Online Appendix for Adverse Selection in Corporate Loan Markets*

Mehdi Beyhaghi† Cesare Fracassi‡ Gregory Weitzner§

Abstract

We provide additional details on our data filters and include specific instructions from the Federal Reserve regarding their distinction between small business and corporate loans. We present additional descriptive statistics of the data and offer further analyses related to the adverse selection channel. We test the extent to which banks uniformly set loans rates across different markets and perform placebo tests using a sample of public firms. We show that our main results are robust to matching counties, controlling for county-level measures, using an alternative measure of the number of banks, splitting the sample across term loans and credit lines, and controlling for proxies of local loan demand, nonlinearities, and interaction terms. Additionally, we include further analysis regarding the GSIB shock and survey data on the prevalence of non-bank lenders in the markets we analyze. We provide more details on the AUC approach to measuring PD accuracy. Finally we show that the sensitivity of risk assessments to interest rates and loan performance does not change meaningfully with the number of banks in the market.

*The views expressed in this Online Appendix are those of the authors. They do not necessarily represent the views of the Federal reserve Board or the Federal Reserve System.

†Board of Governors of the Federal Reserve System. Email: mehdi.beyhaghi@rich.frb.gov.

‡University of Texas at Austin. Email: cesare.fracassi@mccombs.utexas.edu.

§McGill University. Email: gregory.weitzner@mcgill.ca.

Contents

1. Additional Details on Data Filters

In this section, we provide a detailed explanation of the data filtering process.

We begin with the universe of all newly issued commercial and industrial (C&I) loans to domestic US borrowers, excluding loans to government entities, individual borrowers, nonprofit organizations, financial firms, and special purpose entities in the Y-14Q dataset. Banks are required to report financials for all domestic C&I loan borrowers. Additionally, starting in the fourth quarter of 2014, banks were required to report their private risk assessments (i.e., probability of default and loss given default). Accordingly, we apply some initial filters which include excluding, borrowers with missing or nonzero assets, loans with missing or zero interest rates, and loans with missing or zero maturity or bank estimates of risk (PD and LGD).[1]

To keep focus on issues of local information asymmetry, we exclude loans to publicly traded firms (i.e., firms with a ticker) and syndicated loans, as these are typically sourced on a national rather than local level. The sample period begins in 2014Q4 and ends in 2019Q4 resulting in a starting sample of 41,099 loans extended to 25,892 borrowers.

We apply two groups of filters on this starting sample. The first group ensures that the loans in the sample are as comparable as possible in terms of interest rates. The second group addresses reporting errors. Detailed data cleaning steps, along with the number of observations dropped at each step, are provided in the following table.

[1]Interest rates are only reported in the quarter when the borrower makes a payment on the loan; otherwise, the interest rate is recorded as zero. This is particularly relevant for credit lines, as firms may not draw them down immediately. To address this, if the interest rate is reported as zero, we use the rate form the next quarter when it is available. Credit lines that remain undrawn for more than two quarters after initiation are excluded from the sample, as no interest rate is reported for these loans.

Data Cleaning Steps	Firms (Loans)	% dropped
Newly issued loans to US domestic private firms, with initial filters applied, excluding syndicated loans.	25,892 (41,099)	
Drop if loans less than $1mm since bank are only required to report loan commitments that are $1mm or more	25,861 (41,030)	0.12% (0.17%)
Drop loans with over 30 year maturity	25,823 (40,983)	0.12% (0.17%)
Drop if loan is guaranteed by the US government.	25,575 (40,699)	0.96% (0.69%)
Drop if loan is tax-exempt.	25,489 (40,536)	0.34% (0.40%)
Drop if loan is subordinated.	25,427 (40,439)	0.24% (0.24%)
Drop if loan has mixed interest (both floating and fixed) rate or entirely fee-based.	24,943 (39,525)	1.90% (2.26%)
Drop if loan has a prepayment penalty clause to ensure that the nonlinear effects of option-like features on interest rates do not influence our tests.	19,289 (27,583)	22.67% (30.21%)
In cases where an interest rate floor or an interest rate ceiling is specified for the loan, we keep only loans with reported interest rates between the reported floor and the reported ceiling. If an interest rate spread is reported for variable-rate loans, we ensure that the total interest rate is at least as much as the interest rate spread.	17,814 (25,123)	7.65% (8.92%)
Drop if loan amount exceeds borrower's book value of assets. Given that these are new loans extended within the quarter, it is reasonable to expect that the borrower's end-of-quarter book assets should exceed the loan amount. Firms sometimes report financials in different units (e.g., thousands or millions) instead of dollars, and there is no simple way to systematically adjust for these inconsistencies.	16,331 (23,111)	8.32% (8.01%)
Drop loans with PDs that exceed 99th percentile, or are reported as defaulted (rated D).	16,114 (22,809)	1.33% (1.31%)

Trim the sample on borrower size above the 99th percentile to ensure that results are not affected by the sample of public firms with unreported ticker information.	15,990 (22,642)	0.77% (0.73%)
Address overrepresentation by dropping borrowing firm with more than the 99th percentile in the total number of new loans over the sample. Almost all these firms are finance companies—more specifically equipment financing or leasing companies belonging to an industrial parent company. Because their reported NAICS code is the NAICS code of their parents they were not removed when we dropped financial firms.	15,960 (22,126)	0.19% (2.28%)
Finally, trim interest rates at the 1st and 99th percentiles to mitigate the effects of outliers.	15,827 (21,924)	0.83% (0.91%)

2. Detailed Federal Reserve Instructions

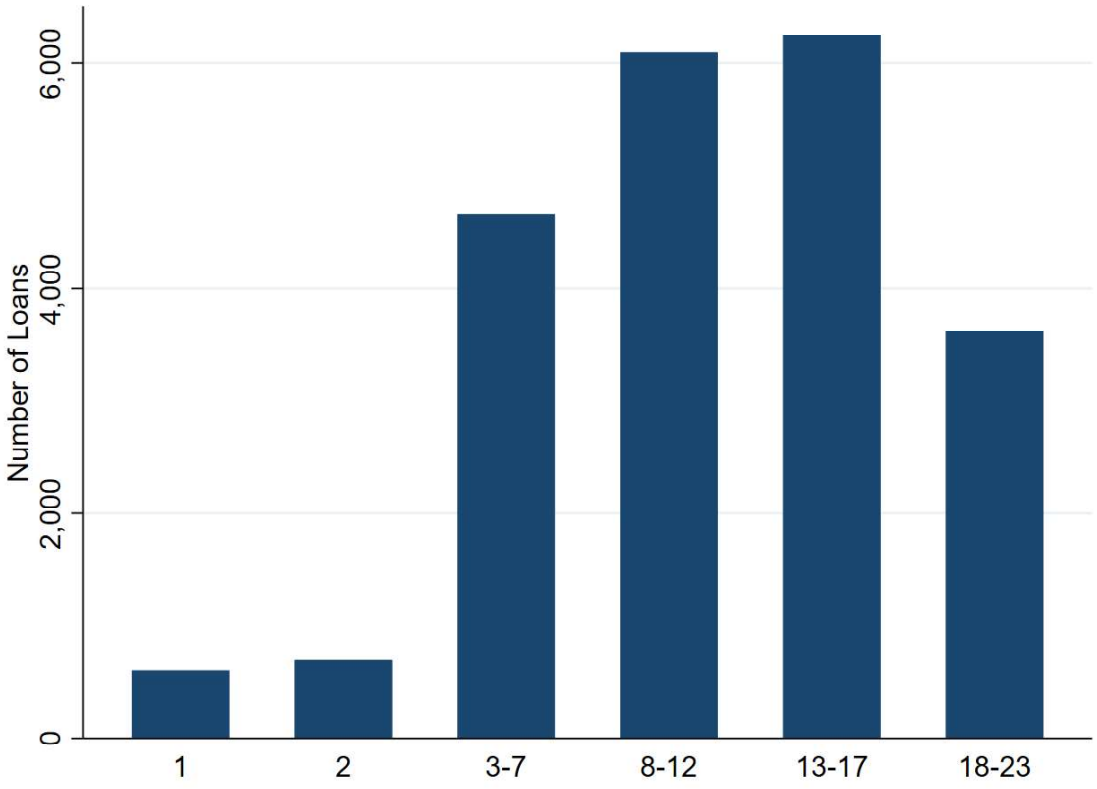
Below we include additional details from Federal Reserve instructions distinguishing the Fed's definition of "small business loans" versus "corporate loans". These instructions can be found at https://www.federalreserve.gov/reportforms/formsreview/FR%20Y-14Q_Instructions_DFAST_2021_Draft.pdf.

> "The main differentiating factor between corporate loans and small business loans is how the consolidated holding company evaluates the creditworthiness of the borrower. For corporate lending, banks look at the commercial operations process (commercial grading or internal risk rating) to assess credit risk. Therefore, corporate loans are loans that are "graded" or "rated" using the consolidated holding company's commercial credit rating system, as it is defined in the consolidated holding company's normal course of business. Meanwhile, for small business lending, banks look at the credit score of the borrower (scored rating) and/or use delinquency management. Therefore, small business loans are loans that are "scored" or "delinquency managed" for which a commercial internal risk rating is not used or that uses a different scale than other corporate loans." Federal Reserve (2022) See Federal Reserve Y-14Q's Instructions for the Capital Assessments and Stress Testing Information Collection at https://www.federalreserve.gov/reportforms/formsreview/FR%20Y-14Q_Instructions_DFAST_2021_Draft.pdf

3. Additional Summary Statistics

This section contains additional descriptive statistics. Figure 1 plots the total number of loans issued in counties with different numbers of banks. Table 1 includes correlations between the main loan characteristics we use as controls in the analysis. Table 2 includes a comparison of loan, firm and geographic characteristics for loans in counties with many banks versus those that are not.

Online Appendix Figure 1: Distribution of Loan Observations Across Market Structures



This figure plots the total number of loans issued in counties with different numbers of banks.

Online Appendix Table 1: Correlation Between Loan Characteristics

This table contains a correlation matrix between the main loan characteristics we use as controls in the analysis.

Variables	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
(i) Interest Rate	1.00						
(ii) Log(Maturity)	-0.02	1.00					
(iii) Log(Amount)	-0.18	0.13	1.00				
(iv) Guaranteed	-0.00	-0.04	-0.10	1.00			
(v) Line of Credit	0.01	-0.38	0.17	0.05	1.00		
(vi) Floating Interest Rate	-0.07	-0.22	0.15	0.08	0.34	1.00	
(vii) Senior Secured	0.12	0.05	-0.01	0.13	0.09	0.15	1.00

Online Appendix Table 2: Summary Statistics (Top Quartile of Number of Banks Versus the Rest of Sample)

This table contains summary statistics for loan-level, firm and geographic characteristics comparing firms in the top quartile of number of banks in a given quarter versus those in the bottom three quartiles.

	Top Quartile		Bottom 3 Quartiles	
	Mean	Median	Mean	Median
Amount (million USD)	7.54	2.75	6.78	2.54
Interest Rate (%)	3.74	3.74	3.58	3.57
Probability of Default (%)	1.42	0.90	1.26	0.77
Loss Given Default (%)	35.79	37.74	34.39	35.00
Expected Loss (%)	0.48	0.29	0.41	0.25
Floating Interest Rate	0.81	1.00	0.76	1.00
Guaranteed	0.48	0.00	0.51	1.00
Maturity (months)	40.18	36.00	43.31	40.00
Non-Performance (%)	2.30	0.00	1.79	0.00
Number of Prior Lenders	0.82	0.00	0.82	0.00
New Borrower	0.28	0.00	0.25	0.00
Line of Credit	0.53	1.00	0.46	0.00
Realized Default (%)	0.82	0.00	0.83	0.00
Secured	0.90	1.00	0.92	1.00
Secured by Blanket Lien	0.42	0.00	0.34	0.00
Stay Bank	0.74	1.00	0.77	1.00
GSIB	0.45	0.00	0.38	0.00
Assets (million USD)	175.03	22.94	130.72	24.35
Net Sales (million USD)	254.23	45.33	203.28	46.68
Leverage	0.32	0.29	0.35	0.32
Profitability	0.12	0.07	0.11	0.07
Tangibility	0.91	0.99	0.91	0.99
Number of Banks	16.35	15.00	6.66	7.00
Number of Banks (Annual)	8.37	8.00	2.95	3.00
Number of GSIBs (2015)	2.93	3.00	1.27	1.00
Number of All Banks	45.88	39.00	15.35	14.00
Population Density	7.76	7.64	5.85	5.94
Wages	9.66	9.61	9.34	9.33
Financial Industry Wages	10.06	10.00	9.61	9.59
Population	14.24	14.04	12.25	12.40
Deposit HHI	0.18	0.18	0.21	0.19
Loan HHI	0.31	0.29	0.70	0.70

4. Additional Analysis on Mechanism

This section contains additional tests regarding the adverse selection channel as well as the importance of aggregate bank-effects on interest rates. In Table 3 we test whether banks are more likely to specialize estimating the same regressions as in our main analysis but with a dummy variable that equals one if the bank is specializing in the industry of the borrower. Intuitively, specialization may help banks avoid adverse selection issues. The results suggest that banks do not appear to specialize more in markets with more banks. However, Table 8 of the main text suggests that banks may be protecting themselves from adverse selection through collateralization instead.

We also perform additional tests to show that loans in markets with more banks are not simply transactional loans. In the model of Petersen and Rajan (1995) in which there is no asymmetric information, markets with fewer banks first time borrowers are 1) more risky and 2) receive lower initial interest rates on a firm's first loan, followed by higher rates over the firm's subsequent borrowing. Intuitively, if markets are highly competitive, banks would have no incentives to fund new risky borrowers and give initial discounts to those borrowers as they cannot recoup future rents from them. To test this, we define a new borrower as a firm that has not appeared previously in the data[2] and test whether new borrowers receive better terms. The results are displayed in Table 4. The coefficient of interest is $New\ Borrower \times Number\ of\ Banks$ which is negative and statistically significant for PD and $Markup$. These results suggest that firms appear to receive better terms on their first loans in markets with more banks and that initial borrowers tend to be more risky. These results suggest that if anything markets with more banks are even less transactional than markets with few banks, perhaps because of the severity of adverse selection in these markets.

One concern could be that banks set loan rates uniformly across branches as they do

[2]Unfortunately, we cannot measure new borrowers perfectly because we only see loans on firms' balance sheets beginning in 2010.

with deposits (e.g., Granja and Paixao, 2023). However, given we use bank by time fixed effects throughout all of our analysis, our results already absorb any differences in aggregate bank-level rates. Nonetheless, we test the extent to which banks loan rates uniformly across branches as they do with deposits (e.g., Granja and Paixao (2023)). In Table 5, we compare the adjusted R-squared of the main specification of interest rates on number of banks (Table 5 of the main text) with and without bank-time fixed effects. The adjusted R-squared in Column (1) which includes bank/time fixed effects is about 8pp larger than in Column (2) which excludes them (52pp versus 44pp). Hence, while bank/time effects seem to explain some of the variation in lending terms, they do not appear to explain most of it. In fact, the relative explanatory power of the bank/time effects go down as we add additional controls to the specifications (Columns (3) - (6)).

Online Appendix Table 3: Market Structure and Bank Specialization

This table tests the relationship between the number of banks and banks' specialization. Specialization is a dummy variable that equals one if the bank specializes in that industry, where the specialization measure follows Paravisini, Rappoport, and Schnabl (2023). T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Specialization		
	(1)	(2)	(3)
Number of Banks	-0.000	-0.000	-0.000
	(0.623)	(0.231)	(0.434)
Log(Assets)		0.001	0.001
		(0.875)	(0.904)
Leverage		0.027***	0.026***
		(3.783)	(3.762)
Tangibility		-0.009	-0.009
		(0.838)	(0.841)
Profitability		0.001	0.001
		(0.128)	(0.094)
Population Density			0.002
			(1.121)
Wages			-0.013
			(0.915)
Financial Industry Wages			0.004
			(0.389)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	21,853	21,388	21,348
Adj. R-squared	0.39	0.40	0.40

Online Appendix Table 4: Market Structure and Relationship Dynamics

This table tests the relationship between the evolution of lending terms and borrower risk over time across market structure. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)	Probability of Default (%)	Interest Rate (%)
	(1)	(2)	(3)
New Borrower	0.219***	-0.095	0.228***
	(4.633)	(1.075)	(5.036)
New Borrower × Number of Banks	-0.004	0.010**	-0.005*
	(1.274)	(2.068)	(1.702)
Probability of Default (%)			0.085***
			(5.450)
Loss Given Default (%)			0.003***
			(3.483)
Expected Loss (%)			0.075*
			(1.711)
Log(Assets)	-0.143***	-0.124***	-0.126***
	(16.017)	(6.533)	(13.864)
Leverage	0.211***	0.887***	0.119***
	(5.657)	(10.350)	(3.238)
Tangibility	-0.685***	-0.323***	-0.633***
	(12.064)	(2.883)	(11.441)
Profitability	-0.388***	-1.782***	-0.206***
	(8.001)	(20.267)	(4.310)
Loan Controls	YES	YES	YES
County-Quarter FE	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	17,207	17,207	17,207
Adj. R-squared	0.59	0.31	0.61

Online Appendix Table 5: Market Structure and Interest Rates (The Effect of Bank-Time Fixed Effects)

This table tests the relationship between the number of banks and interest rates with and without bank-time fixed effects. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Number of Banks	0.012***	0.013***	0.013***	0.015***	0.009**	0.012***
	(6.338)	(7.357)	(6.318)	(6.838)	(2.433)	(3.139)
Log(Assets)			-0.151***	-0.163***	-0.152***	-0.164***
			(20.304)	(21.389)	(20.735)	(21.549)
Leverage			0.204***	0.300***	0.207***	0.303***
			(6.366)	(7.941)	(6.559)	(8.150)
Tangibility			-0.671***	-0.695***	-0.672***	-0.695***
			(14.876)	(14.027)	(14.922)	(14.055)
Profitability			-0.388***	-0.467***	-0.382***	-0.459***
			(9.027)	(9.499)	(9.070)	(9.638)
Population Density					-0.008	-0.007
					(0.369)	(0.380)
Wages					0.142	0.271***
					(1.479)	(2.818)
Financial Industry Wages					0.037	-0.077
					(0.569)	(1.071)
Loan Controls	YES	YES	YES	YES	YES	YES
Bank-Quarter FE	YES		YES		YES	
Industry-Quarter FE	YES	YES	YES	YES	YES	YES
Observations	21,853	21,868	21,388	21,404	21,348	21,364
Adj. R-squared	0.52	0.44	0.54	0.48	0.54	0.49

5. Placebo Tests on Public Firms

In this section, we perform a placebo test by reestimating our main results (Tables 5, 6 and 9) using a sample of public firms. We expect adverse selection to not be as severe a problem for large publicly traded firms as there is more publicly available information. Moreover, public firms can source their loans nationally rather than locally. Consistent with this hypothesis, we find no relationship between the number of banks in the county and interest rates, PDs and markups in Tables 6 - 8, respectively.

Online Appendix Table 6: Market Structure and Interest Rates (Public Firms)

This table tests the relationship between the number of banks and interest rates among publicly traded firms. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of Banks	0.005	0.006	-0.003
	(0.802)	(0.976)	(0.296)
Log(Assets)		-0.087***	-0.085***
		(4.418)	(4.332)
Leverage		0.606***	0.598***
		(4.740)	(4.687)
Tangibility		-0.304**	-0.299**
		(2.067)	(2.060)
Profitability		-1.481***	-1.498***
		(4.056)	(4.135)
Population Density			0.061*
			(1.752)
Wages			0.092
			(0.607)
Financial Industry Wages			-0.085
			(0.697)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	2,267	2,145	2,144
Adj. R-squared	0.54	0.57	0.57

Online Appendix Table 7: Market Structure and Borrower Risk (Public Firms)

This table tests the relationship between the number of banks and probability of default among publicly traded firms. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Probability of Default (%)		
	(1)	(2)	(3)
Number of Banks	-0.014	-0.006	0.005
	(1.203)	(0.606)	(0.421)
Log(Assets)		-0.169***	-0.172***
		(4.292)	(4.370)
Leverage		0.736**	0.752**
		(2.449)	(2.469)
Tangibility		0.513	0.500
		(1.432)	(1.401)
Profitability		-4.227***	-4.214***
		(4.098)	(4.038)
Population Density			-0.092
			(1.553)
Wages			0.156
			(0.432)
Financial Industry Wages			-0.048
			(0.184)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	2,267	2,145	2,144
Adj. R-squared	0.16	0.23	0.24

Online Appendix Table 8: Market Structure and Markups (Public Firms)

This table tests the relationship between the number of banks and markups among publicly traded firms. We refer to markups as any variation in interest rates after controlling for the risk of the loan. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of Banks	0.007	0.006	-0.004
	(1.200)	(1.051)	(0.484)
Probability of Default (%)	0.154***	0.158***	0.163***
	(4.437)	(5.332)	(5.407)
Loss Given Default (%)	0.004	0.005**	0.005**
	(1.542)	(2.173)	(2.345)
Expected Loss (%)	0.048	-0.021	-0.031
	(0.476)	(0.269)	(0.400)
Log(Assets)		-0.061***	-0.058***
		(3.244)	(3.069)
Leverage		0.502***	0.490***
		(4.380)	(4.248)
Tangibility		-0.339**	-0.332**
		(2.520)	(2.499)
Profitability		-0.912***	-0.925***
		(3.104)	(3.219)
Population Density			0.078**
			(2.416)
Wages			0.055
			(0.416)
Financial Industry Wages			-0.076
			(0.659)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	2,267	2,145	2,144
Adj. R-squared	0.57	0.60	0.60

6. Robustness Tests

In this section we perform several robustness tests. In Section 6.1 we show that our main results are robust to controlling for county-level rental rates. In Section 6.2 we perform a matching analysis. In Section 6.3 we show that our results are robust to using a measure of number of banks based on FDIC branch-level data as well as other measures of market concentration created using Y-14Q data. Finally, in Section 6.4 we show that our results regarding interest rates and markups hold across both term loans and credit lines.

6.1. Control for Rent

In this section we show that our main results are robust to controlling for county-level rental rates. We obtain monthly residential rent data from Zillow.[3] Table 9 reestimates Column (3) of Tables 5, 6 and 9, respectively including the log rental rate as an additional control. The point estimate is similar to the main analysis and statistically significant in all three specifications.

[3]Ideally we would have commercial rent data; however, Zillow does not provide it.

Online Appendix Table 9: Market Structure and Lending Outcomes Controlling for Rental Rates

This table tests the relationship between the number of banks and probability of default (PD), interest rates and markups after controlling for the log of average rental rates in the county. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)	Probability of Default (%)	Interest Rate (%)
	(1)	(2)	(3)
Number of Banks	0.006*	0.008**	0.006*
	(1.762)	(2.043)	(1.683)
Probability of Default (%)			0.062***
			(3.520)
Loss Given Default (%)			0.002***
			(2.622)
Expected Loss (%)			0.136***
			(2.877)
Log(Assets)	-0.150***	-0.133***	-0.132***
	(18.745)	(9.619)	(16.523)
Leverage	0.173***	0.938***	0.083**
	(5.106)	(10.826)	(2.564)
Tangibility	-0.692***	-0.254***	-0.646***
	(14.385)	(2.710)	(13.838)
Profitability	-0.366***	-1.758***	-0.188***
	(8.484)	(23.136)	(4.358)
Population Density	-0.004	0.052***	-0.009
	(0.225)	(3.039)	(0.530)
Wages	0.055	-0.127	0.074
	(0.504)	(0.931)	(0.693)
Financial Industry Wages	-0.058	-0.127	-0.049
	(0.701)	(0.875)	(0.594)
Rent	0.272***	0.084	0.256***
	(4.965)	(1.040)	(4.770)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	17,525	17,525	17,525
Adj. R-squared	0.54	0.25	0.56

6.2. Matching Estimation

In this section we perform a matched analysis to address the concern that linear controls may not fully capture the relationship between various county characteristics and interest rates, borrower risk and markups. To address this issue, we follow the approach in Scharfstein and Sunderam (2016), suggested by Imbens (2015).

Like Scharfstein and Sunderam (2016), in each quarter, we estimate the probability that a county has high number of banks based on county characteristics. Specifically, we estimate a logit regression predicting *Treated*, which equals one if the county is in the top quartile of number of banks that quarter, on county-level controls which include population density, overall average wages, average wages in the financial sector, and population, all in logs. Panel A of Online Appendix Table 10 shows the results of this first stage. The last three county characteristics are positive and statistically significant, with a pseudo R-squared of 67%.

We then match each treated county to the closest untreated county in that quarter in terms of propensity scores calculated from the logit regression in the first stage. Following Scharfstein and Sunderam (2016), we restrict the sample in two ways. We first exclude counties where the estimated propensity score is close to zero (specifically less than 0.2) or close to one (specifically greater than 0.8) to ensure that the overlap assumption holds. We also exclude matches where the difference between the propensity score of the nearest neighbor and the treated is more than one quarter of the standard deviation of the propensity scores in the first stage.

We then rerun our main analyses relating number of banks to interest rates, PDs and markups in the matched sample by replacing number of banks with the treated dummy. Panels B, C, and D show the results for interest rate, PD, and markup, respectively. Column (1) of each table shows the full matched sample with propensity scores between 0.2 and 0.8. The estimates are consistent with the main analysis in the paper. Given that the filtering drops a significant number of observations, we lose the statistical significance in one of the regressions, but the economic magnitude is comparable. Columns (2) - (4) of each table

break down the effect based on different ranges of propensity scores, i.e., 0.2 to 0.4, 0.4 to 0.6 and 0.6 to 0.8. That is, we estimate the baseline regression, restricting the sample to counties whose propensity score is in the range specified in the column heading. We do not find statistically different results across propensity scores bins. However, because the first stage pseudo R-squared is high, few counties have low propensity scores, and thus columns (2) and (3) have fewer observations, and thus larger standard errors, than column (4).

Finally, Panel E shows that the covariates are well-balanced in our matched sample. We do this by regressing the treated dummy on each of the county-level variables.

Online Appendix Table 10: Matching Counties

Panel A: Estimated Propensity Score

	Treated
	(1)
Population Density	0.075
	(1.237)
Wages	4.524***
	(8.951)
Financial Industry Wages	0.995***
	(2.910)
Population	3.307***
	(29.233)
Quarter FE	YES
Observations	8,026
Pseudo R-squared	0.67

Panel B: Estimated Treatment Effect on Interest Rate

	Full matched sample	P-score [.2, .4]	P-score [.4, .6]	P-score [.6, .8]
	(1)	(2)	(3)	(4)
Treated	0.103***	0.320*	0.034	0.196**
	(2.671)	(1.929)	(0.512)	(2.393)
Log(Assets)	-0.161***	-0.126**	-0.212***	-0.137***
	(8.570)	(2.323)	(7.100)	(4.819)
Leverage	0.281***	0.408	0.432**	0.317***
	(4.130)	(1.099)	(2.294)	(3.213)
Tangibility	-0.819***	-0.843*	-0.939***	-0.704***
	(7.131)	(1.822)	(3.677)	(3.155)
Profitability	-0.251**	0.219	-0.169	-0.454***
	(2.322)	(0.516)	(0.895)	(3.065)
Population Density	-0.023	-0.081	0.040	-0.000
	(0.650)	(0.682)	(0.582)	(0.005)
Wages	0.473**	0.784	-0.095	-0.762
	(2.355)	(0.443)	(0.112)	(0.765)
Financial Industry Wages	-0.076	-0.042	0.408	-0.443
	(0.493)	(0.039)	(1.112)	(1.501)
Population	0.232***	-0.002	0.294	-0.692
	(2.742)	(0.002)	(0.454)	(1.228)
Loan Controls	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES
Observations	4,128	380	1,316	2,039
Adj. R-squared	0.64	0.73	0.78	0.66

Panel C: Estimated Treatment Effect on PD

	Full matched sample	P-score [.2, .4]	P-score [.4, .6]	P-score [.6, .8]
	(1)	(2)	(3)	(4)
Treated	0.066	-0.072	0.033	0.116
	(0.999)	(0.174)	(0.166)	(1.079)
Log(Assets)	-0.153***	-0.116	-0.163***	-0.156***
	(4.748)	(1.243)	(3.988)	(3.105)
Leverage	0.577***	1.634*	1.537***	0.080
	(3.285)	(1.949)	(3.346)	(0.353)
Tangibility	-0.413**	-0.627	-0.070	-0.262
	(2.252)	(0.706)	(0.146)	(0.759)
Profitability	-1.910***	-0.607	-1.625***	-1.887***
	(10.008)	(0.636)	(5.213)	(5.612)
Population Density	0.024	0.280	0.017	0.003
	(0.447)	(0.634)	(0.124)	(0.022)
Wages	0.406	-0.246	-0.902	-1.021
	(0.900)	(0.073)	(0.660)	(0.674)
Financial Industry Wages	-0.232	0.951	-0.137	-0.669
	(0.774)	(0.645)	(0.133)	(1.377)
Population	0.268	1.251	0.305	-0.797
	(1.654)	(0.476)	(0.330)	(1.033)
Loan Controls	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES
Observations	4,128	380	1,316	2,039
Adj. R-squared	0.24	0.34	0.42	0.31

Panel D: Estimated Treatment Effect on Markup

	Full matched sample	P-score [.2, .4]	P-score [.4, .6]	P-score [.6, .8]
	(1)	(2)	(3)	(4)
Treated	0.089**	0.303*	0.059	0.167**
	(2.293)	(2.035)	(0.789)	(2.249)
Probability of Default (%)	0.140***	0.107	0.165**	0.139***
	(4.534)	(1.190)	(2.508)	(3.006)
Loss Given Default (%)	0.004**	0.004	0.008***	0.002
	(2.246)	(0.670)	(2.895)	(0.644)
Expected Loss (%)	0.074	0.190	-0.261	0.220
	(0.806)	(0.505)	(1.200)	(1.631)
Log(Assets)	-0.134***	-0.101**	-0.193***	-0.104***
	(7.450)	(2.099)	(6.865)	(3.341)
Leverage	0.192***	0.169	0.323*	0.296***
	(2.954)	(0.466)	(1.893)	(3.230)
Tangibility	-0.744***	-0.691	-0.914***	-0.656***
	(6.657)	(1.560)	(3.640)	(3.124)
Profitability	0.024	0.275	-0.082	-0.078
	(0.261)	(0.629)	(0.409)	(0.617)
Population Density	-0.030	-0.111	0.032	-0.002
	(0.910)	(0.969)	(0.431)	(0.023)
Wages	0.426**	0.921	-0.125	-0.555
	(2.016)	(0.582)	(0.136)	(0.652)
Financial Industry Wages	-0.053	-0.175	0.473	-0.295
	(0.320)	(0.173)	(1.330)	(0.898)
Population	0.190**	-0.113	0.275	-0.516
	(2.333)	(0.122)	(0.435)	(1.077)
Loan Controls	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES
Observations	4,128	380	1,316	2,039
Adj. R-squared	0.67	0.75	0.79	0.70

Panel E: Covariate Balance in Matched Pairs

	Number of Banks	Population Density	Wages	Financial Sector Wages	Population
	(1)	(2)	(3)	(4)	(5)
treated	5.891***	0.136	0.046	0.079	0.133
	(9.227)	(0.892)	(0.972)	(1.189)	(1.143)
Quarter FE	YES	YES	YES	YES	YES
Observations	3,642	3,642	3,642	3,642	3,642
R-squared	0.64	0.01	0.11	0.18	0.02

6.3. Alternative Measure of Number of Banks

In this section we show that our main results are robust to measuring the number of banks in a county based on FDIC Summary of Deposits branch data as well as different measures of market concentration using Y-14Q data. We also discuss

We calculate the number of banks based on the number of unique intuitions that have branches in each county, in a given year. In order to count a bank, they must be either a national member bank, state member bank, state non-member bank, or a savings/savings and loans bank. These institutional categories make up 99.8% of the branches in the data. We also require branches to be a full service brick and mortar office (90.8% are in this category). Tables 11 - 13 recreate Tables 5, 6 and 9 in the main text by analyzing the relationship between market structure (as measured using the FDIC branch data), interest rates, PDs and markups, respectively.

Table 14 shows that our results are robust to different measures of market concentration (e.g., HHI) and measuring markets at the MSA level. It also shows that deposit HHI is not related to loan interest rates.

Online Appendix Table 11: Market Structure (Based on Branch Data) and Interest Rates

This table tests the relationship between the number of banks with commercial lending branches in a county and interest rates. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of All Banks	0.003***	0.003***	0.002***
	(5.103)	(4.974)	(3.616)
Log(Assets)		-0.151***	-0.152***
		(20.221)	(20.689)
Leverage		0.200***	0.206***
		(6.188)	(6.512)
Tangibility		-0.673***	-0.675***
		(14.805)	(14.933)
Profitability		-0.389***	-0.382***
		(9.049)	(9.104)
Population Density			-0.005
			(0.290)
Wages			0.188*
			(1.900)
Financial Industry Wages			0.010
			(0.145)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	21,833	21,368	21,329
Adj. R-squared	0.52	0.54	0.54

Online Appendix Table 12: Market Structure (Based on Branch Data) and Borrower Risk

This table tests the relationship between the number of banks with commercial lending branches in a county and probability of default (PD). T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Probability of Default (%)		
	(1)	(2)	(3)
Number of All Banks	0.002***	0.002***	0.001*
	(3.038)	(3.982)	(1.764)
Log(Assets)		-0.138***	-0.137***
		(10.758)	(10.708)
Leverage		0.960***	0.962***
		(11.554)	(11.616)
Tangibility		-0.232***	-0.228***
		(2.701)	(2.665)
Profitability		-1.821***	-1.826***
		(24.597)	(24.814)
Population Density			0.053***
			(3.662)
Wages			-0.129
			(1.132)
Financial Industry Wages			-0.034
			(0.322)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	21,833	21,368	21,329
Adj. R-squared	0.17	0.23	0.23

Online Appendix Table 13: Market Structure (Based on Branch Data) and Markups

This table tests the relationship between the number of banks with commercial lending branches in a county and markups. We refer to markups as any variation in interest rates after controlling for the risk of the loan. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of All Banks	0.003***	0.003***	0.002***
	(4.799)	(4.700)	(3.566)
Probability of Default (%)	0.076***	0.064***	0.065***
	(4.684)	(3.964)	(4.031)
Loss Given Default (%)	0.003***	0.002***	0.002***
	(4.384)	(2.995)	(2.974)
Expected Loss (%)	0.154***	0.142***	0.142***
	(3.537)	(3.303)	(3.321)
Log(Assets)		-0.132***	-0.134***
		(17.871)	(18.256)
Leverage		0.104***	0.110***
		(3.318)	(3.577)
Tangibility		-0.627***	-0.628***
		(14.244)	(14.355)
Profitability		-0.200***	-0.192***
		(4.721)	(4.634)
Population Density			-0.011
			(0.609)
Wages			0.208**
			(2.179)
Financial Industry Wages			0.005
			(0.070)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	21,833	21,368	21,329
Adj. R-squared	0.55	0.56	0.56

Online Appendix Table 14: Market Concentration and Interest Rates

This table tests the relationship between alternative measures of market concentration and interest rates. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county or MSA depending on whether county or MSA measures of concentration are used in the regression. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Loan HHI	-0.190***	-0.205***						
	(4.411)	(4.597)						
Number of Banks MSA			0.009***	0.009***				
			(5.414)	(5.380)				
MSA Loan HHI					-0.173***	-0.177***		
					(4.175)	(4.240)		
Deposit HHI							-0.126	-0.105
							(1.080)	(0.885)
Log(Assets)		-0.150***		-0.149***		-0.149***		-0.149***
		(20.225)		(20.330)		(20.008)		(20.210)
Leverage		0.201***		0.201***		0.197***		0.193***
		(6.207)		(6.212)		(6.013)		(5.892)
Tangibility		-0.674***		-0.672***		-0.680***		-0.677***
		(14.863)		(14.766)		(14.833)		(14.832)
Profitability		-0.387***		-0.387***		-0.388***		-0.383***
		(8.977)		(9.063)		(9.004)		(8.854)
Loan Controls	YES	YES	YES	YES	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	21,853	21,388	21,853	21,388	21,375	20,916	21,853	21,388
Adj. R-squared	0.52	0.54	0.52	0.54	0.52	0.54	0.52	0.54

6.4. Loan Fees / Splits by Credit Lines and Term Loans

One concern is that we do not observe loan fees in our data. If lenders substitute between fees and interest rates, differences in fees could potentially explain part of our results regarding interest rates. However, while fees can affect interest rates, they should not explain the differences in PDs we observe across markets given that PDs are entirely based on the risk of the borrower. Hence, at least a part of the reason interest rates are higher in markets with more banks should be due to the higher risk of those borrowers, which is the central prediction of adverse selection models. Second, to the extent that fees are correlated with the costs of processing loans, the impact of fees should be mitigated by controlling for county-level labor and rental costs. Third, syndicated loans Berg, Saunders, and Steffen (2016) and mortgages Buchak and Jørring (2021) are often originated and then sold off, i.e., "originate to distribute", while the loans in our sample are all held on balance sheet. Hence, we would expect the forces that affect fees for these loans to be quite different. For example, Berg, Saunders, and Steffen (2016) show that fees are highly affected by the structure of the syndicated and the number of lead arrangers. Finally, fees are far more prevalent among credit lines than term loans (Berg, Saunders, and Steffen (2016)). In Tables 15 - 18, we show that our results for interest rate and markup are very similar if we split the sample across credit lines and term loans.

Online Appendix Table 15: Market Structure and Interest Rates (Credit Lines Only)

This table tests the relationship between the number of banks and interest rates among credit lines only. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of Banks	0.014***	0.015***	0.010**
	(5.989)	(6.314)	(2.317)
Log(Assets)		-0.147***	-0.147***
		(13.717)	(13.871)
Leverage		0.178***	0.186***
		(3.954)	(4.152)
Tangibility		-0.714***	-0.709***
		(9.714)	(9.635)
Profitability		-0.334***	-0.323***
		(6.083)	(6.062)
Population Density			0.002
			(0.092)
Wages			0.132
			(1.076)
Financial Industry Wages			0.016
			(0.214)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	10,844	10,581	10,568
Adj. R-squared	0.55	0.56	0.56

Online Appendix Table 16: Market Structure and Markups (Credit Lines Only)

This table tests the relationship between the number of banks and markups across lines of credit among credit lines only. We refer to markups as any variation in interest rates after controlling for the risk of the loan. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of Banks	0.013***	0.014***	0.009**
	(5.948)	(6.122)	(2.342)
Probability of Default (%)	0.097***	0.086***	0.086***
	(6.845)	(6.492)	(6.430)
Loss Given Default (%)	0.003***	0.002**	0.002**
	(3.062)	(2.454)	(2.391)
Expected Loss (%)	0.081*	0.083*	0.084*
	(1.750)	(1.929)	(1.955)
Log(Assets)		-0.128***	-0.128***
		(11.935)	(12.051)
Leverage		0.078*	0.085**
		(1.807)	(1.989)
Tangibility		-0.665***	-0.661***
		(9.195)	(9.134)
Profitability		-0.121**	-0.111**
		(2.296)	(2.165)
Population Density			-0.003
			(0.123)
Wages			0.126
			(1.076)
Financial Industry Wages			0.024
			(0.326)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	10,844	10,581	10,568
Adj. R-squared	0.57	0.58	0.58

Online Appendix Table 17: Market Structure and Interest Rates (Term Loans Only)

This table tests the relationship between the number of banks and interest rates among term loans only. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of Banks	0.010***	0.011***	0.008**
	(4.135)	(4.423)	(2.316)
Log(Assets)		-0.161***	-0.163***
		(16.250)	(16.686)
Leverage		0.290***	0.289***
		(6.729)	(6.713)
Tangibility		-0.569***	-0.575***
		(9.650)	(9.725)
Profitability		-0.473***	-0.471***
		(7.829)	(7.801)
Population Density			-0.021
			(1.238)
Wages			0.140
			(1.423)
Financial Industry Wages			0.065
			(0.805)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	10,934	10,725	10,698
Adj. R-squared	0.52	0.55	0.55

Online Appendix Table 18: Market Structure and Markups (Term Loans Only)

This table tests the relationship between the number of banks and markups across term loans among term loans only. We refer to markups as any variation in interest rates after controlling for the risk of the loan. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Number of Banks	0.009***	0.010***	0.006*
	(3.873)	(4.084)	(1.923)
Probability of Default (%)	0.060**	0.045*	0.048**
	(2.520)	(1.777)	(1.993)
Loss Given Default (%)	0.003***	0.002*	0.002*
	(3.111)	(1.815)	(1.878)
Expected Loss (%)	0.229***	0.199***	0.195***
	(3.961)	(3.154)	(3.213)
Log(Assets)		-0.140***	-0.142***
		(14.832)	(15.217)
Leverage		0.203***	0.201***
		(4.890)	(4.869)
Tangibility		-0.525***	-0.530***
		(9.099)	(9.187)
Profitability		-0.301***	-0.296***
		(4.880)	(4.798)
Population Density			-0.023
			(1.435)
Wages			0.199**
			(2.037)
Financial Industry Wages			0.055
			(0.658)
Loan Controls	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	10,934	10,725	10,698
Adj. R-squared	0.55	0.57	0.57

6.5. Controlling for Demand

In this section we show that our results regarding interest rates, PDs and markups are robust to controlling for various proxies for loan demand. The proxies include new business applications per capita, number of establishments per capita, jobs growth, wages growth, business applications growth, establishment growth, and number of bank branches per capita.

Online Appendix Table 19: Market Structure and Interest Rates with Additional Loan Demand Controls

This table tests the relationship between the number of banks and interest rates, controlling for various measures of loan demand at the county level. T-statistics are shown below the parameter estimates in parentheses and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of Banks	0.009**	0.009**	0.008**	0.007**	0.008**	0.009**	0.007*
	(2.429)	(2.476)	(2.333)	(2.069)	(2.402)	(2.450)	(1.875)
Log(Assets)	-0.152***	-0.152***	-0.152***	-0.152***	-0.152***	-0.152***	-0.151***
	(20.719)	(20.724)	(20.740)	(20.670)	(20.680)	(20.739)	(20.734)
Leverage	0.207***	0.207***	0.208***	0.208***	0.207***	0.207***	0.208***
	(6.550)	(6.539)	(6.577)	(6.585)	(6.552)	(6.563)	(6.580)
Tangibility	-0.672***	-0.673***	-0.672***	-0.670***	-0.671***	-0.672***	-0.679***
	(14.925)	(14.928)	(14.928)	(14.874)	(14.930)	(14.930)	(15.070)
Profitability	-0.382***	-0.382***	-0.383***	-0.387***	-0.383***	-0.381***	-0.382***
	(9.060)	(9.062)	(9.091)	(9.165)	(9.085)	(9.056)	(9.065)
Population Density	-0.008	-0.007	-0.006	-0.011	-0.008	-0.007	-0.009
	(0.372)	(0.330)	(0.280)	(0.539)	(0.368)	(0.352)	(0.441)
Wages	0.142	0.140	0.120	0.149	0.143	0.140	0.148
	(1.480)	(1.454)	(1.259)	(1.557)	(1.498)	(1.464)	(1.577)
Financial Industry Wages	0.037	0.033	-0.009	0.016	0.039	0.036	0.067
	(0.576)	(0.506)	(0.141)	(0.248)	(0.606)	(0.560)	(1.039)
Jobs Growth	0.135						
	(0.552)						
Wages Growth		0.099					
		(1.059)					
Establishment Per Capita			3.338***				
			(2.947)				
Business Applications Per Capita				5.691***			
				(2.827)			
Number of Establishments Growth					1.037*		
					(1.932)		
Business Applications Growth						-0.046	
						(0.546)	
Number of Branches Per Capita							-0.347**
							(2.337)
Loan Controls	YES	YES	YES	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Observations	21,345	21,345	21,348	21,348	21,348	21,345	21,329
Adj. R-squared	0.54	0.54	0.54	0.54	0.54	0.54	0.54

Online Appendix Table 20: Market Structure and Borrower Risk with Additional Loan Demand Controls

This table tests the relationship between the number of banks and probability of default (PD), controlling for various measures of loan demand at the county level. T-statistics are shown below the parameter estimates in parentheses and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Probability of Default (%)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of Banks	0.009**	0.009**	0.009**	0.009**	0.009**	0.009**	0.009**
	(2.312)	(2.231)	(2.335)	(2.302)	(2.347)	(2.326)	(2.137)
Log(Assets)	-0.137***	-0.137***	-0.137***	-0.137***	-0.137***	-0.137***	-0.137***
	(10.758)	(10.812)	(10.755)	(10.765)	(10.771)	(10.764)	(10.746)
Leverage	0.961***	0.962***	0.962***	0.961***	0.961***	0.961***	0.962***
	(11.655)	(11.649)	(11.644)	(11.654)	(11.645)	(11.653)	(11.676)
Tangibility	-0.232***	-0.232***	-0.232***	-0.232***	-0.232***	-0.232***	-0.229***
	(2.718)	(2.721)	(2.715)	(2.714)	(2.720)	(2.714)	(2.667)
Profitability	-1.828***	-1.828***	-1.828***	-1.828***	-1.827***	-1.828***	-1.827***
	(24.866)	(24.823)	(24.860)	(24.919)	(24.881)	(24.920)	(24.834)
Population Density	0.045***	0.042***	0.045***	0.045***	0.045***	0.044***	0.045***
	(3.164)	(3.096)	(3.311)	(3.121)	(3.163)	(3.154)	(3.151)
Wages	-0.169	-0.163	-0.180	-0.169	-0.169	-0.169	-0.172
	(1.536)	(1.490)	(1.597)	(1.542)	(1.538)	(1.536)	(1.555)
Financial Industry Wages	-0.034	-0.018	-0.057	-0.033	-0.035	-0.032	-0.034
	(0.325)	(0.184)	(0.521)	(0.324)	(0.336)	(0.313)	(0.304)
Jobs Growth	0.051						
	(0.103)						
Wages Growth		-0.363*					
		(1.714)					
Establishment Per Capita			1.675				
			(1.087)				
Business Applications Per Capita				-0.143			
				(0.055)			
Number of Establishments Growth					-0.464		
					(0.467)		
Business Applications Growth						0.059	
						(0.403)	
Number of Branches Per Capita							0.026
							(0.137)
Loan Controls	YES	YES	YES	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Observations	21,345	21,345	21,348	21,348	21,348	21,345	21,329
Adj. R-squared	0.23	0.23	0.23	0.23	0.23	0.23	0.23

Online Appendix Table 21: Market Structure and Markups with Additional Loan Demand Controls

This table tests the relationship between the number of banks and markups, controlling for various time-varying measures of loan demand at the county level. We refer to markups as any variation in interest rates after controlling for the risk of the loan. T-statistics are shown below the parameter estimates in parentheses and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of Banks	0.008**	0.008**	0.007**	0.007**	0.008**	0.008**	0.006*
	(2.340)	(2.398)	(2.223)	(1.967)	(2.305)	(2.362)	(1.753)
Probability of Default (%)	0.064***	0.065***	0.064***	0.065***	0.065***	0.064***	0.065***
	(3.991)	(4.039)	(3.961)	(3.999)	(3.999)	(3.989)	(4.043)
Loss Given Default (%)	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(2.957)	(2.976)	(2.949)	(2.982)	(2.963)	(2.950)	(2.965)
Expected Loss (%)	0.142***	0.142***	0.142***	0.142***	0.142***	0.142***	0.142***
	(3.334)	(3.342)	(3.327)	(3.333)	(3.328)	(3.330)	(3.329)
Log(Assets)	-0.133***	-0.133***	-0.133***	-0.133***	-0.133***	-0.133***	-0.133***
	(18.254)	(18.259)	(18.297)	(18.218)	(18.226)	(18.274)	(18.235)
Leverage	0.111***	0.110***	0.112***	0.112***	0.111***	0.111***	0.112***
	(3.618)	(3.604)	(3.659)	(3.657)	(3.623)	(3.634)	(3.645)
Tangibility	-0.625***	-0.626***	-0.625***	-0.623***	-0.624***	-0.625***	-0.633***
	(14.325)	(14.326)	(14.320)	(14.267)	(14.323)	(14.331)	(14.480)
Profitability	-0.192***	-0.192***	-0.193***	-0.197***	-0.193***	-0.192***	-0.192***
	(4.617)	(4.612)	(4.640)	(4.747)	(4.646)	(4.614)	(4.633)
Population Density	-0.012	-0.011	-0.011	-0.016	-0.012	-0.012	-0.014
	(0.624)	(0.571)	(0.530)	(0.796)	(0.620)	(0.600)	(0.706)
Wages	0.165*	0.163*	0.145	0.172*	0.166*	0.164*	0.172*
	(1.791)	(1.761)	(1.586)	(1.881)	(1.811)	(1.775)	(1.891)
Financial Industry Wages	0.032	0.027	-0.011	0.011	0.034	0.031	0.062
	(0.501)	(0.419)	(0.169)	(0.168)	(0.532)	(0.483)	(0.965)
Jobs Growth	0.128						
	(0.515)						
Wages Growth		0.120					
		(1.316)					
Establishment Per Capita			3.104***				
			(2.808)				
Business Applications Per Capita				5.746***			
				(2.787)			
Number of Establishments Growth					1.090**		
					(2.047)		
Business Applications Growth						-0.052	
						(0.634)	
Number of Branches Per Capita							-0.350**
							(2.404)
Loan Controls	YES	YES	YES	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Observations	21,345	21,345	21,348	21,348	21,348	21,345	21,329
Adj. R-squared	0.56	0.56	0.57	0.57	0.56	0.56	0.57

6.6. Interactions and Non-Linearities

In this section we show that our main results regarding interest rates, PDs and markups are robust to interacting observables with number of banks and including nonlinear squared terms.

In Tables 25 - 24 we reestimate Tables 5, 6 and 9 of the main text on interest rates PDs and markups, but interact number of banks with county and firm/loan controls. Across all specifications the average marginal effect remains positive and only marginally changes from the baseline estimates in the main text.

We also show that our results on interest rates and market structure are robust to a two-stage regression. Specifically, we first compute the residual from a fully saturated model of observables and bank assessments predicting interest rate (residual of Online Appendix 25, Column (2)) and then regress the residual on the number of banks in the market. In Table 26, we compare a specification where the first stage does not have the interaction variables (Column (1)) with a specification where the first stage includes a fully saturated model (Column (2)). The coefficient on number of banks is positive and significant in both columns, and it is basically unchanged, further suggesting that nonlinearities and interactions do not materially affect the relationship between the number of banks and interest rates.

In Tables 27 - 29 we reestimate Tables 5, 6 and 9 of the main text on interest rates PDs and markups, but include squared terms of observables. Across all outcome variables the average marginal effect of the number of banks is basically unaffected.

Online Appendix Table 22: Market Structure and Interest Rates (Interactions with Firm and Loan Characteristics)

This table tests the relationship between the number of banks and interest rates, with interactions between the number of banks and firm-level and loan-level characteristics. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)	
	(1)	(2)
Number of Banks	0.009**	0.054***
	(2.433)	(2.981)
Log(maturity)	-0.005	0.017
	(0.605)	(1.056)
Log(Amount)	-0.068***	-0.076***
	(7.721)	(4.824)
Guaranteed	0.018	0.099***
	(1.018)	(3.253)
Log(Assets)	-0.152***	-0.140***
	(20.735)	(11.041)
Leverage	0.207***	0.365***
	(6.559)	(5.411)
Tangibility	-0.672***	-0.350***
	(14.922)	(3.362)
Profitability	-0.382***	-0.402***
	(9.070)	(4.147)
Number of Banks × Log(maturity)		-0.002*
		(1.758)
Number of Banks × Log(Amount)		0.001
		(0.616)
Number of Banks × Guaranteed		-0.007***
		(2.685)
Number of Banks × Log(Assets)		-0.001
		(1.102)
Number of Banks × Leverage		-0.013***
		(2.661)
Number of Banks × Tangibility		-0.027***
		(3.689)
Number of Banks × Profitability		0.002
		(0.307)
Population Density	-0.008	-0.007
	(0.369)	(0.351)

Continued on next page

Continued from previous page

Wages	0.142	0.137
	(1.479)	(1.428)
Financial Industry Wages	0.037	0.036
	(0.569)	(0.550)
Average Marginal Effect NOB	0.009	0.009
p-value NOB	0.015	0.015
Loan Purpose FE	YES	YES
Loan Type FE	YES	YES
Bank-Quarter FE	YES	YES
Industry-Quarter FE	YES	YES
Observations	21,348	21,348
Adj. R-squared	0.5435	0.5444

Online Appendix Table 23: Market Structure and Borrower Risk (Interactions with Firm and Loan Characteristics)

This table tests the relationship between the number of banks and probability of default (PD), with interactions between the number of banks and firm-level and loan-level characteristics. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Probability of Default (%)	
	(1)	(2)
Number of Banks	0.009**	-0.005
	(2.330)	(0.139)
Log(maturity)	-0.120***	-0.076**
	(6.586)	(2.408)
Log(Amount)	0.086***	0.059*
	(5.350)	(1.664)
Guaranteed	-0.107***	-0.116**
	(4.013)	(2.128)
Log(Assets)	-0.137***	-0.144***
	(10.764)	(6.105)
Leverage	0.961***	0.860***
	(11.648)	(7.500)
Tangibility	-0.232***	0.049
	(2.715)	(0.300)
Profitability	-1.828***	-2.163***
	(24.871)	(11.773)
Number of Banks × Log(maturity)		-0.004*
		(1.715)
Number of Banks × Log(Amount)		0.002
		(0.725)
Number of Banks × Guaranteed		0.001
		(0.157)
Number of Banks × Log(Assets)		0.000
		(0.252)
Number of Banks × Leverage		0.008
		(1.001)
Number of Banks × Tangibility		-0.024*
		(1.792)
Number of Banks × Profitability		0.026**
		(2.094)
Population Density	0.045***	0.045***
	(3.164)	(3.198)

Continued on next page

Continued from previous page

Wages	-0.169	-0.166
	(1.536)	(1.499)
Financial Industry Wages	-0.034	-0.036
	(0.327)	(0.346)
Average Marginal Effect NOB	0.009	0.009
p-value NOB	0.020	0.024
Loan Purpose FE	YES	YES
Loan Type FE	YES	YES
Bank-Quarter FE	YES	YES
Industry-Quarter FE	YES	YES
Observations	21,348	21,348
Adj. R-squared	0.2336	0.2339

Online Appendix Table 24: Market Structure and Markups (Interactions with Firm and Loan Characteristics)

This table tests the relationship between the number of banks and markups, with interactions between the number of banks and firm-level and loan-level characteristics. We refer to markups as any variation in interest rates after controlling for the risk of the loan. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors. clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)	
	(1)	(2)
Number of Banks	0.008**	0.053***
	(2.343)	(3.104)
Probability of Default (%)	0.064***	0.054**
	(3.988)	(2.278)
Loss Given Default (%)	0.002***	0.001
	(2.950)	(0.647)
Expected Loss (%)	0.142***	0.228***
	(3.330)	(3.135)
Number of Banks × Probability of Default (%)		0.001
		(0.435)
Number of Banks × Loss Given Default (%)		0.000
		(1.052)
Number of Banks × Expected Loss (%)		-0.007
		(1.153)
Log(maturity)	0.011	0.030*
	(1.200)	(1.911)
Log(Amount)	-0.071***	-0.080***
	(8.527)	(5.336)
Guaranteed	0.026	0.109***
	(1.504)	(3.739)
Log(Assets)	-0.133***	-0.118***
	(18.270)	(9.708)
Leverage	0.111***	0.269***
	(3.630)	(4.177)
Tangibility	-0.625***	-0.324***
	(14.322)	(3.143)
Profitability	-0.192***	-0.150
	(4.627)	(1.593)
Number of Banks × Log(maturity)		-0.002
		(1.559)

Continued on next page

Continued from previous page

Number of Banks × Log(Amount)		0.001
		(0.715)
Number of Banks × Guaranteed		-0.007***
		(2.970)
Number of Banks × Log(Assets)		-0.001
		(1.412)
Number of Banks × Leverage		-0.013***
		(2.797)
Number of Banks × Tangibility		-0.025***
		(3.377)
Number of Banks × Profitability		-0.003
		(0.429)
Population Density	-0.012	-0.013
	(0.620)	(0.626)
Wages	0.165*	0.161*
	(1.789)	(1.727)
Financial Industry Wages	0.032	0.033
	(0.494)	(0.507)
Average Marginal Effect NOB	0.008	0.008
p-value NOB	0.019	0.020
Loan Purpose FE	YES	YES
Loan Type FE	YES	YES
Bank-Quarter FE	YES	YES
Industry-Quarter FE	YES	YES
Observations	21,348	21,348
Adj. R-squared	0.5646	0.5656

Online Appendix Table 25: Risk Assessments and Interest Rates (Interactions with Firm and Loan Characteristics)

This table examines how banks' internal risk assessments predict loan interest rates, with interactions between risk assessments and firm-level and loan-level characteristics. T-statistics are shown below the parameter estimates in parentheses and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)	
	(1)	(2)
Probability of Default (%)	0.065***	-0.186**
	(3.965)	(2.175)
Loss Given Default (%)	0.002***	0.007
	(2.989)	(0.726)
Expected Loss (%)	0.143***	0.136***
	(3.303)	(3.560)
Log(maturity)	0.010	0.033*
	(1.074)	(1.738)
Log(Amount)	-0.070***	-0.078***
	(8.285)	(3.672)
Guaranteed	0.023	0.034
	(1.292)	(0.903)
Log(Assets)	-0.130***	-0.139***
	(17.785)	(9.231)
Leverage	0.097***	0.181**
	(3.032)	(1.985)
Tangibility	-0.629***	-0.643***
	(14.239)	(5.704)
Profitability	-0.191***	-0.380***
	(4.527)	(2.582)
Probability of Default (%) × Log(maturity)		0.024***
		(4.779)
Probability of Default (%) × Log(Amount)		0.013***
		(2.729)
Probability of Default (%) × Guaranteed		-0.015
		(1.356)
Probability of Default (%) × Log(Assets)		0.007***
		(2.714)
Probability of Default (%) × Leverage		-0.057***
		(3.238)
Probability of Default (%) × Tangibility		-0.114***
		(3.950)

Continued on next page

Continued from previous page

Probability of Default (%) × Profitability		0.152***
		(4.232)
Loss Given Default (%) × Log(maturity)		-0.002***
		(3.624)
Loss Given Default (%) × Log(Amount)		-0.000
		(0.521)
Loss Given Default (%) × Guaranteed		0.000
		(0.276)
Loss Given Default (%) × Log(Assets)		0.000
		(0.221)
Loss Given Default (%) × Leverage		0.000
		(0.035)
Loss Given Default (%) × Tangibility		0.005**
		(2.067)
Loss Given Default (%) × Profitability		0.001
		(0.393)
Average Marginal Effect PD	0.065	0.091
p-value PD	0.000	0.000
Average Marginal Effect LGD	0.002	0.003
p-value LGD	0.003	0.000
Loan Purpose FE	YES	YES
Loan Type FE	YES	YES
Bank-Quarter FE	YES	YES
Industry-Quarter FE	YES	YES
Observations	21,388	21,388
Adj. R-squared	0.56	0.57

Online Appendix Table 26: Market Structure and Interest Rates (Two-Stage Regression)

This table tests the relationship between the number of banks and interest rates using a two-stage regression. The dependent variables in this table are the residuals from Models 1 and 2 in Online Appendix Table 25. T-statistics are shown below the parameter estimates in parentheses and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Residual from Baseline Model	Residual from Saturated Model
	(1)	(2)
Number of Banks	0.010***	0.010***
	(11.526)	(11.485)
Constant	-0.118***	-0.116***
	(10.292)	(10.256)
Observations	21,388	21,388
Adj. R-squared	0.01	0.01

Online Appendix Table 27: Market Structure and Interest Rates (Non-linear Effects of Firm and Loan Characteristics)

This table tests the relationship between the number of banks and interest rates, incorporating squared terms of firm-level and loan-level characteristics to capture potential non-linear effects. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)	
	(1)	(2)
Number of Banks	0.009**	0.013***
	(2.433)	(4.330)
Log(maturity)	-0.005	-0.001
	(0.605)	(0.031)
Log(Amount)	-0.068***	-0.383**
	(7.721)	(2.573)
Guaranteed	0.018	0.020
	(1.018)	(1.132)
Log(Assets)	-0.152***	-0.998***
	(20.735)	(12.527)
Leverage	0.207***	0.281***
	(6.559)	(3.392)
Tangibility	-0.672***	-1.536***
	(14.922)	(5.240)
Profitability	-0.382***	-0.954***
	(9.070)	(10.249)
Population Density	-0.008	-0.140***
	(0.369)	(3.094)
Wages	0.142	-1.978
	(1.479)	(0.844)
Financial Industry Wages	0.037	-0.848
	(0.569)	(0.671)
Log(maturity)^2		0.001
		(0.148)
Log(Amount)^2		0.011**
		(2.213)
Log(Assets)^2		0.024***
		(10.265)
Leverage^2		-0.132
		(1.311)
Tangibility^2		0.634***
		(3.139)

Continued on next page

Continued from previous page

Profitability^2		0.715***
		(7.272)
Population Density^2		0.010**
		(2.479)
Wages^2		0.109
		(0.888)
Financial Industry Wages^2		0.041
		(0.637)
Loan Purpose FE	YES	YES
Loan Type FE	YES	YES
Bank-Quarter FE	YES	YES
Industry-Quarter FE	YES	YES
Observations	21,348	21,348
Adj. R-squared	0.54	0.55

Online Appendix Table 28: Market Structure and Borrower Risk (Non-linear Effects of Firm and Loan Characteristics)

This table tests the relationship between the number of banks and probability of default (PD), incorporating squared terms of firm-level and loan-level characteristics to capture potential non-linear effects. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Probability of Default (%)	
	(1)	(2)
Number of Banks	0.009**	0.011***
	(2.330)	(3.323)
Log(maturity)	-0.120***	-0.205**
	(6.586)	(2.191)
Log(Amount)	0.086***	-0.594*
	(5.350)	(1.917)
Guaranteed	-0.107***	-0.079***
	(4.013)	(3.055)
Log(Assets)	-0.137***	-0.217
	(10.764)	(1.138)
Leverage	0.961***	0.540**
	(11.648)	(2.110)
Tangibility	-0.232***	-0.325
	(2.715)	(0.690)
Profitability	-1.828***	-4.631***
	(24.871)	(26.824)
Population Density	0.045***	-0.002
	(3.164)	(0.046)
Wages	-0.169	-0.703
	(1.536)	(0.206)
Financial Industry Wages	-0.034	1.884
	(0.327)	(0.837)
Log(maturity)^2		0.016
		(1.044)
Log(Amount)^2		0.022**
		(2.183)
Log(Assets)^2		0.002
		(0.371)
Leverage^2		0.362
		(0.997)
Tangibility^2		0.114
		(0.336)

Continued on next page

Continued from previous page

Profitability^2		3.735***
		(21.414)
Population Density^2		0.003
		(0.800)
Wages^2		0.026
		(0.147)
Financial Industry Wages^2		-0.097
		(0.856)
Loan Purpose FE	YES	YES
Loan Type FE	YES	YES
Bank-Quarter FE	YES	YES
Industry-Quarter FE	YES	YES
Observations	21,348	21,348
Adj. R-squared	0.23	0.26

Online Appendix Table 29: Market Structure and Markups (Non-linear Effects of Firm and Loan Characteristics)

This table tests the relationship between the number of banks and markups, incorporating squared terms of firm-level and loan-level characteristics to capture potential non-linear effects. We refer to markups as any variation in interest rates after controlling for the risk of the loan. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors. clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)	
	(1)	(2)
Number of Banks	0.008**	0.012***
	(2.343)	(4.187)
Probability of Default (%)	0.064***	0.064***
	(3.988)	(4.376)
Loss Given Default (%)	0.002***	0.002***
	(2.950)	(3.036)
Expected Loss (%)	0.142***	0.132***
	(3.330)	(3.360)
Log(maturity)	0.011	0.025
	(1.200)	(0.552)
Log(Amount)	-0.071***	-0.344**
	(8.527)	(2.375)
Guaranteed	0.026	0.024
	(1.504)	(1.454)
Log(Assets)	-0.133***	-0.936***
	(18.270)	(11.980)
Leverage	0.111***	0.225***
	(3.630)	(2.805)
Tangibility	-0.625***	-1.512***
	(14.322)	(5.410)
Profitability	-0.192***	-0.488***
	(4.627)	(5.506)
Population Density	-0.012	-0.141***
	(0.620)	(3.195)
Wages	0.165*	-1.535
	(1.789)	(0.691)
Financial Industry Wages	0.032	-1.168
	(0.494)	(0.962)
Log(maturity)^2		-0.001
		(0.116)
Log(Amount)^2		0.009**
		(1.984)

Continued on next page

Continued from previous page

Log(Assets)^2		0.023***
		(9.978)
Leverage^2		-0.161
		(1.591)
Tangibility^2		0.644***
		(3.344)
Profitability^2		0.339***
		(3.678)
Population Density^2		0.010**
		(2.491)
Wages^2		0.087
		(0.751)
Financial Industry Wages^2		0.057
		(0.923)
Loan Purpose FE	YES	YES
Loan Type FE	YES	YES
Bank-Quarter FE	YES	YES
Industry-Quarter FE	YES	YES
Observations	21,348	21,348
Adj. R-squared	0.56	0.57

7. Additional GSIB Analysis

In this section we include additional analysis regarding the GSIB shock.

In Figure 2 we reestimate Figure 11 of the main text, but include all syndicated loans and loans to public firms we find no drop in aggregate lending. In Table 30 we show that the results regarding number of banks and loan volume in Table 10 of the main text are robust to estimating these regressions at the county-year and county-quarter level, respectively. In Table 31 we show that the drop in number of banks is specifically driven by a drop in GSIBs, not non-GSIBs and in Table 32 we show that the drop in lending volume following the GSIB shock is driven by GSIB banks.

One concern could be that GSIBs cut back lending to the riskiest borrowers following the imposition of the surcharges, rather than there being a reduction in market-wide adverse selection. To test this alternative channel, we estimate the following regression:

$$y_l = \beta GSIB_l \times Post_t + \Gamma X_l + \delta_b + \alpha_{i,t} + u_l,$$

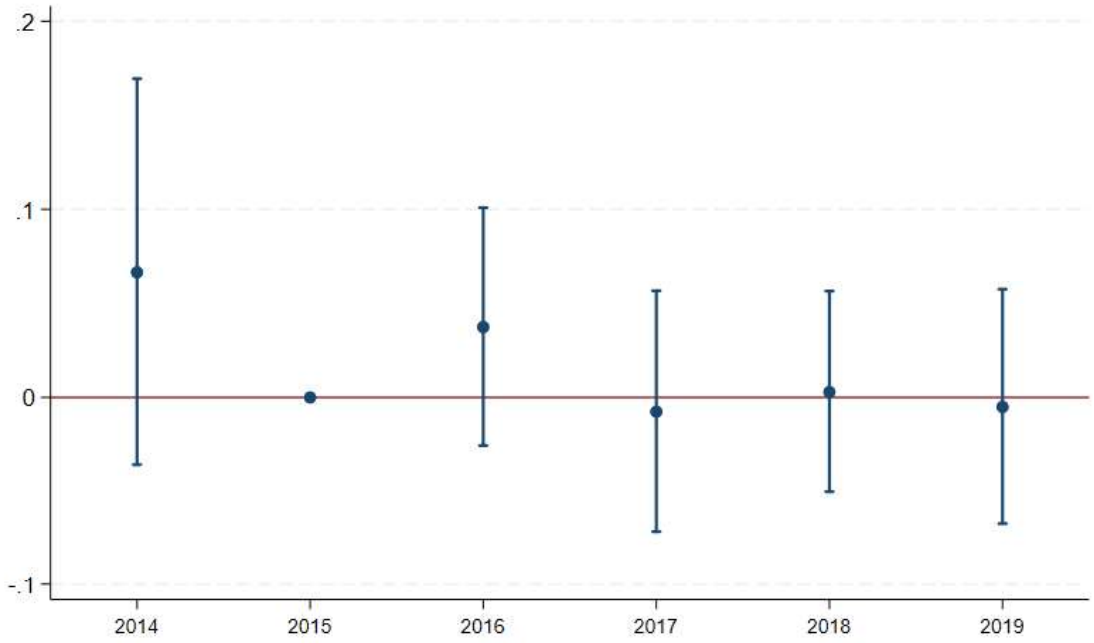
where y_l is a loan/firm-level outcome variable, $GSIB$ is a dummy variable that equals one if the bank making the loan is a GSIB, $Post$ is a dummy variable that equals one if the loan is made in 2016 or later, X_l is the same set of loan-controls we use throughout the GSIB analysis, δ_b are bank fixed effects and $\alpha_{i,t}$ are industry-quarter fixed effects. We cluster our standard errors by county.

Table 33 displays the results. In Column (1) PD is the dependent variable and the interaction coefficient is positive and statistically insignificant. This result suggests that GSIB banks are not simply cutting back lending to high-risk borrowers. In Columns (2) - (4), we also include our other main firm-level control variables as outcomes variables (i.e., log(assets), leverage, tangibility and profitability). Among these, only log(assets) is statistically significant. In fact, the coefficient is negative which is consistent with the results on PD as it appears, if anything, the GSIBs are lending more to smaller, riskier borrowers.

To further address this concern, in Tables 34 and 35, we also reestimate our reduced form difference-in-difference regression and IV analysis of Tables 12 and 13 of the main text, but restrict the sample to non-GSIBs. We find similar and even slightly stronger results than in our main analysis, suggesting that the results are not simply due to the GSIBs cutting back lending to higher risk borrowers.

In Table 36, we analyze which types of counties are most affected by the capital surcharges. Specifically, we regress the change in number of banks and the change in the number of GSIBs in the county following the imposition of the surcharges on various aggregate county-level variables interacted with the number of GSIBs in the county prior to the surcharge.

Online Appendix Figure 2: The Effect of GSIB Surcharges on Lending Volume (All Loans)



This figure plots estimated regression coefficients with 90% confidence intervals from a version of regression equation (7) from the main text with annual interaction terms and the log of loan volume as the dependent variable but including public and syndicated loans in the sample. Standard errors are clustered by county.

Online Appendix Table 30: The Effect of GSIB Surcharges on the Number of Banks and Lending Volume

This table contains difference-in-differences regressions testing how the number of GSIB banks in a county prior to the surcharges affects the number of banks and lending volume after the imposition of the surcharges. Column (1) is at the county-year level and the sample period is 2015Q1 - 2019Q4. Column (2) is at the county-quarter level and the sample period is 2014Q4 - 2019Q4. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Number of Banks	log(Loan Volume)
	(1)	(2)
Post × Number of GSIBs (2015)	-0.314***	-0.178***
	(6.812)	(6.916)
Observation Level	County-Year	County-Quarter
County FE	YES	YES
Year FE	YES	
Quarter FE		YES
Observations	2,815	6,744
Adj. R-squared	0.81	0.36

Online Appendix Table 31: The Effect of GSIB Surcharges on the Number of GSIB and Non-GSIB Banks

This table contains difference-in-differences regressions testing how the number of GSIB banks in a county prior to the surcharges affects the number of GSIB and non-GSIB banks after the imposition of the surcharges. The sample period is 2015Q1 - 2019Q4 in all specifications. Columns (1) and (3) are at the loan level, while Columns (2) and (4) are at the county-year level. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Number of GSIBs		Number of Non-GSIBs	
	(1)	(2)	(3)	(4)
Post × Number of GSIBs (2015)	-0.237***	-0.386***	0.037	0.064
	(7.344)	(13.513)	(0.424)	(1.516)
Observation Level	Loan	County-Year	Loan	County-Year
Loan Controls	YES		YES	
Bank-County FE	YES		YES	
Bank-Quarter FE	YES		YES	
Industry-Quarter FE	YES		YES	
County FE		YES		YES
Year FE		YES		YES
Observations	12,697	2,815	12,697	2,815
Adj. R-squared	0.84	0.63	0.86	0.71

Online Appendix Table 32: The Effect of GSIB Surcharges on GSIB and Non-GSIB Bank Loan Volume

This table contains difference-in-differences regressions testing how the number of GSIB banks in a county prior to the surcharges affects the amount of GSIB and non-GSIB lending volume after the imposition of the surcharges. The sample period is 2014Q4 - 2019Q4 in all specifications. Columns (1) and (3) are at the loan level, while Columns (2) and (4) are at the county-quarter level. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	GSIB log(Loan Volume)		Non-GSIB log(Loan Volume)	
	(1)	(2)	(3)	(4)
Post × Number of GSIBs (2015)	-0.125**	-0.208***	-0.050	-0.047*
	(2.535)	(4.398)	(1.273)	(1.704)
Observation Level	Loan	County-Quarter	Loan	County-Quarter
Loan Controls	YES		YES	
Bank-County FE	YES		YES	
Bank-Quarter FE	YES		YES	
Industry-Quarter FE	YES		YES	
County FE		YES		YES
Quarter FE		YES		YES
Observations	10,127	3,689	11,972	4,978
Adj. R-squared	0.58	0.24	0.59	0.29

Online Appendix Table 33: Changes in GSIB Lending Behavior

This table tests whether GSIBs change their lending behavior relative to non-GSIBs after the imposition of the surcharges. Specifically we estimate the following regression:

$$y_l = \beta GSIB_l \times Post_t + \Gamma X_l + \delta_b + \alpha_{i,t} + u_l,$$

where $GSIB$ is a dummy variable that equals one if the bank making the loan is a GSIB, $Post$ is a dummy variable that equals one if the loan is made in 2016 or later, X_l is the same set of loan-controls we use throughout the GSIB analysis, δ_b are bank fixed effects and $\alpha_{i,t}$ are industry-quarter fixed effects. The analysis is conducted at the loan level, covering the period from 2014 to 2019 for all specifications. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Probability of Default (%)	Log(Assets)	Leverage	Tangibility	Profitability
	(1)	(2)	(3)	(4)	(5)
GSIB× Post	0.087	-0.259***	-0.003	-0.007	0.001
	(1.123)	(5.001)	(0.316)	(1.173)	(0.187)
Loan Controls	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES	YES
Observations	16,023	16,023	15,676	15,983	16,023
Adj. R-squared	0.16	0.42	0.21	0.20	0.10

Online Appendix Table 34: GSIB Surcharges and Market Outcomes (Reduced Form Difference-in-Differences, Non-GSIBs Only)

This table contains reduced form difference-in-differences regressions testing whether the number of GSIBs induces changes in market outcomes following the imposition of capital surcharges, restricting the sample to loans granted by non-GSIBs. The sample period is 2014Q4 - 2019Q4 except for Column (1) which is 2015Q1 - 2019Q4 in order to calculate the number of banks based on a full year. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Number of Banks	log(Loan Volume)	Interest Rate (%)	Probability of Default (%)	Interest Rate (%)
	(1)	(2)	(3)	(4)	(5)
Post × Number of GSIBs (2015)	-0.157*	-0.084***	-0.052**	-0.084	-0.041*
	(1.931)	(2.950)	(2.421)	(1.638)	(1.870)
Probability of Default (%)					0.070**
					(2.576)
Loss Given Default (%)					0.004***
					(3.780)
Expected Loss (%)					0.100
					(1.613)
Loan Controls	YES	YES	YES	YES	YES
Bank-County FE	YES	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES	YES
Observations	7,415	7,931	7,931	7,931	7,931
Adj. R-squared	0.91	0.71	0.61	0.40	0.63

Online Appendix Table 35: GSIB Surcharges and Market Outcomes (Two-Stage Least Squares, non-GSIBS only)

This table contains two-stage least-squares regressions of market outcomes on the number of banks in the county, restricting the sample to loans granted by non-GSIBs. The excluded instrument is Number of GSIBs $(2015)_c \times \text{Post}_c$. The first stage is shown in Column (1) of Table 34. The sample period is 2015Q1 - 2019Q4 in all specifications. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	log(Loan Volume)	Interest Rate (%)	Probability of Default (%)	Interest Rate (%)
	(1)	(2)	(3)	(4)
Number of Banks (Annual)	0.658***	0.348**	0.548*	0.280**
	(3.607)	(2.406)	(1.859)	(2.046)
Probability of Default (%)				0.077***
				(5.950)
Loss Given Default (%)				0.005***
				(5.025)
Expected Loss (%)				0.064*
				(1.696)
Loan Controls	YES	YES	YES	YES
Bank-County FE	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES
Observations	7,415	7,415	7,415	7,415

Online Appendix Table 36: County Characteristics and Impact of Capital Surcharges on the Number of Banks

This table presents results from difference-in-differences regressions conducted at the county level. The dependent variable is the change in the number of banks in the pre (2015) versus post-surcharge period. These are regressed on county characteristics as of 2015 and their interaction with the number of GSIBs in 2015. T-statistics are shown below the parameter estimates in parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta NumBank$	
	(1)	(2)
Population Density (pre)	0.060*	0.094*
	(1.664)	(1.755)
Wages (pre)	-0.164	-0.663
	(0.578)	(1.584)
Financial Industry Wages (pre)	0.657***	0.652*
	(2.838)	(1.915)
Average Borrower log(assets) (pre)	0.022	0.049
	(0.622)	(0.957)
Average Borrower Leverage (pre)	0.095	0.165
	(0.457)	(0.584)
Average Borrower Tangibility (pre)	0.226	0.463
	(0.727)	(0.998)
Average Borrower Profitability (pre)	0.644*	0.680
	(1.768)	(1.437)
Number of GSIBs (2015)	-0.441***	-3.133
	(9.924)	(1.586)
Number of GSIBs (2015) × Population Density (pre)		-0.030
		(0.855)
Number of GSIBs (2015) × Wages (pre)		0.454
		(1.461)
Number of GSIBs (2015) × Financial Industry Wages (pre)		-0.064
		(0.277)
Number of GSIBs (2015) × Average Borrower log(assets) (pre)		-0.026
		(0.555)
Number of GSIBs (2015) × Average Borrower Leverage (pre)		-0.095
		(0.333)
Number of GSIBs (2015) × Average Borrower Tangibility (pre)		-0.305
		(0.716)
Number of GSIBs (2015) × Average Borrower Profitability (pre)		0.032
		(0.069)
Observations	700	700
Adj. R-squared	0.12	0.12

8. Prevalence of Non-Bank Lenders

In this section we provide data on the prevalence of non-bank lenders in the loan markets we consider. In our data, all loans are above $1mm, and about 90% of firms have more than $10mm in revenue. The 10th percentile of net sales in our sample is $9.22mm; however, this number deducts any trade discounts, returned sales and allowances for which credit is given to customers less returns and allowances, freight out, and cash discounts.

Online Appendix Table 37: Results from the Federal Reserve Bank of Cleveland "Clicking for Credit: Experiences of Online Lender Applicants from the Small Business Credit Survey"

This table contains the results for the of a survey conducted by the Federal Reserve Bank of Cleveland in which they ask firms whether they have applied to each type of institution. Online lenders include non-banks that operate online and finance companies include non-banks that provide loans, leases and other financial services.

	Financing Sources Applied To		
Financing Sought	Banks Only	Banks and Online Lenders	Online Lenders Only
$25,000 or less	58%	13%	29%
$25,001-$50,000	63%	15%	22%
$50,001-$100,000	67%	14%	19%
$100,001-$250,000	78%	13%	9%
$250,001-$1M	83%	9%	8%
More than $1M	96%	2%	1%

	Financing Sources Applied To				
Annual Revenue	Large Bank	Small Bank	Credit Union	Finance Company	Online Lender
$100K or less	48%	28%	12%	15%	31%
$100K-$1M	43%	32%	8%	18%	26%
$1M-$10M	39%	50%	6%	19%	10%
More than $10M	48%	53%	2%	10%	1%

9. Additional Details on the Area Under the Receiver Operating Characteristic Curve (AUC)

In Section 4 of the main text, we show banks' PDs are more predictive of loan performance in markets with more banks using the area under the receiver operating characteristic curve (AUC). In this section, we explain in more detail how the AUC works.

The receiver operating characteristic (ROC) curve uses banks' PDs and realized defaults (or non-performance) to plot the "true positive rate" against the "false positive rate" for each possible threshold PD. Specifically, for a given threshold PD, the ROC curve considers any PD larger than that threshold a predicted default and any PD less than that threshold a predicted non-default. The true positive rate is defined as the ratio of correctly predicted defaults divided by the total number of predicted defaults, whereas the false positive rate is defined as the ratio of incorrectly predicted defaults divided by the total number of predicted defaults. The ROC curve plots each of these points with the false positive rate on the x-axis and the true positive rate on the y-axis. The AUC is the area under the ROC curve where a higher AUC means that banks' PDs have higher discriminatory power.

The AUC has a simple probabilistic interpretation: given a randomly chosen defaulting loan and solvent loan, the AUC is the probability that the defaulting loan's PD is higher than the solvent one. Hence, a higher AUC means that banks' PDs have higher discriminatory power. A completely random prediction model will have an AUC of 0.5, while a perfect prediction model will have an AUC of 1. As a rule of thumb, an AUC of 0.6 is generally considered desirable in environments with less information, whereas AUCs of 0.7 or greater are desirable in information-rich environments (Iyer et al. (2016), Berg, Puri, and Rocholl (2020)).

We use the Stata function `roccomp`, which numerically integrates ROC curves and tests for statistical significance of differences in AUCs using the DeLong test (DeLong, DeLong, and Clarke-Pearson (1988)). The DeLong test is the standard approach to testing differences

in AUCs and is similar to the Mann-Whitney test.

10. Sensitivity of Risk Assessments to Interest Rates and Loan Performance

In this section we analyze the relationship between the sensitivity of bank risk assessments to interest rates and loan performance and the number of banks in the market. In Tables 38 and 39 we reestimate Tables 3 and 4 of the main text, but include additional columns in which we interact the risk assessments with the number of banks in the county. Across both tables, only the interaction between LGD and number of banks is statistically significant in predicting interest rate (Column (3) of Table 38).

Online Appendix Table 38: Risk Assessments and Interest Rates (Interactions with Number of Banks)

This table examines how banks' internal risk assessments predict loan interest rates, with interactions between risk assessments and the number of banks. T-statistics are shown below the parameter estimates in parentheses and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Interest Rate (%)		
	(1)	(2)	(3)
Probability of Default (%)		0.077***	0.051**
		(4.660)	(2.264)
Loss Given Default (%)		0.003***	0.001
		(4.366)	(0.721)
Expected Loss (%)		0.155***	0.277***
		(3.542)	(3.906)
Number of Banks			0.006
			(1.275)
Number of Banks × Probability of Default (%)			0.002
			(1.110)
Number of Banks × Loss Given Default (%)			0.000*
			(1.759)
Number of Banks × Expected Loss (%)			-0.010
			(1.607)
Log(maturity)	-0.001	0.016*	0.017*
	(0.154)	(1.842)	(1.956)
Log(Amount)	-0.159***	-0.151***	-0.153***
	(20.598)	(20.563)	(20.953)
Guaranteed	0.062***	0.061***	0.064***
	(3.255)	(3.416)	(3.616)
Loan Purpose FE	YES	YES	YES
Loan Type FE	YES	YES	YES
Bank-Quarter FE	YES	YES	YES
Industry-Quarter FE	YES	YES	YES
Observations	21,853	21,853	21,853
Adj. R-squared	0.5162	0.5462	0.5491

Online Appendix Table 39: Interest Rates, Risk Assessments and Loan Performance (Interactions with Number of Banks)

This table tests whether interest rates and banks internal risk assessments predict non-performance and default, with interactions between risk assessments and the number of banks, and after controlling for loan characteristics and fixed effects. T-statistics are shown below the parameter estimates in parenthesis and are calculated using robust standard errors clustered by county. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Non-Performance (%)				Realized Default (%)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Interest Rate (%)	0.527***		0.101	0.092	0.354***		0.093	0.097
	(3.699)		(0.541)	(0.494)	(3.346)		(0.620)	(0.651)
Probability of Default (%)		1.392**	1.384**	1.918***		0.888***	0.880**	0.778*
		(2.259)	(2.206)	(2.848)		(2.624)	(2.524)	(1.860)
Loss Given Default (%)		0.028	0.028	0.022		0.014	0.014	-0.002
		(1.501)	(1.450)	(0.924)		(1.469)	(1.375)	(0.100)
Expected Loss (%)		-1.229	-1.244	-2.537		-0.816	-0.830	-0.259
		(0.918)	(0.940)	(1.449)		(1.262)	(1.307)	(0.243)
Number of Banks				0.005				-0.048
				(0.078)				(1.081)
Number of Banks × Probability of Default (%)				-0.040				0.008
				(0.807)				(0.311)
Number of Banks × Loss Given Default (%)				0.001				0.001
				(0.380)				(1.204)
Number of Banks × Expected Loss (%)				0.095				-0.044
				(0.710)				(0.646)
Loan Controls	YES	YES	YES	YES	YES	YES	YES	YES
Bank-Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry-Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	18,246	18,246	18,246	18,246	18,246	18,246	18,246	18,246
Adj. R-squared	0.0874	0.0994	0.0993	0.0995	0.0653	0.0768	0.0768	0.0768

References

Berg, Tobias, Manju Puri, and Jörg Rocholl, 2020, Loan officer incentives, internal rating models, and default rates, *Review of Finance* 24, 529–578.

Berg, Tobias, Anthony Saunders, and Sascha Steffen, 2016, The total cost of corporate borrowing in the loan market: Don't ignore the fees, *The Journal of Finance* 71, 1357–1392.

Buchak, Greg and Adam Jørring, 2021, Do mortgage lenders compete locally? evidence beyond interest rates, *Evidence Beyond Interest Rates (January 7, 2021)* .

DeLong, Elizabeth R, David M DeLong, and Daniel L Clarke-Pearson, 1988, Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach, *Biometrics* 837–845.

Federal Reserve, 2022, Instructions for preparation of capital assessments and stress testing report (fr yâĂŘ14q), oMB No. 7100-0341.

Granja, Joao and Nuno Paixao, 2023, Bank consolidation and uniform pricing, *Available at SSRN 3488035* .

Imbens, Guido W, 2015, Matching methods in practice: Three examples, *Journal of Human Resources* 50, 373–419.

Iyer, Rajkamal, Asim Ijaz Khwaja, Erzo FP Luttmer, and Kelly Shue, 2016, Screening peers softly: Inferring the quality of small borrowers, *Management Science* 62, 1554–1577.

Paravisini, Daniel, Veronica Rappoport, and Philipp Schnabl, 2023, Specialization in bank lending: Evidence from exporting firms, *The Journal of Finance* 78, 2049–2085.

Petersen, Mitchell A and Raghuram G Rajan, 1995, The effect of credit market competition on lending relationships, *The Quarterly Journal of Economics* 110, 407–443.

Scharfstein, David and Adi Sunderam, 2016, Market power in mortgage lending and the transmission of monetary policy, *Unpublished working paper. Harvard University* 2.