As Interest Rates Surge: Flighty Deposits and Lending*

Giuseppe Cappelletti† David Marques-Ibanez‡ Alessio Reghezza§
Carmelo Salleo¶

February 13, 2025

Abstract

How do bank deposits shape lending? We estimate the impact of the deposit channel of monetary policy by looking at a large, and unexpected, increase in policy rates which led to many banks experiencing deposits outflows. By using an extensive credit register that includes the vast majority of bank-firm lending relationships in euro area countries, we find that banks experiencing deposit outflows reduce credit rather than increase the interest rate they charge (to the same borrower relative to other lenders). This credit restriction is stronger for longer maturity loans, but not for riskier borrowers. The effect is larger for banks coming into the hiking period with a larger unhedged duration gap. This result is consistent with banks considering holistically their assets and liabilities and prioritizing the management of their duration gap, which affects the value of their deposits franchise, rather than specific profitability considerations linked to their loan book. Firms don't manage to compensate the loss of funding by tapping other banks. Monetary policy is transmitted to the loan supply and firms via its impact on funding, and mainly with rationing strategies aimed at managing interest rate risk.

Keywords: Monetary policy, Banks, Bank deposits
JEL Codes: E51, E58, G21

*The findings of this paper cannot be attributed to the European Central Bank. The conclusions are those of the authors only, and do not necessarily represent the views of (or imply any responsibility for) the European Central Bank. The authors are thankful for useful comments and discussions by Greg Buchak, Daniel Foos, Zhiguo He, Erica Xuewei Jiang, Peter de Marzo, Camelia Minoiu, Donald (Don) Morgan, Steven Ongena, Enrico Perotti, Alex Popov, Andrea Presbitero, Veronica Rappoport, Ahmed Rashad, David Scharfstein, Jean-David Sigaux, Emil Verner, Xavier Vives, Olivier Wang, Luigi Zingales and participants at the ECB seminar series, at the American Economic Association (AEA) 2025, at the CEPR/Study Center Gerzensee European Summer Symposium in Financial Markets (ESSFM) 2024, at the 2024 BIS/CEPR conference on "Banks' liquidity in volatile macroeconomic and market environments" and at the 2024 IJCB conferene on "The transmission of monetary policy in a post-pandemic world". We are most grateful to James 't Hooft and Jure Podlogar for their help and suggestions. The dataset used in this paper contains confidential statistical information. Its use for the purpose of the analysis described in the text has been approved by the relevant ECB decision making bodies. All the necessary measures have been taken during the preparation of the analysis to ensure the physical and logical protection of the information.

†giuseppe.cappelletti@ecb.europa.eu
‡david.marques@ecb.europa.eu
§alessio.reghezza@ecb.europa.eu
¶carmelo.salleo@ecb.europa.eu

1 Introduction

According to banking theory,[1] the stability of deposits underpins the banking business and is a necessary component to preserve its soundness. Recent research highlights the importance of deposits as a transmission channel of monetary policy (Drechsler et al., 2017).[2] With the deposit channel, when policy rates rise, banks earn more via the increase on the markdown on deposits. As the opportunity cost of holding deposits goes up, savers move out of sight deposits and into higher yielding products, from term deposits to money market funds. However, rather than repricing the yield on deposits, which would increase the cost of the whole stock, or issuing securities at market rates, banks prefer to let marginal savers move out. Their market power allows banks to implement only a low pass-through of policy rates and keep a high markdown on the vast majority of deposits.[3] Thus banks choose to reduce lending in correspondence with net funding outflows. This mechanism highlights the importance of banks' differences in funding structures in explaining how increases in rates affect the loan supply. Empirically the funding side should matter more during certain periods, namely when policy rates increase unexpectedly, as this would heighten the opportunity cost of holding deposits, making previously assumed stable sources of funding potentially unstable and expensive. This type of mechanism and its implications are the focus of this paper.

We analyze how deposits outflows modulate the transmission of monetary policy during the largest increase in policy rates since the creation of the euro (Figure 1).[4] The jump in rates was mostly unanticipated, particularly in its magnitude (see Figure 2), and provides an opportunity to causally identify how banks' funding shocks affect the transmission to the loan supply. The magnitude, surprise and speed of the shock was such that it led to an unanticipated funding shock scenario and forced banks to make stark choices in terms of pricing of funding and of lending conditions, thereby allowing us to delve into the drivers of

[1] See Diamond and Dybvig (1983); Goldstein and Pauzner (2005); Diamond (1984).

[2] Previously, the idea was that under most instances banks were willing and able to easily complement deposits with alternative forms of funding at the new policy rate to sustain their loan portfolios.

[3] However, to be noted that digitalization is eroding this market power as shown by Koont et al. (2023).

[4] Figure A.1 in the Appendix shows that the current hiking cycle is the fastest and one of the largest even when going back to 1970s.

banks' reaction functions.

From June 2022 to September 2023, the European Central Bank (ECB) increased aggressively its main policy rate by more than 400 basis points. The extent of the increase was largely unforeseen and it reflected a spike in inflation connected to exogenous shocks, meaning that banks would not have thought of adjusting their actions in advance (see Gagliardone and Gertler, 2023). This offers a unique opportunity to clearly identify banks' funding dynamics with possible nonlinear effects related to the magnitude and the speed of the policy action. Banks' profits (and their stock market prices) experienced a turnaround and suddenly improved, which was mostly due to greater short-term net interest rate revenues, as the pass-through of higher rates to depositors was often slow and incomplete. In its wake banks also experienced the biggest reductions in sight deposits since the creation of the euro in 1999 (Figure 3). Part of the outflow was compensated by an increase in term deposits but the overall net flow implies a sizeable reduction in the total volume of deposits (see Figure 4 and 5). Many banks experienced a net outflow, which they did not replace with other sources. On average over the period considered (2021Q1 and 2023Q1) the distribution of the net flows of deposits (inflows and outflows) across banks shifted to negative values after the beginning of the tightening of the monetary policy. After July 2022 a larger share of banks experienced a net outflow of deposits.

We shed light on how this deposit shock generated by the rapid increase in the ECB policy rates impacted the supply of credit and the mechanism thereof. We use a detailed credit register to document how the funding shock is transmitted to lending, identifying the borrowers and the banks' priorities in terms of profitability and asset and liability management. We make use of very detailed information on lending relationships between banks and their (individual) borrowers via Anacredit,[5] a recently constructed pan-European credit register which stores detailed data on the universe of bank loans to euro area firms. We build on the methodology developed by Khwaja and Mian (2008) to isolate supply shocks by looking at the differences in lending conditions to the same borrowers between banks affected by deposit

[5]AnaCredit is the acronym for Analytical Credit Datasets. It consists of a harmonized statistical database on credits granted by financial institutions in Euro area countries to corporations for loans larger than €25,000.

outflows and banks not affected, before and after the increases in rates. That is, by using firms borrowing from several banks (i.e. multiple lending relations), including at least one bank suffering deposits outflows and at least one bank with stable deposits funding, we can identify the impact of deposits on lending conditions in terms of quantities and prices. In this way we are able to fully control for other shocks, such as changes in borrowers' loan demand and riskiness. In additional tests, we study the extensive margin, that is the probability to establish new lending relationships.

We first test a simple version of the deposit channel hypothesis, and focus on whether as the central bank raises rates, banks more affected by deposit outflows curtail lending more aggressively and if they increase lending rates by a larger amount. Indeed, following a large increase in monetary policy rates, banks that experience the largest deposit outflows subsequently reduce their lending supply the most. Our first finding is that they do this by rationing credit rather than by adjusting rates, which remain mostly stable, in line with Khwaja and Mian's findings. In practice, contrary to what is posited in standard models, banks don't transmit an increase in the cost of funding by a corresponding relative increase in the cost of lending, they adjust only via quantities: less funding with deposits translates directly into less lending; banks actively choose which borrowers to ration rather than increasing rates and letting the demand for loans adjust consequently.

We then turn to analyzing which borrowers are rationed and why. Our key finding is that new borrowers and loans with longer maturities suffer the most from the supply constraints imposed by banks. This is consistent with banks trying to avoid adverse selection,[6] and wanting to minimize changes to their duration gap, in line with findings by Drechsler et al. (2018a) and Hoffmann et al. (2019), who show that banks try to isolate themselves from interest rate risk. Deposit outflows, which reduce the duration of funding, are therefore compensated by reducing loans with longer maturities (and therefore duration). It appears that banks put more weight on preserving the balance between assets and liabilities via a stable duration gap, than on short-term profitability considerations which would have led to other choices, such as decreasing lending to less profitable borrowers. Consistent with this,

[6]New borrowers that apply in the context of a sharp increase in rates would likely be very risky.

we find that borrowers of those banks entering the hiking phase more exposed to monetary policy increases (i.e. those with a larger interest rate risk measured by their duration gap) were more affected by the supply constraints connected to the outflow in deposits. Indeed, at low rates many banks aimed to extract the maximum value from their deposits franchise by taking interest rate risk and increasing their duration gap, since deposits were considered a stable form of long-term funding particularly in periods of low interest rates. Thus the prolonged low interest rates created over time a cluster of borrowers more vulnerable to supply constraints. These borrowers were not able to compensate the reduction in funding by banks most hit by deposit outflows by tapping other banks.

Our results are supportive of the predictions of a stylized bank deposit channel and contribute to its understanding in terms of how it actually works. Following a large increase in monetary policy rates, banks experiencing large deposit outflows reduce their lending supply, and they do this by rationing credit rather than adjusting rates, which remain broadly stable. During interest rate increases new borrowers, and loans with longer maturity are most affected by supply constraints imposed by banks. This is consistent with banks trying to minimize changes to their duration gap, in line with findings by Drechsler et al. (2018b). Risk management and longer-term profitability concerns seem to prevail over shorter-term considerations.

The use of an extensive dataset including borrower-bank relationships for 13 countries helps us identify supply shocks at the bank level thus assuaging concerns of endogeneity. Yet an identification challenge can still persist if deposit outflows are driven by some other variable that also happens to move with lending standards. In order to minimise this risk as much as possible, we proceed progressively. First, our specifications already include bank characteristics which account for changes in banks individual conditions over time. Some of the specifications also add bank fixed effects to consider the effect of any unobserved bank invariant characteristic likely to impact on bank lending standards. Then, to address concerns that our results can be due to divergences in the characteristics of banks, we limit our sample to very comparable banks lending to the same borrower by resorting to propensity score matching estimations. Therefore we run our main estimation restricting our sample

to lending relationships to the same borrower only by very similar banks. Still it can be be argued that the effect is linked to a different allocation of borrowers due to changing credit risk preferences as monetary policy increases which is linked statistically to both deposits outflows and lending standards. Thus we test also whether banks with deposit outflows reduce lending to borrowers for which risk-adjusted returns are the lowest and we do not find any significant evidence in this direction.

Finally and importantly, we construct two instrumental variables that are relevant to deposit outflows but not connected to lending standards. For the first one, building on Drechsler et al. (2017, 2021) we calculate a pre-determined measure of effective (i.e. realized) market power on the deposit market. This "deposit beta" indicator aims to capture the sensitivity of a bank's deposit cost to changes in the short-term interest rate. By using a deposit beta calculated before the increase in policy rates we sidestep the criticism of the identification channel of Begenau and Stafford (2022), which rests on simultaneous measures of market concentration. The second instrumental variable addresses potential concerns of reverse causation. It might be the case that banks with less lending opportunities are less motivated to attract or retain deposits. To address this potential issue we use as an instrument the change in the borrowing allowance that each bank has with the central bank in one of its funding schemes. The change in regulation is completely exogenous to subsequent changes in policy rates as it happened well before, is the same for all banks and it affects funding options but not lending. The results confirm the reliability of our findings.

The paper proceeds as follows: Section 2 presents a comprehensive literature review. Section 3 introduces the data and the empirical strategy, while Section 4 includes the main results, with the robustness checks presented in Section 5. Section 6 concludes.

2 Related Literature

Our work is most closely connected to the literature on the bank deposit channel (Drechsler et al., 2017; Drechsler et al., 2021) that builds on banks' market power in the market for deposits which generates upward stickiness on deposits' rates. This is attributed to imperfect

oligopolistic competition in the deposit markets (see also earlier work by Hannan and Berger, 1991; Neumark and Sharpe, 1992). Drechsler et al. (2017) show that banks adjust their balance sheets to the outflow of deposits by reducing lending, and more so where they have more market power on deposits, but they don't investigate further whether banks reach their goal by increasing rates or by rationing firms, and which borrowers are targeted. Is this effect measurably strong when it matters the most; that is when interest rates rise unexpectedly? That would be the gist of our paper.

Repullo (2020) claims that the relationship between increases in rates and deposit outflows is ambiguous, at least in theory, and advocates further analysis on how lending is affected. Tella and Kurlat (2021) develop a model in which banks actually expose themselves to the risk of an increase in interest rates, the effects of which are masked by accounting rules. We provide evidence both on the channel of transmission from funding to lending, and on the types of loans and borrowers that are hit. We don't dwell on the competitive structure of the market for deposits in Europe, as there is already evidence that banks have significant market power (see e.g. Focarelli and Panetta, 2003), and that bank deposits are quite "sticky" (Ferrer et al., 2023). For our purposes it is sufficient to demonstrate that banks' deposit beta is low and heterogeneous, possibly attributable to market power, market imperfections or search and transactions costs. We do however measure how well banks hedge interest rate risk as they enter into the hiking period, as this hedging is bound to affect their decisions regarding the transmission to lending of a funding shock. Our findings add to this literature by showing that banks adjust their lending to compensate for a funding gap exclusively by maneuvering quantities, rather than by using a relative price or credit-risk composition mechanism, at least for the crucial first part of a cycle of rate hikes. This allows them to be more in control of exactly who is targeted by their changes in lending strategy. Our results are consistent with and add to the findings of Drechsler et al. (2018a) and Hoffmann et al. (2019), who find that banks lock in the term premium and the premium on deposits (the difference between the market rate and the deposits rate) by insulating themselves from interest rate risk via asset liabilities management. We find that banks reduce the supply of loans with longer maturities. This way they compensate for the loss of deposits, which are considered to be behaviorally

a source of long-term funding. They also reduce loans to new borrowers, consistent with the literature on adverse selection in lending markets (see Crawford et al., 2018).

There is consistent evidence that certain bank characteristics have an impact on lending practices and thus on the transmission of monetary policy to the real economy (Peek and Rosengren, 2000; Jiménez et al., 2012). Better capitalized banks tend to lend more for a variety of reasons, including lower funding costs and the ability to better withstand shocks. There is also strong evidence from the United States that banks restrain lending following a monetary policy tightening not only if they face liquidity constraints (Kashyap and Stein, 1995) but also if they have low capital levels (Kishan and Opiela, 2000).

We show that in the context of our paper, banks' capital position does not seem to matter so much in their lending decisions, also perhaps because banks were sufficiently capitalized at the beginning of the hiking cycle. What seems to matter more in the context of high and unexpected increases in policy rates is their duration gap. Banks with a greater duration gap experience a decrease in their economic value of equity, which translates into greater reductions in lending following deposit outflows.

Our results can be read also through the lens of the literature modelling banks as liquidity providers that engage in maturity transformation (Diamond and Dybvig, 1983; Gorton and Pennacchi, 1990; Diamond and Rajan, 2001; Kashyap et al., 2002). This dual role renders banks vulnerable to liquidity risk, as deposits are both a source of stable funding and subject to rapid outflows which imply a hidden fragility in funding structures based on deposits, which in extreme cases can lead to runs when there are doubts about banks' solvency, as witnessed by the failure of Silicon Valley Bank in the spring of 2023. We show that banks compensate for deposit outflows on their lending independently of their capital position.

Finally, our focus on the effects of large increases in interest rates in 2022 and 2023 after a period of large injections of liquidity and prolonged low rates, is also linked to recent work on the impact of interest rate changes on financial stability. Jiang et al. (2023) explore the financial stability consequences associated with the unrealized losses on securities portfolio that appear due to the unprecedented speed of interest rate rises by the Federal Reserve and show that these losses significantly increased the fragility of the US banking system

to uninsured depositor runs. More broadly, Acharya et al. (2023) raised concerns about the financial stability implications when the Federal Reserve reversed its balance-sheet expansion after a long period of ample liquidity and expansion of central banks' balance sheets. We show that banks try to contain the decrease in liquidity due to deposit outflows by avoiding an increase their most illiquid assets (i.e. their loans).

3 Data and empirical strategy

3.1 Data

We rely on several proprietary administrative sources to build our dataset.[7] We start with bank-level information for all banks operating in the euro area from the first quarter of 2021 to the first quarter of 2023. Bank balance-sheet characteristics are gathered from two administrative databases; COREP (reporting on banks' capital) and FINREP (financial statements), respectively. They are both supervisory confidential databases based on common supervisory reporting standards and European Union banks are obliged to provide accurate information.[8] We match this supervisory data with granular data on different types of deposits obtained from the Individual Balance Sheet Items (IBSI) statistics.[9] The bank-level data from above is then combined with bank-firm level information taken from AnaCredit, the credit register of the European System of Central Banks that contains information on all individual bank loans above €25,000 to euro area firms. Thus AnaCredit has matched bank-borrower instrument-level information including type of credit, credit volume, interest rate, firm location, firm size and firm sector. The data is collected by the ECB from the National Central Banks of the euro area in a harmonized manner to ensure consistency across countries. Importantly,

[7]For recent papers relying on similar data sources see, for instance, Barbiero et al. (2022) and Altavilla et al. (2021).

[8]COmmon REPorting (COREP) is the standardized reporting framework issued by the European Banking Authority (EBA) to comply with the Capital Requirements Directive reporting. It covers credit risk, market risk, operational risks, own funds and capital adequacy ratios. FINancial REPorting Standards (FINREP) include balance sheet, income statement, disclosure of financial assets and liabilities, off balance sheet activities and non-financial instrument disclosures.

[9]Individual Balance Sheet Items (IBSI) data is collected by ECB for monetary policy purposes to calculate credit and monetary aggregates for all banks operating in the euro area.

we define the lending volume as the total agreed amount, i.e. including the undrawn credit line rather than only the outstanding amount. Therefore, the change in volume would not be affected by a firm drawing on pre-existing (pre-tightening) credit lines. The combination of these databases covers approximately 80 per cent of all banking assets of euro area banks, and two-thirds of all loans to firms.

Table 1 presents summary statistics of our main variables of interest including central tendencies, dispersion, and distribution. Thus, the table shows the number of observations, mean, standard deviation, minimum and maximum values, as well as 25th and 75th percentiles. As indicated in Panel A, the unweighted change in loans is, on average, negative (approximately decreasing by 2 percentage points), suggesting an overall decline in loan growth with a moderate level of variability. Panel B shows that the share of banks that experienced a sizeable and persistent outflow of deposits since the onset of the monetary policy tightening ranges between 20 and 40 percent. Figure A.2 in the Appendix displays the distribution of deposit outflows across banks pre and post monetary policy tightening. The distribution appears rather symmetrical with more than 10% of banks in the sample experiencing neither an outflow or an inflow of deposits over the sample period. However, since the start of the monetary policy tightening there is a visible shift of the distribution to left indicating more banks suffered deposit outflows. Banks in our sample display a quite heterogeneous level of capital and liquidity (Panel C: Control variables). As shown in Panel C, the average core equity (CET1) ratio is above 15 percent but varies across the sample from the regulatory minimum to above 30 per cent, while the average cash over total assets ratio is around 12%, ranging from 0.5% to 32%. Banks in our sample rely on deposits as their main source of funding, as more than three quarters have a share of deposits to total assets above 70 per cent (the simple average is almost 80%). They have different business models and show different levels of profitability and asset quality. For instance, the share of loans over total assets varies between 40 and 90 per cent, indicating that some banks are mainly intermediating deposits and loans, while others focus on other types of financial services. Banks also differ in terms of their credit risk, while the average share of non-performing loans (to total loans) is about 3%, although for some banks it is above 10%. Table A.1

reports the country coverage in terms of number of banks and firms. As displayed, the post estimation sample comprises 1,620 banks and 746,315 firms, with most banks concentrated in Germany, Austria and Italy in line with the large number of banks in those countries, while the majority of firms are located in Italy, Spain, Germany and France consistently with the importance of those countries for the euro area economy.

3.2 Empirical strategy

Our empirical setting relies on two factors that link bank deposit outflows to loan supply. The first focuses on the sensitivity of deposits to changes in interest rates on seminal work on the deposits channel (Drechsler et al., 2017). When the central bank raises the policy rate, holding low-yielding cash and deposits becomes more expensive in relative terms for savers as their alternative investments become more profitable. Households then have an incentive to reduce their holdings of deposits. This decline would depend on the gap between the policy rate and the remuneration of deposits but also on banks' market power over their local deposit markets. From a funding perspective, banks can lift the interest rate they generally pay on deposits or raise funds from other sources of funding at market rates (e.g. by issuing bonds). In both cases, there would be a major increase in banks' funding costs. The alternative, if the withdrawal of deposits is large enough and the new funding too onerous, would be to reduce their new lending.

In the latter case, monetary policy is effectively transmitted to the loan supply via changes in the quantity of deposits for two reasons. First, the jump in funding rates would force banks to raise their lending rates and thus augment the likelihood of adverse selection. Second, the widening gap from "cheap" sight deposits to "expensive" alternative sources in the funding of loans could prove so large that granting new loans is no longer profitable. In terms of identification this appears particularly relevant in our setting; as the ECB started raising reference rates the cost of deposit funding by banks increased only modestly—by around 50 bps—, while that of bank bonds rose by eight times as much, by 400 basis points in 2023Q1

(see Figure 6).[10][11] Despite the moderate increase in deposit rates, a bank augmenting its deposits' remuneration by 50 bps would suffer from an increase of 80% of its overall funding costs. This is due to the fact that banks can't raise rates only on marginal deposits, as they would do if they funded on markets, but they have to do it for a large part of their funding base, as they can't really identify depositors most likely to leave. The evidence shows that banks with more deposit outflows (i.e. flighty deposits) passed the rise in the short-term interest rate to their depositors to a far lower extent compared to other banks. This is shown by the average beta for rates on deposits for these banks which is around 7.5% compared to 13% for other banks (see Figure 7).

The second channel connects changes in banks' duration gap to their loan supply. Banks manage their assets and liabilities so as to broadly insulate themselves from interest rate risks. Even though their contractual nature is short term, especially with low interest rates sight deposits are, in practice, a stable source of funding for banks. The increase in rates would make sight deposits' expected duration suddenly shorter. Hence to contain their duration risk banks would be forced to either issue expensive long-term debt, or to reduce their loan supply. This reduction would be expected to be more pronounced for longer-term loans.

Our identification relies on within-firm comparisons across banks to dissect the effect connected to banks that experienced more deposits outflows keeping other factors constant. In the spirit of Khwaja and Mian (2008) we exploit multiple bank-firm relationships and employ borrower and time fixed effects regressions as they allow us to effectively disentangle credit supply from demand shocks.

$$\begin{aligned} Y_{b,j,t} = \alpha DEP_OUTFLOW_{b,t} + \beta DEP_OUTFLOW_{b,t} \times MP_Tightening + \\ \Psi \Sigma X_{b,t-1} + \eta_{j,t} + \rho_b + \epsilon_{b,j,t} \end{aligned} \tag{1}$$

Where b, j and t indicate bank, firm and time, respectively. Y represents credit growth

[10] The approximately 3.5% spread difference between these two alternative funding sources is mostly driven by sight deposits whose pricing appears quite sticky and is the main source of deposit funding for banks.

[11] The weights for the cost of deposits are the deposit volumes for sight, term and redeemable at notice deposits, whilst the weights for the cost of bonds issuance are the amounts issued.

(i.e. difference in the logarithm of the amounts outstanding by bank b to debtor j), or the interest rate charged by bank b to debtor j. $DEP_OUTFLOW$ is a dummy variable that takes the value one for banks experiencing persistent deposit outflows since the start of the monetary policy tightening (2022Q3), and 0 otherwise.[12] MP_Tightening is a dummy that takes the value one from 2022Q3, and 0 otherwise. β is our main coefficient of interest as it captures whether banks' experiencing deposit outflows during the monetary policy tightening cycle curtail lending (or increase lending rates) more aggressively to the same borrowers relative to the other banks.

Arguably, Equation 1 presents several additional empirical challenges. First, the demand for credit during interest rate increases might be heterogeneous across firms. The use of borrower-time fixed effects absorbs time-varying heterogeneity across firms so that η is effectively identified by comparing how loan supply responds post tightening for two banks with different deposit outflows *lending to the same firm*. The demand for loans could be differential also across products and maturities. Suppose for example that the bank experiencing more deposit outflows offers a variable rate short-term loan and the banks experiencing lower deposit outflows offers a fixed rate long-term loan. The same firm might prefer to borrow more fixed rate long-term if it expects rates to increase further. Hence, the differential higher equilibrium lending for control banks relative to treated banks to the same firm is coming from a product- and maturity-specific demand by the (same) firm.[13] To address this concern we further saturate our model with borrower $\times$ time $\times$ product type (or maturity buckets) fixed effects, therefore comparing loan supply by at least two banks with heterogeneous deposit outflow post monetary policy tightening lending with the same interest rate type (or within the same maturity bucket) to the same firm.[14] In alternative specifications, we also include bank-fixed effects to account for bank unobservable characteristics potentially correlated to deposit inflows/outflows which can affect lending patterns, consider local market deposit developments with a set of dummies and introduce banks headquarter country-time

[12] As a robustness check for the main results we consider as control group only those banks that experienced a constant inflows of deposits. The results do not change.

[13] With the caveat that the product type might also endogenously change in response to the shock.

[14] The maturity buckets are based on quartiles of the original loan maturity distribution.

fixed effects to control for the heterogeneous effect of monetary policy tightening across euro area countries.

Second, bank characteristics may be correlated with the outflow of deposits affecting our coefficient of interest. For instance, weakly capitalized banks may face greater deposit outflows resulting in lower lending supply. We take into account these confounding factors with an X vector of lagged bank-level controls that includes bank size (i.e. logarithm of total assets, TA), and relevant balance sheet and prudential ratios to account for (i) Deposits (Deposits to total assets, DEP/TA); (ii) Credit risk (Nonperforming to total loans, NPLs); (iii) Profitability (Return on assets, ROA); (iv) Liquidity (Cash and cash at the central bank to total assets, CASH/TA); (v) Capital (Core capital to risk-weighted assets, CET1), and (vi) Total loans to assets ratio (LOAN/TA).[15]

Third, we plot deposit flows before and after the tightening for the two groups of banks (Fig. 8). From visual inspection it is rather clear that there was no significant difference between them before, whule they diverge markedly after. We take this as evidence that the two groups of banks had no discernible difference with respect to the key variable prior to the unexpected monetary policy shock.

Fourth, we also create a matched sample of banks with very similar characteristics prior to the tightening so that characteristics of treated and control groups are balanced. Fifth, we also make use of instrumental variables for our treatment variable to account for lingering confounding factors. Standard errors are two-way clustered at the bank and firm level.

4 Results

4.1 Intensive and extensive margins and the unexpected outflowws

Our results are striking and underline bank deposits as a key element modulating the transmission of monetary policy when it matters the most: when interest rates surge steeply and

[15]In a robustness check, we follow Gomez et al. (2021) and interact the bank-specific characteristics with the we the monetary policy tightening dummy, therefore allowing these control variables to have a heterogeneous effect on lending following the start of the monetary policy tightening.

unexpectedly. Following equation 1, the use of borrower-time fixed effects enables the estimation on firms borrowing from *at least* one bank experiencing deposit outflows, and *at least* another institution. This ensures that we capture the effects on the credit supply of banks undergoing deposit outflows, compared to other banks on the same borrower.

We find that during the period of intense monetary tightening deposit outflows had a substantial impact on the credit supply and thus on the transmission of monetary policy across banks. Banks that experienced a persistent reduction in deposits decreased the supply of credit *to the same borrower* by around 1.9 percentage points more compared to other institutions (see Column 1 in Table 2). The results are consistent when accounting for both unobserved bank characteristics with bank fixed effects (Column 2), for (changing) country economic conditions with country-time fixed effects (Column 3), for maturity buckets and interest rate type fixed effects (Columns 4 and 5) and their interaction with borrower $\times$ fixed effects (Columns 6 and 7). These results underlie the tenet of the bank deposit channel during the crucial period of sharply tightening interest rates (Drechsler et al., 2018b).

By focusing on banks that use internal models to predict liquidity needs, we leverage on supervisory data on their expectations for future deposit outflows. For each quarter, we compare these expected outflows to actual (realized) outflows. When actual outflows exceed expected ones, we identify such instances as unexpected outflows of deposits. To assess the impact of these unexpected outflows on lending, we interact the difference between expected and realized outflows with dummy variables for banks experiencing significant outflows and for quarters marked by monetary policy tightening. The regression results in Table **??** reveal that unexpected outflows have a significant, additional adverse effect on lending: when deposit outflows were greater than anticipated, lending contracted by an extra 0.1 percentage points. This suggests that unanticipated liquidity strains amplify the reduction in lending, particularly in a tightened monetary policy environment.

An important question is whether the outflow of deposits shapes the access of *new* borrowers to credit; what we call the extensive margin. By new borrowers, we refer to firms receiving credit from a *new* bank.[16] We answer this question in Table 3 where the depen-

[16]Note that another form to calculate the extensive margin can be constructed based on the termination of

dent variable is whether borrowers establish a new bank relationship. It suggests that banks suffering from deposit outflows are about 2 percentage points less likely to establish a relationship to new borrowers relative to the other banks (Column 1). This result is robust even after accounting for factors such as the bank size, solvency, or liquidity. Again, the results remain when including unobservable bank attributes (i.e bank fixed effects), when allowing for (changing) conditions at the country level or when further saturating the econometric specification with interest rate type and maturity buckets with effects.

4.2 Lending rates

The "pass-through" from monetary policy to lending rates is, besides volumes of credit, another major dimension of the transmission of monetary policy. We explore this, again following Equation 1, on the same sample used for our core estimation. We test whether banks consistently experiencing deposit outflows charge different lending rates to the same borrower, relative to the other banks. The results on lending rates are in stark contrast with those of quantities. We find that as monetary policy rates surge, banks experiencing deposit outflows do *not* charge higher rates, compared to other banks (see Table 4, Columns 1-6). The only exception is Column 7 where the interaction $DEP_OUTFLOW \times MPTightening$ is posititve statistically significant at the 5% level but economically negligible.

These *no* results appear quite striking: we would have expected an adjustment on the tightening via lending rates and not only via quantities of credit, so in Table A.2 in the Appendix we also show the results for the same equation with a sample of matched banks. This matching tests if sample composition drives our results and aims at improving the comparability of treated and untreated banks. It was done by implementing the within (borrower $\times$ time) estimators for each borrower restricting the sample only to the bank(s) with similar characteristics to those suffering the deposit outflow before the treatment period.[17] The re-

existing lending relationships as in Khwaja and Mian (2008). In our setting we chose not to use terminations of credit relationships to construct our extensive margin indicator. The reason is that descriptive statistics suggest that estimations would be more affected by the lingering maturity of existing lending relationships in our sample.

[17]Section 4.7 (Robustness) provides further information on how the matched sample is constructed.

sults confirm that changes in rates to the same borrower are statistically insignificant when comparing banks with deposit outflows and similar banks in the matched sample, also when the models are saturated with several combination of fixed effects. This confirms the mechanism; during the monetary policy tightening period, banks experiencing deposit outflows toughened their credit standards (vis-à-vis other banks) via restricting quantities rather than by increasing the price of lending.

4.3 Loan maturity

We now analyse the mechanisms behind the findings above. One mechanism consistent with the tightening via quantities hinges on the stability of banks' deposits. The gushing out of deposits for some banks would increase the risks of granting new loans. Deposits, which are the main source of loan funding, would be perceived as more uncertain and volatile. This would affect the funding of existing but also of potential borrowers.

Deposits are considered a highly stable or "sticky" source of funding. In a situation of low-for-long interest rates the perceived stability of deposits would be high as the opportunity cost of holding deposits is small. Yet the increase in interest rates makes banks vulnerable to withdrawals of depositors in search of more lucrative investments. In this situation banks would aim to contain their funding risk and be reluctant to grant additional loans as they are hard to redeem for liquidity, particularly at short notice. The withdrawal of deposits would also expand banks' interest rate repricing mismatch. As short-term interest rates increase and new funding is needed, banks' liabilities would reprice faster than their assets, and more so for banks with a wider mismatch.

If this is the case, borrowers would be exposed to the duration risk of their lender. One way for banks to decrease this mismatch would be to shorten the maturity of new loans. If the deposit shock truly forces banks to suddenly shrink their interest rate risk exposure, one would expect a shortening in the maturity of loans. This is what we see in Table 5. As indicated by the interaction between deposit outflow and the dummy indicating the monetary policy tightening period, Columns (6) to (10) show that banks experiencing deposit outflows

are less likely to grant longer term loans (above 2 years) compared to other banks, whilst the result is negative but not statistically significant for shorter term loans (below 2 years).

4.4 Duration gap

Up to this point we focused on how deposit outflows alter lending conditions. Yet *if* the interest rate risk mechanism is at play the liability side of banks should also matter. Specifically, the difference in duration between banks' assets and liabilities would be expected to affect banks' lending. In this section we dig deeper to assess how the increase in interest rates impacts lending in relation to their *existing* interest rate risk at the time of the tightening. Thus for each bank we calculate their duration gap defined as the difference between the duration of each banks' assets and liabilities before the monetary tightened started (see BSBS, 2004; BCBS, 2006). Crucially, this measure of duration gap provides an indication of banks' interest rate risk exposure taking into account the use of derivatives for interest rate risk hedging purposes.[18] Data about banks' duration gap is calculated for supervisory purposes and contains granular confidential cash flow data divided by 14 maturity buckets for all on and off-balance sheet assets and liabilities. Appendix B explains the construction of the duration gap variable in further detail. As flagged in Table 6 we set the duration gap at the second quarter of 2021 (before the hiking cycle) to avoid endogeneity concerns and test whether a greater duration gap drives the supply of credit at the borrower level.

The findings on Table 6 are telling. First, banks experiencing deposit outflows contract lending (to the same borrower) *even* when their initial duration mismatch (i.e. gap) is equal to zero. Indeed, the coefficient of the double interaction term *DEP_OUTFLOW x Tightening* is negative and statistically significant across specifications. It points toa relative lending reduction of about 4 pp for banks experiencing deposit outflows in an hiking cycle. This suggest that even banks with lower interest rate risk would restrict their credit due to concerns about the instability of their "cheap" overnight deposits.

Second, the rationing effect of deposit outflows on access to credit is amplified for banks

[18]There is evidence from the United States suggesting that a significant percentage of banks entered the tightening cycle with significant (unhedged) interest rate exposure McPhail et al. (2023).

(entering the hiking cycle) with wider duration gaps: a 1 percent higher duration gap results in an additional contraction of credit of around 4 pp to the same borrower (see columns 1-3 of Table 6 and triple interaction term *DEP_OUTFLOW x Tightening x Duration Gap*). Considering a median duration gap of about 8 percent, this suggests that banks' starting positions of their interest rate risk are highly relevant in the transmission of monetary policy to their borrowers as interest rates surge (see, for instance, Coulier et al. (2024)). In other words, firms entering the tightening cycle mostly connected to lenders with higher duration gaps were significantly less likely to obtain credit as the tightening started. This likelihood becomes even lower for banks experiencing deposit outflows.[19]

4.5 Firm-level Analysis

Our analysis thus far indicates that banks experiencing persistent deposit outflows since the onset of the monetary policy tightening curtail lending more relative to other banks. In this section, we investigate whether these lending contractions had any real implications for firms' ability to access funds. In principle, firms exposed to banks experiencing deposit outflows may resort to other banks for funding. If this is the case, there will be no effect on total credit supply but simply a redistribution of market share from banks experiencing deposit outflows to other banks. In a fast rising interest rate environment, however, banks with more stable deposits might be unwilling to pick up the slack, leaving firms with lower overall credit. To assess whether borrowers with outstanding credit relations with banks experiencing a deposit outflow saw an overall reduction in available credit, we collapse the dataset at the firm-level and use the following econometric specification:

$$\begin{aligned} \Delta Log(borrowing)_{j,t} = \alpha Exposed_j + \beta Exposed_j \times MP\ Tightening + \\ \Psi X_{b,t-1} + \eta_{ils,t} + \rho_j + \epsilon_{b,j,t} \end{aligned} \tag{2}$$

where $\Delta Log(borrowing)_{j,t}$ is the change in overall borrowing of firm j at quarter t.

[19]The sample size is different compared to the baseline regressions as duration gap is available only for a subset of banks.

Exposed is a dummy variable that equals 1 for firms whose borrowing prior to the monetary policy tightening (second quarter of 2021) is 50% or more coming from banks experiencing deposit outflows, and 0 otherwise. In equation 2 β is our coefficient of interest. A negative coefficient implies lack of credit substitution, that is firms mainly borrowing from treated banks exhibit a reduction in aggregate borrowing during the interest rate hiking period. The vector $X_{b,t-1}$ represents weighted averages of bank control variables, where the weights are the proportion of each bank's loans to the firm relative to the firm's total loans. η refers to ILS $\times$ quarter fixed effects that are introduced to control for differences in credit demand across firms, whilst ρ is a firm fixed effects that accounts for time-invariant unobservable firm-specific characteristics.[20] Standard errors in the firm-level regressions are clustered by firms' largest lender (Behn et al., 2016).

Table 7 presents the estimates from equation 2. The interaction term *Exposed* $\times$ *MP Tightening* is negative and statistically significant, even after including firm fixed-effects (column 2). Specifically, we find that firms exposed to banks experiencing deposit outflows faced an overall reduction in available credit of about 3.1 to 4.6 percentage points more than less exposed firms. This result indicates that exposed firms were unable to replace loans from affected banks with new loans, potentially influencing their investment decisions. Thus, monetary policy impacted firms by transmitting through deposits to loans, ultimately reducing loan supply for final borrowers.

5 Robustness

5.1 Credit risk

The third crucial component of the loan supply, besides quantities and prices, would be the composition of credit. More specifically, whether as monetary policy changes deposit

[20] We acknowledge limitations due to the omission of time-varying firm-specific characteristics in the econometric specification as the latter are not available in AnaCredit. Information about firms would require a merge between publicly available databases and AnaCredit that would expose the analysis to a frequency issue considering that AnaCredit is quarterly while the majority of firm-specific characteristics are available on a yearly frequency.

outflows would alter the risk profile of banks' new borrowers. The latter could be a possible confounding factor with respect to the two previous dimensions which focus more narrowly on interest rate and lending quantities rather than on credit risk. To investigate this dimension, we interact our double interaction of interest *DEP_OUTFLOW x Tightening* with a bank-firm level risk-adjusted return variable computed as the ratio between interest rate and probability of default (*risk-adjusted returns).* This ratio provides an indication of how much interest income the lender expects to earn per unit of risk in default. A higher ratio indicates that the lender receives more compensation compared to the risk, while a lower ratio may imply lower compensation for the level of risk involved.

Table 8 shows that the composition of credit risk is not significantly different for banks suffering deposit outflows compared to other banks during the tightening period. The triple interaction of tightening monetary policy (*MP Tightening*), deposit outflows (*Treated*) and our proxy for credit risk (*risk-adjusted returns*) does not show a large or significant coefficient (see columns 1 to 7). Banks don't seem to lend more or lend less to riskier firms when they ration credit after an outflow of deposits. This would again support the hypothesis that the predominant channel on banks' restriction of credit would be their efforts to reduce their interest rate risk exposures as their funding becomes more uncertain, expensive and unstable.

5.2 Propensity score matching

It can be argued that banks suffering deposit outflows are inherently different from other banks and that these differences in turn have a knock-on effect on lending. Thus to control for the possibility that this type of lingering endogeneity drives our results we complement the specification in equation 1 by using Propensity Score Matching (PSM) (Rosenbaum and Rubin, 1983). By pairing each bank experiencing deposit outflows with a control (bank) unit, we are able to compare banks with the closest attributes (i.e. as similar as possible during the pre-tightening period), thus mitigating the concern that changes in deposit outflows are driven by bank-specific characteristics.[21]

[21]The PSM applied a logit model and one-to-one nearest neighbour with replacement, imposing a tolerance level of up to to 0.03 on the maximum propensity score distance (caliper) between the control and the

Table 10 shows the differences in characteristics for both groups of banks: those experiencing deposit outflows (i.e. treated) and the control group. Panel A indicates that prior to the matching the characteristics of banks in treated and control groups exhibit some minor differences. In contrast, Panel B vouches for the comparability of both groups in terms of banks' key characteristics. With this matching only *similar* banks that also lend to the the *same* borrower are included (see Table 11), and as a result the sample of banks and borrowers declines signifcantly.[22] Compared with our results using the unmatched sample, the new matched results are consistent and illustrate even more vividly how banks suffering from deposit outflows curtail lending even more aggressively than banks that are very similar ex-ante (before the tightening). Figure A.4 vouches for the existence of parallel trends for treated and control group of banks prior to the tightening episode.

5.3 Instrumental variables

Our second approach that also tests whether endogeneity drives our results, introducing biased estimates, is to employ an instrumental variable estimation. As our initial instrument we resort to calculating a "deposit beta" for each individual bank we follow (Drechsler et al., 2018b), and measure the changes of a bank's deposit costs relative to changes in the monetary policy rate.[23] The deposit beta is a measure of market power at the individual bank level that influences deposit outflows. In a first stage, we examine the relationship between our treated variable (deposit outflows) and the overnight deposit beta during the second quarter of 2021, which predates the monetary policy tightening under investigation. The overnight deposit beta is calculated as the ratio of total weighted overnight deposit rates over the short-term (i.e. Euribor) interest rate calculated in the period before our sample estimations. It is important to note that the Euribor rate was in negative territory during part of this period

treatment group.

[22]Figure A.3 in the Appendix shows (from left to right) how after the sample is balanced due to the matching—effectively moving from Panel A to Panel B on Table 10— there is an improvement in the comparability of banks included as treated and control.

[23]To implement this we use a confidential dataset constructed for monetary policy purposes (the so called IMIR dataset) that contains historical information of the average costs of all types of deposits (stocks and flows) for each time period for each bank and matched to our main dataset

thus amplifying the deposit beta for banks with negative overnight deposit rates.[24] Then we regress the treatment variable against not only the overnight deposit beta but also an array of bank-specific characteristics.[25] Based on the first stage results there is a meaningful relationship between deposit beta and deposit outflows. This means that banks characterized by lower deposit beta values in 2021Q2 are at a higher risk of suffering deposit outflows after the monetary policy tightening. In the second stage, we use the predicted deposit outflows of the first stage interacted with the monetary policy tightening dummy variable. The results, in Table 12, confirm earlier findings on the relevance of deposit outflows on lending. A potential concern regarding our identification strategy is that banks with greater market power might have selected a different composition of assets and liabilities during the prolonged period of low interest rates. Consequently, these banks could have been more vulnerable to deposit shocks when monetary policy began to tighten. To address this issue, we conducted the same estimation using a sample of banks matched through Propensity Score Matching (PSM) that also takes into consideration the structure of banks balance sheet. The results from this matched sample are consistent with those obtained from the full sample, indicating robustness of our findings.

We also check our results with a second instrumental variable. To address potential reverse causation concerns—whereby banks with less profitable lending opportunities might also be less motivated to attract or retain deposits—we use an exogenous shock to banks' funding as an instrumental variable. Specifically, we utilize the unexpected and significant change in the supply of liquidity from the European Central Bank, prior to monetary tightening and clearly unrelated to it, to assess the impact of exogenous funding changes on banks' behavior. The allocation rule for the last wave of Targeted Long-Term Refinancing Operations (TLTRO III) by the European Central Bank changed unexpectedly in June 2019 as banks' borrowing allowance increased markedly compared to previous TLTRO iterations. The revised TLTRO III rule allowed banks to borrow up to 50% of their eligible loans to non-financial corporations and households, excluding mortgages, with a maturity of 3 years—a substantial increase

[24]Deposit beta is a useful instrument as it is significantly correlated with deposit outflows and satisfies the exclusion restriction.

[25]The controls include the banks' characteristics used in the baseline estimation.

from the 7% cap in earlier TLTROs. This policy shift, aimed at bolstering bank liquidity and funding, is particularly suited as an instrumental variable due to its exogenous nature, being driven by policy rather than individual bank characteristics or performance. The new round of TLTRO was more attractive for banks facing more competition or a more elastic supply of deposits from the non-financial private sector, as it provided a readily available source of stable funding. Following this reasoning the participation in the TLTRO III is a good instrument for deposit outflows. Furthermore, in order to control for possible selection into treatment related to the participation in the TLTROs being voluntary, we use as an instrument not the actual drawn amount of TLTRO III but the initial borrowing allowance (see Benetton and Fantino, 2021 and Andreeva and García-Posada, 2021).

This instrument's exogeneity is further supported by its uniform application across banks, based on predetermined criteria unrelated to banks' current or anticipated lending opportunities. By utilizing this positive external funding shock, we can more reliably isolate the effect of deposit outflows on lending behavior, circumventing endogeneity issues. This instrument also addresses issues of simultaneity between deposit outflows and lending, as it is calculated well before the monetary policy change of stance. The results of the first stage regression, detailed in Table 13, validate the borrowing limit's instrumental relevance, showing that the TLTRO III allocation rule change significantly predicts deposit outflows during the policy tightening phase. The results of the second stage regression confirm the pivotal role of deposit outflows in the transmission of monetary policy tightening, aligning with our baseline findings and reinforcing the notion that deposit dynamics are a critical driver of lending adjustments. This approach not only mitigates potential reverse causation issues but also enriches our understanding of the interplay between central bank policy measures and commercial bank funding strategies. By confirming the instrumental variable's validity through rigorous statistical testing, including a robust first-stage regression, we confirm the reliability of our findings. This analysis contributes to the broader literature on monetary policy's effectiveness and the mechanisms through which central bank initiatives influence bank lending practices, highlighting the nuanced impact of non-conventional monetary interventions on

the banking sector's operational dynamics.[26]

6 Conclusions

We study how banks transmit increases in interest rates to the loan supply. We use the largest (unexpected) rise in interest rates since the creation of the euro to understand the impact on lending, starting from the effects of a large drop in sight deposits. We build on a comprehensive credit register which includes all bank-firm lending relationships (above 25.000 euro) in the majority of euro area countries, which we match with bank-level information on banks' deposit funding and financial conditions. We find that banks experiencing persistent deposits outflows restrict directly credit to certain borrowers, rather than adjust rates and let markets clear. Our findings seem to be driven by exposure to interest rate risk as the effect is larger for banks with a larger duration gap, and credit is less available for new borrowers, and for loans with fixed rates or longer maturities. Our results indicate that during periods of increasing rates, bank's assets and liabilities management could be crucial for the transmission of monetary policy. Banks try to preserve their duration gap, which reflects the value of their deposit franchise, by rationing credit rather than by transmitting the increase in policy rates to borrowers and by targeting longer duration loans. Rationed firms don't manage to compensate the drop in borrowing by obtaining credit from other banks.

[26]We conduct a battery of further robustness checks to corroborate the validity of our findings. First, in Table A.3 we consider as control group only those banks that experienced a constant inflow of deposits since the onset of the monetary policy tightening. Despite the significant drop in the number of observations, the coefficient of the double interaction $DEP_OUTFLOW \times MP\ Tightening$ keeps sign and statistical significance in line with the baseline results. As expected, the magnitude of the coefficient is also larger as we removed banks that during the hiking cycle experienced both inflows and outflows of deposits. Second, in Table A.4 we remove from the treatment group banks that, during the monetary policy tightening period, had constant but low deposit outflows. In particular, we remove banks that are below the first quartile of the cumulative deposit outflows distribution post monetary policy tightening. Banks below the first quartile of the distribution lost, on average, 1.3 pp overnight deposits relative to total deposit outstanding during the monetary tightening period, whilst the decline for banks above the first quartile is about 5pp. Despite the reduction in the number of treated banks entering the estimation, the results are still statistically significant. The point estimates are also generally higher than the baseline in line with the removal of less affected banks.

References

Acharya, V., Chauhan, R., Rajan, R., and Steffen, S. (2023). Liquidity Dependence and the Waxing and Waning of Central Bank Balance Sheets. National Bureau of Economic Research Working Papers 31050, NBER.

Altavilla, C., Boucinha, M., Peydro, J.-L., and Smets, F. (2021). Banking supervision, monetary policy and risk-taking: Big data evidence from 15 credit registers. SSRN Electronic Journal.

Andreeva, D. C. and García-Posada, M. (2021). The impact of the ecb's targeted long-term refinancing operations on banks' lending policies: The role of competition. Journal of Banking Finance, 122:105992.

Barbiero, F., Schepens, G., and Sigaux, J.-D. (2022). Liquidation value and loan pricing. Working Paper Series 2645, European Central Bank.

BCBS (2006). International convergence of capital measurement and capital standards: a revised framework.

BCBS (2016). Interest rate risk in the banking book. BCBS, Basel Committee on Banking Supervision.

Begenau, J. and Stafford, E. (2022). Uniform rate setting and the deposit channel. Mimeo.

Behn, M., Haselmann, R., and Wachtel, P. (2016). Procyclical capital regulation and lending. Journal of Finance, 71(2):919–956.

Benetton, M. and Fantino, D. (2021). Targeted monetary policy and bank lending behavior. Journal of Financial Economics, 142(1):404–429.

BSBS (2004). Principles for the management and supervision of interest rate risk.

Coulier, L., Pancaro, C., and Reghezza, A. (2024). Are low interest rates firing back? interest rate risk in the banking book and bank lending in a rising interest rate environment. Technical report, European Central Bank Working Paper Series, No 2950.

Crawford, G. S., Pavanini, N., and Schivardi, F. (2018). Asymmetric information and imperfect competition in lending markets. American Economic Review, 108(7):1659–1701.

Diamond, D. and Rajan, R. (2001). Liquidity risk, liquidity creation, and financial fragility: A theory of banking. Journal of Political Economy, 109:287–327.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. The Review of Economic Studies, 51(3):393–414.

Diamond, D. W. and Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. Journal of Political Economy, 91.

Drechsler, I., Savov, A., and Schnabl, P. (2017). The Deposits Channel of Monetary Policy. The Quarterly Journal of Economics, 132(4):1819–1876.

Drechsler, I., Savov, A., and Schnabl, P. (2018a). Liquidity, risk premia, and the financial transmission of monetary policy. Annual Review of Financial Economics, 10(1):309–328.

Drechsler, I., Savov, A., and Schnabl, P. (2018b). Liquidity, risk premia, and the financial transmission of monetary policy. Annual Review of Financial Economics, 10:309–328.

Drechsler, I., Savov, A., and Schnabl, P. (2021). Banking on deposits: Maturity transformation without interest rate risk. The Journal of Finance, 76(3):1091–1143.

Focarelli, D. and Panetta, F. (2003). Are mergers beneficial to consumers? evidence from the market for bank deposits. American Economic Review, 93(4):1152–1172.

Gagliardone, L. and Gertler, M. (2023). Liquidity, risk premia, and the financial transmission of monetary policy. National Bureau of Economic Research Working Papers 31263, NBER.

Goldstein, I. and Pauzner, A. (2005). Demand–deposit contracts and the probability of bank runs. Journal of Finance, 60(3):1293–1327.

Gomez, M., Landier, A., Sraer, D., and Thesmar, D. (2021). Banks' exposure to interest rate risk and the transmission of monetary policy. Journal of Monetary Economics, 117.

Gorton, G. and Pennacchi, G. (1990). Financial intermediaries and liquidity creation. Journal of Finance, 45:49–71.

Hannan, T. and Berger, A. N. (1991). The rigidity of prices: Evidence from the banking industry. American Economic Review, 81:938–945.

Hoffmann, P., Langfield, S., Pierobon, F., and Vuillemey, G. (2019). Who Bears Interest Rate Risk? Review of Financial Studies, 32(8):2921–2954.

Jiang, E., Matvos, G., Piskorski, T., and Seru, A. (2023). Monetary tightening and U.S. bank fragility in 2023: Mark-to-market losses and uninsured depositor runs? . National Bureau of Economic Research Working Papers 31048, NBER.

Jiménez, G., Ongena, S., Peydró, J.-L., and Saurina, J. (2012). Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. American Economic Review, 102(5):2301–26.

Kashyap, A., Rajan, R., and Stein, J. (2002). Liquidity risk, liquidity creation, and financial fragility: A theory of banking. Journal of Finance, 57:33–73.

Kashyap, A. and Stein, J. (1995). The impact of monetary policy on bank balance sheets. Carnegie Rochester Conference Series on Public Policy, 42:151–195.

Khwaja, A. I. and Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. American Economic Review, 98.

Kishan, R. and Opiela, T. (2000). Bank size, bank capital, and the bank lending channel. Journal of Money, Credit, and Banking, 32:121–141.

Koont, N., Santos, T., and Zingales, L. (2023). Destabilizing digital" bank walks". Technical report, New Working Paper Series.

Macaulay, F. (1936). The movements of interest rates, bond yields and stock prices in the United States . National bureau of economic research working papers, NBER.

McPhail, L., Schnabl, P., and Tuckman, B. (2023). Do banks hedge using interest rate swaps? Working Paper 31166, National Bureau of Economic Research.

Neumark, D. and Sharpe, S. A. (1992). Market structure and the nature of price rigidity: Evidence from the market for consumer deposits. The Quarterly Journal of Economics, 107:657–680.

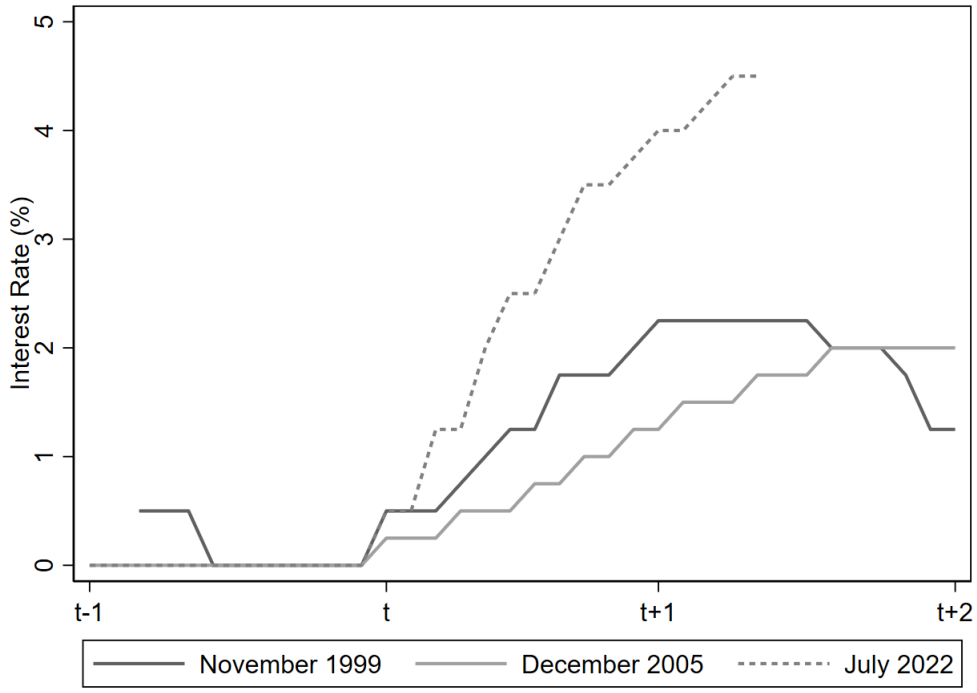
Peek, J. and Rosengren, E. (2000). Collateral damage: Effects of the japanese bank crisis on real activity in the united states. American Economic Review, 90:30–45.

Repullo, R. (2020). The deposits channel of monetary policy a critical review. CEMFI Working Paper, No. 2025.

Rosenbaum, P. R. and Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. Biometrika, 70:41–55.

Tella, S. D. and Kurlat, P. (2021). Why Are Banks Exposed to Monetary Policy? American Economic Journal: Macroeconomics, 13(4):295–340.

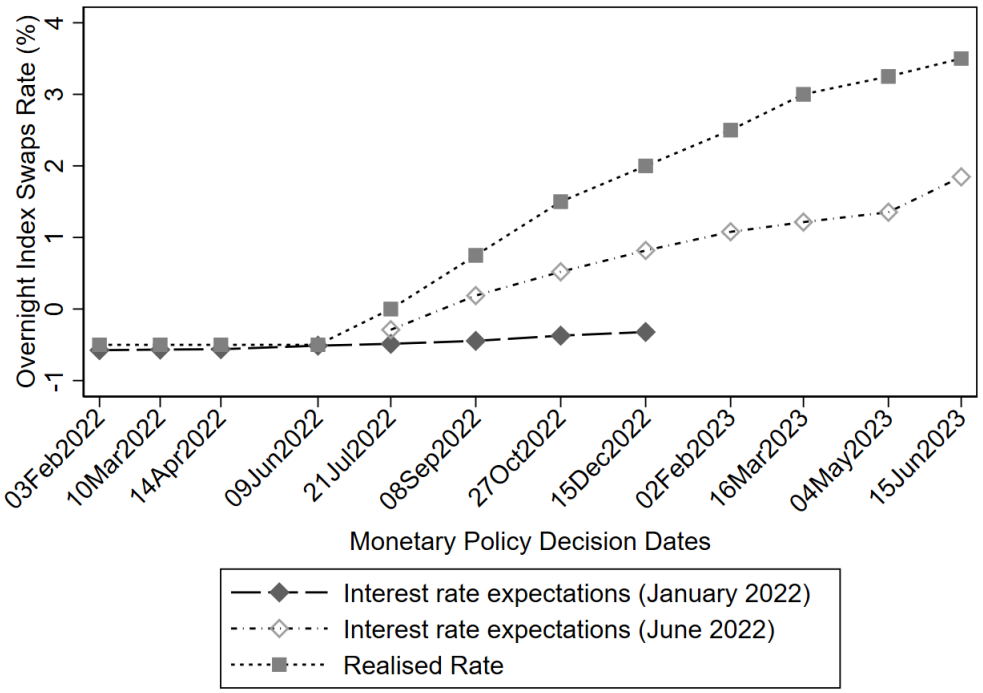
Figure 1: Tightening cycles: monetary policy in the Euro area
(annualized interest rate, monthly data)



Source: ECB.

Note: The chart includes all hiking cycles since the start of the Euro. Monthly data. t indicates the month of the first rise of the relevant policy rate (interest rate on the main refinancing operations (MRO) up to May 2014 and the deposit facility rate (DFR) thereafter). $t + 1$ indicates 12 months after the first rise of the policy rate.

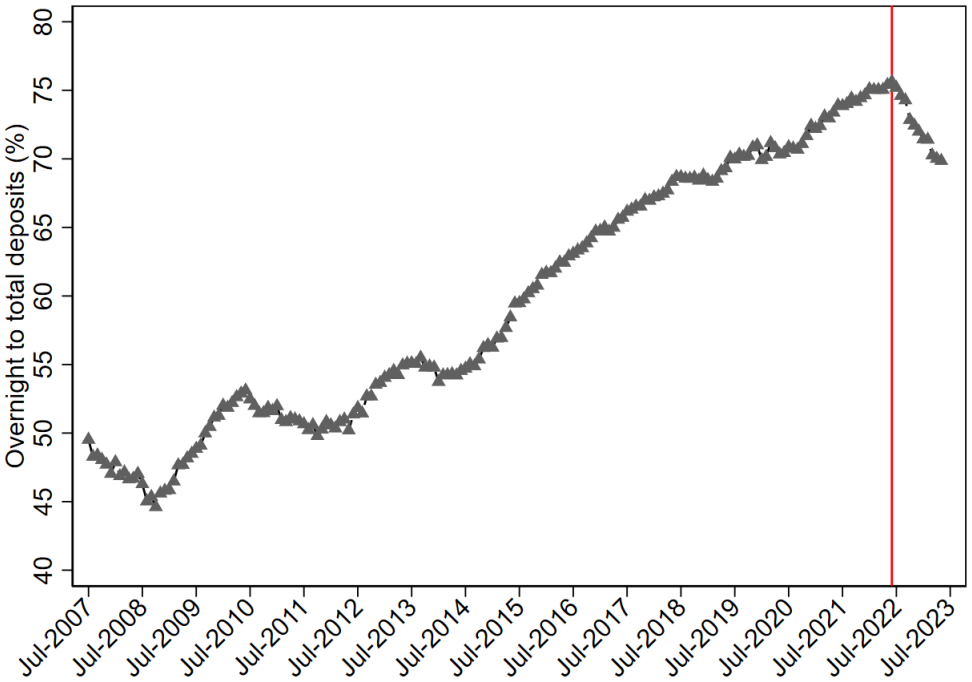
Figure 2: Expected and realized monetary policy rates
(annualized interest rates)



Source: ECB.

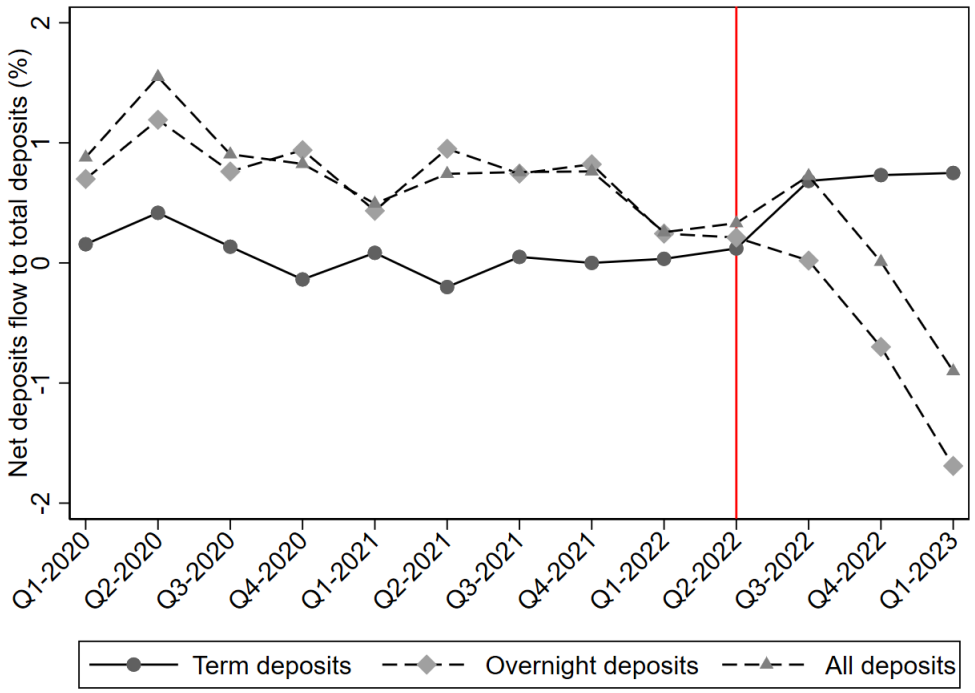
Note: Euro area monetary policy rate expectations are obtained from forward overnight indexed swap rate where the settlement is the date of the ECB's Governing Council monetary policy meeting. On the x-axis are the dates of the ECB's Governing Council monetary policy meetings.

Figure 3: Overnight over total deposits
(percentages)



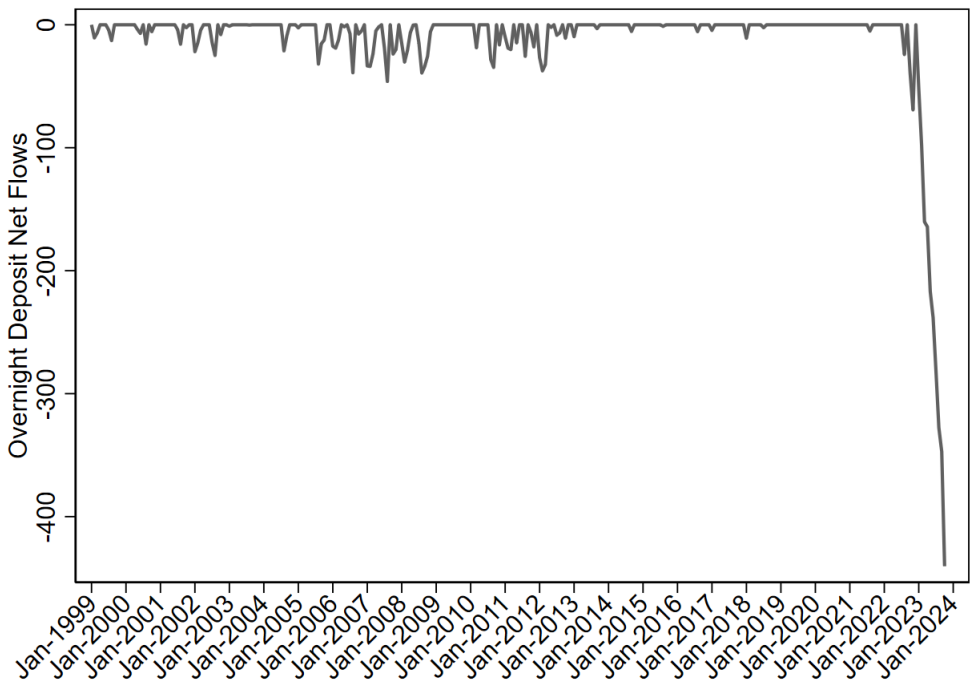
Source: ECB. **Note:** Monthly data on the amount of outstanding overnight over total deposits from end of July 2007 to end of March 2023 in percentages. Monthly data. The dashed vertical line indicates the start of the last ECB's hiking cycle.

Figure 4: Deposit net flow by type (overnight, term and total deposits)
(percentages)



Source: ECB. **Note:** Overnight (and term) flows of deposits are calculated as the difference between overnight (and term) deposits outstanding at time t and t-1 to lagged total deposits outstanding. Quarterly data ranging from the first quarter of 2020 to the first quarter 2023. Net flows of deposits is calculated as the difference between deposits outstanding at the end of quarter t and t-1 over the deposits outstanding at the end of quarter t-1. The vertical dashed line indicates the start of the monetary policy tightening.

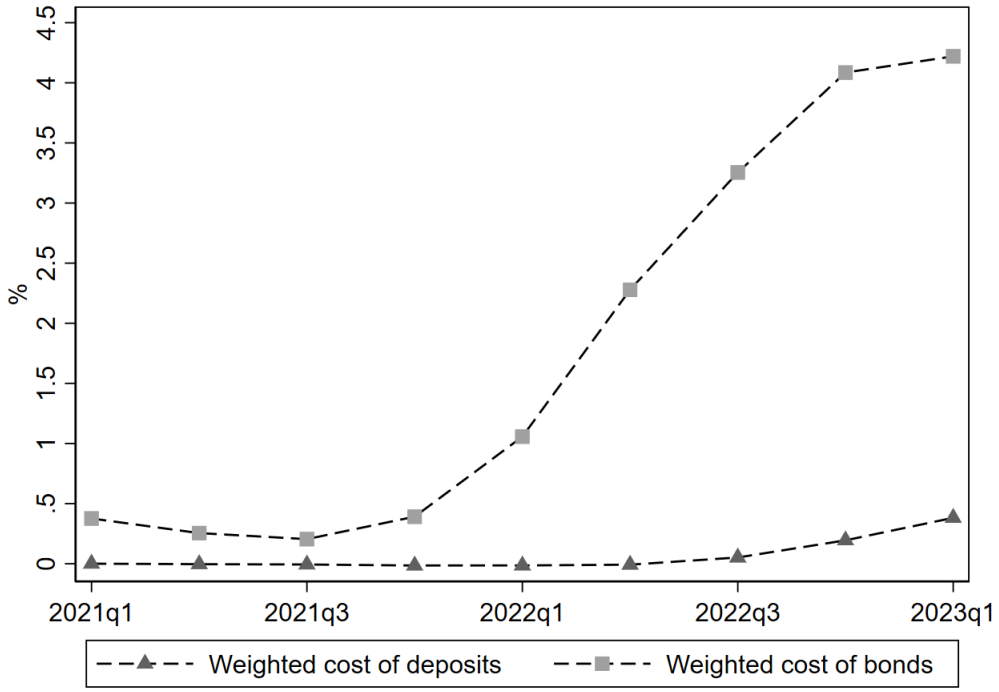
Figure 5: Net flow of overnight deposits and total deposits from their peak to through.
(billions of Euro; monthly data)



Source: ECB.

Note: Net flow of deposits from the its peak. The peak is calculated as the maximum value before the beginning of the outflow.

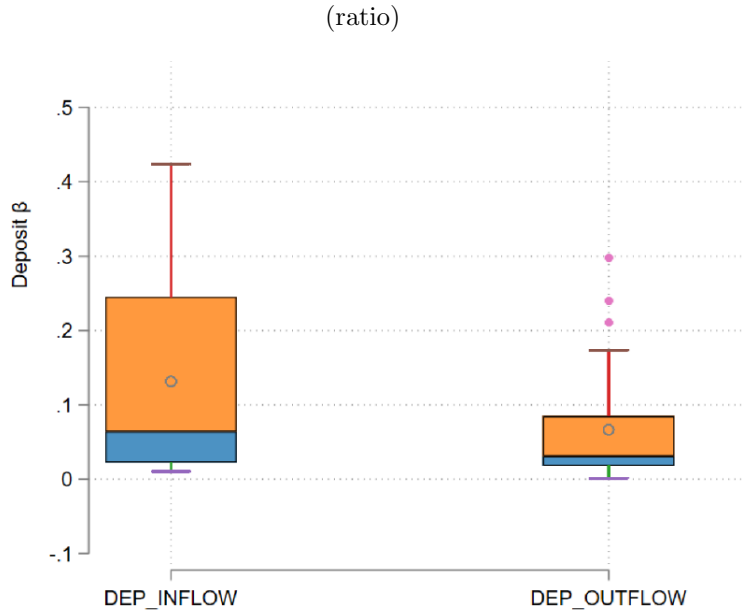
Figure 6: Cost of banks' funding: deposits and bonds
(percentages)



Source: ECB.

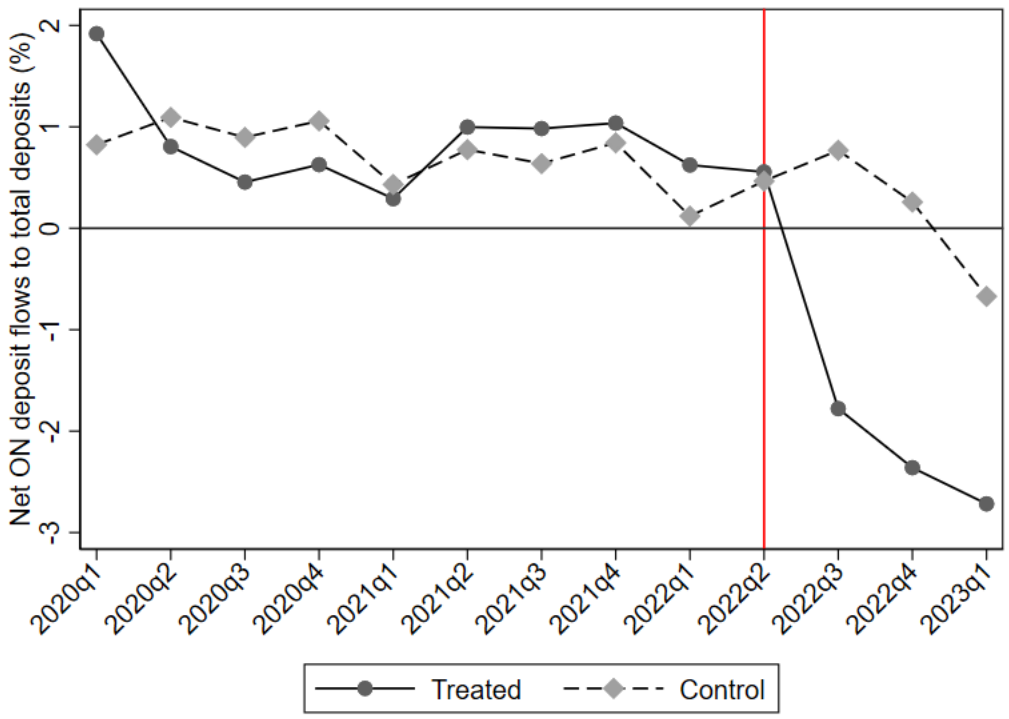
Note: Cost of deposit and bonds outstanding from the first quarter of 2021 to the first quarter of 2023. The weighted average cost is calculated based on the value of outstanding deposits (including overnight and term deposits). The weights for the cost of bonds issuance are the amount issued in each quarter.

Figure 7: Deposit betas: distribution for banks with net inflows/outflows



Note: Beta of banks calculated as the pass-through of interest rates from the monetary policy rates to the sight deposit rates during the tightening period (see paper identification). The sample of banks is divided into two groups, distinguishing between banks with net inflows and banks with continuous net outflows of sight deposits after July 2022. Each panel of the chart show the max, the 75th percentile the median, the 25th percentile and the minimum of the distribution. The circle represents the average of the distribution.

Figure 8: Average overnight deposit flow by treatment group
(percentages)



Source: ECB. **Note:** Overnight flows of deposits are calculated as the difference between overnight (and term) deposits outstanding at time t and t-1 to lagged total deposits outstanding. Quarterly data ranging from the first quarter of 2020 to the first quarter 2023. The vertical solid line indicates the start of the monetary policy tightening whilst the black horizontal line the zero.

Table 1: Summary statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
			Panel A				
Δ Log (loans)	11,529,195	-0.020	0.275	-1.001	-0.068	0	1.207
New relationships	28,521,157	0.045	0.208	0.000	0.000	0.000	1.000
Δ interest rate	11,529,195	0.029	0.021	0.002	0.015	0.038	0.119
			Panel B				
DEP_OUTFLOW	11,529,195	0.212	0.408	0.000	0.000	0.000	1.000
Fixed rate	11,529,195	0.720	0.448	0.000	0.000	1.000	1.000
Low_D2MDA	11,527,316	0.307	0.461	0.000	0.000	1.000	1.000
Duration gap	3,812,148	0.004	0.302	-0.623	-0.099	0.190	0.808
			Panel C				
L.CET1 ratio	11,529,195	0.152	0.040	0.099	0.125	0.164	0.318
L.DEP/TA	11,529,195	0.789	0.116	0.289	0.735	0.872	0.924
L.TA (log)	11,529,195	11.184	2.155	6.561	9.583	13.299	14.697
L.LOAN/TA	11,529,195	0.629	0.112	0.397	0.562	0.672	0.927
L.ROA	11,529,195	0.435	0.448	-0.906	0.187	0.617	1.941
L.NPLs ratio	11,529,195	3.625	2.223	0.472	2.150	4.447	13.688
L.CASH/TA	11,529,195	0.127	0.062	0.005	0.081	0.168	0.320

Note: The sample includes 1,620 banks and 746,315 firms. The period starts from the first quarter of 2021 till the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. New relationships refer to new bank-firm relationships and is a dummy variable taking the value 1 if in a given quarter a firm with an already existing bank relationship at t-1 establishes a new relationship with a different bank. Δ interest rate is the change in the bank-firm weighted average interest rate (weighted by the volume of different instruments). DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. Fixed rate is a dummy variable taking the value 1 for fixed rate loans, and 0 otherwise. Low D2MDA is a dummy variable taking the value 1 for those banks with a distance to the MDA below the first quartile of the distance to MDA distribution. Duration gap is the difference between the duration of assets and the duration of liabilities net of interest rate derivatives for interest rate risk hedging purposes scaled by total assets and calculated as of 2021Q2. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets ratio.

Table 2: Baseline results

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Original maturity FE is a categorical variable representing quartiles of original maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are two-way clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (loans)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0050						
	(0.004)						
DEP_OUTFLOW×MP Tightening	-0.0188**	-0.0167**	-0.0167**	-0.0163**	-0.0152*	-0.0146**	-0.0143**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)
L.CET1 ratio	-0.0719***	0.0013	-0.0003	-0.0014	0.0105	0.0624	0.0081
	(0.019)	(0.049)	(0.049)	(0.051)	(0.048)	(0.048)	(0.048)
L.DEP/TA	0.0343***	0.1119*	0.1132*	0.1352*	0.1119*	0.1159*	0.1473**
	(0.011)	(0.067)	(0.068)	(0.071)	(0.066)	(0.063)	(0.068)
L.TA (log)	0.0020***	0.0004	0.0010	0.0123	0.0051	0.0260**	0.0171
	(0.001)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)
L.LOAN/TA	-0.0179**	-0.0254	-0.0254	-0.0209	-0.0228	-0.0147	0.0099
	(0.008)	(0.040)	(0.040)	(0.042)	(0.039)	(0.039)	(0.039)
L.ROA	0.0049*	0.0132***	0.0132***	0.0140***	0.0144***	0.0126***	0.0147***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
L.NPLs ratio	0.0007	0.0018	0.0018	0.0020	0.0018	0.0021*	0.0026**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
L.CASH/TA	-0.0035	-0.0085	-0.0089	-0.0190	-0.0176	-0.0004	-0.0047
	(0.015)	(0.037)	(0.037)	(0.040)	(0.036)	(0.040)	(0.037)
Observations	11,529,195	11,529,182	11,529,182	10,212,195	11,529,182	5,670,385	7,285,725
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm×Time FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Time FE	No	No	Yes	No	No	No	No
Original maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time× Original maturity FE	No	No	No	No	No	Yes	No
Firm×Time× IR type FE	No	No	No	No	No	No	Yes

Table 3: Baseline results - Extensive margin

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm including new loans. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Original maturity FE is a categorical variable representing quartiles of original maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: New bank-firm relationships						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0146***						
	(0.004)						
DEP_OUTFLOW×MP Tightening	-0.0200***	-0.0137**	-0.0140**	-0.0166***	-0.0141**	-0.0164***	-0.0164***
	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)
L.CET1 ratio	-0.1630***	0.1509*	0.1446*	0.1604*	0.1491*	0.1890**	0.1410**
	(0.029)	(0.086)	(0.086)	(0.082)	(0.086)	(0.075)	(0.069)
L.DEP/TA	-0.0632***	-0.0986	-0.0885	-0.0060	-0.0959	-0.0159	-0.0284
	(0.014)	(0.076)	(0.071)	(0.059)	(0.076)	(0.052)	(0.057)
L.TA (log)	-0.0056***	0.0823***	0.0876***	0.1068***	0.0822***	0.1213***	0.0936***
	(0.001)	(0.024)	(0.022)	(0.020)	(0.024)	(0.020)	(0.019)
L.LOAN/TA	0.0216	0.1369**	0.1323**	0.1151*	0.1374**	0.1440**	0.1670***
	(0.015)	(0.067)	(0.066)	(0.069)	(0.067)	(0.069)	(0.065)
L.ROA	0.0140***	0.0025	0.0021	0.0023	0.0024	0.0010	0.0018
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
L.NPLs ratio	-0.0004	-0.0006	-0.0005	0.0005	-0.0007	0.0002	-0.0004
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
L.CASH/TA	0.0187	0.0281	0.0244	0.0050	0.0301	0.0202	0.0307
	(0.022)	(0.051)	(0.050)	(0.050)	(0.051)	(0.051)	(0.046)
Observations	14,183,615	14,183,609	14,183,609	12,352,415	14,183,609	6,880,912	8,981,679
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes	No	No
Country-Quarter FE	No	No	Yes	No	No	No	No
Original maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time× Original maturity FE	No	No	No	No	No	Yes	No
Firm×Time×IR type FE	No	No	No	No	No	No	Yes

Table 4: Interest rate pass-through

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ interest rate (loans) is the change in bank-firm lending rates. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Residual maturity FE is a categorical variable representing quartiles of residual maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ interest rate						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	-0.0000						
	(0.000)						
DEP_OUTFLOW×MP Tightening	0.0001	0.0002	0.0002	0.0003	0.0003	0.0002	0.0003**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.CET1 ratio	-0.0013	0.0039	0.0040	0.0038	0.0047*	0.0036	0.0051**
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
L.DEP/TA	0.0005	0.0017	0.0015	0.0010	0.0020	0.0008	0.0034**
	(0.000)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
L.TA (log)	-0.0000	0.0003	0.0003	-0.0003	0.0006	-0.0002	-0.0010*
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
L.LOAN/TA	-0.0010**	0.0011	0.0012	0.0023	0.0012	0.0019	-0.0000
	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
L.ROA	-0.0001	-0.0000	-0.0000	-0.0000	0.0001	-0.0001	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.NPLs ratio	-0.0001***	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.CASH/TA	-0.0005	0.0001	0.0001	0.0008	-0.0003	0.0007	-0.0006
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Observations	11,529,195	11,529,182	11,529,182	10,212,195	11,529,182	5,670,385	7,285,725
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm×Time FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Time FE	No	No	Yes	No	No	No	No
Residual maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time×Residual maturity FE	No	No	No	No	No	Yes	No
Firm×Time×-IR type FE	No	No	No	No	No	No	Yes

Table 5: Short vs long-term

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (loans)									
	Short-term <2Y					*Long-term > 2Y*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DEP_OUTFLOW	-0.0061					0.0056				
	(0.007)					(0.004)				
DEP_OUTFLOW × MP Tightening	-0.0173	-0.0111	-0.0106	-0.0078	-0.0108	-0.0182**	-0.0162**	-0.0161**	-0.0148*	-0.0142**
	(0.014)	(0.012)	(0.012)	(0.013)	(0.012)	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)
L.CET1 ratio	0.0792	0.8091***	0.8131***	0.8066***	1.1172***	-0.0810***	-0.0259	-0.0282	-0.0176	-0.0309
	(0.059)	(0.198)	(0.199)	(0.191)	(0.222)	(0.019)	(0.049)	(0.049)	(0.048)	(0.048)
L.DEP/TA	0.0597**	0.0990	0.0988	0.0784	0.1214	0.0352***	0.1023	0.1034	0.1026	0.1386*
	(0.026)	(0.131)	(0.132)	(0.136)	(0.138)	(0.011)	(0.067)	(0.067)	(0.066)	(0.071)
L.TA (log)	0.0082***	-0.0025	-0.0050	0.0241	0.0339	0.0018**	0.0047	0.0055	0.0088	0.0206*
	(0.002)	(0.038)	(0.038)	(0.038)	(0.046)	(0.001)	(0.011)	(0.011)	(0.012)	(0.012)
L.LOAN/TA	0.0184	0.0142	0.0122	0.0151	0.0421	-0.0203***	-0.0073	-0.0071	-0.0026	0.0282
	(0.016)	(0.103)	(0.104)	(0.106)	(0.117)	(0.008)	(0.038)	(0.038)	(0.037)	(0.037)
L.ROA	0.0121**	0.0302***	0.0305***	0.0289***	0.0294***	0.0045*	0.0113***	0.0113***	0.0124***	0.0130***
	(0.005)	(0.008)	(0.008)	(0.008)	(0.010)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
L.NPLs ratio	0.0041***	0.0026	0.0026	0.0026	0.0063*	0.0007	0.0015	0.0015	0.0015	0.0023*
	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
L.CASH/TA	0.0526	0.0770	0.0770	0.0427	0.0805	-0.0154	0.0038	0.0036	-0.0037	0.0047
	(0.033)	(0.092)	(0.093)	(0.093)	(0.114)	(0.015)	(0.036)	(0.036)	(0.036)	(0.037)
Observations	276,048	275,868	275,863	275,868	143,360	10,468,749	10,468,739	10,468,739	10,468,739	6,574,168
Bank FE	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Borrower×Time FE	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Country×Time FE	No	No	Yes	No	No	No	No	Yes	No	No
IR type FE	No	No	No	Yes	No	No	No	No	Yes	No
Firm×Time×IR type FE	No	No	No	No	Yes	No	No	No	No	Yes

Table 6: The role of duration gap

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.risk-adjusted return is the lag of the interest rate to probability of default ratio calculated as of 2021Q2. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Original maturity FE is a categorical variable representing quartiles of original maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (loans)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0193***						
	(0.003)						
DEP_OUTFLOW× MP Tightening	-0.0420***	-0.0437***	-0.0438***	-0.0438***	-0.0414***	-0.0423***	-0.0418***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
DEP_OUTFLOW×Tighening×Duration Gap	-0.0454***	-0.0359***	-0.0357***	-0.0350***	-0.0355***	-0.0260***	-0.0295***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
L.CET1 ratio	-0.1364**	-0.3781	-0.3793	-0.3892	-0.3213	-0.3397	-0.3744
	(0.058)	(0.283)	(0.285)	(0.299)	(0.264)	(0.305)	(0.339)
L.DEP/TA	0.0500**	-0.0511	-0.0521	-0.0670	-0.0134	-0.1899	0.0179
	(0.022)	(0.209)	(0.210)	(0.218)	(0.203)	(0.203)	(0.222)
L.TA (log)	0.0032	-0.0073	-0.0076	-0.0071	0.0083	0.0052	0.0100
	(0.002)	(0.032)	(0.032)	(0.034)	(0.031)	(0.032)	(0.034)
L.LOAN/TA	-0.0786*	0.0518	0.0522	0.0542	0.0459	0.1354	0.0208
	(0.040)	(0.117)	(0.118)	(0.124)	(0.121)	(0.120)	(0.137)
L.ROA	0.0147***	0.0144**	0.0145**	0.0155**	0.0164***	0.0129***	0.0228***
	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.006)
L.NPLs ratio	0.0055***	0.0123***	0.0124***	0.0127***	0.0118***	0.0160***	0.0120***
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
L.CASH/TA	0.0988*	0.1463	0.1472	0.1568	0.1042	0.2713	0.1509
	(0.055)	(0.172)	(0.173)	(0.182)	(0.169)	(0.185)	(0.194)
Observations	3,812,148	3,812,148	3,812,110	3,463,141	3,812,148	1,702,862	2,119,181
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm×Quarter FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Quarter FE	No	No	Yes	No	No	No	No
Original maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time×Original maturity FE	No	No	No	No	No	Yes	No
Firm×Time×IR type FE	No	No	No	No	No	No	Yes
Stand alone variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Double interactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Firm-level results

This table shows the results of the firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (borrowing) is the change in firm borrowing in logarithm. Exposed is a dummy variable equals 1 for firms whose borrowing prior to the monetary policy tightening (second quarter of 2021) is 50% or more coming from banks experiencing deposit outflows, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the weighted average of the lag of the common equity tier1 ratio. L.DEP/TA is the weighted average of the lag of the deposits-to-total asset ratio. L.TA.(log) is the weighted average of the lag of the logarithm of bank total assets. L.LOAN/TA is the weighted average of the lag of the credit exposures-to-total assets ratio. L.ROA is the weighted average of the lag of the return on assets. L.NPLs in the weighted average of the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the weighted average of the lag of the ratio of cash and cash held at the central bank-to-total assets ratio. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (borrowing)	
	(1)	(2)
Exposed	0.0491***	
	(0.008)	
Exposed*MP Tightening	-0.0313***	-0.0461***
	(0.004)	(0.007)
wL.CET1 ratio	-0.0975	0.1637
	(0.086)	(0.376)
wL.DEP/TA	-0.0537	0.0448
	(0.044)	(0.293)
wL.TA (log)	-0.0052*	0.0063
	(0.002)	(0.238)
wL.LOAN/TA	0.0280	0.2879
	(0.035)	(0.238)
wL.ROA	0.0122	-0.0015
	(0.010)	(0.022)
wL.NPLs ratio	0.0017	0.0091
	(0.002)	(0.008)
wL.CASH/TA	0.0123	0.1326
	(0.070)	(0.250)
Observations	3,597,980	3,516,884
Industry×Location×Size×Time FE	Yes	Yes
Firm FE	No	Yes

Table 8: Risk-adjusted returns

This table shows the results of the bank-firm panel regressions as in Equation 1. The quarterly data is from 2021Q1-2023Q1. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. L.risk-adjusted return is the lag of the interest rate to probability of default ratio calculated as of 2021Q2. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets ratio. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (loans)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0115**						
	(0.005)						
DEP_OUTFLOW×Tightening	-0.0248**	-0.0221**	-0.0221**	-0.0219**	-0.0207**	-0.0187**	-0.0188**
	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)	(0.009)
DEP_OUTFLOW×Tightening×L.risk-adjusted return	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.CET1 ratio	-0.0704**	-0.1124	-0.1127	-0.1757	-0.1013	-0.1173	-0.1035
	(0.027)	(0.132)	(0.132)	(0.136)	(0.125)	(0.148)	(0.149)
L.DEP/TA	0.0875***	-0.0747	-0.0744	-0.0750	-0.0635	-0.1013	0.0372
	(0.027)	(0.125)	(0.125)	(0.132)	(0.122)	(0.125)	(0.129)
L.TA (log)	0.0052***	0.0838***	0.0844***	0.0906***	0.0904***	0.0942***	0.1141***
	(0.002)	(0.027)	(0.027)	(0.028)	(0.027)	(0.025)	(0.030)
L.LOAN/TA	-0.0483**	0.1437**	0.1431**	0.1506**	0.1557**	0.1655**	0.1815**
	(0.021)	(0.072)	(0.072)	(0.073)	(0.074)	(0.078)	(0.083)
L.ROA	0.0096***	0.0068**	0.0068**	0.0079**	0.0094***	0.0092***	0.0110***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
L.NPLs ratio	0.0028***	0.0079*	0.0079*	0.0082*	0.0074*	0.0104**	0.0099**
	(0.001)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
L.CASH/TA	0.0020	0.1149	0.1144	0.1120	0.1089	0.1473	0.0992
	(0.025)	(0.078)	(0.078)	(0.084)	(0.078)	(0.091)	(0.096)
Observations	4,716,829	4,716,829	4,716,829	4,238,109	4,716,829	2,191,725	2,774,694
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Borrower×Time FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Time FE	No	No	Yes	No	No	No	No
Original maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time×Original maturity FE	No	No	No	No	No	Yes	No
Firm×Time×IR type FE	No	No	No	No	No	No	Yes
Stand alone variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Double interactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Expected$_{O}utflow$

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

VARIABLES	(1) delta_log_vw	(2) delta_log_vw	(3) delta_log_vw	(4) delta_log_vw
treated = 1	0.0128**			
	(0.005)			
1.treated#1.tightening	-0.0429***	-0.0434***	-0.0434***	-0.0428***
	(0.004)	(0.004)	(0.004)	(0.005)
1.treated#c.Delta_ShareUp_3M_STE_t1	0.0006**	0.0005	0.0005	0.0005
	(0.000)	(0.000)	(0.000)	(0.000)
1.tightening#c.Delta_ShareUp_3M_STE_t1	-0.0001	0.0001	0.0001	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
1.treated#1.tightening#c.Delta_ShareUp_3M_STE_t1	-0.0012***	-0.0017***	-0.0017***	-0.0018***
	(0.000)	(0.001)	(0.001)	(0.001)
cet1_r, Winsorized fraction .01 = L,	-0.0888	-0.2134	-0.2137	-0.2437
	(0.065)	(0.244)	(0.245)	(0.256)
dep_ta, Winsorized fraction .01 = L,	0.0722**	-0.0555	-0.0547	-0.0681
	(0.031)	(0.204)	(0.205)	(0.209)
log_ta, Winsorized fraction .01 = L,	0.0056**	-0.0015	-0.0014	0.0002
	(0.002)	(0.030)	(0.030)	(0.032)
loan_ta, Winsorized fraction .01 = L,	-0.0614*	0.0788	0.0780	0.0822
	(0.032)	(0.099)	(0.099)	(0.103)
is_roa, Winsorized fraction .01 = L,	0.0161***	0.0146**	0.0146**	0.0156***
	(0.004)	(0.006)	(0.006)	(0.006)
aq_nplr, Winsorized fraction .01 = L,	0.0042***	0.0094***	0.0095***	0.0098***
	(0.002)	(0.004)	(0.004)	(0.004)
cash_ta, Winsorized fraction .01 = L,	0.0651*	0.1092	0.1084	0.1143
	(0.033)	(0.154)	(0.155)	(0.161)
Constant	-0.1268*	-0.0293	-0.0298	-0.0412
	(0.069)	(0.490)	(0.494)	(0.517)
Observations	4,773,782	4,773,781	4,773,780	4,331,323
Bank Fe	No	Yes	Yes	Yes
Firm-Quarter Fe	Yes	Yes	Yes	Yes
Country-Quarter Fe	No	No	Yes	No
Maturity Fe	No	No	No	Yes
IR type	No	No	No	No
Firm-Quarter-Maturity Fe	No	No	No	No
Firm-Quarter-IR type Fe	No	No	No	No

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

Table 10: Differences in bank characteristics

This table shows bank-specific characteristics for banks with constant deposit outflows and banks with mixed inflows and outflows post-tightening. The table is divided in two panels. Panel A reports descriptive statistics for the unmatched sample of bank covariates employed in the bank-firm-level analysis, whilst Panel B reports descriptive statistics for the matched sample. The PSM applies a logit model and one-to-one nearest neighbour with replacement imposing a tolerance level on the maximum propensity score distance (caliper) between the control and the treatment group equals to 0.03. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets ratio. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	DEP_OUTFLOWS=1 N. banks=151	**DEP_OUTFLOW=0 N. banks= 1,426**	**Welch test**
Panel A: Pre-PSM			
CET1 ratio	0.184	0.174	0.010**
DEP/TA	0.837	0.858	-0.020***
TA (log)	8.895	7.794	1.101***
LOAN/TA	0.645	0.684	-0.038***
ROA	0.400	0.275	0.125***
NPLs ratio	0.026	0.025	0.001
CASH/TA	0.136	0.091	0.045***
Panel B: Post-PSM			
	DEP_OUTFLOWS=1 N. banks=151	**DEP_OUTFLOW=0 N. banks= 131**	**Welch test**
CET1 ratio	0.184	0.187	-0.002
DEP/TA	0.837	0.841	-0.003
TA (log)	8.89	8.64	0.254
LOAN/TA	0.645	0.642	0.03
ROA	0.400	0.434	-0.03
NPLs ratio	0.025	0.027	-0.002
CASH/TA	0.136	0.139	-0.03

Table 11: Baseline results - Propensity Score Matching

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Original maturity FE is a categorical variable representing quartiles of original maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. The PSM applies a logit model and one-to-one nearest neighbour with replacement imposing a tolerance level on the maximum propensity score distance (caliper) between the control and the treatment group equals to 0.03. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (loans)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0057						
	(0.004)						
DEP_OUTFLOW×MP Tightening	-0.0282***	-0.0253***	-0.0257***	-0.0247***	-0.0248***	-0.0204***	-0.0227***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)
L.CET1 ratio	-0.0634	0.1248	0.1197	0.1208	0.1218	0.1924	0.1902*
	(0.040)	(0.116)	(0.118)	(0.119)	(0.116)	(0.117)	(0.098)
L.DEP/TA	0.0097	0.1089	0.1229	0.1199	0.1128	0.1334	0.3563**
	(0.011)	(0.167)	(0.173)	(0.170)	(0.168)	(0.155)	(0.172)
L.TA (log)	0.0027**	0.0561*	0.0610**	0.0586*	0.0528*	0.0747**	0.0893***
	(0.001)	(0.029)	(0.030)	(0.030)	(0.029)	(0.029)	(0.031)
L.LOAN/TA	-0.0122	0.0283	0.0169	0.0410	0.0356	0.0605	0.0107
	(0.010)	(0.087)	(0.085)	(0.089)	(0.086)	(0.077)	(0.075)
L.ROA	0.0002	0.0158**	0.0166**	0.0159**	0.0152**	0.0153**	0.0130**
	(0.003)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)
L.NPLs ratio	0.0006	0.0034	0.0032	0.0035	0.0032	0.0027	0.0053**
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
L.CASH/TA	-0.0180	-0.0512	-0.0585	-0.0452	-0.0599	-0.0452	-0.1357
	(0.029)	(0.092)	(0.092)	(0.097)	(0.090)	(0.096)	(0.108)
Observations	2,199,608	2,199,606	2,199,597	2,010,655	2,199,606	970,714	1,249,806
Bank Fe	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm×Time FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Time FE	No	No	Yes	No	No	No	No
Original maturity×Time FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time×Original maturity FE	No	No	No	No	No	Yes	No
Firm×Time×IR type FE	No	No	No	No	No	No	Yes

Table 12: IV regressions - deposit Beta

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm logarithm of outstanding lending. DEP/OUTFLOW is a dummy variable that takes the value 1 for banks experiencing deposit outflows in all quarters following the start of monetary tightening, and 0 otherwise. Deposit Beta is the ratio between the weighted sight deposit rate (weighted by volume of deposits to HHs and NFCs) and the euribor rate calculated as of 2021Q2. Columns 4-6 reports the results over the PSM matched sample (see Table **??**). L.CET1 ratio is the lag of the Common Equity Tier1 ratio. L.DEP / TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets ratio. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Treated	$\Delta Log(loans)$		*Treated*	$\Delta Log(loans)$	
	(1)	(2)	(3)	(4)	(5)	(6)
Deposit Beta (2021Q2)	0.4505***			2.6757***		
	(0.005)			(0.018)		
DEP_OUTFLOW		0.1496			0.0479**	
		(0.164)			(0.020)	
DEP_OUTFLOW × Tightening		-0.0515**	-0.0695***		-0.0286***	-0.0377***
		(0.020)	(0.026)		(0.008)	(0.007)
L.CET1 ratio	10.602***	0.0321	-0.4080**	15.3096***	-0.2101	-0.8420***
	(0.028)	(0.248)	(0.194)	(0.094)	(0.143)	(0.292)
L.DEP/TA	0.4005***	0.0485	-0.0233	3.8964***	-0.0546	-0.8248**
	(0.0107)	(0.097)	(0.146)	(0.043)	(0.067)	(0.372)
L.TA (log)	0.2581***	-0.0091	0.0009	1.1272***	-0.0266*	-0.0111
	(0.000)	(0.016)	(0.036)	(0.003)	(0.015)	(0.095)
L.LOAN/TA	0.4782***	-0.0801	-0.0852	4.7407***	-0.0854	0.2798*
	(0.012)	(0.140)	(0.150)	(0.025)	(0.093)	(0.163)
L.ROA	-0.2767***	0.0003	0.0080	-0.4429***	0.0075	-0.0128
	(0.002)	(0.017)	(0.010)	(0.006)	(0.009)	(0.016)
L.NPLs ratio	-0.2322***	0.0143	0.0050	-0.3525***	0.0016	-0.0394
	(0.000)	(0.011)	(0.006)	(0.001)	(0.003)	(0.024)
L.CASH/TA	-3.2484***	0.1877	0.0926	-11.8956***	0.2043***	0.4423*
	(0.013)	(0.236)	(0.098)	(0.044)	(0.064)	(0.239)
Observations	6,000,078	4,623,573	4,623,573	1,464,154	885,270	885,270
Bank FE	No	No	Yes	No	No	Yes
Borrower×Time FE	No	Yes	Yes	No	Yes	Yes
Cragg-Donald Wald F-statistic	4276.464			1.0e+05		

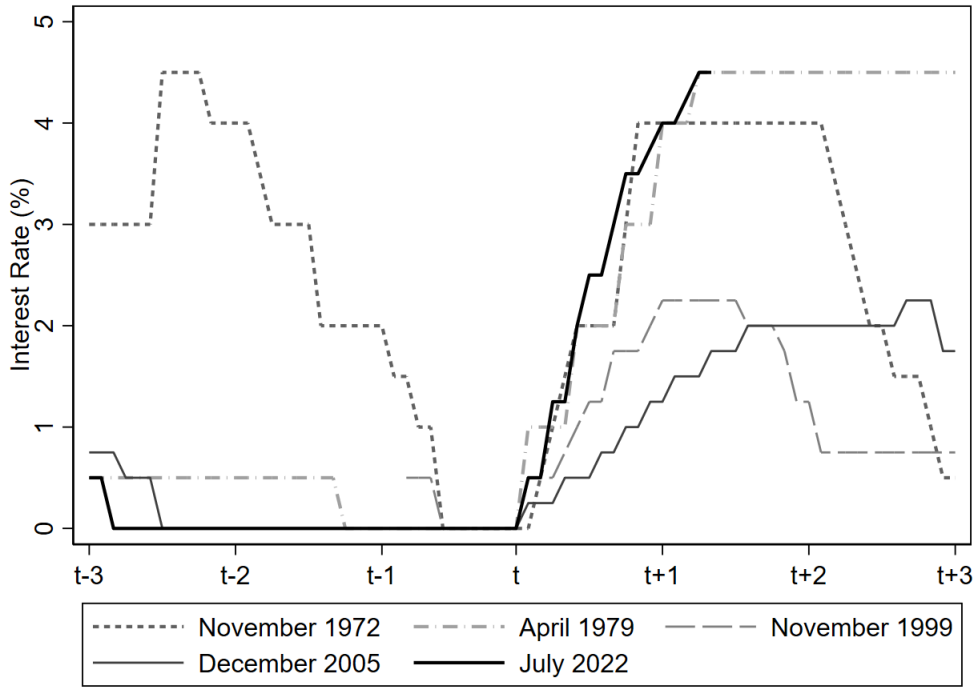
Table 13: IV regressions - TLTRO

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm logarithm of outstanding lending. DEP/OUTFLOW is a dummy variable that takes the value 1 for banks experiencing deposit outflows in all quarters following the start of monetary tightening, and 0 otherwise. Deposit Beta is the ratio between the weighted sight deposit rate (weighted by volume of deposits to HHs and NFCs) and the euribor rate calculated as of 2021Q2. L.CET1 ratio is the lag of the Common Equity Tier1 ratio. L.DEP / TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets ratio. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Treated	$\Delta Log(loans)$	
	(1)	(2)	(3)
TLTROBID/TA	70.751***		
	(0.302)		
DEP_OUTFLOW		0.0045	
		(0.010)	
DEP_OUTFLOW × Tightening		-0.0339***	-0.0334***
		(0.009)	(0.008)
L.CET1 ratio	11.950***	0.0599	-0.6512**
	(0.090)	(0.072)	(0.262)
L.DEP/TA	-1.836***	0.0667**	-0.7077***
	(0.030)	(0.027)	(0.251)
L.TA (log)	1.615***	0.0090*	0.2036**
	(0.004)	(0.005)	(0.091)
L.LOAN/TA	15.303***	0.0277	0.3524
	(0.054)	(0.034)	(0.311)
L.ROA	-1.848***	0.0066	0.0019
	(0.004)	(0.007)	(0.010)
L.NPLs ratio	-0.424***	0.0048***	0.0004
	(0.001)	(0.001)	(0.009)
L.CASH/TA	6.597***	0.0936*	0.3068**
	(0.046)	(0.052)	(0.150)
Observations	3,646,063	2,046,670	2,046,670
Bank FE	No	No	Yes
Borrower×Time FE	No	Yes	Yes
Cragg-Donald Wald F-statistic	6.2e+05		

A Additional charts and tables

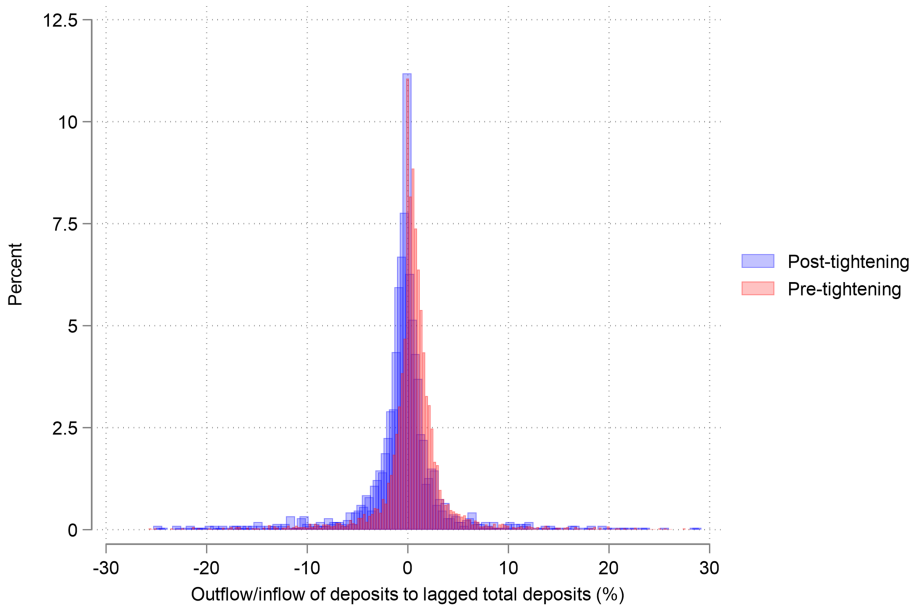
Figure A.1: Monetary policy rates
(annualized interest rates, monthly data)



Sources: Sources: ECB and Bundesbank.

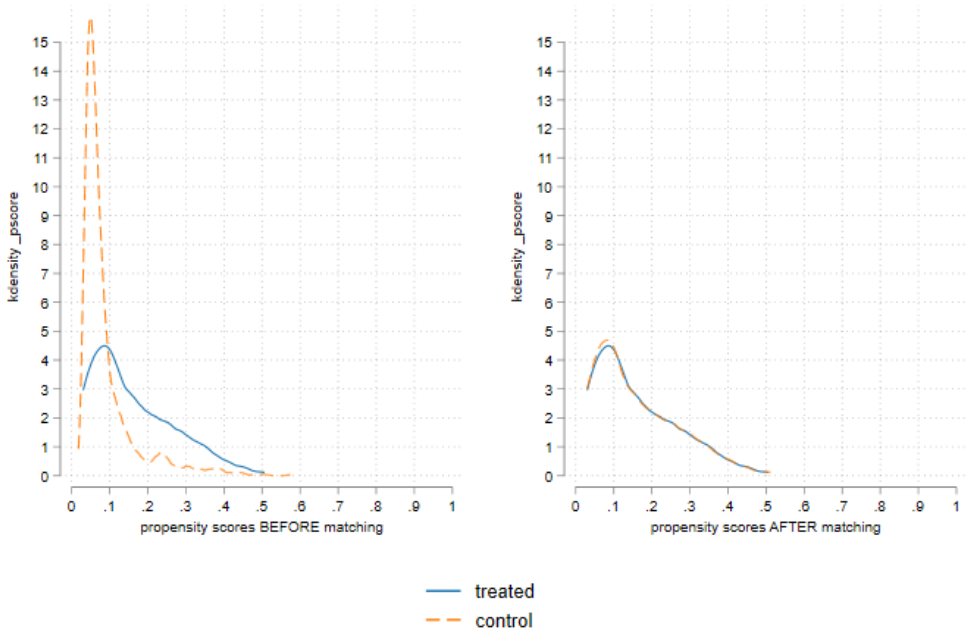
Notes:: The relevant policy rate is the Lombard rate up to December 1998, the MRO up to May 2014 and the DFR thereafter. t marks the start of each hiking cycle.

Figure A.2: Deposits changes: distribution pre and post tightening
(percentages)



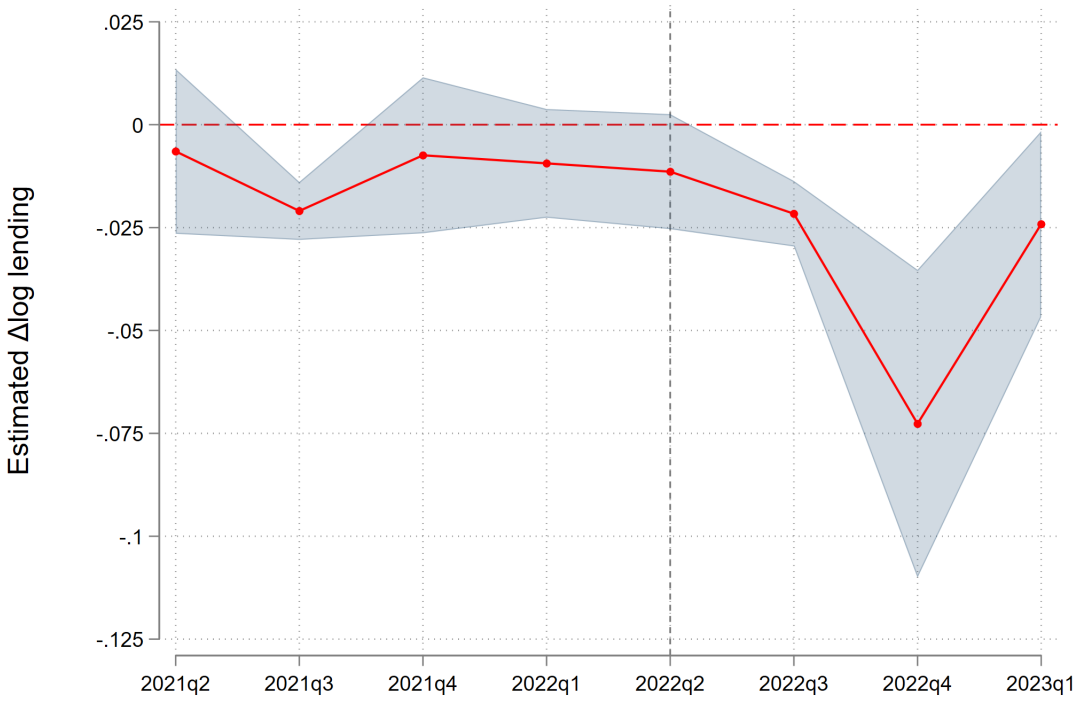
Note: Distribution of net flows deposits in percentages before (from the first quarter of 2021 to the second quarter of 2022) and after (from the third quarter of 2022 to the first quarter of 2023) the start of the tightening in the monetary policy.

Figure A.3: Propensity score before and after matching



Note: The chart plots the Kernel density function of the propensity scores for the treated (blue solid line) and the control (yellow dashed line) before (left) and after (right) the application of the propensity score matching. The propensity score matching is applied via a logit model and one-to-one nearest neighbour with replacement, imposing a tolerance level on the maximum propensity score distance (caliper) between the control and the treatment groups equaling to 0.03.

Figure A.4: Conditional parallel trend assumption based on PSM



Note: The chart plots the propensity score matching (PSM) point estimates (red solid line) along with the confidence intervals at the 90% level (grey shaded area) from dynamic regressions, where the dummy DEP_OUTFLOW is interacted with quarterly dummies. The horizontal red dashed line indicates the zero while the vertical grey dashed line the start of the monetary policy tightening in Q2 2022.

Table A.1: Number of banks by country

Country	N.Banks	N.Firms
AT	345	20,467
BE	12	29,699
CY	9	2,924
DE	787	126,482
EE	8	1,360
ES	40	159,102
FI	10	15,588
FR	57	87,867
GR	9	1,241
IE	12	4,982
IT	214	261,697
LT	4	662
LU	48	6,909
LV	9	296
MT	9	297
NL	12	1,935
PT	14	36,029
SI	13	3,979
SK	8	3,658
TOT	1,620	746,315

Table A.2: Interest rate pass-through: Propensity Score Matching

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ interest rate (loans) is the change in bank-firm lending rates. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Residual maturity FE is a categorical variable representing quartiles of residual maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ interest rate						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0001						
	(0.000)						
DEP_OUTFLOW×MP Tightening	0.0002	0.0003	0.0003	0.0002	0.0003	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.CET1 ratio	-0.0038**	-0.0016	-0.0016	-0.0042	-0.0012	-0.0045	0.0021
	(0.002)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
L.DEP/TA	0.0008	-0.0081	-0.0090	-0.0074	-0.0075	-0.0041	-0.0001
	(0.001)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.004)
L.TA (log)	0.0000	-0.0007	-0.0009	-0.0012	-0.0006	-0.0005	0.0004
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
L.LOAN/TA	0.0006	-0.0054	-0.0052	-0.0034	-0.0055	-0.0051	-0.0028
	(0.001)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
L.ROA	-0.0009***	-0.0007**	-0.0007**	-0.0006*	-0.0007**	-0.0006*	-0.0003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.NPLs ratio	-0.0001	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.CASH/TA	0.0018	0.0012	0.0016	0.0024	0.0009	0.0021	0.0009
	(0.001)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Observations	2,199,608	2,199,606	2,199,597	2,010,655	2,199,606	970,714	1,249,806
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm×Time FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Time FE	No	No	Yes	No	No	No	No
Residual maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time×Residual maturity FE	No	No	No	No	No	Yes	No
Firm×Time×-IR type FE	No	No	No	No	No	No	Yes

Table A.3: Baseline results - Intensive margin on a restricted sample

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 for banks experiencing constant deposit inflows post tightening. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Original maturity FE is a categorical variable representing quartiles of original maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (loans)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0030						
	(0.006)						
DEP_OUTFLOW×MP Tightening	-0.0276***	-0.0205**	-0.0214**	-0.0216**	-0.0202*	-0.0218**	-0.0137*
	(0.010)	(0.010)	(0.010)	(0.011)	(0.010)	(0.009)	(0.008)
L.CET1 ratio	-0.0539*	0.2881***	0.2856***	0.2763**	0.2884***	0.2589**	0.2954***
	(0.033)	(0.104)	(0.106)	(0.109)	(0.103)	(0.101)	(0.097)
L.DEP/TA	0.0525***	0.2127	0.2416	0.2174	0.2192	0.2400*	0.3201*
	(0.018)	(0.175)	(0.178)	(0.181)	(0.175)	(0.145)	(0.167)
L.TA (log)	0.0046***	0.1291***	0.1425***	0.1327***	0.1253***	0.1452***	0.1581***
	(0.002)	(0.040)	(0.043)	(0.041)	(0.039)	(0.040)	(0.041)
L.LOAN/TA	-0.0347**	0.0160	-0.0158	0.0275	0.0220	0.0002	0.1135
	(0.015)	(0.107)	(0.107)	(0.107)	(0.104)	(0.098)	(0.109)
L.ROA	-0.0017	0.0132*	0.0134*	0.0126	0.0127*	0.0079	0.0123
	(0.003)	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
L.NPLs ratio	-0.0003	0.0057	0.0055	0.0067	0.0057	0.0064	0.0117*
	(0.001)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)
L.CASH/TA	-0.0797**	-0.1510*	-0.1640*	-0.1653*	-0.1424*	-0.2108**	-0.1926
	(0.036)	(0.085)	(0.089)	(0.090)	(0.084)	(0.093)	(0.122)
Observations	1,137,038	1,137,035	1,137,031	1,048,721	1,137,035	546,415	726,372
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm×Time FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Time FE	No	No	Yes	No	No	No	No
Original maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time×Original maturity FE	No	No	No	No	No	Yes	No
Firm×Time×IR type FE	No	No	No	No	No	No	Yes

Table A.4: Removing banks with low deposit outflow

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data cover the period from the first quarter 2021 and the first quarter 2023. Δ Log (loans) is the change in bank-firm lending in logarithm. DEP_OUTFLOW is a dummy variable that takes the value 1 for banks experiencing constant deposit outflows post tightening, and 0 otherwise. MP Tightening is a dummy variable that takes the value 1 for all quarters after the second quarter 2022, the start of the monetary policy tightening. L.CET1 ratio is the lag of the common equity tier1 ratio. L.DEP/TA is the lag of the deposits-to-total asset ratio. L.TA.(log) is the lag of the logarithm of bank total assets. L.LOAN/TA is the lag of the credit exposures-to-total assets ratio. L.ROA is the lag of the return on assets. L.NPLs in the lag of the non-performing loans-to-total loans ratio. L.CASH/TA is the lag of the ratio of cash and cash held at the central bank-to-total assets. Original maturity FE is a categorical variable representing quartiles of original maturity. Interest rate type FE is a categorical variable identifying fixed, floating and mixed rate loans. Standard errors are two-way clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

	Dependent variable: Δ Log (loans)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DEP_OUTFLOW	0.0076*						
	(0.004)						
DEP_OUTFLOW×MP Tightening	-0.0191**	-0.0183*	-0.0183*	-0.0178*	-0.0170*	-0.0159*	-0.0169**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.008)
L.CET1 ratio	-0.0726***	-0.0027	-0.0032	-0.0053	0.0043	0.0638	0.0019
	(0.019)	(0.052)	(0.052)	(0.056)	(0.052)	(0.052)	(0.051)
L.DEP/TA	0.0347***	0.0986	0.0995	0.1200*	0.0990	0.0912	0.1260**
	(0.011)	(0.065)	(0.065)	(0.069)	(0.064)	(0.062)	(0.062)
L.TA (log)	0.0015**	-0.0073	-0.0073	0.0052	-0.0023	0.0184	0.0083
	(0.001)	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)	(0.014)
L.LOAN/TA	-0.0182**	-0.0362	-0.0355	-0.0268	-0.0342	-0.0167	0.0044
	(0.008)	(0.044)	(0.044)	(0.046)	(0.044)	(0.044)	(0.042)
L.ROA	0.0053*	0.0138***	0.0138***	0.0147***	0.0151***	0.0135***	0.0159***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
L.NPLs ratio	0.0008	0.0015	0.0015	0.0016	0.0015	0.0017	0.0021*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
L.CASH/TA	0.0083	0.0026	0.0026	-0.0033	-0.0069	0.0209	0.0162
	(0.015)	(0.038)	(0.038)	(0.041)	(0.038)	(0.040)	(0.038)
Observations	10,593,967	10,593,958	10,593,958	9,335,095	10,593,958	5,125,669	6,610,035
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm×Time FE	Yes	Yes	Yes	Yes	Yes	No	No
Country×Time FE	No	No	Yes	No	No	No	No
Original maturity FE	No	No	No	Yes	No	No	No
IR type FE	No	No	No	No	Yes	No	No
Firm×Time× Original maturity FE	No	No	No	No	No	Yes	No
Firm×Time× IR type FE	No	No	No	No	No	No	Yes

B Duration gap

We utilize the concept of duration pioneered by Macaulay (1936). We divide banks' cash-flows in 14 time bands according to their remaining time to maturity or repricing schedule for all instruments on the balance sheet and off-balance sheet items. Data for the duration gap computation are from banks' supervisory reports to the ECB, therefore available for a subset of banks relative to those entering in the baseline estimation. Equation 3 shows in detail the computation of the duration gap.

$$DurationGap = \sum_{j=1}^{14} \frac{DUR_j}{1+i} \left(\frac{A^j - L^j}{Z} \right) \tag{3}$$

A refers to items in the asset side: debt securities, loans and advances, derivatives, and other assets, while L to the liability side including debt securities, non-maturity deposits (divided into retail vs wholesale and transactional vs non-transactional non-maturity deposits), deposits other than non-maturity, derivatives, and other liabilities. Off-balance sheet items comprise contingent assets and liabilities. Cash flows are normalized by total assets (Z) for comparability purposes.

Each cash-flow is weighted by their duration. In particular, the term $(\frac{DUR}{1+i})$ represents the modified duration which reflects the percentage change in the economic value of the instrument for a given percentage change in 1 + i (BCBS, 2016).[27] As such, the duration gap captures the difference between the time to receive the cash-flows coming from assets and liabilities in addition to the time to receive the cash-flows coming from off-balance sheet items, where cash-flows are weighted by their present value. A positive duration gap signals a loss in the economic value of equity when interest rates increase as assets have a longer duration than liabilities, indicating that the value of assets is more sensitive to changes in interest rates than the value of liabilities. Importantly, we use cash-flows which have been reported on a behavioural basis by banks to calculate the duration gap. Finally, another important feature of the data is that it includes information on the derivative positions, thus

[27]The modified duration assumes a linear relationship between the percentage changes in value and percentage changes in interest rates, which is assumed to be equal for all items on and off balance sheet.

controlling for hedging positions against interest rate risk exposure.