ARTICLE IN PRESS
JID: MONEC [m3Gsc;May 8, 2023;13:29]
Journal of Monetary Economics xxx (xxxx) xxx
Contents lists available at ScienceDirect
Journal of Monetary Economics
journal homepage: www.elsevier.com/locate/jmoneco

Deposit market power, funding stability and long-term credit[☆]

Lei Li[a], Elena Loutskina[b,*], Philip E. Strahan[c]

[a] Federal Reserve Board
[b] University of Virginia, 100 Darden Blvd, Charlotteville VA 22901, USA
[c] Boston College & NBER, Boston, USA

ARTICLE INFO

Article history:
Received 17 June 2021
Revised 12 April 2023
Accepted 13 April 2023
Available online xxx

JEL classification:
G21

Keywords:
Deposits
Market power
Funding stability
Loan maturity
Maturity premiums

ABSTRACT

By increasing funding stability, deposit market power reduces banks' funding risk over the cycle and provides the flexibility to originate long-term loans. Banks with deposit HHI one standard deviation above average extend loans with about 20% longer maturity than those one standard deviation below average. Deposit market power also allows banks to charge lower maturity premiums. The effects persist in the sample of zero-duration, floating rate loans. This has real effects: access to banks raising funds in less competitive markets improves growth in bank-dependent borrowers needing long-term finance. Deposit market power, by stabilizing bank funding costs, helps alleviate credit cycles.

1. Introduction

Does the ability of the banking sector to lend long-term matter for real outcomes? The macroeconomic literature focuses on lending quantities and pricing, rather than maturity, as amplifiers of the business cycle. The finance literature has focused on borrower heterogeneity in shaping the demand for long-term debt with higher risk borrowers choosing to borrow long term to alleviate refinancing risk (Flannery, 1986, Diamond, 1991, Berger et al., 2005, and Hertzberg et al., 2018). Consistently, long-term borrowers experience fewer defaults during adverse macro-economic conditions due to lower refinancing risk (Almeida et al., 2012). Yet this literature remains mostly silent as to what factors enable banks to provide long-term credit.

In lending long term, banks face funding stability risk. Unlike bonds, bank loans are illiquid and thus generally stay on bank balance sheets. Diamond and Rajan (2001) emphasize the risk of funding long-term projects with unstable short-term funds. As such, uncertainty about *future* funding conditions could constrain banks' willingness to supply long-term finance *today*. Recent literature shows that deposit market power allows banks to stabilize their funding over the interest rate cycle,

☆ The views expressed in this paper do not necessarily represent those of the Federal Reserve or any institution with which the authors are affiliated. We thank Giovanni Favara and seminar participants at the 2020 Cavalcade North America Conference, The Bank of England, Boston College, the Federal Reserve Banks of Philadelphia and Richmond, HEC, University of Virginia Darden, FISF at Fudan University, PBC School of Finance at Tsinghua University, and Tulane

* Corresponding author.
E-mail address: eloutskina@virginia.edu (E. Loutskina).

https://doi.org/10.1016/j.jmoneco.2023.04.004
0304-3932/

Please cite this article as: L. Li, E. Loutskina and P.E. Strahan, Deposit market power, funding stability and long-term credit, Journal of Monetary Economics, https://doi.org/10.1016/j.jmoneco.2023.04.004

as it enables them to balance the rents extracted from depositors against funding profitable lending opportunities (Drechsler et al., 2017, DSS hereafter).[1]

This paper argues that deposit market power also contributes to banks' ability to lend long-term. We show that by stabilizing banks' funding, deposit market power alleviates the risk of holding illiquid long-term commercial and industrial (C&I) loans. Banks with more deposit market power, measured by local-market concentration (Bank HHI), make longer maturity loans and charge lower maturity premiums. Moreover, those banks experience less pro-cyclical loan losses, consistent with longer maturity lowering borrowers' refinancing risk during busts. Such default patterns, in turn, contribute to the stability of banks' equity capital, which further stabilizes banks' funding and contributes to their willingness to supply long-term credit. This has real effects: the greater availability of long-term bank credit contributes to faster industry growth, particularly for those in need of long-term debt. Our results imply that deposit market power, by increasing long-term credit supply, helps alleviate credit cycles.

Our results capture a set of equilibrium conditions. On the supply side, banks facing high demand for higher yielding long-term loans may enter high-HHI markets to raise stable funds and increase their funding stability. On the demand side, firms in need of long-term credit may sort toward banks able to supply such credit at a lower maturity premium. Both channels are consistent with the mechanism we advocate.

We exploit C&I lending data from the 1997–2017 *Survey of the Terms of Business Lending* (STBL). These data allow us to study maturity and pricing for a large sample of small business loans originated by a randomly selected set of banks. The data contain price and non-price terms on all new loans originated by each surveyed bank during a one-week window; the survey occurs four times per year. The STBL also offers some information on borrower heterogeneity, including a measure of borrower credit risk and location (in the 2012–2017 sub-sample). We limit our analysis to small business loans – those below $1 million – as they allow us to focus on bank dependent borrowers. Furthermore, in contrast to other categories of bank loans, small business loans have essentially zero market liquidity. Funding stability is less relevant for loans that can be sold after origination (e.g., via securitization), such as mortgages, credit cards, student loans, and even large corporate loans.[2]

We first use the full sample to show that banks raising funds in more concentrated deposit markets (as captured by *Bank HHI*) make longer-maturity business loans. We then eliminate alternative explanations stemming from heterogeneity in local economic conditions. Specifically, using the 2012–2017 sample, we construct *Out-of-state Bank HHI*, which captures bank deposit market power across all counties outside the borrower's state and thus is plausibly exogenous to in-state economic conditions. In this analysis, we can explicitly control for local lending competition via *In-state Branch HHI,* which measures concentration in the borrower's home state.

The results are consistent across models: banks raising funds in more concentrated deposit markets make longer-maturity business loans. Magnitudes are large. Banks with deposit HHI (*Out-of-state Bank HHI*) one standard deviation above average extend loans with about 20% longer maturity than banks with HHI one standard deviation below average. The tests further show that local lending competition has little effect on maturity, and its inclusion in the model does not attenuate the effect of funding stability (i.e., on the effect of *Out-of-state Bank HHI*). We report similar results after including borrower-location fixed effects. Unlike studies focusing on loan quantity (e.g., the bank lending channel literature), we find that deposit concentration is associated with longer loan maturity in both the boom and bust phases of the business cycle.

Second, we document that banks raising deposits in more concentrated markets charge lower maturity premiums. The direct effect of maturity on loan rates is positive: longer-term loans are more profitable for banks, but also are riskier. However, the relationship between loan maturity and the interest rate flattens for banks raising funds in more concentrated deposit markets. Banks with one standard deviation below-average concentration (*Out-of-state Bank HHI*) increase loan rates by about 30 basis points for each standard deviation increase in loan maturity; in contrast, for banks above average in deposit concentration, maturity has approximately zero effect on interest rates. Deposit market power mitigates banks' funding risk, thus allowing them to charge lower maturity premiums.

We offer a wide set of robustness tests to our core results. We show that interest rate risk (Drechsler et al., 2021) cannot explain our results: the effects of deposit market power on maturity and the maturity risk premium persists even in the sample of floating rate (zero duration) loans. We also document that our core findings are independent of borrower credit risk, as the effects persist in every credit risk bin of STBL loans.

In the third set of results, we document that banks with more deposit market power exhibit less pro-cyclical loan performance. This evidence is consistent with long-term borrowers of these banks being less exposed to the refinancing risk during busts (Almeida et al., 2012) and, by extension, experiencing fewer defaults during adverse macroeconomic conditions. We then show that less pro-cyclical loan losses go hand-in-hand with less pro-cyclical profits. These patterns help stabilize bank equity capital over the business cycle, further reinforcing their ability to extend longer maturity credit.

In our last set of tests, we explore real effects. Specifically, we use the *County Business Patterns* (CBP) data to measure employment and wage growth at the industry-county-year level. For identification, we exploit heterogeneity across

[1] Earlier research, such as Berger and Hannan (1989 and 1991) focus on the relationship between the level (as opposed to variation) of deposit rates and market concentration, finding lower deposit rates in more concentrated markets.

[2] Some measures of loan liquidity capture the presence of market liquidity, such as the depth of securitization markets (Loutskina, 2009).

industries in their reliance on long-term debt (vs. short-term debt), based on *Compustat* firms (in the spirit of Rajan and Zingales, 1998). We show that firms in industries reliant on long-term debt grow more quickly in counties served by banks with more deposit market power and more slowly in counties served by banks operating in competitive deposit markets.

Our paper extends several aspects of the literature on debt maturity. First, a wide set of papers explore how borrower heterogeneity (e.g., risk, asymmetric information, or opacity) affects loan maturity, both theoretically (Flannery, 1986; Diamond, 1991) and empirically (e.g., Berger et al., 2005; Barclay and Smith, 1995; Stohs and Mauer, 1996). This work concludes that riskier firms, firms lacking collateral, and/or firms with more asymmetric information use longer maturity debt in anticipation of higher refinancing risk. We augment these studies by offering a mechanism whereby bank financial conditions affect their supply of long-term debt. In this line of literature, Paligorova and Santos (2017) is the closest study to ours. It documents that in the syndicated loan market banks relying more on repo and short-term funding (subject to higher roll-over risks) extend shorter maturity credit and offer steeper loan yield curves.[3]

Second, we demonstrate a new connection from one side of bank balance sheets (funding stability fostered by deposit market power) to the other (loan maturity). Most of the banking literature emphasizes informational advantages (e.g., Fama, 1985) or liquidity synergies (e.g. Diamond and Dybvig, 1983; Calomiris and Kahn, 1991; Flannery, 1994; Diamond and Rajan, 2001; Kashyap et al., 2002; and Gatev and Strahan, 2006) to explain bank dominance in business lending. We argue that deposit market power provides banks an additional source of comparative advantage by helping them pursue higher-yield, longer-term lending. This strategy both relies on and contributes to more stable funding. Deposit market power, by reducing funding risk, allows banks to charge lower maturity premiums and thus enhances the sustainability of this strategy. Intuitively, deposit market power allows a stable equilibrium in which banks dominate long-term but illiquid business lending, in part because of their greater funding stability compared to other financial intermediaries.

Third, we contribute to the literature on bank market power. Numerous studies have documented the *costs* of less-than-perfect competition (See, e.g., Berger and Hannan, 1989 and 1991, Jayaratne and Strahan, 1996, among others). Only a few papers have found benefits associated with bank deposit market power (see, e.g., Keeley, 1990, Petersen and Rajan, 1995). More recent papers show that deposit market power creates a bank lending channel (DSS, 2017). This monetary policy transmission mechanism has an impact on credit supply similar to that of capital requirements (Wang et al., 2020). In regulated deposit markets, sticky deposit rates also amplify the effects of monetary policy (Duquerroy et al., 2020). We document that funding stability fostered by deposit market power contributes to banks' ability to extend long-term credit to businesses, charge lower maturity premiums, and enhance economic growth.

In this literature, Drechsler et al. (2021) is the closest study to ours. This paper shows that deposit market power allows for maturity transformation without interest rate risk. Our effects are distinct from Drechsler et al. (2021), as we show that funding stability fosters long-maturity lending even for floating rate loans which reprice automatically to changes in market interest rates. Such repricing mitigates interest rate risks, but does not hedge the liquidity risks associated with long maturity credit, which commits the bank to funding a given investment over a long period of time. Long maturity forces banks to rely on future external funding conditions for future lending opportunities. In contrast, short maturity lending provides banks the option to use internal funds for future lending by potentially refusing to roll over the short-term loan in favor of a more profitable opportunity. Floating rates on loans do not hedge this aspect of long-term bank lending.

Fourth, we add to the literature on financial accelerator models which suggest variation in bank funding costs and capital amplify business cycles. Macro-economists document that changes in bank funding costs engineered by central banks, for example, can limit bank credit (e.g., Bernanke and Blinder, 1988; Gertler and Gilchrist, 1994). Declines in bank capital and bank failures worsen business conditions because capital-constrained banks tighten credit supply, thereby exacerbating the initial downturn (e.g., Bernanke, 1983; Peek and Rosengren, 2000). These papers focus on lending quantities and pricing, rather than loan maturity. Ours suggests that bank funding stability can alleviate credit cycles by fostering long-term credit.

2. Data and sample selection

2.1. Bank lending data

We utilize several sources of data. For loans, we exploit the Federal Reserve's proprietary *Survey of the Terms of Business Lending* (STBL), which contains micro-data on all commercial and industrial (C&I) loans originated by a random sample of banks during one week each February, May, August, and November. The selection of banks leads to a representative sample of C&I loans. These loans are most suitable for our analysis. Other loan types (mortgages, large corporate loans, credit card loans, student loans, auto loans) have substantial market liquidity, thereby de-coupling maturity from funding risk.

The STBL data include the loan amount (i.e., loan size), interest rate, maturity, whether or not the loan comes with a prepayment penalty, collateral status, the location of the borrower (based on state, available only since 2012), and so on.[4] In addition, the STBL reports the lender's internal risk rating for each loan. The rating ranges from 1 to 4, with 1

[3] Consistent with our results, Carletti et al. (2020) find that increases in deposits due to a tax change in Italy increased the supply of long-term bank loans.

[4] The credit line data reported in the STBL are not well suited for understanding loan maturity. First, these data only capture credit lines which have been drawn during the sample period, as opposed to new originations of credit lines. Second, the STBL codes their maturity at zero. Thus, we drop these observations from our analysis.

Table 1
Summary statistics.
This table reports summary statistics for bank characteristics, small business loan terms, county economic characteristics, and industry long-term-debt dependence. Data sources are Consolidated Report of Condition and Income (Call Reports), Survey of Terms of Business Lending (STBL), Summary of Deposits (SOD), County Business Patterns (CBP), and Compustat.

	Matched STBL Sample			Full Call Reports Sample		
	Mean	Median	St.Dev.	Mean	Median	St.Dev.
Panel A: Bank Characteristics (1997Q1–2017Q1)						
Bank HHI	0.192	0.183	0.075	0.217	0.187	0.121
Log of Bank Assets	14.37	14.18	2.24	11.79	11.64	1.36
Equity/Assets	0.100	0.093	0.029	0.108	0.099	0.045
Deposits / Assets	0.790	0.807	0.090	0.835	0.854	0.085
C&I Loans / Assets	0.134	0.118	0.077	0.098	0.081	0.072
Cash + Securities / Assets	0.276	0.254	0.129	0.300	0.278	0.154
Consumer Loans / Assets	0.056	0.037	0.056	0.058	0.040	0.070
Mortgage Loans / Assets	0.395	0.405	0.156	0.409	0.411	0.171
Trading Assets / Assets	0.10%	0%	0.10%	0.04%	0%	0.78%
ROA (annualized)	1.0%	1.1%	0.9%	0.9%	1.0%	1.1%
ROE (annualized)	10.9%	11.2%	10.0%	9.2%	9.9%	11.0%
NPL/Assets	1.0%	0.7%	1.2%	1.0%	0.5%	1.3%
LLP/Assets (annualized)	0.4%	0.2%	0.7%	0.3%	0.1%	0.6%
Number of observations		*15,292*			*585,374*	
Panel B: STBL Loan Terms (1997 Q2–2017 Q2)						
Loan Rate (percentage points)	5.70	5.25	2.51			
Log of Loan Size	10.759	10.700	1.431			
Loan Size ($)	118,618	44,334	177,229			
Maturity (months)	14.89	9.10	17.53			
Log(Days to Maturity)	5.515	5.613	1.155			
Rating (1=safest; 4=riskiest)	3.285	3.000	0.702			
Loan is Secured?	0.831					
Prepayment Penalty?	0.088					
Fixed Rate?	0.124					
Local Bank? (available since 2012)	0.798					
Number of observations	*1,618,261*					
Panel C: County Economic Characteristics (1997–2017)						
Branch Deposit HHI	0.231	0.196	0.128			
County Deposit HHI	0.221	0.205	0.074			
Δ log (Employment)	0.005	0.005	0.171			
Δ log (Wages)	0.033	0.034	0.199			
Number of observations	*1,920,723*					
Panel D: Industry Long-Term-Debt Dependence						
Long-Term Debt/Assets	0.215	0.216	0.109			

representing loans with the lowest risk and 4 the highest. We exclude distressed loans (risk rating = 5), because these do not reflect new originations. Capturing loan risk helps rule out alternative explanations, so we begin our analysis in 1997 and exclude the unrated loans (risk rating = 0). We drop syndicated loans and loans with commitment amounts above $1 million. Unfortunately, the STBL data do not capture information on the borrower's industry or other characteristics such as balance sheet or income statement variables, nor do they allow us to follow the same borrower over time.

We focus on stated loan maturity, rather than effective or realized maturity. While banks can shorten effective maturity by forcing early repayments, this only occurs after firms violate covenants. Otherwise, stated maturity obligates the lender to wait for full re-payment. Hence, long maturity lending, even with some lender control via covenants, does not provide them with the same degree of flexibility as short-term lending.

Table 1 reports the summary statistics for our final STBL sample. In Panel B, the average loan size is about $119,000, with an interest rate of 5.7%. Floating rate loans comprise 87% of the sample. On average, these loans have maturity of a bit over one year. We observe substantial variation in the loan interest rates, both in the cross-section as well as in the time-series. Loan maturity, however, is more stable over time, with most of the variation reflecting the cross-section.

To capture bank characteristics, we use the quarterly bank *Call Reports*, as is standard in the literature. We report the summary statistics for the full *Call Report* sample during 1997–2017 period as well as for the STBL-matched sample of banks. Overall, the observed sample characteristics are similar to those used in prior studies.

2.2. Measures of deposit market power

To capture deposit market power, we build concentration based on the branch-level *Summary of Deposits* (SOD) data, available at the Federal Deposit Insurance Corporation (FDIC) website. The SOD data come out each June, so we merge variables into the subsequent August, November, February, and May versions of STBL, as well as the following four quarters of the *Call Reports*. Following DSS we build deposit concentration at branch-level, at bank-level, and at county-level.[5] All three begin with *Branch HHI,* which equals the sum of the square of each bank's deposit share in a given county-year (*c,t*), as follows:

$$Branch\ HHI_{c,t} = \sum_{b} (Deposit\ Market\ Share_{b,c,t})^2 \tag{1}$$

This variable captures the competitive conditions in the county, but not the aggregate funding conditions of a given bank operating in the county, since most banks operate in multiple counties.

To capture a given bank's deposit funding condition, we then build *Bank HHI* that varies by bank (*b*) and year (*t*), as follows:

$$Bank\ HHI_{b,t} = \sum_{c} Bank\ Deposit\ Share_{b,c,t} \times Branch\ HHI_{c,t} \tag{2}$$

This variable captures a bank's average market power across all markets in which it has branches, weighted by the share the bank raises in each market. As such, two banks operating in the same county will generally have different levels of *Bank HHI* (representing different funding conditions). The correlation between *Branch HHI* and *Bank HHI* is 0.62, indicating that these two measures do capture different economic forces.

Finally, we build *County HHI* to capture a county's exposure to funding conditions across all banks operating within it:

$$County\ HHI_{c,t} = \sum_{b} Deposit\ Market\ Share_{b,c,t} \times Bank\ HHI_{b,t} \tag{3}$$

County HHI and *Branch HHI* are correlated (0.72), as one is a weighted average of the other.

Panel C of Table 1 reports the summary statistics for *Branch HHI* and *County HHI* (which both vary at county-year level), while Panel A reports similar statistics for *Bank HHI (*which varies at bank-year level). The average *Bank HHI* is 0.19, with a standard deviation of 0.075. Most of the variation in *Bank HHI* reflects cross-bank heterogeneity, as variation in banking market concentration over the 1997–2017 sample period within individual banks is minimal.[6]

2.3. Business cycle fluctuations and bank funding

Prior studies (e.g., DSS) focus on interest rate risk and use the Fed Funds rate to capture business cycle fluctuations. The Fed Funds rate comes with a major disadvantage in our setting, as it stays at the zero lower bound between 2008 and 2015, a significant part of our sample period. This problem is exacerbated because many tests use the 2012–2017 period, the only period with data on borrower location. Consequently, we pursue a broader approach and use GDP growth to capture business cycle fluctuations. Note that before 2008 movements in GDP and interest rates are highly correlated.

We first show that deposit market power mitigates banks' funding cyclicality. To do so, we report reduced form models similar to those in DSS:

$$Y_{bt} = \alpha_b + \ \beta_0 Bank\ HHI_{bt-1} + \beta_1 \Delta Z_t + \beta_2 \Delta Z_t * Bank\ HHI_{bt-1} + \varepsilon_{bt} \tag{4}$$

$$Y_{bt} = \alpha_b + \delta_t + \beta_0 Bank\ HHI_{bt-1} + \ \beta_2 \Delta Z_t * Bank\ HHI_{bt-1} + \varepsilon_{bt} \tag{5}$$

where Y_{bt} represents bank-quarter level outcomes for bank b in quarter t, and ΔZ_t represents GDP growth. We focus mainly on Eq. (4) because it allows us to understand how cyclicality patterns vary with deposit concentration by comparing β_1 (the direct effect of GDP shocks) with β_2 (the interaction of shocks with *Bank HHI*). Similar to DSS, we aim to illustrate how equilibrium bank outcomes move through the cycle, rather than attempting to identify separately credit supply vs. credit demand effects.

We study five bank outcomes. For liabilities, we consider the growth of deposits, the cost of deposits, the growth of non-deposit funding, and the overall cost of borrowing (which combines both deposit and non-deposit debt); for assets, we consider the growth of total loans. Growth rates are constructed using the first difference of the natural log of each outcome. We winsorize all variables of interest at the 1st and 99th percentiles.

Table 2 shows that bank access to deposit market power mitigates funding cyclicality, thus enabling stable lending over the cycle. Both bank deposit costs and overall funding costs are strongly procyclical, but this cyclicality is smaller for banks raising deposits in concentrated markets (columns 1 & 3). Growth in deposit quantities, in contrast, covaries negatively with GDP growth, and this pattern is stronger for banks with higher market power (column 5). During busts, banks facing less

[5] The literature continues to measure deposit market power based on the local HHI, relying on FDIC guidance to book deposits at branches that are physically close to the customer. The rise of online banking, which has emerged in recent years (and increased due to the COVID crisis), both threatens banks' local deposit market power and undermines the idea of using the local HHI to measure deposit competition. New deposit technologies, however, have a small effect on our results as our sample ends in 2017, before digital banking became prominent in the marketplace.

[6] Appendix Table A1 reports the correlations between *Bank HHI* and bank financials. We find that: (i) *Bank HHI* is weakly positively correlated with bank capital and the share of assets funded with deposits; (ii) *Bank HHI* exhibits a higher correlation with bank profits (*ROA*), consistent with lower funding costs from market power; (iii) *Bank HHI* correlates negatively with bank size (*Log of Bank Assets*).

Table 2
Deposit concentration, bank liabilities, and lending: bank-level analysis.
This table reports the results of the OLS analysis following regression Eqs. (4) and (5). The level of analysis is bank-quarter. *Bank HHI* is a weighted average of *Branch HHIs* across all counties where a given bank operates. The sample covers the period between 1997 and 2017. Standard errors are clustered at bank level. T-statistics are reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Δ *Cost of Deposits in%*		Δ *Interest Expense to Liabilities in%*		Δ log *Total Deposits*		Δ log *Wholesale Funding*		Δ log *Total Loans*	
GDP Growth$_t$	1.629***		1.809***		0.015*		0.658***		0.193***	
	(68.35)		(75.26)		(1.86)		(12.45)		(23.07)	
Bank HHI$_{t-1}$	0.059***	0.003	0.067***	0.001	0.000	0.009**	−0.019	0.003	0.007	0.015***
	(5.94)	(0.50)	(6.43)	(0.11)	(0.04)	(2.34)	(1.35)	(0.24)	(1.58)	(3.37)
GDP Growth$_t$ x Bank HHI$_{t-1}$	−0.460***	−0.301***	−0.615***	−0.440***	−0.135***	−0.184***	0.486**	0.275	−0.120***	−0.184***
	(4.93)	(3.28)	(6.52)	(4.77)	(4.74)	(6.52)	(2.27)	(1.29)	(3.83)	(5.93)
Bank Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	–	Yes	–	Yes	–	Yes	–	Yes	–	Yes
Observations	585,475	585,475	585,475	585,475	585,475	585,475	585,470	585,470	585,475	585,475
R^2	3.8%	39.8%	4.4%	39.9%	8.4%	11.7%	0.8%	2.7%	11.1%	16.3%

deposit competition move into deposits (column 5) and rely less on scarce wholesale funds (column 7). During booms, these banks do not raise their deposit rates as much (column 1) and experience deposit outflows (column 3), consequently supplementing their funding with readily available wholesale funds (column 7). Overall, deposit market power provides banks with the flexibility not to fully adjust their deposit rates over the business cycle, contributing to a more stable through-the-business-cycle funding. This funding stability enables less procyclical lending (column 9): loans grow faster when GDP growth is high and slower when GDP growth is low, but this cyclicality is smaller for banks in concentrated deposit markets.[7]

3. Empirical methods and results

3.1. Deposit-Market power and loan maturity

Long-term lending commands higher returns, but originating long-term loans exposes banks to more risks than originating short-term loans. More importantly in our setting, long-term loans expose banks to more funding risks than shorter ones because business loans are illiquid and thus must be held to maturity. Expected future declines in profits (during busts) or deposits (during booms) could thereby constrain current lender's ability to extend long-term credit. Deposit market power (i.e., concentration) mitigates these funding effects by allowing banks to stabilize their funding throughout the business cycle.

To test these ideas, we estimate our core models, which link *Bank HHI* to C&I loan maturity and the maturity premiums. For maturity, we report results from the following regressions:

$$Log(Maturity)_{jbt} = \alpha_t + \beta_1 \text{Bank HHI}_{bt-1} + Bank\ Controls_{bt-1} + Loan\ Controls_j + \varepsilon_{jbt} \quad (6)$$

The analysis is at the level of loan j originated by bank b during quarter t. *Bank HHI* varies by bank-year (b, $t-1$) and is measured as of the last June prior to the loan origination quarter. Since most of the variation in *Bank HHI* represents the cross-section (see discussion above), we do not include bank-level fixed effects in the model. If banks with access to concentrated deposit markets have more stable funding, as we claim, then loan maturity should increase with *Bank HHI* (i.e., $\beta_1 > 0$).

We eliminate a number of alternative explanations by controlling for observed heterogeneity. On the loan side, we control for the (log of) loan size; borrower risk indicators, one for each category from 1 to 4 (with 4 being the highest risk category); an indicator for loans with prepayment penalties; an indicator for secured loans; an indicator for floating rate loans; and an indicator for loans made by banks located in the same state as the borrower (available only after 2012). Controlling for loan risk is crucial because it helps eliminate alternative explanations stemming from bank risk preferences.

On the bank side, we control for the log of bank assets (and its square to address the non-linearity of the effect), non-performing loans/assets, return on assets (net income/assets), C&I loans/assets, (cash + securities)/assets, mortgage loans/assets, trading assets/assets, consumer loans/assets, equity/assets, and deposits/assets. All bank controls vary by quarter and are measured as of the last quarter prior to loan origination. We capture macro-economic conditions via time fixed effects (α_t). Given that we have many loans per bank, we cluster standard errors at the bank level.

Panel A of Table 3 reports the baseline result, using the 1997–2017 sample. Consistent with our hypothesis, banks with more deposit market power extend longer-maturity loans: $\beta_1 > 0$. The effect is both economically and statistically signifi-

[7] Tables A2 and A3 reported in the Internet Appendix shows that the results presented in Table 2 are robust towards alternative specification and measures of the business cycle. Furthermore, it shows that banks with deposit market power exhibit less pro-cyclical cost of deposits and lending growth even if we include *both* GDP growth and Federal-Funds Rate based regressors at the same time. This re-emphasizes the notion that GDP growth captures aspects of the business cycle that span beyond interest rate risk.

Table 3
Bank deposit concentration and loan maturity.
This table reports the results of the OLS analysis following regression Eq. (6). The dependent variable is (log of) loan maturity in days. Panel A reports the results for the 1997–2017 sample of small business loans. Panels B and C report the result for the 2012–2017 subsample where we have information on the location (state) of the borrower. *Bank HHI* is a weighted average of *Branch HHIs* across all counties where a given bank operates. Loan controls include the (log of) loan size; the bank's assessment of borrower risk; an indicator for loans with pre-payment penalties; an indicator for floating rate loans; and an indicator for secured loans. Bank controls are log of total assets and its square, return on assets (net income/assets), C&I loans/assets, (cash + securities)/assets, mortgage loans/assets, trading assets/assets, consumer loans/assets, non-performing loans/assets, equity/assets, and deposits/assets. Standard errors are clustered at bank level. T-statistics are reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Dependent Variable = Log(Days to Maturity)					
	Panel A: Sample 1997–2017, No State Controls		Panel B: Sample 2012–2017, No State Controls		Panel C: Sample 2012–2017, With State Controls	
Bank HHI$_{t-1}$	**1.359*** (3.22)**	**1.323*** (2.70)**	**2.442*** (3.20)**	**2.385*** (3.01)**	**2.677*** (4.11)**	**2.575*** (3.68)**
Bank HHI$_{t-1}$ x GDP Growth		1.455 (0.28)		2.518 (0.36)		4.506 (0.75)
log (Loan Size)	0.073*** (5.74)	0.073*** (5.74)	0.038* (1.81)	0.038* (1.81)	0.041** (2.13)	0.041** (2.12)
Local Bank Dummy					−0.516*** (5.93)	−0.516*** (5.93)
Other Bank Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	–	–
State x Quarter Fixed Effects	–	–	–	–	Yes	Yes
Observations	1,618,261	1,618,261	414,726	414,726	414,726	414,726
R^2	4.5%	4.5%	7.4%	7.4%	10.9%	10.9%

cant. A bank with deposit concentration one standard deviation above average would extend loans with about 20% longer maturity than a bank one standard deviation below average (= 2*0.075*1.36, from column 1).

STBL provides little borrower-specific information beyond the risk rating, yet for loans originated after 2012 we observe the borrower's home state. This allows us to introduce state-quarter fixed effects (Panel C of Table 3), and hence control for local economic conditions (including local loan demand). It also allows us to control for a bank's proximity to the borrower, as suggested by the literature linking distance to lenders' ability to develop relationships with their borrowers (e.g., Berger et al., 2005). Hence, we include *Local Lender,* an indicator for loans originated by lenders with a branch in the same state as the borrower (Cortes et al., 2019).

Panels B and C of Table 3 report the results for the 2012–2017 sample, with and without the state-year-level controls. Consistent with Panel A, *Bank HHI* positively affects loan maturity. The coefficient magnitude increases during the post-2012 period, which may reflect the greater importance of deposits in funding to banks after the end of the Financial Crisis (although we have no specific test for this claim). More importantly, the magnitude is not sensitive to including more granular fixed effects and/or adding the *Local Lender* indicator (compare columns 3 and 5).

Finally, we find that the effect of deposit market power on loan maturity does not vary with business cycle conditions. Across all three panels, the coefficient on the interaction term (*Bank HHI x GDP Growth*) is statistically close to zero and exhibits unstable magnitudes across samples (see the even-numbered columns of Table 3). This supports our arguments: banks with less cyclical funding are better able to originate long-term loans in both booms and busts.

A possible concern with these results is that *Bank HHI* is not exogenous to local economic conditions and the results might be due to, e.g., local lending competition. After all, *Branch HHI* (and hence *Bank HHI*) captures aspects not only of funding markets but also of lending markets. For banks operating in a single market, it is hard to know if variation in *Bank HHI* represents funding conditions or lending conditions (or both).

To rule out these concerns, we isolate variation in *Bank HHI* more exogenous to local economic conditions by using only multi-state banks. Gilje et al. (2016) show that multi-market banks move deposits from markets with relatively weak loan demand into those with relatively strong loan demand. So, firms located in state *s* which borrow from multi-state bank *b* would depend on bank *b*'s funding conditions in states other than *s*. We exploit this notion and build *Out-of-state Bank HHI*, equal to a weighted average of *Branch HHI* across all counties where a bank operates *other than* counties located in the borrower's home state (Table 4). This revised measure leaves out the variation in *Bank HHI* from the borrower's state. The necessity to know the geographic location of the borrower, however, limits this analysis to the 2012–2017 sample.

The analysis of the multi-state banks also allows us to control for local lending market competition by introducing *In-state Branch HHI*, which equals the average HHI in counties located in the borrower's state. With both *Out-of-state Bank HHI* and *In-state Branch HHI*, we can test whether our results reflect bank funding conditions, lending conditions near the borrower, or both (Panel B of Table 4). Finally, we can eliminate any alternative explanations based on local-to-borrower economic conditions by saturating our multi-state bank loan analysis with state-time fixed effects.

The results, reported in Table 4, confirm that funding effects drive our core findings. The coefficient on *Out-of-state HHI* is very similar in magnitude to the one reported in Table 3, and retains large statistical power. Second, the effect of *In-state Branch HHI* is economically small and statistically weak. Third, even when we absorb local heterogeneity (Panel C), we

Table 4
Bank deposit concentration and loan maturity.
This table reports the results of the OLS analysis following regression Eq. (6). The dependent variable is (log of) loan maturity in days. All Panels report the results for the 2012–2017 subsample where we have information on the location (state) of the borrower. *Out-of-state Bank HHI* is a weighted average of *Branch HHIs* across all counties outside of the borrower state where a given bank operates. *In-state Branch HHI* is the deposit market HHI in the borrower's state. Loan controls include the (log of) loan size; the bank's assessment of borrower risk; an indicator for loans with pre-payment penalties; an indicator for floating rate loans; and an indicator for secured loans. Bank controls are log of total assets and its square, return on assets (net income/assets), C&I loans/assets, (cash + securities)/assets, mortgage loans/assets, trading assets/assets, consumer loans/assets, non-performing loans/assets, equity/assets, and deposits/assets. Standard errors are clustered at bank level. T-statistics are reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Dependent Variable = Log(Days to Maturity)					
	Panel A: Sample 2012–2017, No State Controls		Panel B: Sample 2012–2017, No State Controls		Panel C: Sample 2012–2017, With State Controls	
Out-of-state Bank HHI$_{t-1}$	**1.677****	**1.639****	**1.785****	**1.727****	**1.947****	**1.922****
	(2.22)	**(2.07)**	**(2.32)**	**(2.14)**	**(2.46)**	**(2.15)**
Out-of-state Bank HHI$_{t-1}$ x GDP Growth$_t$		1.657		2.511		1.086
		(0.23)		(0.35)		(0.15)
In-state Branch HHI$_{t-1}$	–	–	0.796*	0.831*	*(absorbed)*	*(absorbed)*
			(1.82)	(1.90)		
In-state Branch HHI$_{t-1}$ x GDP Growth$_t$		–		−1.469		*(absorbed)*
				(0.36)		
log (Loan Size)	0.033	0.033	0.034	0.034	0.035*	0.035*
	(1.48)	(1.48)	(1.55)	(1.55)	(1.74)	(1.74)
Local Bank Dummy					−0.518***	−0.518***
					(5.55)	(5.55)
Other Bank Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	–	–
State x Quarter Fixed Effects	–	–	–	–	Yes	Yes
Observations	391,017	391,017	391,017	391,017	391,009	391,009
R^2	7.3%	7.3%	7.5%	7.5%	11.2%	11.2%

continue to observe that banks with higher (out-of-state) deposit market power extend longer-maturity loans. This evidence thus undermines the argument that our core results are driven by local economic fundamentals.

3.2. Deposit market power and maturity premiums

If deposit market power mitigates banks' funding risk, as we argue, then we should see concentration affect maturity premiums. This motivates our second core model, which relates C&I loan interest rates on measures of borrower credit risk, loan maturity, and *Bank HHI* using the following regression specification:

$$Loan\ Rate_{jbt} = \alpha_t + \beta_1 \text{Bank HHI}_{bt-1} + \beta_2 Log(Maturity)_{jbt} + \beta_3 \text{Bank HHI}_{bt-1} \times Log(Maturity)_{jbt} + Bank\ Controls_b + Loan\ Controls_j + \varepsilon_{jbt} \quad (7)$$

Since longer-maturity loans are riskier than shorter ones, we expect them to command higher premiums ($\beta_2 > 0$). But banks with deposit market power (higher *Bank HHI*) – banks with less funding risk – should charge lower maturity premiums ($\beta_3 < 0$).

Table 5 reports these results. Consistent with prior literature, interest rates increase with loan maturity. More importantly, banks facing less competition in deposit markets (those with higher *Bank HHI* or *Out-of-state HHI*) charge lower maturity premiums: the coefficient β_3 is negative and economically and statistically significant across all models. For example, in the most complete model (column 6 of Panel A), a bank with *Bank HHI* one standard-deviation below the mean (0.12) would increase loan rates by about 35 basis points for each one-standard deviation increase in log loan maturity (=1.155 x (0.551 - 2.125 × 0.12)). In contrast, for a bank with *Bank HHI* one standard deviation above average (0.27), maturity has approximately zero effect on interest rates (=1.155 x (0.551 - 2.125 × 0.27)).

Panel B further supports our interpretation. The interaction of loan maturity with *Out-of-state Bank HHI* remains economically and statistically large. In fact, the effect is larger (i.e., more negative) than what we estimate in Panel A. In contrast, the effects of *In-state Branch HHI* are small. Combined, Tables 2 through 5 suggest that deposit market power provides banks with the flexibility to mitigate funding risk. This competitive advantage enables them to originate more long-terms loans and to charge lower maturity premiums.

3.3. Alternative explanations and robustness tests

The results so far represent equilibrium outcomes for the price and quantity of long-term bank loans. We do not take a stand on whether deposit market power allows banks to enter long-term lending markets, or whether long-term credit

Table 5
Bank deposit concentration and loan interest rates.
This table reports the results of the OLS analysis following regression Eq. (7). The dependent variable is loan interest rate. Panel A reports the results based on *Bank HHI* - a weighted average of *Branch HHIs* across all counties where a given bank operates. Panels B exploits the *Out-of-state Bank HHI* (a weighted average of *Branch HHIs* across all counties where a given bank operates outside of a borrower's state) and *In-state Branch HHI* (the deposit market HHI in the borrower's state). Loan controls include the (log of) loan size; the bank's assessment of borrower risk; an indicator for loans with pre-payment penalties; an indicator for floating rate loans; and an indicator for secured loans. Bank controls are log of total assets and its square, return on assets (net income/assets), C&I loans/assets, (cash + securities)/assets, mortgage loans/assets, trading assets/assets, consumer loans/assets, non-performing loans/assets, equity/assets, and deposits/assets. Standard errors are clustered at bank level. T-statistics are reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Dependent Variable = Loan Interest Rate					
Panel A	Sample 1997–2017		Sample 2012–2017, No State Controls		Sample 2012–2017, With State Controls	
Bank HHI_{t-1}	−0.457	3.875**	−5.564*	8.898***	−6.258**	5.986***
	(0.44)	(2.23)	(1.84)	(3.56)	(2.30)	(2.77)
log (Loan Maturity)	0.0878***	0.232***	0.140**	0.642***	0.128**	0.551***
	(2.87)	(3.69)	(2.39)	(4.10)	(2.37)	(3.84)
Bank HHI_{t-1}x log(Loan Maturity)		**−0.786***		**−2.529*****		**−2.125*****
		(1.85)		**(3.52)**		**(3.39)**
Other Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State x Quarter Fixed Effects	–	–	–	–	**Yes**	**Yes**
Observations	1,618,261	1,618,261	414,726	414,726	414,726	414,726
R^2	79.7%	79.7%	27.8%	28.7%	32.1%	32.7%
Panel B	Sample 2012–2017		Sample 2012–2017, No State Controls		Sample 2012–2017, With State Controls	
Out-of-state Bank HHI_{t-1}	−7.246**	9.445***	−7.254**	9.336***	−8.554***	5.751***
	(2.603)	(3.743)	(2.533)	(3.680)	(3.265)	(2.693)
log (Loan Maturity)	0.130**	0.707***	0.130**	0.746***	0.121**	0.666***
	(2.171)	(5.030)	(2.194)	(4.984)	(2.188)	(4.631)
Out-of-state Bank HHI_{t-1}x log(Loan Maturity)		**−2.871*****		**−2.851*****		**−2.443*****
		(5.034)		**(4.988)**		**(4.566)**
In-state Branch HHI_{t-1}	–	–	−0.0538	2.279	*(absorbed)*	*(absorbed)*
			(0.0820)	(1.516)		
In-state Branch HHI_{t-1}x log(Loan Maturity)		–		−0.414	–	−0.501**
				(1.506)		(2.374)
Other Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State x Quarter Fixed Effects	–	–	–	–	**Yes**	**Yes**
Observations	391,017	391,017	391,017	391,017	391,009	391,009
R^2	29.7%	30.8%	29.7%	30.9%	34.4%	35.2%

demand leads banks to enter less competitive deposit markets to get more stable funding. Both channels are consistent with the mechanism we advocate and lead to similar policy implications. However, we address alternative explanations for our results. First, we rule out interest rate risk as an explanation (Drechsler et al., 2021); second, we show that borrower heterogeneity does not drive our results (Flannery, 1986, Diamond, 1991, Berger et al., 2005); third, we summarize additional tests reported in a set of appendix tables.

3.3.1. Deposit market power and loan maturity: funding risk or interest rate risk?

Do our results represent interest rate risk in banks' maturity transformation, rather than funding risk through the business cycle? Drechsler et al. (2021) argue that deposit market power allows maturity transformation without interest rate risk, as banks "hedge" longer duration (yet demandable) deposits with longer duration loans. They demonstrate that banks raising deposits in more concentrated markets invest in longer duration (time to repricing) assets because greater market power reduces the sensitivity of deposit interest rates and net interest margin (NIM) to market rates.[8] The richness of our sample allows us to separate the two effects – interest rate risk (duration mismatch) vs. funding risk (loan illiquidity) – because we can separate fixed-rate and floating-rate loans.

It is worth emphasizing that interest rate and liquidity are distinct risks. The ability to reprice floating rate loans in response to market conditions does mitigate interest rate risk, but does not hedge the funding risks associated with maturity. Long maturity forces banks to rely on future external funding conditions for future lending opportunities. In contrast, short

[8] Begenau and Stafford (2021) argue that interest rate (duration) risk exposure is poorly identified from interest income, interest expense, and NIM based sensitivity analysis.

Table 6
Floating rate loan maturity and pricing.
This table reports the results of the OLS analysis following regression Eqs. (6) and (7). Panel A dependent variable is (log) loan maturity. Panel B dependent variable is loan interest rate. The sample contains floating rate small business loans originated between 2012 and 2017. *Out-of-state Bank HHI* is a weighted average of *Branch HHIs* across all counties outside of the borrower state where a given bank operates. *In-state Branch HHI* is the deposit market HHI in the borrower's state. Loan controls include the (log of) loan size; the bank's assessment of borrower risk; an indicator for loans with pre-payment penalties; and an indicator for secured loans. Bank controls are log of total assets and its square, return on assets (net income/assets), C&I loans/assets, (cash + securities)/assets, mortgage loans/assets, trading assets/assets, consumer loans/assets, non-performing loans/assets, equity/assets, and deposits/assets. Standard errors are clustered at bank level. T-statistics are reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Sample 2012–2017, No State Controls		Sample 2012–2017, No State Controls		Sample 2012–2017, With State Controls	
Panel A: Dependent Variable = Log*(Days to Maturity)*						
Out-of-state Bank HHI$_{t-1}$	**2.068****	**2.144****	**2.161****	**2.221****	**2.514*****	**2.587*****
	(2.36)	**(2.43)**	**(2.39)**	**(2.45)**	**(3.53)**	**(3.38)**
Out-of-state Bank HHI$_{t-1}$ x GDP Growth$_t$		−3.258		−2.611		−3.197
		(0.50)		(0.39)		(0.47)
In-state Branch HHI$_{t-1}$	–	–	0.583	0.605*	*(absorbed)*	*(absorbed)*
			(1.55)	(1.71)		
In-state Branch HHI$_{t-1}$ x GDP Growth$_t$		–		−0.957		*(absorbed)*
				(0.32)		
Other Bank Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	–	–
State x Quarter Fixed Effects	–	–	–	–	**Yes**	**Yes**
Observations	336,924	336,924	336,924	336,924	336,920	336,920
R^2	7.6%	7.6%	7.7%	7.7%	12.3%	12.3%
Panel B: Dependent Variable = Loan Interest Rate						
Out-of-state Bank HHI$_{t-1}$	−7.423***	6.585*	−7.478***	6.425	−8.767***	2.71
	(2.89)	(1.67)	(2.80)	(1.64)	(3.78)	(0.72)
log (Loan Maturity)	0.0182	0.515***	0.0189	0.551***	0.0158	0.463***
	(0.40)	(3.48)	(0.42)	(3.21)	(0.40)	(2.92)
Out-of-state Bank HHI$_{t-1}$x log(Loan Maturity)		**−2.414*****		**−2.394*****		**−1.965*****
		(3.24)		**(3.27)**		**(2.99)**
In-state Branch HHI$_{t-1}$	–	–	−0.336	1.78	*(absorbed)*	*(absorbed)*
			(0.55)	(0.92)		
In-state Branch HHI$_{t-1}$ x log(Loan Maturity)		–		−0.377		−0.394
				(1.04)		(1.38)
Other Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	–	–
State x Quarter Fixed Effects	–	–	–	–	**Yes**	**Yes**
Observations	336,924	336,924	336,924	336,924	336,920	336,920
R^2	28.1%	28.9%	28.1%	29.0%	33.8%	34.3%

maturity provides banks the option to avoid external funding by refusing to roll over a loan, in favor of a more profitable future lending opportunity. Floating rates on loans do not hedge this aspect of long-term bank lending.

Table 6 reports our core maturity and pricing tests for the sub-sample of floating-rate loans, which constitutes about 87% of our sample. The results are similar to those reported in Tables 4 and 5. Banks with deposit market power extend longer maturity floating rate loans and charge lower maturity premium, ceteris paribus. Our results are thus distinct from and extend those of Drechsler et al. (2021): deposit market power fosters maturity transformation by enhancing banks' ability to manage both loan duration risk and loan liquidity risk.

3.3.2. Credit risk and demand for long-term loans

Perhaps the relationship between loan maturity and deposit market concentration reflects unobserved borrower heterogeneity related to refinancing risk. Or perhaps bank decisions to enter markets depend on borrower risk. We have in part mitigated these explanations by explicitly controlling for borrowers' credit risk ratings, and by incorporating state-quarter fixed effects. To further rule them out, we next conduct the analysis of both loan maturity (Table 7, Panels A and B) and interest rates (Panels C and D) by credit-risk-rating bin: from least risky loans (risk ratings equal to 1 or 2, columns 1 and 2), to the riskiest loans (risk rating equal to 4, columns 5 and 6). We report each set, first, with *Bank HHI*, and then splitting the variation of concentration into *Out-of-State Bank HHI* and *In-state Branch HHI*.

The results show that banks with higher *Bank HHI* originate loans with longer maturity, irrespective of the credit risk of the borrower and irrespective of the sample period. If anything, the effect is economically stronger (in Panel A) for borrowers

Table 7
Bank deposit concentration, loan maturity, and loan interest rates: by loan risk.
Panels A and B report the results of the OLS analysis following regression Eq. (6), where the dependent variable is (log) loan maturity. Panels C and D report the results following regression Eq. (7), where the dependent variable is loan interest rate. *Bank HHI* is a weighted average of *Branch HHIs* across all counties where a given bank operates. *Out-of-state Bank HHI* is a weighted average of *Branch HHIs* across all counties outside of the borrower state where a given bank operates. *In-state Branch HHI* is the deposit market HHI in the borrower's state. Each column reports the results of analysis when the sample loans are confined to one credit risk category. Loan controls include the (log of) loan size; the bank's assessment of borrower risk; an indicator for loans with pre-payment penalties; an indicator for floating rate loans; and an indicator for secured loans. Bank controls are log of total assets and its square, return on assets (net income/assets), C&I loans/assets, (cash + securities)/assets, mortgage loans/assets, trading assets/assets, consumer loans/assets, non-performing loans/assets, equity/assets, and deposits/assets. Standard errors are clustered at bank level. T-statistics are reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Risk Rating $\leq$ 2		Risk Rating = 3		Risk Rating = 4	
Panel A: Log(Days to Maturity), 1997–2017 Sample						
Bank HHI$_{t-1}$	**2.097*** **	**2.213** **	**1.033** **	**0.811**	**1.387*** **	**1.482*** **
	(2.79)	**(2.53)**	**(2.35)**	**(1.54)**	**(2.86)**	**(2.74)**
Bank HHI$_{t-1}$ x GDP Growth$_t$		−4.802		8.616		−4.081
		(0.44)		(1.54)		(0.63)
Other Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	170,400	170,400	784,008	784,008	663,853	663,853
R^2	6.2%	6.2%	5.4%	5.4%	5.1%	5.1%
Panel B: Log(Days to Maturity), 2012–2017 Sample						
Out-of-state Bank HHI$_{t-1}$	**2.837** **	**2.843* **	**1.850** **	**1.618* **	**1.650* **	**1.861**
	(2.06)	**(1.80)**	**(2.35)**	**(1.96)**	**(1.77)**	**(1.63)**
Out-of-state Bank HHI$_{t-1}$ x GDP Growth$_t$		−0.274		10.132		−9.314
		(0.01)		(1.61)		(0.71)
Other Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
State x Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37,815	37,815	177,197	177,197	175,919	175,919
R^2	30.7%	30.7%	13.2%	13.2%	13.7%	13.7%
Panel C: Loan Interest Rates, 1997–2017 Sample						
Bank HHI$_{t-1}$	−0.745	3.271	−0.135	3.894**	−0.681	4.608**
	(0.71)	(1.02)	(0.16)	(2.40)	(0.48)	(2.20)
log (Loan Maturity)	0.126***	0.258*	0.077***	0.210***	0.075*	0.254***
	(5.30)	(1.93)	(2.95)	(3.48)	(1.91)	(3.54)
Bank HHI$_{t-1}$x log(Loan Maturity)		**−0.729**		**−0.724* **		**−0.970** **
		(1.16)		**(1.83)**		**(1.98)**
Other Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	170,400	170,400	784,008	784,008	663,853	663,853
R^2	78.7%	78.7%	81.5%	81.5%	79.0%	79.1%
Panel D: Loan Interest Rates, 2012–2017 Sample						
Out-of-state Bank HHI$_{t-1}$	0.572	15.61***	−7.699***	4.784**	−10.45***	3.940
	(0.275)	(6.893)	(3.245)	(2.015)	(4.154)	(1.539)
log (Loan Maturity)	0.112***	0.660***	0.0738*	0.530***	0.131**	0.715***
	(4.129)	(6.418)	(1.789)	(3.988)	(2.016)	(4.329)
Out-of-state Bank HHI$_{t-1}$ x log(Loan Maturity)		**−2.634*** **		**−2.114*** **		**−2.449*** **
		(5.331)		**(4.030)**		**(4.465)**
Other Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Other Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
State x Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Control for In-state Branch HHI x log(Maturity)	–	Yes	–	Yes	–	Yes
Observations	37,815	37,815	177,197	177,197	175,919	175,919
R^2	52.5%	53.4%	39.8%	40.4%	35.3%	36.3%

in the lowest rather than highest credit risk category. We also observe that banks facing less competition in deposit markets (higher *Bank HHI*) charge lower maturity premiums (Panels C and D), again irrespective of the credit risk category.

3.3.3. *Additional robustness tests*

In the Internet Appendix Tables A4 through A8, we provide several additional robustness tests on our core results. We show that the effects, both in terms of statistical as well as economic significance, are not dependent on (i) bank asset shares in different loan categories; (ii) a bank's liability mix; or (iii) bank size. Both large and small banks exhibit a positive

Table 8
Deposit concentration, lending, and equity capital.
This table reports the results of the OLS analysis following regression Eqs. (4) and (5). The level of analysis is bank-quarter. *Bank HHI* is a weighted average of *Branch HHIs* across all counties where a given bank operates. The dependent variables are nonperforming loans normalized by the beginning of the period total loans (Panel A); (annualized) loan-loss provisions normalized by the beginning of the period total loans (Panel B); (annualized) ROA defined as earnings before extraordinary items normalized by beginning of the period total assets (Panel C); and (annualized) ROE defined as earnings before extraordinary items normalized by the beginning of the period equity capital. The sample covers the period between 1997 and 2017. Standard errors are clustered at bank level. T-statistics are reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Panel A: NPL_t/Total $Loans_{t-1}$		Panel B: LLP_t/Total $Loans_{t-1}$		Panel C: ROA_t		Panel D: ROE_t	
GDP $Growth_t$	−0.099***		−0.041***		0.054***		0.583***	
	(26.71)		(24.57)		(30.91)		(33.25)	
Bank HHI_{t-1}	**−0.008*** **	**−0.008*** **	**−0.005*** **	**−0.003*** **	**0.002** **	**0.002** **	**0.015**	**0.022** **
	(3.21)	**(3.24)**	**(5.71)**	**(3.26)**	**(1.97)**	**(2.02)**	**(1.44)**	**(2.29)**
GDP $Growth_t$ x Bank HHI_{t-1}	0.163***	0.181***	0.069***	0.067***	−0.069***	−0.073***	−0.791***	−0.867***
	(11.13)	(12.49)	(10.57)	(10.50)	(10.47)	(11.30)	(12.06)	(13.33)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	–	Yes	–	Yes	–	Yes	–	Yes
Observations	585,463	585,463	585,465	585,465	585,475	585,475	585,475	585,475
R^2	30.9%	40.5%	19.1%	26.2%	33.4%	38.4%	32.8%	38.8%

link from *Bank HHI* to loan maturity, although the effect on the maturity premium is only there for large banks.[9] Our results are also stronger for smaller loans (those under $250,000). We show that the result is strong in both the pre-crisis and post-crisis samples, with magnitudes somewhat larger in the post-crisis period. Last, we split our sample into banks with above v. below median loans to core deposits, motivated by the idea that banks with more lending per unit of deposits would be more likely to respond to variation in deposit market power. We find our effects are indeed stronger in the latter sample based on maturity, but we find little difference using maturity premiums.[10]

3.4. Loan-Loss cyclicality and equity contributions

We have shown that funding stability from deposit market power (concentration) allows banks to make long-term loans at better prices for their borrowers. Long-term borrowers are less exposed to refinancing risk (Flannery, 1986; Diamond, 1991; Berger et al., 2005), which amplifies during economic downturns (Almeida et al., 2012). By extension, long-term loan portfolios should exhibit lower delinquencies and default rates during busts (and potentially higher delinquencies and default rates during booms as busts would eliminate weaker borrowers in portfolios of banks pursuing short-term lending).

To test this idea, we compare the cyclicality of loan losses across banks with varying degrees of deposit market power. Table 8 reports regressions following Eqs. (4) and (5), where we evaluate the dynamics of non-performing loans (NPL) and loan-loss provisions (LLP) throughout the business cycle (from *Call Report* data). Notably, while LLP captures loan performance, it is subject to lender discretion in the timing of recognizing loan losses. NPLs (loans 90 or more days past due or non-accrual loans) better reflect borrower actions and, as such, provide a clearer measure of the health of bank credit portfolios.

NPLs are half as sensitive to GDP shocks for banks one standard deviation *above* average concentration, relative to those one standard deviation below ($-\ 0.099+0.163^*0.34=-0.044$ v. $-\ 0.099+0.163^*0.10=-0.083$). Similarly, LLPs at banks with higher deposit market power exhibit significantly less sensitivity toward business cycle fluctuations. Since loan losses feed directly into bank profitability and capital (ROA and ROE), we evaluate whether the heterogeneity in loan loss cyclicality translates to heterogeneity in cyclicality of ROA (Panel C) and ROE (Panel D). Consistent with our core argument, ROA and ROE exhibit lower cyclical variation for banks with higher deposit-market concentration.

To evaluate the robustness of these results, we follow Drechsler et al. (2021) and construct a bank-specific measure of sensitivities of credit outcomes to business cycle fluctuations (βs). We estimate these betas by running a within-bank time-series regression of each outcome against contemporaneous and three lags of GDP growth rates. We then sort banks into twenty bins based on their *Bank HHI* and average the sum of each bank's estimated βs for all banks in the same bin. Fig. 1 reports the resulting bin-scatter plot. Consistent with the regressions, all of the cross-bank cyclicality measures decline substantially (by half or more) in moving from the lower portion of the *Bank HHI* distribution to the upper portion. In other words, for banks with more deposit market power, loan losses increase less with GDP declines, and profits increase less with GDP increases.

Table 8 and Fig. 1 provide new evidence that banks with more deposit market power have more stable profits over the business cycle. This evidence is consistent with long-term borrowers being less exposed to refinancing risk during busts. It

[9] The results for small banks are hard to interpret because most operate in a single state. Thus, there is no way to estimate the effect of funding concentration separately from the effect of lending concentration, as we do in Table 7.

[10] This analysis separates the sample based on the endogenous bank choice of lending and deposit-taking, so we hesitate to give too much emphasis to it.

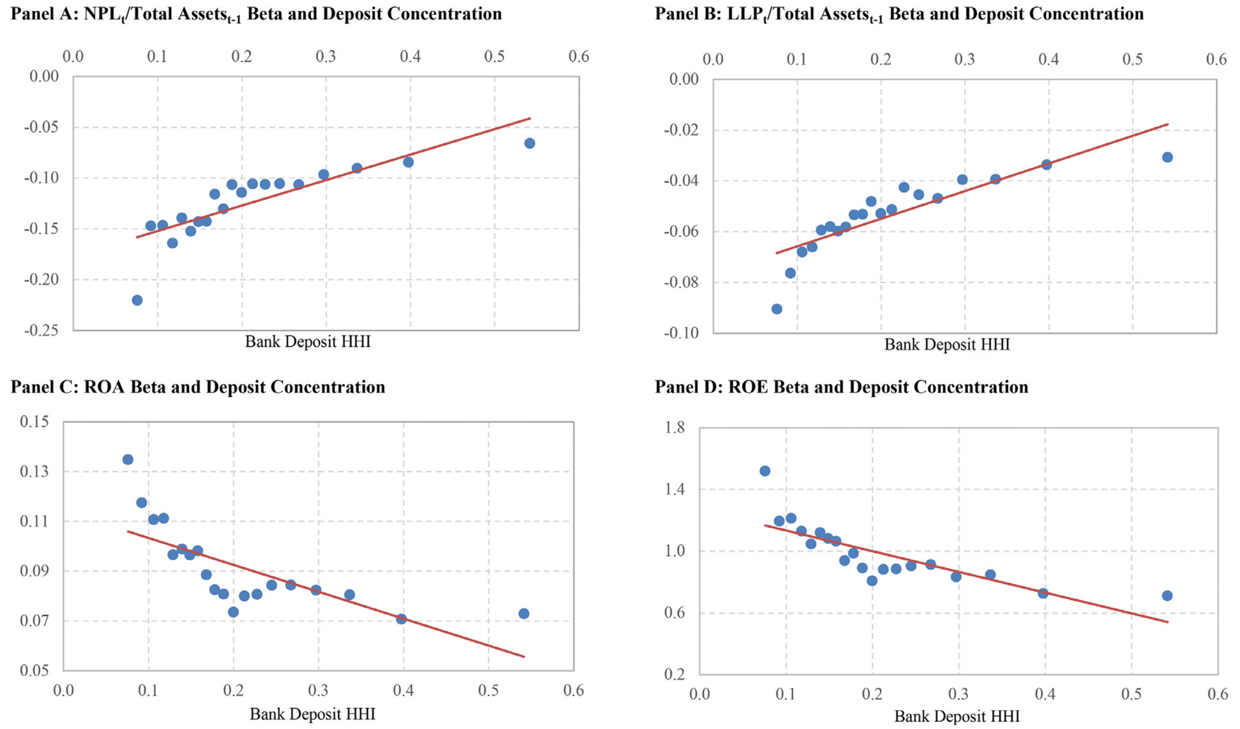

Fig. 1. Deposit concentration and cyclicality of bank profits.
This figure reports the comparison of deposit market power (*Bank HHIs*) and time series sensitivities (betas) of bank balance sheet measures to business cycles (GDP growth). The betas are calculated by regressing the balance sheet measures on the contemporaneous and three lagged quarterly GDP growth rates. Only banks with at least 20 quarterly observations are included. The betas are winsorized at the 1% level. Panel A plots average non-performing loans (NPL) betas for 20 bank deposit HHI bins. Panel B reports loan-loss provisions (LLP) betas. Panels C and D report ROA and ROE betas respectively. The sample is from 1997 to 2017.

is also consistent with borrowers of banks with higher deposit market power benefitting from more stable credit supply (e.g., DSS). Less procyclical loan losses help stabilize bank equity capital over the business cycle, further reinforcing banks' ability to extend longer maturity credit.[11]

3.5. Real effects

Do borrowers which need long-term debt benefit from proximity to banks with deposit market power? To test this idea, we evaluate how industry growth varies with local banks' access to concentrated deposit markets. This analysis creates several empirical challenges. First, we need to evaluate growth of companies that do not secure debt finance alongside those that do (e.g., those in STBL data) and map those companies to banks and their funding conditions. Second, we need to capture local borrowers' demand for long-term credit. Third, the mechanism we advocate should only affect bank-dependent borrowers and should not affect large companies with access to public capital (e.g., *Compustat* firms).

To address these challenges, we start with the *County Business Patterns (CBP)* data to construct the quarterly growth in total wages, as well as the size of local establishments with high geographic (county) and industry (NAICS3) granularity. We map these data to aggregate county-year bank characteristics. Following DSS, we build *County HHI* (defined above in Eq. (3)), which captures the exposure of a given county to funding risk conditions based on the average across all of the banks operating in the county. Since the vast majority of small C&I loans are originated within the lender's branch domain, this approach allows us to map broad population of borrowers to lenders with reasonable precision.

To capture borrower-level demand for long-term debt, we exploit heterogeneity among *Compustat* firms in their dependence on long-term debt. In the spirit of Rajan and Zingales (1998), we compute time-invariant median *Long-term debt/assets* (*LTD*) ratio within 3-digit NAICS industries from 1994 to 2017. Following Rajan and Zingales, we argue that *Compustat* firms face the least supply-side constraints on their capital structure decisions, so their *LTD* will provide the best measure of the demand for long maturity debt at the industry level. Appendix Table A9 reports the *LTD* measure for the top 10 and bottom 10 NAICS 3-digit industries.

[11] Appendix Tables A2 and A3 show that using the change in the Federal Funds rate as a measure of the business cycle yields similar results. Similarly, bin-scatter plots could be constructed using the change in the Federal Funds rate rather than GDP growth.

Finally, many prior studies indicate that small firms rely more on local credit conditions than large ones, which implies that funding conditions of local banks ought to matter in driving real outcomes most for the smallest enterprises (e.g., Berger et al., 2005). So, we split our county-industry-year sample into two subsamples based on the average county-industry-year establishment size relative to the median within industry-year establishment size across all counties.[12]

Armed with these data, we implement the following regressions:

$$\begin{aligned} Economic\,Growth_{ict} = \alpha_{it} + \alpha_c + \epsilon_{ict} + \beta_1 \text{County HHI}_{ct-1} + \beta_2 \text{County HHI}_{ct-1} \\ \times \Delta Z_t + \beta_3 \text{County HHI}_{ct-1} \times LTD_i + \gamma_1 \text{Branch HHI}_{ct-1} + \gamma_2 \text{Branch HHI}_{ct-1} \\ \times \Delta Z_t + \gamma_3 \text{Branch HHI}_{ct-1} \times LTD_i \end{aligned} \quad (8)$$

The level of analysis is industry i, county c, and year t. The dependent variable is growth in total wages.[13] As in Eq. (4), ΔZ_t represents aggregate business-cycle fluctuations (e.g., GDP growth). *County* $\text{HHI}_{\text{ct-1}}$ equals the weighted average deposit market concentration ($Bank\ HHI_{bt-1}$) across all banks b operating in county c in year $t-1$. This measure gets most of its variation from concentration in other counties, because most banks draw funds from multiple localities.

One clear advantage of this approach, relative to what was possible using the STBL data, is our ability to control separately for the funding effects of deposit market concentration (measured by *County HHI*) and for the effects of local banking competition (measured by *Branch HHI*). By incorporating $Branch\ HHI_{ct-1}$ and all related interaction terms, alongside $County\ HHI_{ct-1}$, we can confirm the effect of deposit market power and related funding stability even after we control for local banking competition characteristics.

We further include the interaction terms between aggregate shocks and both *County HHI* and *Branch HHI*. We do so because DSS (and our earlier results) suggest that lending by banks with deposit market power varies less cyclically. We absorb unobserved heterogeneity by including industry-year fixed effects. These absorb the direct effect of *LTD.* Finally, since our identification stems from heterogeneity captured by LTD_i and related interaction terms, we saturate some models with county-year fixed effects to capture unobserved heterogeneity at the county-year level, including local economic conditions and local loan demand. The latter helps justify the credit-supply interpretation of our results.

Our identification relies on the heterogeneity of the effect of bank funding stability across industries that rely more (less) on long-term debt. We argue that industries dependent on long-term debt in their capital structure ought to benefit most from close proximity to banks with access to concentrated deposit markets. Hence, we expect $\beta_3 > 0$. Notably, this expectation follows if the positive effect of *Bank HHI* on maturity, documented above, in fact reflects credit supply. We have argued that the micro-evidence is hard to explain otherwise, but this last test helps bolster that interpretation.

Table 9 reports the results for the full sample of county-industry-year observations (Panel A) as well as for subsamples of county-industry-years characterized by size (below the median in Panel B and above the median in Panel C). We report models with just the *County HHI* (and interactions), just the *Branch HHI* (and interactions), and both sets of variables.[14]

Notably, the effects of *Branch HHI* might be biased due to reverse causality – markets that are growing fast will experience faster growth in deposits. Growth in deposits will, in turn, feedback to *Branch HHI.* This concern is much less important for *County HHI*, which is our focus, because it depends mainly on deposits raised in <u>other</u> markets. Given this difference, we do not attempt to interpret the effects of *Branch HHI*; instead, we use it to demonstrate the robustness of our key variable. In addition, we report the models with and without the most granular set of fixed effects, again to help establish the robustness of our main finding.

First, and consistent with our earlier results, columns (1) and (3) of Table 9 show that counties exposed to banks with more deposit market power (higher *County HHI*) experience less pro-cyclical economic growth. Second, the positive effect of *County HHI* on employment growth increases within industries that are more likely to demand long-term credit (LTD_i), but only within the subsample dominated by smaller industry establishments (Panel B). Consistent with larger firms being less dependent on local finance, we do not find that county exposure to banks with deposit market power affects large firms' employment growth (Panel C). These conclusions persist even after we saturate our models with county-year fixed effects that fully absorb the effects of local economic conditions.

To understand magnitudes, consider the effect of *County HHI* on small establishments during the midpoint of the business cycle (i.e., setting GDP Growth to 2.5%, the average level in our sample). For an industry with the mean level of *LTD* (=0.22), the marginal effect of *County HHI* equals $0.009 + 0.112 \times 0.22$ - $0.738 \times 0.025 = 0.0152$ (Table 9, Panel B, column 7). This implies that wage growth would be 0.22% ($=0.0152 \times 0.074 \times 2$) faster for industries located in counties with *County HHI* one standard deviation above average, compared to those one standard deviation below average. The growth differential rises to 0.41% for industries that are one-standard deviation above average in their reliance on the long-term debt ($\text{LTD} = 0.22 + 0.11$).

Table 9 results show that the economic mechanism we advocate has a real economic effect: access to banks raising funds in concentrated markets improves employment and wage growth among bank-dependent borrowers in need of long-term finance.

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[12] Our results are robust to alternative splits of the sample. For example, we split the sample into county-industry-year observations with above (below) global median establishment size and found qualitatively and quantitatively similar results. Using annual benchmarks for sample split allows for a balanced over sample period panel of observations in both above-median and below-median subsamples.

[13] Appendix Table A10 shows similar results using growth in total employment.

[14] Appendix Tables A11 shows that using the change in the Federal Funds rate as a measure of the business cycle yields similar results as those reported in Table 9.

Table 9
Deposit concentration and wage growth.
This table reports the results from the OLS regressions following Eq. (8). The dependent variable is (log) growth in total wages measured at county-industry-year level. Panel A reports the results for the full sample covering the 1995–2017 period. Panel B reports the results based on the subsample confined to county-industry-year observations that are characterized by below-median establishment size. Similary, Panel C reports the results based on the subsample confined to county-industry-year observations that are characterized by above-median establishment size. Standard errors are clustered by county and industry-year. T-statistics reported in parentheses. '*' denotes significance at the 10% level, '**' the 5% level, and '***' the 1% level.

	Dependent Variable: Δ log Total Wages											
	Panel A: Full Sample				Panel B: Counties with Below-Median Average Establishment Size				Panel C: Counties with Above-Median Average Establishment Size			
County Bank HHI$_{t-1}$	0.020**		0.004		0.024**		0.009		−0.007		−0.016	
	(2.00)		(0.30)		(1.97)		(0.54)		(0.52)		(0.87)	
County Bank HHI$_{t-1}$ x *LTD*	**0.051****		**0.067***	**0.066***	**0.089*****		**0.112****	**0.131*****	**0.078****		**0.047**	**0.004**
	(2.05)		**(1.83)**	**(1.90)**	**(2.81)**		**(2.34)**	**(2.72)**	**(2.14)**		**(0.85)**	**(0.07)**
County Bank HHI$_{t-1}$ x *GDP Growth$_t$*	−0.444***		−0.480**		−0.416***		−0.738***		−0.314**		0.109	
	(3.56)		(2.21)		(2.74)		(2.67)		(2.14)		(0.48)	
Branch HHI$_{t-1}$		0.017***	0.016*			0.023***	0.020*			0.001	0.008	
		(2.78)	(1.78)			(2.78)	(1.74)			(0.14)	(0.77)	
Branch HHI$_{t-1}$ x *LTD*		0.020	−0.011	−0.008		0.035*	−0.016	−0.027		0.044**	0.023	0.043
		(1.33)	(0.50)	(0.39)		(1.79)	(0.56)	(0.93)		(2.10)	(0.73)	(1.30)
Branch HHI$_{t-1}$ x *GDP Growth$_t$*		−0.181**	0.034			−0.072	0.249			−0.242***	−0.292**	
		(2.23)	(0.24)			(0.82)	(1.57)			(2.66)	(2.06)	
Industry x Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	–	Yes	Yes	Yes	–	Yes	Yes	Yes	–
County x Year Fixed Effects	–	–	–	Yes	–	–	–	Yes	–	–	–	Yes
Observations	1,920,723	1,920,723	1,920,723	1,919,231	960,573	960,573	960,573	958,566	960,118	960,118	960,118	955,221
R^2	5.2%	5.2%	5.2%	10.2%	4.6%	4.6%	4.6%	12.8%	7.7%	7.7%	7.7%	15.1%

4. Conclusion and discussion

In this paper, we document a new channel linking deposits to bank credit supply. We argue that banks facing lower competition in deposit markets can stabilize their funding over the business cycle, which in turn reduces the risk of originating long-term illiquid business loans. As evidence, we provide three new results: First, banks facing less competition in deposit markets originate longer-maturity loans and charge lower maturity premiums. These results are consistent with deposit market power mitigating the funding risks associated with long-term loan originations. Second, banks with access to concentrated deposit markets experience less procyclical loan losses and more stable contributions to equity capital that further reinforce funding stability of these banks. Third, this mechanism has real effects. Non-financial firms located near banks raising deposits in concentrated markets grow faster, especially for industries with high demand for long-term debt.

We help complete the explanation for the unique structure of banks, financial institutions which combine on-demand deposits with term business loans. Existing studies emphasize informational advantages or liquidity synergies. Our paper suggests another mechanism from deposit market power, which limits funding risk. This unique feature enables banks to make long-term but illiquid loans without facing as much risk as competing intermediaries like finance companies relying on competitive funding sources (e.g., commercial paper). Our results along with those of Drechsler et al. (2021) suggest that deposit market power fosters maturity transformation by enhancing banks' ability to manage both duration risk and funding stability risk.

Why should we care about banks' willingness to supply long-term credit? After all, the macroeconomic literature on financial accelerators has focused on marginal lending quantities and pricing, rather than maturity. We care because banks extending longer term credit experience fewer loan losses and higher equity contributions during downturns. This suggests that banks' access to stable funding enables lower business defaults and higher economic activity in the busts, thus smoothing business cycles and weakening financial accelerators.

What about the meteoric growth in online deposit markets, which accelerated during the COVID-19 pandemic? Online banking makes markets more competitive, as it eliminates frictions depositors face moving funds. For example, traveling to a local branch to open/close an account or waiting for a paper check to clear is becoming increasingly obsolete. New technologies make deposit markets more national or even global, thus reducing bank deposit market power. Our results suggest that this may create disincentives for banks to supply long-term finance. These changes could also have real effects. Because the sample ends in 2017, our results are largely free from the impact of digital banking, but future researchers exploring the effects of deposit competition, particularly post-2019, may need to move beyond local, deposit-based concentration metrics.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Supplementary materials

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jmoneco.2023.04.004.

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