Lending-Driven Crowding Out of Bank Deposits

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Abstract

We demonstrate how a drop in lending leads to a crowding-out of deposits. We provide evidence that a decline in the origination of new corporate loans causes a shift in banks' assets towards derivative products, which reduces their pledgeable income. Depositors anticipate this and therefore banks are forced to offer lower deposit rates and receive less deposits to be able to credibly promise deposit repayment.

JEL classification: G21; E40; E32

Keywords: Bank Lending; Deposits; Derivatives

1. Introduction

Two of the main functions of banks are to provide deposits for savers and credit (loans) to firms. Within each bank, deposits and loans can interact in various ways and these interactions may affect the amounts of deposits and loans offered by the bank and the contribution of the banking system to the economy. Potentially, exogenous shocks in deposits may affect loans and vice versa. The existing literature has extensively studied how an exogenous change in deposits drives banks' decisions about the supply of credit (Bernanke and Blinder, 1988; Kashyap and Stein, 1995; Drechsler, Savov and Schnabl, 2017).[1] However, the effect an exogenous change on loans can have on deposits has received little attention.

This paper proposes a new channel through which an exogenous fall in bank lending leads to a drop in deposits and provides supporting empirical evidence for the economic mechanism that is in work. Specifically, the suggested mechanism is the following: a decline in the origination of new loans is followed by an increase in non-performing loans and a fall in banks' net income. This causes a shift in banks' assets towards derivative products to adjust hedging on their portfolio of loans. This leads to a further reduction in bank's pledgeable income. Depositors anticipate that, and hence banks are forced to offer lower deposit rates and consequently to receive less deposits to be able to credibly promise deposit repayment. This results in an endogenous crowding out of deposits caused by an exogenous fall in bank lending.

[1] See also Drechsler, Savov and Schnabl (2021), Hanson, Shleifer, Stein and Vishny (2015), Kashyap, Rajan and Stein (2002), Bernanke, Gertler and Gilchrist (1999), Bernanke and Gertler (1989).

We test the predictions of the new channel empirically in aggregate bank-level and branch-county-level data for the United States. Consistent with our suggestion, we document that a contraction in bank lending crowds out bank deposits. This holds for different categories of lending in the aggregate level, such as for syndicated loans, commercial and industrial loans. The aggregate tests are subject to a common identification challenge: the change in deposits might drive the decline in bank lending instead of the opposite. We address this identification challenge by exploiting geographic variation across counties. Particularly, we provide further insights that strengthen our results by exploiting the local bank level impact that a decline in loans has in bank deposits via a difference-in-differences approach. To achieve that, we study the recession caused in specific counties during the contraction in the price of oil in 2014 by creating two groups of counties: oil-concentrated counties where their GDP is depended by more than 20% in oil, and counties which are not concentrated in oil. First, we use county level small business lending from the Community Reinvestment Act (CRA), syndicated loans provided by banks to firms that locate in the specific counties in our treatment group, banks' local deposit rates by county and banks deposit amounts by county.

We find that during the period of recession for concentrated (treat) counties, firms' demand for lending evaporates, banks' lending declines, bank deposit rates decrease, and deposits outflow. Further, using data on banks' provision of lending by county, we identify banks with significant exposures to regions where the oil industry concentrates. We find that for these banks during the period of recession relative to banks operating in other non-affected regions, when lending declines,

net income declines and investments in derivatives increase. This finding confirms our initial results that when bank lending declines, banks have less pledgeable income. In turn, this is anticipated by depositors and therefore banks are forced to offer lower deposit rates to credibly fulfill their obligation, leading to crowding-out of deposits.

Next, we investigate why bank lending drops. Lower economic growth and recessions may reduce both the demand and the supply of loans. The effect a contraction in bank lending has in bank deposits is especially important to understand because declines in the origination of new loans often occur during macroeconomic downturns where the credit market is distorted, firms' demand for lending is affected and the banking sector is more fragile. Empirically, while the literature has mostly focused on distortions in the supply of credit, this paper identifies the drop in lending through a decrease in firms' demand for loans, which has received little attention. More precisely, we find that when economic activity contracts, firms' demand for loans evaporates (see also Figure 1). The lower demand for loans results in a decline in the origination of new loans.

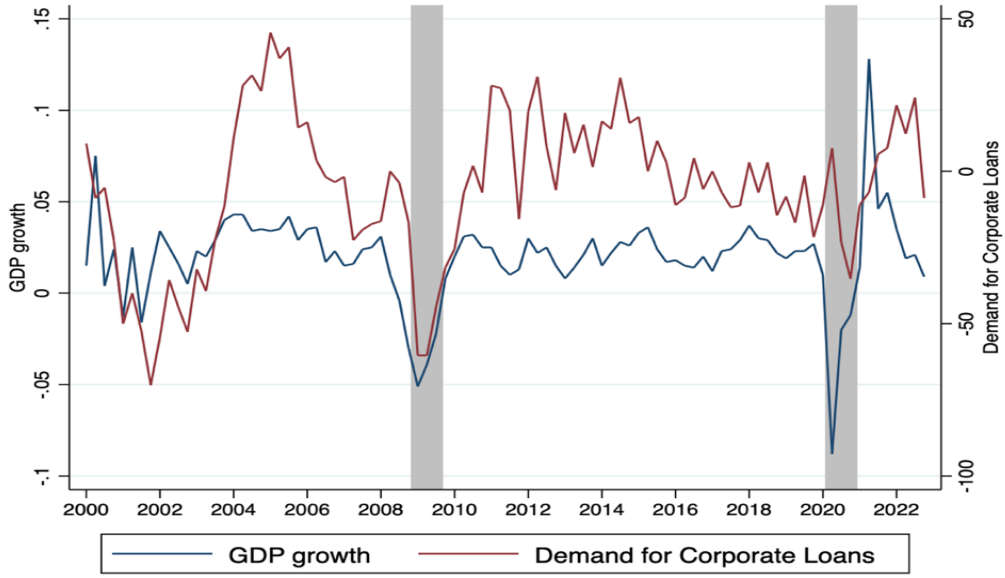


Figure 1 Demand for Corporate Loans and the Business Cycle. In this figure, we plot a line graph of US real GDP growth and demand for industrial and commercial loans by large and middle-market firms. The sample period is from 2000 to 2022. The data frequency is quarterly, and both indicators are derived from the FRED database.

In order to show this, we separate demand from supply by using a range of methodologies: i. we use macroeconomic shocks that impact firms' revenues as instruments to determine how macroeconomic conditions cause, in a structural sense, fluctuations in the demand for credit; ii. we separately identify firm borrowing shocks from bank supply shocks, by using bank level responses on changes in the demand for lending as reported on the Federal Reserve Board's Senior Loan Officer Opinion Survey on Bank Lending Standards (SLOOS) while taking into account bank-level changes in the supply of credit; iii. we use adverse oil shocks that negatively impact firms' revenues in counties that produce (export) oil, as instruments to determine how this condition impacts the origination of new loans compared to counties that consume (import) oil. To achieve that, we employ granular bank-firm-loan data with bank-time fixed effects that separate demand

from supply; iv. we estimate the elasticity of a firm's total credit demand and the elasticity of a bank's total credit supply (Altavilla, Boucicha and Bouscasse, 2022).

Particularly, we find that when there is an economic contraction, firms' revenues decline and therefore demand for credit decreases too. Demand for credit is constructed by using bank-level responses on changes in the demand for corporate lending while taking into account bank-level changes in the supply of credit, as described on the Federal Reserve Board's Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS). This is the first paper that uses bank-level responses to study the role of economic fluctuations in the demand for credit. In the past, papers that use SLOOS survey data investigate credit supply factors and shocks (Lown and Morgan, 2006; Bassett et al., 2014). We find that fluctuations in economic activity impact firms' demand for loans. Specifically, an adverse economic shock is associated with a decline of 2.8% and 3.3% in the origination of new bank loans 1 and 2 quarters after the shock respectively. We find that the contraction in lending is driven by a significant decline on firms' demand for new loans. We also show that when the contraction in bank lending is driven by lower firms' demand for loans, bank deposits decline independent of banks' market power.

The literature has shown an increase in the supply of Treasury securities satisfies investors' demand for safe liquidity and therefore it might lessen investors' demand for bank deposits (Li, Ma, and Zhao 2023; Krishnamarthy and Vissing-Jorgensen 2012). We contribute to this literature by showing that the decline in bank lending decreases the yield in bank deposits relative to other

assets, and that decrease in the deposit rate is the key driver for the increase in Treasury – Deposit rate spread.

The reminder of the paper is organized as follows. Section 2 discusses the literature. Section 3 describes the data sources. Section 4 describes the empirical strategy, and the results. Section 5 concludes.

2. Literature Review

Bank lending is exposed to fluctuations in economic activity. This paper shows the existence of a new channel, where bank lending drives banks' incentives on deposits. The banking literature has studied extensively how an exogenous change in bank deposits affects the supply of credit (Bernanke and Blinder 1988, Kashyap and Stein 1995….. Particularly, Bernanke and Blinder (1988) suggest that tight monetary policy drives to deposit outflows and therefore the supply of credit declines. We show that an alternative mechanism can also be in work. Precisely, this paper shows that an important determinant in the crowding out of deposits is the contraction in the bank lending and the associated decline in the pledgeability power that banks have to credibly promise higher deposit rates.

Our work also contributes on the literature which shows that Treasury securities are substitutes to bank deposits, and therefore an increase in the supply of Treasury securities crowds out bank deposits (Li, Ma, and Zhao 2022, Krishnamurthy and Vissing-Jorgensen, 2012, 2015, Greenwood, Hanson and Stein, 2010, 2015). Precisely this literature assumes that an exogenously triggered change in bank deposits drives banks' decisions for the supply of credit in the economy.

Finally, our work contributes on the literature that investigates how economic contractions impact bank lending. This literature is dominated with works that show exogenous economic shocks impact the balance sheet of banks and by extension the supply of credit in the economy (Berg, Saunders, Schafer and Steffen, 2021; Amiti and Weinstein, 2018; Bassett, Chosak, Driscoll and Zarkajsek 2014; Khwaja and Mian, 2008; Kashyap and Stein, 2000). This paper shows a different channel can be at work during economic contractions. Precisely, firms' demand for lending can decline and therefore the origination of new corporate loans decreases…

3. Data and Summary Statistics

This section summarizes the data used in the empirical analysis.

3.1 Data

National Bank-Level Data: We use quarterly Consolidated Financial Statements for Bank Holding Companies (BHC) available from the National Information Center.[2] Our data covers the period from 2000:1 to 2022:12. For each BHC we use the following variables: Commercial and Industrial Loans, Deposits, non-performing loans, net income, and derivatives. Also, we construct the following ratios to use as control variables when needed: Equity/Assets ratio, Return on Assets (ROA), and Tier-1 capital. We report summary statistics of these variables at Table 1 Panel A.

Regional Bank Lending Data:

[2] Banks' Balance Sheet data sources: https://www.ffiec.gov/npw/FinancialReport/FinancialDataDownload and https://www.ffiec.gov/npw

We complement the information from BHC with bank-county-time level information on small business lending from the National Community Reinvestment Coallition (NCRC) balance sheet data are from US Call Reports. The small business lending data covers the period from 2000:1 to 2021:12 and contains annual data on the loans provided by banks to local small businesses.

Syndicated Lending:

A third source of lending is collected through the Thomson Reuters LPC's DealScan. An important feature of this data is that it records the origination of new loans in a monthly basis with information on the lender, the amount, the spread over LIBOR (all-in-drawn-spread), the maturity of the loan, and the borrower.

Bank Deposit Amounts:

We use two sources of bank deposit amounts data: From BHC and for the local individual branch level data from the Federal Deposit Insurance Corporation (FDIC). The former has quarterly frequency, whilst the latter has annual frequency. We aggregate the FDIC dataset in the county level.

Bank Deposit Rates:

Ratewatch dataset provides information on the deposit rate for each bank by branch by time. We aggregate this data on the county level in a quarterly and annual basis when needed. Ratewatch contains information for many different deposit products.

Firm-Level Data:

We collect firms' balance sheet data from Compustat to capture firm-level characteristics, at quarterly frequency from 2000:1 till 2022:12. From Compustat

data we use the following variables: revenues, Z-score, R&D. Through this matching procedure, we can obtain the financial statements of the borrowers at the time of loan origination. Our full sample consists of 200,769 syndicated loans made by 514 US banks to 5,942 global firms between 2000 Q1 and 2022 Q4.

Macroeconomic Data:

We use Real GDP data in the national level with quarterly frequency from the Federal Reserve Economic Data (FRED) and in the county level with annual frequency from the Bureau of Economic Statistics.

Federal Funds Rate:

We use the Fed funds effective rate from the Federal Reserve Economic Data (FRED).

Treasury Bill:

Finally, we use the US 3 month and 1 year Treasury Yield data obtained from Refinitiv.

3.2 Summary Statistics

Table 1 presents the summary statistics for the dataset used in the national level. banks in the national level, while Table 2 presents the descriptive statistics for the dataset used in the county level.

Table 1 National Level Summary Statistics

This table presents branch-level descriptive statistics. All panels provide a breakdown by high and low HHI using the mean and standard deviation values. Panel A showcases branch characteristics, specifically deposits in millions of dollars, deposit growth, and Branch-HHI. The underlying data for this panel comes from the FDIC. Panel B focuses on the difference between the Treasury and deposit spread for CDs, with data sourced from Ratewatch. Panel C provides information on bank characteristics such as total assets in millions of dollars, Tier 1 (core) capital in millions of dollars, equity capital to assets percentage, and return on assets percentage. The data for this segment is extracted from the Call Reports. Panel D outlines data related to small business loans, indicating new loans in millions of dollars and CRA loan growth. This data is sourced from the CRA. Lastly, the Macro Aggregate Index from FRED is detailed, highlighting the net percentage in demand for commercial and industrial loans and Real GDP growth in percentages.

	Obs	Mean	Std.Dev.	Min	Max
Bank characteristics (Call Reports)					

log C&I Loan	648525	9.299	1.819	0	19.684
C&I Growth	636888	.02	.237	-8.902	11.134
log Deposit	679867	11.823	1.474	0	21.692
Deposit Growth	668272	.022	.14	-9.918	10.455
log NPLs	455018	5.131	2.124	0	16.481
NPL Growth	316155	-.023	.978	-9.252	9.41
log Derivatives	101791	9.785	3.095	0	25.245
Derivatives Growth	72440	-.031	.678	-8.892	9.947
log Net Income	613133	6.735	1.743	-4.605	17.462
Net Income Growth	450672	.474	.413	-7.456	8.885
log Total Asset	680101	12.048	1.439	4.19	21.969
log Tier1 Capital	678947	9.769	1.39	1.792	19.413
Equity to Assets (%)	680101	11.699	7.735	-519.469	100
ROA (%)	680101	.901	4.027	-761.905	562.272
Corporate Loans (DealScan)					
log Syndicate Loan	761645	5.181	1.557	-4.605	11.029
Syndicate Loan Growth	685617	.066	.822	-6.871	7.461
Tenor Maturity (monthly)	747061	48.596	23.53	0	515
Small Business Loans (CRA)					
log CRA Loan	22391	11.662	1.613	.693	17.913
CRA Growth	19089	.046	.548	-9.703	11.855
Firm characteristics (Compustat)					
Z Score	2559414	-33.085	3387.516	-1420277.6	883597.75
log Revenue	2321243	4.612	3.294	-9.21	26.215
log RD Exps	3037716	.14	.647	-3.817	9.943
Summary of Deposit (FDIC_SOD)					
log Deposit	170563	11.816	1.459	0	21.479
Deposit Growth	159090	.083	.258	-11.18	12.92
Deposit Rate (RateWatch)					
12MCD10k_rate	495789	1.612	1.612	.001	7.5
12MCD10k_rate growth	458046	-.07	.333	-4.688	5.59
Spread 1 year	495 789	0.018	1.053	-4.562	4.723
Macro Aggregate Index (FRED)					
Real GDP growth %	92	1.984	2.439	-8.8	12.8
Net % in Demand for Commercial and Industrial Loans	92	-5.32	24.493	-70.2	45.5

Table 2 Bank-County Level Descriptive Statistics

This table offers a comprehensive set of bank-level descriptive statistics across the full sample. Data is meticulously organized into categories highlighting various facets of financial metrics. It is essential to emphasize that the presented data spans the entire sample. Given that the majority of the explanatory variables are time-series macro variables, the complete sample has been preserved during the database merging process for further analysis.

Variable	Obs	Mean	Std. Dev.	Min	Max
post	168156	.556	.497	0	1
treat	168156	.172	.378	0	1
DiD	168156	.097	.295	0	1
log Deposit by bank by county	145676	11.343	1.525	0	20.012
12MCD10k_rate by bank by county	53869	.511	.372	.01	2.5
log CRA Loan by bank by county	27518	6.888	2.973	0	13.974
Equity to Assets (%)	147430	11.296	4.089	-3.604	98.926
log Tier1 Capital	147343	12.697	3.169	6.066	19.048
log Total Asset	147430	15.036	3.248	8.108	21.52
ROA (%)	147430	1.014	2.246	-20.484	390.69
Net % in Demand for Commercial and Industrial Loans	168156	4.342	10.273	-9.45	19.2
Spread 1 year by bank by county	53869	.209	.891	-2.392	2.591

4. Empirical Strategy

4.1 Bank Lending Impact on Bank Deposits

We first investigate the impact of bank lending on bank deposit amounts, by estimating the following model:

$$\text{Deposit\_Amount}_{i,t} = \beta_1 \text{Bank\_Lending}_{t-1} + \beta_2 \text{ Bank\_Lending\_Shock}_{t-1} + \beta_3 \text{ Bank Controls}_{i,t-1} + \varepsilon_{it} \quad (1)$$

Where i denotes the bank and t is time. The bank lending shock is a group of banks for which lending declines. To account for bank-specific heterogeneities that might influence lending behavior, we control for a set of bank-level characteristics. These include the Equity-to-Assets ratio in percentages, the natural logarithm of Tier 1 Capital, the natural logarithm of Total Assets, and ROA in percentages. These variables encapsulate differences in bank size and financial health that could potentially affect lending activities. In Panel A of Table 3 we present evidence that a drop in bank lending crowds out bank deposits. We present results for three different categories of loans: Commercial & Industrial loans, Small Business

Lending (CRA), and for Syndicated loans. The statistical and economic significance of the results is stronger when we use a bank lending shock which contains a group of banks that experienced a decline in their lending in the previous quarter (for C&I column 2, and for syndicated loans column 4) or in the previous year (for small business lending column 6). Overall, these results establish that a contraction in bank lending leads to crowding out bank deposits. In the next sections, we present the mechanism through which the drop in bank lending impacts bank deposits.

Table 3
Deposit Volume and Bank Lending

Table 3 presents the regression of deposit volumes, as reported in the Call Reports and by the FDIC, against the lagged variables of bank lending and the dummy of lending decline. Control variables include Equity_to_Asset, Tier_1_Capital, Total Asset and ROA at bank level. All control variables are lagged by 1 period. Panel A shows a log-level analysis for deposit volume and bank lending. Panel B shows log-difference analysis for deposit volume and bank lending. In both Panel, column (1) (2) (3) (4)show the results of the Commercial & Industrial (C&I) loans and Syndicated loan and their shock respectively on deposit from Call report. All variables are at quarterly basis. Column (5) (6) show the results of the Community Reinvestment Act (CRA) loans and its shock on deposit from FDIC. All variables are at yearly basis. Notably, Syndicated loan data is treated at the log-level for both panels. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: Log-Level Analysis: Deposit Volume and Bank Lending

	$\log(\text{Deposit}_{it})$ *Call Report*				$\log(\text{Deposit}_{it})$ *FDIC*	
	1	2	3	4	5	6
$\log(\text{C\&I loan}_{i,t-1})$	0.009***					
	(7.64)					
C&I loan shock		-0.011***				
		(-17.41)				
$\log(\text{Syndicated loan}_{i,t-1})$			-0.032			
			(-0.98)			
Syndicated loan shock				-0.073**		
				(-2.05)		
$\log(\text{CRA loan}_{i,t-1})$					0.007	
					(1.12)	
CRA loan shock						-0.018***
						(-5.65)
$\text{EA}_{i,t-1}$	-0.011***	-0.021***	-0.027**	-0.027**	-0.014**	-0.012**
	(-10.80)	(-11.26)	(-2.11)	(-2.18)	(-2.14)	(-2.36)
$\log(\text{Tier 1 capital}_{i,t-1})$	0.092***	0.221***	0.972***	0.452**	0.142***	0.124***
	(8.80)	(9.26)	(3.97)	(2.49)	(2.81)	(2.82)
$\log(\text{Total asset}_{i,t-1})$	0.851***	0.750***	0.184	0.964***	0.769***	0.773***
	(80.99)	(33.32)	(0.89)	(3.89)	(18.91)	(19.81)

$ROA_{i,t-1}$	-0.003***	-0.009***	-0.006***	-0.002	0.004	0.003
	(-2.41)	(-2.60)	(-2.86)	(-0.33)	(0.79)	(0.59)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	636332	667163	471928	482616	18337	19806
Adj. R^2	0.994	0.985	0.986	0.986	0.988	0.987

Panel B: Log-Difference Analysis: Deposit Volume and Bank Lending

	$\Delta\log(Deposit_{it})$ *Call Report*				$\Delta\log(Deposit_{it})$ *FDIC*	
	1	2	3	4	5	6
$\Delta\log(C\&I\ loan_{i,t-1})$	0.017***					
	(11.25)					
C&I loan shock		-0.012***				
		(-37.48)				
$\log(Syndicate\ loan_{i,t-1})$			0.032**			
			(2.25)			
Syndicate loan shock				0.003		
				(0.08)		
$\Delta\log(CRA\ loan_{i,t-1})$					0.024***	
					(4.82)	
CRA loan shock						-0.031***
						(-9.34)
$EA_{i,t-1}$	0.006***	0.012***	-0.002	-0.002	0.002	0.007**
	(13.68)	(17.65)	(-0.64)	(-0.63)	(1.00)	(2.54)
$\log(Tier\ 1\ capital_{i,t-1})$	0.003	-0.051***	0.033	-0.003	-0.061**	-0.076**
	(0.60)	(-6.09)	(0.56)	(-0.07)	(-2.58)	(-2.35)
$\log(Total\ asset_{i,t-1})$	0.003	-0.050***	-0.010	-0.006	0.021	0.016
	(0.71)	(-6.04)	(-0.35)	(-0.24)	(0.81)	(0.50)
$ROA_{i,t-1}$	-0.001	-0.002*	0.009	0.010	0.015*	0.009
	(-1.30)	(-1.70)	(1.01)	(1.08)	(1.86)	(1.13)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	624856	667111	471888	482576	15721	19780
Adj. R^2	0.122	0.190	0.057	0.059	0.090	0.125

4.2 Bank Lending impact on Banks' Balance Sheet

In this section we describe the mechanism that leads to the crowding out of bank deposits. We start by investigating the impact a contraction in bank lending has in net income by estimating the following model:

$$\text{Net Income}_{i,t} = \beta_1 \text{Bank\_Lending}_{t-1} + \beta_2 \text{ Bank\_Lending\_Shock}_{t-1} + \beta_3 \text{ Bank Controls}_{i,t-1} + \varepsilon_{it} \quad (2)$$

Table 4 presents evidence that a drop in bank lending is associated with a decline in net income. We present results for three different categories of loans: Commercial & Industrial loans, Small Business Lending (CRA), and for

Syndicated loans. The statistical and economic significance of the results is stronger when we use a bank lending shock which contains a group of banks that experienced a decline in their lending in the previous quarter (for C&I column 2, and for syndicated loans column 4) or in the previous year (for small business lending column 6).

Table 4
Net Income and Bank Lending

Table 4 presents regressions of net income from Call Report on lagged bank lending and decline on lending as dummies. Control variables include Equity_to_Asset, Tier_1_Capital, Total Asset and ROA at bank level. All control variables are lagged by 1 period. Panel A shows a log-level analysis for net income and bank lending. Panel B shows log-difference analysis for net income and bank lending. In both Panel, column (1) and (2) show the results of the Commercial & Industrial (C&I) loans and its shock on net income. Column (3) and (4) show the results of Syndicated loan and its shock on net income. All variables are at quarterly basis. Column (5) and (6) show the results of the Community Reinvestment Act (CRA) loans and its shock on net income. All variables are at yearly basis. Notably, Syndicated loan data is treated at the log-level for both panels. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: Log-Level Analysis: Net Income and Bank Lending

	$\log(\text{Net income}_{it})$					
	1	2	3	4	5	6
$\log(\text{C\&I loan}_{i,t-1})$	0.040***					
	(9.16)					
C&I loan shock		-0.023***				
		(-12.43)				
$\log(\text{Syndicated loan}_{i,t-1})$			0.002			
			(0.25)			
Syndicated loan shock				-0.089***		
				(-4.77)		
$\log(\text{CRA loan}_{i,t-1})$					0.038***	
					(3.44)	
CRA loan shock						-0.034***
						(-4.46)
$EA_{i,t-1}$	-0.007***	0.004	0.005	0.005	0.019***	0.023***
	(-2.86)	(1.44)	(0.97)	(1.08)	(2.87)	(4.38)
$\log(\text{Tier 1 capital}_{i,t-1})$	0.428***	0.353***	0.409**	0.446***	-0.286***	-0.270***
	(8.08)	(12.61)	(2.58)	(3.64)	(-3.70)	(-4.21)
$\log(\text{Total asset}_{i,t-1})$	0.749***	0.851***	0.674***	0.635***	0.177**	0.127**
	(18.70)	(31.55)	(5.12)	(5.87)	(2.45)	(2.11)
$ROA_{i,t-1}$	0.095	0.049**	0.037*	0.052*	-0.437***	-0.416***
	(1.33)	(2.03)	(1.73)	(1.69)	(-14.39)	(-13.03)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FEs	Yes	Yes				

Year FEs			Yes	Yes	Yes	Yes
No. of obs.	577663	603366	5638	8858	16935	18274
Adj. R^2	0.902	0.900	0.906	0.911	0.919	0.917

Panel B: Log-Difference Analysis: Net Income and Bank Lending

	$\Delta\log(\text{Net income}_{it})$					
	1	2	3	4	5	6
$\Delta\log(\text{C\&I loan}_{i,t-1})$	0.030***					
	(8.81)					
C&I loan shock		-0.016***				
		(-14.12)				
$\log(\text{Syndicated loan}_{i,t-1})$			-0.008			
			(-1.28)			
Syndicated loan shock				-0.044***		
				(-3.55)		
$\Delta\log(\text{CRA loan}_{i,t-1})$					0.008	
					(0.84)	
CRA loan shock						-0.036***
						(-4.46)
$EA_{i,t-1}$	0.006***	0.004***	0.006**	0.009***	0.019***	0.023***
	(7.29)	(4.93)	(2.47)	(3.18)	(2.87)	(4.38)
$\log(\text{Tier 1 capital}_{i,t-1})$	-0.147***	-0.123***	-0.166***	-0.200***	-0.286***	-0.270***
	(-11.83)	(-14.00)	(-3.58)	(-4.20)	(-3.70)	(-4.21)
$\log(\text{Total asset}_{i,t-1})$	0.105***	0.080***	0.112**	0.146***	0.177**	0.127**
	(9.55)	(8.88)	(2.41)	(3.06)	(2.45)	(2.11)
$ROA_{i,t-1}$	-0.019	-0.010**	-0.025**	-0.027***	-0.437***	-0.416***
	(-1.25)	(-1.97)	(-2.56)	(-2.99)	(-14.39)	(-13.03)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FEs	Yes	Yes				
Year FEs			Yes	Yes	Yes	Yes
No. of obs.	422,153	450,476	4260	6813	14,020	17,720
Adj. R^2	0.256	0.254	0.037	0.046	0.157	0.146

To clarify why net income drops, we test what happens to banks' non-performing loans when bank lending declines. We estimate the following model:

$$\text{Non\_Performing\_Loans}_{i,t} = \beta_1 \text{Bank\_Lending}_{t-1} + \beta_2 \text{Bank\_Lending\_Shock}_{t-1} + \beta_3 \text{Bank Controls}_{i,t-1} + \varepsilon_{it} \quad (3)$$

Table 5 shows that the drop in bank lending is associated with an increase in banks' non-performing loans. We present results for three different categories of loans: Commercial & Industrial loans, Small Business Lending (CRA), and for Syndicated loans. The statistical and economic significance of the results is stronger when we use a bank lending shock which contains a group of banks that

experienced a decline in their lending in the previous quarter (for C&I column 2, and for syndicated loans column 4) or in the previous year (for small business lending column 6).

Table 5
Non-Performing Loans and Bank Lending

Table 5 presents regressions of Non-Performing Loans (NPLs), as reported in the Call Reports, against the lagged variables of bank lending and the dummy of lending decline. Control variables include Equity_to_Asset, Tier_1_Capital, Total Asset and ROA at bank level. All control variables are in the base period. Table 3 captures the correlation between NPLs and lending activities. The dependent variable is subjected to a logarithmic form, while the independent variables, namely the Commercial & Industrial (C&I) loans and the Community Reinvestment Act (CRA) loans, are differenced. The Syndicated loan variable is treated with a logarithmic form. All independent variables are based on the baseline period. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	$\log(NPLs_{it})$					
Variable	1	2	3	4	5	6
$\Delta\log(C\&I\ loan_{i,t})$	-0.215***					
	(-16.18)					
C&I loan shock		0.128***				
		(26.04)				
$\log(Syndicated\ loan_{i,t})$			-0.007**			
			(-1.98)			
Syndicated loan shock				0.067***		
				(2.63)		
$\Delta\log(CRA\ loan_{i,t})$					-0.047**	
					(-2.17)	
CRA loan shock						0.096***
						(4.69)
$EA_{i,t}$	0.008	0.003	0.025	0.025	0.016	0.008
	(1.54)	(0.51)	(1.46)	(1.47)	(1.09)	(0.52)
$\log(Tier\ 1\ capital_{i,t})$	-0.046	-0.021	0.371	0.362	-0.138	-0.074
	(-0.88)	(-0.41)	(0.66)	(0.65)	(-1.06)	(-0.60)
$\log(Total\ asset_{i,t})$	1.091***	1.068***	0.644	0.653	1.361***	1.272***
	(19.71)	(19.43)	(1.11)	(1.13)	(10.09)	(9.83)
$ROA_{i,t}$	-0.167***	-0.153***	-0.005	-0.005	-0.123***	-0.123***
	(-20.03)	(-15.60)	(-0.34)	(-0.33)	(-6.71)	(-6.89)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	443217	454587	390507	391720	16053	18603
Adj. R^2	0.567	0.571	0.910	0.910	0.722	0.718

Next, we test the impact on banks assets. More precisely, we test whether a contraction in bank lending causes an increase in banks' investments in derivative products. We estimate the following model:

$$\text{Derivatives}_{i,t} = \beta_1 \text{Bank\_Lending}_{t-1} + \beta_2 \text{ Bank\_Lending\_Shock}_{t-1} + \beta_3 \text{ Bank Controls}_{i,t-1} + \varepsilon_{it} \quad (4)$$

Table 6 shows that the drop in bank lending leads to a shift in banks' assets towards derivative investments. This might also be related with the change in the available opportunities for investments banks have in an environment where non-performing loans increase. We present results for three different categories of loans: Commercial & Industrial loans, Small Business Lending (CRA), and for Syndicated loans. The statistical and economic significance of the results is stronger when we use a bank lending shock which contains a group of banks that experienced a decline in their lending in the previous quarter (for C&I column 2, and for syndicated loans column 6) or in the previous year (for small business lending column 4).

Table 6
Derivatives

Table 6 presents regressions of derivatives on GDP shock and bank lending shock. It includes interaction terms of GDP shock with loan demand and CRA loan shocks. Columns (1) (2) (3) (4) capture the effects of the GDP shock, the interaction between GDP shock and loan demand, CRA lending, and the interaction of GDP shock and CRA lending on the differenced Derivatives, respectively. All control variables are lagged by one period. Columns (5) and (6) illustrate the impact of syndicated loans and their negative shock on the logarithmical form Derivatives. All control variables are in their current period. Control variables include Equity_to_Asset, Tier_1_Capital, Total Asset and ROA at bank level. All control variables are at basis period or lagged by 1 period. All regressions are ordinary least squares regressions with bank or bank and year fixed effects. Standard errors are clustered by bank, and t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta\log(\text{Derivatives}_{it})$				$\log(\text{Derivatives}_{it})$	
	1	2	3	4	5	6
GDP shock	0.162***		0.363***			
	(8.42)		(9.11)			
GDP shock* Loan demand		0.002***				
		(5.19)				
$\Delta\log(\text{CRA loan}_{i,t-1})$			-0.059***			
			(-3.05)			
GDP shock* CRA loan shock				0.180**		
				(2.22)		
$\log(\text{Syndicated loan}_{i,t})$					-0.014***	
					(-4.30)	
Syndicated loan shock						0.037**
						(2.54)
$EA_{i,t}$					-0.059***	-0.059***
					(-3.84)	(-3.85)
$\log(\text{Tier 1 capital}_{i,t})$					0.241	0.237
					(0.43)	(0.42)
$\log(\text{Total asset}_{i,t})$					1.001**	1.004**
					(1.98)	(1.99)
$ROA_{i,t}$					0.134**	0.135**
					(2.37)	(2.37)
$EA_{i,t-1}$	0.001	0.001	-0.001	0.007		
	(0.54)	(0.30)	(-0.09)	(0.71)		
$\log(\text{Tier 1 capital}_{i,t-1})$	0.012	0.017	0.122	0.088		
	(0.40)	(0.59)	(1.05)	(0.75)		
$\log(\text{Total asset}_{i,t-1})$	-0.041	-0.047*	-0.267**	-0.222*		
	(-1.46)	(-1.67)	(-2.20)	(-1.81)		
$ROA_{i,t-1}$	0.005	0.005	-0.002	0.005		
	(1.58)	(1.57)	(-0.14)	(0.37)		
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FEs						
Year FEs	Yes	Yes			Yes	Yes
No. of obs.	71925	71925	7363	8172	379126	380190
Adj. R^2	0.016	0.015	-0.011	-0.031	0.976	0.976

4.3 Bank Lending impact on Deposit rates: The Role of Pledgeability

In the previous section we provide strong evidence that the decline in bank lending causes a shift in banks assets towards derivative investments and a drop in net income. This channel lowers the pledgeability banks have. Depositors anticipate that and force banks to offer lower deposit rates to credibly fulfil their commitments. We show this by using the following model:

$$\text{Deposit\_rate}_{i,t} = \beta_1 \text{Bank\_Lending}_{t-1} + \beta_2 \text{Bank\_Lending\_Shock}_{t-1} + \beta_3 \text{Net Income*Bank\_Lending\_Shock}_{t-1} + \beta_4 \text{Bank Controls}_{i,t-1} + \varepsilon_{it} \quad (5)$$

Table 7 shows that the drop in bank lending forces banks to offer lower deposit rates for bank deposits. Moreover, we show that a drop in net income is associated with a lower deposit rate. We provide further tests by using an interaction between net income and each category of loans, and some results still hold.

Table 7
Deposit Rate and Bank Lending

Table 7 presents regressions of deposit rate(12mCDS) from Ratewatch on decline on lending and net income as dummies. It also includes interaction term of decline in lending dummy and decline in net income dummy. These dummy variables take the value of 1 when either loans or net income declines from the previous period. Interaction terms between the lending dummy and the net income dummy are included, which captures the changes in the deposit rates of banks experiencing declines in both loans and net income. Control variables include Equity_to_Asset, Tier_1_Capital, Total Asset and ROA at bank level. All control variables are lagged by 1 period. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: Level Analysis: Deposit Rate, Net Income and Bank Lending

	$Deposit\ rate_{it}$						
	1	2	3	4	5	6	7
C&I loan shock	-0.004***						
	(-3.47)						
Syndicated loan shock		-0.019*					
		(-1.85)					
CRA loan shock			-0.014*				
			(-1.92)				
NI shock				-0.071***			
				(-14.52)			
NI shock* C&I loan shock					-0.078***		
					(-11.61)		
NI shock* Syndicated loan shock						-0.209	
						(-1.04)	
NI shock* CRA loan shock							0.005
							(0.56)
$EA_{i,t-1}$	0.003***	-0.037***	-0.003	-0.005***	-0.005***	-0.037***	-0.004
	(3.52)	(-2.81)	(-0.77)	(-4.50)	(-4.51)	(-2.85)	(-1.10)
$\log(\text{Tier 1 capital}_{i,t-1})$	-0.002	0.192	0.114**	0.133***	0.133***	0.185	0.003
	(-0.15)	(0.93)	(2.21)	(7.64)	(7.62)	(0.92)	(0.05)
$\log(\text{Total asset}_{i,t-1})$	0.034**	-0.092	-0.136***	-0.119***	-0.118***	-0.084	-0.014
	(2.12)	(-0.48)	(-2.82)	(-6.78)	(-6.75)	(-0.45)	(-0.29)
$ROA_{i,t-1}$	-0.003**	0.014	0.011	-0.003**	-0.003**	0.015	-0.003

	(-2.32)	(0.69)	(1.48)	(-2.03)	(-2.15)	(0.71)	(-0.51)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FEs	Yes						
Year FEs		Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	341261	308995	11883	341261	341261	308995	11742
Adj. R^2	0.958	0.958	0.920	0.933	0.933	0.958	0.948

Panel B: Difference Analysis: Deposit Rate, Net Income and Bank Lending

	$\Delta Deposit\ rate_{it}$						
	1	2	3	4	5	6	7
C&I loan shock	-0.003**						
	(-2.29)						
Syndicated loan shock		-0.035**					
		(-2.18)					
CRA loan shock			0.000				
			(0.08)				
NI shock				-0.018***			
				(-4.59)			
NI shock* C&I loan shock					-0.025***		
					(-4.73)		
NI shock* Syndicated loan shock						-0.152**	
						(-2.30)	
NI shock* CRA loan shock							-0.001
							(-0.07)
$EA_{i,t-1}$	-0.015***	-0.020*	-0.004*	-0.015***	-0.015***	-0.020*	-0.004*
	(-8.60)	(-1.90)	(-1.66)	(-8.59)	(-8.60)	(-1.91)	(-1.66)
log(Tier 1 $capital_{i,t-1}$)	0.330***	0.203*	0.055*	0.331***	0.331***	0.197*	0.055*
	(16.48)	(1.95)	(1.88)	(16.50)	(16.50)	(1.93)	(1.88)
log(Total $asset_{i,t-1}$)	-0.223***	-0.218*	-0.063**	-0.223***	-0.223***	-0.212*	-0.063**
	(-11.29)	(-1.95)	(-2.24)	(-11.32)	(-11.32)	(-1.91)	(-2.24)
$ROA_{i,t-1}$	-0.000	-0.011	0.009**	-0.000	-0.000	-0.010	0.009**
	(-0.22)	(-0.98)	(2.17)	(-0.13)	(-0.15)	(-0.92)	(2.16)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FEs	Yes						
Year FEs		Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	320120	304608	11497	320120	320120	304608	11497
Adj. R^2	0.034	0.562	0.852	0.034	0.034	0.561	0.852

Finally, we show in Table 8 that the drop in deposit rates crowds out deposit amounts. We show this by using the following model:

$$\text{Deposit\_amount}_{i,t} = \beta_1 \text{Deposit\_Rate}_{t-1} + \beta_2 \text{Deposit\_Rate\_Shock}_{t-1} + \beta_3 \text{Bank Controls}_{i,t-1} + \varepsilon_{it} \quad (6)$$

Table 8 shows that the drop in bank lending forces banks to offer lower deposit rates for bank deposits. Moreover, we show that a drop in net income is associated

with a lower deposit rate. We provide further tests by using an interaction between net income and each category of loans, and some results still hold.

Table 8
Deposit Volume and Deposit Rate

Table 8 presents regressions of deposit volume from Call Report and FDIC on lagged deposit rate(12mCDS). Deposit rate shock is 1 when Deposit rate decreases compared to the previous period. Control variables include Equity_to_Asset, Tier_1_Capital, Total Asset and ROA at bank level. All control variables are lagged by 1 period. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: Log-Level Analysis: Deposit Volume and Deposit Rate

	$\log(\text{Deposit}_{it})$ *Call Report*		$\log(\text{Deposit}_{it})$ *FDIC*	
	1	2	3	4
$\text{Deposit rate}_{it-1}$	0.010***		0.012***	
	(8.70)		(7.72)	
Deposit rate shock		-0.000		0.003
		(-0.03)		(1.59)
$\text{EA}_{i,t-1}$	-0.017***	-0.015***	-0.008**	-0.006*
	(-4.00)	(-3.83)	(-2.02)	(-1.79)
$\log(\text{Tier 1 capital}_{i,t-1})$	0.148***	0.137***	0.088*	0.072*
	(3.07)	(2.89)	(1.90)	(1.77)
$\log(\text{Total asset}_{i,t-1})$	0.821***	0.834***	0.854***	0.870***
	(19.04)	(19.99)	(19.77)	(23.40)
$\text{ROA}_{i,t-1}$	-0.007**	-0.008**	-0.005*	-0.005*
	(-2.01)	(-2.10)	(-1.77)	(-1.74)
Bank FEs	Yes	Yes	Yes	Yes
Quarter FEs	Yes	Yes		
Year FEs			Yes	Yes
No. of obs.	320,117	341,257	90,520	92,552
Adj. R^2	0.996	0.996	0.994	0.994

Panel B: Log-Difference Analysis: Deposit Volume and Deposit Rate

	$\Delta\log(\text{Deposit}_{it})$ *Call Report*		$\Delta\log(\text{Deposit}_{it})$ *FDIC*	
	1	2	3	4
$\Delta\text{Deposit rate}_{it-1}$	0.006***		0.019***	
	(9.36)		(10.84)	
Deposit rate shock		-0.001*		0.001
		(-1.80)		(0.35)
$\text{EA}_{i,t-1}$	0.007***	0.011***	0.015***	0.019***
	(6.96)	(9.58)	(3.94)	(4.91)
$\log(\text{Tier 1 capital}_{i,t-1})$	-0.026**	-0.058***	-0.117***	-0.100***
	(-2.32)	(-4.45)	(-3.52)	(-2.68)
$\log(\text{Total asset}_{i,t-1})$	0.001	0.033***	0.084**	0.061
	(0.06)	(2.75)	(2.50)	(1.64)
$\text{ROA}_{i,t-1}$	-0.002	-0.003	0.002	-0.014***
	(-0.90)	(-1.50)	(0.68)	(-5.35)

Bank FEs	Yes	Yes	Yes	Yes
Quarter FEs	Yes	Yes		
Year FEs			Yes	Yes
No. of obs.	305,160	341,253	84,904	92,372
Adj. R^2	0.107	0.159	0.146	0.174

5. Why Bank Lending Declines

In this section we investigate what causes the decline in bank lending. The existing literature has provided ample evidence for shocks in the supply of credit that cause credit tightening. We investigate a different path, which is the impact on bank lending from a drop on firms' demand for loans.

5.1 Demand for Lending and Economic Activity

We start by testing first the impact contractions in economic activity and in firms' revenues have in bank lending. We use the following model:

$$\text{Bank\_lending}_{i,t} = \beta_1 \text{Real\_GDP\_Growth}_{t-1} + \beta_2 \text{Real\_GDP\_Shock}_{t-1} + \beta_3 \text{Firm Revenues\_Shock}_{i,t-1} + \beta_4 \text{Revenue\_Shock*GDP\_Shock}_{i,t-1} + \beta_5 \text{Firm Controls}_{i,t-1} + \varepsilon_{it} \quad (7)$$

We employ a widely used identification strategy at the bank-firm-loan level data, but with firm controls and bank level fixed effects to capture the demand for loans impact on the origination of new loans. The empirical specification allows us to rule out concerns that the drop in lending might be led by the supply side. Table 9 presents the results. A negative shock in GDP is associated with a significant decline in the origination of new loans. Accordingly, a negative shock in firms' revenues is associated with a drop in firms' demand for lending and causes a decline in the origination of new loans. When we use an interaction between firms' revenues shock and GDP shock the results hold and show again a drop in the origination of new loans which is caused by the drop in the demand for loans. Importantly, in unreported regressions we test whether the contraction in bank

lending is driven by a change in bank specific standards (the supply of loans channel) and we find that this test is rejected.

Table 9
Why bank lending contracts

Table 9 identifies mechanisms behind the contraction of bank lending from the demand side, employing firm-level control variables and bank-level fixed effects to capture the impact of a recession-induced decline in firm revenues on bank lending. GDP shock, representing a recession, is assigned a value of 1 when real GDP growth rate is below 0 and Revenue shock is set to 1 when a firm revenue decline compared to the previous year. Columns (1) and (2) demonstrate the co-movement of syndicated loans with real GDP growth and the adverse effects of GDP declines. Similarly, columns (3) and (4) show the co-movement between syndicated loans and firm revenues, along with the negative impact of decreases in firm revenue. Column 5 examines the interaction of these two shocks to assess the significance of adverse impacts more thoroughly. Control variables include Z-score, Revenue and R&D expenditure at firm level. All control variables are lagged by 1 period. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	log(Syndicate loan$_{i,t}$)				
	1	2	3	4	5
Real GDP growth$_{t-1}$	0.925***				
	(2.86)				
GDP shock		-0.186***			
		(-5.04)			
Revenue shock				-0.096***	
				(-6.33)	
Revenue shock* GDP shock					-0.111***
					(-4.01)
log(Revenue$_{j,t-1}$)	0.280***	0.286***	0.287***	0.280***	0.280***
	(20.36)	(18.53)	(18.48)	(20.35)	(20.36)
	(7.38)	(6.20)	(6.22)	(7.39)	(7.38)
Z score$_{j,t-1}$	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***
	(-2.92)	(-4.49)	(-4.65)	(-2.94)	(-2.92)
log(R&D exps$_{j,t-1}$)	0.047***	0.043***	0.043***	0.047***	0.047***
	(9.38)	(7.75)	(7.81)	(9.31)	(9.38)
Bank FEs	Yes	Yes	Yes	Yes	Yes
Quarter FEs			Yes	Yes	
Year FEs	Yes	Yes			Yes
No. of obs.	244,504	244504	183524	183524	244504
Adj. R^2	0.358	0.359	0.389	0.390	0.358

Furthermore, we use an additional identification strategy to disentangle demand from supply of loans. Particularly, we use the Federal Reserve's Loan Officer Survey with bank-level responses to study how the demand for loans is affected over the business cycle. The survey contains specific bank level questions every quarter on whether firms' demand for loans has changed positively or negatively or it has remained the same. We use the following model:

$$\text{Lending\_Demand}_{i,t} = \beta_1 \text{Real\_GDP\_Growth}_{t-1} + \beta_2 \text{Real\_GDP\_Shock}_{t-1} + \beta_3 \text{Firm Controls}_{i,t-1} + \varepsilon_{it} \quad (8)$$

In Panel A of Table 10 we present the results. We find that demand for loans declines when there is a negative shock in the economic activity. In Panel B we provide results for a probit model where we test what is the probability that demand for lending will decline over the business cycle. The dependent variable is firms' demand for lending. This variable is set to 1 when there is a decline in the demand for lending when economic contraction takes place one quarter before. We find that the area below the receiver operating characteristic curve (AUROC) is 0.73, which is a strong indicator that firms' demand for bank lending will decrease in an adverse economic condition (Figure 2). These results are notably higher than the 0.5 threshold, indicating that the model has a satisfactory ability to discriminate between instances where loan demand increases and where it does not.

An AUROC above 0.7 is considered acceptable since it implies that the model's predictions have a relatively high true positive rate while keeping the false positive rate low (see for example Schularik and Taylor, 2012, Iyer, Kwatza, Luttmer and Shue, 2016, Jorda, Richter, Schulari and Taylor, 2021). The model's

predictive ability is especially salient given that we're studying complex economic behaviors, and the AUC values indicate that our logit models are effectively capturing the underlying dynamics of loan demand in relation to these variables. If the ROC curve is closer to the top left corner or the area under the curve (AUC) is near 1, this suggests a high accuracy of the model. Conversely, if the curve hovers close to the 45-degree diagonal line, the model's accuracy is no better than random guessing. The shape of our ROC curve, which prominently arches towards the upper left, attests to the stellar performance of the employed Logit model in predicting whether the demand for C&I loans will increase, showcasing its commendable discriminative capability.

Table 10

Demand for Corporate Loans and Economic Activity

Table 10 panel A presents OLS estimation of C&I loan demand and lagged real GDP growth and dummy of GDP growth decline. Control variables include Z-score, Revenue and R&D expenditure at firm level. All control variables are lagged by 1 period. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. Panel B presents Probit regression outcomes on the determinants of C&I loan demand, represented as a dummy variable where 1 signifies an increase in demand. The main predictors are lagged Real GDP growth rates. Control variables include Z-score, Revenue and R&D expenditure at firm level. All control variables are lagged by 1 period. The AUC values provide the model's discriminatory power, with values closer to 1 indicating better prediction capabilities. Pseudo R^2 values measure the model's goodness of fit. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

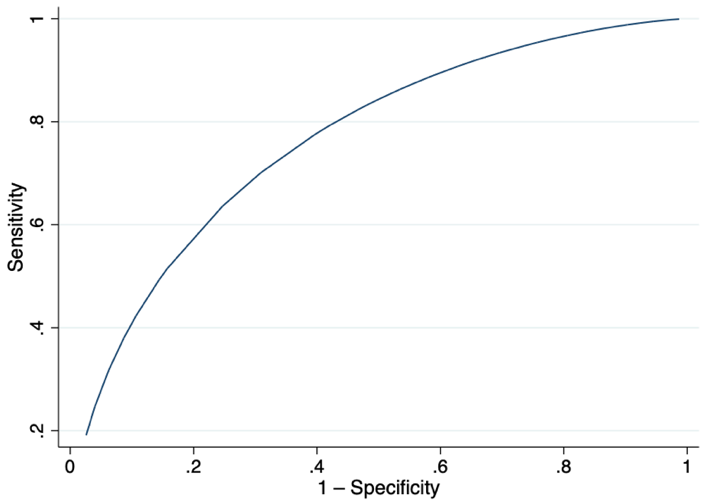
Panel A: Demand for Corporate Loans and GDP

	Corporate Loan demand $_t$	
	1	2
Real GDP growth$_{t-1}$	208.490***	
	(25.95)	
GDP shock		-4.442***
		(-4.88)
Z score$_{j,t-1}$	-0.012	-0.044***
	(-0.74)	(-3.63)
Revenue$_{j,t-1}$	-0.186**	-0.146
	(-2.01)	(-1.50)
R&D exps$_{j,t-1}$	0.061	0.127
	(0.47)	(0.98)
Bank FEs	Yes	Yes
Quarter FEs		

Year FEs	Yes	Yes
No. of obs.	3,183	3,183
Adj. R^2	0.860	0.844

Panel B: Probit model Demand for Corporate Loans and GDP

	Corporate loan demand $_t$
Real GDP growth$_{t-1}$	105.853***
	(0.639)
$Z\ score_{j,t-1}$	0.002
	(0.95)
$Revenue_{j,t-1}$	-0.015***
	(-6.30)
$R\&D\ exps_{j,t-1}$	-0.052***
	(-18.53)
AUC	0.743
	(0.004)
Pseudo R^2	0.258
No. of obs.	111,362



Area under ROC curve=0.743; SD=0.004

Figure 2 AUROC Probability of Loan Demand for Corporate Loans. Figure 2 presents the ROC curve associated with the model of table 8 panel B. The ROC curve plots the True Positive Rate (or sensitivity) on the vertical axis against the False Positive Rate on the horizontal axis. A curve that bows towards the upper left corner indicates that as the True Positive Rate increases, the False Positive Rate also rises, but at a slower pace than the former. If the ROC curve is closer to the top left corner or the area under the curve (AUC) is near 1, this suggests a high accuracy of the model. Conversely, if the curve hovers close to the 45-degree diagonal line, the model's accuracy is no better than random guessing. The shape of our ROC curve, which prominently arches towards the upper left (Area under ROC curve=0.743), attests to the stellar performance of the employed Probit model in predicting whether the demand for C&I loans will increase, showing its commendable discriminative capability.

5.2 Lending and Deposits during a local adverse economic shock

We provide further tests of a causal impact from the decline in bank lending to deposits by using an adverse shock in oil prices in 2014 that leads to economic contraction at the local county level. More precisely, the oil shock is an idiosyncratic shock that affected mainly the oil and gas production industry. Therefore, the negative effect is concentrated in specific counties whilst other counties' GDP was mostly unaffected. The contrasting effect across counties generates the perfect setting to employ a difference-in-difference methodology to isolate a demand for credit shock from firms concentrated in counties with a decline in economic activity in 2014. We use as a treat group bank lending for small businesses (CRA) and syndicated loans provided in firms which are based in counties with GDP highly dependent on the production of oil, and we also have a control group with lending provided in the rest of the counties. First, we use the following model to identify what is the impact of a contraction in economic activity for counties highly concentrated in the production of oil:

$$\log \_CRA\_lending_{i,t} = a_1 + b_1(Post*Treat)_{i,t} + \beta_4 \text{ Bank Controls}_{i,t} + \varepsilon_{it} \quad (9)$$

where CRA lending is lending originated and provided by county and time. Post is the post economic shock time period and treat is a group of counties which are highly concentrated in the production of oil. The results in Table 11 columns (4), (7) and (8) show that the decline in economic activity is associated with a drop in small business lending.

Next, we test the impact the contraction in lending has for deposit rates in banks operating in these specific counties that are highly concentrated in the production of oil. We use the following regression:

$$\log \_Deposit\_rate_{i,t} = a_1 + b_1(Post*Treat\_Bank\_Lending\_CRA)_{i,t} + \beta_2 (Post*Treat\_Syndicated\_Lending)_{i,t} + \beta_3 Post_{i,t} + \beta_4 Bank\ Controls_{i,t} + \varepsilon_{it} \quad (10)$$

where deposit rate is the local by bank-branch level deposit rate which is used at the bank-county level. The results in Table 11 reveal that the deposit rate

Finally, we test the impact the contraction in lending has for deposits in banks operating in these specific counties that are highly concentrated in the production of oil. We use the following regression:

$$\log \_Deposit\_amount_{i,t} = a_1 + b_1(Post*Treat\_Bank\_Lending\_CRA)_{i,t} + \beta_2 (Post*Treat\_Syndicated\_Lending)_{i,t} + \beta_3 Post_{i,t} + \beta_4 Bank\ Controls_{i,t} + \varepsilon_{it} \quad (11)$$

where deposit amount is the local FDIC deposit by branch by county and Post is the adverse oil shock which causes a decline in the local economic activity. The results in Table 11 columns (5) show that the decline in economic activity and in bank lending is associated with a drop in deposit rates for banks concentrated in these counties.

Table 11
Difference-in-differences Analysis

Table 11 reports the impact of the 2014 oil shock on bank loans, deposits and deposit rates over the sample period 2010 to 2018. We distinguish between treatment and control groups based on the share of oil industry to GDP in the counties where the banks are located. Considering that the treatment effect is higher in counties with a larger share of the oil industry in GDP, counties with more than the first 30 percentage points of the oil industry in GDP are classified as the treatment group. The dependent variable in columns (1) (2) (3) (4) is the log deposits, the dependent variable in columns (5) and (6) is the deposit rate, and the dependent variable in columns (7) and (8) is the log CRA loans. The interaction term Post*Treat captures the difference in the outcome variable between the treatment and control groups after the shock. Post*Treat* log(CRA $\text{loan}_{i,t}$) captures the effect of oil shocks on deposits at different levels of CRA loan. Post*Treat*(Treasury yield − Deposit rate)Spread_{it} captures the effect of oil shocks on deposits at different spread levels. Control variables include Equity_to_Asset, Tier_1_Capital, Total Asset and ROA at bank level. All control variables are in the base period. All regressions are ordinary least squares regressions and have bank and time fixed effects. Standard errors are clustered by bank. t-statistics are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable							
	log(Deposit_{it})				*Deposit rate*$_{it}$		log(CRA $\text{loan}_{i,t}$)	
Variable	1	2	3	4	5	6	7	8
Post*Treat	-0.120***	-0.125***			-0.009*	-0.006*	-0.535***	-0.544***
	(-2.43)	(-2.53)			(-1.68)	(-1.13)	(-3.61)	(-3.73)
Post*Treat* log(CRA $\text{loan}_{i,t}$)			-0.023**					
			(-2.51)					
Post*Treat* (Syndicated_Loans)$_{it}$				-0.079***				
				(-2.94)				
$EA_{i,t}$		-0.030***	-0.031	-0.015*		-0.011**		-0.039
		(-4.08)	(-1.35)	(-1.85)		(-2.34)		(-1.32)
log(Tier 1 $\text{capital}_{i,t}$)		0.281**	0.752*	0.209*		0.181***		0.945**
		(2.47)	(1.86)	(1.65)		(2.64)		(2.43)
log(Total $\text{asset}_{i,t}$)		0.222**	-0.204	0.455***		-0.066		-0.256
		(2.02)	(-0.60)	(4.01)		(-1.08)		(-0.66)
$ROA_{i,t}$		-0.009*	-0.020	-0.008*		-0.009**		-0.033
		(-1.81)	(-1.61)	(-1.67)		(-2.44)		(-1.62)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	145,637	145,443	12,356	46,775	48,220	12,358	12,358	12,358
Adj. R^2	0.478	0.479	0.354	0.621	0.759	0.733	0.323	0.327

7. Conclusion

This paper finds that a decline in bank lending reduces banks' pledgeability and crowds out bank deposits. We empirically show the economic mechanism that is in work. The decline in bank lending is associated with an increase in non-performing loans and a reduction in net income. It also causes a shift in banks' assets by increasing banks' investments in derivative products. Therefore, banks' pledgeability is reduced. Depositors anticipate that, and banks are forced to offer lower deposit rates which result to crowding out of deposits. This is an important new channel which shows how deposits can crowd out.

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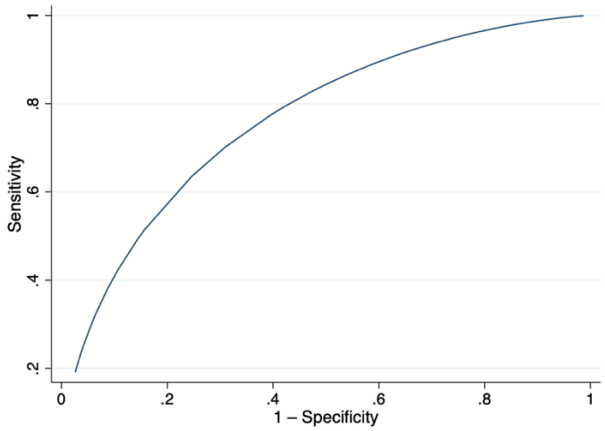
Appendix A.

Table A.1 Crowding-out of Deposits and Banks' Market Power

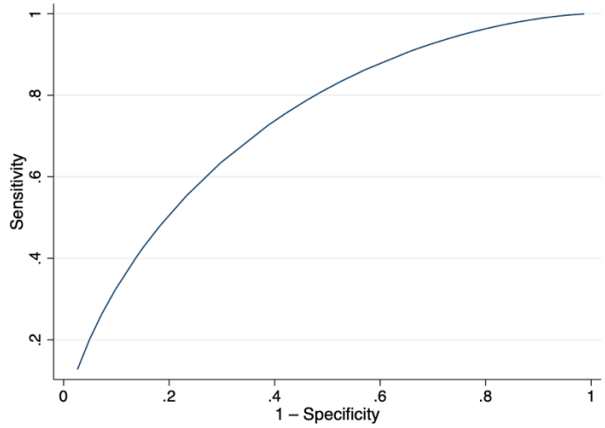
	deposit growth$_t$			
	(1)	(2)	(3)	(4)
bin × ΔTreasury - Deposit Spread (CD)$_t$	-0.001***			
	(-7.20)			
bin × ΔTreasury - Deposit Spread (CD)$_{t-1}$		-0.001***		
		(-6.84)		
bin × SMB loan growth$_t$			0.000**	
			(2.28)	
bin × SMB loan growth$_{t-1}$				0.001***
				(5.06)
Year FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
Observations	153970	144947	1069198	1006558
R^2	0.010	0.010	0.013	0.013

Notes: This table presents estimated coefficients from regressions examining the interactions between deposit growth for bank i at time t and various predictors. Specifically, the regression model can be represented as: $Deposit\ \ Growth_{it} = \gamma_h 1\{bin_h\} * \Delta Deposit\ Spread_{i,t} + \gamma_h 2\{bin_h\} * \Delta Deposit\ Spread_{i,t-1} + \gamma_h 3\{bin_h\} * bank\ lending_{i,t} + \gamma_h 4\{bin_h\} * bank\ lending_{i,t-1} + \theta_t + \eta_C + \varepsilon_{it}$, Where Deposit $Deposit\ Growth_{it}$ stands for the rate of deposit growth for bank i. The term bin interacts with the Treasury-Deposit Spread for Certificates of Deposit (both in the current period and lagged by one period) and with Small and Medium-sized Business (SMB) loan growth (again, both contemporaneous and lagged by one period). Year Fixed Effects (FE) and County FE have been incorporated to adjust for time-specific and county-specific influences, respectively. The deposit growth rate and spreads are determined using bank-specific records, with changes reflecting quarter-to-quarter fluctuations. The variable SMB loan growth signifies the growth trajectory of loans issued to small and medium-sized firms. *p<0.1,**p<0.05,***p<0.01.

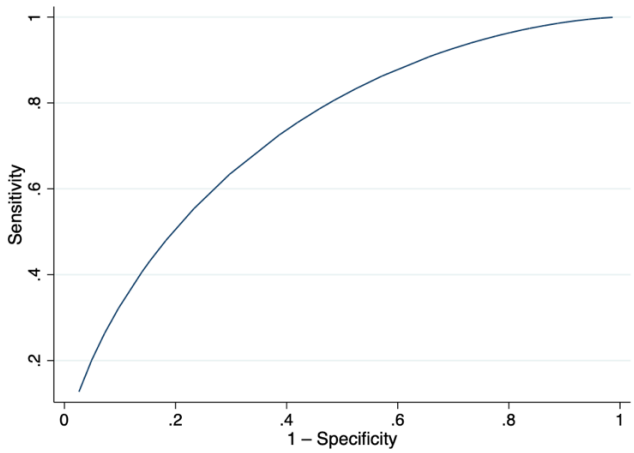
Figure A.1 AUROC Probability of Loan Demand for Corporate Loans



(a) Area under ROC curve=0.766



(b) Area under ROC curve=0.733



(c) Area under ROC curve=0.732

Notes: This figure plots AUROC Probability of Loan Demand for Corporate Loans. Figure 1a presents the ROC curve associated with the model of column 1,3 and 4 in Table 5. Figure 1b presents the ROC curve associated with the model of column 2 and 5 in Table 5. Figure 1c presents the ROC curve associated with the model of column 6 in Table 5.

Table A2 Impact of Business Cycle on Corporate Loan Spread

	log Syndicate loan spread$_t$							
	（1）	（2）	（3）	（4）	（5）	（6）	（7）	（8）

Real GDP growth$_{t-1}$	-0.495***		-0.715***					
	(-6.65)		(-6.06)					
Real GDP level$_{t-1}$		0.294**		-0.554***				
		(2.36)		(-2.89)				
Real GDP growth$_{t-2}$					-1.112***		-0.903***	
					(-16.23)		(-7.78)	
Real GDP level$_{t-2}$						-2.287***		-1.550***
						(-16.93)		(-7.23)
Tenor maturity$_t$	0.006***	0.006***	0.004***	0.004***	0.005***	0.005***	0.004***	
	(113.26)	(113.12)	(52.18)	(52.25)	(109.18)	(108.92)	(47.56)	
EA$_{t-1}$	-0.002***	-0.002***	-0.002***	-0.003***				
	(-8.82)	(-8.66)	(-6.83)	(-6.98)				
Tier1 capital$_{t-1}$	-0.045***	-0.047***	-0.027***	-0.027***				
	(-9.17)	(-9.39)	(-3.72)	(-3.62)				
TA$_{t-1}$	0.013**	0.013**	-0.029***	-0.030***				
	(2.30)	(2.45)	(-3.53)	(-3.58)				
ROA$_{t-1}$	-0.000***	-0.000***	-0.000	-0.000				
	(-2.60)	(-2.63)	(-1.26)	(-0.98)				
Z-score$_{t-1}$			-0.004***	-0.004***				
			(-14.20)	(-14.08)				
Sales$_{t-1}$			-0.109***	-0.109***				
			(-120.77)	(-120.73)				
FFER$_{t-1}$	-3.829***	-4.196***	-3.262***	-3.258***	-3.763***	-3.157***	-3.221***	
	(-15.03)	(-16.11)	(-8.38)	(-8.19)	(-14.64)	(-12.03)	(-8.09)	
EA$_{t-2}$					-0.002***	-0.002***	-0.002***	-0.002***
					(-8.25)	(-8.55)	(-6.84)	(-6.93)
Tier1 capital$_{t-2}$					-0.048***	-0.049***	-0.026***	-0.027***
					(-10.03)	(-10.09)	(-3.61)	(-3.66)
TA$_{t-2}$					0.017***	0.019***	-0.024***	-0.023***
					(3.20)	(3.48)	(-2.96)	(-2.77)
ROA$_{t-2}$					-0.001***	-0.001***	-0.001***	-0.001***
					(-4.57)	(-3.32)	(-3.67)	(-2.99)
Z-score$_{t-2}$							-0.007***	-0.007***
							(-21.01)	(-20.95)
Sales$_{t-2}$							-0.107***	-0.107***
							(-117.39)	(-117.35)
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	413842	413842	169170	169170	405810	405810	164509	164509
R^2	0.1985	0.1984	0.2269	0.2268	0.1995	0.1995	0.2248	0.2248

Notes: The table presents the Impact of Business Cycle on Corporate Loan Spread estimated from the following model of a business cycle at time t-1 or t-2 (quarter-year): $Syndicate\ loan\ spreadt_{i,t} = \beta_1\ Real\ GDP\ Growth\ _{t-1/t-2} + \beta_2\ Real\ GDP\ level\ _{t-1/t-2} + \beta_3\ Bank\ Control_{i,t-1/t-2} + \beta_4\ Firm\ Control_{j,t-1/t-2} + \beta_5\ Loan\ Variables_{i,t} + \beta_6 FFERt - 1\ + \alpha_i + \theta_t + \varepsilon_{it}$,where Syndicate loan spreadt$_{i,t}$ denotes the log of syndicate loan spread, and Real GDP growth and Real GDP level are also taken as natural logarithms. The independent variables are standardized. * p < 0.1, ** p < 0.05, *** p < 0.01

Lending Driven Crowding Out of Deposits

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ON-LINE SUPPLEMENTARY APPENDIX
(not-intended for publication)

A. Data Sources and Definitions

A1.