The Collateral Channel and Bank Credit

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Abstract

Our paper studies the role of the collateral channel for bank credit using a confidential bank-firm-loan data set. We find that the use of real estate collateral is concentrated in private bank-dependent borrowers and in markets with low real estate supply elasticities. We identify the sensitivity of firms' borrowing capacity to commercial real estate values controlling for firm-, bank-, and market-level characteristics as well as credit demand factors identified from the micro-panel data. We estimate that for every percent increase in collateral values, firms pledging real estate collateral experience 12 basis point higher growth in bank lending with higher sensitivities for more constrained firms. By relaxing borrowing constraints and increasing credit to bank-dependent borrowers, higher real estate values boost firm capital expenditures, and lead to aggregate effects associated with lower unemployment, higher employment growth and business creation. Our estimates imply that as much as 37 percent of employment variation can be attributed to relaxation of borrowing constraints over the period from 2013 to 2019. By highlighting the importance of real estate collateral for bank-dependent borrowers, our study contributes to a growing empirical literature that explores the importance of the collateral channel for macroeconomic fluctuations.

JEL Classification: E44, G21

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1 Introduction

Monitoring borrowers and enforcing loan contracts is costly, and pledging of real estate collateral often mitigates problems of asymmetric information and incompleteness in debt contracts. In such contractual situations, fluctuations in the values of real estate collateral determine borrowing capacity and credit allocations. Higher asset values relax collateral constraints, allowing firms to secure more credit and increase investment. The higher investment demand further increases asset values creating a positive feedback loop between asset prices and investment. This macro-finance mechanism, also referred to as the *collateral channel*, is an important amplification mechanism of shocks in theoretical models studying macroeconomic fluctuations. While the predictions of theory about the role of collateral values for credit allocations and business cycles are unambiguous, empirical analysis on the role of real estate values on firm credit constraints has been sparse and predominantly focused on large publicly traded firms. However, as we argue in this paper, collateral constraints are most important for private and bank-dependent borrowers, and for those firms there has been less empirical work done due to lack of detailed enough micro-level data.

Our study attempts to fill in this gap by empirically examining the role of commercial real estate collateral for bank credit and the real effects of bank credit allocations that result from the relaxation of borrowing constraints due to higher real estate values. We use confidential supervisory bank-firm-loan dataset derived from supervisory reports, FR Y-14Q, for both publicly traded and private firms in the United States covering the period from 2013:Q1 to 2019:Q4. Our data allow us to quantify the collateral channel conditioning on both borrower and lender characteristics. On the borrower side, we capture a diverse set of firms. We can identify constrained and high bank-dependent firms and empirically model their optimal choice of collateral. Our data allow us to observe the pledging of different types of collateral and compare the relative relaxation of borrowing constraints based on the collateral use and the changes in the value of real estate collateral. On the lender side, our data include the largest banking organizations in the United States, which provide a significant fraction of bank credit to corporate borrowers of different sizes and across different geographic regions. These unique features of our data allow us to distinguish between the collateral channel and the broad net worth effects of changes in real estate collateral values.

The identification of the collateral channel is equivalent to describing the extent to which a firm's borrowing constraint binds and restricts the firm from achieving an optimal level of capital. A binding collateral constraint creates a tight link between asset values and credit growth. The identification challenge is that such associations can be confounded with changes in credit demand that co-move with real estate values as well as changes in credit supply. To address these endogeneity issues, we use a two-pronged approach. First, we create exogenous changes in market-level commercial real estate prices using real estate supply elasticities constructed by Saiz (2010) as instruments for real estate values. Second, we exploit the detailed bank-borrower data set to decompose changes in bank lending into borrower-specific loan demand factors and lender-specific credit supply factors following Amiti and Weinstein (2018). Such a decomposition allows us to identify the collateral channel separately from other credit allocation channels. In particular, we show that bank-level credit supply shocks affect credit constrained borrowers more than less constrained borrowers. Furthermore, bank lending is significantly more sensitive to the credit demand conditions of unconstrained borrowers than the credit demand conditions of more constrained borrowers.

The next step in our identification strategy is to characterize the determinants of the choice of pledging real estate collateral, which we then use as controls in our estimation. We establish several stylized facts on the use of real estate collateral. First, the use of real estate collateral is higher in price-inelastic markets that are more likely to experience rapid appreciation in real estate values in economic expansion periods. Second, we establish that firms with higher shares of fixed assets are more likely to pledge real estate collateral following increases in real estate values. Third, we document that smaller, bank-dependent firms are significantly more likely to pledge real estate as compared with large firms that have access to market-based funding. Fourth, the use of real estate collateral declines monotonically with firm size. We document that, on the margin, as firms increase in size, the use of real estate collateral is replaced with the pledging of accounts receivables and inventories. This is consistent with larger and older firms having longer histories and more predictable tangible cashflows that can be pledged, whereas smaller and younger firms being more opaque to external investors in their ability to generate pledgeable income. Fifth, consistent with the stylized facts in Lian and Ma (2021), we find that large, publicly traded firms are more likely to use earnings based types of collateral or be subject to no collateral requirements. However, unlike the universe of publicly traded firms, in our sample, close to 60 percent of borrowers use asset-based forms of collateral and 28 percent of borrowers pledge real estate.

We identify the magnitude of the relaxation of borrowing constraints following increases in real estate collateral values. We find that a 1 percentage point increase in values contributes a 7 to 12 basis point annual increase in committed bank credit. Consistent with more binding credit constraints, we document that the collateral channel has a higher effect on high bank-dependent borrowers. Our micro-level estimates also show a clear rank order of tightness of borrowing constraints based on collateral use. Borrowing constrains are progressively relaxed for firms that pledge fixed assets, blanket liens, cash and securities, and accounts receivable. Firms that are able to borrow on an unsecured basis have the highest growth in credit. All else being equal, firms that pledge real estate collateral are the most constrained, if those firms operate in markets in which collateral values remain stagnant or decline. In contrast, firms that pledge real estate collateral in markets with the largest appreciation of real estate collateral experience the largest relaxation of borrowing constraints.

Apart from increases in bank credit, the collateral channel also manifests itself in reductions in credit spreads and increases in the maturity of newly originated loans. However, higher collateral values do not have a statistically significant effect on banks' expected default probabilities or loss given default, because, on the margin, the higher value of collateral is counterbalanced with firms borrowing more and increasing their leverage.

We document that the relaxation of borrowing constraints has significant real effects both at the firm level and at the market level. At the firm level, the increases in bank credit and the reductions in the cost of credit allow firms to increase investment and grow in size. A 1 percent increase in real estate values increases investment expenditures of bank-dependent firms by about 7 basis points and asset growth by about 9 basis points. Although the firm-level effects are concentrated in small bank-dependent borrowers, they are economically important for the aggregate. We find that the collateral channel has the largest effect on economic activity in geographic markets with high shares of bank-dependent borrowers that pledge real estate collateral. The relaxation of borrowing constraints increases overall bank credit in a geographic area, reduces the unemployment rate, and stimulates growth in employment and establishments. Our estimates imply that, following a 1 percentage point increase in real estate values, the median market experiences about a 0.8 basis point decrease in unemployment rate, about a 14 basis point increase in total employment, and a 4 basis point higher growth rate in the number of business establishments. Consistent with the relatively smaller firm-size distribution and higher bank dependence of non-tradable firms, we document significant improvements in employment growth at firms in the non-tradable sectors in markets with increasing collateral values. The collateral channel also affects the growth in the number of small establishments mainly in the non-tradable sector employing between 1 and 9 individuals. We also find evidence for significant effects of collateral channel on the growth in the number of medium-sized establishments in the tradable sector.

A large theoretical literature explores the role of the collateral channel for macroeconomic fluctuations such as Barro (1976), Stiglitz and Weiss (1981), Bernanke and Gertler (1989), Hart and Moore (1994), Kiyotaki and Moore (1997), Holmstrom and Tirole (1997), Bernanke et al. (1999), and Miao and Wang (2018). This theoretical work is unambiguous and places the collateral channel as a main amplification mechanism for aggregate fluctuations. Increases in asset values boost firms' net worth and expands borrowing capacities leading to significant increases in aggregate activity. However, the empirical analysis on the role of the collateral channel has been less clear cut. One of the first empirical studies based on micro-level data is Gertler and Gilchrist (1994), who study the effects of monetary policy on credit to small manufacturing firms, providing indirect evidence for the role of the collateral channel. Their findings are consistent with the collateral channel because small manufacturing firms experience a larger contraction in credit following a monetary policy tightening and reduction in real estate collateral values.

Chaney et al. (2012) examines the effects of changes in value of commercial real estate holdings of large publicly traded companies on investment. They estimate an increase in investment of six cents for every dollar increase in the value of a firm's commercial real estate. This empirical finding has been replicated by a number of more recent studies that use the same sample of publicly traded firms. For example, Cvijanovic (2014) documents that changes in real estate values have persistent effects on firm leverage and capital structure. Similarly, Campello et al. (2021) estimate the sensitivity of corporate investment and capital structure to changes in real estate values taking into account the location of companies' real estate holdings. The effects of the collateral channel have been documented in a few studies that use non-U.S. data. Gan (2007) documents the effects of the collateral channel on firm investment decisions following the real estate price collapse in Japan in the early 1990s. Banerjee and Blickle (2021) study the positive relationship between changes in housing prices and the growth of small firms across European countries. They find that these correlations are significantly higher for more opaque borrowers and in countries with more complex and costlier bankruptcy resolution.

Lian and Ma (2021) documents that most publicly traded firms do not use real estate as collateral even if the firm owns real estate properties. Instead, most large firms have debt contracts that are unsecured or use earnings-based collateral, whose recovery value depends on the continuation value of the firm. One potential reason for the low use of tangible assets as collateral is that the bankruptcy code in the United States makes it harder to liquidate the assets of large corporations and instead restructurings are the preferred method of bankruptcy resolution. Furthermore, Benmelech et al. (2020) document a secular decline in the share of secured debt by publicly traded firms citing a number of factors behind these trends including financial and technological improvements that reduced uncertainty regarding repayments of debt. Kermani and Ma (2020) examine cross-sectional factors behind the choice of asset-based or cash-flow based collateral use by public firms including the role of liquidation values and lender monitoring. Rampini and Vishwanathan (2020) highlight an important distinction between secured debt and unsecured debt. Secured debt uses explicit collateral, whereas unsecured debt is a claim on the unencumbered assets of the firm and thus implicitly collateralized. Although explicitly collateralized debt is costlier, it enables higher borrowing capacity. Therefore, constrained firms are more likely to issue collateralized debt. In our context, pledging of specific assets is also optimal for the bank, because an increase in the value of a pledged asset would accrue exclusively to the bank in the case of borrower default, whereas an increase in the value of unencumbered assets not explicitly pledged to the bank would be diluted across all debt holders, leading to a more uncertain debt recovery in bankruptcy. Therefore, the effect of the collateral channel on firm borrowing constraints are more likely to be identified, if the pledging of collateral is observed in the data. This is consistent with our empirical findings. We document that high bank-dependent borrowers are more likely to pledge asset-based collateral including commercial real estate, whereas publicly traded borrowers with access to the corporate bond markets are more likely to obtain bank credit that is unsecured.

A number of studies have also examined bank lending to small bank-dependent firms using bank-firm-loan level data. However, none of these studies use data that has information on all three components needed to identify the effects of the collateral channel—the collateral use, the credit demand condition of the borrower, and the credit supply condition of the lender— and, therefore, the evidence provided in these studies for the effects of the collateral channel is indirect. Berger and Udell (1990) study the role of collateral using the Federal Reserve's Survey of Terms of Business Lending (STBL) and document that riskier borrowers are more likely to pledge real estate collateral. Glancy (2021) uses loan portfolio data from the Community Reinvestment Act to show how real estate losses on banks' books affected the supply of credit and employment for young firms and bank-dependent industries during the Great Recession. Our paper is also not the first to use FR Y-14Q data to study bank lending to private firms. For example, Luck and Santos (2019) examine how the use of different collateral types affects the interest rates on bank loans. Caglio et al. (2021) study the effect of monetary policy on bank risk-taking behavior and how changes in policy rates affect access to credit through different collateral constraints. Chodorow-Reich et al. (2021a) examine how banks set price and non-price terms on credit facilities across the size distribution of firms. They document that while large firms were able to draw on their credit lines during the pandemic, small firms were significantly more restricted in their access to bank credit and relied more on government programs such as the Paycheck Protection Program (PPP). However, none of these studies examines the role of the collateral channel for bank credit allocations and economic outcomes.

The role of the collateral channel for economic fluctuations has been challenged by empirical studies by Mian and Sufi (2011) and Mian and Sufi (2014), who argue that the main transmission channel of financial shocks to the real economy during the Great Recession was the significant reduction in aggregate demand driven by declines in household net worth. These empirical studies document that the reduction in house values was a primary driver of unemployment, whereas the tightening of firm borrowing constraints was a less likely cause. Greenstone et al. (2020) use data from the Small Business Administration to examine the role of bank lending during the Great Recession and document that small businesses were less likely to switch lenders and were disproportionately more likely to be credit constrained following a credit supply shock affecting their bank. However, Greenstone et al. (2020) document that the restricted access to credit for small businesses did not have a significant effect on economic activity. In contrast, Adelino et al. (2015), which use the County Business Patterns (CBP) data, document that small businesses in geographic markets with greater increases in house prices experienced stronger growth in employment than large firms in the same areas and industries. They attribute this finding to the workings of the collateral channel that explains 15 to 25 percent of employment variation across geographic markets. However, none of these studies provide direct evidence for the presence or lack thereof of the collateral channel. In contrast, our analysis provides direct evidence for the workings of the collateral channel and its manifestation in both quantities and prices of credit as well as in its real effects on investment, employment, and establishment growth. Our estimates imply that as much as 37 percent of employment variation over our sample period from 2013 to 2019 can be attributed to the relaxation of borrowing constraints and increases in bank credit to high bank-dependent borrowers.

We organize the remainder of our paper as follows. In section 2, we describe the data sources and our sample construction. In section 3, we develop our empirical framework and identification strategy. In section 4, we describe different approaches to control for endogeneity. In section 5, we present the estimation results and discuss their economic importance. In section 6, we provide more details on the economic significance of our estimates and their implications for the role of the collateral channel during the COVID-19 pandemic. We conclude in section 7.

2 Data

Our analysis is based on data collected by the Federal Reserve for the purposes of the annual Dodd-Frank Act Stress Test (DFAST) and the Comprehensive Capital Analysis and Review (CCAR). Schedule H1 of the FR-Y14Q report collects detailed loan-level and borrower-level information on the commercial and industrial (C&I) loans of the largest bank holding companies operating in the United States with total consolidated assets exceeding \$100 billion.[1] The data contain information on all corporate credit facilities with committed

[1] More detailed information is contained in the instructions to the FR Y-14Q reporting forms. Because of the confidentiality of the data, our analysis presents only aggregated results that do not reveal the identities of the individual banks or borrowers in our sample.

balances exceeding $1 million of both term loans and credit lines.[2] [3]

We restrict our sample to U.S. domiciled nonfinancial borrowers, for which we observe consistent balance sheet and income statement information. We also focus on borrowers that operate in one of 68 major metropolitan statistical areas (MSAs) for which we have commercial real estate prices and real estate supply elasticities, which we obtain from Saiz (2010). Our final analysis sample spans the period from 2013:Q1 to 2019:Q4 and consists of 32 bank holding companies, 92,069 borrowers across 68 MSA-level markets. For the analysis in section 6, we extend our sample to 2021:Q1 to cover the COVID-19 pandemic.

Insert Table 1.

Panel A of Table 1 provides summary statistics of the borrower characteristics in our sample. The median firm has total assets of about $17 million, which is significantly smaller than a publicly traded firm. For example, the median publicly traded firm in Compustat has total consolidated assets close to $900 million, and the median firm that obtains credit through loan syndication recorded in DealScan has total assets of $2.4 billion. Compared with those data sets, our sample is representative of small and medium-sized enterprises. Borrowers with $6 million in total assets make up 25 percent of our sample, and 5 percent of our sample are firms with total assets of $2 million or less.[4]

The median firm obtains about $4 million in committed bank credit, which could be either in the form of a credit line or a term loan. Because larger firms are more likely to obtain credit lines, the average committed amount on credit lines is more than twice the size of a term loan. The average utilization rates of credit lines are about 50 percent,

[2]The $1 million leaves a large number of very small borrowers. Bank lending to those borrowers is reported in a separate schedule–FR Y-14Q Schedule A. This schedule, however, collects only loan portfolio data with no individual borrower information or information on the use of collateral, which limits their usefulness for our analysis. Furthermore, those borrowers are likely to include the smallest businesses and sole proprietorship that are likely to pledge residential properties as collateral as proposed by Adelino et al. (2015). The loans in our sample are large enough, so that we can rule out that they are collateralized by the value of a house.

[3]The FR Y14Q distinguishes between C&I loans, which are reported in schedule H1, and commercial real estate (CRE) loans, which are reported in schedule H2. The commercial real estate properties, that are used as collateral in C&I schedule, are properties occupied by the owner. In constrast, all CRE loans are secured by properties that are eventually used for the purpose of generating rental income and are not owner occupied. Although our focus is on the FR Y-14Q H1 schedule, it does not contain well populated information on the market values of the properties used as collateral to construct reliable loan-to-value (LTV) ratios. To obtain such estimates, we use the H2 schedule, which contains information on the LTV at origination.

[4]To validate balance sheet and income statement information for the largest firms in FR Y-14Q, we use Compustat data. For the small and non-public companies, we rely on reports submitted by the banks. We employ a multi-step procedure described in the appendix to construct and validate the data. See our data appendix A for further details on our data construction.

with more than a quarter of credit lines remaining fully undrawn. In addition, banks report the expected utilization at default, which takes into account covenants and other contractual characteristics of credit lines that would allow a firm to utilize its credit lines even in distress. The average expected utilization at default is about 73 percent, indicating a significant additional borrowing capacity for firms that have credit lines.

For the average borrower bank credit forms around half of overall liabilities. We define high bank-dependent borrowers as all non-publicly traded firms whose bank credit comprises more than 50 percent of their reported liabilities. High bank-dependent borrowers comprise close to 45 percent of our sample.[5] In terms of credit risk, the median firm in our sample has a bank-assessed internal credit rating that corresponds to an S&P credit rating of BB. Banks also report expected probability of default (PD) and expected loss given default (LGD) for each loan. The median loan in our sample has an expected PD of 70 basis points and an LGD of 34 percent.[6] Finally, the average debt-to-asset ratio of firms in our sample is 60 percent.

Panel B summarizes information on the average characteristics of banks in our sample based on FR Y-9C data. Our sample contains the largest banking holding companies that become subject to enhanced capital and liquidity regulation in the period following the Great Recession. All banks operate with common equity tier 1 (CET1) capital well above the regulatory requirements under the Basel III capital requirements. Similarly, banks in our sample have large stocks of high-quality liquid assets (HQLA) and comply with the liquidity coverage ratio (LCR) requirement with significant liquidity buffers. The average bank originated about $90 billion in C&I credit to about 3,400 borrowers and operated in about 60 out of the 68 markets in our sample. Banks have geographically diversified loan portfolios with an average Herfindahl–Hirschman (HHI) index of about 7 percent. The largest market share in a single geographic area is, on average, 21 percent of a bank's portfolio and the share of the largest three markets is 34 percent. If we group markets based on the quartiles of the real estate supply elasticities, about 40 percent of bank credit is allocated to the lowest quartile, and 16 percent are allocated to the highest quartile, indicating larger credit allocations to the low supply elasticity markets.

The real estate supply elasticities from Saiz (2010) are based on the topography of a geographic area that takes into account the presence of large bodies of water or steep terrains that make additional land development and construction increasingly costly. We combine information on supply elasticities with quarterly market-level commercial real estate prices

[5] Our definition of high bank dependence takes into account the unused portion of credit lines. We define the total credit of a firm as the sum of all of its on-balance sheet liabilities, funded bank loans and other corporate debt, and the unused portion of credit lines. We also classify borrowers with missing information on total liabilities as high bank-dependent.

[6] Each bank uses its own internal credit rating system. The loan-level internal credit ratings are mapped into S&P rating equivalents and aggregated to the firm level.

from CBRE Econometric Advisors. We construct an aggregate commercial real estate price index based on the prices of office, industrial, hotels, and retail properties. Panel A of Figure 1 shows the time-series variation in the commercial real estate price index across the 68 geographic areas in our sample. Over our sample period, the median market experiences about a 42 percent cumulative increase in commercial real estate prices. Markets with low supply elasticities experience larger price increases of about 51 percent, whereas prices in markets with low supply elasticities reach 41 percent cumulative appreciation over our sample period.

Insert Figure 1.

Table 2 provides further information on the 68 MSAs that are part of our sample. In panel A, we document that market-level bank credit grew by about 7 percent on an annual basis with some significant dispersion in growth rates across markets and over time. On average, the credit growth to high bank-dependent borrowers is higher and more volatile than the credit growth to low bank-dependent borrowers. Similarly, the decomposition of credit growth into credit supply and demand factors, which we describe in detail in section (4.3), reveals that the growth in credit demand by high bank-dependent borrowers is higher and more volatile as compared to the average growth and volatility of demand by low bank-dependent borrowers. In terms of loan volumes, about 80 percent of aggregate credit is to low-bank dependent borrowers. This significant share is explained by the fact that high bank-dependent borrowers, even if more numerous, are significantly smaller firms than low bank-dependent borrowers. When broken down by tradable and non-tradable sectors, around 55 percent of high bank-dependent firms are in the non-tradable sector, compared to only 37 percent of low bank-dependent borrowers.

Insert Table 2.

Moving to panel B, the average market receives about $31 billion in credit from 28 banks in our sample. In comparison, C&I credit originated by small regional banks is less than $3 billion for the average market. For the average market, 86 percent of C&I credit comes from the sample of large multi-market banks indicating the importance of those banks for market-level bank credit. The within-market concentration of lending is also relatively low, with the HHI index at around 11 percent for the average market. In terms of supply elasticities, the average market has a supply elasticity of about 1.74. We define markets with a supply elasticity of less than 1, the bottom quartile, as low supply-elasticity markets, and those with a supply elasticity exceeding 2.35, the top quartile, as high supply-elasticity markets. Markets experience significant variations in the average annual growth rate in real estate prices. The annualized quarterly growth in commercial real estate prices is 6.4 percent for the average market with some notable cross-sectional and time-series variation. Some markets experience declines in commercial real estate prices, whereas other markets experience growth in prices that exceeds 15 percent.

Panel C documents the distributions of the market-level shares of firms that use the different collateral types that we observe in the data. The average share of real estate collateral is 21 percent with across market variation ranging from 9 percent for the 5th percentile market to 35 percent for the 95th percentile market. The second most common form of collateral is accounts receivable followed by blanket lien, non-real estate fixed assets, and cash and securities. For the average market, about 18 percent of firms obtain unsecured bank credit. We provide further details on those collateral types and their firm-level determinants in section (4.2).

We obtain information on market-level economic activity from the Quarterly Census of Employment and Wages published by the Bureau of Labor Statistics as well as the County Business Patterns (CBP) dataset published by the Census Bureau. Panel D shows summary statistics of the three economic activity measures—unemployment rate, growth in employment, and growth in establishments. The bulk of economic activity is concentrated in non-tradable sectors and in small establishments, which tend to be high bank-dependent borrowers. For example, the average market has 72 percent of employment and 77 percent of establishments in non-tradable sectors. Overall, employment and establishment growth in the tradable sector is twice as volatile as compared to the non-tradable sector. Small firms also represent a significant portion of employment with more than 70 percent of establishments employing no more than 9 employees. In most markets, around a quarter of establishments have between 10 and 99 employees, and less than a percent of establishments have more than 500 employees. Finally, it is worth highlighting that our sample period from 2013:Q1 until 2019:Q4 covers the recovery period from the Great Recession, and most markets experience improvements in their unemployment rates and positive growth in employment and establishments. However, there is significant heterogeneity in those growth rates in the cross section of markets and around one-fourth of our sample includes periods in which some markets experience declines in total employment and establishment growth.

3 Empirical framework

3.1 Conceptual framework

To motivate our empirical analysis, consider a geographic area hit by a temporary positive aggregate demand shock. Following the shock, real estate values increase, expanding the borrowing capacity of credit-constrained firms that pledge real estate as collateral. The higher borrowing leads to stronger asset demand and further increases in collateral values. In addition, agents revise up their expectations about future borrowing capacity and asset demand, and those revised expectations further increase collateral values in the current period. This is the standard inter-temporal feedback loop channel between asset prices and borrowing capacity described in Kiyotaki and Moore (1997).

Our empirical framework takes this aggregate channel as given and examines the behavior of a credit-constrained firm f, which pledges $K_{f,m,t}$ units of real estate located in market m and priced at $P_{m,t}$ to obtain a loan from bank b. Our analysis relies on the assumption that the representative firm in our sample is small enough that its asset demand and pledging of collateral do not affect the price of collateral. The borrowing constraint that the firm faces has the following form

$$L_{b,f,m,t} \leq \delta_{b,m,t} \times \underbrace{P_{m,t} \times K_{f,m,t}}_{\text{Market value of collateral}} . \tag{1}$$

The credit constraint indicates that the borrowed amount $L_{b,f,m,t}$ from bank b cannot exceed the market value of the firm's real estate collateral. A departure from original framework is that we observe the credit allocation decisions of banks that operate in multiple geographic areas. Each geographic area has its own asset price dynamics and investment opportunity set. We assume that a bank follows a credit policy summarized by a LTV ratio $\delta_{b,m,t} \in (0, 1]$ that may vary with the bank's liquidity and capital constraints, or its monitoring activity in the market. Banks' credit policies $\delta_{b,m,t}$ could also depend on the opportunity cost the bank faces in lending to firms in market m and that opportunity cost could be determined by the lending opportunities in the other markets the bank operates in. In our empirical analysis, we control for such allocation mechanisms by exploiting the richness of the bank-firm-market data.

The credit constraint is binding if the market value of the firm's collateral is low relative to the firm's loan demand (marginal product of capital), or if the firm faces restrictive credit supply policies of the bank.[7] The credit constraint can be modified to include other forms of asset-based or earnings based collateral, which, however, would not be directly related to

[7] See Appendix B for further description of the determinants of the firm's borrowing relative to its investment opportunity set, the credit supply policies of the bank, and the value of its collateral.

the value of real estate. In our empirical specification, we control for the presence of other forms of collateral and identify the changes of borrowing capacity due to the pledging of real estate and changes in real estate values relative to those alternative forms of collateral a firm could have pledged.

3.2 Identification of the collateral channel

Our empirical framework aims to identify the average sensitivity of firms' borrowing capacities defined in (1) to changes in the value of collateral

$$\begin{aligned}\Delta L_{b,f,m,t} = \theta_0 \mathbb{I}\{\text{Real estate}_{f,b,m,t}\} + \theta_1 \Delta^c P_{m,t} \times \mathbb{I}\{\text{Real estate}_{f,b,m,t}\} + \\ \Theta' \mathbb{I}\{\text{Non-real estate}_{f,b,m,t}\} + \Gamma' \mathbf{X}_{f,t-1} + \phi_f + \gamma_\alpha \alpha_{f,t} + \delta_{b,m,t} + \epsilon_{f,b,m,t}.\end{aligned} \tag{2}$$

The left-hand side variable $\Delta L_{f,b,t} = \frac{L_{f,b,t} - L_{f,b,t-1}}{L_{f,b,t-1}}$ is the year-over-year growth in bank credit of firm f located in market m borrowing from bank b. $\Delta^c P_{m,t}$ is the cumulative growth in commercial real estate prices. The indicator $\mathbb{I}\{\text{Real estate}_{f,b,m,t}\}$ equals to one, if the borrower pledges commercial real estate as collateral, and zero otherwise. We also include as controls a vector of dummy variables for the use of other forms of collateral that are not real estate $\mathbb{I}\{\text{Non-real estate}_{f,b,m,t}\}$. This allows us to gauge the relative importance of real estate collateral for credit growth vis-à-vis other forms of collateral. The coefficient θ_0 quantifies the relationship between the pledging of real estate collateral and the firm's credit growth relative to other forms of collateral. The coefficient θ_1 captures the sensitivity of bank credit to changes in collateral values and is one of our main objects of interest.

Because our empirical specification absorbs bank-market-time variation through the fixed effect $\delta_{b,m,t}$, we control for macroeconomic factors, as well as bank-specific and bank-market-specific credit supply conditions. Therefore, we are left to explain an across-firm and within-firm variation. Our empirical specification compares two firms located in the same market and borrowing from the same bank. One firm pledges real estate collateral and the other firm pledges a different form of collateral or borrows unsecured. We expect θ_1 to be positive, because firms pledging real estate collateral benefit from the relaxation of borrowing constraints when collateral prices increase. An alternative interpretation is to examine the regression from the perspective of the cross section of markets. The regression specification compares two firms borrowing from the same bank but each firm operates in a different market with different cumulative changes in real estate values. The coefficient θ_1 captures the additional relaxation of credit constraints for firms in markets with higher collateral values. Finally, the regression compares the same firm over time. In some periods, the firm is not pledging real estate but in others it pledges real estate collateral. The additional borrowing capacity of the firm pledging real estate is captured by the combined effect of using real estate as collateral and the collateral value at the time of pledging $\theta_0 + \theta_1 \Delta^c P_{m,t}$.

The coefficient θ_1 is a function of an extensive margin—the mass of credit constrained firms—and intensive margin—the degree to which credit constraints are binding. Therefore, a test on the statistical significance of θ_1 is a test for the presence of credit constrained firms that use real estate collateral to relax borrowing constraints. Second, the magnitude of the θ_1 captures both the mass of credit constrained firms and the degree to which collateral constraints are binding. We expect θ_1 to be larger for the sample of borrowers that are more credit-constrained, as those firms experience a higher relaxation of borrowing constraints following increases in collateral values. We do not directly observe the degree to which credit constraints are binding in the cross-section of firms and over time. However, we expect this coefficient to be larger for high bank-dependent firms, because, by definition, those firms are likely to have limited access to other forms of external financing and be more constrained.

The degree to which credit constraints are binding also depends on credit demand. All else being equal, firms with a higher marginal product of capital and, hence, higher loan demand are more likely to be credit constrained as compared with firms without good investment opportunities. To control for loan demand, we include a credit demand factor $\alpha_{f,t}$ based on Amiti and Weinstein (2018) decomposition. Furthermore, we control for lagged observable firm characteristics $\mathbf{X}_{f,t-1}$ that incorporate several measures of firm creditworthiness, such as leverage, investment-grade status, the share of fixed assets, and profitability measured by return on assets. We also use firm fixed-effects ϕ_f to condition on unobservable and time-invariant firm characteristics.

The credit supply conditions could also lead to restrictions of credit that could be observationally equivalent to binding collateral constraints. We use bank-market-time fixed effects $\delta_{b,m,t}$ to absorb credit supply effects including the role of banks' internal capital markets in allocating credit across geographic markets. The market-time dimension of $\delta_{b,m,t}$ controls for local economic conditions and also allows us to compare borrowers across markets that obtain credit from the same bank but each each borrower experiences different changes in its collateral values as discussed above.

We use the same regression framework to also examine the effects of relaxation of collateral constraints on firms' investment decisions and asset growth. We also explore the effect of the real estate values on the terms of newly originated credit facilities such as the credit spread, the maturity, the bank-reported expected loss given default (LGD), and the expected probability of default (PD).

To quantify effects of the collateral channel on macroeconomic outcomes, we aggregate the micro-level empirical specification to the market level. We exploit the large heterogeneity in the cross section of market characteristics documented in Table 2 to identify those aggregate effects. In particular, the regression framework for this analysis takes the following form

$$\begin{aligned}Y_{m,t} =& \theta_0^m \text{Share real estate}_{m,t-1} + \theta_1^m \Delta^c P_{m,t-1} \times \text{Share real estate}_{m,t-1} + \\ & \Theta^{m\prime} \text{Share non-real estate}_{m,t-1} + \gamma_\beta^m \beta_{m,t} + \gamma_\alpha^m \alpha_{m,t} + \mu_m + \tau_t + \epsilon_{m,t}^m.\end{aligned} \quad (3)$$

The aggregation to the market level transforms the firm-level collateral use indicators into shares of firms pledging a particular type of collateral as summarized in panel C of Table 2. Those shares represent the relative composition of collateral constraints faced by borrowers in each market. Following Amiti and Weinstein (2018), we aggregate the firm-level credit demand factor $\alpha_{m,t}$ using the loan amounts at time $t-1$ as weights. We similarly construct a weighted average credit supply factor $\beta_{m,t}$ at the market level. Finally, to control for unobservable market-level effects and macroeconomic conditions, we use market and time-fixed effects, respectively. With those controls in place, our identification strategy relies on examining the cross section of markets. Markets with higher shares of firms that pledge real estate collateral are expected to experience a larger relaxation of borrowing constraints following increases in collateral values and this expanded borrowing capacity is expected to allow for increases in employment and business creation. We consider market-level outcomes $Y_{m,t}$ such as credit growth, unemployment rates, growth rates in employment and business creation. We identify the collateral channel as the sensitivity of the outcome variable to the share of firms that pledge real estate collateral and the interaction of this share with the instrumented commercial real estate values.

4 Endogeneity concerns and solutions

4.1 Commercial real estate values

The main endogeneity issue in identifying the coefficients of interest in equation (2) is that firm loan demand and collateral values could be jointly determined by local economic conditions. Therefore, the ordinary least squares (OLS) coefficient estimates would pick a positive correlation between collateral values and bank lending even without the presence of credit constraints.[8] In other words, the OLS estimate of θ_1 would be positively biased if such associations are not controlled for.

We address this concern by using Saiz (2010) supply elasticities as instruments for commercial real estate values. This instrument has been applied in a number of studies

[8]See Appendix B for further illustration of this point.

such as Himmelberg et al. (2005), Mian and Sufi (2011), Chaney et al. (2012), Adelino et al. (2015), and Campello et al. (2021). Compared with the existing literature, which has relied mainly on house prices, our work relies on commercial real estate prices, which are more likely to be relevant for corporate borrowers in our sample. Figure 2 shows the supply elasticities across the geographic areas in our sample. Coastal areas and areas close to mountains have significantly lower supply elasticities and are shown in dark red. Those lower supply elasticities indeed translate into notable differences in real estate prices between low and high elasticity markets as shown in Figure 1.

Insert Figure 2.

The real estate supply elasticity measure is a static characteristic of a geographic area. We create time-series variation in the local demand for real estate properties by interacting the supply elasticity with the 30-year national mortgage rate similar to Chaney et al. (2012). Lower mortgage rates increase demand for real estate properties. In markets with high supply elasticities, the higher demand translates into a higher supply of properties, whereas in the low supply elasticity markets higher demand translates into higher prices. We capture this mechanism through our first-stage regression, which takes the following form

$$\Delta^c P_{m,t} = \mu_m + \beta \times \text{Elasticity}_m \times \text{30Y-Mortgage rate}_t + u_{m,t}, \tag{4}$$

where μ_m are market fixed effects. The interaction of the mortgage interest rate and the supply elasticity identifies the differential price response across markets with different supply elasticities to common interest rate movements. The results of the first-stage regression are summarized in Table 5. In column (1), we show the coefficient estimate of our baseline specification, which implies that a 100 basis point decrease in mortgage rates leads to a 5 basis point increase in the prices of commercial real estate properties. To account for nonlinearity, in specifications 2, we fit a linear spline function with different slope coefficients for the lowest quartile, the interquartile range, and the upper quartile. As expected, markets with lower supply elasticities have higher sensitivities to changes in interest rates. Specifically, for a 100 basis point decrease in mortgage rates, markets with supply elasticities in the lowest quartile experience an average price appreciation of 18 basis points, whereas high supply-elasticity markets appreciate by less than 4 basis points. Based on the goodness-of-fit and F-test statistic, we pick the nonlinear model in column (2) as our preferred specification.

Because most papers in the literature use house prices, it is useful to compare our estimates based on the commercial real estate prices to the estimates based on the FHFA house prices. Columns (3) and (4) of Table 5 present the results of the baseline specifications using house prices. First, the coefficient estimates reveal that house prices are notably less sensitive to changes in aggregate interest rates as compared to commercial real estate prices, and especially in the low supply-elasticity markets. Following a 100 basis point decrease in mortgage rates house prices increase about 12 basis points compared with the 18 basis points increase in commercial real estate prices. Second, in terms of model fit as measured by the F-test, the regressions with commercial real estate prices dominate the house price regressions, further validating the use of commercial real estate prices in our analysis and the relevance of the Saiz (2010) supply elasticity instrument for commercial real estate prices.

Insert Table 5.

Panel B of Figure 1 presents the fitted commercial real estate prices based on specification (2) of Table 5. The fitted values do not have the upward trend in the underlying price indices. Consistent with differences in the slope coefficients between low and high supply-elasticity markets, the average gap in the commercial real estate values between low and high supply-elasticity markets is time-varying and varies between 1 and 6 percentage points over our sample period.

4.2 Use of real estate as collateral

A credit constrained firm would choose to pledge real estate as collateral if it is the optimal form of collateral that would allow the firm to expand its borrowing capacity. The borrowing capacity of the firm increases with the real estate values and, hence, higher real estate values should also increase the use of real estate collateral. However, the decision to pledge real estate collateral could also depend on the firm's investment opportunities and loan demand. Therefore, a positive association between the pledging of real estate, real estate values, and bank credit could reflect high loan demand and not necessarily the relaxation of collateral constraints. Therefore, to control for the endogeneity of the collateral choice, we begin by identifying a set of firm-specific, market-specific, and bank-specific factors that determine the decision to pledge real estate, and subsequently include these factors as controls in the baseline regression.

We first document that the use of real estate collateral is significantly influenced by the size of the firm. Figure 3 illustrates that the use of real estate collateral declines monotonically with firm size. Small firms rely heavily on real estate collateral with more than 60 percent of credit to the smallest asset size decile in our sample collateralized with real estate. As size increases, firms substitute away from real estate and increase the use of accounts receivable and inventories. This is consistent with the notion that small firms tend to be younger and have shorter and uncertain histories of generating tangible and pledgeable income in the form of accounts receivable and inventories that could be used as collateral. As firms grow in size, they also increase their income generating sources reflected in their customer relationships and accounts receivable. The third category of collateral is blanket lien, which gives the lender the power to seize and liquidate all assets that are not already encumbered by other liens. The use of blanket liens is relatively constant across the size distribution except for the largest firms. Borrowers in the top decile have more than 60 percent of bank credit in the form of unsecured loans, which is in stark contrast to the significant reliance on real estate collateral for very small firms but is in line with findings for large publicly-traded firms in Lian and Ma (2021).

Insert Figure 3.

We next put the choice of pledging real estate collateral in the broader context of the choice between asset-based or earnings-based collateral. Following the taxonomy of Lian and Ma (2021), we group collateral types into asset-based collateral and earnings-based collateral. Asset-based collateral includes real estate, accounts receivable and inventories, fixed assets other than real estate, and cash and securities.[9] Loans secured by asset-based collateral involve the pledging of specific assets, whose liquidation value determines the recovery value to the lender in case of default. We summarize the characteristics of borrowers that use asset-based collateral in Table 3. In contrast, earnings-based collateral involves unsecured loans or blanket-lien loans the recovery value of which is determined at default of the borrower by the residual value of the borrower's unencumbered assets or the value of the reorganized firm in a chapter 11 bankruptcy filing. Table 4 provides summary information on the borrowers that use cash-flow based collateral, which includes the use of blanket liens, unsecured loans, and other collateral that is not specific. Lian and Ma (2021) document that, for the sample of publicly traded firms, around 80 percent of debt contracts use earnings-based forms of collateral and only 20 percent of debt contracts are secured by specific assets. In contrast, in our data, 68 percent of borrowers use some form of asset-

[9]Although accounts receivable and inventories could be viewed as an earnings-based collateral, because those accounts involve the pledging of specific tangible assets, they are considered an asset-based collateral in Lian and Ma (2021). This classification is also consistent with the treatment of such collateral by bank supervisors as discussed in the Comptroller's Handbook OCC (2000).

based collateral and about 37 percent of borrowers use real estate collateral. If we subset our data to high bank-dependent borrowers, the use of asset-based collateral is significantly more prevalent consistent with previous studies on the use of collateral such as Berger and Udell (1990).

The firms that pledge real estate collateral are significantly smaller firms than borrowers that pledge other forms of collateral. The median firm that pledges real estate has $4 million in total assets, which is less than half of the size of the median firm that pledges accounts receivable and more than 15 times smaller than the median firm that borrows unsecured. Despite their small size, however, those firms have higher shares of fixed assets in total assets, lower share of accounts receivable, higher dependence on bank credit, and are also more likely to have a below-investment grade status. Even though the firms, that pledge real estate, are riskier borrowers, banks expect that losses given default on loans secured by real estate to be lower than losses on loans secured by other fixed assets or loans that are not secured. This is consistent with the idea that commercial real estate collateral is relatively easy to repossess in bankruptcy, and its value is easy to assess and is not specific to the business model of the borrower.

We model the choice of real estate collateral pledging in the following probit regression specification

$$\begin{aligned}\mathbb{E}\{\text{RE collateral}_{f,b,m,t}\} = \Phi(&\beta_1 \text{Elasticity}_m + \beta_2 \Delta^c \widehat{P_{m,t}} + \\ &\beta_3 \text{Share fixed assets}_{f,t-1} + \\ &\beta_4 \Delta^c \widehat{P_{m,t}} \times \text{Share fixed assets}_{f,t-1} + \\ &\Gamma' X_{f,m,t-1} + \zeta' Z_{b,m,t-1}).\end{aligned} \tag{5}$$

We control for market characteristics such as the real estate supply elasticity and the instrumented commercial real estate prices. We also include a set of firm controls. We do not measure directly the value of real estate nor what fraction of real estate assets remains unencumbered. Instead, we use the share of fixed assets in total assets as a proxy for the firms' available real estate assets. We also interact the share of fixed assets with the instrumented commercial real estate price to control for changes in networth due to changes in real estate values. As additional firm controls $X_{f,m,t-1}$, we include firm size, leverage, return on assets, the share of bank credit in firm's liabilities, and an indicator for high bank-dependence. Third, we control for bank characteristics $Z_{b,m,t-1}$ such as regulatory capital buffers above regulatory requirements, liquidity ratios, and the bank-market LTV ratios. These bank characteristics capture potential capital and liquidity constraints that banks face as well as differences in underwriting standards among banks and across markets.

The results of the analysis are summarized in Table 6. The first two specifications examine market characteristics only. Firms operating in geographic markets with lower supply elasticities are more likely to pledge real estate as collateral. The use of real estate collateral also increases when interest rates are low. However, higher prices of real estate do not increase the pledging of real estate. In fact, the coefficient estimate of the instrumented commercial real estate price is negative in (2). In specification (3), we can see that a necessary condition for a positive effect of prices on real estate collateral use is if the firm has a sufficiently high share of fixed assets. This is consistent with the fact that only firms that own real estate collateral can take advantage of higher real estate values. Higher shares of fixed assets are both a predictor for the ownership of real estate and its use as collateral. The use of real estate collateral is concentrated in smaller firms and declines with firm size as already shown in Figure 3. Furthermore, firms that rely more on bank credit, use more leverage, and have lower profitability, all of which suggests higher credit risk and tighter credit constraints, are more likely to pledge commercial real estate collateral.

Finally, in specification (4), we examine the role of bank characteristics. Conditioning on bank capital and liquidity, looser credit policies in terms of higher LTV ratios in a market lead to higher use of real estate collateral. Examining the log-likelihood ratios of the different specifications as a measure of the goodness-of-fit, we can see that adding firm characteristics leads to significantly higher log likelihood ratios. Introducing bank controls only marginally increases the log-likelihood ratio. Therefore, in our baseline empirical estimation we focus on those firm-level controls as predictors of real estate collateral use and apply bank-time fixed effects as controls for underwriting policies. In addition, as we discuss next, we also condition on the firm loan demand factors and credit supply conditions.

Insert Table 6.

4.3 Controls for credit supply and demand

Our second approach to address the endogeneity problem of our baseline regression framework is to control for firm loan demand and bank credit supply conditions. We adopt the methodology of Amiti and Weinstein (2018), which generalizes the fixed effects approach of Khwaja and Mian (2008), and decomposes growth in bank credit into idiosyncratic credit demand and credit supply factors. To make this decomposition operational, we need to adapt the original framework to our data. Unlike the Japanese firm-bank dataset used by Amiti and Weinstein (2018), most bank-dependent firms in FR Y-14 have a single bank relationship. As a result, we cannot identify the demand factors for the majority of borrowers in our data. To incorporate those borrowers in the analysis, we assign borrowers into groups based on geographic location, 2-digit NAICs industry code, investment-grade status, and high or low bank dependence.[10] We assume that all firms within a group have a common credit demand process. The characteristics of the groups are chosen with the purpose of isolating credit demand that is driven by the location of the firm and its industry, which allows us to pick up differences in the marginal product of capital across geographic areas and industries. The last two characteristics are related to the degree to which the firms are credit constrained because of their elevated credit risk or lack of access to nonbank credit.

To see how the decomposition works, suppose that firm f belongs to group i, then we assume that the growth in lending for that firm can be be decomposed into group i common demand factor $\alpha_{i,t}$ and bank supply factor $\beta_{b,t}$

$$\Delta L_{f,b,m,t} = \alpha_{i,t} + \beta_{b,t} + \xi_{f,b,m,t}, \tag{6}$$

such that for all firms $\{f_1, ..f_k\} \in i : \alpha_{f_1} = \alpha_{f_2} = .. = \alpha_{f_k} = \alpha_{i,t}$. The residual $\xi_{f,b,m,t}$ contains all the remaining bank-firm-market specific variation in bank credit including the effects of collateral use, collateral values, and bank credit policies across markets. For example, the decomposition does not model how a bank would allocate its extra lending capacity to the existing borrowers or to new lending relationships. If there are no frictions, all markets and firms the bank lends to in period $t-1$ will experience the same growth in lending equal to the bank's supply shock $\beta_{b,t}$. However, if bank's credit allocations are driven by additional variables such as the price of collateral, those factors would be captured by the residual term $\xi_{f,b,m,t}$ and our baseline regressions. Similarly, if a firm or groups of firms experience a positive demand shock, those firms will increase their borrowing from all banks in proportion to the demand shock. Therefore, any substitutions of borrowing across the different lenders including due to borrowing constraints would remain in the residual and be captured by our empirical framework.[11] Furthermore, the grouping of firms based on the degree to which a firm is bank-dependent or whether it has an investment-grade status allows us to distinguish between more credit constrained firms for which substitutions across different lenders are harder and less constrained firms for which such substitutions are easier. As we will see in the empirical results, banks have different sensitivities to credit demand across the two groups of borrowers validating these groupings.

[10]This is similar to the approach taken by Degryse et al. (2019) who apply the Amiti and Weinstein (2018) decomposition to credit registry data from Belgium. To generate a time-invariant groups, we use the average credit rating and the average bank dependence for a firm throughout the sample.

[11]See the online appendix of Amiti and Weinstein (2018) for discussion on how this framework incorporates Khwaja and Mian (2008) procedure and other methodologies as special cases. See appendix A for more details on the construction.

5 Estimation results

5.1 Firm-level effects of the changes in collateral values

We present a summary of the estimates of our baseline specification (2) in Table 7. The first three columns are based on an OLS estimation. The last three columns present regression results using the instrumented commercial real estate price indices. To simplify the notation and the interpretation of the economic magnitudes of the estimates, we have expressed the price indices in decimals as in Figure 1, whereas the growth in lending is expressed in annualized percentage points. Therefore, the estimate of θ_1 in column (1) implies that a 1 percentage point appreciation in the commercial real estate prices results in about 14 basis points higher annual growth in credit.

Although the OLS regression controls for loan demand, this control may not completely purge associations between loan demand and commercial real estate values. There could still be a positive bias in the θ_1 estimate due to the correlation between real estate values and loan demand. Comparing the OLS estimates in column (1) with the IV estimates in column (4), we observe that indeed the sensitivity of bank lending to collateral values declines by half. The IV estimate implies that, on average, lending increases by about 7 basis points for every percentage point increase in real estate values for firms that pledge real estate collateral.

The specifications in columns (2) and (5) include the borrowers' share of fixed assets and the interaction of this share with the price index. The OLS estimate uncovers that, on average, a percentage point increase in the price index leads to about a 3 basis point increase in borrowing for a firm with 50 percent share of fixed assets. However, the effect disappears once we introduce the IV estimation in column (5) or reintroduce the real estate collateral terms in columns (3) and (6). This confirms that collateral values impact firms' borrowing capacity through the pledging of real estate collateral and not necessarily through a broader net worth channel based on the asset composition of the firm.

Similar to the reasoning in Rampini and Vishwanathan (2020), when a specific asset such as real estate is pledged, any increase in the collateral value would accrue exclusively to the bank in the case of borrower default. In contrast, any increase in the value of an unencumbered real estate asset or any other fixed asset not explicitly pledged to the bank would accrue to all debt holders in a bankruptcy. Pledging of a specific asset improves the expected recovery rate on the loan, and saves the bank costs associated with uncertainties and delays in assessing and liquidating unencumbered assets inherent in the bankruptcy process that general creditors have to go through. We interpret the evidence in columns (2) and (5) as capturing the collateral channel mechanism and highlighting the importance of observing the actual collateral used, similar to the arguments in Lian and Ma (2021).

Insert Table 7.

Our next specifications explore the extent to which credit constraints change the magnitude of the collateral channel estimates. Recall that we categorize all firms that are not publicly traded and have more than 50 percent of their committed credit coming from banks in our sample as high bank-dependent borrowers. We treat this sample as a set of borrowers that are more likely to be credit constrained and dependent on their bank for credit. In Table 8, we present results for sample splits based on low versus high bank dependence. Consistent with the hypothesis that high bank-dependent borrowers are more credit constrained, the coefficient estimates of θ_1 are economically and statistically larger for high bank-dependent borrowers. High bank-dependent borrowers experience larger relaxation of borrowing constraints compared with low bank-dependent borrowers following appreciation of real estate collateral. In the first two columns, the OLS estimates show that a 1 percentage point increase in real estate values increases the borrowing of high bank-dependent borrowers by 18 basis points compared with 12 basis points for low bank-dependent borrowers. Consistent with a positive bias of the OLS estimates, the IV coefficient estimates are smaller, but, nevertheless, still statistically and economically significant for high bank-dependent borrowers. A 1 percentage point increase in collateral values increases the borrowing of high bank-dependent borrowers by 10 basis points. The coefficient for low bank-dependent borrowers is 7 basis points and is no longer statistically significant. The coefficient estimates of the demand factor reveal further evidence for differences in credit constraints between high and low bank-dependent borrowers. Bank lending is almost three times more sensitive to the loan demand of low bank-dependent borrowers than it is for high bank-dependent borrowers.

It is also worth highlighting the coefficient estimates on some of the firm controls. For example, higher profitability as measured by the borrower's return-on-assets, lower leverage as measured by the borrower's debt-to-assets ratio, and an investment grade rating all increase borrowing. Let us compare the magnitude of the collateral channel effect to the effect of gaining an investment grade rating. All else being equal, a firm that has or obtains an investment grade rating has, on average, a 140 basis point higher bank credit growth than a firm that is below-investment-grade. A below-investment-grade high-bank dependent borrower that pledges real estate collateral would achieve the same relaxation of borrowing constraints equivalent to obtaining an investment grade rating, if its real estate collateral appreciated by about 14 percent.

Insert Table 8.

To further gauge the relative magnitude of the collateral channel, we examine the effect of other forms of collateral on bank lending growth and we also examine the growth in utilized amounts on credit lines. Table 9 summarizes results from this analysis where we extend the results of our baseline regression and those in Table 8 by including all six major types of collateral as controls. We show results for the full sample and the split between high and low bank-dependent borrowers. First, the magnitudes of the real estate collateral terms remain roughly unchanged from the previous regressions. The estimate of the collateral channel elasticity θ_1 is now higher at 12 basis points. Second, there is a clear rank-order in the sensitivity of bank credit to collateral types. Holding other things constant, borrowers that obtain unsecured loans are the least constrained and experience the fastest average growth in credit of about 11 percent. Pledging cash and securities, accounts receivable, or a blanket lien, lead to similar average growth rates of about 6 percent. Pledging fixed assets other than real estate leads to the lowest average growth of about 1 percent. Finally, pledging real estate collateral, keeping the growth in price of real estate unchanged, leads to about 3 percentage points growth in lending. This rank order of collateral constraints reveals that firms that pledge real estate collateral are relatively credit constrained compared with other asset-based collateral categories such as accounts receivable. This rank order is consistent with the patterns in Figure 3 showing that smaller firms, which tend to be more credit constrained, rely more heavily on real estate collateral to secure funding.

The last three columns of Table 9 examine the utilization of credit lines. Normally larger and investment-grade borrowers are able to obtain committed credit lines and such borrowers are less likely to be constrained. Furthermore, most credit lines are fully committed and borrowers can draw and repay those credit lines without much restrictions, if relevant covenants are satisfied. Because FR Y-14 does not contain information on the existing covenants, we cannot assess the degree to which a borrower's credit line drawdowns are constrained by covenants, and if covenants are more binding for high bank-dependent borrowers. Nevertheless, the estimates imply, that for low bank-dependent firms that pledge real estate collateral, changes in real estate values do not impact the utilization of credit lines. In contrast, high bank-dependent firms that pledge real estate collateral experience significant growth in utilized amounts due to higher real estate valuations. For every percentage point increase in real estate values, high bank-dependent borrowers increase utilized amounts on credit lines by about 60 basis points. This sensitivity could reflect both relaxation of covenants that govern the ability of firms to draw on credit lines and the general increase in committed credit to the firm. Consistent with utilization of credit lines absorbing credit demand conditions of firms, there is no significant difference in the sensitivity of utilized amounts to changes in the credit demand factor across the two groups of firms.

Insert Table 9.

Apart from the effects on loan amounts, the collateral channel could also affect price and non-price terms of loans. We next examine how collateral type and real estate values affect credit spreads, maturity, and expected losses on newly originated loans. Results of this analysis, shown in Table 10, reveal that higher collateral values reduce the cost of credit for firms that pledge real estate collateral. A 10 percent increase in real estate values leads to about a 5 basis point decline in credit spreads. Banks also increase the maturity of new loans to firms that pledge real estate collateral in markets experiencing an appreciation in collateral values. For every 10 percentage point increase in collateral values, banks increase the maturity of newly originated loans by about a month and a half. Somewhat surprisingly, the expected loss-given default and the expected probability of default are not sensitive to the collateral values. A likely explanation for this result is that the relaxation of borrowing constraints allows those firms to increase leverage. At the margin, the improvements in net worth due to higher collateral values of borrowers pledging real estate are counterbalanced with the increase in leverage. Consistent with the relative ease in repossessing and liquidating real estate collateral, pledging of real estate collateral reduces the expected loss given default about 3 percentage points. As a comparison, pledging accounts receivable and inventories or other fixed assets have a smaller effect on the loss given default. In contrast, unsecured loans increase the loss given default because the bank has a claim only on the unencumbered assets of the borrower, which it potentially shares with other lenders.

Insert Table 10.

Finally, we examine the effect of the collateral values on firm capital expenditures and asset growth. Table 11 reports the results of this estimation. Similar to the loan growth regressions, firms that pledge real estate collateral in markets with higher real estate values experience higher investment rates and the effect of the collateral channel is statistically significant for high bank-dependent borrowers. A 1 percent increase in real estate collateral values increases investment rates about 3 basis points for all firms and by about 7 basis points for high bank-dependent borrowers. Because this regression explains variation at the firm level, we drop the bank-market-time fixed effects and instead, following Amiti and Weinstein (2018), we include both the credit supply and demand factors in this regression. Credit supply has a significant effect on firm capital expenditures and especially for high bank-dependent borrowers. A 1 percent increase in the credit supply increases capital expenditures by about 1 basis point for all firms and for low bank-dependent borrowers, and by about 3 basis points for high bank-dependent borrowers. Those estimates provide further validation of our treatment of high bank-dependent borrowers as more credit constrained borrowers.

The last three columns of the table show the effects of the collateral channel on asset growth. Consistent with increased borrowing and higher capital expenditures, assets of high bank-dependent borrowers that pledge real estate collateral grow by about 9 basis points for every percentage point increase in collateral values. The effects of the collateral channel are statistically significant both for the full sample and for the sample of low bank-dependent borrowers, but at smaller magnitudes of about 6 basis points and 4 basis points, respectively.

Insert Table 11.

5.2 Market-level effects of collateral use and values

In this section, we examine whether the firm-level effects have measurable aggregate effects. To achieve identification, we explore the heterogeneity in aggregate outcomes at the market level. To gain intuition on how collateral values and the resulting bank credit allocations affect market-level outcomes, let us examine Figure 4. Panel A shows that in the cross-section of geographic markets, the cumulative bank credit is positively associated with the appreciation in commercial real estate prices. Furthermore, by the end of the sample period low supply elasticity markets have both notably higher commercial real estate prices as well as higher bank credit growth compared with low supply elasticity markets. Panel B reveals further that markets with low supply elasticities experienced larger increases in bank credit compared with markets with high supply elasticities. The divergence in cumulative credit growth exceeds 20 percentage points by the end of 2019. Finally, panel C shows the same comparison but restricting the sample to high bank-dependent borrowers. The figure reveals that high bank-dependent borrowers in low supply elasticity markets experienced larger increases in bank credit both compared with borrowers in high supply elasticity markets as well as compared with other borrowers in low supply elasticity markets. The divergence in cumulative credit growth for this group of borrowers across the two types of markets is even more stark reaching close to 60 percentage points by the end of 2019.

Insert Figure 4.

These plots suggest a strong association between commercial real estate prices and credit allocations and especially for high bank-dependent borrowers. These aggregate relationships are consistent with our firm-level findings in the previous section. We next turn to our regression framework (3) to more formally assess the role that collateral channel plays in generating those credit allocations and resulting economic activity outcomes.

We begin by estimating the aggregate regression framework (3) with aggregate market-level credit as an outcome variable. Results from the estimation are summarized in Table 12. First, we do not find evidence that the collateral channel interaction term affects market level credit allocations. However, consistent with the micro-level estimates, market-level bank credit to high bank-dependent borrowers is highly sensitive to real estate collateral values and the share of firms that pledge real estate collateral. In particular, in the median market with 20 percent share of firms pledging real estate as collateral, a 1 percentage point increase in commercial real estate prices leads to about an 82 basis points higher growth in bank credit to high bank-dependent borrowers. Second, there is evidence that a higher share of firms pledging real estate collateral has positive effects on overall credit growth and credit growth to low bank-dependent borrowers regardless of real estate values. An increase of this share by a 1 percentage point leads to about 9 and 6 basis points increase in overall credit and credit to low bank-dependent borrowers, respectively. These results are suggestive of potential agglomeration effects resulting from the increased borrowing and capital expenditures of high bank-dependent borrowers.

The credit supply factor impacts market-level credit to both groups of borrowers. For every percentage point increase in the credit supply factor, credit growth to all firms increases by about 65 basis points. We also condition on the credit demand conditions of low and high bank-dependent borrowers. Market-level bank credit responds differently to credit demand conditions of the two groups of firms. Overall bank credit is more sensitive to the demand conditions of low bank-dependent borrowers, which tend to be larger firms. A 1 percentage point increase in credit demand conditions of those borrowers raises credit growth by about 3 percentage points. In contrast, total credit growth increases by 30 basis points in response to a one percentage point increase in the credit demand conditions of high bank-dependent borrowers. Second, columns two and three also show that there is no significant crowding-out or crowding-in effects of credit demand of low bank-dependent borrowers on high bank-dependent borrowers and vice versa.

Insert Table 12.

We next evaluate the effect of the collateral channel on market-level economic activity.

The results of this analysis are summarized in Table 13. Although the relaxation of borrowing constraints had statistically significant effects on bank credit to small and high-bank dependent borrowers, small firms have disproportionately larger shares in employment as documented by Neumark et al. (2011). The coefficient estimates on the unemployment rate and the growth in employment capture both the disproportionately higher shares of employment in small businesses as well as any agglomeration effects of the collateral channel. The estimates imply that a 1 percentage point increase in collateral values in the median market, which has 20 percent of borrowers pledging real estate collateral, leads to about a 0.8 basis point decrease in unemployment rate and about a 14 basis point increase in total employment. Consistent with the fact that the non-tradable sectors concentrate a higher share of high bank-dependent borrowers, the collateral channel has large and statistically significant impact on employment in the non-tradable sector of about 20 basis points for the median market. We do not find evidence that the collateral channel affects employment growth in the non-tradable sector.

Insert Table 13.

We next examine the effect of the collateral channel on net business creation using annual data from the Census Bureau's CBP. These data allow us to measure net growth in establishments by industry sector and employment size. We group establishments into tradable and non-tradable sectors and in four size groups: very small establishments with employment sizes up to 9 employees, which constitute more than 70 percent of all establishments; medium-sized establishments with total employees between 10 and 99, which represent about one-fourth of all establishments; medium-to-large establishments with total employees between 100 and 499, which represent about 2 percent of all establishments; and the very large establishments with total employees exceeding 500, which represent less than 1 percent of all establishments. We use the annual growth in establishments for each market and group as an outcome variable.

The results from this estimation are summarized in Table 14. The coefficient estimates imply that for the median market a 1 percent increase in commercial real estate values boosts overall establishment growth about 4 basis points. The effect is concentrated in the non-tradable sector in the smallest size group of establishments with up to 9 employees. This evidence is consistent with smaller firms in the non-tradable sector being more credit constrained and more dependent on bank credit. In contrast, we do not find evidence for an effect of the collateral channel on the overall growth in the smallest size establishments in tradable sector establishments. However, we find a statistically significant and economically large effect of the collateral channel in the 100 to 499 employee size category. The coefficient estimates imply that a 1 percent increase in commercial real estate prices leads to a 74 basis point growth in tradable sector establishments in this size category for the median market. While this size category is both less likely to be credit constrained than the smaller establishment sizes and more likely to have access to some form of non-bank financing, we cannot completely rule out the workings of the collateral channel either directly or through agglomeration effects. The publicly available CBP data do not allow us to distinguish between gross establishment creation and destruction, nor can we record transitions between size categories due to employment growth at the establishment level. Nevertheless, the results on establishment growth are in line with the overall effects of the collateral channel on the unemployment rate and the growth in employment in the non-tradable sector.

Insert Table 14.

6 Economic significance and implications for the COVID-19 pandemic

The average market in our sample period from 2013 to 2019 experiences an economic expansion characterized with positive growth in real estate prices and relaxation of borrowing constraints. The average annual growth in commercial real estate prices is 6.4 percent, which combined with a firm-level elasticity of about 12.4 basis points in column (3) of Table 9 implies that the average relaxation of borrowing constraints accounts for about 79 basis points of additional annual growth in credit or about 9 percent of the average annual growth in bank credit for high bank-dependent borrowers. Our market-level estimates imply a significantly larger effect of the collateral channel than our firm-level estimates. For the median market with 20 percent of firms pledging real estate collateral, a 1 percentage point increase in commercial real estate prices leads to 5.2 percent higher annual growth in credit to high bank-dependent borrowers, which is about 60 percent of the average annual growth in credit to those borrowers over the sample period. This significant difference between the micro and macro elasticities could be attributed to agglomeration effects resulting from the increased borrowing and capital expenditures of high bank-dependent borrowers on the overall local economy. Applying the average annual growth of commercial real estate prices in our sample period to our estimates, we derive that the relaxation of borrowing constraints of small bank dependent borrowers increase the annual growth in overall employment by about 86 basis points and the growth in establishments by about 26 basis points. The collateral channel contributes to about 37 percent of the average annual growth in employment over the period from 2013 to 2019. This effect is larger than the estimates provided by Adelino et al. (2015), who find that the collateral channel accounts for 10 to 25 percent of the increase in employment from 2002 to 2007.

We do not have a long enough time series to assess the effects of recessions on the collateral channel. However, we can use our estimates to quantify the role of the collateral channel for bank credit and economic activity during the recent COVID-19 pandemic, with the caveat that this is a counterfactual exercise that does not factor in the effects of government lending programs or other monetary and fiscal support on credit conditions and the prices of commercial real estate collateral.[12] The recent literature that studies the effects of the pandemic on small bank-dependent borrowers has documented that the pandemic had a particularly negative effect on small firms and led to decreased sales for small businesses (Bloom et al. (2021)), a reduction in total factor productivity in the private sector by nearly 5 percent (Bloom et al. (2020)), and higher failure rates (Gourinchas et al. (2020)). Several papers (Chodorow-Reich et al. (2021b), Li and Strahan (2020)) show that loans under the PPP program helped to alleviate credit constraints faced by small businesses during the pandemic. Minoiu et al. (2021) document that, despite the relatively low take-up, the MSLP program had a positive supply effects on credit to small bank dependent borrowers.

The COVID-19 pandemic led to a significant curtailment in economic activity that resulted in significant increases in commercial properties vacancies and sharp declines in commercial real estate prices. Table 15 provides information on the implied effects of the collateral channel during the first five quarters of the COVID-19 pandemic from 2020Q1 to 2021Q1. The average market experiences about 4 percent decline in commercial real estate prices over this period with some significant variation in the cross-section of markets. Commercial real estate prices in some markets declined as much as 23 percent in the second quarter of 2020, whereas in some markets commercial real estate prices continued to grow. The low supply elasticity markets in our sample experienced a slightly smaller decline in prices than the high supply elasticity markets. We combine the declines in commercial real estate prices with the collateral channel elasticities reported in Tables 12, 13, and 14 to evaluate the economic magnitude of the effects of the collateral price declines. The cumulative declines in real estate values imply a reduction in credit to high bank-dependent borrowers of about 313 basis points, a decline in employment of about 52 basis points, a decline in the number of establishments by about 16 basis points, and an increase in the unemployment rate of about 3 basis points. Those estimates pale in comparison to the significant impact of the pandemic and the social distancing policies on economic activity

[12]Government lending programs to non-financial firms during the pandemic include the Paycheck Protection Program (PPP) or the Main Street Lending Program (MSLP), among others.

during the same period. However, they are informative for how a persistent decline in commercial real estate values could further compress credit and economic activity through the collateral channel.

7 Conclusion

To the best of our knowledge, our paper is the first to show direct evidence that the collateral channel is most relevant for private bank-dependent firms and that the firm-level effects of this channel lead to aggregate market-level effects with significant amplification of the micro-level elasticities. The key to our identification is that we are able to directly observe the use of real estate collateral at the firm level and appropriately disentangle idiosyncratic bank supply and firm demand factors when quantifying the effects of borrowing constraints. Our data and methodology allows us to aggregate the micro-level effects of collateral constraints and examine their aggregate effects controlling for other credit allocation mechanisms and the endogenous substitutions among a menu of available asset-based and earnings-based types of collateral.

While the recent literature represented by Lian and Ma (2021) has questioned the role of the collateral channel as a relevant channel for economic fluctuations, we show that the omission of small bank-dependent borrowers from the analysis misses the set of firms for which this channel is most relevant. Furthermore, our findings both underscore the importance of the collateral channel for aggregate fluctuations and help quantify the underlying mechanisms through which this channel operates. Although our estimates are reduced-form, they could be useful in calibrating a more structural approach, that would incorporate the heterogeneous exposures to the collateral channel along the firm size distribution, to assess the agglomeration and general equilibrium effects along the lines of work by Midrigan and Xu (2014) and Catherine et al. (2018).

8 Tables and Figures

8.1 Tables

Table 1: Descriptive statistics of corporate borrowers and bank lenders

Statistic	mean	sd	p5	p25	p50	p75	p95
				A. Borrower characteristics			
Total assets ($mln)	601.19	3198.77	2.05	6.35	17.27	70.18	2078.52
Total bank credit ($mln)	32.83	175.52	1.13	1.85	4.05	14	122.2
Credit lines ($mln)	39.02	171.3	1.23	2.18	5.47	19.06	160
Utilization rate (pct)	49.32	40.21	0	0	51.87	93.32	100
Term loans ($mln)	17.14	104.37	1.08	1.52	2.86	8.31	62.64
Share of bank credit (pct)	49.2	32.2	2.1	21.7	46.5	75.4	100
Growth in bank credit (pct)	15.2	41.7	-41.9	-2.7	0	31.7	101
Cash-to-assets (pct)	11.69	16.18	0	1.42	5.72	15.14	44.58
Capital expenditure (pct)	1.57	8.3	-7.62	0	0.03	2.61	13.91
Credit rating	BB	D	CCC	BB	BB	BBB	A
Expected default prob.	2.81	10.25	0.06	0.27	0.7	1.7	9.06
Expected LGD	32.62	18.22	5	20.7	34	42	60
Expected utilization at default	73.82	75.98	18.11	50	75.9	100	102.57
Debt-to-assets (pct)	60	23	17	44	63	78	93
				B. Bank characteristics			
Total assets ($mln)	488,788	674,996	65,951	122,034	176,900	381,451	2,191,626
CET1 ratio (pct)	12.7	3.5	9.5	10.7	11.9	13.6	17.8
HQLA-assets (pct)	17.1	11.4	4.8	9.8	14.5	19.9	47.9
Number of borrowers	3391.9	3463	117.6	1441	2291	3598	12687.2
Committed credit ($mln)	88,389	115,338	6,830	22,719	42,150	85,143	399,007
Number of markets	59.1	11.5	35	57	62	66	68
Market concentration [HHI] (0,100)	7	4	4	4	6	8	13
Largest market share [0,1]	0.21	0.1	0.11	0.13	0.21	0.25	0.37
Share of largest 3 markets [0,1]	0.34	0.1	0.22	0.25	0.35	0.41	0.53
Credit to low-elasticity markets [0,1]	0.4	0.13	0.2	0.29	0.4	0.48	0.6
Credit to high-elasticity markets [0,1]	0.16	0.08	0.06	0.1	0.16	0.21	0.32

Note: Panel A contains summary statistics of 92,069 nonfinancial corporate borrowers headquartered in one of 68 MSA areas over the period from 2013:Q1 through 2019:Q4. The sample includes both publicly traded and private companies that borrow from the 34 large multi-market banks reporting in FR Y-14. Capital expenditures are net of depreciation and are shown as percent of the lag of total assets. Total bank credit measures the sum of committed amounts on credit lines and term loans. Expected utilization at default is based on the bank reported expected exposures at default. Share of bank credit is the ratio of bank term loans and credit lines to total liabilities and unused credit lines of obligors. Panel B summarizes the average characteristics of the multi-market banks in the FR Y-14 dataset. Balance sheet and income statement information for those banks is obtained from FR Y-9C. Source: Federal Reserve Board, Forms FR Y-14 and FR Y-9C, Call Reports, and author's calculations.

Table 2: Descriptive statistics of geographic markets

Statistic	mean	sd	p5	p25	p50	p75	p95
	A. Credit growth						
Annualized growth in credit	6.95	32.91	-32.5	-6.36	5.18	17.49	49.13
—high bank-dependent	8.93	56.95	-40.88	-8.55	4.87	21.37	68.93
—low bank-dependent	6.96	36.61	-38.02	-7.83	4.68	18.91	55.57
Credit supply factor	1.36	3.42	-2.46	-0.45	0.7	2.62	6.8
Credit demand factor high-bank dependent	3.29	9.24	-7.12	-1.22	2.15	6.05	17.12
Credit demand factor low-bank dependent	1.7	7.1	-8.01	-1.68	1.29	4.62	12.68
Share of credit to low-bank dependent borrowers	0.8	0.08	0.66	0.75	0.81	0.85	0.89
—non-tradable sector	0.3	0.13	0.12	0.21	0.28	0.39	0.52
—tradable sector	0.49	0.15	0.23	0.39	0.51	0.6	0.73
Share of credit to high-bank dependent borrowers	0.2	0.08	0.11	0.15	0.19	0.25	0.34
—non-tradable sector	0.11	0.06	0.05	0.08	0.1	0.14	0.2
—tradable sector	0.09	0.05	0.04	0.06	0.08	0.11	0.2
	B. Market characteristics						
Credit (multimarket)	31,034	35,326	3,559	9,516	21,509	38,638	86,869
Credit (regional)	2,960	9,059	42	292	772	1,954	10,322
C&I share of multi-market banks	0.86	0.15	0.6	0.81	0.92	0.96	0.99
Multi-market HHI (0,100)	10.52	3.33	7.54	8.44	9.49	11.11	17.66
Number of multi-market banks	27.86	5.98	11	27	29	31	34
Supply elasticity	1.74	0.86	0.66	1	1.61	2.35	3.29
Commercial real estate price growth	6.39	5.61	-2.69	3.22	6.34	9.59	15.18
	C. Use of collateral						
Share of real estate collateral	21	8	9	15	20	26	35
Share of accounts receivable	21	6	12	16	2	26	31
Share of cash and securities	8	5	3	5	7	10	16
Share of other fixed assets	10	3	6	8	10	12	16
Share of blanket lien	20	6	10	16	20	23	29
Share of unsecured	18	6	9	14	19	23	28
Share of other	9	3	5	6	8	11	14
	D. Economic activity						
Unemployment rate	4.87	1.69	2.8	3.7	4.5	5.6	8.1
Growth in employment: all	2.34	8.66	-9.6	-2.89	1.21	6.95	16.57
Growth in employment: non-tradable sector	2.03	9.58	-13.12	-3.51	1.31	7.18	18.3
Growth in employment: tradable sector	1.72	22.13	-22.85	-4.62	0.98	7.15	25.8
Share of non-tradable sector employment	72	5	65	69	71	75	80
Growth in establishments: all	1.99	5.03	-6.3	-0.19	2.44	4.72	8.07
Growth in establishments: non-tradable	2.18	5.24	-5.6	-0.05	2.47	4.61	8.74
Growth in establishments: tradable	1.76	12	-14.69	-3.29	1.34	6.14	19.57
Share of non-tradable establishments	77	3	72	74	76	79	82
Share establishments 1-9 employees	71.57	2.13	68.15	70.31	71.43	72.62	75.36
Share establishments 10-99 employees	25.88	1.94	22.33	24.86	26	27.07	28.89
Share establishments 100-499 employees	2.3	0.32	1.79	2.08	2.29	2.52	2.85
Share establishments 500+ employees	0.25	0.06	0.14	0.21	0.25	0.3	0.35

NOTE: The sample covers 68 geographic markets and over the period from 2013:Q1 to 2019:Q4. The credit supply and demand factors are aggregated to the market level using bank-level and firm-level lagged loan volume weights, respectively. SOURCE: Federal Reserve Board, Forms FR Y-14 and FR Y-9C; Bureau of Labor Statistics; Call Reports; Federal Deposit Insurance Corporation, Summary of Deposits; Census Bureau, Country Business Patterns; real estate supply elasticities Saiz (2010) and author's calculations.

Table 3: Asset-based collateral types and borrower characteristics

Statistic	mean	sd	p25	p50	p75	N
	A. Real estate					
Total assets ($mln)	52	485	2	4	14	41263
Share fixed assets (pct)	44	33	13	40	74	41263
Cash-to-assets (pct)	14	19	2	7	18	41263
Share accounts receivable (pct)	13	17	0	4	20	41263
Committed amount ($mln)	4	9	1	2	3	41263
Debt-to-assets (pct)	61	24	45	65	80	41263
Share bank credit (pct)	49	30	21	48	76	41263
Investment grade	0.16	0.36	0	0	0	41263
Expected prob. of default (pct)	3.46	10.4	0.67	1.26	2.22	41263
Expected loss given default (pct)	30.6	11.63	23.88	31	38.29	41263
	B. Accounts receivable					
Total assets ($mln)	179	1034	5	11	34	16672
Share fixed assets (pct)	16	20	3	8	22	16672
Cash-to-assets (pct)	11	14	2	6	14	16672
Share accounts receivable (pct)	23	22	4	17	37	16672
Committed amount ($mln)	13	57	2	3	10	16672
Debt-to-assets (pct)	64	22	50	68	81	16672
Share bank credit (pct)	46	27	25	46	66	16672
Investment grade	0.18	0.38	0	0	0	16672
Expected prob. of default (pct)	3.49	8.5	0.64	1.37	2.98	16672
Expected loss given default (pct)	28.97	15.72	17.9	27	37.44	16672
	C. Fixed assets other than real estate					
Total assets ($mln)	331	1521	6	22	91	10609
Share fixed assets (pct)	27	30	2	13	46	10609
Cash-to-assets (pct)	25	27	3	14	39	10609
Share accounts receivable (pct)	12	16	0	3	18	10609
Committed amount ($mln)	5	16	1	2	4	10609
Debt-to-assets (pct)	52	27	28	53	75	10609
Share bank credit (pct)	37	34	6	27	63	10609
Investment grade	0.53	0.49	0	1	1	10609
Expected prob. of default (pct)	1.11	3.04	0.09	0.32	0.93	10609
Expected loss given default (pct)	53.94	41.87	12.75	40	100	10609
	D. Cash and securities					
Total assets ($mln)	922	3262	8	26	152	8607
Share fixed assets (pct)	40	26	17	37	61	8607
Cash-to-assets (pct)	12	16	2	6	15	8607
Share accounts receivable (pct)	17	16	5	13	26	8607
Committed amount ($mln)	7	19	1	2	6	8607
Debt-to-assets (pct)	61	21	47	63	76	8607
Share bank credit (pct)	25	27	2	14	43	8607
Investment grade	0.31	0.46	0	0	1	8607
Expected prob. of default (pct)	2.59	8.02	0.39	1.01	2.18	8607
Expected loss given default (pct)	32.4	14.68	23.14	31.44	39.6	8607

NOTE: The sample period covers 2013:Q1 through 2019:Q4. The number of unique borrowers that use a particular collateral is reported in the last column. SOURCE: Federal Reserve Form FR Y-14 and authors' calculations.

Table 4: Earnings-based collateral types and borrower characteristics

Statistic	mean	sd	p25	p50	p75	N
			A. Blanket lien			
Total assets ($mln)	167	1233	3	8	24	19018
Share fixed assets (pct)	24	25	4	14	37	19018
Cash-to-assets (pct)	16	19	3	9	21	19018
Share accounts receivable (pct)	23	22	3	17	37	19018
Committed amount ($mln)	9	46	1	2	6	19018
Debt-to-assets (pct)	58	23	41	60	76	19018
Share bank credit (pct)	44	26	23	43	64	19018
Investment grade	0.16	0.36	0	0	0	19018
Expected prob. of default (pct)	3.29	9.48	0.64	1.08	2.17	19018
Expected loss given default (pct)	39.12	15.1	32.8	37.74	43.33	19018
			B. Other collateral			
Total assets ($mln)	595	2318	5	20	132	6310
Share fixed assets (pct)	33	31	5	22	56	6310
Cash-to-assets (pct)	13	18	2	6	17	6310
Share accounts receivable (pct)	11	16	0	3	15	6310
Committed amount ($mln)	19	72	2	4	13	6310
Debt-to-assets (pct)	62	24	45	65	80	6310
Share bank credit (pct)	37	32	7	30	63	6310
Investment grade	0.29	0.45	0	0	1	6310
Expected prob. of default (pct)	3.9	10.82	0.43	1.2	3.57	6310
Expected loss given default (pct)	32.05	19.8	17.86	30	45	6310
			C. Unsecured			
Total assets ($mln)	1566	4040	8	66	675	10536
Share fixed assets (pct)	29	29	5	18	48	10536
Cash-to-assets (pct)	14	18	2	7	19	10536
Share accounts receivable (pct)	14	17	1	8	21	10536
Committed amount ($mln)	38	188	2	4	17	10536
Debt-to-assets (pct)	55	24	37	57	73	10536
Share bank credit (pct)	26	30	1	12	42	10536
Investment grade	0.44	0.49	0	0	1	10536
Expected prob. of default (pct)	1.97	8.29	0.17	0.48	1.16	10536
Expected loss given default (pct)	44.02	17.68	37	45	49.79	10536

NOTE: The sample period covers 2013:Q1 through 2019:Q4. The number of unique borrowers that use a particular collateral is reported in the last column. SOURCE: Federal Reserve Form FR Y-14 and authors' calculations.

Table 5: Supply elasticities and real estate prices

	Dependent variable: Real estate prices			
	Commercial		Residential	
	(1)	(2)	(3)	(4)
Elasticity × Mortgage rate 30yr, t	−0.050***		−0.035***	
	(0.004)		(0.003)	
Elasticity × {Elasticity $< Q1$}× Mortgage rate 30yr, t		−0.179***		−0.116***
		(0.014)		(0.018)
Elasticity × {Elasticity $\in (Q1, Q3)$}× Mortgage rate 30yr, t		−0.058***		−0.044***
		(0.006)		(0.004)
Elasticity × {Elasticity $> Q3$}× Mortgage rate 30yr, t		−0.036***		−0.026***
		(0.003)		(0.004)
Observations	5,606	5,606	5,341	5,341
R^2	0.303	0.390	0.293	0.322
F-test	33.85	48.53	32.59	36.28

NOTE: The regression sample includes 68 MSA areas and covers 2000:Q1 through 2019:Q4. Regressions in columns (2) and (4) fit linear splines that allow for different slope coefficients for markets with supply elasticities in the first quartile, the interquartile range, and the fourth quartile. All regressions include market fixed-effects. Heteroscedasticity consistent standard errors are clustered at the market level and are shown in parenthesis. Significant at *p<0.1; **p<0.05; ***p<0.01. SOURCE: The commercial real estate prices in columns (1) and (2) are from CBRE Econometric Advisors, residential real estate prices are from the Federal Housing Finance Agency, and real estate supply elasticities are from Saiz (2010).

Table 6: Determinants of real estate collateral use

	Dependent variable: Use of real estate collateral $\{0, 1\}$			
	(1)	(2)	(3)	(4)
Mortgage rate 30yr, t	-0.13^{***}			
	(0.01)			
Elasticity × Mortgage rate 30yr, t	0.02^{***}			
	(0.005)			
Elasticity	-0.21^{***}	-0.14^{***}	-0.14^{***}	-0.13^{***}
	(0.02)	(0.002)	(0.002)	(0.002)
$\widehat{P_{l,t}}$		-0.29^{***}	-0.56^{***}	-0.44^{***}
		(0.02)	(0.03)	(0.03)
$\widehat{P_{l,t}}\times$ Share fixed assets,t-1			0.59^{***}	0.60^{***}
			(0.07)	(0.07)
Share fixed assets, t-1			0.96^{***}	0.94^{***}
			(0.01)	(0.01)
High bank-dependence			0.28^{***}	0.29^{***}
			(0.004)	(0.004)
Share of bank credit, t-1			0.31^{***}	0.32^{***}
			(0.01)	(0.01)
log(Total assets), t-1			-0.20^{***}	-0.20^{***}
			(0.001)	(0.001)
Debt-to-assets, t-1			0.002^{***}	0.002^{***}
			(0.0001)	(0.0001)
Return on assets, t-1			-0.005^{***}	-0.004^{***}
			(0.0001)	(0.0001)
CET1 buffer, t-1				0.07^{***}
				(0.001)
HQLA-to-assets, t-1				-0.001^{***}
				(0.0002)
LTV, t-1				0.07^{***}
				(0.01)
Constant	-0.18^{***}	-0.65^{***}	-0.48^{***}	-0.76^{***}
	(0.03)	(0.004)	(0.01)	(0.01)
Observations	1,341,757	1,341,757	1,341,757	1,341,757
Log Likelihood	−635,434.80	−635,658.50	−492,515.80	−489,032.60
Akaike Inf. Crit.	1,270,878.00	1,271,323.00	985,051.60	978,091.20

NOTE: The regression is a probit on the indicator function for whether the predominant form of collateral is real estate. Commercial real estate prices are instrumented based on column (2) of Table 5. Significant at *p<0.1; **p<0.05; ***p<0.01.

Table 7: The collateral channel effects on firm-level bank credit

	Dependent variable:					
	Growth in bank credit $\Delta L_{f,b,m,t}$					
	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta^c P_{m,t} \times \mathbb{I}\{\text{RE collateral}_{f,b,t}\}$	13.80***		13.37***	7.40**		7.75**
	(1.45)		(1.53)	(3.56)		(3.65)
$\mathbb{I}\{\text{RE collateral}_{f,b,t}\}$	−2.78***		−2.68***	−0.30		−0.35
	(0.56)		(0.57)	(0.63)		(0.65)
$\Delta^c P_{m,t} \times$ Share fixed assets, t-1		6.37**	3.39		−3.03	−4.29
		(2.57)	(2.56)		(6.31)	(6.40)
Share of fixed assets, t-1		−0.19	0.55		1.94*	2.11*
		(1.00)	(0.99)		(1.09)	(1.11)
log(Total assets),t-1	−0.64***	−0.59***	−0.62***	−0.59***	−0.59***	−0.58***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Return on assets, t-1	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Debt-to-assets, t-1	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\mathbb{I}\{\text{Investment grade}_{f,t-1}\}$	1.45***	1.46***	1.44***	1.47***	1.46***	1.46***
	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)
Credit demand factor $\alpha_{f,t}$	0.11***	0.11***	0.11***	0.11***	0.11***	0.11***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Firm fixed effects	X	X	X	X	X	X
Bank-market-time fixed effects	X	X	X	X	X	X
Observations	726,328	726,328	726,328	726,328	726,328	726,328
R^2	0.27	0.27	0.27	0.27	0.27	0.27
Adjusted R^2	0.14	0.14	0.14	0.14	0.14	0.14

NOTE: The regression analysis is based on an unbalanced panel of 32 banks, 68 MSA markets, and 73,760 borrowers, of which 27,124 borrowers pledge real estate as collateral. The left-hand side variable is the year-over-year growth rate in lending of bank b to firm f in market m. The growth in lending is expressed in percentage points, whereas commercial real estate prices are expressed in decimals. Therefore, the magnitudes of the θ_1 estimates are in basis points (that is, in column (1), a 1 percentage point increase in commercial real estate prices leads to a 13.8 basis point increase in borrowing). All regressions include firm and bank-market-time fixed effects. Market level commercial real estate prices are instrumented based on first-stage regression reported in column (2) of Table 5. The standard errors in columns (4) though (6) are constructed based on a bootstrap with clustering at the borrower and market level. Significant at *p<0.1; **p<0.05; ***p<0.01

Table 8: The collateral channel and bank dependence

	Dependent variable:			
	Growth in bank credit $\Delta L_{f,b,m,t}$			
	OLS		IV	
Bank dependence	Low	High	Low	High
	(1)	(2)	(3)	(4)
$\Delta^c P_{m,t} \times \mathbb{I}\{\text{Real estate}_{f,b,m,t}\}$	11.61***	18.41***	7.37	10.43**
	(1.89)	(2.63)	(5.01)	(4.24)
$\mathbb{I}\{\text{Real estate}_{f,b,m,t}\}$	−2.12**	−3.59***	−0.21	−0.40
	(0.81)	(0.82)	(0.95)	(0.75)
log(Total assets),t-1	−0.77***	−0.49**	−0.75***	−0.44**
	(0.17)	(0.20)	(0.17)	(0.21)
Share fixed assets, t-1	−0.29	1.93***	−0.28	1.99***
	(0.80)	(0.54)	(0.81)	(0.54)
Return-on-assets, t-1	0.09***	0.02***	0.09***	0.02***
	(0.01)	(0.01)	(0.01)	(0.01)
Debt-to-assets, t-1	−0.10***	−0.07***	−0.10***	−0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
$\mathbb{I}\{\text{Investment grade}_{f,t-1}\}$	1.39***	1.37***	1.40***	1.42***
	(0.39)	(0.38)	(0.39)	(0.39)
Credit demand factor $\alpha_{f,t}$	0.16***	0.05***	0.16***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)
Firm fixed effects	X	X	X	X
Bank-market-time fixed effects	X	X	X	X
Observations	460,357	265,971	460,357	265,971
R^2	0.28	0.35	0.28	0.35
Adjusted R^2	0.13	0.18	0.13	0.18

NOTE: The left-hand side variable is the year-over-year growth rate in lending of bank b, to firm f in market m. Market level commercial real estate prices are instrumented based on first-stage regression (5) in columns (4). A borrower is categorized as high bank-dependent if it is a non publicly traded company that obtains at least 50 percent of total credit from banks in our sample. All regressions include firm and bank-market-time fixed effects. Heteroscedasticity consistent standard errors are clustered at the borrower and market level. Market level commercial real estate prices are instrumented based on first-stage regression reported in column (2) of Table 5. The standard errors for IV specifications in columns (4) though (6) are constructed based on a bootstrap with clustering at the market level in the first stage and clustering at the borrower and market level in the second stage. Significant at *p<0.1; **p<0.05; ***p<0.01.

Table 9: Collateral types, credit growth, and bank dependence

	Growth in					
Dependent variable:	*Credit commitments* $\Delta L_{f,b,t}$			Utilized amounts $\Delta L^U_{f,b,t}$		
Bank dependence	All	Low	High	All	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{P_{m,t}} \times \mathbb{I}\{\text{Real estate}_{f,b,t}\}$	7.10*	7.24	12.40**	22.99	16.50	57.87*
	(3.61)	(4.40)	(5.40)	(24.21)	(33.14)	(29.82)
$\mathbb{I}\{\text{Real estate}_{f,b,t}\}$	3.02***	2.95***	3.23***	3.62	3.37	0.36
	(0.70)	(0.90)	(1.07)	(5.50)	(7.08)	(7.66)
$\mathbb{I}\{\text{Cash and securities}_{f,b,t}\}$	6.17***	6.02***	6.66***	18.86***	20.16***	4.77
	(0.75)	(0.82)	(2.07)	(3.37)	(3.52)	(11.70)
$\mathbb{I}\{\text{Accounts receivable}_{f,b,t}\}$	6.47***	6.16***	8.44***	23.75***	24.20***	19.78***
	(0.40)	(0.43)	(0.96)	(2.38)	(2.72)	(5.72)
$\mathbb{I}\{\text{Fixed assets}_{f,b,t}\}$	1.28**	0.82	4.99***	7.29***	6.74***	9.47**
	(0.50)	(0.52)	(0.92)	(1.87)	(1.98)	(4.59)
$\mathbb{I}\{\text{Blanket lien}_{f,b,t}\}$	6.34***	6.35***	6.47***	23.25***	23.73***	20.56***
	(0.38)	(0.41)	(0.94)	(1.90)	(2.22)	(4.92)
$\mathbb{I}\{\text{Unsecured}_{f,b,t}\}$	10.88***	10.86***	11.67***	21.36***	22.49***	2.14
	(0.50)	(0.52)	(1.74)	(3.06)	(3.38)	(7.54)
$\mathbb{I}\{\text{Other}_{f,b,t}\}$	(omitted)					
Share of fixed assets, t-1	1.50***	−0.39	1.66***	19.53**	16.20	20.54***
	(0.47)	(0.73)	(0.52)	(7.41)	(10.29)	(5.58)
log(Total assets),t-1	−0.62***	−0.88***	−0.43**	−3.95***	−3.07**	−9.22***
	(0.12)	(0.17)	(0.18)	(0.95)	(1.18)	(1.62)
Return on assets,t-1	0.04***	0.09***	0.01	0.26***	0.30***	0.15
	(0.01)	(0.01)	(0.01)	(0.07)	(0.09)	(0.12)
Debt-to-assets,t-1	−0.08***	−0.11***	−0.06***	−0.93***	−1.01***	−0.67***
	(0.01)	(0.01)	(0.01)	(0.07)	(0.10)	(0.08)
$\mathbb{I}\{\text{Investment grade}_{f,t-1}\}$	1.39***	1.45***	1.04***	4.03	4.67	−0.70
	(0.29)	(0.37)	(0.36)	(2.47)	(3.01)	(2.69)
Credit demand factor $\alpha_{f,t}$	0.12***	0.16***	0.04***	0.12***	0.16***	0.16***
	(0.002)	(0.003)	(0.002)	(0.01)	(0.01)	(0.01)
Firm fixed effects	X	X	X	X	X	X
Bank-market-time fixed effects	X	X	X	X	X	X
Observations	728,104	501,344	226,760	545,603	425,920	119,683
R^2	0.27	0.28	0.35	0.18	0.19	0.29
Adjusted R^2	0.14	0.14	0.16	0.05	0.05	0.06

NOTE: Growth in credit commitments is the year-over-year growth rate in total committed amounts of both credit lines and term loans. Growth in utilized amounts is the annualized growth rate in utilized amounts on existing credit lines. Market-level commercial real estate prices are instrumented based on first-stage regression (5). The different collateral types represent the dominant form of collateral used by the firm across all its credit facilities obtained from bank b. A borrower is categorized as high bank-dependent if it is a non-publicly traded company that obtains at least 50 percent of total credit from banks in our sample. Market-level commercial real estate prices are instrumented based on first-stage regression reported in column (2) of Table 5. The standard errors are constructed based on a bootstrap with clustering at the borrower and market level in the second stage. Significant at *p<0.1; **p<0.05; ***p<0.01.

Table 10: The effect of the collateral channel on loan spreads, maturity, and expected losses

	Dependent variable:			
	Spread	Maturity	LGD	PD
	(1)	(2)	(3)	(4)
$\widehat{P_{m,t-1}} \times \mathbb{I}\{\text{Real estate}_{f,b,t}\}$	-0.46^{**}	13.65^{**}	4.86	0.55
	(0.22)	(6.65)	(3.92)	(1.44)
$\mathbb{I}\{\text{Real estate}_{f,b,t}\}$	0.11^{***}	0.08	-3.13^{***}	-0.02
	(0.04)	(1.16)	(0.74)	(0.38)
$\mathbb{I}\{\text{Cash and securities}_{f,b,t}\}$	0.12^{***}	-1.82^{***}	-2.07^{***}	0.09
	(0.03)	(0.61)	(0.55)	(0.28)
$\mathbb{I}\{\text{Accounts receivable}_{f,b,t}\}$	0.05^{***}	-1.44^{***}	-1.43^{***}	0.26
	(0.02)	(0.35)	(0.32)	(0.16)
$\mathbb{I}\{\text{Fixed assets}_{f,b,t}\}$	0.04^{**}	-1.57^{***}	-0.73^{**}	-0.22
	(0.02)	(0.37)	(0.29)	(0.18)
$\mathbb{I}\{\text{Blanket lien}_{f,b,t}\}$	0.005	-1.35^{***}	0.87^{***}	-0.22
	(0.02)	(0.39)	(0.31)	(0.19)
$\mathbb{I}\{\text{Unsecured}_{f,b,t}\}$	-0.05^{**}	-3.49^{***}	4.18^{***}	-0.12
	(0.02)	(0.35)	(0.33)	(0.13)
$\mathbb{I}\{\text{Other}_{f,b,t}\}$	(omitted)			
log(Total assets),t-1	-0.0004	-0.09	0.22^{**}	0.02
	(0.01)	(0.15)	(0.11)	(0.09)
Return on assets, t-1	-0.003^{***}	0.04^{***}	0.005	-0.04^{***}
	(0.001)	(0.01)	(0.01)	(0.01)
Firm debt-to-assets, t-1	0.004^{***}	-0.06^{***}	-0.005	0.04^{***}
	(0.001)	(0.01)	(0.01)	(0.01)
$\mathbb{I}\{\text{Investment grade}_{f,t-1}\}$	-0.09^{***}	0.01	-0.34	-0.04
	(0.02)	(0.37)	(0.21)	(0.10)
Credit demand factor $\alpha_{f,t}$	-0.001^{***}	0.004	-0.0001	-0.004^{***}
	(0.0002)	(0.01)	(0.002)	(0.001)
Firm fixed-effects	X	X	X	X
Bank-market-time fixed-effects	X	X	X	X
Observations	50,206	50,206	50,206	50,206
R^2	0.78	0.80	0.77	0.70
Adjusted R^2	0.66	0.70	0.65	0.54

NOTE: Maturity of credit facilities are measured in months. LGD and PD stand for expected loss-given default and expected probability of default of the loan, respectively. Commercial real estate prices are instrumented based on specification (2) in Table 5. All regressions include firm, market, and bank-time fixed effects. Heteroscedasticity consistent standard errors are clustered at the bank level. Significant at *p<0.1; **p<0.05; ***p<0.01

Table 11: The effect of the collateral channel on capital expenditures and asset growth

	Dependent variable:					
	Firm capital expenditures, t			Growth in firm assets, t		
Bank dependence	All	Low	High	All	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{P_{m,t}} \times \mathbb{I}\{\text{RE collateral}_{f,b,t}\}$	3.48**	2.37	6.85*	5.62***	4.15**	8.75***
	(1.70)	(1.95)	(3.67)	(1.49)	(1.93)	(2.27)
$\mathbb{I}\{\text{Real estate}_{f,b,t}\}$	−0.20	−0.01	−0.37	−0.72***	−0.55*	−1.01**
	(0.30)	(0.33)	(0.74)	(0.27)	(0.33)	(0.48)
$\mathbb{I}\{\text{Cash and securities}_{f,b,t}\}$	0.002	−0.03	0.43	0.16	0.17	0.16
	(0.12)	(0.12)	(0.80)	(0.19)	(0.20)	(0.73)
$\mathbb{I}\{\text{Accounts receivable}_{f,b,t}\}$	0.21***	0.11	1.28***	0.29***	0.26**	0.64**
	(0.08)	(0.08)	(0.33)	(0.11)	(0.12)	(0.32)
$\mathbb{I}\{\text{Fixed assets}_{f,b,t}\}$	0.44***	0.36***	1.34***	0.37***	0.31***	0.89**
	(0.09)	(0.09)	(0.42)	(0.11)	(0.12)	(0.39)
$\mathbb{I}\{\text{Blanket lien}_{f,b,t}\}$	0.16*	0.09	0.87**	0.44***	0.43***	0.59*
	(0.08)	(0.09)	(0.36)	(0.12)	(0.13)	(0.33)
$\mathbb{I}\{\text{Unsecured}_{f,b,t}\}$	0.23***	0.19**	0.82*	0.01	0.05	−0.43
	(0.08)	(0.08)	(0.48)	(0.13)	(0.14)	(0.43)
log(Total assets),t-1	−0.53***	−0.43***	−1.78***	−2.80***	−3.14***	−1.70***
	(0.09)	(0.09)	(0.39)	(0.12)	(0.15)	(0.15)
Return on assets,t-1	0.04***	0.04***	0.04***	0.04***	0.05***	0.02***
	(0.005)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Debt-to-assets,t-1	−0.01	−0.003	−0.03**	−0.08***	−0.09***	−0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\mathbb{I}\{\text{Investment grade}\}$, t-1	0.29***	0.31***	0.17	0.0003	−0.06	0.14
	(0.09)	(0.10)	(0.24)	(0.16)	(0.19)	(0.20)
Credit demand factor $\alpha_{f,t}$	−0.002	−0.002	−0.0003	0.003	0.003	0.002
	(0.001)	(0.001)	(0.003)	(0.002)	(0.003)	(0.003)
Credit supply factor $\beta_{b,t}$	0.01***	0.01***	0.03***	0.002	−0.001	0.02*
	(0.002)	(0.002)	(0.01)	(0.003)	(0.004)	(0.01)
Lagged dependent variable, t-1	0.50***	0.50***	0.50***	−0.09***	−0.08***	−0.13***
	(0.005)	(0.01)	(0.01)	(0.003)	(0.003)	(0.003)
Observations	642,288	551,746	90,542	948,256	747,043	201,213
R^2	0.76	0.76	0.79	0.15	0.14	0.17
Adjusted R^2	0.74	0.74	0.75	0.07	0.07	0.04

NOTE: Firm capital expenditures are expressed as the annualized percent of lagged total assets. Firm asset growth is the year-over-year growth of firms' total assets. Commercial real estate prices are instrumented based on specification (2) in Table 5. All regressions include firm, bank, and market-time fixed effects. Heteroscedasticity consistent standard errors are clustered at the firm level. Significant at *p<0.1; **p<0.05; ***p<0.01

Table 12: The effect of the collateral channel on market-level bank credit

	Dependent variable: Market-level bank credit growth		
Bank dependence	All	Low	High
	(1)	(2)	(3)
$\widehat{P_{m,t}}$ × Share real estate$_{m,t}$	131.68	55.88	414.14*
	(136.87)	(181.46)	(233.29)
Share real estate$_{m,t}$	91.49**	63.70*	82.12
	(36.73)	(32.15)	(75.03)
Share accounts receivable$_{m,t}$	11.28	27.87	64.02
	(37.97)	(40.71)	(68.29)
Share cash and securities$_{m,t}$	−61.26*	−19.12	17.27
	(33.88)	(36.48)	(55.76)
Share fixed assets$_{m,t}$	−20.72	−20.64	42.73
	(40.65)	(32.33)	(76.20)
Share blanket lien$_{m,t}$	24.74	59.32	10.28
	(38.26)	(38.32)	(71.07)
Share unsecured$_{m,t}$	−12.69	−35.18	−23.73
	(24.07)	(30.32)	(53.40)
$\widehat{P_{m,t}}$	−41.50	35.57	−14.09
	(27.87)	(51.45)	(54.62)
Credit supply factor, $\beta_{m,t}$	0.65***	0.60*	0.40**
	(0.15)	(0.34)	(0.20)
Credit demand low bank-dependent, t	2.98***	3.51***	0.38
	(0.09)	(0.09)	(0.23)
Credit demand high bank-dependent, t	0.30***	−0.03	2.17***
	(0.07)	(0.07)	(0.17)
Lagged dependent variable, t-1	−0.08***	−0.05***	−0.19***
	(0.02)	(0.02)	(0.03)
Observations	1,768	1,768	1,768
R^2	0.55	0.58	0.36
Adjusted R^2	0.53	0.56	0.33

NOTE: Bank credit growth is the year-over-year growth in market-level committed amounts of bank credit lines and term loans. The regressions are based on a panel of 68 MSA areas from 2013:Q1 to 2019:Q4. Commercial real estate prices are instrumented based on specification (2) in Table 5. The regressions are weighted by the lagged market-level bank credit. All regressions include market and time fixed effects. Heteroscedasticity and autocorrelation robust standard errors are clustered at the market level. Significant at *p<0.1; **p<0.05; ***p<0.01

Table 13: The effect of the collateral channel on market-level employment

	Dependent variable:			
	Unemployment	Growth in employment		
	rate	Total	Non-tradable	Tradable
	(1)	(2)	(3)	(4)
$\widehat{P_{m,t-1}}$ × Share real estate$_{m,t-1}$	−3.81*	68.51**	98.27***	−16.68
	(2.16)	(31.85)	(24.23)	(125.90)
$\widehat{P_{m,t-1}}$	1.80*	−25.27**	−31.22***	−12.25
	(0.92)	(10.32)	(7.40)	(32.96)
Share real estate$_{m,t-1}$	0.50	1.07	0.38	−32.94
	(0.97)	(7.17)	(6.99)	(29.43)
Share accounts receivable$_{m,t-1}$	−2.16*	−2.39	0.78	−40.19*
	(1.09)	(5.52)	(7.07)	(20.90)
Share cash and securities$_{m,t-1}$	−2.60*	9.14	21.34***	−64.59*
	(1.35)	(6.68)	(6.61)	(33.26)
Share fixed assets$_{m,t-1}$	0.28	10.14	11.78	−39.90
	(1.15)	(7.00)	(7.30)	(28.39)
Share blanket lien$_{m,t-1}$	−1.43	9.29	17.50***	−19.29
	(0.99)	(5.63)	(6.48)	(20.50)
Share unsecured$_{m,t-1}$	0.23	4.79	8.23	−15.86
	(0.80)	(4.93)	(4.97)	(20.82)
Credit supply factor, $\beta_{m,t}$	−0.003	0.20***	0.14**	−0.06
	(0.004)	(0.04)	(0.06)	(0.30)
Credit demand low bank-dependent, t	0.001	−0.002	0.02	−0.05
	(0.001)	(0.02)	(0.03)	(0.05)
Credit demand high bank-dependent, t	−0.002*	0.03	0.03*	0.04
	(0.001)	(0.02)	(0.02)	(0.07)
Lagged dependent variable, t-1	0.77***	−0.29***	−0.31***	−0.32***
	(0.03)	(0.06)	(0.05)	(0.04)
Observations	1,674	1,768	1,768	1,768
R^2	0.97	0.63	0.74	0.20
Adjusted R^2	0.97	0.61	0.72	0.15

NOTE: The regression is based on a panel of 68 MSA areas from 2013:Q1 to 2019:Q4. Commercial real estate prices are instrumented based on specification (2) in Table 5. All regressions include market, time fixed effects, and are weighted by the lagged bank credit. Heteroscedasticity and autocorrelation robust standard errors are clustered at the market level. Significant at *p<0.1; **p<0.05; ***p<0.01

Table 14: The effect of the collateral channel on the growth in establishments

	Dependent variable: Growth in establishments								
	Aggregate	Non-tradable				Tradable			
	All	1-9	10-99	100-499	500+	1-9	10-99	100-499	500+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\widehat{P_{m,t-1}}$ × Share real estate$_{m,t-1}$	21.26**	24.71*	19.25	−34.50	396.98	13.79	21.40	374.52***	142.39
	(10.42)	(13.86)	(20.51)	(54.86)	(276.88)	(30.87)	(36.80)	(132.09)	(460.83)
$\widehat{P_{m,t-1}}$	−1.96	0.34	−10.79	−3.23	−39.09	−9.05	−15.29	−89.68**	154.31
	(5.04)	(8.42)	(7.31)	(18.07)	(125.56)	(10.40)	(13.28)	(42.29)	(166.33)
Share real estate$_{m,t-1}$	−9.88**	−12.74*	−3.40	−9.79	−128.78*	−16.96*	6.01	−79.63**	163.43
	(4.39)	(7.50)	(7.29)	(19.90)	(65.05)	(8.91)	(9.76)	(39.25)	(137.43)
Share accounts receivable$_{m,t-1}$	−1.67	−5.05	7.40	−13.55	6.58	−14.29	18.46**	−24.14	227.39*
	(4.54)	(7.09)	(4.57)	(18.82)	(83.81)	(9.33)	(8.60)	(29.65)	(123.34)
Share cash and securities$_{m,t-1}$	−9.61**	−13.84	−5.03	−9.24	−78.38	−20.40**	8.75	−23.11	258.85**
	(4.45)	(8.38)	(6.90)	(19.15)	(69.11)	(9.12)	(9.13)	(40.33)	(129.10)
Share fixed assets$_{m,t-1}$	−4.06	−6.07	3.55	−3.74	−85.26	−16.95**	7.65	−29.30	157.14
	(4.39)	(8.26)	(5.80)	(21.01)	(69.31)	(7.49)	(7.97)	(40.39)	(96.42)
Share blanket lien$_{m,t-1}$	0.26	−1.33	5.53	−2.26	−54.62	−5.80	8.93	−5.27	106.86
	(3.64)	(6.18)	(4.58)	(13.90)	(56.27)	(8.21)	(7.73)	(29.07)	(81.89)
Share unsecured$_{m,t-1}$	−6.04	−12.68	2.02	9.31	−56.85	−7.36	13.71*	1.08	43.33
	(4.51)	(8.50)	(5.12)	(17.52)	(71.47)	(6.83)	(7.83)	(30.39)	(117.40)
Credit supply factor, $\beta_{m,t-1}$	0.003	−0.03	−0.02	0.27*	0.83	0.03	0.06	0.19	−0.28
	(0.03)	(0.05)	(0.04)	(0.15)	(1.48)	(0.06)	(0.10)	(0.28)	(0.91)
Credit demand low bank-dependent, t-1	0.02	0.04	0.01	−0.02	0.40	0.02	0.07**	0.05	−0.18
	(0.01)	(0.03)	(0.01)	(0.05)	(0.27)	(0.02)	(0.03)	(0.08)	(0.30)
Credit demand high bank-dependent, t-1	−0.06*	−0.10	−0.03***	0.03	−0.19	−0.02	−0.03	−0.31***	−0.25
	(0.04)	(0.07)	(0.01)	(0.08)	(0.20)	(0.02)	(0.04)	(0.05)	(0.36)
Lagged dependent variable, t-1	−0.14***	−0.20***	−0.28***	−0.32***	−0.38***	−0.27***	−0.35***	−0.23***	−0.35***
	(0.04)	(0.02)	(0.05)	(0.04)	(0.11)	(0.06)	(0.05)	(0.05)	(0.06)
Observations	372	372	372	372	372	372	372	372	361
R^2	0.69	0.44	0.64	0.57	0.48	0.49	0.41	0.41	0.53
Adjusted R^2	0.60	0.30	0.54	0.45	0.34	0.36	0.25	0.25	0.40

NOTE: The regressions are based on a panel of 68 MSA areas from 2013 to 2019. Commercial real estate prices are instrumented based on specification (2) in Table 5. All regressions include market and year fixed effects. Heteroscedasticity and autocorrelation robust standard errors are clustered at the market level. Significant at *p<0.1; **p<0.05; ***p<0.01

Table 15: The effects of the collateral channel during COVID-19 pandemic

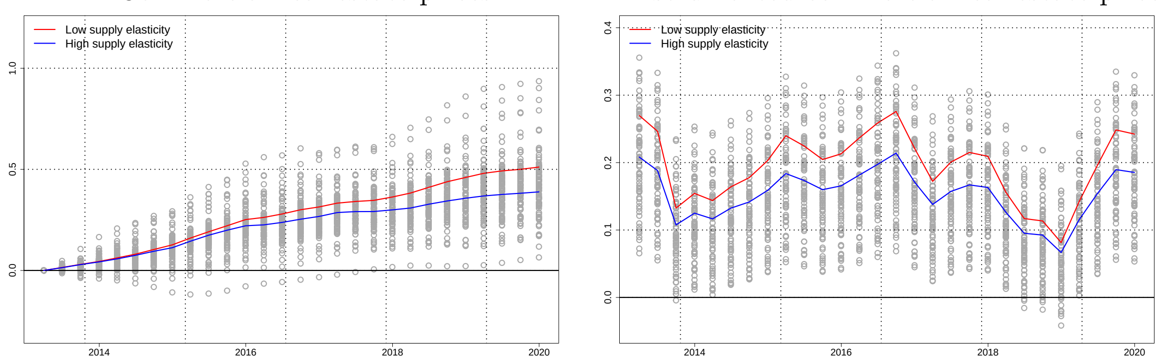
Statistic	mean	sd	p5	p25	p50	p75	p95
Commercial real estate price growth (pct)	-4.1	3.3	-8.2	-5.5	-4.1	-3	2.5
Credit growth to high bank-dependent (bps)	-313.7	267.1	-646.6	-443.6	-318.1	-223.1	201.8
Employment growth (bps)	-51.9	44.2	-107	-73.4	-52.7	-36.9	33.4
Establishment growth (bps)	-16.1	13.7	-33.2	-22.8	-16.3	-11.5	10.4
Change in the unemployment rate (bps)	2.9	2.5	-1.9	2.1	2.9	4.1	5.9

Note: The first row is the realized cumulative growth in the commercial real estate prices during the first year of the COVID-19 pandemic 2020:Q1 to 2021Q1. The rest of the rows calculate the implied changes in bank credit, employment growth, establishment growth, and the unemployment rate across the 68 markets in our sample based on the estimated collateral channel elasticities in Tables 12, 13, and 14.

8.2 Figures

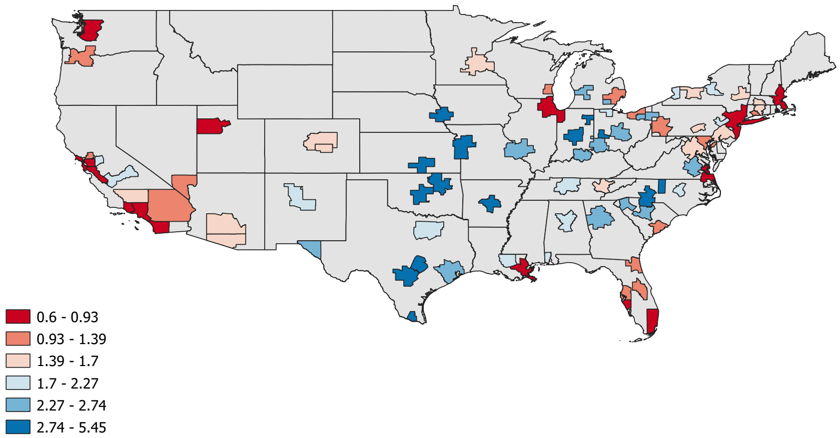
Figure 1: Commercial real estate prices

A. Commercial real estate prices B. Instrumented commercial real estate prices



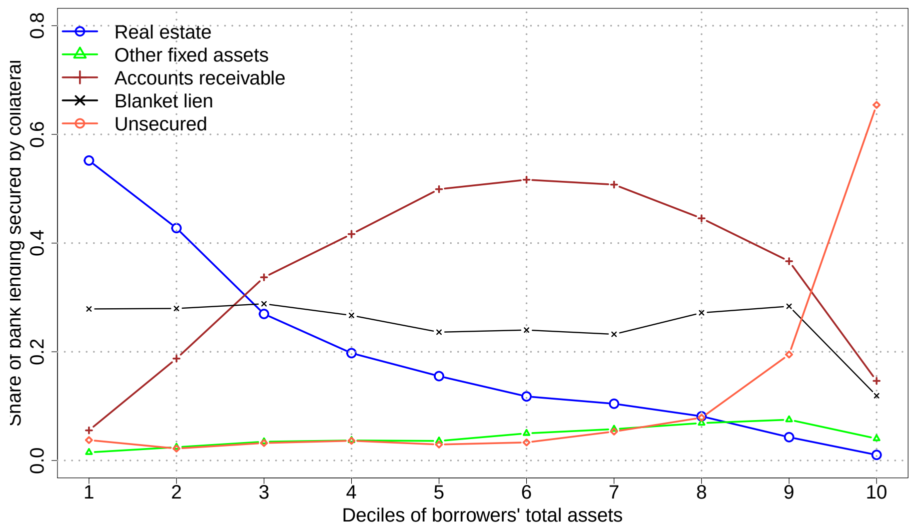
Note: The commercial real estate index is a composite price index of office, retail, industrial, and hotel properties. Each gray circle represents the market-level price index. Housing supply elasticities are obtained from Saiz (2010). Low supply elasticity markets are markets with supply elasticities in the first quartile, whereas high supply elasticity markets are those with supply elasticities in the third quartile. The instrumented commercial real estate prices are the fitted values of regression specification (2) in Table 5.
Source: CBRE Econometric Advisors, Saiz (2010), and authors' calculations.

Figure 2: Real estate supply elasticities by MSA



NOTE: The housing supply elasticities are plotted for the 68 MSA areas in our data. Blue color indicates markets with relatively low real estate supply elasticities (less then 1.7), whereas red color indicates markets with high real estate supply elasticities. SOURCE: Saiz (2010)

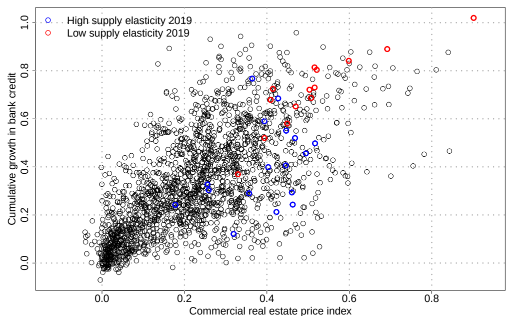
Figure 3: Collateral use in bank credit by firm size



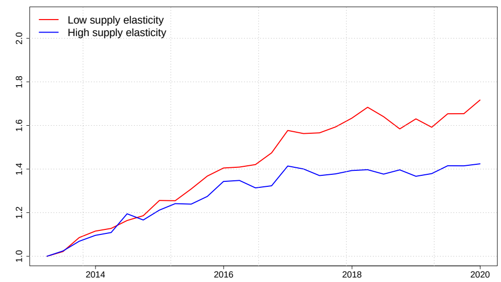
NOTE: For each decile of the firm size distribution, we compute the loan-volume share of loans secured by the particular type of collateral. FR Y-14 collect information on collateral at the credit facility level into seven mutually exclusive categories: real estate, cash and marketable securities, accounts receivable and inventories, fixed assets excluding real estate, blanket lien, other, and unsecured. SOURCE: Federal Reserve Form Y-14Q H1 Schedule and authors' calculations

Figure 4: Commercial real estate prices, bank credit, and employment growth

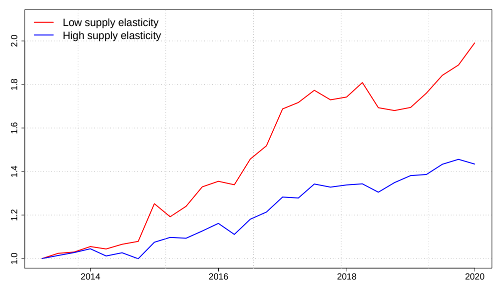
A. Commercial real estate prices and bank credit



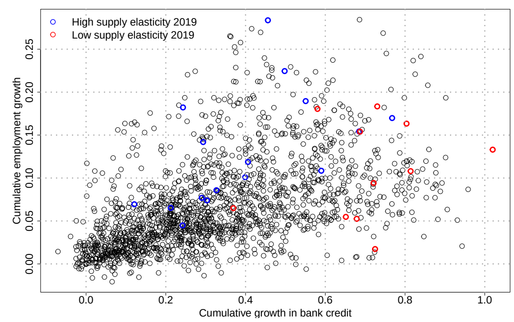
B. Credit to all borrowers



C. Credit to high bank-dependent borrowers



D. Bank credit and employment growth



Note: Panel A examines the cumulative growth in bank credit and commercial real estate prices across the different geographic areas over the sample period from 2012Q3 to 2019Q4. Panel B examines the cumulative growth in bank credit in low- and high-supply-elasticity markets over the sample period. Panel C examines the cumulative growth in bank credit in low- and high-supply-elasticity markets for high bank-dependent borrowers. Panel D examines the cumulative employment growth across the different geographic areas over the sample period 2012Q4 to 2019Q4 against commercial real estate prices. Red dots indicate low-supply-elasticity markets, whereas blue dots indicate high-supply-elasticity markets. Source: CBRE Econometric Advisors, Federal Reserve Form Y-14Q H1 Schedule, and Saiz (2010).

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A Data construction

Our main dataset is based on the FR Y-14Q schedule. The data are submitted by banks quarterly and contain the quarter-end loan balances of all commercial and industrial (C&I) loans with total committed amounts exceeding $1 million. We restrict the sample to U.S. domiciled nonfinancial borrowers containing consistent balance sheet and income statement information. We conduct a number of screens of the data to filter out outliers and inconsistent or stale information. For example, we verify that all balance sheet quantities are non-negative and satisfy the balance sheet identities. We also drop extreme observations that are in the 2.5 and 97.5 percentiles of the distribution for each variable.

We collapse the loan-level data to a bank-firm-market panel dataset by aggregating all outstanding credit facilities between a bank and a borrower. When we collapse the data, we make distinctions between term loans, credit lines, and the utilization on credit lines. We select the predominant form of collateral used based on the largest loans. We use the location of the headquarters of the borrower defined by a zip code to assign a borrower to a particular MSA area. We assume that the real estate collateral pledged is in the same location as the reported headquarters of the borrower. This assumption is very likely to be correct for the bulk of very small borrowers in our sample. We merge the FR Y-14 data with data on commercial real estate prices constructed by CBRE Econometric Advisors. We also restrict our sample to borrowers located in one of 68 major metropolitan statistical areas (MSAs) for which we have commercial real estate prices as well as real estate supply elasticities (Saiz, 2010).

We start with a sample of over 250,000 borrowers and after applying our different filters and validity checks, we are left with our final analysis sample that spans the period from 2013:Q1 to 2019:Q4 and consists of 32 bank holding companies that lend to 92,069 borrowing firms across 68 MSA-level markets. Below we describe the construction of each variable used in the regression analyses:

- $\Delta L_{f,b,t}$ is the annualized simple growth rate in total commitments (CLCOG074) of bank b to firm f in market m at time t. The distribution of this variable is a mixture of a discrete distribution of firms that do not experience any changes in their borrowing and firms that experience changes, and a continuous distribution of growth rates for firms that obtain new loans or refinance existing loans. Around 40 percent of our data records no changes in committed amounts. In our analysis, we exclude firms with no growth in commitments and to account for potential sample selection bias due to the exclusion of these observations, we implement a Tobit model in which we use the remaining maturity of a loan as a predictor for whether a firm would obtain a new loan or not. Adding the inverse Mills ratio to our baseline regression does not change our results. Results from this analysis are available upon request. Source: FR Y-14Q H1 schedule and authors' calculations.

- $\mathbb{I}\{\text{RE collateral}_{f,b,m,t}\}$ is a {0,1} dummy variable equal to 1 if the firm f in market m at time t uses real estate collateral as the dominant form of collateral for loans obtained from bank b. The dominant form of collateral is based on the loan amount. We do similar collapse for all the other collateral types. Source: FR Y-14Q H1 schedule and authors' calculations.

- $\Delta^c P_{m,t}$ is the average commercial real estate price in market m at time t. We take the average of the MSA-level price indices across retail, office, hotels, and industrial properties and normalize this index to 0 at the beginning of our sample. Source: CBRE Econometric Advisors

- $\text{Capital expenditures}_{f,t}$ represents the capital expenditures (CLCEM324) divided by total assets (CLCEM316) of f at time t. FR Y-14 reports capital expenditures net of depreciation. We exclude depreciation from our analysis and use gross capital expenditures. Source: FR Y-14Q H1 schedule and authors' calculations.

- $\text{Share of fixed assets}_{f,t}$ is the total amount of fixed assets (CLCEM316) divided by total firm assets (CLCE2170). Source: FR Y-14Q H1 schedule and authors' calculations.

- The firm loan demand factor $\alpha_{i,t}$ and the bank supply factor $\beta_{b,t}$ are constructed following Amiti and Weinstein (2018) and Degryse et al. (2019). To implement the decomposition, suppose there are N_B banks and N_F firm groups. Then define the total credit growth of firms in group i as $\Delta L_{i,t}$ and, similarly, the total lending growth of bank b as $\Delta L_{b,t}$. Let $D_{b,t-1}$ denote the set of borrowers of bank b and $B_{i,t-1}$ denote the set of banks that i firms borrow from. Then supply and demand factors are identified as a solution to the system of equations

$$\begin{aligned}\Delta L_{b,t} &= \beta_{b,t} + \sum_{j \in D_{b,t-1}} \omega_{b,j,t-1}\alpha_{j,t}, \text{for } b = 1, .., N_B \\ \Delta L_{i,t} &= \alpha_{i,t} + \sum_{l \in B_{i,t-1}} \tilde{\omega}_{i,l,t-1}\beta_{b,t}, \text{for } i = 1, .., N_F.\end{aligned} \tag{7}$$

where $\omega_{b,j,t-1} = \frac{L_{j,b,t-1}}{\sum_k L_{k,b,t-1}}$ and $\tilde{\omega}_{i,l,t-1} = \frac{L_{i,l,t-1}}{\sum_k L_{i,k,t-1}}$ are the lagged shares of credit from the respective counterparty j for bank b and bank l for firms i.[13] A desirable

[13]Because the system of equations contains $N_B + N_F$ unknowns but is only rank $N_B + N_F - 2$, the demand

feature of the Amiti-Weinstein decomposition is that it allows for easy aggregation by using the lagged loan volumes as weights. Source: FR Y-14Q H1 schedule and authors' calculations.

- Total assets$_{f,t}$ is the firm's total assets (CLCE2170). Source: FR Y-14Q H1 schedule

- Return no assets$_{f,t}$ is the firm's net income (CLCEM306) divided by the lag of total assets (CLCE2170). Source: FR Y-14Q H1 schedule and authors' calculations.

- Debt-to-assets$_{f,t}$ is the firm's total liabilities (CLCE2950) divided by its total assets (CLCE2170). Source: FR Y-14Q H1 schedule and authors' calculations.

- $\mathbb{I}\{\text{Investment grade}_{b,f,t}\}$ is a {0,1} dummy variable equal to 1 if the lender has assessed the borrower with a credit rating (CLCOG080) equivalent to BBB or higher. These credit ratings are assigned as part of the bank's reporting of risk-weighted assets to regulators. Source: FR Y-14Q H1 schedule and authors' calculations.

- $\mathbb{I}\{\text{High bank dependent}_{f,t}\}$ is a {0,1} dummy variable equal to 1 if the borrower is a non-publicly traded firm with bank credit of more than 50 percent of reported liabilities. We also classify borrowers with missing information on total liabilities as high bank-dependent. Source: FR Y-14Q H1 schedule and authors' calculations.

- Unemployment rate$_{m,t}$ is the quarterly unemployment rate in an MSA. Source: Bureau of Labor Statistics (BLS).

- Employment growth$_{m,t}$ is the annualized quarterly growth rate in employment by industry NAICs code and MSA area. Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages (BLS QCEW)

- Establishment growth$_{m,n,t}$ is the annualized quarterly growth rate in establishments by industry NAICs code and MSA area. Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages (BLS QCEW)

- Establishment growth by firm size$_{m,n,t}$ is the annual growth rate in establishments by industry NAICs code, MSA area, and firm size distribution. Source: Census Bureau, County Business Patterns datasets

and supply factors are identified relative to a reference bank and reference group of borrowers. We select the largest bank and borrower based on loan volume. Following Amiti and Weinstein (2018), we re-normalize the demand factors relative to median firm demand factor.

B A model of a collateral constrained firm

To provide intuition behind our baseline specification and empirical results, let us examine the problem of a firm that borrows from a bank. The firm starts with some level of capital (real estate) K_0 and net debt L_0 in period 0. The firm has an investment opportunity in the next period characterized by a production function $F(A_1, K_1) = A_1 K_1^{\eta}$ with $\eta < 1$. The next period capital of the firm is $K_1 = (1 - \psi)K_0 + I_1$ given a depreciation rate of capital equal to ψ. The amount borrowed needs to cover both investments in capital and the roll-over of existing debt $L_1 = I_1 + L_0$.

The productivity parameter A_1 is observable in period 0 but income is not pledgeable to the bank due to frictions such as moral hazard or limited commitment described in Holmstrom and Tirole (1997). However, the firm can pledge its capital to the bank and faces a collateral constraint $L_1 \leq \delta P_1 K_1$, where δ is the loan-to-value ratio that the bank imposes on the firm and P_1 is the price of capital in period 1. The firm optimizes period 1 profit

$$max_{K_1,L_1} \Big\{ A_1 K_1^{\eta} - P_1 I_1 - R L_1 \Big\} \tag{8}$$

subject to the collateral constraint and the law of motion of capital and loan balances. The first-order optimality condition for next period capital is given by

$$A_1 \eta K_1^{\eta - 1} = \lambda(1 - \delta P_1) + R - P_1, \tag{9}$$

where $\lambda \geq 0$ is the Lagrange multiplier on the collateral constraint. If the firm is not constrained by the value of its collateral relative to its borrowing needs, then $\lambda = 0$. The first-order condition is a standard optimality condition that equates the marginal product of capital with the user cost of capital. If the firm is credit constrained, then the user cost increases with the shadow cost of the constraint. We can solve for the optimal growth in the amount borrowed $\Delta L_1 \equiv L_1 - L_0$

$$\Delta L_1 = \begin{cases} \left(\frac{\eta A_1}{\lambda(1-\delta P_1)+R-P_1} \right)^{\frac{1}{1-\eta}} - (1-\psi)K_0, & \text{if constrained} \\ \left(\frac{\eta A_1}{R-P_1} \right)^{\frac{1}{1-\eta}} - (1-\psi)K_0, & \text{if unconstrained} \end{cases} \tag{10}$$

It is easy to verify that, keeping the price of collateral fixed, smaller (lower K_0) or more productive firms (higher A_1) borrow more, whereas more constrained firms ($\lambda > 0$) borrow less than unconstrained firms. While borrowing increases in the price of capital regardless of whether the firm is constrained or not, the sensitivity of borrowing to the price of capital is higher for the constrained firm. The sensitivity of borrowing to collateral values is reduced by more restrictive underwriting policies of the bank (lower δ).