15] The data also contains borrower

[12]A credit facility is defined as a credit extension to a legal entity under a specific credit agreement, basically a loan contract.

[13]We keep loans identified on the FR Y-9C as C&I loans domiciled in the U.S. (item 4(a)), loans to finance agricultural production (item 3), loans secured by owner-occupied real estate domiciled in the U.S. (item 1(e)(1)), and other leases (item 10(b)).

[14]The comparisons between FR Y-14Q and FR Y-9C are not one-to-one and are complicated by the at least three factors: 1) HC-C only reports utilized exposures; 2) the committed exposures reported on HC-L are aggregated differently and include loans that are not necessarily U.S. C&I loans. For example, HC-L reports total committed exposure for all C&I loans (Y-9C item 4), which includes loans to foreign addresses (item 4(b) in addition to those those domiciled in the U.S (item 4(a)). In addition, the HC-L reports the total committed amount of loans secured by real-estate (item 1), which includes various types of loans secured by real estate in addition to loans secured by owner-occupied real estate domiciled in the U.S. (item 1(e)(1)). 3) FR Y-14Q data only includes loans over $1mn. Therefore, FR Y-14Q comparisons of the total committed loans amounts to FR Y9-C represent lower bounds of the overall amount of C&I lending done in the U.S.

[15]Few commercial data providers, such as, Moody's ORBIS and D&B provide some of this data but for a very select set of private firms that volunteer the information. Other sources such as FED's small business

identifiers such as tax identification numbers, CUSIPS, and company names and addresses. These firm identifiers allow us to match the data with other data sources to cross-check information and determine the relative importance of different sets of borrowers *e.g.* public versus private companies, SMEs versus large firms, and syndicated versus non-syndicated loans. Our paper exploits information on a large cross-section of private borrowers, first time, to convey the importance of including private firms, most of which are SMEs, for aggregate economic activity and for the transmission of monetary policy.

3.2 Sample Construction

For each quarter, we define private firms in the data as those that cannot be matched to COMPUSTAT either via 6-digit CUSIP or via tax ID (EIN). Large public firms might report consolidated or unconsolidated accounts to banks. To avoid double counting of financial variables, we use Bloomberg's Corporate Structure Database and match it to our FR Y-14Q data through EIN when possible, or name matching. This way we can clean double counting arising from subsidiaries unconsolidated and their corporate headquarters' consolidated statements. We roll the loans issued to subsidiaries up to the parent company since banks use parent company financial information for loans made to subsidiaries. Treating these subsidiaries as separate "firms" will produce erroneous results for size and distributional cuts of the data.[16]

The final data has 3,798,946 loan-level observations for 155,589 U.S. corporations. Importantly, the data contain nearly 153,000 unique private firms of which 66,000 have balance sheet assets of less than $10 millions. Hence, almost 50 percent of our sample are SMEs. All data cleaning details are provided in appendix.

finance survey and U.S. Census Bureau's QFR data sets are also for select set of firms and not representative of the U.S. economy. See Dinlersoz, Kalemli-Ozcan, Hyatt, and Penciakova (2018) that goes details of the selection problems in the financial data for private firms in the U.S. and how to use U.S. Census Bureau LBD data to correct for this selection.

[16]Note that, relying on the tax ID without the full corporate structure to identify unique firms in the data is problematic because banks frequently report identical tax ids for both parent companies and their subsidiaries. This means that there will be different balance sheet information for the same tax id because the balance sheet information is attributed to two distinct firms. For robustness in all of our regressions, we remove from the sample the loan amounts to identified subsidiaries and find that the results are qualitatively the same.

3.3 Descriptive Statistics and Unique Features

This section provides statistics that highlight the key advantages of the FR-Y14Q data. First, the data allows for a broader cross-sectional representation of U.S corporate borrowers. Compared to COMPUSTAT, LCD Dealscan, and QFR, our data represents a major step forward in terms of firm and sector representation over time and hence will better inform us on the heterogeneous transmission of monetary policy, risk taking channel and the importance of firm level financial constraints. Unlike these datasets, our data not only captures SMEs, it also covers all sectors of the economy; not just manufacturing as in the QFR data of U.S. Census. Figure 3 shows the average and total dollar amounts committed to each two-digit NAICS sector in Panels (a) and (b) respectively. The Figure shows that on average, the largest loans are committed to firms in the utilities; information; and mining, quarrying, and oil and gas extraction sectors. By contrast, aggregate commitments are largest for firms in the manufacturing and wholesale and retail trade sectors, indicating that there are many small loans to a large number of businesses in these sectors.

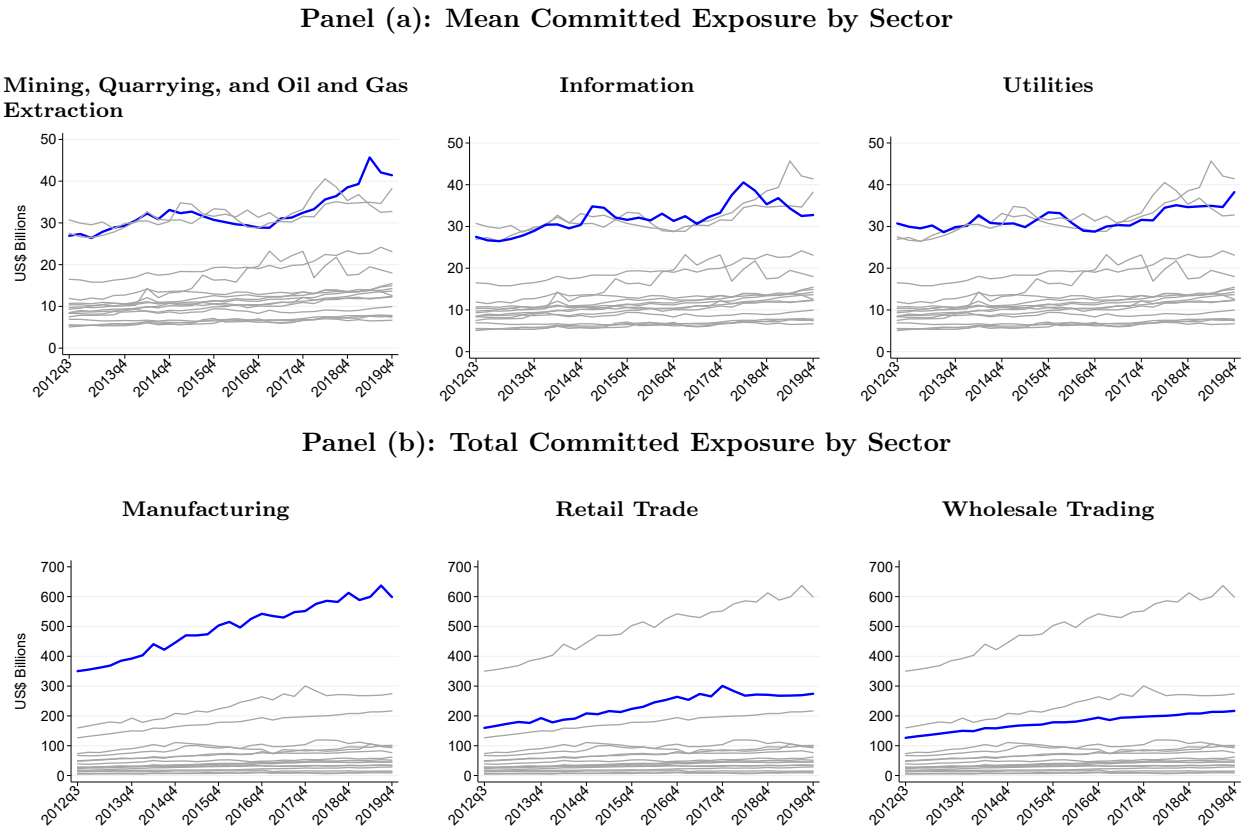
Figure 4 shows the firm size distribution based on assets. Panel (a) shows histograms for all private firms (red bars), public firms (blue bars). Panel (b) shows the histogram for firms in our data who also borrow in syndicated loan markets.[17] Two important features emerge. First, most private borrowers in our data have less that $10 million in total assets, that is they are SMEs. Second, panel (b) identifies the firms who borrow in syndicated loan markets and shows that these firms almost perfectly match the size distribution of public companies. LCD Dealscan and the Shared National Credit Registry (SNC) are two popular data sources for research in loan markets and our data show that the firms who borrow in these markets are clearly not representative of all corporate borrowers among large U.S. banks, much less the entire U.S. economy.

Another advantage of our data is that we observe loan-level details on prices, quantities, and non-price terms such as collateral and lien position, as well as ex-ante internal bank risk assessments for each borrower. These characteristics can be tracked over time. The data also include detailed information on loan losses and delinquencies, which enables us to assess ex-post loan performance and link this performance to ex-ante risk measures. This is a significant improvement as compared to LCD Dealscan data that contain loan information only at origination.

To highlight the quality of FR Y-14 data and the aggregate importance of private firms borrowing in the U.S economy, Figure 5, Panel (a) plots our aggregation of total dollar value of liabilities in the FR Y-14 data (from firms' balance sheets including bonds and loans) as

[17] The FR Y14 data have a syndicated loan flag that allows one to identified syndicated loans.

Figure 3: Loan Commitments by Sector



Note: Panel (a) plots the mean dollar value of loan commitments made by CCAR banks to firms by the borrower's primary 2-digit NAICS industry. Panel (b) plots the total dollar value of committed loans made by CCAR banks to firms by the borrower's primary 2-digit NAICS industry. Source: FR-Y14Q H.1.

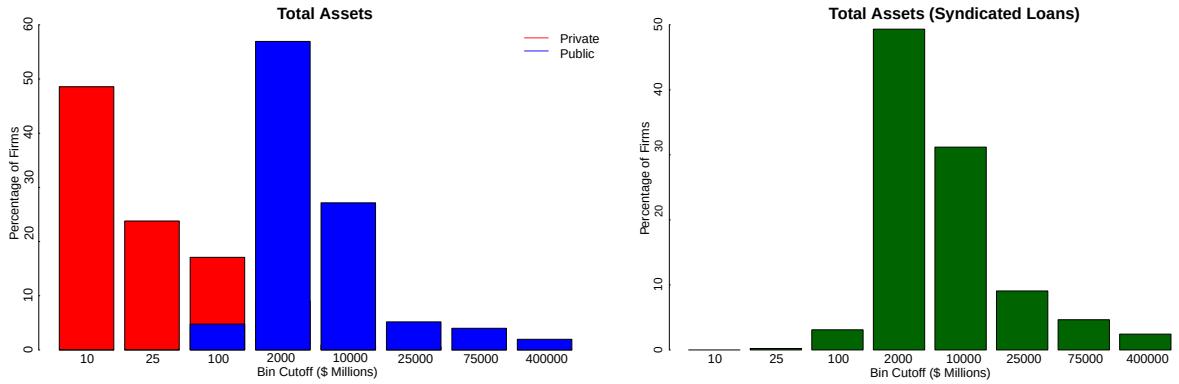
a share of the aggregate dollar value of non-financial business debt liabilities from Flow of Funds data. In terms of total liabilities, our data cover over 60 percent of all total liabilities reported in the official Financial Accounts of the U.S. on average during our sample period.[18] As shown in this figure, publicly listed firm liabilities only account for merely 30 percent of total corporate sector debt shown in Flow of Funds data.

SMEs are also important for measures of aggregate output as shown in Figure 5, Panel (b). We do the same exercise using total gross output from the Bureau of Economic Analysis output tables. Our Y-14 firms represent almost 80 percent of the U.S. economy, where publicly listed firms can account only little over 40 percent of the aggregate output.

Finally, we want to discuss a few drawbacks of the FR Y-14Q data. First, the time-

[18]Note that official data on non-corporate sector liabilities in the Flow of Funds data are partly derived from IRS tax records as a residual category because tax returns do not require liability reporting for private firms in the U.S.

Figure 4: Firm Size Distribution: Private vs. Public Firms and Syndicated Loan Borrowers



Note: The figure shows firm size distribution based on assets, for all private firms (red bars) and public firms (blue bars), in Panel (a), and for firms in our data who also borrow in syndicated loan markets, Panel (b).

Figure 5: Coverage of Y-14 Data: Aggregate U.S. Debt and Output

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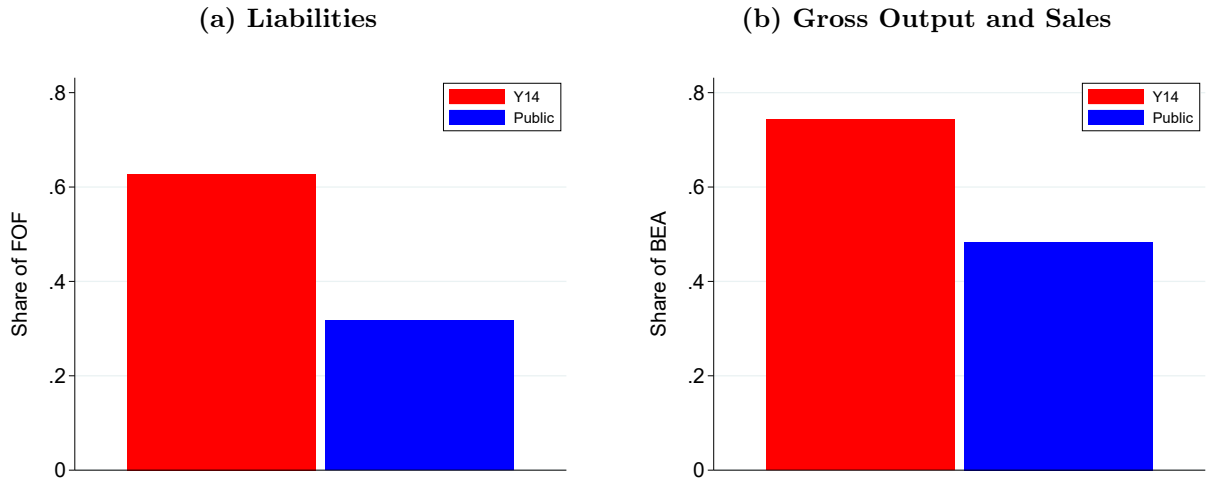


Note: The figure shows the share of Y-14 data in total non-financial business debt liabilities from the Financial Accounts of the U.S. in FoF and in total gross output from the BEA.

series only dates back to 2012, which precludes studying issues related to the 2008 financial crisis. Second, though firm balance sheet data are reported quarterly, banks update balance sheet information for the larger borrowers on a quarterly frequency, for smaller borrowers the information is updated only on an annual or bi-annual basis. Finally, the $1 million loan reporting limit prevents one from studying the smallest establishments in the economy, which will cover the remaining 30 percent of the all U.S. C&I lending.

4 Stylized Facts on the U.S. Credit Market

In this section, we present novel stylized facts using Y-14 data.

4.1 Leverage growth is driven by investment grade public firms and high yield SMEs

Figure 6 breaks down public and private firm leverage ratios by the following credit rating bins: investment grade firms with AAA-A and BBB ratings, and high yield firms with ratings BB and below. These ratings are internal ratings of banks. The ratios are normalized to 1 at the beginning of our sample period. The figure shows that most of the financial leverage increase in the U.S. post the Global Financial Crisis is due to rapid growth in public firm leverage. The leverage growth is equally prominent among high investment grade (rated AAA-A), BBB-rated, and high-yield borrowers. The figure shows that, among private firms, financial leverage has steadily increased only for high-yield equivalent borrowers and is otherwise at a similar level or even slightly lower for investment grade private borrowers over the 6 year period.

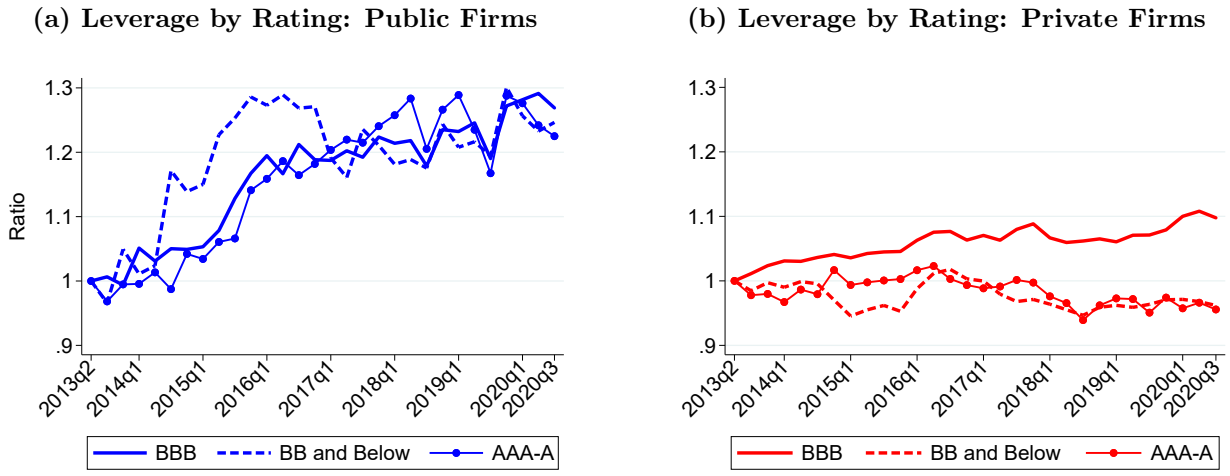
There are two interesting facts here. First, most of the debt growth in the banking system post financial crisis is due to larger, public borrowers. Second, even-though SMEs have slower debt growth, this is driven by high yield-more risky SMEs and hence constitutes a challenge for financial stability as these firms are more likely to default in the future (documented below).

4.2 SMEs are more financially constrained

Tables 1-3 provide summary statistics for a number of balance sheet and loan-level variables. Panel A of each table contains bank balance sheet items, panel B firm balance sheet and income statement items, and panel C contains the loan-level variables. The data are split into three samples: all firms, private firms, and public firms. All variables expressed in levels are reported in millions of dollars. In general, means are substantially larger than medians, indicating there are a large number of relatively small and few very large firms in the data. Clearly the statistics on all firms in the U.S. are driven by private firms. Of particular interest are comparisons between public and private borrowers in Tables 2 and 3.

The summary stats in our data hint at higher level of financial constraints for private borrowers relative to public corporations. The median private firm has $12.9 million in assets

Figure 6: Leverage Growth by Rating (Base 2012Q3)



Note: The figures plot leverage ratio–defined at the sum of short- and long-term debt over total assets– normalized to 1 the 2012Q3. The left (right) panel are the leverage ratios for public (private) borrowers. Each line is the median leverage ratio for among borrowers with the specified bank provided risk-rating. Source: FR Y-14Q H.1

compared to $1.8 billion for the median public firm. Similarly, the median private borrower has $7.3 million in liabilities with a leverage ratio of 0.64 compared to $1.1 billion and 0.56 for the median public firm. In terms of risk, the probability that the median private firm defaults within 12 month is 74 bps compared to 29 pbs for the median public firm, roughly 2.5 times more likely. Lastly, operating income for the median private (public) firm is $956 thousand ($268 million) with retained earnings of $2.9 million ($182 million).

Figure 7 shows that short-term leverage is much higher among smaller private borrowers than public firms, while firms that borrow in the syndicated loan market have similar average leverage ratios to public companies but are much more dispersed. This suggest that SMEs can only borrow short term indicating a higher degree of financial constraints. Below we show that SMEs are also collateral constrained.

4.3 SMEs need collateral to borrow and pledge "operational" collateral more than fixed assets and real estate

Table 4 shows summary stats for loan pricing, quantity, maturity, collateral value, and net charge-offs. The median loan for private borrowers is $3 million, at 3.2 percent interest rate, for 2 years compared to $21.6 million at 1.7 percent for 3 years for the median public borrower. Figure 8 plots the share of loans with some form of collateral broken out by

Table 1: Summary Statistics - All firms

Panel A: All Firms, Bank-level Variables (levels reported in $millions)

	1st Qu.	Median	Mean	3rd Qu	SD
Bank Liabilities-to-Assets	0.868	0.884	0.882	0.897	0.024
Bank Short-Term-Debt-to-Assets	0.69	0.769	0.727	0.808	0.14
Charge-off$_b$	0	10.415	22.618	29.295	38.887
Charge-off/Loan$_b$	0	2.645	5.857	7.347	10.351

Panel B: All Firms, Firm-level Variables (levels reported in $millions)

	1st Qu.	Median	Mean	3rd Qu	SD
Firm Assets	5.102	13.714	420	49.374	5,067
Firm Liabilities-to-Assets	0.422	0.637	0.626	0.798	0.27
Firm Short-Term-Debt-to-Assets	0	0.014	0.144	0.206	0.23
Operating Income	0.187	1.026	103	4.359	3,303
Net Sales	10.869	29.975	617	94.729	17,203
Liabilities	2.734	7.817	271	28.862	3,394
Capital Expenditures	0	0.013	198	1.025	2,874
EBITDA	0.323	1.435	60.849	6.006	896
Retained Earnings	0.502	3.057	89.579	12.238	1,500
Tangible Assets	4.801	12.755	336	43.865	4,429
Probability of Default (Weighted)	0.003	0.007	0.026	0.018	0.095
Probability of Default (Percent)	0.23	0.67	2.567	1.65	9.621
Probability of Future Default	0	0	0.012	0	0.109
NPL$_4$	0	0	0.042	0	0.201
Charge-off$_f$	0	0	0.097	0	2.505
Charge-off/Loan$_f$	0	0	0.025	0	0.656
Obs.	3,798,946				
Firms	155,598				
Banks	39				
Firm-Bank Pairs	215,259				
Firm-Bank-Time Triples	2,550,006				

Note: This table reports summary statistics of the main variables used in the paper. The sample includes 155,598 U.S. firms for the period 2013-2019, excluding financial institutions and utilities. Loans data are from Schedule H1 in FR Y-14 report. Accounting data for firms are from Compustat database, when available, and they are supplemented with financial information reported in the Schedule H1 in FR Y-14 report. All dollar amounts in the table are expressed in millions. Refer to Table A.1 in the Appendix for variable definition.

Table 2: Summary Statistic - Private Firms

Panel A: Private Firms,Bank–level Variables (levels reported in $millions)

	1st Qu.	Median	Mean	3rd Qu	SD
Bank Liabilities-to-Assets	0.868	0.884	0.882	0.897	0.024
Bank Short-Term-Debt-to-Assets	0.69	0.769	0.727	0.809	0.139
Charge-off$_b$	0	9.712	20.828	27.232	35.107
Charge-off/Loan$_b$	0	2.564	5.469	7.011	9.233

Panel B: Private Firms, Firm–Level Variables (levels reported in $millions)

	1st Qu.	Median	Mean	3rd Qu	SD
Firm Assets	4.946	12.967	137	42.411	499
Firm Liabilities-to-Assets	0.423	0.639	0.627	0.8	0.271
Firm Short-Term-Debt-to-Assets	0	0.018	0.148	0.214	0.232
Operating Income	0.176	0.965	12.304	3.87	47.823
Net Sales	10.574	28.681	169	86.325	513
Liabilities	2.642	7.359	89.183	24.883	341
Capital Expenditures	0	0.004	6.189	0.746	28.567
EBITDA	0.31	1.351	17.771	5.285	67.915
Retained Earnings	0.516	2.984	30.181	11.324	109
Tangible Assets	4.652	12.075	108	38.073	379
Probability of Default (Weighted)	0.003	0.007	0.026	0.018	0.095
Probability of Default (Percent)	0.27	0.74	2.697	1.78	9.884
Probability of Future Default	0	0	0.009	0	0.094
NPL$_4$	0	0	0.013	0	0.115
Charge-off$_f$	0	0	0.099	0	2.494
Charge-off/Loan$_f$	0	0	0.026	0	0.62
Obs.	3,125,154				
Firms	152,409				
Banks	38				
Firm-Bank Pairs	193,976				
Firm-Bank-Time Triples	2,224,680				

Note: This table reports summary statistics of the main variables used in the paper for private firms. The sample includes 152,409 U.S. private firms for the period 2013-2019, excluding financial institutions and utilities. Loans data are from Schedule H1 in FR Y-14 report. Accounting data for firms are from Compustat database, when available, and they are supplemented with financial information reported in the Schedule H1 in FR Y-14 report. All dollar amounts in the table are expressed in millions. Refer to Table A.1 in the Appendix for variable definition.

Table 3: Summary Statistic - Public Firms

Panel A: Public Firms, Firm-Bank Variables (levels reported in $millions)

	1st Qu.	Median	Mean	3rd Qu	SD
Bank Liabilities-to-Assets	0.868	0.885	0.883	0.897	0.023
Bank Short-Term-Debt-to-Assets	0.692	0.77	0.728	0.809	0.139
Charge-off$_b$	0	0	1.936	0	7.372
Charge-off/Loan$_b$	0	0	0.426	0	2.321

Panel B: Public Firms, Firm–level Variables (levels reported in $millions)

	1st Qu.	Median	Mean	3rd Qu	SD
Firm Assets	557	1,864	10,010	6,317	28,169
Firm Liabilities-to-Assets	0.404	0.569	0.582	0.714	0.234
Firm Short-Term-Debt-to-Assets	0	0	0.014	0	0.061
Operating Income	68.581	268	3,540	930	20,281
Net Sales	587	1,740	20,105	5,462	113,045
Liabilities	253	1,076	6,457	3,969	18,946
Capital Expenditures	362	1,243	5,716	3,999	14,655
EBITDA	50.959	235	1,518	872	5,060
Retained Earnings	-58.801	182	2,164	1,115	8,720
Tangible Assets	380	1,347	8,106	4,706	24,950
Probability of Default (Weighted)	0.002	0.004	0.022	0.013	0.077
Probability of Default (Percent)	0.12	0.29	1.69	0.88	7.557
NPL$_4$	0	0	0.177	0	0.382
Charge-off$_f$	0	0	0.084	0	2.604
Charge-off/Loan$_f$	0	0	0.018	0	0.923
Obs.	673,792				
Firms	3,189				
Banks	39				
Firm-Bank Pairs	21,283				
Firm-Bank-Time Triples	325,326				

Note: This table reports summary statistics of the main variables used in the paper for public firms. The sample includes 3,189 U.S. public firms for the period 2013-2019, excluding financial institutions and utilities. Loans data are from Schedule H1 in FR Y-14 report. Accounting data for firms are from Compustat database, when available, and they are supplemented with financial information reported in the Schedule H1 in FR Y-14 report. All dollar amounts in the table are expressed in millions. Refer to Table A.1 in the Appendix for variable definition.

Table 4: Loan-level Variables (levels reported in $millions)

Panel A: All Firms

	1st Qu.	Median	Mean	3rd Qu	SD
Loans	1.654	3.65	14.913	12.534	43.705
Interest Rate	0.011	0.03	0.028	0.041	0.022
Charge-off$_l$	0	0	0.006	0	0.255
Charge-off/Loan$_l$	0	0	0.001	0	0.076
Collateral: Fixed assets and real estate	0	0	0.243	0	0.429
Collateral: Cash and marketable sec	0	0	0.024	0	0.152
Collateral: Act. receiv. and inventory	0	0	0.284	1	0.451
Collateral: Blanket lien and other	0	0	0.304	1	0.46
Collateralized	1	1	0.854	1	0.353
Maturity	0	2	3.079	4	3.977
Collateral (restricted)	2.885	8.424	26.732	26.803	85.667
Collateral/Loan (restricted)	0.92	1.375	4.413	2.908	22.165

Panel B: Private Firms

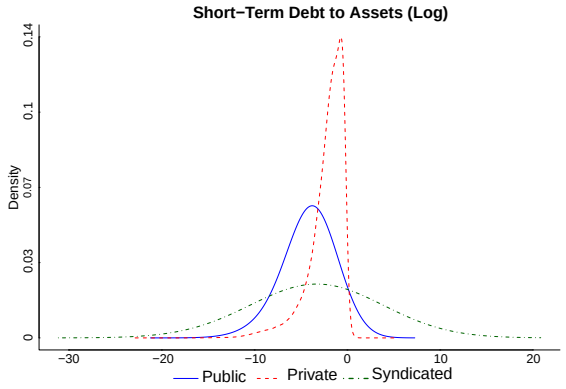
	1st Qu.	Median	Mean	3rd Qu	SD
Loans	1.5	3	8.91	8	20.195
Interest Rate	0.018	0.032	0.03	0.043	0.021
Charge-off$_l$	0	0	0.006	0	0.261
Charge-off/Loan$_l$	0	0	0.002	0	0.075
Collateral: Fixed assets and real estate	0	0	0.266	1	0.442
Collateral: Cash and marketable sec	0	0	0.022	0	0.145
Collateral: Act. receiv. and inventory	0	0	0.308	1	0.462
Collateral: Blanket lien and other	0	0	0.322	1	0.467
Collateralized	1	1	0.916	1	0.277
Maturity	0	2	3.1	4	4.296
Collateral (restricted)	2.835	7.53	11.76	24.922	10.11
Collateral/Loan (restricted)	0.948	1.402	2.765	2.805	3.848

Panel C: Public Firms

	1st Qu.	Median	Mean	3rd Qu	SD
Loans	5.688	21.6	42.723	50	89.049
Interest Rate	0	0.017	0.019	0.032	0.022
Charge-off$_l$	0	0	0.003	0	0.226
Charge-off/Loan$_l$	0	0	0.001	0	0.083
Collateral: Fixed assets and real estate	0	0	0.14	0	0.347
Collateral: Cash and marketable sec	0	0	0.034	0	0.181
Collateral: Act. receiv. and inventory	0	0	0.172	0	0.377
Collateral: Blanket lien and other	0	0	0.224	0	0.417
Collateralized	0	1	0.567	1	0.495
Maturity	2	3	2.994	4	2.243
Collateral (restricted)	3.829	27.989	123	113	207
Collateral/Loan (restricted)	0.728	1.112	14.957	3.98	58.41

Note: This table reports summary statistics of loan level variables used in the paper. The sample includes 155,598 U.S. firms for the period 2013-2019, excluding financial institutions and utilities. Loans data are from Schedule H1 in FR Y-14 report. All dollar amounts in the table are expressed in millions. Refer to Table A.1 in the Appendix for variable definition.

Figure 7: Distribution of Leverage: Private vs. Public



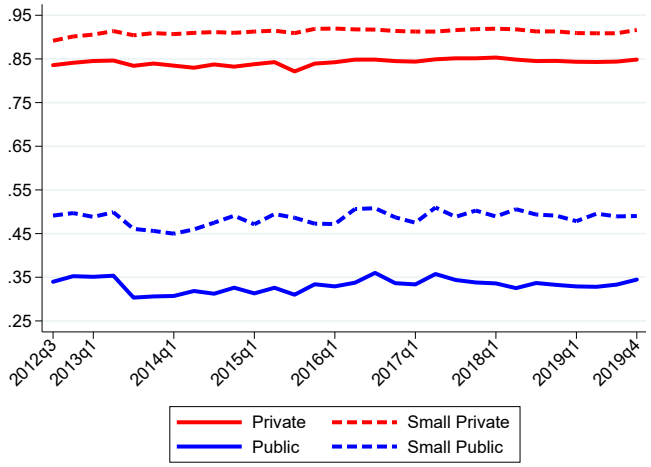
Note: The figure plots the density of short-term debt-to-assets ratios (in logs) for all public (in blue) and private (in red) borrowers in the FR Y14Q data. The green density plots are the the same leverage ratios for borrowers in FR-Y14Q that are identified as borrowers in the syndicated loan market used a the syndicated loan flag available in the FR-14Q data. Source: FR Y-14Q H.1

private and public borrowers. Around 85% of all private loans are collateralized (red line), compared to roughly 33% for public borrowers (blue line). This breakdown is consistent with the literature showing that only a small fraction of large public firm loans are collateralized. Our data with its much broader coverage also shows that for smaller private firms without access to public capital markets, collateral remains an extremely prominent and important feature of borrowing arrangements. In fact, for small private firms (red dashed line)—firms in the bottom 25th percentile of the revenue distribution, almost all loans are collateralized, where for the same group in public firms (blue dashed line) only 48 percent are collateralized.

Banks also report the dollar value of collateral that require ongoing or periodic valuation. These loans represent 11.5 percent of all loans in the data. Among these loans whose collateral needs periodic valuation, the collateral-to-loan ratio for the median private borrower is 1.4 compared to 1.2 for the median public borrower, which means that private firms/SMEs have to post much more collateral than public firms for the same size loan (see Figure 9). Taken together, banks generally require private firms put down collateral to access credit, but the firms do not have access to large amounts of collateral to obtain larger loans compared to larger public borrowers. Hence, private borrowers are also collateral constrained relative to public borrowers.

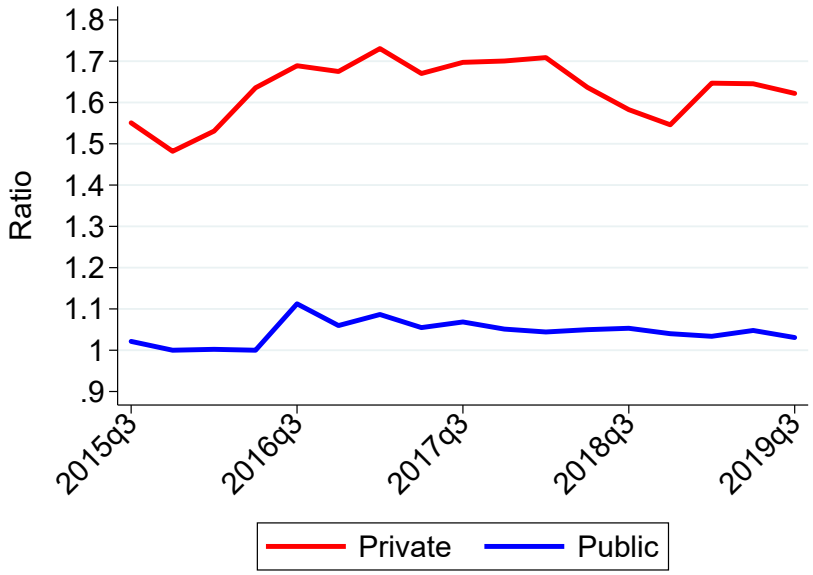
The FR-Y14Q data contain detailed information about the type of collateral used to secure a loan. The different types of collateral in the data are the following: real estate and fixed assets; cash and marketable securities; accounts receivable and inventory (AR&I); blanket liens, and other. Blanket liens are loans secured by "substantially all assets of the

Figure 8: Share of Loans that are Collateralized–Extensive Margin: Public vs. Private



Note: The figure reports the share of total loans that are collateralized, for private (red) and public (blue) borrowers. The dashed line represents the share of total loans that are collateralized for firms in the 25th percentile of the net income distribution (small), for both the private and public firm sample. The solid line is the share of loans collateralized at the median of firm net-income distribution. Source: FR Y-14Q H.1

Figure 9: Collateral to Loan Ratio–Intensive Margin: Private vs. Public



Note: The figure plots median collateral-to-loan ratio for private borrowers (in red) and public borrowers (in blue). The dollar value of collateral is reported by banks at the loan level. The collateral-to-loan ratios are computed for loans in which the dollar value of collateral is non-zero. Source: FR Y-14Q H.1

firm". For example, a lender will put a lien on the entire firm and all of its assets that are not already encumbered in other lending arrangements. This means that if a firm has a blanket lien against it, it will not be able to pledge specific assets as collateral for future borrowing. A firm may however pledge an asset as collateral to a lender, and then have a blanket lien placed on the firm for future borrowing which will entail all assets and operations of the firm aside from the assets it has already pledged.

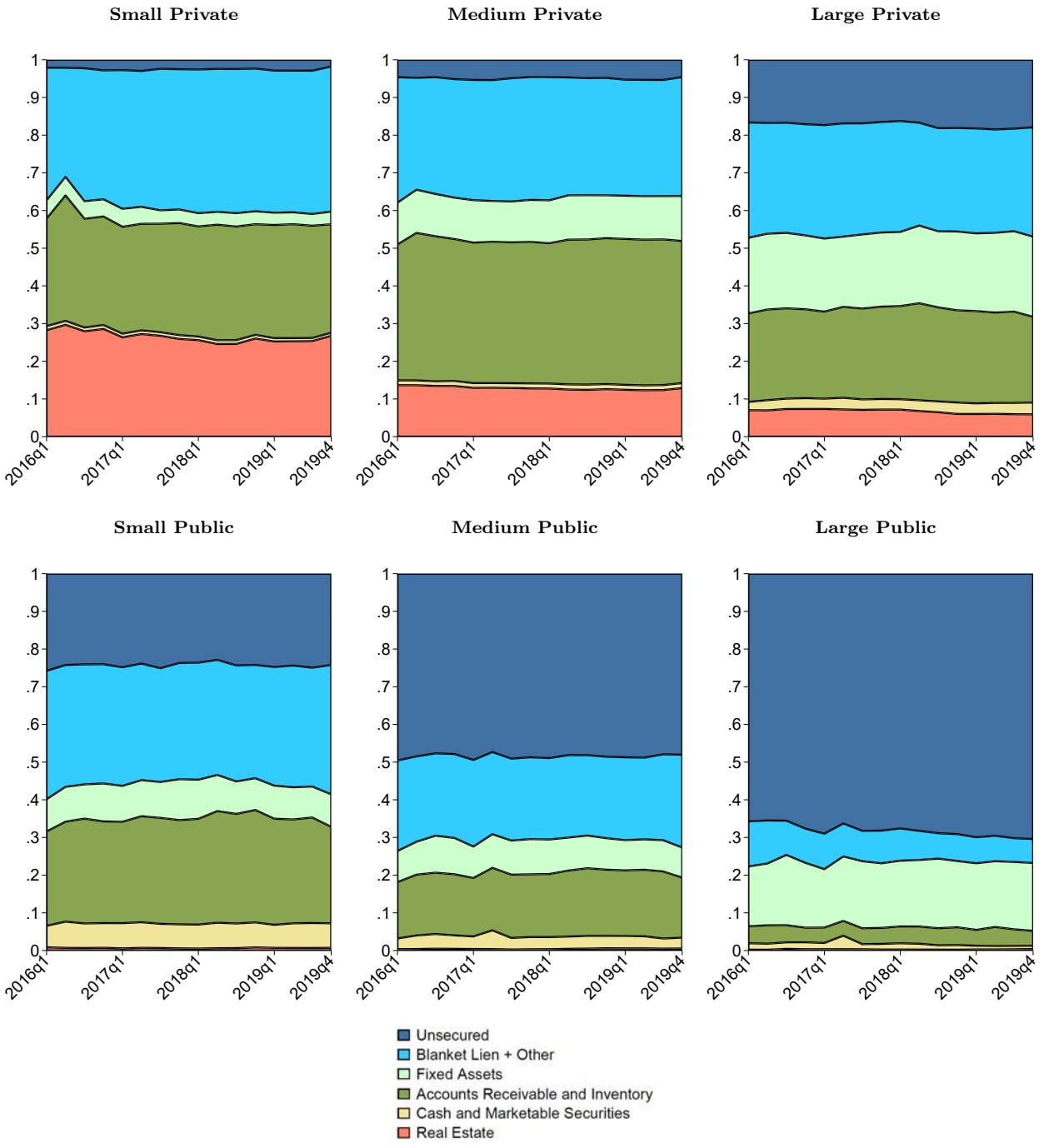
Figure 10 shows the loan shares secured by fully dis-aggregated pledged collateral types. There are several remarkable features about collateral use in the data. First, real estate collateral (in red) is important only for the smallest borrowers and virtually absent among public borrowers. Second, fixed assets (light green) as a fraction of all collateralized loans are only important sources for the largest private and public firms, largely reflecting capitalized loans and leases (Eisfeldt and Rampini, 2008). Third, AR&I (dark green) and blanket liens (light blue) are equally important collateral sources across the firm size and ownership distribution except for the largest public companies, especially important for SMEs. Finally, unsecured borrowing (dark blue) increases monotonically across firm size.

Lian and Ma (2020) and Kermani and Ma (2021) draw an important distinction between debt secured by assets (asset based loans or ABLs) and debt tied to firm cash-flows and earnings (earnings-based or going concern debt). In our data, loans secured by fixed assets, real estate, AR&I, and cash and marketable securities are considered ABLs by their industry and law based convention; blanket liens and unsecured debt fall under earnings-based debt. Thus as in our data and in Lian and Ma (2020) largest listed companies debt is mostly going-concern and cash-flow based owing mostly to unsecured debt.

Figure 11 shows that collateral break down for SME's in our data. The figure clearly shows that real estate, fixed assets, cash/securities, and AR&I collateral is used for about 55 percent of all borrowing and the remaining 45 percent is blanket-lien, which is based on firms' continuation value/going-concern. As we argued before, AR&I collateral and blanket liens should be thought as similar forms of collateral for measuring borrowing constraints and monetary policy transmission despite the fact that AR&I collateral is based on liquidation value and blanket liens may be more closely aligned with cash-flows. Our reasoning is based on the fact that both of these are "operational" collateral and drive their value from firms' ongoing operations and not from the resale value as in the case of fixed assets.[19]

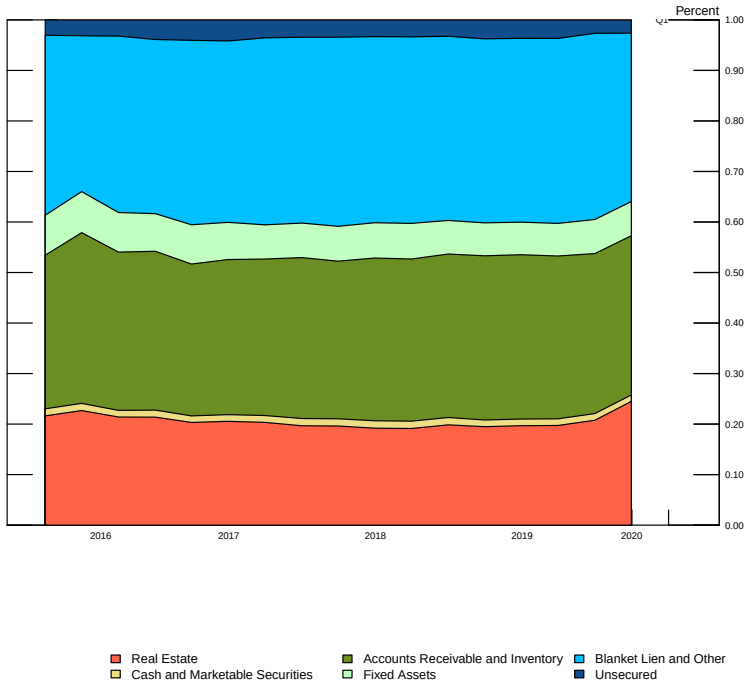
[19]Lenders generally lend against a fraction of the book value of receivables (called the advance rate) rather than the future value of receipts, which technically places AR&I in the asset-based/liquidation value category rather than the going concern/cash-flow based category according to the standard industry dichotomy. See the documentation in the OCC *Comptroller's Handbook on Asset-Based Lending*.

Figure 10: Collateral Types: Public vs. Private



Note: The figure plots the proportion of loans secured by different collateral types over time. The different types of collateral are cash and marketable securities (in yellow); accounts receivable, inventory (in dark green); blanket liens (in light blue); fixed assets (in light green); real estate (in orange); and unsecured loans (in dark blue). The top three panels from left to right show the proportion of loans secured by the different collateral types and unsecured for private borrowers in the bottom quartile of assets (small), below the median of assets (median), and below the top quartile of assets (large). The bottom three panels present the same information for public borrowers. Source: FR Y14-Q H.1.

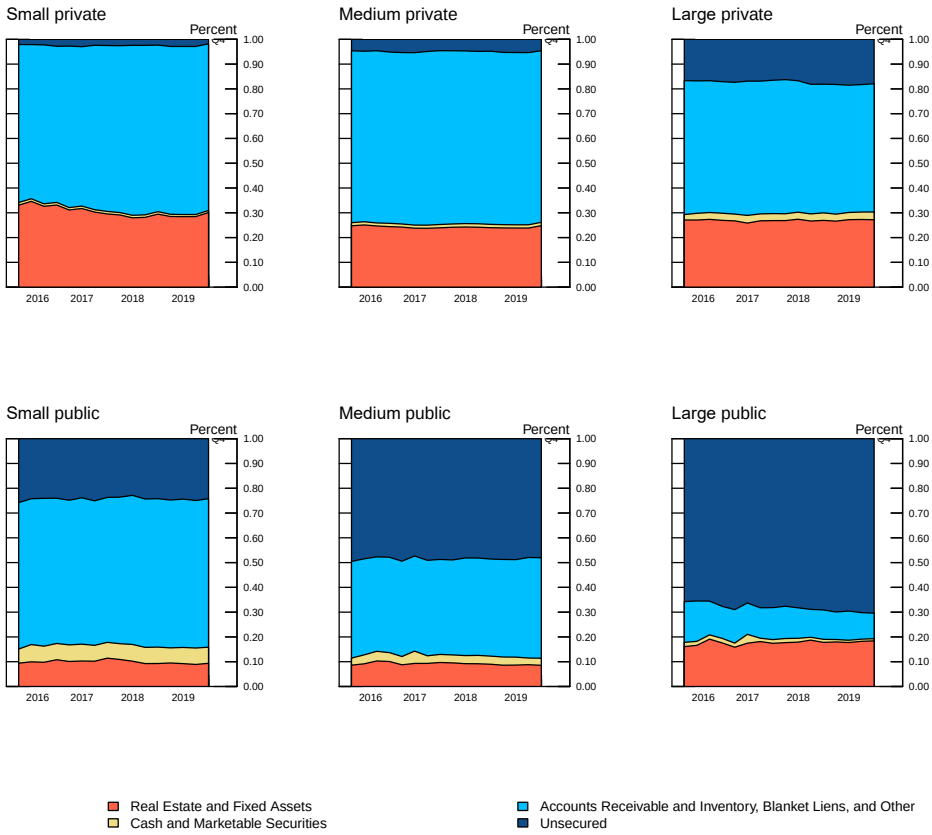
Figure 11: Collateral Types among SMEs



Note: The figure plots the proportion of loans secured by different collateral types over time for SME borrowers. SMEs are defined as firms with annual sales less than $50mn$.The different types of collateral are real estate collateral (salmon); cash and marketable securities (yellow); accounts receivable, inventory (green); fixed assets (mint); blanket liens and other (light blue); and unsecured (dark blue). Source: FR Y14-Q H.1.

We combine AR&I with blanket liens in Figure 12 and call them earnings and operation based constraints for three reasons. First, our empirical analysis that follows shows that these two distinct collateral categories based on industry and law definition turn out to impact firm borrowing–both prices and quantities–in similar ways during expansionary monetary policy. Second, the value of AR&I and blanket liens collateral is inherently tied to firm operations in an important way that other fixed assets are not. In the one-period debt case (Kiyotaki and Moore, 1997), the relationship between collateral value and borrowing can be seen by the standard borrowing constraint $Rb_t \leq q_{t+1}k_{t+1}$, where Rb_t is the gross repayment amount on borrowing at time t and k_{t+1} and q_{t+1} are the holdings and price of capital in following period. The distinction between these tangible assets k and AR&I is that the book value of AR&I collateral only exists because of firm operations and its ability to create sales that generate the receivables and inventory. The firm's intellectual property,

Figure 12: Collateral Type: Public vs. Private



Note: The figure plots the proportion of loans secured by different collateral types over time. The different types of collateral are real estate and fixed assets (in red); cash and marketable securities (in yellow); accounts receivable, inventory, and blanket liens (in light blue); and unsecured loans (in dark blue). The top three panels from left to right show the proportion of loans secured by the different collateral types and unsecured for private borrowers in the bottom quartile of assets (small), below the median of assets (median), and below the top quartile of assets (large). The broom three panels present the same information for public borrowers. Source: FR Y14-Q H.1.

managerial talent, marketing, etc. thus combine to create the sales and the receipts that the firm uses as collateral. In this sense, the firm itself *creates* its own collateral value through production rather than purchasing it as it would land or machines that is uses for production. Third, because blanket liens are secured by substantially all firm assets, AR&I are generally encompassed in blanket liens unless explicitly perfected to separate creditors in other lending arrangements. The inability to separate the liquidation value of AR&I from the going-concern value embedded in blanket liens is particularly important for small private

borrowers who do not have large amounts of other tangible fixed assets to pledge in addition to AR&I. In these cases, blanket liens are close substitutes for AR&I that also give the lender additional security.[20]

In the language of metaphors of trees/machines and fruit/engineers used by Kiyotaki and Moore (1997) and Kiyotaki, Moore, and Zhang (2021), fixed assets and real estate are the trees or the machines that firms purchase from one another in the spot market and against for production. The managerial know how and engineers ability to use tools combines with the machines to generate output or fruit. What makes AR&I collateral and blanket liens different, especially when the latter also capture aspects of the former, is that they represent the fruit produced by the trees, which *can be and frequently is* used as collateral, just not its future value. Hence, the trees and the fruit combine to form the value of the firm, all of which can be used as collateral. The reason is that the sales that firms generate, which combine ideas, intangible capital, marketing of products, etc. get embedded into the value of the fruit they produce and become capitalized on the balance sheet as AR&I. In terms of the metaphor, the fruit that is not consumed becomes compost for the tree providing it more nutrients to continue growing and producing more fruit in the future. Thus, the view that AR&I is a balance sheet item against which lenders advance loans based on their ability to collect in default or liquidation misses the important fact that the true liquidation value of those receivables is actually produced by the firm, which contrasts the spot market liquidation value of the tree or machines that firms purchase from one another.

4.4 SMEs pay higher interest rates, and borrow short-term

Turing to the rest of the stylized facts, Figure 13 shows fraction of loans commitments that are short-term, less than one in maturity. The chart clearly shows that a larger fraction of private firm loans are short-term (less than 1 year) compared to public firms (40 percent versus 18 percent. This suggests that public borrowers obtain the bulk of their funds long-term compared to private firms; SMEs are not only collateral constrained, they are maturity constrained as well in terms of limited access to long-term financing.

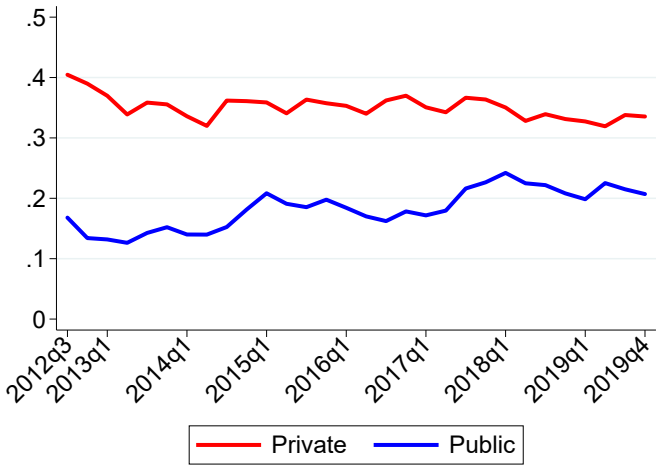
Figure 14 plots the median interest rate for public and private borrowers. In general, public firms borrow at lower interest rates shown by the blue line in the first chart on the left. The middle and right charts show median interest rates by loan and rate type (fixed versus

[20]This intuition that blanket liens and AR&I collateral are substitutes is confirmed in an interview with the CFO of a medium-sized private company, with annual sales of nearly $70mn. They note that in their multiple loan facilities with a large bank, their working capital loans (a standard term for AR&I loans) are secured by a blanket lien on the firm assets, and not just the AR&I.

floating rate loans and credit lines and term loans) for private and public firms. Naturally, floating rate loans (dashed lines) follow closely with monetary policy rates for both borrower types. By contrast, average borrowing rates on fixed rate loans declined for private firms (solid gold line) for most of the sample period, and hovered mostly around 3 percent for public borrowers (solid purple line) before increasing in 2017.

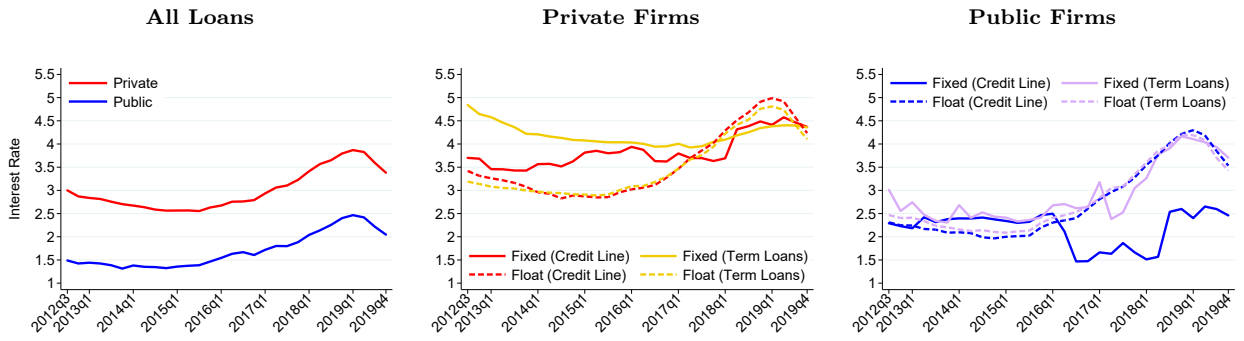
Recent work by Ivashina, Laeven, and Moral-Benito (2020), Chodorow-Reich, Darmouni, Luck, and Plosser (2020), and Greenwald, Krainer, and Paul (2020) highlight the importance of pre-commited credit lines versus term loans as liquidity backstops when shocks hit the economy, especially among large public companies. Figures 14 and 15 suggest that focusing exclusively on credit lines does not tell the whole story for smaller private borrowers. In particular, credit line prices rise significantly more than term loan prices as the Federal Reserve began lift-off. Moreover, among private firms who are more likely to be constrained with less spare borrowing capacity, new loans or extensions of existing loans are particularly important and their pricing in Figure 15 drives the aggregate pricing in Figure 14, which is not the case for public borrowers. Finally, Figure 16 shows that, for private firms, the share of term loans among all loans has increased nearly 7% while the share of floating rate loans has fallen nearly 10%. And as before aggregate dynamics in terms of shares of credit lines, term loans and floating rate loans are driven by private SMEs as oppose to large public firms.

Figure 13: Loan shares Maturity Less than 1 Year



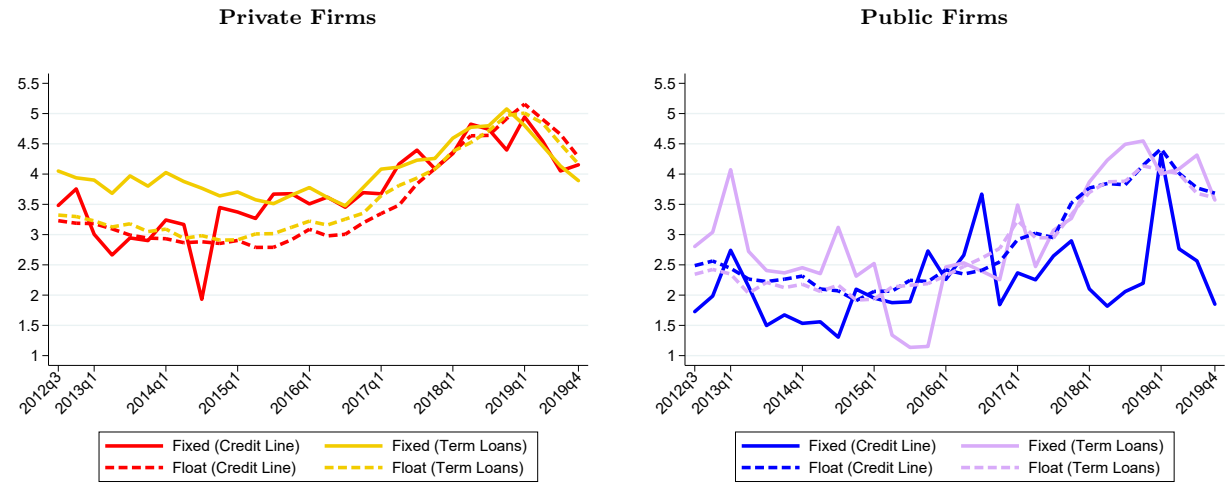
Note: The figure plots the share of loan commitments (in dollars) less than one year old. The blue (red) line are the maturities shares for public (private) borrowers: Source FR Y-14Q H.1.

Figure 14: Interest rates: Fixed versus Floating



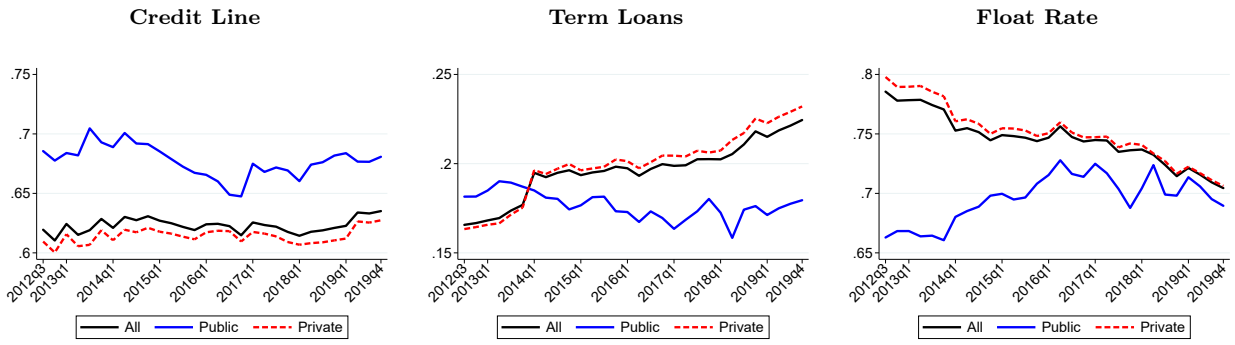
Note: The figure plots the median interest rates (in percent). The first chart plots interest rates for all loans for private borrowers in red and public borrowers in blue. The middle chart plots median interest rate for private borrowers for different loan types and rates. Solid lines plot rate on fixed rate loans (credit lines in red and term loans in gold). The dashed lines are rate on floating rate loans (credit lines in red and term loans in gold). The right chart plots median interest rate for public borrowers for different loan types and rates. Solid lines plot rate on fixed rate loans (credit lines in blue and term loans in purple). The dashed lines are rate on floating rate loans (credit lines in blue and term loans in purple). Source: FR Y-14Q H.1.

Figure 15: Interest rates on New Originations



Note: The figure plots the median interest rate (in percent) for new loan origination broken out by credit lines, term loans with fixed versus floating rates. The chart on the left plots the various loan rates for for private borrowers on the left and public borrowers on the right. The solid lines are fixed rate loans and the dashed lines are floating rate loans. Credit lines are plotted in red lines and term loan rates plotted in blue. Source: FR Y-14Q H.1. Source: FR Y-14Q H.1.

Figure 16: Loan shares: Credit Lines/Term loans and Floating/Fixed Rates



Note: The share of credit lines among all loan types in the left panel. The middle panel plots the term loans shares. The right panel plots the share of loans with floating interest rates. Source: FR Y-14Q H.1. Source: FR Y-14Q H.1.

5 Monetary Policy Transmission with Heterogeneous Firms and Banks

Having shown a great deal of heterogeneity among SMEs and large firms, private and public borrowers in terms of collateral posted, loan rate, maturity and amount of loans, we now turn to the transmission of monetary policy.

5.1 Measuring Monetary Policy Surprises

We measure of monetary policy surprises, MP, estimated from the high frequency methodology following Gürkaynak, Sack, and Swanson (2005). In particular, we compute the surprise component of a policy announcement as:

$$MP_t^m = \gamma_t \times \left(\text{ffr}_t^m - \text{ffr}_{t-\Delta t}^m\right) \tag{1}$$

where m denotes the month, ffr_t is the implied Fed Funds Rate from a current-month Federal Funds future contract at time t, and the adjustment factor, $\gamma_t \equiv \frac{\tau^n}{\tau^n - \tau^d}$, controls for the timing of the announcement within the month. To extract the surprise component, we measure price changes 15 minutes before and 45 minutes after the FOMC as in Ottonello and Winberry (2020) and Wong (2019). τ^n is the number of days in the month of the FOMC meeting, and

τ^d is the day of the FOMC meeting.[21]

We follow Ottonello and Winberry (2020) and convert the monthly surprise series to a quarterly variable using a weighted moving average of the surprises based on the number of days in the quarter after the surprise has occurred. This ensures that the surprises are weighted according to the amount of time banks and firms have to react to the changes. In addition, because our data begin in 2012Q4 at the zero-lower bound (ZLB), the size of the raw surprises are small–the average surprise less than 1bps with a max (min) of 6bps (-6bps). Such small surprises are insufficient to identify the impact of monetary surprises on credit and investment decisions. To address this issue, we construct 4 and 8-quarter moving averages of the quarterly surprises. The moving average representation has the benefit that it allows for monetary policy to have delayed and persistent effects. For example Romer and Romer (2004) find that monetary policy transmits to real variables and prices with a several quarter delay and has persistent effects over twenty quarters in the future. Hence, a moving average representation of the quarterly surprises help us to link the surprises to the stance of the monetary policy. Finally, because short rates are effectively bound at the ZLB during most of our sample, we use the future contract that corresponds to the 4th FOMC meeting from time t, which is usually the 6-month contract.[22]

5.2 The Role of Firm and Bank Leverage

We begin by disentangling the effect of monetary policy surprises on the demand for credit from the supply of credit. We regress the outstanding committed loan amount, Log (Loan), and the nominal loan interest rate, Log $(1+i)$, on measures of bank and firm risk interacted with monetary policy surprises. This strategy allows us to investigate the response of credit quantities and prices to a monetary policy surprise within the same period, differentially for leveraged firms and banks where we measure the leverage ex-ante before the policy surprise. Hence, we run:

[21] Note that the multiplier becomes quite large for FOMC events at the end of the month. This could magnify measurement errors. When the adjustment factor is greater than 4, we follow Gürkaynak, Sack, and Swanson (2005) and replace the adjustment factor with the rate change in the following month federal futures contract without a multiplier.

[22] For similar reasons, Greenwald, Krainer, and Paul (2020) use the high frequency methodology on prices changes of two-year U.S. Treasury securities to identify the impact of contractionary surprises on credit line utilization. Our baseline results hold using the 9-month ahead Fed futures and the 2yr Treasuries, see Appendix.

$$\log \mathrm{Y}_{f,b,q} = \alpha_{f,b} + \alpha_{f,q} + \kappa(\textbf{Bank Leverage}_{b,q-1} \times \frac{1}{N}\sum_{k=0}^{N} \mathrm{MP}_{q-k}) + \vartheta_{f,b,q} \tag{2}$$

$$\log \mathrm{Y}_{f,b,q} = \alpha_{f,b} + \alpha_{b,q} + \kappa(\textbf{Firm Leverage}_{f,q-1} \times \frac{1}{N}\sum_{k=0}^{N} \mathrm{MP}_{q-k}) + \vartheta_{f,b,q} \tag{3}$$

where $\log \mathrm{Y}_{f,b,q}$, is either the total loan amount or one plus the loan interest rate, $(1 + i_{f,b,q})$ for a given bank-firm pair, (b, f) and quarter (q), and N captures 4 or 8-quarter moving average, indexed by k. The coefficient $\alpha_{f,b}$ is the bank×firm fixed effect, which controls for unobserved firm- and bank-level time-invariant heterogeneity. Therefore, identification comes from within bank-firm variation for each pair over time. The loan interest rates are value-weighted interest rates as there might be several loans between a given bank-firm pair with different interest rates. The interest rate contains a risk-free rate, which is typically LIBOR, plus an idiosyncratic credit spread. Thus, the time fixed effects will absorb the common risk-free rate and all variation will come through the idiosyncratic risk spread.

The firm and bank leverage ratios are lagged and de-meaned, hence the interpretation of κ is the effect of a monetary policy surprise driven by more risky firms' credit demand conditional on banks' credit supply (in specification (3)) or by more risky banks' credit supply conditional on firms' credit demand (in specification (2)) relative to the average firm or bank. Notice that we show the same specifications with time invariant leverage of firms and banks, where the leverage variables does not need de-meaning, in robustness section.

The first regression controls for firm×time fixed effects, $(\alpha_{f,q})$, which means this regression will identify κ from firms that borrow from multiple banks in a given quarter. This methodology was popularized by Khwaja and Mian (2008), so that the researcher can solely focus on the credit supply provided by banks controlling all that varies at firm-time level including firm credit demand and firm credit risk. Hence, we interact our monetary policy surprises with a measure of bank risk that is bank leverage. The second regression, does the opposite and controls for bank×time fixed effects, $(\alpha_{b,q})$, identifying from banks lending to multiple firms. This means that now we condition on bank-time varying variables including bank credit supply and bank riskiness and interact our monetary policy surprises with a measure of firm riskiness, that is firm leverage.

Table 5 shows the baseline results. Columns (1) and (3) show the credit demand regressions for quantities and prices respectively, and columns (2) and (4) present credit supply regressions. For the demand regressions, the interaction-term coefficient on loan quantity is

-1.08 and statistically significant at 0.1 percent. The interpretation is that an unexpected decrease in the federal funds rate, or monetary policy easing, increases borrowing among highly-levered firms relative to the average firm. In terms of magnitude, a monetary surprise easing from the 75th to 25th percentile of the distribution represents an 8 percentage point change. Multiplying this by our estimated coefficient (and adding the normal time effect of leverage) gives us a 7 percentage point change in loan amount. Interestingly, column (3) shows that loan pricing is moving in the opposite direction of the standard credit channel story, where i general increase borrowing and lower prices go together. The coefficient of **-0.0725** implies that highly levered firms borrow at higher rates (half percentage point higher), when monetary policy eases. Our DID regression has a "relative" interpretation. Even though, there can be a reduction in the external finance premium with easy monetary policy, implying lower borrowing costs for everyone, these "riskier" levered firms still pay higher rates than "less -risky" firms. Given the fact that bank credit supply is controlled in these regressions, if lower rates induce overall more *demand* for credit, then loan prices should be higher in equilibrium, meaning "risky firms" end up paying relatively more. In sum, having data both on loan *amounts* and *prices* allows us to pin down the risk-taking channel: even though "risky" firms borrow more, they also pay more, and hence even though there is risk-taking, firm-specific interest rates reflect that.

Columns (2) and (4) shows that banks with higher leverage than average do not provide different loan amounts nor do they charge different prices when policy rates ease. In column (2) we have a positive coefficient on the interaction term suggesting high levered banks *lower* their credit supply during easy monetary policy conditional on firm credit demand but this effect is significant only at 10 percent. Interestingly, we find a strong effect of bank leverage during normal times. The coefficients of **0.3833** on loan amounts and **-0.0085** on interest rates show that, during normal times, levered banks supply more credit and offer lower prices in general.

Table 6 shows the results for the same regressions for two separate firm samples: private versus publicly listed firms. All of the aggregate effects in Table 5 in the firm demand regressions operate through *private* firms, who are SMEs as shown before. The magnitude of the effect is slightly stronger for private borrowers than the overall sample average (**-1.81** vs. **-1.08**); a monetary surprise easing from the 75th to 25th percentile of the distribution leads to a 13 percentage point increase in loan demand among highly levered private firms relative to the average private firm.

Turning to the regressions that investigate the role of banks' leverage on private firm borrowing in columns (2) and (4), we find that highly levered banks supply fewer loans at

Table 5: Monetary Policy and Credit Outcomes: Firm-Bank Level—All Firms

	Quantity		*Prices*	
	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$
Firm Leverage$_{q-1}$	0.0219		-0.0012	
	(0.0256)		(0.0014)	
Firm Leverage$_{q-1}$ × MP Surprise$_q$	-1.0868***		-0.0725***	
	(0.2592)		(0.0142)	
Bank Leverage$_{q-1}$		0.3833***		-0.0085***
		(0.0866)		(0.0019)
Bank Leverage$_{q-1}$ × MP Surprise$_q$		0.8553*		0.0057
		(0.3737)		(0.0093)
Observations	2199353	633771	2210232	639054
Adjusted R^2	0.946	0.911	0.772	0.854
Bank×Firm F.E.	Yes	Yes	Yes	Yes
Bank×Time F.E.	Yes	No	Yes	No
Firm×Time F.E.	No	Yes	No	Yes

$^{+}$ $p < 0.1$ * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions for bank-firm level at a quarterly frequency. Interest rates are weighted by the loan shares for a given firm-bank. *Log Collateral* is the log of the market value of the collateral as of the reporting date, lagged and demeaned. Firm Leverage and Bank Leverage are lagged and demeaned. They are both based on short-term debt. Double-clustered standard errors by firm and time are reported in parentheses.

Table 6: Monetary Policy and Credit Outcomes: Firm-Bank Level—Private vs. Public Firms

	Private Firms				**Public Firms**			
	Quantity		*Prices*		*Quantity*		*Prices*	
	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$
Firm Leverage$_{q-1}$	-0.0231		-0.0025^{+}		0.0619		0.0002	
	(0.0263)		(0.0012)		(0.0674)		(0.0014)	
Firm Leverage$_{q-1}$ × MP Surprise$_q$	-1.8097***		-0.0951***		-0.0484		-0.0082	
	(0.2410)		(0.0097)		(0.0.7931)		(0.0209)	
Bank Leverage$_{q-1}$		0.3486**		-0.0041		0.3957**		-0.0106***
		(0.1077)		(0.0026)		(0.1127)		(0.0020)
Bank Leverage$_{q-1}$ × MP Surprise$_q$		1.7704**		0.0293*		0.4098		0.0110
		(0.5686)		(0.0138)		(0.5292)		(0.0088)
Observations	1935430	337330	1944550	340486	263915	296120	265674	298156
Adjusted R^2	0.94	0.93	0.774	0.86	0.839	0.864	0.674	0.820
Bank×Firm F.E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank×Time F.E	Yes	No	Yes	No	Yes	No	Yes	No
Firm×Time F.E	No	Yes	No	Yes	No	Yes	No	Yes

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions for bank-firm pairs at a quarterly frequency, for private (columns 1 to 4) and public firms (columns 5 to 8). The dependent variable in columns (1)-(2) and (5)-(6) is the natural logarithm of the total committed loan amount for a bank-firm pair; the dependent variable in columns (3)-(4) and (7)-(8) is the natural logarithm of one plus the nominal interest rate weighted for loan shares for a given bank-firm pair. Firm Leverage and Bank Leverage are lagged and demeaned. They are both based on short-term debt. Double-clustered standard errors by firm and time are reported in parentheses.

lower prices to private borrowers, but price effect is significant only at 10 percent. These results are the opposite of a supply-side risk taking channel by banks among smaller and less transparent private borrowers. During normal times, levered banks supply more loans in general to private firms, as found in the all firms sample. When we investigate public firms behavior reported in the last 4 columns, we see that there is nothing going on with firm leverage. High levered banks also do not alter their supply patterns to public firms during easy policy. During normal times though, high levered banks supply more at lower prices to public firms. Thus, the effect of levered banks on credit supply in normal times that we saw in the all firms sample is driven by public firms, whereas the effect of firm leverage during expansionary policy in the all firms sample is driven by private firms/SMEs.

To determine whether our baseline result is driven by risky firms proxied through leverage or specifically by risky SMEs, we use the sample for all firms, public and private, and we cut the sample on size and leverage to show the importance of both for our main result. To have a clear interpretation, we define a time-invariant dummy for high leverage firms being 1 if leverage is above sample median, and also define a time-invariant dummy of being an SME if firms revenue is less than $50 million on average over the sample.

Table 7 shows the results based on a triple difference-in-differences regression. Our main result that high leveraged firms increase their demand for credit when monetary policy is

expansionary and receive higher rates is robust to using time invariant treatment groups in all firms sample and now we see that this result is driven by leveraged SMEs. The last line of the table shows that being a leveraged SME during a monetary expansion drives the result, whereas the significance of the double interaction for leverage and the monetary policy disappears and the magnitude of the coefficient crashes. Levered SMEs borrow more at higher rates as our main result. Levered firms also pay higher interest rates as shown in last column. Interestingly, as shown in the second line of the table, SMEs, relative to large firms in the sample borrow less, even they pay less, indicating the fact that they are financially constrained relative to large firms even though expansionary policy lower their rates overall. Overall these results confirm our key result on the risk taking channel of monetary policy leading to credit growth being driven by leveraged SMEs increasing their credit demand when rates are lower as they are financially constrained during normal times.

Table 7: Monetary Policy and Credit Outcomes: The Role of Leverage and Size

	Quantity			*Prices*		
	Log(Loan)	Log(Loan)	Log(Loan)	Log(1+i)	Log(1+i)	Log(1+i)
High leverage$_i$ × MP Surprise$_q$	-0.4212***		-0.1503$^+$	-0.0262***		-0.0189***
	(0.0772)		(0.0856)	(0.0027)		(0.0026)
SME$_i$ × MP Surprise$_q$		0.5530***	1.0737***		0.0140***	0.0288***
		(0.1012)	(0.1984)		(0.0014)	(0.0028)
High leverage$_i$ × SME$_i$ × MP Surprise$_q$			-0.7368***			-0.0199***
			(0.1633)			(0.0032)
Observations	2460475	2460475	2460475	2472261	2472261	2472261
Adjusted R^2	0.945	0.945	0.945	0.768	0.767	0.768
Bank× Firm F.E	Yes	Yes	Yes	Yes	Yes	Yes
Bank× Time F.E	Yes	Yes	Yes	Yes	Yes	Yes

$^+$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents results for the OLS regressions for bank-firm pairs using quarterly data for the all sample. The dependent variable in columns (1)-(3) is the natural logarithm of the total committed loan amount for a bank-firm pair; the dependent variable in columns (4)-(6) is the natural logarithm of one plus the nominal interest rate weighted for loan shares for a given bank-firm pair. *SME$_i$* is a dummy indicating whether a firm is a SME (less than 50 millions in net sales) or non-SME. *High Leverage$_i$* is a dummy indicating whether whether a firm is in the "low" (= 0) or "high" (= 1) bin of firms defined by their average leverage ratio over the sample period. Double-clustered standard errors by firm and time are reported in parentheses.

5.3 Risk-Taking by Banks

So far we have shown that banks with low capital/high leverage do the right thing when monetary policy is easy and not take risk. Recall that our period is after the 2008 crisis when banks are heavily regulated in capital requirements. Thus, leverage may not be the right variable to capture risk-taking.

We explore risk-taking further through an alternative risky bank measure, actual loan-losses. In FR Y-14 form, each bank reports the cumulative net charge-off amount on each loan that it makes. Net charge-offs are the dollar value of the loans banks determine they will not recover in default, that is non performing loans that are expected to be written down. The advantage of net charge-off relative to default probability or simple delinquency that is commonly used in the literature is that charge-offs take into account the fact that recovery rates are on average 80 percent of the face value. Moreover, the losses associated with defaulted loans that are highly collateralized are generally much smaller than uncollateralized loans and net charge-off amounts capture this difference.

We aggregate the cumulative net charge-offs to the bank-firm level and normalize by the total committed loan amount for each borrower. The charge-off ratio varies by bank-firm-quarter, hence these regressions identify risk-taking from same set of bank-firm pairs where we test whether banks lend more in the future to the same firms that they have written off in the past. The charge-off ratio is then demeaned to aid in interpretation.

The charge-off results are reported in Table 8 and show a clear difference in the way that monetary policy easing impacts lending to private SMEs versus large public firms. The first column shows that private borrowers with higher charge-off rates on outstanding loans receive less credit when policy rates fall (**2.8959** and significant at 1 percent). This implies that a surprise fall in the policy rate from the 75th to the 25th percentile of the distribution lowers the amount of credit extended to more risky private borrowers by 24 percentage points relative to the average-risk private borrower. By contrast, column (3) shows that there is not impact of credit received by public firms. In sum, we do not find evidence of supply-side risk taking due to lower interest rates because high risk banks cut lending to risky private firms for whom they booked past losses.

5.4 The Role of Collateral: Loan Level Analysis

In this section we explore how financial constraints impact credit growth focusing on collateral constraints. A large number of studies have proposed models in which agents borrow in order to finance projects and they are subject to collateral constraints. Following the work by Kiyotaki and Moore (1997), many papers show that financial frictions have substantial ability to amplify business cycle fluctuations and can affect monetary policy transmission. In most of these models, agents borrowing is limited by a certain fraction of their capital, that is collateral is required to obtain credit and the amount of credit is determined by the value of this collateral.

Table 8: Monetary Policy and Bank Risk-Taking via Loan Losses: Firm–Bank Level

	Private Firms		*Public Firms*	
	Log (Loan)	Log $(1+i)$	Log (Loan)	Log $(1+i)$
$(\text{CCO}/\text{Loan})_{q-1}$	-0.0612	-0.0001	-0.2491	-0.0058
	(0.0553)	(0.0022)	(0.2025)	(0.0052)
$(\text{CCO}/\text{Loan})_{q-1} \times$ MP Surprise$_q$	2.8959**	0.0327	-1.4709	-0.0450
	(0.8349)	(0.0268)	(1.6931)	(0.0446)
Observations	310023	297044	285175	277986
Adjusted R^2	0.933	0.874	0.868	0.835
Bank×Firm F.E	Yes	Yes	Yes	Yes
Firm×Time F.E	Yes	Yes	Yes	Yes

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table reports OLS estimates of alternative risk measures for banks at the bank-firm level for the private firm sample (Panel A) and the public firm sample (Panel B) using quarterly data. The dependent variable in columns (1)-(4) is the natural logarithm of the total committed loan amount for a bank-firm pair; the dependent variable in columns (5)-(8) is the natural logarithm of one plus the nominal interest rate weighted for loan shares for a given bank-firm pair. The measure of bank risk is the ratio of a bank-firm's total net charge off amount divided its committed loan amount for each firm, lagged one quarter. Each column sequentially adds different fixed effects. Standard errors are double clustered at the firm and quarter levels, and *** indicates significance at the 0.1% level, ** at the 1% level, and * at the 5% level.

Our data allows us to test for the existence of such constraints and whether monetary policy transmission has different effects on credit growth and pricing via *relaxation/tightening* of these constraints. We run similar difference-in-differences regressions as in the previous section, but we exploit the loan level granularity of our data combined with our observation of pledged collateral. Specifically, we regress the outstanding committed loan amount, ($Loan$), and the nominal loan interest rate, (i), on the monetary policy surprise measure and a collateral variable that takes different forms. Collateral is loan specific and can vary by type for a given firm-bank pair.

We first consider an indicator variable equal to 1 if the loan is collateralized and 0 otherwise. The indicator captures the extensive margin of pledging collateral in a loan contract. As before, we include bank×firm fixed effects to control for unobserved average differences between firms and banks. We also control firm×time fixed effects and bank× fixed effects to control for unobserved time-varying firm and bank differences. Note that since these regressions are computed at the loan-level we can also include firm×bank×time fixed effects as denoted by $\varrho_{f,b,q}$. This most strict specification captures *within-loan* variation, where a firm takes out two or more loans at the same time from the same bank, with different collateral requirements. All regressions have double-clustered standard errors by firm and time as before. Formally, we estimate the following equation:

$$\log \mathrm{Y}_{f,b,l,q} = \varrho_{f,b,q} + \beta_1 \mathrm{Collateral}_{f,b,l,q} + \beta_2 (\mathrm{Collateral}_{f,b,l,q} \times \frac{1}{N} \sum_{k=0}^{N} \mathrm{MP}_{q-k} + \epsilon_{f,b,l,q} \qquad (4)$$

The first set of collateral results highlight a stark difference in the way that pledging collateral interacts with access to and pricing of credit across firm types as shown in Table 9. This table shows that for private borrowers, collateralizing a loan is associated with improved access to credit and lower prices. For example, column (2) reports the results on the log of loan quantity and column (5) on the interest rate–$\log(1+i)$–and both specifications include bank×firm and firm×time fixed effects, identifying a credit supply effect. The coefficient on the collateralized dummy is **0.3467** for loan amount and **-0.0045** on the rate, both of which are significant at 0.1 percent. Interestingly columns (1) and (4) tells the same story on the credit demand side. By contrast, the corresponding columns (1), (2) and (4), (5) in Table 10 show the exact opposite effect for public borrowers; pledging collateral is associated with restricted access to credit and higher prices. The results suggest that small private borrowers with no access to alternative funding sources besides bank loans must post collateral to access funding. Large public borrowers have access to unsecured funding from commercial paper and bond markets and generally obtain unsecured bank loans. Therefore, posting collateral to obtain bank financing is a sign of distress for which access to capital is restricted and interest rates are higher.

Columns (3) and (6) in Tables 9 and 10 report the most restrictive specification that includes bank×firm×time fixed effects. The variation in collateral is therefore coming from the loan-level for a fixed bank-firm pair controlling for relationship matching, bank, and firm unobserved variables. This specification helps address the common critique of the Khwaja and Mian (2008) regression that requires firms borrowing from different banks to identify supply effects in an environment where firm and bank matching may not be random. The results for both sets of firms are similar and suggest that in normal times, access to collateral improves financing conditions for private firms and that public firms post collateral only when in distress, which is associated with less credit and higher prices.

To assess whether the relation between collateral and credit growth changes with monetary policy surprise, we interact the collateral dummy variable with the surprise. The credit supply regressions for private firms in columns (2) and (5) of Table 9 show that private firms receive more credit, **-2.1818**, at higher prices, **-0.0190**, when posting collateral amid lower policy rates (the coefficient on loan quantity (price) is significant at 0.1 (5) percent). When we calculate the total effect of pledge collateral during a monetary policy expansion,

we have higher loans and lower rates both in columns (1) and (4) and (2) and (5). This suggests that risk taking does not operate through increased credit access via relaxed collateral constraints. Only when private firms have collateral, even when rates ease, do they obtain credit, both on the credit demand side and credit supply side. Risk taking would imply the opposite at least on the supply side; risky firms without collateral would receive more loans when rates falls. The total effect of collateral is the sum of the collateralized dummy and interaction term coefficients. For private borrowers, collateral always improves access to credit, especially when interest rates are low, compared to unsecured borrowing. These results hold within-loan level in the most restrictive specifications of columns (3) and (6).

The results in column (2) of Table 10 show that public firms also obtain more credit when posting collateral when rates fall. However, the estimate is not precise and different from zero in column (2) and in column (1), demand side, it is weakly significant. Furthermore, columns (4) and (5) suggests that for public borrowers, posting collateral when rates ease results in even higher interest rates, further supporting the sorting effect of collateral where risky public borrowers post collateral to obtain credit. In the most restrictive within-loan specifications of columns (3) and (6), public firms still do worse by posting collateral. In sum, risk-taking does not appear to manifest through reduced collateral requirements for riskier borrowers as a result of lower policy rates.

Table 9: Monetary Policy and Loan Level Outcomes: Private Firms

	Quantity			*Prices*		
	Log (Loan)	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$	Log $(1+i)$
Collateralized$_q$	0.2888***	0.3467***	0.4181***	-0.0023***	-0.0045***	-0.0058***
	(0.0353)	(0.0523)	(0.0606)	(0.0005)	(0.0009)	(0.0012)
Collateralized$_q$ × MP Surprise$_q$	-0.9698***	-2.1818***	-2.3107***	-0.0130***	-0.0190*	-0.0264*
	(0.1719)	(0.3730)	(0.4394)	(0.0033)	(0.0073)	(0.0105)
Observations	2984365	1563912	1371794	3128248	1564644	1377795
Adjusted R^2	0.724	0.454	0.282	0.634	0.428	0.357
Bank×Firm F.E	Yes	Yes	No	Yes	Yes	No
Bank×Time F.E	Yes	No	No	Yes	No	No
Firm×Time F.E	No	Yes	No	No	Yes	No
Bank×Firm×Time F.E	No	No	Yes	No	No	Yes

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions for the effect of collateral using loan level data at a quarterly frequency, for private firm sample. The dependent variable in columns (1) through (3) is the natural logarithm of the total committed loan amount; the dependent variable in columns (4) through (6) is the natural logarithm of the nominal real interest rates. *Collateralized*$_q$ is a dummy variable equal to one if the loan is collateralized, and zero otherwise. Double-clustered standard errors by firm and time are reported in parentheses.

Table 10: Monetary Policy and Loan Level Outcomes: Public Firms

	Quantity			*Prices*		
	Log (Loan)	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$	Log $(1+i)$
Collateralized$_q$	-0.6190***	-0.6384***	-0.8910***	0.0074***	0.0081***	0.0108***
	(0.0481)	(0.0490)	(0.0770)	(0.0006)	(0.0006)	(0.0009)
Collateralized$_q$ × MP Surprise$_q$	-0.6125*	-0.4756	-2.0066*	-0.0233***	-0.0157*	-0.0092
	(0.2575)	(0.3938)	(0.7709)	(0.0050)	(0.0069)	(0.0100)
Observations	644446	634710	485440	639445	629677	481327
Adjusted R^2	0.506	0.490	0.284	0.479	0.513	0.378
Bank×Firm F.E	Yes	Yes	No	Yes	Yes	No
Bank×Time F.E	Yes	No	No	Yes	No	No
Firm×Time F.E	No	Yes	No	No	Yes	No
Bank×Firm×Time F.E	No	No	Yes	No	No	Yes

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions of the effect of collateral using loan level data at a quarterly frequency, for the public firm sample. The dependent variable in columns (1) through (3) is the natural logarithm of the total committed loan amount ; the dependent variable in columns (4) through (6) is the natural logarithm of the nominal real interest rates. *Collateralized*$_q$ is a dummy variable equal to one if the loan is collateralized, and zero otherwise. Double-clustered standard errors by firm and time are reported in parentheses.

5.5 The Importance of "Operational" Collateral, Earnings, and Operations Based Constraints

The FR Y-14Q data contains rich collateral detail that allows us to explore the relationship between different types of collateral and access to and price of credit, as well as whether risk taking operates through collateral heterogeneity. To study these issues, we replace the binary collateral indicator with indicators specifying the type of collateral pledged.

Recall from Figure 10 that, in the raw data we have 6 collateral categories. The categories that group loans secured with fixed assets and real estate based on the notion that the market value of these assets determines their collateral value; the tress in Kiyotaki and Moore (1997). Another category are loans secured by cash and marketable securities. The value of cash, marketable securities, fixed assets, and real estate loans can be mostly divorced from the risks associated with firm operations. The other category is loans secured by AR&I, and the final group is loans secured by blanket liens and other collateral. Unsecured loans is the omitted category.

To show that the impact of AR&I and blanket liens is similar, what we call "operational" collateral, we first show all results with separate collateral categories separate (only adding fixed assets and real estate together) and leaving unsecured as the omitted category. The results are reported in Tables 11 and 12 show a collateral-sorting affect, highlighting the

importance of constraints tied to the operations of the firm for SMEs compared to other forms of tangible asset-based collateral. In particular, for private borrowers, collateral improves access to credit and pricing (in the top four rows, the coefficients in the quantity (price) regressions are positive (negative) and significant at 0.1 percent except for fixed assets and real estate). Interestingly, a "collateral pecking order" emerges: the most useful form of collateral to obtain larger loans at lower prices is accounts receivable and inventory, followed by blanket liens and cash and marketable securities. The association between fixed assets and real estate and access to credit is not statistically significant. These results suggest that, for private borrowers, collateral that is closely tied to the operation of the firm–accounts receivable and inventory–and earnings–blanket liens–are most advantageous. This result should not be surprising given Figure 11: fixed assets and real estate are most frequently used by the SMEs. Thus, real estate and fixed assets appear to be in limited supply for SMEs and other forms of collateral must be used. By contrast, for public firms, as shown in Table 12, access to credit is restricted when posting any type of collateral and interest rates are higher. However, the same collateral pecking order is present for public firms to a certain extent: credit is less restricted and prices are lower when using collateral tied to the operations of the firm such as accounts receivable, inventory, and blanket liens, followed by cash and marketable securities, and lastly fixed assets and real estate. The big difference is that fixed assets and real estate have a significant role for public firm borrowing but not for private firms in normal times.

The bottom four rows in Tables 11 and 12 present the results on the role of collateral during monetary policy expansions. These columns provide further evidence that risk taking does not operate through a reduction in collateral requirements of different types. The results for private borrowers are consistent with our previous extensive margin results and shows that those results are driven by "operational collateral". Column (1) shows that posting AR&I and blanket line improves access to credit, where column (4) shows that only AR&I improves pricing. On the credit supply side of columns, all type of collateral has a role in expanding credit but weak effect on pricing. The most restrictive within-loan regressions, show a role for ARI, blanket lien and fixed assets to increase loan amounts but strong price effect in terms of obtaining lower prices comes from AR&I during monetary policy expansions. Similarly for public borrowers, in Table 12, accounts receivable and inventory remain the best collateral source during expansions. Hence, collateral whose value derives mostly from operations and ability to generate revenue is superior for both types of firms.

Based on the fact that AR&I and blanket lien collateral appear to impact access to and pricing of credit for all borrowers in a similar way, we report the results of aggregating

Table 11: The Role of Collateral Type I: Private Firms

	Quantity			*Prices*		
	Log (Loan)	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$	Log $(1+i)$
Fixed assets and real estate$_q$	0.0362	-0.0298	0.0332	0.0015**	0.0009	-0.0000
	(0.0324)	(0.0433)	(0.0494)	(0.0005)	(0.0009)	(0.0012)
Cash and marketable sec.$_q$	0.2225***	0.3331***	0.3270***	-0.0049***	-0.0070***	-0.0093***
	(0.0361)	(0.0536)	(0.0713)	(0.0006)	(0.0010)	(0.0013)
Act. receiv. and inventory$_q$	0.5424***	0.7790***	0.8924***	-0.0046***	-0.0082***	-0.0102***
	(0.0406)	(0.0509)	(0.0535)	(0.0006)	(0.0010)	(0.0013)
Blanket lien and other$_q$	0.3668***	0.4817***	0.5787***	-0.0024***	-0.0046***	-0.0053***
	(0.0332)	(0.0431)	(0.0514)	(0.0005)	(0.0008)	(0.0010)
Fixed assets and real estate$_q$ × MP Surprise$_q$	-0.0606	-1.0468***	-1.1313***	-0.0008	-0.0107*	-0.0178*
	(0.0811)	(0.2082)	(0.2485)	(0.0017)	(0.0051)	(0.0072)
Cash and marketable sec.$_q$ × MP Surprise$_q$	-0.1948	-0.9140**	-0.7354$^+$	0.0009	-0.0040	-0.0054
	(0.1258)	(0.2931)	(0.4310)	(0.0026)	(0.0062)	(0.0093)
Act. receiv. and inventory$_q$ × MP Surprise$_q$	-1.0223***	-2.1088***	-2.3031***	-0.0118***	-0.0135*	-0.0227**
	(0.1391)	(0.3011)	(0.3342)	(0.0026)	(0.0052)	(0.0077)
Blanket lien and other$_q$ × MP Surprise$_q$	-0.5070***	-0.9747***	-0.6990*	-0.0018	-0.0105*	-0.0120$^+$
	(0.1064)	(0.2348)	(0.3015)	(0.0018)	(0.0045)	(0.0065)
Observations	2650313	1362500	1192230	2781417	1365280	1199252
Adjusted R^2	0.734	0.472	0.307	0.647	0.442	0.376
Bank×Firm F.E	Yes	Yes	No	Yes	Yes	No
Bank×Time F.E	Yes	No	No	Yes	No	No
Firm×Time F.E	No	Yes	No	No	Yes	No
Bank×Firm×Time F.E	No	No	Yes	No	No	Yes

$^+$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions of the effect of collateral type using loan level data at a quarterly frequency, for the private firm sample. The dependent variable in columns (1) through (3) is the natural logarithm of the total committed loan amount ; the dependent variable in columns (4) through (6) is the natural logarithm of the nominal real interest rates. The dependent variables are dummy variables equal to one if the loan is collateralized by specific type of collateral, zero otherwise; we drop the category "Unsecured". The coefficients for the collateral types are calculated but not displayed. Double-clustered standard errors by firm and time are reported in parentheses.

Table 12: The Role of Collateral Type I: Public Firms

	Quantity			*Prices*		
	Log (Loan)	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$	Log $(1+i)$
Fixed assets and real estate$_q$	-1.4410***	-1.4400***	-1.8022***	0.0178***	0.0174***	0.0219***
	(0.0609)	(0.0703)	(0.0757)	(0.0009)	(0.0009)	(0.0011)
Cash and marketable sec.$_q$	-0.5642***	-0.5283***	-0.7002***	0.0034**	0.0048***	0.0060**
	(0.0633)	(0.0697)	(0.1222)	(0.0011)	(0.0011)	(0.0020)
Act. receiv. and inventory$_q$	-0.1679*	-0.2192**	-0.2921*	0.0032***	0.0036***	0.0028*
	(0.0690)	(0.0756)	(0.1187)	(0.0007)	(0.0008)	(0.0013)
Blanket lien and other$_q$	-0.3759***	-0.3934***	-0.5355***	0.0045***	0.0052***	0.0073***
	(0.0483)	(0.0505)	(0.0913)	(0.0005)	(0.0005)	(0.0009)
Fixed assets and real estate$_q$ × MP Surprise$_q$	1.0635*	0.9617$^+$	-0.3164	0.0139	0.0060	0.0275*
	(0.4006)	(0.5166)	(0.8001)	(0.0097)	(0.0105)	(0.0127)
Cash and marketable sec.$_q$ × MP Surprise$_q$	-1.7177**	-1.6142*	-2.5546$^+$	0.0041	0.0216$^+$	0.0760**
	(0.5340)	(0.6360)	(1.4276)	(0.0102)	(0.0116)	(0.0246)
Act. receiv. and inventory$_q$ × MP Surprise$_q$	-1.7494***	-2.8136***	-5.5757***	-0.0399***	-0.0287***	-0.0465**
	(0.3921)	(0.5887)	(1.1364)	(0.0055)	(0.0072)	(0.0134)
Blanket lien and other$_q$ × MP Surprise$_q$	-0.7591*	-1.1205*	-2.2961*	-0.0333***	-0.0226**	-0.0203$^+$
	(0.3102)	(0.4592)	(0.9398)	(0.0047)	(0.0065)	(0.0116)
Observations	644446	634710	485440	639445	629677	481327
Adjusted R^2	0.538	0.523	0.339	0.491	0.525	0.398
Bank×Firm F.E	Yes	Yes	No	Yes	Yes	No
Bank×Time F.E	Yes	No	No	Yes	No	No
Firm×Time F.E	No	Yes	No	No	Yes	No
Bank×Firm×Time F.E	No	No	Yes	No	No	Yes

$^+$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions of the effect of collateral type using loan level data at a quarterly frequency, for the public firm sample. The dependent variable in columns (1) through (3) is the natural logarithm of the total committed loan amount ; the dependent variable in columns (4) through (6) is the natural logarithm of the nominal real interest rates. The dependent variables are dummy variables equal to one if the loan is collateralized by specific type of collateral, zero otherwise; we drop the category "Unsecured". The coefficients for the collateral types are calculated but not displayed. Double-clustered standard errors by firm and time are reported in parentheses.

collateral types according to source of collateral value. In particular, we combine fixed assets and real estate and cash and securities in asset-based collateral where the market based liquidation values are important for borrowing capacity. AR&I and blanket liens are combined into earnings and operations based collateral where the value of the collateral is based on firm operations and earnings. This is the grouping shown in Figure 12.

The results shown in Tables 13 and 14 confirm the previous findings. Earnings and operations based collateral constraints are very important for SMEs, in terms of higher borrowing and lower rates during normal times regardless of demand or supply side, or when we use within-loan variation for the same pair. In contrast, both asset based and earnings/operations based collateral are important for public firms but they both signal riskiness; posting either type is associated with less borrowing and higher spreads in normal times.

During expansionary monetary policy, both types of constraints help SMEs to borrow even more with overall lower spreads based on total effects. Note that this result holds on the supply side and within-loan variation of columns (2), (3), (5), (6) and not in columns (1) and (4), suggesting that on the demand side, private firms do not prefer to pledge asset based constraints, most likely because they do not have much. Interestingly, for public firms, only earnings and operations based constraints improve access to credit and prices during monetary policy expansions. In fact, total effects suggest that their constraints relax when posting more earnings and operations based collateral. They borrow at higher prices, which still reflects their risk.

5.6 Future Delinquency and Financial Stability

Overall, our results suggest that monetary policy transmission during the low interest rate environment works mostly through firm demand for credit rather than credit supplied in the banking system. In particular, lower policy rates lead to increased demand for loans among smaller and more leveraged private companies, but no change in the supply of funds among banks necessarily as a function of their leverage or in terms of banks lending to firms who defaulted before. In this sense we do not find any evidence of risk-taking *by banks*. This does not mean there are no risks to financial stability. Thus, this section assesses whether the increase in firm leverage due to low rates is any evidence of risk-taking, that is, is it the case that these firms are most likely to default in the future.

We address this issue using the same specification of Jiménez, Ongena, Peydró, and Saurina (2014). In particular, we use non-performing loans of more than 30 days and regress

Table 13: The Role of Collateral Type II: Private Firms

	Quantity			*Prices*		
	Log(Loan)	Log(Loan)	Log(Loan)	Log(1+i)	Log(1+i)	Log(1+i)
Asset-based	0.0544^{+}	-0.0204	0.0278	0.0009^{+}	-0.0001	-0.0010
	(0.0301)	(0.0458)	(0.0546)	(0.0005)	(0.0009)	(0.0012)
Earnings & Operations-based	0.4106***	0.5765***	0.6912***	-0.0038***	-0.0067***	-0.0085***
	(0.0402)	(0.0545)	(0.0608)	(0.0005)	(0.0009)	(0.0012)
Asset-based × MPq	-0.1172	-1.5071***	-1.5839***	-0.0021	-0.0165*	-0.0260*
	(0.1277)	(0.3319)	(0.4050)	(0.0031)	(0.0077)	(0.0107)
Earnings & Operations-based × MPq	-1.4829***	-2.5766***	-2.5402***	-0.0173***	-0.0203*	-0.0293*
	(0.2144)	(0.4032)	(0.4689)	(0.0035)	(0.0074)	(0.0107)
Observations	2984365	1563912	1371794	3128248	1564644	1377795
Adjusted R^2	0.731	0.474	0.310	0.635	0.435	0.366
Bank × Firm F.E.	Yes	Yes	No	Yes	Yes	No
Bank × Time F.E.	Yes	No	No	Yes	No	No
Firm × Time F.E.	No	Yes	No	No	Yes	No
Bank × Firm × Time F.E.	No	No	Yes	No	No	Yes

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions of the effect of collateral type using loan level data at a quarterly frequency, for the private firm sample. The dependent variable in columns (1) through (3) is the natural logarithm of the total committed loan amount ; the dependent variable in columns (4) through (6) is the natural logarithm of the nominal real interest rates. The dependent variables are dummy variables equal to one if the loan is collateralized by specific type of collateral, zero otherwise. "Asset Based" is a dummy variable equal to one if the collateral pledge is either Real Estate, Fixed Assets or Cash and marketable securities; "Earning and Operation Based" is equal to one if the collateral pledged is either blanket lien, account receivable and inventory or other; we drop the category "Unsecured". The coefficients for the collateral types are calculated but not displayed. Double-clustered standard errors by firm and time are reported in parentheses.

Table 14: The Role of Collateral Type II: Public Firms

	Quantity			*Prices*		
	Log(Loan)	Log(Loan)	Log(Loan)	Log(1+i)	Log(1+i)	Log(1+i)
Asset-based	-1.2454***	-1.2489***	-1.6386***	0.0146***	0.0148***	0.0195***
	(0.0543)	(0.0607)	(0.0719)	(0.0008)	(0.0008)	(0.0010)
Earnings & Operations-based	-0.3105***	-0.3421***	-0.4388***	0.0041***	0.0048***	0.0054***
	(0.0516)	(0.0538)	(0.0949)	(0.0005)	(0.0006)	(0.0009)
Asset-based × MP_q	0.5611	0.5472	-0.3345	0.0116	0.0088	0.0305*
	(0.3421)	(0.4600)	(0.7612)	(0.0086)	(0.0094)	(0.0120)
Earnings & Operations-based × MP_q	-1.3400***	-1.7572***	-4.0888***	-0.0364***	-0.0260***	-0.0300**
	(0.2895)	(0.4475)	(0.9127)	(0.0046)	(0.0064)	(0.0106)
Observations	644446	634710	485440	639445	629677	481327
Adjusted R^2	0.530	0.516	0.330	0.486	0.521	0.390
Bank × Firm F.E.	Yes	Yes	No	Yes	Yes	No
Bank × Time F.E.	Yes	No	No	Yes	No	No
Firm × Time F.E.	No	Yes	No	No	Yes	No
Bank × Firm × Time F.E.	No	No	Yes	No	No	Yes

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents the results of OLS regressions of the effect of collateral type using loan level data at a quarterly frequency, for the public firm sample. The dependent variable in columns (1) through (3) is the natural logarithm of the total committed loan amount ; the dependent variable in columns (4) through (6) is the natural logarithm of the nominal real interest rates. The dependent variables are dummy variables equal to one if the loan is collateralized by specific type of collateral, zero otherwise. "Asset Based" is a dummy variable equal to one if the collateral pledge is either Real Estate, Fixed Assets or Cash and marketable securities; "Earning and Operation Based" is equal to one if the collateral pledged is either blanket lien, account receivable and inventory or other; we drop the category "Unsecured". The coefficients for the collateral types are calculated but not displayed. Double-clustered standard errors by firm and time are reported in parentheses.

Table 15: Monetary Policy and Future Delinquency, Bank-Firm Level

	Panel A: All Firms		*Panel B: Private Firms*		*Panel C: Public Firms*	
	Non-performing	Non-performing	Non-performing	Non-performing	Non-performing	Non-performing
High leverage $bank_k$ × MP $Surprise_q$	0.1302***		0.1218**		0.2420***	
	(0.0275)		(0.0366)		(0.0417)	
High leverage $firm_i$ × MP $Surprise_q$		-0.0498**		-0.0594**		-0.0705^{+}
		(0.0153)		(0.0164)		(0.0377)
Observations	647889	2469016	342990	2150032	304899	318976
Adjusted R^2	0.699	0.647	0.710	0.636	0.699	0.700
Bank×Firm f.e	Yes	Yes	Yes	Yes	Yes	Yes
Bank×Time f.e	No	Yes	No	Yes	No	Yes
Firm×Time f.e	Yes	No	Yes	No	Yes	No

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table reports OLS estimates of the effect of MP shocks on the probability that loans become delinquent at any point in the future at the bank-firm level using quarterly data. Panel A uses all firms, panel B uses the private firm sample, and panel C uses the public firm sample. The dependent variable is an indicator variable that equals 1 if a firm has any loan outstanding that becomes delinquent for more than 30 days at any point in the future. *High leverage* $firm_i$ is a dummy variable equal to one if the first quarter leverage of firm i is higher than the median leverage of the firms in the sample, and zero otherwise. *High leverage* $bank_k$ is a dummy variable equal to one if the first quarter leverage of bank k is higher than the median leverage of the banks in the sample, and zero otherwise. Each column sequentially adds different fixed effects. Standard errors are double clustered at the firm and quarter levels, and *** indicates significance at the 0.1% level, ** at the 1% level, and * at the 5% level.

it on our measures of firm and bank leverage, separately, and interacted with the monetary policy surprise variable. Banks report whether or not a loan is non-performing past 30 days meaning that the borrower is delinquent. We compute a dummy variable equal to one if a firm has a non-performing loan at any point in the future with a given bank. Thus, the variable captures whether or not loans to risky firms or loans by risky banks (risk captured by ex-ante time invariant leverage) are more likely to become non-performing at any point in the future.

Table 15 contains the results for the different firm samples. Panel A is the full sample, panel B are only privately-owned firms and panel C are only publicly-owned firms. As before, we do not find any risk-taking by U.S. banks, unlike what Jiménez, Ongena, Peydró, and Saurina (2014) find for Spanish banks. If fact, our results suggest that banks with less capital make more prudent loan decisions in response to surprise monetary policy rate easing. The first row in all three panels shows that the coefficients on the bank leverage and monetary surprise interaction term are positive and statistically significant at 1 percent. Row two presents the demand regressions that include bank-time fixed effects to control for supply factors. The coefficient on the interaction term of firm leverage and the monetary policy surprise is negative and statistically significant at 1 percent for private firms and 10 percent for public firms. Hence, we find that highly leveraged firms are more likely to be delinquent when monetary policy is expansionary. This result suggests that low rates pose a hidden financial stability risk. The increase in leverage for public and private firms documented in Figure 6 suggests that future delinquencies are likely to rise not only for public firms, but also the riskiest private borrowers. These results are consistent with Coimbra and Rey (2017), suggesting a trade-off between stimulating the economy and increasing the financial stability risks.

5.7 Robustness

The first set of robustness results replace the continuous leverage ratio with a time-invariant leverage dummy. We define high leverage firms to be firms with average leverage ratios above the sample median. A time invariant leverage ratio helps ensure that the baseline effects of our interaction terms are being driven by the time variation in the monetary policy surprise variable rather than time varying leverage, even though we always lagged and demeaned this variable.

Table 16 shows that the baseline results are robust to this change. In particular, columns (1) and (3) show that high-risk private firms increase their demand for credit in response

to lower policy rates, and pay higher equilibrium prices. There is no significant response to policy rates for public firm condition on their leverage (columns (5) and (7)). Finally, high risk banks lend *less* to private firms, as before, in response to lower rates (column (2)).

Next set of robustness test study the asymmetric effects of monetary policy. We interpret our results through expansions, but the existing results can also be driven by contractions. This robustness check separates expansionary and contractionary monetary policy. We will also do local projections to evaluate the dynamic effects of monetary policy surprises. Finally we will decompose the monetary surprise measures into the information effect and the signalling effect following the work by Jarociński and Karadi (2020) and Nakamura and Steinsson (2018). This robustness work is still in progress.

Table 16: Robustness: Time-Invariant Leverage

	Private Firms				**Public Firms**			
	Quantity		*Prices*		*Quantity*		*Prices*	
	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$	Log (Loan)	Log (Loan)	Log $(1+i)$	Log $(1+i)$
High Leverage Firm × MP Surprise$_q$	-0.8478***		-0.0395***		-0.1679		-0.0045	
	(0.1221)		(0.0035)		(0.2162)		(0.0051)	
High Leverage Bank × MP Surprise$_q$		0.5429***		0.0066*		0.1605		0.0059*
		(0.1319)		(0.0027)		(0.1559)		(0.0022)
Observations	2140482	349527	2150197	352806	319985	307355	322056	309448
Adjusted R^2	0.939	0.929	0.768	0.858	0.837	0.862	0.675	0.818
Bank×Firm F.E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank×Time F.E	Yes	No	Yes	No	Yes	No	Yes	No
Firm×Time F.E	No	Yes	No	Yes	No	Yes	No	Yes

$+$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 Conclusion

We use new confidential supervisory firm-bank-loan level data from the U.S. to understand monetary policy transmission and risk-taking in an economy with heterogeneous agents and contracts. Our headline results for the period 2012-2019 are as follows. First, during normal times, SMEs are financially constrained and bank dependent but large public firms are not. Second, low interest rates do not lead to risk-taking by banks. Instead, SMEs simply increase their borrowing since credit demand increases when rates are low. Since SMEs pledge collateral based on their continuation value, low interest rates increase the value of this collateral by increasing SMEs ability to pay back the loan. As the SMEs who increase their borrowing are more leveraged SMEs, there is a hidden financial stability risk that policy-makers may over look. Leveraged SMEs drive the results in a sample of all U.S. firms including publicly listed firms. Thus, there is a trade-off between stimulating the economy and financial stability.

Our results build on new facts about the credit markets in the U.S. It is not only the case that, SMEs borrow shorter maturity and pay higher interest rates relative to large publicly listed firms, they also use frequently "operational" collateral tied to their operations and enterprise value rather than fixed assets and real estate. The relation between collateral and risk, at the loan level, is positive for large listed firms but negative for SMEs, where we measure risk by the loan risk premium. That is, SMEs post collateral to borrow, whereas large listed firms use collateral when their default risk is higher.

Understanding the relation between collateral and risk is important for our monetary policy transmission results. During expansionary monetary policy, risk-taking does not operate through increased credit access via higher valued fixed assets. We show that the best type of collateral, especially for SMEs, to obtain more credit at a lower price is "operational" collateral. SMEs largely secure loans using earnings and operations based collateral (blanket lien and accounts receivable and inventory) and this collateral becomes more valuable when policy rates fall because it stimulated demand and increase the value of SME operations, allowing credit growth. Our results show that the effectiveness and power of monetary policy may depend on the size distribution of firms and type of collateral used. SMEs cover more than 50 percent of the real economy, which means that our results have important implications for aggregate boom-bust cycles in a low interest rate environment.

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Appendices

A Variable Definitions

Variable	Definition
Bank leverage	It is calculated both as short-term debt as a fraction of total assets and as total liabilities as a fraction of total assets.
Firm leverage	It is calculated both as short-term debt as a fraction of total assets and as total liabilities as a fraction of total assets.
Collateral amount	Market value of the collateral backing the loan.
Collateral type	Fixed assets and real estate Cash and marketable securities Accounts receivable and inventory Blanket lien and others Unsecured
Collateral to loan ratio	It is calculated as collateral value as a fraction of the committed amount by loan.
Probability of default (Percent)	The firm's estimated probability of default by quarter.
Probability of default (Weighted)	It is computed as average firm's probability of default, weighted by the committed loan amount for each firm-bank.
Probability of future default	It is dummy equal to one if the firm defaults at any point in time in the future.
Charge-offs$_b$	It is calculated as the maximum cumulative net charge-offs by bank weighted by the bank's commitments.
Charge-offs$_f$	It is calculated as the total cumulative net charge-offs by firm.
Charge-offs$_l$	It is calculated as the average cumulative net charge-offs by loan.
NPL$_4$	It is a dummy variable that takes a value of 1 if a firm had a non-performing loan in the past 4 years.
Charge-off ratio$_b$	It is calculated as bank's total net charge off amount divided by the bank's total commitments.
Charge-off ratio$_f$	It is calculated as bank-firm's total net charge off amount divided its committed loan amount for each firm.
Charge-off ratio$_b$	It is calculated as net charge off amount divided its committed loan amount for each loan.
Collateralized$_{t-1}$	It is a dummy variable equal to one if the loan is collateralized, and zero otherwise.

B Supplemental Material

Bank Holding Companies subject to CCAR–The bank holding companies included in the sample are: beginning in Q3:2011 Ally Financial, Bank of America Corporation, BB&T Corporation, Bank of New York Mellon Corporation, Citigroup Incorporated, Capital One Financial Corporation, Fifth Third Bancorp, Goldman Sachs Group Incorporated, JPMorgan Chase & Co., Keycorp, Morgan Stanley, PNC Financial Services Group Incorporate, Regions Financial Corporation, Suntrust Banks Incorporated, State Street Corporation, U.S. Bancorp, Wells Fargo & Company. Beginning in Q3:2012 Comerica Incorporated, Huntington Bancshares Incorporated, HSBC North America Holdings Incorporated, M&T Bank Corporation, Northern Trust Corporation, RBC USA Holdco Corporation, Santander Holdings USA Incorporated, UnionBanCal Corporation (renamed to MUFG Americas Holding

Corporation in Q3:2014), Zions Bancorporation. Beginning in Q2:2014 Discover Financial Services. Beginning in Q4:2014 BNP Parisbas.

HFI, HFS, and Trading Assets–HFS loans and leases are also distinct from loans held on the trading book for market making purposes and subject to different different regulatory capital requirements. Specifically, loans and leases in the trading book are reported on a separate schedule (other than Schedule H1) and typically meet the following trading activities: a) regularly under-writing or dealing in securities; interest rate, foreign exchange rate, commodity, equity, and credit derivative contracts; other financial instruments; and other assets for resale, (b) acquiring or taking positions in such items principally for the purpose of selling in the near term or otherwise with the intent to resell in order to profit from short-term price movements, and (c) acquiring or taking positions in such items as an accommodation to customers or for other trading purposes.

Data Cleaning and Sample Construction

This section describes the intensive data cleaning process needed to use the FR Y14 data for our purposes.

1. Remove from the raw loan-level data loans issued to "Individuals" and loans to foreign addresses.

2. Remove any loans to financial firms (NAICS 52); real estate REITS (NAICS 513); educational servies (NAICS 611); religious, grantmaking, and civil and professional organizations (NAICS 813); and private household (NAICS 814).

3. Drop all observations for which there is no financial data reported and when total firm assets are missing or equal to 0.

4. Drop all facilities where the total value of commitments is less than $1 million due to reporting threshold.

5. To consistently identify firms across banks with missing or different tax ids, we first apply a name cleaning algorithm to make a consistent names for firms that are the same based on string matches, zipcode, and city. For example Firm A LLC, 20002 Washington D.C, Firm A Limited Liability Corporation 20002 Washington D.C., and Firm a LLC, 20002 Washington D.C. are all treated as the same firm, etc.

6. Once we have a clean and uniform set of firm names, we can fill in missing tax ids. For observations loans where firm tax id is missing, we fill in missing observations if the bank reports a consistent tax id through any portion of the loan; for multi-bank

borrowers for which one bank does not report the tax id, we use a consistent tax id reported by other banks.

7. To ensure that firm income statement and balance sheet variables are reasonable and reported in consistent units, we apply a cleaning algorithm that searches for large reporting discrepancies within and across banks over time for the same firm. We set threshold for potential misreported to be a difference in a variable either by the same bank or across different banks of either 10^3, 10^6, 10^9 since these are most common unit differences reported in the data. We also note that when there is miss reporting, all variables appear to be consistently miss reported in the same way, so financial ratios *e.g.* leverage are generally reasonable.

8. After re-scaling miss reporting issues, we take the max value when banks inconsistently report information for the same firm.

Internal Consistency of Balance Sheet Information

We follow Gopinath, Kalemli-Ozcan, Karabarbounis, and Villegas-Sanchez (2017) to check the sensibility of our cleaning procedure by comparing the sum of variables belonging to some aggregate of their respective category:

1. The sum of tangible fixed assets, intangible fixed assets, and other fixed assets as a ratio of total fixed assets.

2. The sum of fixed assets and current assets as a ratio of total assets

3. The sum of long-term debt and other non-current liabilities as a ratio of total non-current liabilities

4. The sum of cash and securities, inventory, and accounts receivable as a ratio or current assets

5. The sum of current assets and tangible assets as a ratio or total assets

6. The sum of accounts payable, short-term debt, and current maturity long-term debt as a ratio of current liabilities

7. The sum of current liabilities, long-term debt and minority interest as a ratio of total liabilities

8. The sum of total liabilities, retained earnings, and capital expenditure as a ratio of total assets.

The table below presents the results of the data quality comparison.

Information on credit facilities and reporting thresholds in FR Y-14–A credit facility is defined as any legally binding credit extension to a legal entity under a specific credit agreement. A credit facility may be secured or unsecured, term or revolving, drawn or undrawn (excluding informal advised lines). There is no materiality threshold for securities reporting at the individual obligor level. BHCs must report their securities holdings if the entire portfolio is greater than either $5 billion or five percent of Tier 1 capital on average for the four quarters preceding the reporting quarter.

Note on Total Liabilities: Flow of funds– Total non financial corporate liabilities reported by the Flow of Funds in the National Accounts of the U.S. (Table B.3, Series i.d. FL104190005.Q) is computed as

$$Liabilities_{total} = taxes + debtsecurities + loans + miscellaneous + FDI.$$

The following source the total liability components:

- Tax data come from Internal Revenue Service, Statement Of Income – This item is smallest line item in the total;
- Debt securities are bond data is from Mergent Fixed Income Securities Database;
- Loan data are pulled from bank call reports – These data are all U.S. chartered bank depository institutions plus foreign bank offices in the U.S. These data also include credit unions;
- Miscellaneous is a catchall category and is the largest single component. This data is the sum of private pension fund contributions from the Department of Labor, and an unidentified category, which is the largest component of miscellaneous. The unidentified category is computed as a residual category from the IRS SOI and flow of founds:

  $$unidentified = total_{assets} - equity - liabilities,$$

  where *liabilities* are the individual liability sub-components in the Flow of Funds;
- FDI comes from BEA

C Appendix Tables

Table 17: Longer Term Rates: Private Firms

	Quantity		*Prices*	
	Log(Loan)	Log(Loan)	Log$(1+i)$	Log$(1+i)$
Firm Leverage	0.0114		-0.0019*	
	(0.0198)		(0.0008)	
Firm Leverage × MP Surprise$_q$	-0.6175***		-0.0416***	
	(0.0632)		(0.0030)	
Bank Leverage		0.3024**		-0.0038
		(0.1056)		(0.0025)
Bank Leverage × MP Surprise$_q$		0.4438*		0.0169**
		(0.2075)		(0.0049)
Observations	1935430	337330	1944550	340486
Adjusted R^2	0.940	0.930	0.774	0.860
Bank × Firm F.E.	Yes	Yes	Yes	Yes
Bank × Time F.E.	Yes	No	Yes	No
Firm × Time F.E.	No	Yes	No	Yes

Table 18: Longer Term Rates: Public Firms

	Quantity		*Prices*	
	Log(Loan)	Log(Loan)	Log$(1+i)$	Log$(1+i)$
Firm Leverage	0.0831		-0.0007	
	(0.0571)		(0.0013)	
Firm Leverage $\times$ MP Surprise$_q$	0.19835		-0.0108	
	(0.2792)		(0.8099)	
Bank Leverage		0.3776**		-0.0102***
		(0.1048)		(0.0019)
Bank Leverage $\times$ MP Surprise$_q$		0.0897		0.0092**
		(0.1929)		(0.0027)
Observations	263915	296120	265674	298156
Adjusted R^2	0.839	0.864	0.674	0.820
Bank $\times$ Firm F.E.	Yes	Yes	Yes	Yes
Bank $\times$ Time F.E.	Yes	No	Yes	No
Firm $\times$ Time F.E.	No	Yes	No	Yes

Table 19: Leverage, NPL, and Default Probabilities

	Sample								
	All Firms			*Private Firms*			*Public Firms*		
Firm Leverage$_{q-1}$	0.0448***		0.0496***	0.0412***		0.0367***	0.1044***		0.1266***
	(0.0028)		(0.0074)	(0.0027)		(0.0063)	(0.0214)		(0.0327)
Non-Performing Loan$_{q-1}$		0.0181***	0.0175**		0.0525***	0.0519***		0.0002	-0.0007
		(0.0049)	(0.0048)		(0.0115)	(0.0114)		(0.0038)	(0.0038)
Observations	1656049	535836	535836	1454694	415830	415830	201355	120006	120006
Adjusted R^2	0.601	0.810	0.811	0.601	0.822	0.822	0.576	0.663	0.673
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes