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 inversely related to the level of short-term interest rates. Using loan-level data on business lending in France, we rule out demand-side explanations and demonstrate that this negative correlation aligns with a supply-side narrative: banks with larger loan spreads when interest rates decline experience lower growth in credit volumes. We provide empirical support for theories linking frictions in the deposit-taking business to the lending behavior of financially constrained banks. Our evidence is consistent with lower interest rates compressing deposit spreads for banks that remunerate deposits below market rates, which reduces their net interest margins, weakens their balance sheets, and prompts constrained banks to reduce credit supply, thereby contributing to the observed rise in loan spreads. Additionally, we find evidence for a complementary channel: lending market power. In particular, lenders with higher market shares and borrowers facing a more severe "hold-up problem" are associated with a lower interest rate pass-through. Finally, we document real effects on corporate financing and investment for firms borrowing from banks with reduced pass-through.

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1. Introduction

Banks earn a significant interest rate spread on the new loans they extend to firms, relative to the yields on securities with similar cash flow profiles in financial markets (Schwert 2020). In aggregate US data, the interest rate spread on existing loans over market interest rates is also positive and exhibits a strong negative relationship with the level of interest rates (O. Wang 2024). This observation suggests a weak pass-through of market interest rates to lending rates, a pattern also evident in the Euro Area. Specifically, when market interest rates are low, spreads on new loans to non-financial corporations tend to be large (Figure 1), averaging approximately 200 basis points (bp) in major Euro Area countries. Conversely, when market interest rates are high, this spread narrows to less than 100 bp.[1]

Such an incomplete pass-through of market interest rates to lending rates may have important implications for monetary policy. Central banks employ a range of tools to influence financing costs for businesses and households, aiming to achieve their inflation and employment mandates. While these tools are generally effective at influencing market interest rates (see, e.g., van Binsbergen & Grotteria 2024), a weak pass-through from market rates to rates on new loans, like the one suggested by Figure 1, can imply that central banks' ability to influence real economic outcomes is limited.

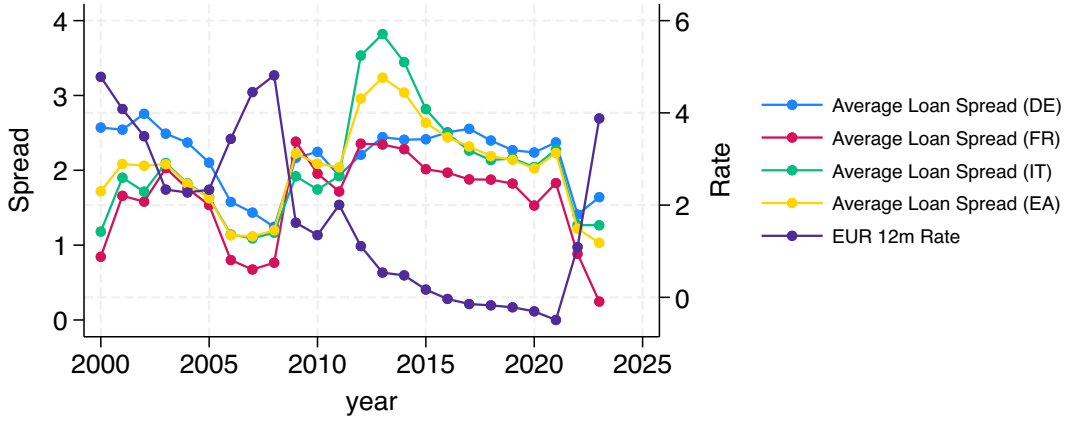
In this paper, we leverage micro data on new loans to investigate the long-run pass-through of market interest rates to loan rates and its implication for real economic outcomes. We make three main contributions. First, we show that the transmission of market interest rates to lending rates to non-financial firms is impaired: when market interest rates fall, the interest rates on new loans do not fall as much. Using loan-level data from France, matched with detailed information about loan characteristics, borrowing firms, and lending banks, enables us to rule out demand-side factors by controlling for variation over time in either the quantity or the price of interest rate and credit risks (e.g., Roberts & Schwert 2020). Instead, our results suggest that the negative correlation between loan spreads and the level of interest rates is consistent with a credit supply shock. In particular, following a drop in interest rates, banks that increase their loan spreads—i.e., banks with lower pass-through of market rates to loan

[1]For the Euro Area, we use aggregate interest rate data on new loans to non-financial corporations (for different thresholds 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.

rates—experience slower growth in lending volumes. Second, we shed light on the mechanisms behind the impaired transmission of market interest rates to lending rates. We find evidence, albeit limited, that variation across banks in loan pricing power explains some cross-sectional differences in loan rate pass-through (e.g., Scharfstein & Sunderam 2015). However, a more significant explanatory factor of cross-sectional differences in loan rate pass-through is variation in deposit funding conditions. Specifically, banks that earn large spreads on their deposit business when interest rates are high—by paying deposit rates significantly below market rates—but lose this source of revenue when rates are low, tend to have lower pass-through from market rates to lending rates. We provide further evidence consistent with the view that low interest rates negatively affect the profitability of the deposit making business and net worth for such banks, leading them to cut lending—as it is tied to their net worth—and resulting in higher equilibrium loan spreads (see, e.g., O. Wang 2024). Consistent with the importance of a net worth channel in explaining this credit supply shock, the effect is stronger among the least capitalized banks. Third, we provide evidence that the impaired pass-through of market interest rates to loan rates, driven by these supply-side channels, has real effects for corporate financing and investment.

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.



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 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 equilibrium 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 in the cross-section of banks in the bank-specific interest rate pass-through after controlling for 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 exhibiting a higher 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 and Mian (2008)-type regressions: banks with lower interest rate pass-through to their borrowers following a decline in short rates are also those that increase their lending volumes by less—after controlling for the lending volume of other banks lending to the same borrower.

We find support for two supply-side mechanisms that can explain the cross-sectional dispersion in bank-specific loan rate pass-through and which may explain the aggregate negative correlation between loan spreads and interest rates in the time series.

First, banks tend to earn large spreads on their deposit business when interest rates are high—by paying deposit rates significantly below market rates—but lose this source of revenue when rates are low. This stylized fact can be rationalized by the competition between money and bank deposits decreasing with the level of interest rates (see, e.g.,

Drechsler, Savov, & Schnabl 2017 and O. Wang 2024). Thus a persistent decline in market interest rates can compress banks' deposit spreads—defined as the difference between market interest rates and deposit rates—as a result of the increasing competition between money (a zero-interest paying asset) and bank deposits. This fall in deposit spreads may hurt banks' profits and equity valuations such that credit supply falls—if the latter is tied to banks' equity, resulting in an increase in equilibrium loan spreads. We refer to this mechanism as the *deposit channel* and we test it in the cross-section of banks by instrumenting the bank-specific sensitivity of deposit spreads to short-term interest rates using the bank-specific initial deposit rate at the beginning of our sample of bank balance sheet data (in 2010), in the spirit of Balloch and Koby (2023). We confirm the intuition that banks with lower initial deposit rates are banks which exhibit subsequently a larger decline in deposit spreads, a larger increase in loan spreads, and a lower credit supply growth. 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 spread - 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 provide further 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. Consistent with the importance of banks' balance sheet strength for lending outcomes, we also find that the 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.

Second, we turn to investigating a *lending market power channel*, whereby banks use their market power to capture larger profits when one of their main intermediation costs, specifically market interest rates, fall (see, e.g. Scharfstein & Sunderam 2015). We find evidence that bank-level measures of lending market power have explanatory power for bank-level loan rate pass-through measures. Notably, 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 at best 1% for market power proxies), 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 our market power proxies.

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 have 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 channel* have important real effects through their effects on lending quantity and prices.

Related literature Our paper first relates to the literature on loan rate stickiness with respect to changes in market interest rates (e.g., Berger & Udell 1992; Roberts & Schwert 2020; O. Wang 2024). We provide novel evidence that interest rate spreads (over market interest rates) on new fixed-rate loans to non-financial companies are negatively related to short-term interest rates. Using administrative loan-level data from France enables us to rule out demand-side narratives related to the composition of borrowers, credit risk, or interest-rate risk. Unlike the literature that focuses on the role of credit risk pricing in explaining time series variation in loan spreads (e.g., Dougal, Engelberg, Parsons, & Van Wesep 2015; Roberts & Schwert 2020; 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. Instead, the cross-sectional dispersion across banks in interest pass-through for new loans is consistent with a supply-side narrative: following a drop in short-term rates, banks providing a lower interest rate pass-through also experience a slower growth in credit supply.

In explaining the source of the correlation between interest rates and loan spreads, our paper also relates to the literature suggesting that conventional monetary policy is impaired when short-term rates are either low or negative.[2] We provide new evidence from France that the interest pass-through is below one even when short-term rates are still positive: loan spreads rise when short-term rates fall from 4pp to 0pp. To the best of our knowledge, we also provide the first piece of evidence that links, in the cross-section of banks, interest rate pass-through for *new* loans with changes in bank deposit-making profitability. Our granular data on new loans also enables us to provide empirical support

[2]See e.g., Claessens, Coleman, and Donnelly (2018), Heider, Saidi, and Schepens (2019), Bottero et al. (2019), Arce, Garcia-Posada, Mayordomo, and Ongena (2020), Ulate (2021), Ampudia and Van den Heuvel (2022), Balloch and Koby (2023), Eggertsson, Juelsrud, Summers, and Getz Wold (2023), Abadi, Brunnermeier, and Koby (2023), and O. Wang (2024).

for O. Wang (2024)'s theoretical prediction regarding the importance of banks' net worth by showing that, following a drop in market interest rates, the cross-sectional correlation between changes in deposit spreads and changes in loan spreads is stronger 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 Heuvel et al. 2002, Gertler & Karadi 2011).

Our findings also relate to the literature that highlights the role of bank 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 higher concentration in local mortgage lending markets reduces the *short-run* sensitivity of mortgage rates to MBS yields. Our evidence is consistent with lending market power also reducing the *long-run* interest rate pass-through in the business 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, Whited, Wu, and Xiao (2022) who find a 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 standard hold-up problem (Sharpe 1990 and Rajan 1992) in explaining interest rate pass-through.

Finally, building on the above-mentioned strands of literature that document a limited interest rate pass-through for loans, we provide novel evidence that the two supply-side channels we identify as drivers of this reduced pass-through have real effects on corporate financing and investment.

The rest of the paper is organized as follows. Section 2 presents our data. Section 3 reports our main results on the negative correlation between loan spreads and market interest rates. Section 4 explores two mechanisms at play: the deposit channel and lending market power. Section 5 investigates real effects and Section 6 concludes.

2. 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 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

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

[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.

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 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 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 correlated with the level of interest rates also holds in French microdata on the issuance of new loans. We show that this result is not explained by changes in the compensation banks receive for taking interest rate risk or credit risk that correlate with the level of interest rates. Additionally, we show that when interest rates are low, banks with higher loan spreads also supply less credit to firms, supporting a supply-side narrative.

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:

$$s_{lbit} = \beta\, i_t + \mathbf{FE} + u_{lbit}. \tag{1}$$

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-month 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 changes in the composition of loans over time. For the specification with

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

maturity-matched swap rates, we also include a set of time fixed effects to control for the level of interest rates and to study asymmetric changes in the term structure of interest rates across maturities.

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

Table 1 reports the results for new loans with an initial maturity above 1 year, as 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

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

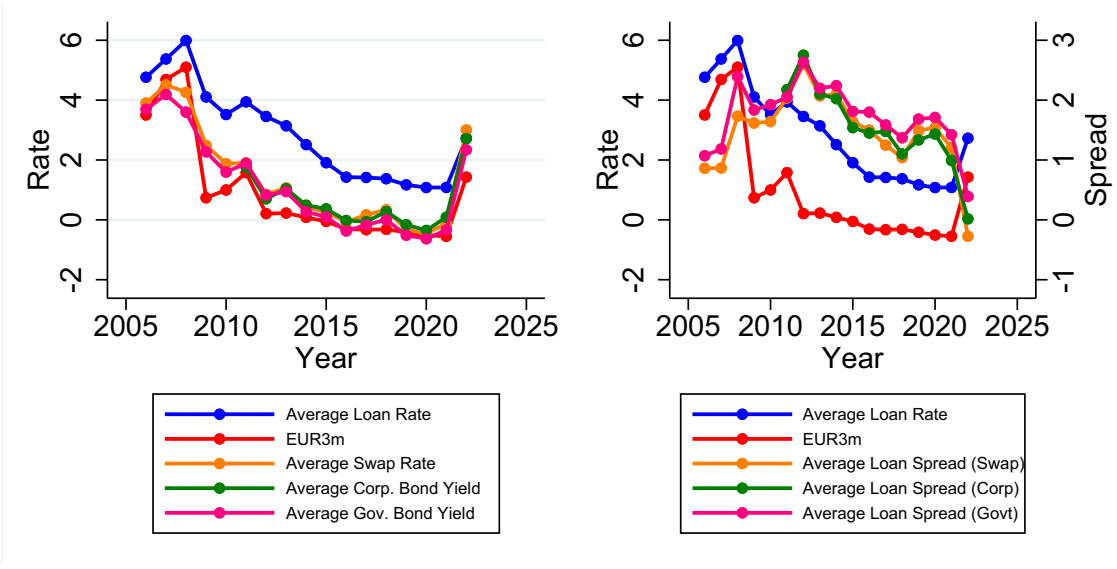
maturity-matched swap rates. This finding suggests weak transmission of policy rates, and more broadly market interest rates, to bank loan interest rates.

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

Figure 2 illustrates these results graphically. Panel (a) shows the average interest rate dynamics on loans in the loan-level dataset alongside the dynamics of a proxy for short-term interest rates (the 3-month Euribor) and the dynamics of 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 market interest rate dynamics with the dynamics of 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 that it is not quantitatively important whether one measures the loan-level interest rate spread using the loan-level maturity-matched interest rate swap,

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

rather than 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 that 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 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 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 as to whether the variation in loan spreads may result from changes in 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 (the 3-month Euribor) and dummies indicating either loan maturity or credit rating:

$$s_{lbit} = \beta\, i_t + \Theta \cdot \mathbf{Z}_l \times i_t + \mathbf{FE} + u_{lbit}, \tag{2}$$

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 rate, i_t is the 3-month Euribor rate at time t, and $\mathbf{Z}_l$ is a vector of dummies indicating either the maturity or the borrower credit rating of loan l.

Table 2 reports the results for new loans with an 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 appears to play only 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 the marginal cost of funds for banks is the OIS rate with a 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). They show that the negative 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 slope or curvature). However, the similarity in the magnitudes of the coefficients in columns (1)–(4), which by construction rely only on variation from shifts in short-term rates, and those in 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 maturities drops uniformly, interest rate spreads on loans over their respective marginal financing costs 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 for credit risk or interest rate risk.

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

[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 on corporate bonds with otherwise similar characteristics. Figure 2 suggests that 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

In this section, we investigate the relationship between short-term rates and lending volumes in an attempt to distinguish whether the lower pass-through of declines in interest rates to loan rates is broadly the result of a relative demand shock (i.e., firms relatively increasing their 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 responses to understand the source of the aggregate correlation. More precisely, we investigate whether, in response to a decline in interest rates, banks with lower lending growth are also characterised by lower loan rate pass-through, which would support a supply-side narrative. 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 interest rate pass-through to loan rates in our sample. We refer to this pass-through measure as the bank's loan spread beta.

Banks' loan spread betas are the bank-specific slopes on the short-term interest rate estimated from our baseline specification in column (2) of Table 1. The specification further controls for interaction terms between the short-term interest rate and credit rating dummies, as well as 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 that is not explained by loan maturity or firm credit rating.

Banks with lower loan spread betas are those that earn higher spreads as interest rates decrease, that is, banks with a lower pass-through of declining short-term interest rates. As shown in the summary statistics in Table A.6, the loan spread beta is negative for more than 90% of banks, and there is substantial variation in this measure. The average loan spread beta is –0.16, and the interquartile range is 0.07 in our sample of 75 banks present throughout 2010–2021.

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

$$\log(\text{credit}_{bit}) = \gamma \cdot i_t \times \text{LoanSpreadBeta}_b + \mathbf{FE} + u_{bit}, \tag{3}$$

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

bank–firm–year level.

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

In column (3) of Table 3, we run Khwaja and Mian (2008)-type 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 exploiting variation across banks lending to the same firm at the same point in time. The coefficient is quantitatively unchanged, reinforcing a supply-side narrative: banks that provide less interest rate pass-through to their borrowers when short-term 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

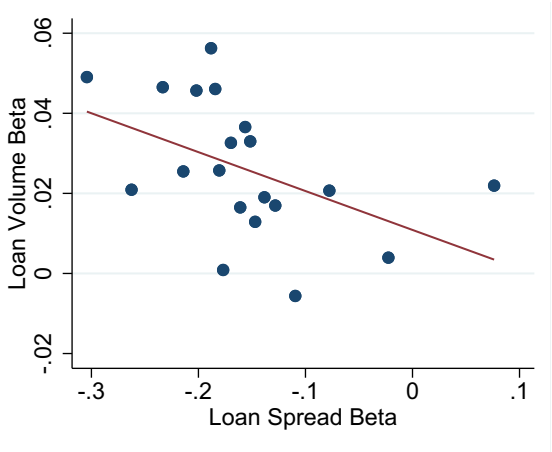
Figure 3 illustrates a supply-side narrative of the increase in loan spreads when short-term rates decrease. It shows the correlation between banks' loan spread betas and loan volume betas. The latter are defined as the sensitivities of banks' loan volumes to the 3-month Euribor rate at the bank level.[9] Banks with high loan volume betas are banks that relatively cut credit when short-term rates decrease (i.e., banks that increase volumes

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

by less than banks with low loan volume betas). The negative correlation highlights that banks providing lower pass-through of market interest rate declines are also those with lower loan volume growth.

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 loan rates are also banks that relatively decrease their loan volumes, we investigate two potential supply-side mechanisms that may explain the cross-section of bank-level loan rate pass-through and thus drive 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 banks' net worth, resulting in a contraction of credit supply for constrained banks and higher loan spreads.

Second, although we find no evidence that variation in bank-level exposure to concentrated lending markets has explanatory power for variation in bank-level pass-through measures, we do find evidence that banks' market share in aggregate lending can explain part of this variation. Additionally, we find evidence supporting the role of market power in explaining differences in loan spreads within banks across borrowers.

4.1. Deposit Channel in the Constrained Lending Regime

O. Wang (2024) argues that the secular decline in interest rates affects equilibrium loan

spreads by compressing banks' deposit spreads as a result of 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.

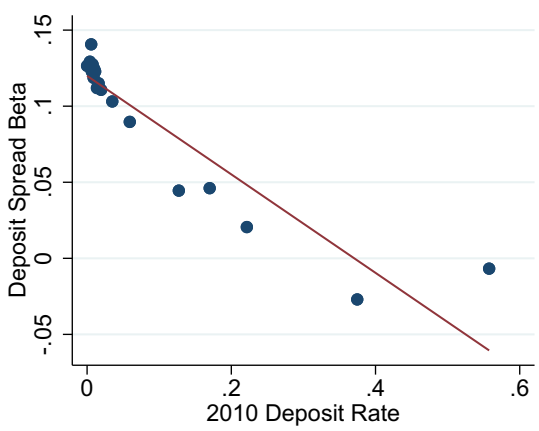
We test this mechanism by instrumenting banks' deposit spread betas (the sensitivity of deposit spreads to short-term interest rates), in the cross-section of banks, with their initial deposit rate at the beginning of our bank balance sheet sample (i.e., 2010), in the spirit of Balloch and Koby (2023). 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 experiencing larger compression in their deposit spreads subsequently extend less credit and charge 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 consistent with the mechanism proposed in O. Wang (2024), whereby banks that experience a drop in equity due to lower deposit spreads have to cut lending.

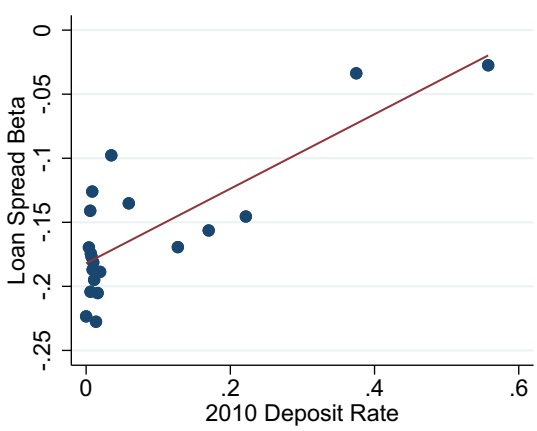
Compression of deposit spreads, drop in loan volume and increase in loan spreads. Figure 4 shows the correlation between banks' initial deposit rates at the beginning of our sample in 2010 and their deposit spread betas, loan spread betas, and loan volume betas calculated over the 2010–2023 period. It is apparent that banks with lower deposit rates in 2010 subsequently exhibit 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 declined, subsequently: (i) experienced a decrease in their deposit spreads, (ii) increased their loan spreads (i.e., provided relatively less pass-through of rate declines to loan rates), and (iii) relatively decreased lending volumes.

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

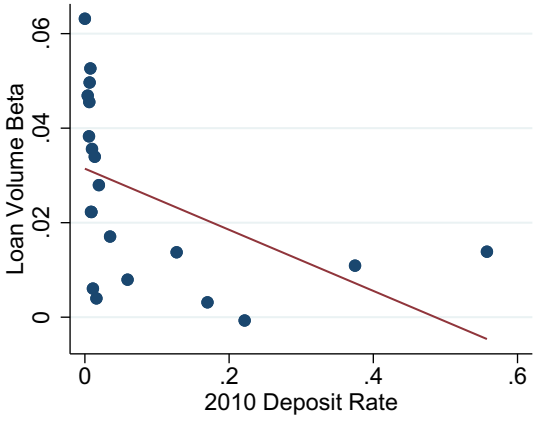
Notes: The panels show binned scatter plots that groups banks into 20 bins by their deposit rate at the beginning of our sample of bank-balance sheet and income statement data in 2010 and plots respectively the average estimated deposit spread betas, loan spread betas, and loan volume betas within each 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. Both correlations are economically and statistically significant. A one-standard-deviation decrease in deposit rates is associated with a 4 bp lower loan rate pass-through of a 100 bp decrease in the short rate (i.e., the loan spread beta)—about half of the standard deviation of loan spread betas across banks—and a 90 bp lower loan volume beta—about 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), a reduction in deposit spreads has no implications for loan

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

spreads when aggregate bank lending capacity remains sufficiently high 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.

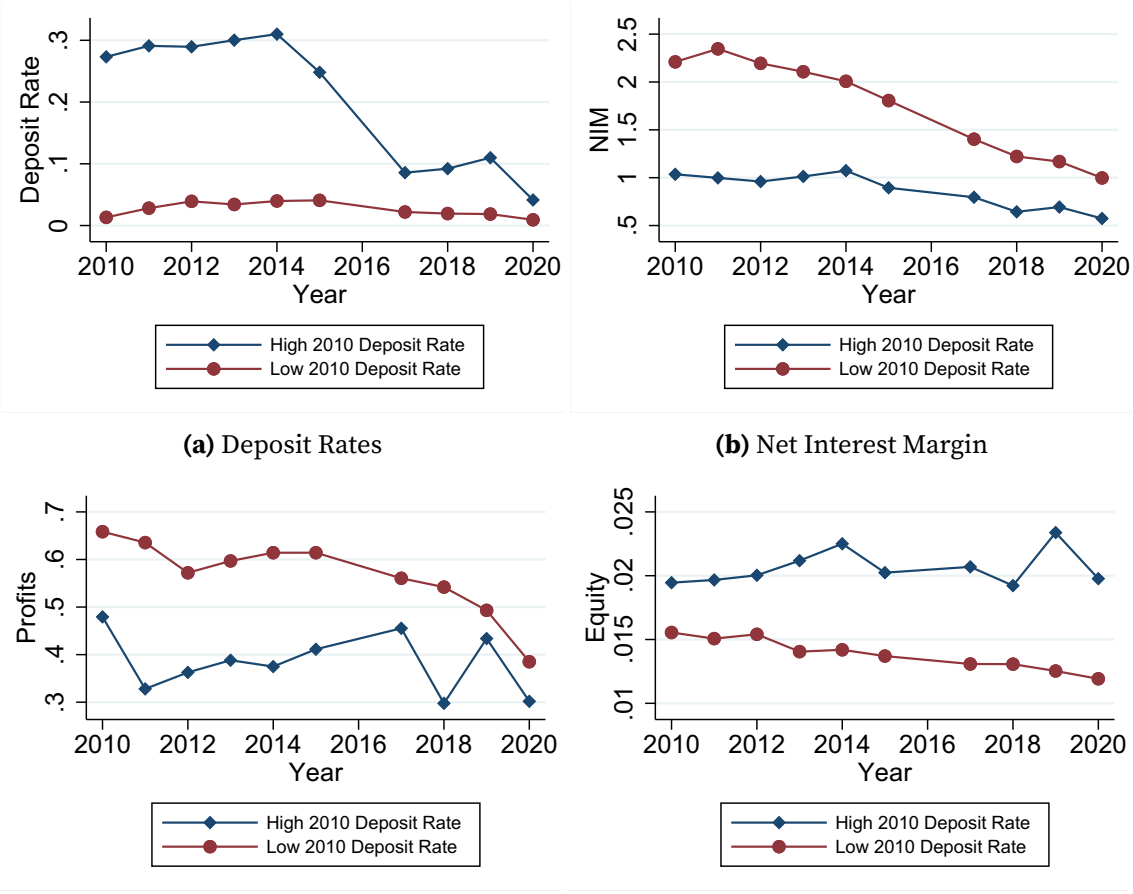
In columns (3)–(4) of Table 4, we test whether cross-sectional variation in the initial level of bank equity, which we use as a proxy for distance to capital constraints, is useful in explaining the correlation between a bank's initial deposit spread and its loan spread beta. Overall, we find that within 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 variation in the profitability of 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), which 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 for banks that were paying an above-median deposit rate in 2010 and for banks that were paying a below-median 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

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)

a compression in the deposit spreads earned by the latter relative to the former.

Panels (b) and (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 keep their NIM relatively constant throughout the period, banks paying low deposit rates in 2010 experienced a larger decline in NIM. Even though these banks appear to compensate for the compression of their deposit spreads with an increase in loan spreads, this increase has not been sufficient to prevent 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 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 decline in equity and therefore to lending volumes (as lending is tied

to equity).

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

$$y_{bt} = \gamma \cdot i_t \times \text{DepositRate}_{b,2010} + \mathbf{FE} + u_{bt}, \tag{4}$$

where y_{bt} is a bank–time outcome (deposit spreads, 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 over the 2010–2023 period is associated with lower deposit spreads, net interest margins, profits, and equity values for banks with relatively low initial deposit rates 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 loan pricing. This analysis is motivated by Scharfstein and Sunderam (2015), who document lower short-term pass-through of MBS interest rates to the interest rates on newly originated mortgages in more concentrated local markets in the US.

We find no evidence that variation in bank-level exposure to concentrated lending markets has explanatory power for variation in bank-level pass-through measures. However, we do find evidence that banks' market share of aggregate lending can explain part of this variation. 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 a role for market power in explaining differences in loan spreads charged by the same bank to different borrowers with varying degrees of hold-up problems. Using regressions at the loan interest rate level, we find evidence of 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 levels of concentration.

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

$$\text{LoanSpreadBeta}_b = \gamma \cdot C_b + u_b. \tag{5}$$

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

We use two bank-level measures of exposure to market concentration: a bank-level weighted average of the local Herfindahl–Hirschman Index (HHI) and a bank-level weighted average of the local share of the top four lenders (Top4Share). We also use each bank's share of aggregate lending. The bank-level average HHI and Top4Share are constructed in the same way: for each bank b, we compute a weighted average of the local HHI, respectively the local Top4Share, across the commuting zones in which the bank operated in 2006, where the weights are given by the bank's share of lending in each commuting zone relative to its total lending:

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

where HHI_{cz} is the local HHI in commuting zone cz, and $\omega_{b,cz}$ is the ratio of bank b's total lending in commuting zone cz to bank b's total lending. The bank-level average Top4Share is defined analogously. 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 neither economically nor statistically significant. However, a one-standard-deviation

increase in a bank's market share of aggregate lending is associated with a 0.9 bp lower loan rate pass-through of a 100 bp decrease in the short rate (i.e., loan spread beta). The non-negative coefficient in column (6) for the corresponding loan volume beta regression is also consistent with a supply-side narrative.

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 assess the relative importance of the deposit channel and the market power channel.

Table 7 reports the bank-level results. Column (1) reproduces the specification from Section 4.1. Columns (2)–(4) report the results of horse-race regressions between the measure of initial deposit rates and our alternative measures of bank-level market power. First, the results highlighted above remain robust in the horse-race setting. We interpret this as evidence that the two mechanisms operate concomitantly.

Second, column (4) confirms our earlier estimates, showing that a one-standard-deviation decrease in deposit rates in 2010 is associated with a 4.1 bp lower loan rate pass-through of a 100 bp decrease in the short rate. At the same time, a one-standard-deviation increase in a bank's market share of aggregate lending is associated with a 1.1 bp lower loan rate pass-through. In other words, cross-sectional

variation in deposit rates across banks appears to be more important in explaining cross-sectional variation in loan rate pass-through than variation in our measure of bank market power. This suggests that the deposit channel is more important than the market power channel, both in the cross-section and in the aggregate. The relatively small increase in the R^2 between columns (1) and (4) is also consistent with this conclusion.

The results from the horse-race regressions above suggest that market power may not play an important role in the negative relationship between loan spreads and short-term interest rates. However, our proxies for market power are measured at the bank level and rely on potentially noisy measures of local concentration. In what follows, we therefore conduct two alternative tests of the market power channel by examining within-bank heterogeneity 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 reappraise the market power channel by comparing differential pass-through of market interest rates to loan rates across firms subject to the hold-up problem to different degrees (see, e.g., Sharpe 1990; Rajan 1992). We estimate the following regressions at the

loan level:

$$s_{lbit} = \Theta \cdot \mathbf{Z}_{i,2006} \times i_t + \mathbf{FE} + u_{lbit}, \tag{7}$$

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 rate, i_t is the 3-month Euribor rate at time t, and $\mathbf{Z}_{i,2006}$ is a vector of dummies indicating firm size, firm age, and whether the firm borrows from multiple banks simultaneously, as measured in 2006.

Table 8 reports the results. Columns (1)–(6) separately test the role of firm size, firm age, and borrowing from multiple banks. Each regression is estimated with and without bank–time fixed effects, which allow us to control for all bank balance-sheet-related channels that do not operate through bank pricing power. The estimated coefficients on the interaction term are increasing in firm size (i.e., positive for size = 2, although not increasing from size = 2 to size = 3) and in firm age, and they are positive for the multi-bank dummy. This implies that small firms, young firms, and firms borrowing from a single bank receive less pass-through of a decrease in the 3-month Euribor rate from their bank, consistent with a classic hold-up problem. Columns (7)–(8) show that these results continue to hold when size and age are included jointly in the same regression, although the significance of the multi-bank dummy disappears.

Table B.9 reports the results from credit volume regressions using the credit register. The decreasing coefficients with respect to firm size and age, together with the negative coefficient on the multi-bank dummy, imply that small firms, young firms, and firms borrowing from a single bank experience a relatively smaller increase in loan volumes following a decrease in the 3-month Euribor rate. Taken together with the results from the loan spread regressions above, these findings indicate that banks decrease the relative supply of loans to these firms as short-term interest rates decline.

Even though we do not detect a meaningful effect of market concentration in the cross-section of banks on the negative relationship between loan spreads and short-term interest rates, banks appear able to price discriminate based on firm characteristics, and the magnitudes in the cross-section of firms are substantial. Firms outside the group of small firms experience, on average, a 5 bp higher loan rate pass-through of a 100 bp decrease in the short rate compared with small firms. Firms in the highest tercile of the age distribution experience a 3 bp higher loan rate pass-through compared with firms in the lowest tercile of the age distribution. These

cross-sectional differences represent, respectively, about one third and one quarter of the unconditional gap to full pass-through 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 implement an alternative within-bank, across-firms test of the market power channel by comparing differential pass-through of market interest rates to loan rates across firms borrowing in commuting zones with different levels of concentration. This

identification strategy mirrors that used in the short-term pass-through regressions of Scharfstein and Sunderam (2015). To this end, we estimate the following regressions:

$$s_{lbit} = \gamma \cdot C_{i,2006} \times i_t + \mathbf{FE} + u_{lbit}, \tag{8}$$

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 rate, i_t is the 3-month Euribor rate at time t, and $C_{i,2006}$ is a measure of local bank concentration in 2006 for the commuting zone in which firm i is located. We consider two measures commonly used in the literature: the local Herfindahl–Hirschman Index (HHI) and the local share of the top four lenders. These measures are computed using lending data from 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 while controlling for loan-level composition effects over time. Columns (2) and (5) further include time fixed effects to control for changes in the distribution of loans across commuting zones over time in our dataset. Columns (3) and (6) further include bank–time fixed effects, which control for the average pass-through at the bank level and restrict identification to within-bank variation across locations.

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

However, the decline in both economic and statistical significance in columns (3) and (6) indicates that the scope for discriminatory pass-through across locations is limited within banks. One possible explanation is that regional banks, which account for a large share of business lending, do not discriminate across commuting zones within their regions.

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 final section, we investigate whether lower interest rate pass-through and a lower relative supply of bank loans following a decline in short-term interest rates have real effects. Specifically, we examine whether, after a decrease in the short rate, firms that borrow more from banks with lower loan rate pass-through (i) reduce their debt issuance and (ii) decrease investment in fixed assets, relative to other firms.

Real effects of low interest rate pass-through. To assess these effects, we estimate the following regression:

$$\log(y_{it}) = \gamma \cdot i_t \times \text{LoanSpreadBeta}_i + \mathbf{FE} + u_{it}, \tag{9}$$

where y_{it} is either 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 betas of the banks from which firm i borrows in 2006:

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

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

Column (1) in Panels (a) and (b) of Table 10 reports the estimated coefficients for the logarithm of total firm debt and net PP&E, respectively. Firms that are exposed to banks characterised by relatively low interest rate pass-through experience lower debt and investment growth following a decrease in the short rate.

A one-standard-deviation increase in firm-level exposure (i.e., relatively more borrowing from banks providing lower pass-through) is associated with a 3.1 (1.9) percentage point lower growth in debt (investment) following a 1 percentage point decrease in the short rate. This effect is sizeable, as a one-standard-deviation difference in the firm-level average loan spread beta corresponds to a 9 bp difference in pass-through following a 1 percentage point decrease in the short rate.[10] The 3.1 (1.9) percentage point differential effect on debt (PP&E) growth is also economically significant relative to the interquartile range of 54 (7.3) percentage points.

Real effects of low interest rate pass-through via the deposit channel. We show that these differences in debt growth and PP&E growth across firms borrowing from banks with different degrees of interest rate pass-through can be explained by the two channels that account for the time variation in aggregate loan spreads.

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

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

where $\mathbb{I}(\cdot)$ is the indicator function.

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, Unconstrained Deposit Rate$_i$, measuring the degree of a firm's exposure to the deposit channel through the banks from which it borrows, constructed in the same way as the firm-level measure of the loan spread beta defined 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, replacing the interaction between the firm-level loan spread beta and the short-term interest rate with an interaction between the newly defined firm-level exposure and the level of short-term interest rates. Column (2) in Panels (a) and (b) of Table 10 shows that firms more exposed to banks whose lending capacity is more constrained by the compression of deposit spreads experience relatively lower debt and investment growth following a decrease in the short rate.

A one-standard-deviation increase in firm-level exposure (i.e., relatively greater borrowing from constrained banks with high deposit spread betas, and thus lower loan rate pass-through) is associated with a 1 (0.6) percentage point lower growth in debt (investment) following a 1 percentage point decrease in the short rate. This result highlights that the deposit channel has economically meaningful real effects through its spillovers to both lending quantities and prices.

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

A one-standard-deviation increase in firm-level exposure (i.e., greater borrowing from banks with higher shares of aggregate lending and thus lower loan rate pass-through) is associated with a 1.3 (0.7) percentage point lower growth in debt (investment) following a 1 percentage point decrease in the short rate. This result highlights that, when examining firm-level exposure to cross-sectional bank-level measures of both channels, the market power channel has real effects that are comparable in magnitude to those of the constrained deposit channel.

Column (4) in Panels (a) and (b) of Table 10 reports the results from horse-race regressions including firm-level exposure to both channels. The robustness of the standalone estimates in these horse races indicates that both channels contribute concomitantly to the real effects on debt and PP&E growth.

6. Conclusion

We provide evidence that cross-sectional variation in frictions within the deposit-taking business and in bank lending market power significantly explains differences in interest

[12] We define the firm-level exposure to banks with high market shares of aggregate lending analogously to Equation 10.

rate pass-through across banks and firms. These frictions, when interacting with changes in interest rates, generate credit supply shocks that are reflected in changes in loan spreads.

Our findings further 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 of banks on wholesale funding—have contrasting implications for the effectiveness of monetary policy transmission to real economic outcomes over recent 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

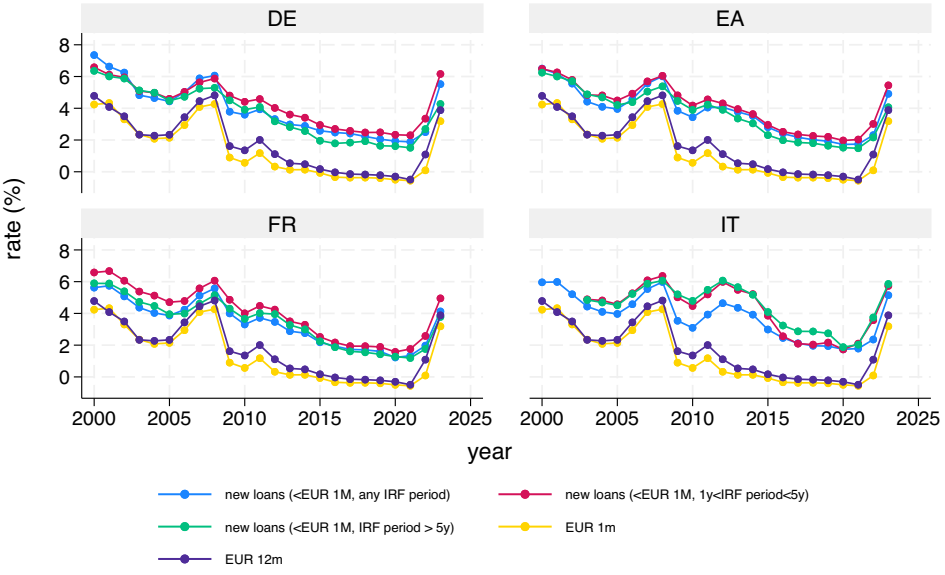


TABLE B.8: Negative correlation between loan spreads and short-term interest rates: level vs. long differences

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