Loan Spreads and Interest Rates: The Role of The Deposit Channel and Lending Market Power

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Abstract

We present evidence that loan spreads earned by banks over marketable interest rates are, in the French business lending context, inversely related to the level of short-term interest rates. Controlling for the pricing of credit and interest rate risks, we show that this negative correlation is consistent with a credit supply shock: banks who increase loan spreads more when interest rates decline also experience lower growth in credit supply. We find empirical support for theories that link frictions in the deposit-taking business to lending outcomes of financially constrained banks. Lower rates compress deposit spreads earned by banks, prompting constrained banks to reduce lending, and explaining the rise in loan spreads. We also find support for a complementary channel, lending market power. Specifically, lenders with higher market share and borrowers facing a higher "hold-up problem" are associated with a lower interest rate pass-through. Finally, we provide novel evidence of negative real effects on corporate financing and investment for firms borrowing from banks with lower interest rate pass-through.

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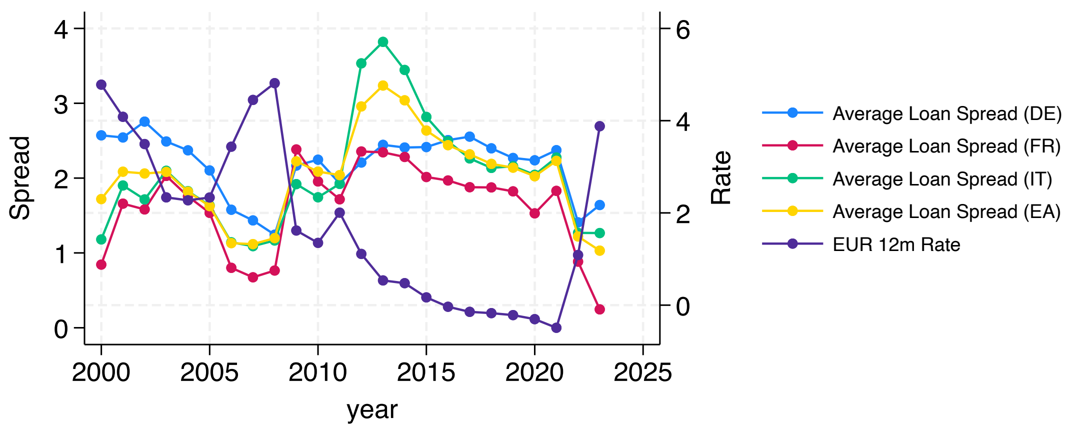
1. Introduction

Banks earn a large interest premium on loans relative to market interest rates (Schwert 2020). In aggregate US data, this interest rate premium is time-varying and exhibits a strong negative relationship with the level of interest rates (O. Wang 2024). The transmission of market interest rates to the interest rates on new loans issued to non-financial corporations is also weak in the Euro Area. Specifically, when market interest rates are low, spreads between the interest rates on new loans and market interest rates are large (Figure 1) - approximately 2 percentage points in major Euro Area countries. Conversely, when market interest rates are high, this spread narrows to less than 1 percentage point.[1]

To achieve their inflation and employment mandates, central banks employ a range of policy tools aimed at influencing economic outcomes by adjusting the financing costs for businesses and households. However, the transmission of monetary policy to real financing costs is indirect. While monetary policy has a strong impact on market interest rates (see e.g., van Binsbergen & Grotteria 2024), the weak pass-through from market rates to the interest rates on new loans, as highlighted in Figure 1, suggests that the ability of monetary policy to influence real outcomes may be limited.

FIGURE 1: Loan spreads and short-term interest rates in the Euro Area

Notes: The figure plots the spreads on the average interest rate on new loans to non-financial corporations with initial loan amount lower than EUR 1M over the 12M Euribor.



In this paper, we shed new light on the mechanisms behind the impaired transmission of market interest rates to loan rates and its real effects, using representative loan-level

[1]For the Euro Area, we use aggregate data interest rates on new loans to non-financial corporations (for different threshold of size and maturity) available for different euro area jurisdictions on the ECB Data Portal. See Figure B.1 for a detailed view of the underlying loan rate dynamics that contribute to the loan spreads shown in Figure 1.

data matched with detailed information about loan characteristics, borrowing firms, and lending banks. We test for the existence of the two main mechanisms proposed in the literature to explain the impaired long-run transmission of market interest rates to loan rates: the deposit channel in the presence of bank capital regulation (O. Wang 2024) and the lending market power channel (Scharfstein & Sunderam 2015).

Our loan-level data matched with bank-level data allows us to perform novel tests regarding the cross-sectional predictions of the two mechanisms regarding the bank-level and firm-level correlation between loan spreads and market interest rates. As opposed to previous research using bank-level data, our granular loan-level data allows us to control for the negative correlation between loan spreads and interest rates that may arise due to changes in the frictionless pricing of credit risk (Roberts & Schwert 2020). Finally, our firm-level data allows us to provide the first evidence of real effects for corporate investment of the impaired transmission of market interest rates to loan rates resulting from these mechanisms.

We begin our empirical analysis by confirming the evidence that loan spreads rise as interest rates fall, using a representative dataset of new fixed-rate loans maintained by the Banque de France for the period 2006Q1–2023Q4. We measure loan spreads as the spread between the loan-specific interest rate and the maturity-matched swap rate. In our main test, we regress loan spreads at the loan-level on the level of short-term interest rates. We show that the negative correlation between loan spreads and short-term rates is economically important. A 100 basis points (bp) drop in the three-month Euribor rate leads to 15 bp increase in the average loan spread.

We rule out that this negative correlation is explained by changes in the compensations for credit risk and interest risk exposures or by time-varying heterogeneity in loan characteristics. First, we find that the negative relationship between the level of short-term interest rates and loan spreads is quantitatively homogeneous across samples of loans with different borrower credit rating and across samples of loans with different maturities. Second, our results are quantitatively robust to running our regressions and including maturity fixed effects, lender fixed effects, borrower credit rating fixed effects, commuting zone fixed effects, and industry fixed effects in order to control for changes in the distribution of loan characteristics over time.

Instead, our analysis of the cross-section of banks reveals that the negative relationship between the level of short-term interest rates and loan spreads aligns with a supply-side explanation. We show there is substantial variation across banks in interest rate pass-through that cannot be explained by time-varying pricing of interest rate risk and credit risk. We investigate this variation and demonstrate that banks exhibiting lower interest rate pass-through - those with a more negative correlation between loan spreads and short-term interest rates - are also the banks showing a positive correlation between credit supply and short-term interest rates. In other words, when interest rates decline, banks characterized by higher increases in loan spreads experience a slower growth in credit supply. We confirm this cross-sectional result using Khwaja-Mian regressions: banks with lower interest rate pass-through to their borrowers following a decline in short rates are also those that decrease their lending volumes by more - after controlling for the lending volume of other banks lending to the same borrower.

We investigate supply-side mechanisms that may explain the cross-section of bank-level pass-through and thus inform us about the aggregate correlation, namely the deposit channel (see Drechsler, Savov, & Schnabl 2017 and O. Wang 2024) and lending market power (see Scharfstein & Sunderam 2015 and Y. Wang, Whited, Wu, & Xiao 2022).

O. Wang (2024) argues that a persistent decline in market interest rates compresses banks' deposit spreads as a result of the increasing competition between money and bank deposits. The fall in deposit spreads hurts banks' profits and equity valuations such that credit supply (which is tied to equity because of regulation) may fall, resulting in an increase in equilibrium loan spreads. We test this mechanism by instrumenting the sensitivity of deposit spreads to short-term interest rates in the cross-section of banks with their initial deposit rate at the beginning of our sample of bank balance sheet data (in 2010), in the spirit of Balloch and Koby (2023).

Consistent with the theoretical predictions in O. Wang (2024), we show that banks with lower initial deposit rates are banks which exhibit subsequently more positive deposit spread betas, more negative loan spread betas, and more positive loan volume betas. In other words, following a decline in short-term interest rates, banks with relatively low initial deposit rates experience a larger decrease in their deposit spreads, a larger increase in their loan spreads, and a larger decrease in credit supply. The correlations are both economically and statistically significant. Following a 100 bp decrease in short-term interest rates, a bank with a 1 standard deviation lower initial deposit rate is associated with (i) a 4 bp higher loan rate - half of the standard deviation of the response across banks - and (ii) a 90 bp lower credit supply growth - one fourth of the standard deviation of the response across banks.

We find evidence for the mechanism proposed in O. Wang (2024) whereby regulatory constraints tie the relationship between variation in bank profitability in the deposit business and variation in loan spreads. Banks with lower initial deposit rates suffer a larger compression in deposit spreads and a larger decline in their net interest margin, profits, and equity measured as share capital. This evidence is consistent with a lower credit supply growth being tied to the drop in equity value, and explaining the rise in loan spreads. We also find that the strong positive correlation between initial deposit rates and the pass-through of interest rates to loan rates is stronger in the sample of low-capitalised banks.

We then turn to investigating the role of market power in explaining the negative correlation between loan spreads and interest rates. We find evidence that bank-level measures of market power have explanatory power for bank-level pass-through measures. We show that following a 100 bp decrease in short-term interest rates, a bank with a 1 standard deviation higher market share of aggregate lending is associated with a 1 bp higher loan rate.

We run horse-race regressions that confirm that the deposit channel and market power channel are two separate channels which both explain the cross-section of bank-level interest rate pass-through. We show that the deposit channel is more important in explaining the cross-sectional variation in the loan rate pass-through as (i) it explains 25% of the cross-sectional variation in bank-level interest rate pass-through (compared to 1% for the market power measure), and as (ii) moving by a 1 standard deviation along the deposit rate measure is associated with a four times larger change in interest rate pass-through compared to moving by 1 standard deviation along the market power measure.

We re-appraise the market power channel by exploiting within-bank across-firms variation in bank market power. We first compare the interest rate pass-through to loan rates between firms subject to different degrees of the classic hold-up problem (see e.g., Sharpe, 1990; Rajan, 1992). We find that small firms, young firms, and firms that only borrow from one bank receive a lower interest rate pass-through by their bank following a decrease in the 3-month Euribor. The economic significance of price discrimination based on characteristics in the cross-section of firms is large. For instance, large (old) firms experience on average a 5 bp (3 bp) higher loan rate pass-through of a 100 bp decrease in the short-rate compared to small (young) firms.

We also run an alternative within-bank across-firms test of the market power channel by comparing the differential pass-through of market interest rates to loan rates between firms borrowing in commuting zones that differ in concentration levels. In accordance with the results from the pass-through regressions of Scharfstein and Sunderam (2015) in the mortgage markets, we find evidence of a lower pass-through of short-term interest rates to loan rates in more concentrated local business lending markets. However, our loan-level data allows to show that this result is not robust to controlling for bank-time fixed-effects. This specification compares the differential pass-through by the same bank to firms borrowing from local lending markets with different concentration levels. Our result stresses the importance of sorting across space of banks with homogeneous pass-through across space, but different average pass-through.

Finally, we show that the lower interest rate pass-through and lower relative supply of bank loans following a decline in short-term interest rates has real effects. Firms that are exposed to banks characterised by a relatively lower pass-through experience a relative lower debt and investment growth following a decrease in the short rate. A 1 standard deviation higher firm-level exposure (i.e., more borrowing from banks with a lower pass-through) is associated with a 3.1 (1.9) percentage points lower debt growth (investment growth) following a drop in the short rate by 1 percentage point. We show that these differentials in debt growth and investment growth for firms borrowing from banks with different interest pass-through can be explained by the two channels that explain the cross-sectional variation in the correlation between loan spreads and interest rates. We show that firms that are more exposed to banks whose lending capacity is more constrained by the compression of deposit spreads experience a relative lower debt and investment growth following a decrease in the short rate. We also show that firms borrowing from banks with relatively higher market shares in aggregate lending experience a relatively lower debt and investment growth following a decrease in the short rate. The robustness of these results to horse race regressions further suggests that both the deposit channel and bank market power have important real effects through their effects on lending quantity and prices.

Related literature Our paper is related to the literature on loan rate stickiness to changes in market interest rates (e.g., Berger & Udell 1992; O. Wang 2024; Roberts & Schwert 2020). We find that loan spreads (over market interest rates) on fixed-rate loans to non-financial companies in France are negatively correlated with short-term interest rates, after controlling for the time-varying composition of borrowers, credit risk, and loan maturity. Unlike the literature that focuses on the role of credit risk pricing in explaining time series variation in loan spreads (e.g., Roberts & Schwert 2020; Dougal, Engelberg, Parsons, & Van Wesep 2015; Demiroglu, James, & Velioglu 2022), we find a very limited role for time-varying credit risk in explaining the negative correlation between loan spread and short-term interest rates.

Motivated by the homogeneous correlation across samples of loans with different maturities or credit risk characteristics, we study the cross-sectional dispersion across banks in interest pass-through, i.e., the correlation between their average loan spread and the level of interest rates. We show that there is substantial cross-sectional dispersion across banks in interest rate pass-through which is not explained by cross-sectional dispersion across credit ratings and loan maturities in interest rate pass-through. Using the dispersion in interest rate pass-through that is purged from composition effects and Khwaja and Mian (2008)-type regressions, we confirm the result of O. Wang (2024), obtained with aggregate bank balance sheet data, that the dispersion across banks is consistent with a supply-side shock: following a drop in short-term rates, banks providing a lower interest rate pass-through also experience a slower growth in credit supply - after controlling for the lending volume of other banks lending to the same borrower.

In explaining the source of this correlation, we relate to the literature showing that conventional monetary policy becomes impaired at low interest rates. Both empirical and theoretical papers suggest that conventional monetary policy becomes impaired when short-term rates cross the effective lower bound on deposit rates due to negative deposit spreads leading to a drop in banks' profitability.[2] Instead, consistent with O. Wang (2024), we find that the interest pass-through is already below one when short-term rates are still positive: loan spreads rise when short-term rates fall from 4pp to 0pp. We also find that banks with higher deposit spread betas (and whose deposit market profitability suffers from declining interest rates) cut credit supply relatively more, and their average loan spreads rise. We find new empirical support for O. Wang (2024)'s theoretical mechanism regarding the importance of capital regulation by showing that the negative correlation between instrumented deposit spread betas and loan spread betas is concentrated in the sample of banks with lower capitalisation. This more broadly highlights the importance of the role of bank equity in the "bank lending channel" of monetary policy (e.g., Van den

[2]See e.g., Abadi, Brunnermeier, and Koby (2023), Ulate (2021), Balloch and Koby (2023), Heider, Saidi, and Schepens (2019), Eggertsson, Juelsrud, Summers, and Getz Wold (2023), Arce, Garcia-Posada, Mayordomo, and Ongena (2020), Heider et al. (2019), Bottero et al. (2019), Claessens, Coleman, and Donnelly (2018), Ampudia and Van den Heuvel (2022).

Heuvel et al. 2002, Gertler & Karadi 2011).

We also relate to the literature that highlights the role of bank of market power in explaining monetary policy transmission. The literature following Drechsler et al. (2017) has highlighted the role of bank market power on the pricing of deposits. Instead, we relate to the strand that focuses on lending market power. Scharfstein and Sunderam (2015) presents evidence that high concentration in local mortgage lending reduces the sensitivity of mortgage rates to MBS yields using *short-run* pass-through regressions. Using regressions of the level of loan rates, we contribute by showing that market power has a *persistent* effect on interest rate pass-through in the non-financial lending market through two sources of identification. First, we show that banks with a higher share of aggregate lending have a lower interest rate pass-through. However, as opposed to Y. Wang et al. (2022) who find an significant role for bank lending market power in the pricing of loans, we find a quantitatively limited impact of bank-level market power in explaining the dispersion in bank-level pass-through. Second, we show there is a significantly lower interest rate pass-through to small, young, and single-bank firms compared to other borrowers of the same bank after controlling for credit risk, which is consistent with the importance of the classic hold-up problem (Sharpe 1990 and Rajan 1992) in explaining interest rate pass-through.

Finally, relative to all the above strands of literature that provide empirical evidence of impaired interest rate pass-through, we provide novel evidence that both bank-level channels that explain the lower interest rate pass-through have real effects on corporate financing and inevestment.

2. French Loan-Level Data

To establish the robustness that loan spreads are negatively related to the level of interest rates in the context of France we combine proprietary data sets maintained by the Banque de France for the period 2006Q1–2023Q4.[3] We first combine a dataset with loan-level information (notably, interest rates) for a representative sample of new loan with datasets containing firm-level ratings from Banque de France and firm-level accounting variables from tax filings. Second, to shed light on mechanisms that could explain this stylised fact, we also link datasets containing bank-level accounting information from individual banks' balance sheet and income statements and firm-bank

[3]These data are made available by the Banque de France through a secured remote server (CASD).

relationship information on the volume of outstanding loans from the credit registry.

In this section, we describe these data sources in greater detail, as well as other data sources that we use in some analyses to construct auxilliary variables.

Loan-level data. We use the Crédits Nouveaux aux Entreprises (NCE) dataset which includes loan-level information on new loans issued in France. This dataset is used by The Banque de France to compute and disseminate quarterly statistics on the interest rates of new loan contracts and to estimate the cap on lending rates set by French law ("taux d'usure"). This dataset lists, line by line, all new loans granted during the first month of each quarter by a representative sample of bank branches and specialized credit institutions. The data set reports the interest rate, the loan size, the purpose of the financing (cash flow, investment, real estate, etc.), the maturity at issuance, and a dummy equal to one if the interest rate is fixed. In addition, the dataset lists the unique lending institution and borrowing firm identifiers allowing to merge this information with other bank- and firm-specific datasets.[4]

We include loans made by individual institutions to non-financial, privately owned corporations, excluding public utilities and individual entrepreneurs. Personal loans and regulated loans or loans subject to government subsidies are excluded. We retain only loans to firms domiciled in Metropolitan France. The analysis focuses on standard investment and liquidity loans, excluding overdraft loans, leasing obligations, factoring-like loans, and subordinated debt. Only fixed-rate loans are considered. We keep loans to firms whose total credit exposure to at least one bank exceeds EUR 25,000, provided there is no missing rating from the Banque de France. We exclude firms with ratings below or equal the 8th rating level (out of 12 levels; i.e., cotation "6"), corresponding to a firm with a financial situation deeply unbalanced and presenting a high credit risk. To construct maturity-matched loan interest rate spreads over comparable publicly traded securities, we restrict the analysis to the main maturity buckets (3, 6, 12, 24, 36, 48, 60, 84, and 120 months), which together represent more than 70 percent of standard investment and liquidity loans to non-financial corporations.

The clean dataset contains 147,146 loans with an average maturity of 4.5 years and an average interest rate of 2.53 percent. Table A.4 reports the summary statistics for the

[4]New loans reported by credit institutions are defined as all financial contracts (without a minimal reporting threshold on either loan size or borrower size) that specify the interest rate on a loan for the first time. We exclude all cases of renegotiation of loans with modification of the initial contractual credit conditions.

loan-level dataset. Table A.2 and Table A.1 reports the summary statistics by respectively maturity and credit rating breakdowns.

Data on bank-firm credit relationships. We collect data on bank-firm credit relationships from the French credit registry (SCR). This registry provides monthly data on the credit exposures of all credit institutions operating in France to firms with a total credit exposure of more than EUR 25,000 to at least one bank. The dataset includes details on both the actual credit extended to firms and the banks' credit commitments to them. Although credit exposure is categorized into term loans and lines of credit, our analysis is focused exclusively on term loans. We also observe firm location which we use to measure local lending markets. We define two level of aggregation: municipalities (approx 35,000) and commuting zones (306).

Bank-level data. Fourth, we merge the previous data sets with balance sheet and income bank-level information from the COMPTE DE RESULTAT and SITUATION datasets obtained at annual frequency starting from 2010. The level of observation for bank-level data in all our datasets is the individual credit establishment rather than the banking group an establishment belongs to. This is relevant given that the EU Capital Requirements Regulation is enforced at both the establishment and banking group levels. For the bank-level analysis, we impose a balanced panel at the bank level by keeping only banks which appear at least once in our sample of loan-level data and appear in all years between 2010 and 2021 in the bank-level dataset (75 unique banks).

Firm-level data. Finally, we obtain data on firms' credit ratings and other balance sheet characteristics from the FIBEN dataset. This dataset is compiled by The Banque de France using tax filings from firms with an annual turnover exceeding EUR 0.75 million or bank debt surpassing EUR 0.38 million. Regarding firm-level accounting variables, we collect total assets, leverage, the age of the firm, the firm's two-digit industry. Regarding firm-level credit ratings, we gather credit assessments of individual firms calculated by the Banque de France and validated by the Eurosystem.[5] The credit assessments are obtained from hard information such as balance sheet data and payment incidents, as well as soft information collected from interviews with company managers. The Banque de France assigns a comprehensive credit rating to monitored firms annually. This rating represents an overall evaluation of a company's ability to meet its financial

[5]The Eurosystem can rely on these credit assessments when evaluating the credit quality of eligible credit claims within its collateral framework.

commitments over a three-year horizon. There are 12 credit rating levels (3++, 3+, 3, 4+, 4, 5+, 5, 6, 7, 8, 9, and P), ranging from the most favorable (3++) to the least favorable (P, indicating formal bankruptcy). For example, a firm with a rating of 4 (the most common rating across firms) ”has an acceptable capacity to fulfill its financial commitments but exhibits some elements of weakness or uncertainty”.

3. Interest Rates, Loan Spreads, and Credit Supply

In this section, we show that the aggregate stylised fact that loan spreads are negatively related to the level of interest rates holds in the French microdata on issuance of new loans. We show this result is not explained by changes in the compensation to banks for taking interest rate risk or credit risk that would correlate with the level of interest rates. We show that, when interest rates are low, banks with higher loan spreads also supply less credit to firms.

Robust negative correlation between loan spreads and short-term interest rates. We start by running the following baseline regression with different sets of fixed effects:

$$s_{lbit} = \beta_0 + \beta_1 \cdot i_t + \epsilon_{lbit}, \tag{1}$$

where s_{lbit} is the spread between the loan rate on loan l issued by bank b to firm i at time t and the maturity-matched Overnight Index Swap (OIS) rate, and i_t is either the 3 months Euribor rate, the ECB deposit facility rate, or the maturity-matched OIS rate at time t. We include loan maturity fixed effects, bank fixed effects, credit rating fixed effects, commuting zone (CZ) fixed effects, and industry fixed effects to control for the composition of loans over time. For the specification with maturity-matched swap rates, we also include a set of time fixed effects to control for the level of interest rates and study asymmetric changes in the term structure of interest rates across maturities.

Table 1 reports the results for new loans with initial maturity above 1 year because they are more likely to finance productive investments.[6] Using the 3-month Euribor (EUR3M) rate and the deposit facility (DF) rate, we observe a consistent negative relationship between the level of short-term rates and the spreads charged by banks over the maturity-matched swap rates. This finding suggests a weak transmission of policy rates, and more broadly market interest rates, to bank loan interest rates.

[6]Table Table A.4 reports the summary statistics of the loan-level data used in regressions for new loans with initial maturity above 1 year.

TABLE 1: Negative correlation between loan spreads and short-term interest rates: micro-evidence

Notes: The regression estimates are based on Equation 1. Standard errors are clustered at the quarterly date-level.

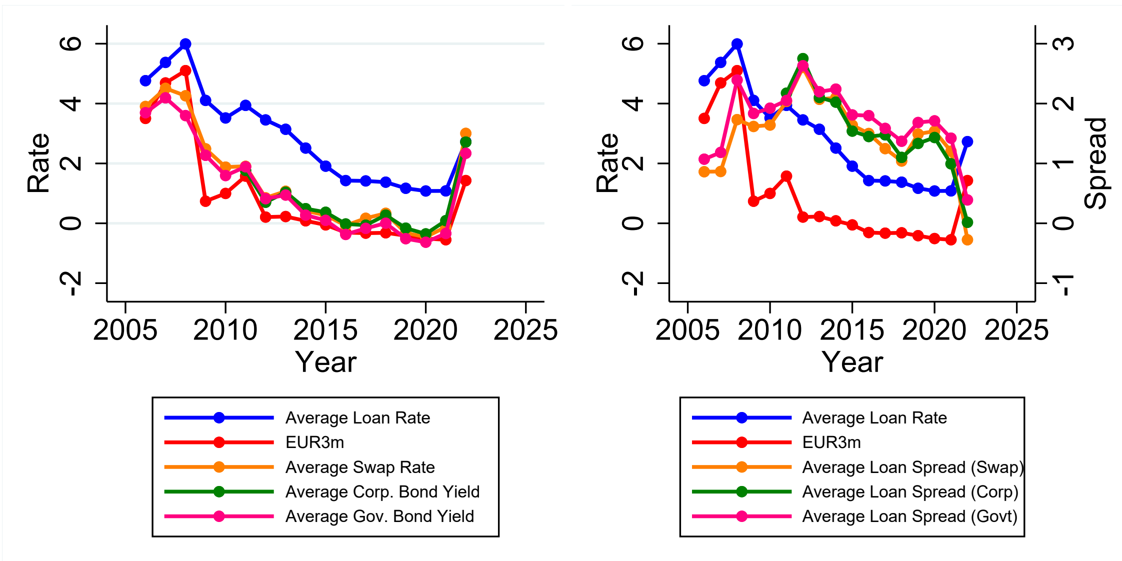
	Loan interest rate spread on maturity-matched swap rate							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EUR3M rate	-0.12**	-0.15***						
	(0.05)	(0.05)						
DF rate			-0.18**	-0.21***				
			(0.07)	(0.07)				
Swap rate					-0.17***	-0.18***	-0.77***	-0.75***
					(0.04)	(0.04)	(0.13)	(0.11)
No FE	✓	–	✓	–	✓	–	–	–
Maturity FE	–	✓	–	✓	–	✓	✓	✓
Bank FE	–	✓	–	✓	–	✓	✓	–
Rating FE	–	✓	–	✓	–	✓	✓	–
CZ FE	–	✓	–	✓	–	✓	✓	–
Industry FE	–	✓	–	✓	–	✓	✓	–
Time FE	–	–	–	–	–	–	✓	–
Bank x Time FE	–	–	–	–	–	–	–	✓
Rating x Time FE	–	–	–	–	–	–	–	✓
CZ x Time FE	–	–	–	–	–	–	–	✓
Ind. x Time FE	–	–	–	–	–	–	–	✓
Ind. x CZ x Time FE	–	–	–	–	–	–	–	✓
Observations	147146	147133	147146	147133	147146	147133	147133	88534
Adjusted R^2	0.030	0.323	0.028	0.320	0.059	0.346	0.570	0.623

Quantitatively, the average effects are economically significant across our specifications and range from a 12 to 21 basis points increase in loan spreads following a one percentage point decrease in the short rates.

Figure 2 illustrates these results graphically. Panel (a) shows the average interest rate dynamics on loans in the loan-level dataset against dynamics for the proxy for short-term interest rates (3-M Euribor) and the dynamics for the average interest rate on publicly traded securities that maturity match the loans in the loan-level dataset (where the publicly traded securities considered are respectively, interest rate swaps, corporate bonds, and government bonds[7]). Panel (b) contrasts the market interest dynamics against the dynamics for the average interest rate spread between a loan in the loan-level dataset and its maturity-matched interest rate swap.

FIGURE 2: Negative correlation between loan spreads and short-term interest rates

Notes: The markers represent simple yearly averages in the loan-level dataset. The loan spreads in Panel (b) are computed at the loan-level using the respective maturity-matched market interest rates.



(a) Loan rates and market interest rates

(b) Loan spreads and market interest rates

Figure 2 also suggests it is not quantitatively important whether one measures the loan-level interest rate spread using the loan-level maturity-matched interest rate swap rather than using the loan-level maturity-matched government bond, or its counterpart from the corporate bond yield curve.

The literature commonly uses short-term *changes* in loan rates and short rates to estimate monetary policy pass-through. In Table B.8, we show our results remain qualitatively robust to specifications using long differences. To the extent that regressions in short differences capture the lags of monetary policy transmission, we prefer our main regressions in levels as we are interested in the long-run equilibrium monetary policy pass-through.

Ruling out the role of compensation to banks for taking interest rate risk or credit risk. We investigate whether the robust average negative relationship between the level

[7] The swap curve data is obtained from S&P Capital IQ for swap rates with 6M EURIBOR variable leg. The corporate bond yield curve is obtained from S&P Capital IQ for European non-financials with AAA ratings. The French government bond yield curve is obtained from Banque de France.

of short-term interest rates and loan rate spreads over the marginal financing cost of loans is heterogeneous across loan maturities and firm-level credit risk. This is informative of whether the variation in loan spreads may result from changes to the compensation for interest rate risk or credit risk.

We run regressions similar to Equation 1, but add a set of interaction terms between the level of short-term interest rates (3-month Euribor) and dummies indicating either loan maturity or credit rating:

$$s_{lbit} = \beta_0 + \beta_1 \cdot i_t + \gamma \cdot \mathbf{Z}_l \times i_t + \epsilon_l, \tag{2}$$

where s_{lbit} is the spread of the loan rate on loan l issued by bank b to firm i at time t over the maturity-matched swap rates, i_t is the 3 months Euribor rate at time t, and $\mathbf{Z}_l$ is a vector of dummies indicating either the maturity or the borrower credit rating for loan l.

Table 2 reports the results for new loans with initial maturity above 1 year where the base group for column (1) is the 24-month maturity loan group and the base group for column (2) is the highest credit rating group (3++). We find no evidence of a significant effect of loan maturity on the relationship between the level of short-term interest rates and loan spreads.

Similarly, credit risk seems to only play a minor role in explaining the cross-sectional variation in the correlation between loan spreads and interest rates. The additional effect on the correlation for the riskiest borrowers (credit rating levels 5 and 5+) is one third of the baseline correlation (–0.06 versus –0.15).

Most importantly, the correlation for the safest borrowers (credit rating level 3++) is quantitatively comparable to the average correlation reported in Equation 1 (–0.15). This suggests that higher loan spreads are not driven by an average higher credit risk and/or an average higher price of credit risk.[8]

Pass-through of symmetric and asymmetric shifts in the term structure of interest rates. A relevant measure of marginal cost of funds for banks is the OIS rate with maturity corresponding to that of the loan being issued. Columns (5)-(6) of Table 1 include the same sets of fixed effects as in columns (1)-(4). It shows that the negative

[8] Furthermore a risk-based explanation common to bank loans to firms and corporate bonds would imply a lower loan spread under low interest rates when computed against yields corporate bonds with otherwise similar characteristics. Figure 2 suggests this is not the case as the aggregate time series of the yield on the maturity-matched bond rate is quantitatively comparable to the aggregate time series of the yield on the maturity-matched swap rate.

TABLE 2: Negative correlation between loan spreads and rates: heterogeneity by risk and maturity

Notes: The regression estimates are based on Equation 2. The base group for column (1) is the 24-month maturity loan group and the base group for column (2) is the highest credit rating group (3++). Standard errors are clustered at the quarterly date-level.

	Loan interest rate spread on maturity-matched swap rate	
	(1)	(2)
EUR3M rate	-0.16***	-0.15***
	(0.04)	(0.04)
Maturity=36 × EUR3M rate	0.02*	
	(0.01)	
Maturity=48 × EUR3M rate	0.00	
	(0.04)	
Maturity=60 × EUR3M rate	0.01	
	(0.05)	
Maturity=84 × EUR3M rate	-0.01	
	(0.04)	
Maturity=120 × EUR3M rate	0.01	
	(0.03)	
Rating=3 × EUR3M rate		0.03**
		(0.01)
Rating=3+ × EUR3M rate		0.00
		(0.02)
Rating=4 × EUR3M rate		0.02
		(0.02)
Rating=4+ × EUR3M rate		0.01
		(0.01)
Rating=5 × EUR3M rate		-0.06***
		(0.02)
Rating=5+ × EUR3M rate		-0.02
		(0.02)
Maturity FE	✓	✓
Bank FE	✓	✓
Rating FE	✓	✓
CZ FE	✓	✓
Industry FE	✓	✓
Observations	147133	147133
Adjusted R^2	0.323	0.324

relationship between *short-term* interest rates and loan spreads extends to a negative relationship between *maturity-matched* interest rates and loan spreads.

Specifications without time fixed effects identify the coefficient on maturity-specific swaps in the time series from both symmetric movements of the OIS curve (i.e., parallel shifts) and asymmetric movements (i.e., changes in the slope or curvature). However, the similarity between the magnitudes of the coefficients from columns (1)-(4), which only use identification from shifts in short-term rates by construction, and from columns (5)-(6) suggests that the latter are mostly identified from parallel shifts in the OIS curve. In other words, when the marginal financing cost for loans of different maturity drops uniformally, interest rate spreads on loans over their respective marginal financing cost rise.

Columns (7)-(8) of Table 1 include different sets of time fixed effects. In these latter specifications, identification occurs solely from asymmetric movements of the curve in the time series. This serves the purpose of studying the relationship between the level of interest rates and loan spreads while controlling for the correlation between parallel shifts in the term structure and time varying compensation in credit risk or interest risk.

The correlation is still negative (even larger in this case), confirming the negative relationship between interest rates and loan spreads is not driven by compensation in credit risk or interest risk.

A supply-side narrative: negative correlation between loan spreads and credit supply. Our analyses so far reveal a negative relationship between short-term rates and loan spreads, which is not driven by changes in the pricing of interest rate risk and credit risk. In this section, we investigate the relationship between short rates and lending volumes in an attempt to distinguish whether the lower pass-through of decline in interest rates to loan rates is broadly the result of a relative demand shock (i.e., firms relatively increasing demand for new bank credit when short-term rates are low) or a relative supply shock (i.e., banks relatively cutting the supply of new credit when short-term rates are low).

We use the cross-section of bank response to understand the source of the aggregate correlation. More precisely, we ask whether, in response to a decline in interest rates, banks with lower growth in lending are also characterised by a lower loan rate pass-through, which would support a supply-side story. Hence we study the correlation between loan rate pass-through and credit supply in the cross-section of banks by regressing credit supply on an interaction term between the level of short-term interest rates and a bank-level measure of the interest rate pass-through to loan rates in our sample. We refer to this pass-through measure as the bank's loan spread beta.

The banks' loan spread betas are the bank-specific slopes for the coefficient on the short-term interest rate estimated from our baseline specification from column (2) of Table 1. The specification further controls for interaction terms between the short-term interest rate and credit rating dummies and between the short-term interest rate and maturity dummies. Thus, a bank's loan spread beta captures the bank-level correlation between its average loan spread and the level of interest rates, which is not explained by loan maturity and firm credit rating.

Banks with lower loan spread betas are those that earn higher spreads as interest rates decrease, i.e., banks with a lower pass-through of declining short-term interest rates. As shown in the summary statistics of Table A.6, the loan spread beta is negative for more than 90% of banks and there is substantial variation in the measure. The average loan spread beta is –.16 and the interquartile range is equal to 0.07 in our sample of 75 banks present throughout 2010-2021.

Using the estimated banks' loan spread betas we estimate the following equation:

$$\log(\text{credit}_{bit}) = \beta_0 + \beta_1 \cdot i_t + \beta_2 \cdot i_t \times \text{LoanSpreadBeta}_b + \epsilon_{bit}, \tag{3}$$

where i_t is the 3-month Euribor rate, and LoanSpreadBeta_b is the sensitivity of bank b's loan spread to a change in the 3-month Euribor rate. The regressions are run using the French credit register, which reports the universe of volumes of outstanding credit at the bank-firm-year level.

Column (1) of Table 3 shows the coefficient on the interaction term is negative and significant, supporting a supply-side story: following a decrease in the 3-month Euribor rate, banks with a lower interest pass-through (lower loan spread betas) are also those that increase volumes relatively less when short-term interest rates decline.

In column (3) of Table 3, we run Khwaja-Mian regressions by including firm-time fixed effects. Under the assumption that a firm's loan demand is homogeneous across banks, this controls for demand-side factors and identifies the coefficient by looking at firms borrowing from multiple banks at the same point in time. The coefficient is quantitatively unchanged reinforcing a supply-side narrative: banks that give less interest rate pass-through to their borrowers when short rates decrease are also those that relatively decrease their lending volumes - in particular after controlling for the lending volume of other banks lending to the same borrower.

TABLE 3: Negative correlation between loan spreads and credit supply across banks

Notes: The regression estimates are based on Equation 3. Standard errors are double clustered at the quarterly date and bank-levels.

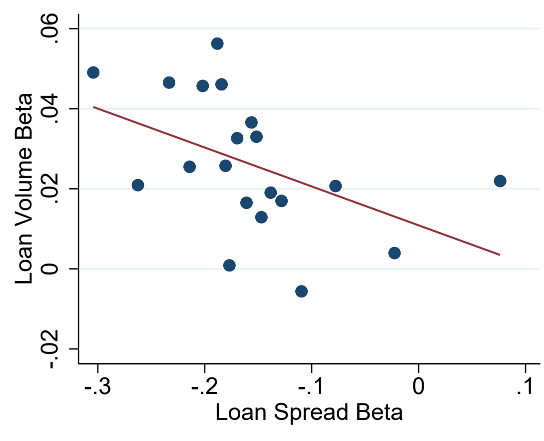
	(1) log(Credit)	(2) log(Credit)	(3) log(Credit)
EUR3M × Loan Spread Beta	-0.11***	-0.12***	-0.13***
	(0.03)	(0.03)	(0.02)
Year FE	✓	✓	–
Firm x Bank FE	✓	✓	✓
Firm x Year FE	–	–	✓
Observations	6424488	1339544	1329798
Adjusted R^2	0.687	0.718	0.727

Figure 3 provides graphical evidence of a supply-side narrative of the increase in loan spreads when short rates decrease. It shows the correlation between banks' loan spread betas and loan volume betas. The former are defined as the sensitivities of banks' loan spreads to the 3-months Euribor rate at the bank level. The latter are defined as the sensitivities of banks' loan volumes to the 3-months Euribor rate at the bank level.[9] Banks with high loan-volume betas are banks that relatively cut credit when short rates decrease (i.e. banks that increase volumes by less than low loan-volume beta banks). The negative correlation stresses that banks giving lower pass-through of market interest rate declines are also those with lower loan volume growth.

[9] Loan volume betas are the bank-specific slopes from the regression of the logarithm of outstanding credit extended by a bank to a firm on the 3-month Euribor including firm-bank and firm-year fixed effects.

FIGURE 3: Loan spread betas and loan volume betas

Notes: The figure shows a binned scatter plot that groups banks into 20 bins by loan spread beta and plots the average loan volume beta within each bin. See details for the estimation of loan spread betas and loan volume betas in the text of Section Section 3.



4. Mechanisms: Deposit Channel and Market Power

Having established that banks with lower pass-through of declining short-term interest rates to bank loan rates are banks that coincidentally decrease their loan volumes, we investigate two potential supply-side mechanisms susceptible to explain the cross-section of bank-level loan rate pass-through and thus driving the aggregate results. We first provide empirical evidence supporting the view that the compression of deposit spreads following a decline in short-term interest rates hurts the net worth of banks resulting in a contraction of credit supply for constrained banks and higher loan spreads. We find no evidence that variation in the bank-level exposure to concentrated lending markets has explanatory power for the variation in bank-level pass-through measures. However, we do find evidence that banks' market share of aggregate lending can explain part of the variation. Additionally, we find evidence supporting the role of market power in explaining the differences in loan spreads within-banks across borrowers.

4.1. Deposit Channel in the Constrained Lending Regime (O. Wang 2024)

O. Wang (2024) argues that the secular decline in interest rates affects equilibrium loan spreads because it compresses banks' deposit spreads as a result of the increasing competition between money and bank deposits at lower interest rates. The fall in deposit spreads hurts banks' profits and equity valuations such that credit supply (which is tied to equity because of regulation) may fall, resulting in an increase in equilibrium loan spreads.

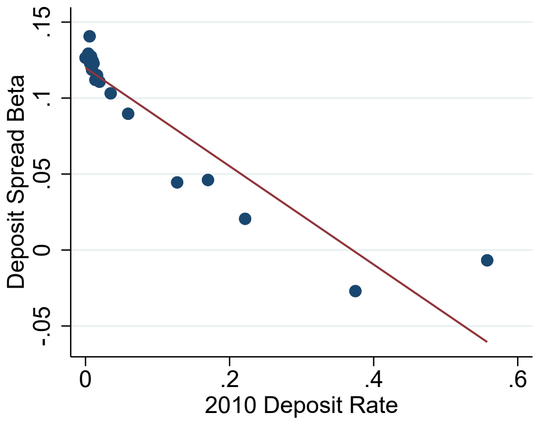
We test this mechanism by instrumenting banks' deposit spread betas (the sensitivity of deposit spreads to short-term interest rates), in the cross-section of banks, with their initial deposit rate at the beginning of our sample of bank balance sheet data (i.e., 2010) in the spirit of Balloch and Koby (2023). We measure the average initial deposit rate on deposit accounts excluding regulated deposit accounts and term deposits. This allows us to compute variation in deposit rates that is not driven by heterogeneity in deposit account composition.

We first show that banks with larger compression in their deposit spreads subsequently extended less credit with higher loan spreads. We also show that this cross-sectional result is stronger in the sample of poorly capitalised banks. When measuring bank equity as share capital, we find evidence for the mechanism proposed in O. Wang (2024), whereby banks who experienced a drop in equity due to lower deposit spreads have to cut lending.

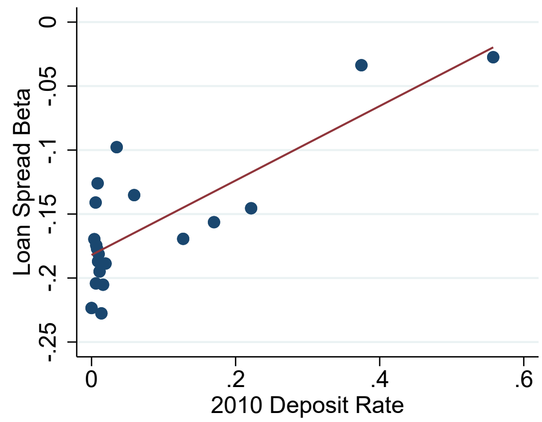
Compression of deposit spreads, drop in loan volume and increase in loan spreads. Figure 4 shows the correlation between banks' initial deposit rates at the beginning of our sample in 2010 and their deposit spread betas, loan spread betas, and loan volume betas calculated over the 2010-2023 period. It is apparent that banks with lower deposit rates in 2010 are banks which exhibit subsequently more positive deposit spread betas, more negative loan spread betas, and more positive loan volume betas. In other words, banks with relatively low deposit rates in 2010 are banks that, as short-term interest rates dropped, subsequently: i) experienced a decrease in their deposit spreads ii) increased their loan spreads (i.e., gave relatively less pass-through of rate drops to loan rates), and iii) relatively decreased lending volumes.

FIGURE 4: Initial deposit rates, deposit spread betas, loan spread betas, and loan volume betas

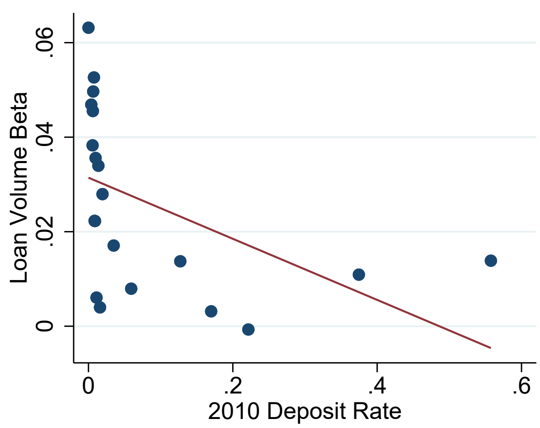
Notes: The panels show binned scatter plots that groups banks into 20 bins by their deposit rate at the beginning of our sample of bank-balance sheet and income statement data in 2010 and plots respectively the average estimated deposit spread betas, loan spread betas, and loan volume betas within each bin. See details for the estimation of loan spread betas and loan volume betas in the text of Section Section 3.



(a) Low deposit rates, low deposit spread betas



(b) Low deposit rates, low loan spread betas



(c) Low deposit rates, high loan volume betas

In columns (1) and (2) of Table 4, we formally test for the latter two correlations. The correlations are both economically and statistically significant. A one-standard-deviation decrease in deposit rates is associated with a 4bp lower loan rate pass-through of a 100bp decrease in the short-rate (formally, the loan spread beta) -half of the standard-deviation of loan spread betas across banks- and a 90bp lower loan volume beta -one fourth of the standard-deviation of loan volume betas across banks.

The constrained lending regime: testing the role of banks' financial constraints. In the model of O. Wang (2024), the reduction in deposit spreads has no implications for

TABLE 4: Initial deposit rates, rate pass-through and credit supply in the cross-section of banks

Notes: The estimates are obtained by regressing the estimated bank-level loan spread betas and loan volume betas on the bank-level average deposit rate in 2010. In columns (3) to (6), we look at sub samples based on the initial level of bank equity in 2010. In columns (3) to (6), we look at sub samples based on the initial level of bank equity in 2010. The bank-level average deposit rate in 2010 is standardised to have a mean of 0 and variance of 1. See details for the estimation of loan spread betas and loan volume betas in the text of Section Section 3. Robust standard errors in parentheses.

	All banks		Low Capitalization Tercile	High Capitalization Tercile
	(1)	(2)	(3)	(4)
	Spread β	Vol. β	Spread β	Spread β
2010 Dep. Rate	0.040***	-0.009**	0.064**	0.043***
	(0.012)	(0.004)	(0.024)	(0.014)
Constant	-0.159***	0.026***	-0.149***	-0.182***
	(0.008)	(0.004)	(0.015)	(0.014)
Observations	75	75	25	25
R^2	0.256	0.052	0.421	0.340

loan spreads when the aggregate bank lending capacity remains high enough relative to aggregate loan demand - the so called “unconstrained regime”. However, when bank lending capacity falls short, for instance when leverage constraints bind in the so called “constrained regime”, lower profits in the deposit business can reduce bank equity and therefore loan supply (which is tied to bank equity), such that loan spreads must rise in equilibrium.

In columns (3)-(4) of Table 4, we test whether cross-sectional variation in the initial level of bank equity, which we use as a proxy for the distance to capital constraints, is useful in explaining the correlation between a bank’s initial deposit spread and its loan spread beta.

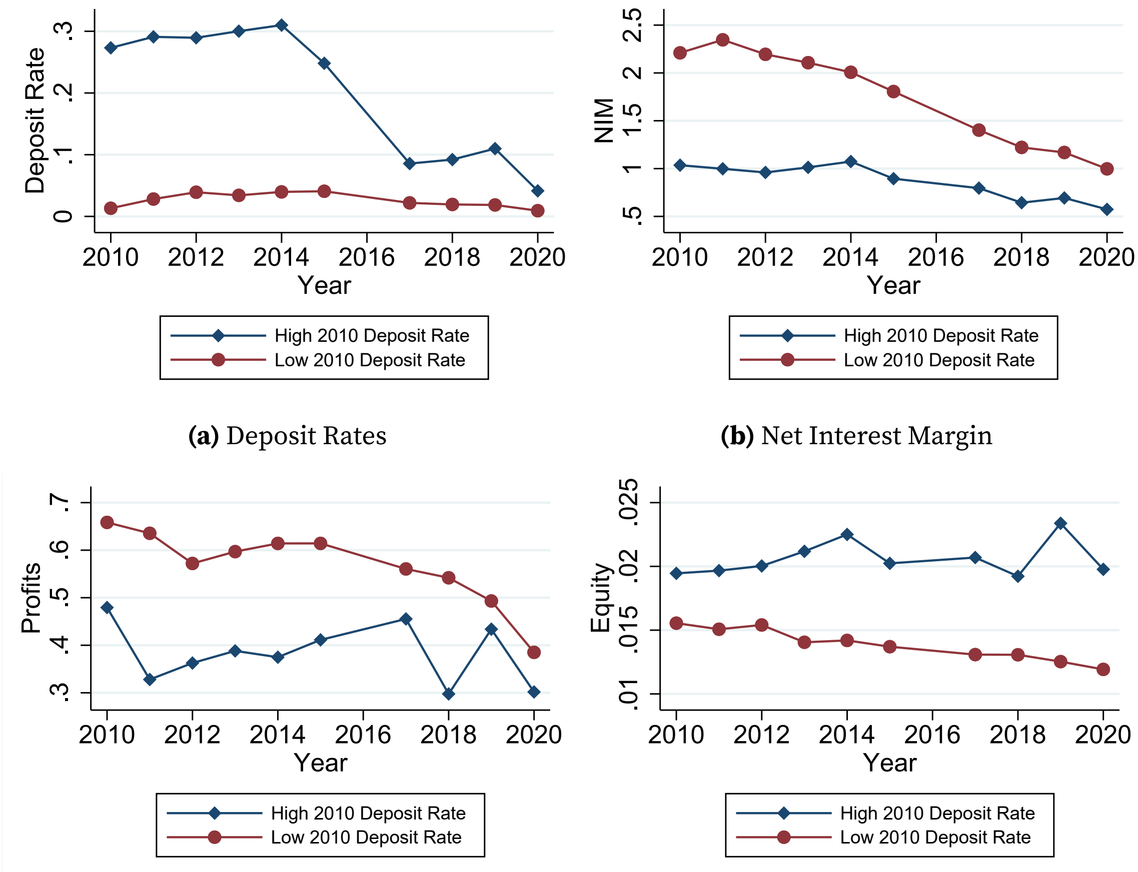
Overall, we find that within the set of low-capitalised banks (first tercile), there is a strong positive correlation between initial deposit rates and the pass-through of interest rates to loan rates. This correlation is weaker in the set of high-capitalised banks (third tercile). This is consistent with regulatory constraints tying the relationship between variation in the profitability in the deposit business to variation in loan spreads.

Exploring the mechanism: dynamics for bank profitability and bank equity. Figure 5 provides evidence in favour of the mechanism proposed by O. Wang (2024) that can jointly explain the negative correlation between deposit spread betas and loan spread betas and the positive correlation between deposit spread betas and loan volume betas.

Panel (a) shows the evolution of the average deposit rate of banks that were paying an above-median deposit rate in 2010 and that of banks that were paying a below-median

FIGURE 5: Dynamics for bank profitability and bank equity

Notes: The panels show the evolution in different profitability and valuation series for the banks that were paying an above-median deposit rate in 2010 and for the banks that were paying a below-median deposit rate in 2010. The series "Equity" is defined as share capital.



(a) Deposit Rates

(b) Net Interest Margin

(c) Profits

(d) Equity (Share Capital)

deposit rate in 2010. Banks paying high deposit rates in 2010 were able to lower them following the fall in market rates, as opposed to banks already paying low rates in 2010, leading to a compression in the deposit spreads earned by the latter relative to the former.

Panel (b) and Panel (c) of Figure 5 show the associated evolution of net interest margins (NIM) and profits. While banks paying high deposit rates in 2010 managed to maintain their NIM relatively constant throughout the period, banks paying low deposit rates in 2010 suffered a larger decline in NIM. Even though these banks seem to compensate the compression of their deposit spreads with an increase in loan spreads, this increase in loan spreads has not been sufficient to avoid a decline in NIM and profits.

Panel (d) of Figure 5 shows the associated evolution of bank equity defined as share capital. Banks paying low deposit rates in 2010 (and which have suffered a larger decline in profits) also experienced a relative decline in the value of their equity. These dynamics are consistent with the mechanism in O. Wang (2024), as lower profits from the deposit business lead to a drop in the equity and therefore to lending volume (as lending is tied to equity).

Table 5 reports the results of the regressions formally testing the cross-sectional results suggested in Figure 5 with the following specifications:

$$y_{bt} = \beta_0 + \beta_1 i_t + \beta_2 \cdot i_t \times \text{DepositRate}_{b,2010} + \epsilon_{bt}, \tag{4}$$

where y_{bt} is a bank-time level outcome (deposit spread, NIM, or profits), i_t is the 3-month Euribor rate at time t, and $\text{DepositRate}_{b,2010}$ is bank b's deposit rate in 2010. The negative coefficients on the interaction term indicate that a decrease in the 3-month Euribor rate in the period 2010-2023 is associated with lower deposit spreads, net interest margins, profits, and equity value for banks with a relatively low initial deposit rate in 2010.

Table 5: Dynamics for bank profitability and bank equity

Notes: The regression estimates are based on Equation 4. Standard errors are double clustered at the quarterly date and bank-level.

	(1) Dep. Spread	(2) NIM	(3) Profits	(4) Equity
EUR3M × 2010 Dep. Rate	-0.37***	-1.34***	-0.28**	-0.01***
	(0.03)	(0.44)	(0.14)	(0.00)
Bank FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Observations	734	734	734	734
Adjusted R^2	0.988	0.838	0.642	0.954

4.2. Bank Market Power in the Lending Market

In this section, we look for evidence of a market power channel, whereby bank market power affects the pass-through of monetary policy to the pricing of loans. This analysis is motivated by Scharfstein and Sunderam (2015) which finds a lower short-term pass-through of MBS interest rates to the interest rates on newly originated mortgages in more concentrated local markets.

We first find mixed evidence that variation in the bank-level exposure to concentrated lending markets has explanatory power for the variation in bank-level pass-through measures. We then show that the economic significance of the market power channel (in explaining cross-sectional variation in loan rate pass-through) is much lower than that of the deposit channel. However, we find evidence supporting the role of market power in explaining the differences in loan spreads charged by the same bank to different borrowers with different degrees of hold-up problem. We use regressions of the level of interest rates and find evidence of a lower pass-through of short-term interest rates to loan rates in more concentrated local markets. We nevertheless find little to no evidence of differential pass-through by the same bank to firms borrowing from local lending markets with different concentration level.

Bank-level variation in market power. We first use the cross-section of banks to investigate whether market power is useful in explaining the aggregate time series variation in loan spreads. We compare the interest rate pass-through of banks with more or less exposure to concentrated markets by running the following regressions:

$$\text{LoanSpreadBeta}_b = \gamma_0 + \gamma_1 \text{Concentration}_b + \epsilon_b, \tag{5}$$

where LoanSpreadBeta_b is the loan spread beta of bank b and Concentration_b is a measure of market concentration bank b is exposed to in 2006.

We use three bank-level measures of market concentration: the bank-level weighted average exposure to the local Herfindahl-Hirschman Index (HHI), the bank-level weighted average exposure to the local share of top 4 lenders (Top4Share) , and the bank-level share in aggregate lending. The bank-level average HHI and bank-level average Top4Share are defined in similar way: by taking the weighted average over the distribution of local HHI, respectively over the distribution of local Top4Share, bank b is exposed to in 2006 in the commuting zones where it is operating, where the weights are given by the bank-level shares of local lending in total bank-level lending. That is:

$$\text{Bank HHI}_b = \sum_{cz} \omega_{b,cz} \text{HHI}_{cz} \tag{6}$$

where HHI_{cz} is the local HHI in commuting zone cz and $\omega_{b,cz}$ is the ratio of bank b's total lending done in commuting zone cz over bank b's total lending. Similarly for the bank-level average Top4Share. The third market concentration measure, bank market share, is defined as the share of bank b's lending in total lending across banks in 2006.

Table 6 shows the results. The coefficients on bank concentration as measured by bank-level average HHI-exposure and bank-level average Top4Share-exposure are not economically and statistically significant. However, a one standard deviation increase in bank-level market share of aggregate lending is associated with a 0.9bp lower loan rate pass-through of a 100bp decrease in the short-rate (formally, the loan spread beta). The positive coefficient in column (6) for the corresponding loan volume beta regression is also consistent with a supply side story.

TABLE 6: Bank-level measure of market power and loan rate pass-through

Notes: The estimates are obtained by regressing the estimated bank-level loan spread betas and loan volume betas on the bank-level measures of exposure to concentrated local markets and the bank-level share in aggregate lending. The bank-level measures are standardised to have a mean of 0 and variance of 1. See details for the estimation of loan spread betas and loan volume betas in the text of Section Section 3. Robust standard errors in parentheses.

	Loan spread β			Loan volume β		
	(1)	(2)	(3)	(4)	(5)	(6)
Bank HHI	-0.004			-0.002		
	(0.008)			(0.003)		
Bank Top4Share		-0.005			-0.002	
		(0.008)			(0.003)	
Bank Market Share			-0.009**			0.001
			(0.004)			(0.001)
Constant	-0.159***	-0.159***	-0.159***	0.026***	0.026***	0.026***
	(0.009)	(0.009)	(0.009)	(0.003)	(0.003)	(0.003)
Observations	75	75	75	75	75	75
R^2	0.002	0.004	0.011	0.004	0.008	0.003

Bank-level market power vs. bank-level deposit channel: horse race regressions We run horse race regressions to determine the relative importance between the deposit channel and the market power channel.

Table 7 reports the results at the bank level. Column (1) reports the results from Section 4.1. Columns (2)-(4) report the results of the horse race between the measure of initial deposit rates and our different measures of bank-level market power. First, the results highlighted above are robust to the horse race. We interpret this as evidence of two mechanisms operating concomitantly.

Second, column (4) confirms the previous estimates which highlight that a one standard deviation decrease in 2010 deposit rates is associated with a 4.1bp lower loan rate pass-through of a 100bp decrease in the short-rate. At the same time, a one standard deviation increase in bank-level market share of aggregate lending is associated with a

1.1bp lower loan rate pass-through. That is, the cross-sectional variation across banks in deposit rate appears to be more important in explaining the cross-sectional variation in the loan rate pass-through than the cross-sectional variation in our measure of bank market power. One may be led to conclude that the deposit channel is more important than the market power channel in the cross-section and in the aggregate. The small relative increase in the R^2 between column (1) and column (4) is also suggestive of the same conclusion.

The results from the previous horse race regressions suggest that market power may not play an important role in the negative relationship between loan spreads and short rates. However, our proxies for market power are measured at the bank level using noisy measure of local concentration. In what follows, we run two alternative tests of the market power channel by looking at heterogeneity within bank in the pass-through of market interest rates to loan rates.

TABLE 7: Loan rate pass-through: horse races

Notes: The estimates are obtained by regressing the estimated bank-level loan spread betas and loan volume betas on bank-level measures standardised to have a mean of 0 and variance of 1. See details for the estimation of loan spread betas and loan volume betas in the text of Section Section 3. Robust standard errors in parentheses.

	Loan spread β			
	(1)	(2)	(3)	(4)
2010 Dep. Rate	0.040***	0.040***	0.040***	0.041***
	(0.012)	(0.012)	(0.012)	(0.012)
Bank HHI		-0.002		
		(0.007)		
Bank Top4Share			-0.005	
			(0.007)	
Bank Market Share				-0.011**
				(0.005)
Constant	-0.159***	-0.159***	-0.159***	-0.159***
	(0.008)	(0.008)	(0.008)	(0.008)
Observations	75	75	75	75
R^2	0.256	0.256	0.260	0.276

Within-bank across-firms variation in market power: hold-up problem. We first re-appraise the market power channel by comparing the differential pass-through of market interest rates to loan rates between firms subject to the hold-up problem to different degrees (See e.g., Sharpe, 1990; Rajan, 1992). We run the following set of regressions:

$$s_{lbit} = \beta_0 + \beta_1 \cdot i_t + \gamma \cdot \mathbf{Z}_{i,2006} \times i_t + \epsilon_{lbit}, \tag{7}$$

where s_{lbit} is the spread of the loan rate on loan l issued by bank b to firm i at time t over the maturity-matched swap rates, i_t is the 3 months Euribor rate at time t, and $\mathbf{Z}_{i,2006}$ is a vector of dummies indicating firm size, firm age, and whether a firm borrows from multiple banks at the same time as measured in 2006.

Table 8 reports the results. Columns (1)-(6) separately test the significance of size, age, and borrowing from multiple banks. We run each regression with and without bank-time fixed effects, which allow to control for all bank balance sheet-related channels that do not build on bank pricing power. The estimated coefficients on the interaction term are all increasing in size (i.e., positive for size= 2 albeit not increasing from size= 2 to size= 3) and age, and they are positive for the multi-bank dummy. This means small firms, young firms, and firms that only borrow from one bank are given less pass-through of a decrease in the 3-month Euribor by their bank, revealing a classic hold-up problem. Columns (7)-(8) show that the results still hold when including both size and age in the same regression, albeit the significance of the multi-bank dummy disappears.

Table B.9 reports the results from credit volume regressions using the credit register. Decreasing coefficients in size and age and the negative coefficient on the multi-bank dummy mean that small firms, young firms, and firms that only borrow from one bank have a relatively lower loan volume increase after a decrease in the 3-month Euribor. Jointly with the results of the previous loan spread regressions, this indicates banks decrease the relative supply of loans to these firms as short rates decrease.

Even though we were not able to detect a meaningful effect of market concentration in the cross-section of banks on the negative relationship between loan spreads and short rates, it appears banks are able to price discriminate based on firm characteristics and the magnitude in the cross-section of firms are large. Firms outside the group of small firms experience on average a 5bp higher loan rate pass-through of a 100bp decrease in the short-rate compared to firms in the group of small firms. Firms in the highest tercile of the age distribution experience a 3bp higher loan rate pass-through compared to firms in the lowest tercile of the age distribution. These cross-sectional differences represent respectively a third and a fourth of the unconditional difference to a full pass-through we have identified in Section 3.

TABLE 8: Firm-level measures of hold-up problem and loan rate pass-through

Notes: The regression estimates are based on Equation 7. The base group for columns (1)-(2) is the low firm size group in 2006, the base group for columns (3)-(4) is the group of firms with lowest firm age in 2006, and the base group for columns (5)-(6) is the group of firms with only one bank in 2006. Standard errors are double clustered at the quarterly date and firm-levels.

	Loan interest rate spread on maturity-matched swap rate							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EUR3M	-0.184***		-0.177***		-0.164***		-0.199***	
	(0.004)		(0.006)		(0.003)		(0.005)	
Size=2 × EUR3M	0.044***	0.046***					0.032***	0.038***
	(0.004)	(0.003)					(0.005)	(0.003)
Size=3 × EUR3M	0.054***	0.042***					0.039*	0.032***
	(0.021)	(0.006)					(0.023)	(0.007)
Age=2 × EUR3M			0.020***	0.022***			0.014*	0.015***
			(0.007)	(0.003)			(0.007)	(0.003)
Age=3 × EUR3M			0.043***	0.033***			0.027***	0.019***
			(0.008)	(0.004)			(0.009)	(0.004)
EUR3M × Multi-bank					0.025***	0.018***	0.013**	0.007**
					(0.006)	(0.003)	(0.005)	(0.003)
Maturity FE	✓	✓	✓	✓	✓	✓	✓	✓
Bank FE	✓	–	✓	–	✓	–	✓	–
Rating FE	✓	✓	✓	✓	✓	✓	✓	✓
Commuting Zone FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓	✓	✓
Bank x Time FE	–	✓	–	✓	–	✓	–	✓
Observations	147133	146548	147133	146548	147133	146548	147133	146548
Adjusted R^2	0.356	0.634	0.335	0.618	0.333	0.617	0.362	0.637

Within-bank across-firms variation in market power: local concentration. We also run an alternative within-bank across-firms test of the market power channel by comparing the differential pass-through of market interest rates to loan rates between firms borrowing in commuting zones that differ in concentration levels. This identification strategy mirrors the one used in the short-term pass-through regressions of Scharfstein and Sunderam (2015). We run the following set of regressions:

$$s_{lbit} = \beta_0 + \beta_1 \cdot i_t + ,\mathbf{Z}_{l,2006} \times i_t + \epsilon_{lbit}, \tag{8}$$

where s_{lbit} is the spread of the loan rate on loan l issued by bank b to firm i at time t over the maturity-matched swap rates, i_t is the 3 months Euribor rate at time t, and $\mathbf{Z}_{l,2006}$ is a vector of proxies for local concentration for commuting zone l measured in 2006. We consider two measures used in the literature: the local Herfindahl-Hirschman Index (HHI) and the local share of top 4 lenders. The measures are computed using data on lending in 2006 in order to limit endogeneity concerns.

Table 9 reports the results. Columns (1) and (4) separately test the significance of the respective concentration measures controlling for loan-level composition effects over time. Columns (2) and (5) further includes time fixed-effects to control for the varying distribution of loans across commuting zones over time in our dataset. Columns (3) and (6) further includes bank-time fixed-effects to control for the average pass-through at the bank-level and restrict the across-location identification within-bank.

The estimated interaction coefficients in respectively columns (1)-(2) and columns (4)-(5) are negative and statistically significant, indicating that firms borrowing in more concentrated lending markets are given less pass-through of a decrease in the 3-month Euribor by their bank, revealing a market power channel. Firms borrowing in lending markets with a one-standard-deviation higher concentration measure experience on average a relative 1bp lower loan rate pass-through of a 100bp decrease in the short-rate.

However the drop in economic and statistical significance in columns (3) and (6) indicate that the prevalence of discriminatory pass-through across locations is limited within-bank. One possible explanation is that regional banks which are responsible for a large share of business lending do not discriminate within regions across commuting zones.

TABLE 9: Measures of local concentration and loan rate pass-through

Notes: The estimates are obtained from regressions of Equation 8. The local-level concentration measures are standardised to have a mean of 0 and variance of 1. Standard errors are double clustered at the quarterly date and commuting zone-levels.

	Loan interest rate spread on maturity-matched swap rate					
	(1)	(2)	(3)	(4)	(5)	(6)
EUR3M	-0.150***			-0.152***		
	(0.005)			(0.006)		
EUR3M × Local HHI	-0.015**	-0.008***	-0.002			
	(0.007)	(0.003)	(0.002)			
EUR3M × Local Top4Share				-0.021***	-0.008**	-0.002
				(0.006)	(0.003)	(0.002)
Maturity FE	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	–	✓	✓	–
Rating FE	✓	✓	✓	✓	✓	✓
Commuting Zone FE	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓
Time FE	–	✓	✓	–	✓	✓
Bank x Time FE	–	–	✓	–	–	✓
Observations	147133	147133	146548	147133	147133	146548
Adjusted R^2	0.324	0.560	0.612	0.325	0.560	0.612

5. Real Effects

In this last section, we investigate whether the lower interest rate pass-through and lower relative supply of bank loans following the decline of short-term interest rates has had real effects. We test whether following a decrease in the short rate, firms borrowing more from banks with lower loan rate pass-through (i) lower their debt issuance and (ii) lower investment in fixed assets.

Real effects of low interest rate passthrough. We start by running the following regression:

$$\log(y_{it}) = \beta \cdot i_t \times \text{LoanSpreadBeta}_i + \epsilon_{it}, \tag{9}$$

where y_{it} either is total firm debt or net PP&E (Property, Plant, and Equipment) of firm i at time t, i_t is the 3-month Euribor rate at time t, and LoanSpreadBeta_i is the firm-level weighted average of the loan spread beta for banks that firm i is borrowing from in 2006:

$$\text{LoanSpreadBeta}_i = \sum_{b \in \mathcal{B}_{2006}} \omega_{ib,2006} * \text{LoanSpreadBeta}_b, \tag{10}$$

where $\mathcal{B}_{2006}$ is the set of banks firm i borrows from in 2006, $\omega_{ib,2006}$ is the share of firm i's total outstanding loans in 2006 that are issued by bank b.

Column (1) of respectively Panel (a) and Panel (b) of Table Table 10 shows the estimated coefficient for respectively the logarithm of total firm debt and of Net PP&E. Firms that are exposed to banks characterised by a relatively lower pass-through experience a relative lower debt and investment growth following a decrease in the short rate.

A one standard deviation lower firm-level exposure (i.e., more borrowing from banks giving less pass-through) is associated with a 3.1 (1.9) percentage points lower debt growth (investment growth) following a drop in the short rate by 1 percentage point. This is quite substantial since a one standard deviation in firm-level average loan spread beta corresponds to an $9bp$ difference in pass-through following a drop in the short rate by 1 percentage point.[10] The 3.1 (1.9) percentage point differential effect on debt growth (PPE growth) is also economically significant in view of the interquartile range of 54 (7.3) percentage points.

Real effects of low interest rate passthrough via the deposit channel. We show that these differentials in debt growth and PPE growth for firms borrowing from banks with different interest pass-through can be explained by the two channels which may explain the time variation in aggregate loan spreads.

To define the firm level exposure to the deposit channel, we first define the following bank-level variable, which unambiguously captures the degree of exposure of a bank to the deposit channel in the constrained lending regime explored in Section Section 4:

$$\text{UnconstrainedDepositRate}_b = (\text{DepositRate}_{b,2010} - 1) * \mathcal{I}(\text{Capital}_{b,2010} < p25(\text{Capital}_{b,2010}))$$

The variable is monotone and decreasing in the exposure to the deposit channel in the

[10] See summary statistics in Table A.6.

TABLE 10: Real effects

Notes: The estimates are obtained from regressions of Equation 9 where the dependent variable is respectively the logarithm of total debt in Panel (a) and the logarithm of investment in Panel (b). The firm-level exposure measures to the loan interest rate pass-through are standardised to have a mean of 0 and variance of 1. Standard errors are double clustered at the quarterly date and firm-levels.

(a) Growth in total debt

	(1) log(Debt)	(2) log(Debt)	(3) log(Debt)	(4) log(Debt)
EUR3M × Loan Spread Beta (Firm)	-0.031***			
	(0.001)			
EUR3M × Unconstrained Deposit Rate (Firm)		-0.010***		-0.007***
		(0.001)		(0.001)
EUR3M × Bank Market Share (Firm)			0.013***	0.011***
			(0.001)	(0.001)
Firm FE	✓	✓	✓	✓
Ind. x Time FE	✓	✓	✓	✓
Observations	2253195	2253195	2253195	2253195
Adjusted R^2	0.683	0.682	0.683	0.683

(b) Growth in investment

	(1) log(PPE)	(2) log(PPE)	(3) log(PPE)	(4) log(PPE)
EUR3M × Loan Spread Beta (Firm)	-0.019***			
	(0.001)			
EUR3M × Unconstrained Deposit Rate (Firm)		-0.006***		-0.004***
		(0.001)		(0.001)
EUR3M × Bank Market Share (Firm)			0.007***	0.006***
			(0.001)	(0.001)
Firm FE	✓	✓	✓	✓
Ind. x Time FE	✓	✓	✓	✓
Observations	2253195	2253195	2253195	2253195
Adjusted R^2	0.825	0.825	0.825	0.825

constrained lending regime (highest exposure = –1 and lowest exposure = 0).[11]

We then define a firm-level variable $\text{Unconstrained Deposit Rate}_i$ measuring the degree of a firm exposure to the deposit channel through the banks it borrows from in the same way as we defined the firm-level measure of loan spread beta in equation (Equation 10).

[11] Well-capitalised banks (not exposed) take a value equal to 0 and poorly-capitalised ones take a value lower than 0 and greater or equal to = –1. Within poorly-capitalised banks, those with higher deposit rates (the least exposed) take a higher value.

We estimate Equation 9 with the interaction term between the newly defined firm-level exposure and the level of short-term rates. Column (2) of respectively Panel (a) and Panel (b) of Table 10 shows that firms that are more exposed to banks whose lending capacity is more constrained by the compression of deposit spreads experience a relative lower debt and investment growth following a decrease in the short rate.

A one standard deviation lower firm-level exposure (i.e., more borrowing from constrained banks with more positive deposit spread betas and thus giving less loan rate pass-through) is associated with a 1 (0.6) percentage points lower debt growth (investment growth) following a drop in the short rate by 1 percentage point. This result highlights that the deposit channel has important real effects through its spillover effects on lending quantity and prices.

Real effects of low interest rate passthrough via the market power channel. Column (3) of respectively Panel (a) and Panel (b) of Table 10 also shows that firms borrowing from banks with relatively high market shares in aggregate lending experience lower growth in both debt and PPE following a decrease in the short rate.[12]

A one standard deviation higher firm-level exposure (i.e., more borrowing from banks with a higher aggregate market share and thus giving less loan rate pass-through) is associated with a 1.3 (0.7) percentage points lower debt growth (investment growth) following a drop in the short rate by 1 percentage point. This result highlights that the market power channel has equally important real effects compared to the constrained deposit channel when examining firm-level exposure to cross-sectional bank-level measures of both channels.

Column (4) of respectively Panel (a) and Panel (b) of Table 10 shows the result from running horse races of the firm-level exposure to both channels. The robustness of the stand alone estimates to the horse races shows that both channels contribute concomitantly to the real effects on debt and PPE growth.

6. Conclusion

We provide evidence that cross-sectional variations in frictions within the deposit-taking business and bank lending market power significantly explain differences in interest rate pass-through across banks and firms. These frictions, interacting with changes in interest

[12] We define the firm-level variable for exposure to banks with a high bank market share of aggregate lending as in Equation 10.

rates, result in credit supply shocks linked to changes in loan spreads.

Our findings also show that the impaired pass-through of market interest rates to loan rates, driven by these frictions, has negative real effects on corporate financing and investment.

In light of these results, recent trends, such as increased consolidation in lending markets and the growing reliance on wholesale funding by banks, have contrasting implications for the effectiveness of monetary policy transmission to real economic outcomes over the last decades.

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Appendix A.   Summary statistics

Table A.1: Loan data: summary statistics by rating

	N	Mean	SD	Min	p25	p50	p75	Max
3								
Maturity (months)	19543	53.94259	18.42679	24	36	48	60	120
Loan Rate	19543	2.12536	1.589663	.25	.87	1.5859	3.106	7.57
Credit Amount (EUR 000s)	19543	250.3179	1699.912	.14	22.939	55	153.83	120000
3+								
Maturity (months)	10001	54.17458	19.23676	24	36	48	60	120
Loan Rate	10001	2.217157	1.656789	.25	.79	1.6625	3.4738	7.57
Credit Amount (EUR 000s)	10001	344.2885	2276.042	.001	27.987	70	200	130000
3++								
Maturity (months)	3181	53.88117	19.51596	24	36	48	60	120
Loan Rate	3181	2.024631	1.636871	.25	.69	1.3319	3.093	7.57
Credit Amount (EUR 000s)	3181	631.3905	3139.018	.11	34.426	100	325.055	88500
4								
Maturity (months)	39805	53.60914	18.90021	24	36	48	60	120
Loan Rate	39805	2.510509	1.643201	.25	1.15	2.0599	3.59	7.57
Credit Amount (EUR 000s)	39805	125.6537	507.7031	.001	20	40	100	34580
4+								
Maturity (months)	31680	53.25152	18.4153	24	36	48	60	120
Loan Rate	31680	2.563082	1.754922	.25	1.02275	2.08	3.9131	7.57
Credit Amount (EUR 000s)	31680	147.304	697.728	.089	20.0565	44	110	54000
5								
Maturity (months)	12187	56.35185	19.90424	24	36	60	60	120
Loan Rate	12187	3.117055	1.72521	.2534	1.6277	2.822	4.4093	7.57
Credit Amount (EUR 000s)	12187	122.8757	583.3576	.001	18	35	100	33700
5+								
Maturity (months)	30749	56.4432	20.26582	24	36	60	60	120
Loan Rate	30749	2.682968	1.682946	.25	1.254	2.2091	3.8597	7.57
Credit Amount (EUR 000s)	30749	138.4725	499.5114	.001	20.7	47.25	120	40000
Total								
Maturity (months)	147146	54.44013	19.19438	24	36	48	60	120
Loan Rate	147146	2.526507	1.696917	.25	1.099	2.057	3.7174	7.57
Credit Amount (EUR 000s)	147146	175.1136	1100.985	.001	20.7	46.8835	120	130000

TABLE A.2: Loan data: summary statistics by maturity

	N	Mean	SD	Min	p25	p50	p75	Max
24								
Maturity (months)	9130	24	0	24	24	24	24	24
Loan Rate	9130	3.21317	1.797426	.25	1.7259	2.9897	4.594	7.57
Credit Amount (EUR 000s)	9130	117.7832	1102.982	.001	10.7	19.4675	35	50000
36								
Maturity (months)	32691	36	0	36	36	36	36	36
Loan Rate	32691	2.717334	1.72825	.25	1.227	2.369	3.93	7.57
Credit Amount (EUR 000s)	32691	90.25604	815.7265	.089	14.881	25	50	50000
48								
Maturity (months)	32209	48	0	48	48	48	48	48
Loan Rate	32209	2.766074	1.779309	.25	1.16	2.45	4.175	7.57
Credit Amount (EUR 000s)	32209	117.5301	1133.14	.05	20	35.062	78.118	130000
60								
Maturity (months)	49644	60	0	60	60	60	60	60
Loan Rate	49644	2.220621	1.595037	.25	.9844	1.65095	3.18	7.57
Credit Amount (EUR 000s)	49644	172.7588	1020.82	.12	29	58	140	88500
84								
Maturity (months)	20185	84	0	84	84	84	84	84
Loan Rate	20185	2.306362	1.544781	.25	1.03	1.8012	3.386	7.57
Credit Amount (EUR 000s)	20185	373.2146	1490.091	1.014	80	160	350	120000
120								
Maturity (months)	3287	120	0	120	120	120	120	120
Loan Rate	3287	2.345582	1.466404	.3193	1.1739	1.7915	3.369	7.57
Credit Amount (EUR 000s)	3287	561.6178	1345.373	.001	113	250	540	41715
Total								
Maturity (months)	147146	54.44013	19.19438	24	36	48	60	120
Loan Rate	147146	2.526507	1.696917	.25	1.099	2.057	3.7174	7.57
Credit Amount (EUR 000s)	147146	175.1136	1100.985	.001	20.7	46.8835	120	130000

Table A.3: Credit panel data: summary statistics

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Credit	239.23	2,168.29	0.06	19.67	33.00	65.67	155.33	381.00	1,108,285.00	6,420,983
log(Credit)	4.31	1.29	-2.77	2.98	3.50	4.18	5.05	5.94	13.92	6,420,983
Loan Spread Beta	-0.17	0.07	-0.31	-0.25	-0.23	-0.18	-0.15	-0.03	0.15	6,420,983
EUR3M	0.64	1.46	-0.58	-0.54	-0.33	0.08	1.43	3.29	4.85	6,420,983

Table A.4: Loan-level data: summary statistics

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Maturity (months)	54.44	19.19	24.00	36.00	36.00	48.00	60.00	84.00	120.00	147,146
Loan Rate	2.53	1.70	0.25	0.71	1.10	2.06	3.72	5.06	7.57	147,146
Swap rate	1.12	1.59	-0.53	-0.31	-0.06	0.39	2.03	4.00	6.69	147,146
Loan Spread	1.41	1.09	-4.36	0.27	0.74	1.28	1.95	2.78	7.53	147,146
EUR3M rate	0.59	1.53	-0.56	-0.45	-0.33	-0.05	0.85	3.50	5.10	147,146
Multi-bank	0.52	0.50	0.00	0.00	0.00	1.00	1.00	1.00	1.00	147,146
Age	1.97	0.82	1.00	1.00	1.00	2.00	3.00	3.00	3.00	147,146
Size	1.80	0.61	1.00	1.00	1.00	2.00	2.00	3.00	3.00	147,146
Local HHI	0.02	0.03	0.00	0.01	0.01	0.02	0.03	0.04	0.69	147,146
Local Top4Share	0.21	0.09	0.07	0.12	0.15	0.19	0.25	0.33	0.87	147,146

Table A.5: Bank panel data: summary statistics

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
2010 Deposit Rate	0.08	0.13	0.00	0.01	0.01	0.01	0.06	0.23	0.60	734
Dep. Spread	0.06	0.60	-1.06	-0.54	-0.39	-0.15	0.26	1.02	1.42	734
NIM	1.53	0.77	0.12	0.52	0.90	1.43	2.16	2.63	3.24	734
Profits	0.52	0.25	0.07	0.23	0.34	0.50	0.68	0.81	1.73	734
Equity	0.02	0.01	0.00	0.00	0.01	0.01	0.02	0.04	0.05	734
Equity (incl. Reserves)	0.08	0.03	0.02	0.03	0.06	0.08	0.10	0.12	0.14	734
EUR3M	0.13	0.61	-0.54	-0.54	-0.33	-0.02	0.27	1.43	1.43	734

Table A.6: Bank time invariant data: summary statistics

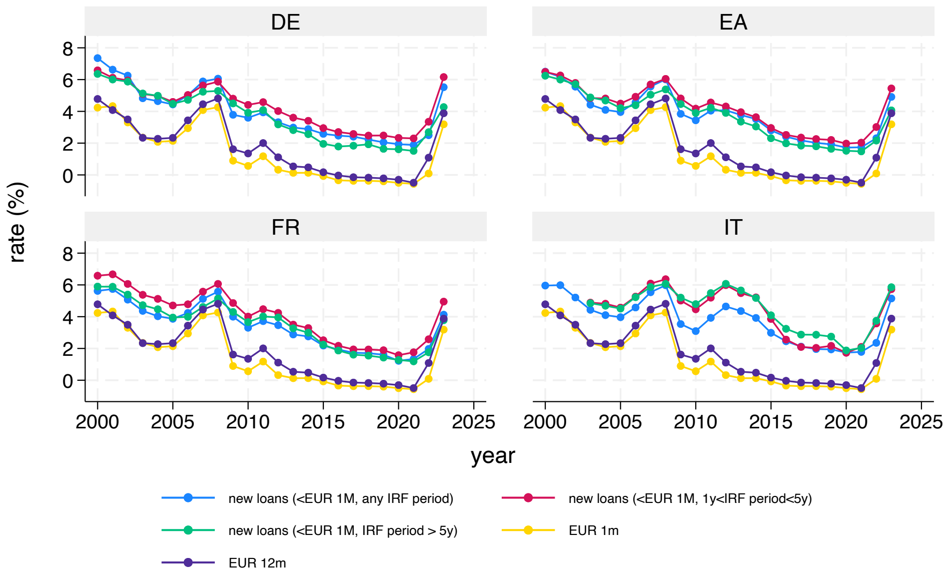
	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Loan Spread Beta	-0.16	0.08	-0.31	-0.25	-0.20	-0.17	-0.13	-0.04	0.15	75
Loan Volume Beta	0.03	0.04	-0.09	-0.01	0.00	0.02	0.05	0.06	0.25	75
2010 Deposit Rate	0.08	0.14	0.00	0.01	0.01	0.01	0.07	0.25	0.60	75
Deposit Spread Beta	0.09	0.05	-0.07	0.00	0.09	0.12	0.13	0.13	0.16	75
Bank HHI	0.03	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.05	75
Bank Top4Share	0.25	0.04	0.17	0.21	0.22	0.24	0.28	0.31	0.38	75
Bank Market Share	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.14	75
2010 Equity	0.02	0.01	0.00	0.00	0.01	0.01	0.03	0.04	0.05	75
2010 Equity (incl. Reserves)	0.07	0.03	0.02	0.02	0.06	0.08	0.10	0.11	0.13	75
Unconstrained Deposit Rate	-0.07	0.03	-0.13	-0.11	-0.10	-0.08	-0.04	-0.02	-0.01	75

Table A.7: Firm panel data: summary statistics

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Total Assets	14.89	578.38	0.00	0.22	0.41	0.96	2.65	8.43	163,181.58	2,253,195
PPE	3.66	152.10	0.00	0.04	0.10	0.25	0.75	2.44	62,184.44	2,253,195
Net PPE	1.41	65.74	0.00	0.01	0.02	0.07	0.22	0.80	19,775.08	2,253,195
Debt	3.22	203.29	0.00	0.01	0.04	0.11	0.36	1.14	89,651.14	2,253,195
Employment	33.34	440.57	0.00	1.25	3.00	7.00	17.25	43.00	140,574.00	2,253,195
Log(Total Assets)	7.08	1.52	-1.01	5.38	6.02	6.87	7.88	9.04	18.91	2,253,195
Log(PPE)	5.67	1.68	-6.21	3.72	4.58	5.53	6.62	7.80	17.95	2,253,195
Log(Net PPE)	4.26	1.96	-29.11	1.93	3.09	4.21	5.41	6.68	16.80	2,253,195
Log(Debt)	4.69	2.01	-6.91	2.37	3.61	4.73	5.88	7.04	18.31	2,253,195
Log(Employment)	2.06	1.36	-6.91	0.22	1.10	1.95	2.85	3.76	11.85	2,253,195
Loan Spread Beta (Firm)	-0.14	0.09	-0.31	-0.24	-0.21	-0.17	-0.03	0.00	0.15	2,253,195
Deposit Rate (Firm)	0.06	0.09	0.00	0.00	0.00	0.01	0.06	0.23	0.60	2,253,195
Unc. Deposit Rate (Firm)	-0.15	0.33	-0.99	-0.88	0.00	0.00	0.00	0.00	0.00	2,253,195
Bank HHI (Firm)	0.02	0.01	0.00	0.00	0.02	0.03	0.03	0.03	0.05	2,253,195
Bank Top4Share (Firm)	0.20	0.10	0.00	0.00	0.21	0.24	0.27	0.29	0.38	2,253,195
Bank Market Share (Firm)	0.02	0.04	0.00	0.00	0.00	0.01	0.02	0.09	0.14	2,253,195

Appendix B. Loan rates

FIGURE B.1: Loan rates and short rates in Euro Area: Big4



Graphs by country

TABLE B.8: Negative correlation between loan spreads and short-term interest rates: level vs. long differences

Notes: The estimates are based on regressions in a four-dimensions panel (bank-maturity-rating-time) of average loan rate which is built from the loan-level dataset. Standard errors are clustered at the quarterly date-level.

	Loan interest rate spread on maturity-matched swap rate					
	(1)	(2)	(3)	(4)	(5)	(6)
	level	$\Delta(t, t-4)$	$\Delta(t, t-8)$	$\Delta(t, t-12)$	$\Delta(t, t-20)$	$\Delta(t, t-40)$
EUR3M	-0.16***					
	(0.05)					
$\Delta(t, t-4)$ EUR3M		-0.30**				
		(0.13)				
$\Delta(t, t-8)$ EUR3M			-0.27***			
			(0.08)			
$\Delta(t, t-12)$ EUR3M				-0.36***		
				(0.07)		
$\Delta(t, t-20)$ EUR3M					-0.51***	
					(0.08)	
$\Delta(t, t-40)$ EUR3M						-0.38***
						(0.11)
Bank x Maturity x Rating FE	✓	✓	✓	✓	✓	✓
Observations	69905	32576	29132	25988	19443	9670
Adjusted R^2	0.375	0.070	0.096	0.142	0.301	0.281

Table B.9: Firm-level measures of hold-up problem and credit growth

Notes: The regression estimates are based on estimating in the credit registry using the same definitions for variables and terms as in Equation 7: $\log(\text{credit}_{bit}) = \beta_0 + \beta_1 i_t + \mathbf{Z}_{it} \times i_t + \epsilon_{bit}$. The base group for columns (1)-(2) is the low firm size group in 2006, the base group for columns (3)-(4) is the group of firms with lowest firm age in 2006, and the base group for columns (5)-(6) is the group of firms with only one bank in 2006. Standard errors are double clustered at the quarterly date and firm-levels.

	(1)	(2)	(3)	(4)	(5)	(6)
	log(Credit)	log(Credit)	log(Credit)	log(Credit)	log(Credit)	log(Credit)
EUR3M	0.095***		0.086***		0.090***	
	(0.000)		(0.001)		(0.000)	
Size=2 × EUR3M	-0.025***	-0.031***				
	(0.001)	(0.001)				
Size=3 × EUR3M	-0.031***	-0.040***				
	(0.003)	(0.003)				
Age=2 × EUR3M			-0.015***	-0.033***		
			(0.001)	(0.001)		
Age=3 × EUR3M			-0.037***	-0.083***		
			(0.001)	(0.001)		
Multi-bank=1 × EUR3M					-0.022***	-0.027***
					(0.001)	(0.001)
Firm FE	✓	✓	✓	✓	✓	✓
Firm x Bank FE	✓	✓	✓	✓	✓	✓
Bank x Year FE	–	✓	–	✓	–	✓
Observations	6420983	6420983	4535921	4535921	6420983	6420983
Adjusted R^2	0.616	0.626	0.635	0.641	0.615	0.625