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## As interest rates surge: flighty deposits and lending

ChaMP

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**Challenges for Monetary Policy Transmission in a Changing World Network (ChaMP)**

This paper contains research conducted within the network "Challenges for Monetary Policy Transmission in a Changing World Network" (ChaMP). It consists of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the European System of Central Banks (ESCB).

ChaMP is coordinated by a team chaired by Philipp Hartmann (ECB), and consisting of Diana Bonfim (Banco de Portugal), Margherita Bottero (Banca d'Italia), Emmanuel Dhyne (Nationale Bank van België/Banque Nationale de Belgique) and Maria T. Valderrama (Oesterreichische Nationalbank), who are supported by Melina Papoutsi and Gonzalo Paz-Pardo (both ECB), 7 central bank advisers and 8 academic consultants.

ChaMP seeks to revisit our knowledge of monetary transmission channels in the euro area in the context of unprecedented shocks, multiple ongoing structural changes and the extension of the monetary policy toolkit over the last decade and a half as well as the recent steep inflation wave and its reversal. More information is provided on its website.

**Abstract**

How a historic drop in bank deposits shapes banks' loan supply? We exploit the effects of a large, and unexpected, increase in monetary policy rates to estimate the deposit channel of monetary policy using an extensive credit register that includes all bank-firm lending relationships in all euro area countries. We find that banks experiencing large deposit outflows reduce credit, but not the interest rate they charge, to the same borrower relative to other lenders. This credit restriction is stronger for fixed rate and longer maturity loans, but not for riskier borrowers. The effect is mostly driven by banks coming into the hiking period with a larger unhedged duration gap that renders borrowers of those banks more vulnerable to credit restrictions due to the deposit outflows as interest rates surge. We resort to the deposit beta as an instrument variable and a matched estimator that bear out the thrust of our results.
**Keywords:** Monetary policy, Banks, Bank deposits
**JEL Codes:** E51, E58, G21

# Non-technical summary

There is a well established literature that documents how banks' solvency plays an active part on the transmission of monetary policy, while more recent research highlights the importance of deposits: As policy rates increase, banks earn more because they can keep rates on deposits low and earn more on their assets. As savers move out of sight deposits towards higher yielding products, banks, instead of increasing rates on deposits or finding alternative sources of funding at market rates, prefer to reduce lending correspondingly. This mechanism highlights the importance of banks' differences in funding structures in explaining how increases in rates affect the loan supply. In this paper we first test a stylized version of the deposit channel in period in which the central bank raises rates aggressively and unexpectedly and focus on how banks react to deposit outflows. To identify which borrowers are cut off by banks we leverage on a database with very detailed information on relationships between banks and their (individual) borrowers so that controlling for all other factors, we can cleanly measure the effects of specific bank-level characteristics on lending.

We find that following a large increase in monetary policy rates, banks with the largest deposit outflows compensated tightening their lending conditions the most. Our key result here is that they do this by rationing credit rather than by adjusting rates, which remain mostly stable compared to other lenders. 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 via quantities. We then turn to analyzing which borrowers are rationed and why to have a better understanding of the mechanism at play.

Our second key finding is that new borrowers and loans with fixed rate or longer maturities suffer the most from the supply constraints imposed by banks. Indeed, by hedging themselves from interest rate risk through their new lending standards, banks can extract the maximum value from their deposit franchise, since deposits are considered a stable long-term form of funding at low rates. Deposit outflows, which reduce the duration of funding, are therefore compensated by reducing fixed rate loans, which all else being equal, have a longer duration than floating rate loans, and loans with longer maturities. To assess whether this mechanism is indeed driven by the interest rate risk mismatch, we test whether this effect is different for banks entering the interest rate increases with a wider duration risk. We find that banks more exposed to changes in monetary policy through a larger duration gap, tightened their credit standards the most as deposits leave. We test also whether banks with deposit outflows reduce lending to borrowers for which risk-adjusted returns are the lowest but we do not find any significant evidence in this direction. It appears that banks put more weight on preserving the balance between assets and liabilities, which allows them to lock in long-term profits via a stable duration gap, than on short-term profitability considerations. We also consider whether other bank characteristics shape the supply of credit, and if the bank capital channel interacts with the deposit channel. We do not find significant evidence that (distance to regulatory) capital is an important driver of the supply of credit in this context.

# 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 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 chose 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 movements in deposits modulate the transmission of monetary policy during the largest increase in policy rates since the creation of the euro (Figure 1). The jump in rates was mostly unanticipated, particularly in its magnitude (see Figure 2), and provides a natural experiment to better understand how banks' funding affects the transmission to the loan supply. The magnitude, surprise and speed of the shock was such that it led to an unanticipated funding scenario and forced banks to make stark choices in terms of pricing

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

[2] Previously, the idea was that under most instances banks are 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).

of funding and lending conditions, thereby allowing us to delve into the drivers of 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 unforeseen as it largely 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 mostly 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 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 flow 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 therein. 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,[4] a recently constructed pan-European credit register

[4]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

which stores detailed data on the universe of bank loans to euro area firms. We build on the pioneer 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 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 lending to all firms (i.e. extensive margin) which would contain also firms borrowing from one bank only.

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 key finding here is that they do this by rationing credit rather than by adjusting rates, which remain mostly stable. 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 second key finding is that new borrowers and loans with fixed rate or longer maturities suffer the most from the supply constraints imposed by banks. This is consistent with banks trying to avoid adverse selection,[5] and wanting to minimize changes to their duration gap, in line with

€25,000.

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

findings by Drechsler et al. (2018a) and Hoffmann et al. (2019). Deposit outflows, which reduce the duration of funding, are therefore compensated by reducing fixed rate loans, which other things being equal have a longer duration than those with floating rates and longer maturities. 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, 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 constrains 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 increasing their duration gap, since deposits were considered a stable form of long-term funding particularly periods of low interest rates. Thus the low interest rates were creating over time a cluster of borrowers more vulnerable to supply constraints. Precisely those borrowers from those banks, in turn more vulnerable to interest rate increases, who would be more likely to restrict lending to their borrowers as the rates increase.

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. Banks with the largest improvements in net interest revenues are better able to smooth the flow of credit. During interest rate increases new borrowers, and loans with fixed rates or 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 to 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 lurking bank invariant characteristic likely to impact on bank lending standards. Then, to address concerns that our results can be due to divergences of 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 still 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.

Another concern is how our results square with the large and influential literature on the bank (capital) channel of monetary policy. There is extensive evidence that bank capital is a major driver of the heterogeneity in the transmission of monetary policy across banks.[6] In our context, this would be a major concern if the bank capital channel interacted with the deposit channel. For example if banks' capital levels are associated with a sheltering effect on lending, then better capitalized banks might be able to take on additional risk and keep lending despite an increased duration mismatch due to the outflow of deposits in an environment of higher rates. To address this concern, we resort to a (confidential) database

[6]The literature has been very extensive starting from Peek and Rosengren (2000); Bernanke and Gertler (1995).

used by supervisors and calculate a measure of distance to regulatory capital which aims to capture, how capitalized banks are from a supervisory perspective. Surprisingly we do not find evidence that (distance to regulatory) capital is an important driver of the supply of credit in this context.[7]

Finally, we construct an instrumental variable that is relevant to deposit outflows but not connected to lending standards. 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. Our IV estimates are significantly larger and in the same direction that our OLS estimates which indicates an underestimation of the effect from our main set of estimates.

# 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 that leads to upward sticknes 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

[7]This result on the effect of bank capital on lending might be explained by the fact that euro area banks are on average quite far away from their capital constraints as they are well capitalized, so that solvency constraints play little or no role. The increase in rates, albeit massive, did not affect banks' capital positions much, contrary to what happened in the US (Jiang et al. (2023)): unrealized losses in Europe were of an order of magnitude lower, and for banks supervised by the ECB, which cover more than 80 per cent of assets and the vast majority of securities portfolios, they amounted overall to 73 billion euro (ECB, 2023), to be measured against almost two trillion euros worth of bank equity.

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 that banks adjust their lending to compensate for a funding gap exclusively by maneuvering quantities, rather than 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. We find that banks reduce the supply of fixed rate loans, which all else being, equal have higher duration than floating rate ones, and 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. What seems to matter more in the context of brutal increases in policy rates is their income gap. Banks with a greater income gap experience higher increases in their net interest income, which translates into smaller reductions in lending following deposit outflow shocks, consistent with the findings of Gomez et al. (2021).

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 securitities 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 sheet. 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.[8] 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.[9] We match this supervisory data with granular data on deposits for different types of deposits obtained from the Individual Balance Sheet Items (IBSI) statistics.[10] 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

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

[9]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.

[10]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.

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, 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 contaminated 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 outflow of deposits between the third quarter of 2022 and the first quarter of 2023 ranges between 20 and 40 percent. Fixed rate loans represent around 70 percent of our observations. 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%.

### 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 and leans 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 becomes 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 pay on deposits or raise funds from other sources of funding (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 (see Figure 6) the cost of deposit funding by banks increased only modestly—by around 50 bps—, while that of bank bonds rose by four times as much, by 400 basis points in 2023Q1.[11][12] 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 (Figure 6). 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 the whole funding base. 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, under 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 or those with fixed rates.

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.

[11] 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.

[12] 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.

$$Y_{b,j,t} = \alpha DEP\_OUTFLOW_{b,t} + \beta DEP\_OUTFLOW_{b,t} \times MP\_Tightening+ \\ \Psi\Sigma X_{b,t-1} + \eta_{j,t} + \rho_b + \epsilon_{b,j,t} \tag{1}$$

Where b, j and t indicate bank, firm and time fixed effects respectively. Y represents credit growth (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. MP_Tightening is a dummy that takes the value one from 2022Q3, and 0 otherwise. $\beta$ 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. For instance, firms relying on fixed-rate debt may be less affected by short-term increases in interest rates. The use of borrower-time fixed effects absorbs time-varying heterogeneity across firms so that $\eta$ is effectively identified by comparing how loan supply responds post tightening for two banks with different deposit outflows *lending to the same firm*.

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). We also include bank-fixed effects to account for bank unobservable characteristics potentially correlated to deposit inflows/outflows which can affect lending patterns. Third, in alternative specifications, we also consider local market deposit developments with a set of dummies and introduce banks headquarter country-time fixed effects to control for the heterogeneous effect of monetary policy tightening across euro area countries. 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.

# 4 Results

## 4.1 Intensive and extensive margins

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 unexpectedly. Following equation 1, the use of 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 2 percentage points 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) and for (changing) country economic conditions with country time fixed effects (Column 3). These results underlie the tenet of the bank deposit channel during the crucial period of sharply tightening interest rates (Drechsler et al., 2018b).[13]

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 new lending relationships between a bank and a borrower which could take two forms, either a borrower obtains bank credit for the *first* time, or receives credit from a *new* bank.[14] We answer this question in Table (3) where the dependent variable is whether borrowers establish any of these credit relationships. It suggests that banks suffering from deposit outflows are less likely to grant credit to new borrowers, even after accounting for factors such as the bank size, solvency, or liquidity. The results remain when including unobservable bank attributes (i.e bank fixed effects) and when allowing for (changing) conditions at the country level.

## 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 in Table 2. 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, Column 1).

[13]An interesting and consistent result throughout the paper is that bank profits smooths the loan supply, see positive value on columns (1) to (3), and act as a buffer on the credit rationing effect of deposits. We do not explore in detail this finding which appears very much in line with findings by Gomez et al. (2021).

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

This no (significant) result remains also when (unobserved) bank and (changing) economic conditions are taken into account (Table 4, columns 2 and 3).

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 on Table 4 we also show the results of the same equation for 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 * 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.[15] Column (4) confirms 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 bank and time * country fixed effects are included (Columns 5 and 6). 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 and interest rate type

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. First 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 potential borrowers.

Deposits are considered as 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

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

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 risk mismatch. As short-term interest rates augment 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 reduce their lending to existing borrowers with fixed interest rate loans as interest rates increase.[16] This is indeed what we see in Table 5. As shown in Columns (1) to (3), during the tightening period, borrowers with fixed interest rate loans experienced a lending contraction, probably as banks make an effort to reduce their repricing mismatch. This effect becomes even more pronounced for banks experiencing deposit outflows during the tightening period as suggested by the triple interaction that further exacerbates the reduction in the supply of credit by around 1.5 additional percentage points.

The other main way to reduce the interest rate and liquidity risk 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 not only an increase (decline) towards borrowers with floating (fixed) loans but also a shortening in the maturity of loans. This is what we see in Table 6. As indicated by the interaction between deposit outflow and tightening variables, Columns (4) to (6) show that banks experiencing deposit outflows are less likely to grant longer term loans (above 2 years) to the same borrower (Columns 5 and 6), compared to other banks.

[16]Note that during the pre-tightening period, banks were subjected to the opposite incentive as low rates would give them incentives to increase revenues by stepping up on their interest rate risk taking. One option to do this is by granting fixed rates which are more lucrative in an environment of compressed margins as they normally have a higher spread than floating rate loans.

## 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 standards. 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 account the use of derivatives for interest rate risk hedging purposes.[17] 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 in further detail. As flagged in Table 7 we set the duration gap at the second quarter of 2021 to avoid endogeneity concerns and test whether a greater duration gap drives the supply of credit at the borrower level.

The findings on Table 7 are telling. First, banks experiencing deposit outflows contract lending to the same borrower *even* when their initial duration mismatch (i.e. gap) is not taken into account. Presumably because of banks' concerns about the stability of their funding deposit base. This is shown by the interaction (*DEP_OUTFLOW x Tightening*) which is negative, sizeable and statistically significant. It points to an additional lending reduction of about 4 percent for banks experiencing the largest deposits outflows to the same borrower, compared with other banks. This is robust to the inclusion of bank and country * time fixed effects.

[17]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).

This effect on the loan supply connected to deposit outflows is larger for banks with wider duration gaps. Specifically, a 1 percent higher duration gap results in an additional contraction of credit of around 4 percent for the same borrower. 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. Overall then, firms that entered the tightening cycle with relationships connected mostly to lenders with higher duration gap were less likely to obtain credit as the tightening started. This likelihood becomes even lower for banks experiencing deposit outflows.

### 4.5 Robustness: 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 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. 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, deposit outflows and our proxy for credit risk does not show a large or significant coefficient (see columns 1 to 3). 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.

### 4.6 Robustness: distance to regulatory capital

The mechanism above hinges on cross sectional differences in banks' deposit outflows. At the same time capital has been consistently shown to be a major component of the transmission of monetary policy as differences in bank capital have been found to be a major determinant of bank lending (see for instance Peek and Rosengren (2000); Gambacorta and Mistrulli (2004); Jimenez et al. (2012); Drechsler et al. (2018a); Bednarek et al. (2023)). In this section we analyse whether bank capital plays a parallel (and potentially confounding) effect on the deposit channel specified above.

Thus we build on our baseline identification to investigate the role of regulatory bank solvency in lending using the distance of banks' capital ratios to the minimum regulatory thresholds. As a regulatory threshold we use the maximum amount available or "distance to MDA" (Couaillier et al., 2023).[18] This distance captures the amount of voluntary capital held by banks on top of the minimum buffer required by regulators. Since a breach of the MDA triggers restrictions on dividend distributions, bonuses and coupon payments, we test whether banks closer to the MDA threshold might curtail lending by more when experiencing deposit outflows. The logic is that this distance would be a relevant factor determining banks' lending standards.

We do not find that regulatory capital is a major factor confounding the effect of deposit outflows during the tightening period. Table 9 shows that banks closer to the regulatory minimum (MDA distance) do not restrict credit, by more when experiencing deposit outflows. This is suggested by the lack of significance of the triple interaction coefficient (corresponding to the control $DEPOUTFLOW * Tightening * lowMDA$).

Crucially note that these results can be consistent with, and work on top of, a bank lending channel operating via bank capital. Our focus in this section is on the joint interaction of deposit outflows and regulatory capital as this is the mechanism we aim to isolate. For instance, certain banks might experience larger hidden loses as was the case in the United States, and that affects their economic capital. This could well be a bank capital channel at

[18] We use the distance that triggers limitations to the maximum amount available for variable payments of a bank (i.e. dividend payments, AT1 coupon distributions or variable remunerations) or "distance to MDA". For an detailed explanation of the MDA, please see Svoronos and Vrbaski (2020)

work (see for instance Jiang et al., 2023), but it isn't the case here.[19]

## 4.7 Robustness: matching and instrumental variable estimation

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 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.[20]

We start by showing the effect of this matching on our new sample in Table (10). It shows the differences in characteristics for both groups of banks: Those experiencing deposit outflows (i.e. treated, DEP-OUTFLOWS=1) and the control group. Panel A indicates that prior to the matching the characteristics of banks in treated and control groups are relatively different in all dimensions but their credit risk (NPL ratio). 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, Columns 1 to 3), and as a result the sample of banks and borrowers declines substantially.[21] Compared with our results using the unmatched sample, the new matched results are consistent and illustrate even more vividly how banks suffering from

[19]Contrary to what happened in the United States, unrealized losses for banks supervised by the ECB, which cover more than 80 per cent of assets and the vast majority of securities portfolios, amounted overall to 73 billion euro (ECB, 2023), to be measured against almost two trillion worth of bank equity.

[20]The PSM applied a logit model and one-to-one nearest neighbour, imposing a tolerance level of up to to 0.01 on the maximum propensity score distance (caliper) between the control and the treatment group.

[21]Figure A.1 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.

deposit outflows curtail lending even more aggressively than banks that are very similar ex-ante (before the tightening). Figure A.2 (see Appendix) vouches for the existence of parallel trends for treated and control group of banks prior to the tightening episode.

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.[22] 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 thus amplifying the deposit beta for banks with negative overnight deposit rates.[23] Then we regress the treatment variable against not only the overnight deposit beta but also an array of bank-specific characteristics.[24] 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 **??**, confirm earlier findings on the relevance of deposit outflows on lending.

As a final robustness test we use banks' beta as an instrument for banks ability *not* to

[22]To implement this we use a confidential dataset constructed for monetary policy purposes (the so called IBSI 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

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

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

convey interest rate increases to borrowers. In a way this is capturing banks' market power or "deposit charter" value which we instrument on bank deposits to avoid possible endogeneity concerns of unobservables connected to those banks experiencing the largest amounts of deposits outflows. Results in **??** are consistent with previous estimations.

# 5 Conclusions

We study how banks transmit increases in interest rates to the loan supply. We analyse the largest rise in interest rates since the creation of the euro starting from the effects of a large drop in sight deposits. We build on a comprehensive credit register which includes bank-firm lending relationships (above 25.000 euro) in all 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 credit to borrowers, rather than adjust rates. Our findings seem to be driven by augmented 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 by rationing credit rather than transmitting the increase in policy rates to borrowers.

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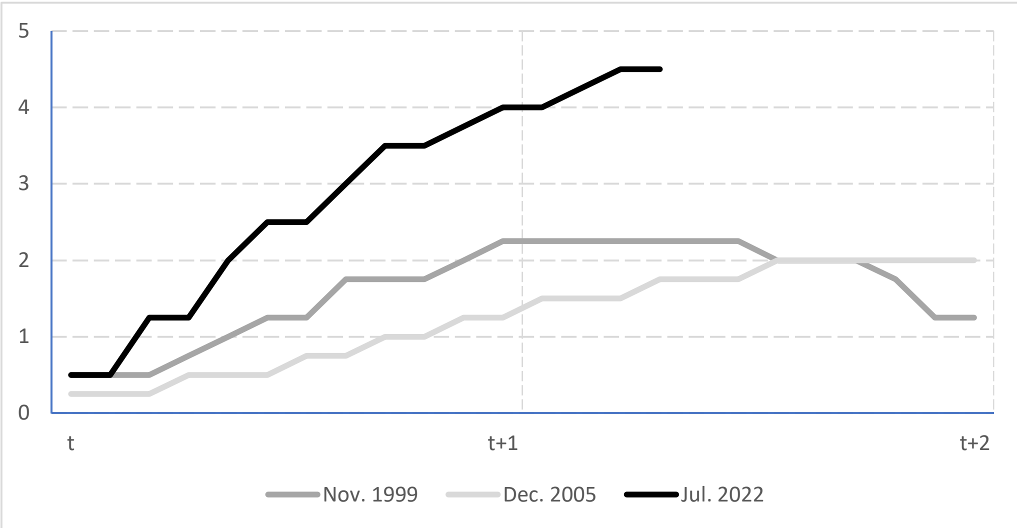
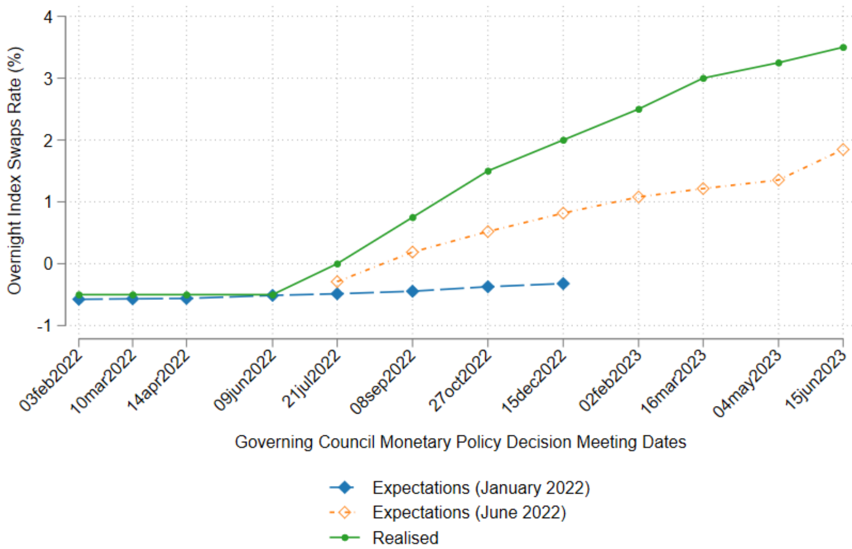
**Figure 1:** Euro area monetary policy rates during tightening cycles
(interest rate, annualized)




**Source:** ECB. **Note:** The ECB relevant policy rate is interest rate on the main refinancing operations (MRO) up to May 2014 and the deposit facility rate (DFR) thereafter. t marks the start of each hiking cycle.

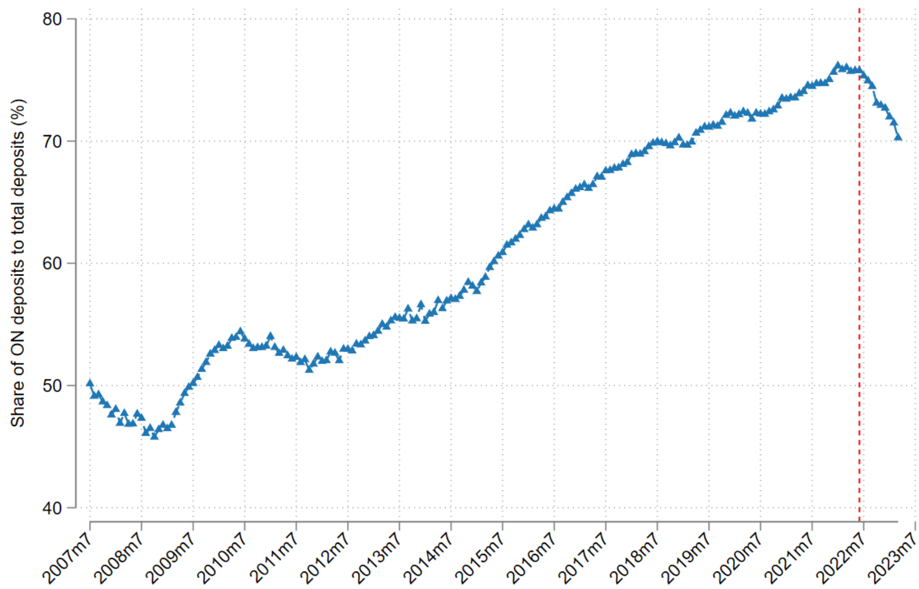
**Figure 2:** Expected and realized monetary policy rates

(annualized interest rates)



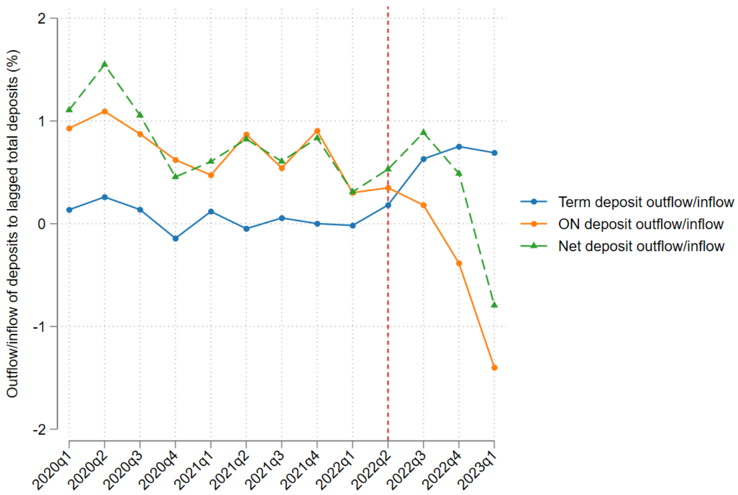

**Source:** ECB. **Note:** Euro area monetary policy rate expectations are obtained from overnight indexed swap implied interest rate expectations observed in January. On the x-axis are the dates of the ECB's monetary policy meetings.

**Figure 3:** Share of sight over total deposits
(percentages)



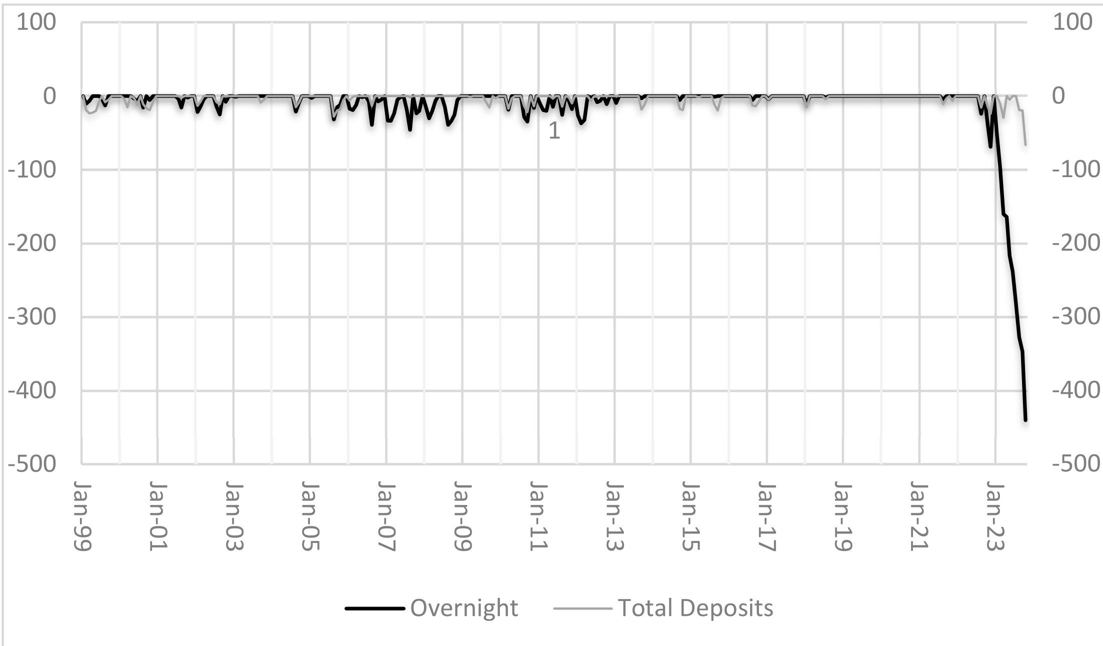

**Source:** ECB. **Note:** Monthly data on the amount of outstanding sight over total deposits from end of July 2007 to end of March 2023 in percentages.

**Figure 4:** Flow of overnight, term and total deposits
(percentages)



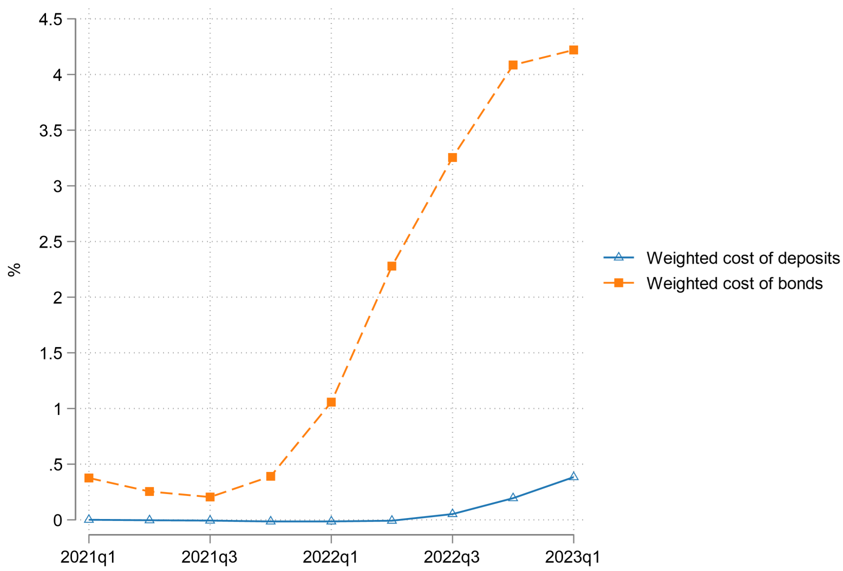

**Source:** ECB. **Note:** Overnight (and term) flows of deposits is calculated as the difference between overnight (and term) deposits outstanding at time t and t-1 to lagged total deposits outstanding from the first quarter of 2020 to the first quarter 2023. Net flows of deposits is calculated as the difference between total deposits outstanding at time t and t-1 to lagged total deposits outstanding from the first quarter of 2020 to the first quarter 2023.

**Figure 5:** Net flow of overnight deposits and total deposits from its peak (billions Euro)



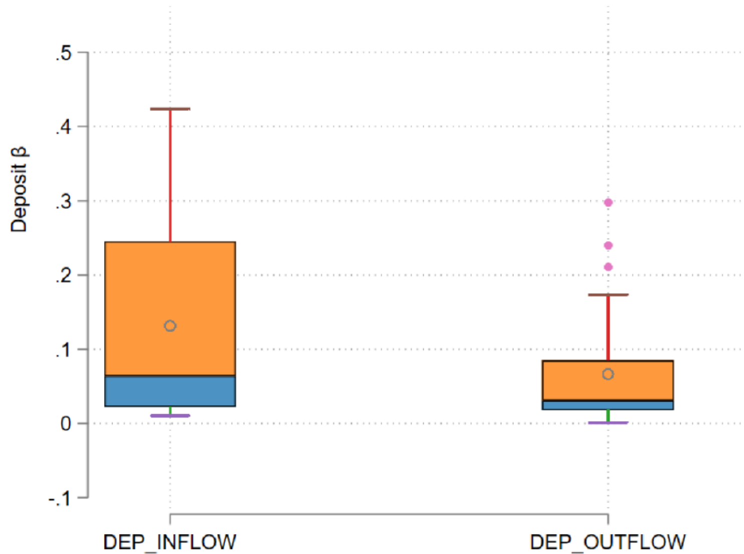

**Source:** ECB.

**Figure 6:** Cost of deposit and bond issuances by banks
(percentages)




**Source:** ECB. **Note:** Weighted cost of deposit and bonds outstanding from first quarter of 2021 to first quarter of 2023. The weights for the cost of deposits are the deposit volumes for sight and term deposits, whilst the weights for the cost of bonds issuance are the amount issued.

**Figure 7:** Deposit betas by bank according of deposits flows
(ratio)




**Note:** Beta of banks calculated as the pass-through of interest rates from the monetary policy 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.

**Table 1:** Summary statistics

| Statistic | N | Mean | St. Dev. | Min | Pctl(25) | Pctl(75) | Max |
|---|---|---|---|---|---|---|---|
| | | | Panel A | | | | |
| $\Delta$ 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 |
| $\Delta$ 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. Over the period starting from the first quarter of 2021 till the first quarter 2023. $\Delta$ 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) a firm enters in the sample establishing a relationship and b) a firm with an already existing bank relationship at t-1 establishes a new relationship with a different bank. $\Delta$ 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 - Intensive 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. $\Delta$ 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. 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:* $\Delta Log(loans)$ | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| DEP_OUTFLOW | 0.0050 | | |
| | (0.004) | | |
| DEP_OUTFLOW $\times$ Tightening | -0.0188** | -0.0167** | -0.0167** |
| | (0.008) | (0.008) | (0.008) |
| L.CET1 ratio | -0.0719*** | 0.0013 | -0.0003 |
| | (0.019) | (0.049) | (0.049) |
| L.DEP/TA | 0.0343*** | 0.1119* | 0.1132* |
| | (0.011) | (0.067) | (0.068) |
| L.TA (log) | 0.0020*** | 0.0004 | 0.0010 |
| | (0.001) | (0.012) | (0.012) |
| L.LOAN/TA | -0.0179** | -0.0254 | -0.0254 |
| | (0.008) | (0.040) | (0.040) |
| L.ROA | 0.0049* | 0.0132*** | 0.0132*** |
| | (0.002) | (0.003) | (0.003) |
| L.NPLs ratio | 0.0007 | 0.0018 | 0.0018 |
| | (0.001) | (0.001) | (0.001) |
| L.CASH/TA | -0.0035 | -0.0085 | -0.0089 |
| | (0.015) | (0.037) | (0.037) |
| Constant | -0.0519*** | -0.1074 | -0.1152 |
| | (0.018) | (0.152) | (0.153) |
| Observations | 11,529,195 | 11,529,182 | 11,529,182 |
| Bank FE | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes |
| Country*time FE | 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 is from 2021Q1-2023Q1. New bank-firm relationships is a dummy variable taking the value 1 if in a given quarter: a) a firm enters in the sample establishing a relationship and b) a firm with an already existing bank relationship at t-1 establishes a new relationship with a different bank. 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. 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) |
| DEP_OUTFLOW | 0.0181*** | | |
| | (0.005) | | |
| DEP_OUTFLOW × Tightening | -0.0223*** | -0.0162*** | -0.0161*** |
| | (0.006) | (0.006) | (0.006) |
| L.CET1 ratio | -0.1431*** | 0.1778 | 0.1764 |
| | (0.037) | (0.118) | (0.118) |
| L.DEP/TA | -0.0620*** | -0.0483 | -0.0444 |
| | (0.020) | (0.087) | (0.085) |
| L.TA (log) | -0.0055*** | 0.0733*** | 0.0757*** |
| | (0.001) | (0.025) | (0.024) |
| L.LOAN/TA | 0.0082 | 0.1041 | 0.0995 |
| | (0.019) | (0.076) | (0.076) |
| L.ROA | 0.0152*** | 0.0019 | 0.0015 |
| | (0.004) | (0.006) | (0.006) |
| L.NPLs ratio | -0.0004 | 0.0008 | 0.0010 |
| | (0.001) | (0.002) | (0.002) |
| L.CASH/TA | 0.0453* | 0.0257 | 0.0224 |
| | (0.026) | (0.058) | (0.059) |
| Constant | 0.1593*** | -0.8351*** | -0.8619*** |
| | (0.027) | (0.305) | (0.296) |
| Observations | 28,521,124 | 28,521,122 | 28,521,122 |
| Bank FE | No | Yes | Yes |
| ILS*time FE | Yes | Yes | Yes |
| Country*time FE | 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 is from 2021Q1-2023Q1. $\Delta$ 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. 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. The matched sample is derived from the propensity score matching approach (PSM). The PSM 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 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: $\Delta$ interest rate* | | | | | |
|---|---|---|---|---|---|---|
| | *Unmatched* | | | *Matched* | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| DEP_OUTFLOW | -0.0000 | | | 0.0001 | | |
| | (0.000) | | | (0.000) | | |
| DEP_OUTFLOW × Tightening | 0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0003 | 0.0003 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.CET1 ratio | -0.0013 | 0.0039 | 0.0040 | -0.0038** | -0.0016 | -0.0016 |
| | (0.001) | (0.003) | (0.003) | (0.002) | (0.006) | (0.006) |
| L.DEP/TA | 0.0005 | 0.0017 | 0.0015 | 0.0008 | -0.0081 | -0.0090 |
| | (0.000) | (0.003) | (0.003) | (0.001) | (0.007) | (0.007) |
| L.TA (log) | -0.0000 | 0.0003 | 0.0003 | 0.0000 | -0.0007 | -0.0009 |
| | (0.000) | (0.001) | (0.001) | (0.000) | (0.001) | (0.001) |
| L.LOAN/TA | -0.0010** | 0.0011 | 0.0012 | 0.0006 | -0.0054 | -0.0052 |
| | (0.000) | (0.002) | (0.002) | (0.001) | (0.005) | (0.005) |
| L.ROA | -0.0001 | -0.0000 | -0.0000 | -0.0009*** | -0.0007** | -0.0007** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.NPLs ratio | -0.0001*** | -0.0002*** | -0.0002*** | -0.0001 | -0.0006*** | -0.0006*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.CASH/TA | -0.0005 | 0.0001 | 0.0001 | 0.0018 | 0.0012 | 0.0016 |
| | (0.001) | (0.002) | (0.002) | (0.001) | (0.003) | (0.003) |
| Constant | 0.0025*** | -0.0037 | -0.0033 | 0.0011 | 0.0220 | 0.0242 |
| | (0.001) | (0.008) | (0.008) | (0.002) | (0.018) | (0.018) |
| Observations | 11,529,195 | 11,529,182 | 11,529,182 | 2,199,608 | 2,199,606 | 2,199,597 |
| Bank FE | No | Yes | Yes | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Country*time FE | No | No | Yes | No | No | Yes |

## Table 5: Fixed vs floating rate loans

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. Fixed rate is a dummy variable taking the value 1 for fixed rate loans, 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. 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) |
| DEP_OUTFLOW | -0.0108*** | | |
| | (0.004) | | |
| DEP_OUTFLOW×Tightening | -0.0068 | -0.0072 | -0.0070 |
| | (0.010) | (0.010) | (0.010) |
| Fixed rate | 0.0251*** | 0.0294*** | 0.0294*** |
| | (0.003) | (0.003) | (0.003) |
| DEP_OUTFLOW×Fixed rate | 0.0207*** | 0.0230*** | 0.0231*** |
| | (0.008) | (0.008) | (0.008) |
| Tightening×Fixed rate | -0.0092*** | -0.0105*** | -0.0105*** |
| | (0.002) | (0.002) | (0.002) |
| DEP_OUTFLOW×Tighening×Fixed rate | -0.0152** | -0.0117* | -0.0119* |
| | (0.007) | (0.007) | (0.007) |
| L.CET1 ratio | -0.0892*** | -0.0119 | -0.0134 |
| | (0.019) | (0.049) | (0.049) |
| L.DEP/TA | 0.0336*** | 0.1133* | 0.1148* |
| | (0.011) | (0.067) | (0.068) |
| L.TA (log) | 0.0013* | -0.0052 | -0.0046 |
| | (0.001) | (0.011) | (0.012) |
| L.LOAN/TA | -0.0188** | -0.0239 | -0.0241 |
| | (0.008) | (0.040) | (0.040) |
| L.ROA | 0.0056** | 0.0132*** | 0.0132*** |
| | (0.002) | (0.003) | (0.003) |
| L.NPLs ratio | 0.0013** | 0.0017 | 0.0017 |
| | (0.001) | (0.001) | (0.001) |
| L.CASH/TA | -0.0026 | -0.0041 | -0.0046 |
| | (0.016) | (0.037) | (0.037) |
| Constant | -0.0591*** | -0.0669 | -0.0754 |
| | (0.018) | (0.149) | (0.150) |
| Observations | 11,529,195 | 11,529,182 | 11,529,182 |
| Bank FE | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes |
| Country*time FE | No | No | Yes |

## **Table 6:** 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 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. 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)* | | | | | |
|---|---|---|---|---|---|---|
| | *Short-term <2Y* | | | *Long-term > 2Y* | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| DEP_OUTFLOW | -0.0061 | | | 0.0056 | | |
| | (0.007) | | | (0.004) | | |
| DEP_OUTFLOW × Tightening | -0.0173 | -0.0111 | -0.0106 | -0.0182** | -0.0162** | -0.0161** |
| | (0.014) | (0.012) | (0.012) | (0.008) | (0.008) | (0.008) |
| L.CET1 ratio | 0.0792 | 0.8091*** | 0.8131*** | -0.0810*** | -0.0259 | -0.0282 |
| | (0.059) | (0.198) | (0.199) | (0.019) | (0.049) | (0.049) |
| L.DEP/TA | 0.0597** | 0.0990 | 0.0988 | 0.0352*** | 0.1023 | 0.1034 |
| | (0.026) | (0.131) | (0.132) | (0.011) | (0.067) | (0.067) |
| L.TA (log) | 0.0082*** | -0.0025 | -0.0050 | 0.0018** | 0.0047 | 0.0055 |
| | (0.002) | (0.038) | (0.038) | (0.001) | (0.011) | (0.011) |
| L.LOAN/TA | 0.0184 | 0.0142 | 0.0122 | -0.0203*** | -0.0073 | -0.0071 |
| | (0.016) | (0.103) | (0.104) | (0.008) | (0.038) | (0.038) |
| L.ROA | 0.0121** | 0.0302*** | 0.0305*** | 0.0045* | 0.0113*** | 0.0113*** |
| | (0.005) | (0.008) | (0.008) | (0.002) | (0.003) | (0.003) |
| L.NPLs ratio | 0.0041*** | 0.0026 | 0.0026 | 0.0007 | 0.0015 | 0.0015 |
| | (0.001) | (0.003) | (0.003) | (0.001) | (0.001) | (0.001) |
| L.CASH/TA | 0.0526 | 0.0770 | 0.0770 | -0.0154 | 0.0038 | 0.0036 |
| | (0.033) | (0.092) | (0.093) | (0.015) | (0.036) | (0.036) |
| Constant | -0.1580*** | -0.1770 | -0.1475 | -0.0489*** | -0.1577 | -0.1672 |
| | (0.041) | (0.469) | (0.473) | (0.018) | (0.150) | (0.151) |
| Observations | 276,048 | 275,868 | 275,863 | 10,468,749 | 10,468,739 | 10,468,739 |
| Bank FE | No | No | Yes | No | No | Yes |
| Borrower*time FE | No | Yes | Yes | No | Yes | Yes |
| Country*time FE | No | No | Yes | No | No | Yes |

## **Table 7:** Duration gap

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data is from 2021Q1-2023Q1. $\Delta$ 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. 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. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

| | *Dependent variable: $\Delta$ Log (loans)* | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| DEP_OUTFLOW | 0.0193*** | | |
| | (0.003) | | |
| DEP_OUTFLOW×Tightening | -0.0420*** | -0.0437*** | -0.0438*** |
| | (0.001) | (0.003) | (0.003) |
| Duration Gap | -0.0041 | | |
| | (0.006) | | |
| DEP_OUTFLOW×Duration Gap | 0.0403*** | | |
| | (0.012) | | |
| Tightening×Duration Gap | 0.0106*** | 0.0110*** | 0.0111*** |
| | (0.003) | (0.004) | (0.004) |
| DEP_OUTFLOW×Tighening×Duration Gap | -0.0454*** | -0.0359*** | -0.0357*** |
| | (0.004) | (0.005) | (0.005) |
| L.CET1 ratio | -0.1364** | -0.3781 | -0.3793 |
| | (0.058) | (0.283) | (0.285) |
| L.DEP/TA | 0.0500** | -0.0511 | -0.0521 |
| | (0.022) | (0.209) | (0.210) |
| L.TA (log) | 0.0032 | -0.0073 | -0.0076 |
| | (0.002) | (0.032) | (0.032) |
| L.LOAN/TA | -0.0786* | 0.0518 | 0.0522 |
| | (0.040) | (0.117) | (0.118) |
| L.ROA | 0.0147*** | 0.0144** | 0.0145** |
| | (0.004) | (0.006) | (0.006) |
| L.NPLs ratio | 0.0055*** | 0.0123*** | 0.0124*** |
| | (0.002) | (0.004) | (0.004) |
| L.CASH/TA | 0.0988* | 0.1463 | 0.1472 |
| | (0.055) | (0.172) | (0.173) |
| Constant | -0.0747 | 0.0652 | 0.0686 |
| | (0.059) | (0.513) | (0.515) |
| Observations | 3,812,148 | 3,812,148 | 3,812,110 |
| Bank FE | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes |
| Country*time FE | No | 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) |
| DEP_OUTFLOW | 0.0109** | | |
| | (0.005) | | |
| DEP_OUTFLOW*Tightening | -0.0213** | -0.0185* | -0.0185* |
| | (0.010) | (0.010) | (0.010) |
| L.risk-adjusted return | 0.0004*** | 0.0005*** | 0.0005*** |
| | (0.000) | (0.000) | (0.000) |
| DEP_OUTFLOW*L.risk-adjusted return | -0.0004** | -0.0005*** | -0.0005*** |
| | (0.000) | (0.000) | (0.000) |
| Tightening*L.risk-adjusted return | 0.0004** | 0.0003 | 0.0003 |
| | (0.000) | (0.000) | (0.000) |
| DEP_OUTFLOW*Tightening*L.risk-adjusted return | -0.0003 | -0.0002 | -0.0002 |
| | (0.000) | (0.000) | (0.000) |
| L.CET1 ratio | -0.0641** | -0.0683 | -0.0684 |
| | (0.025) | (0.116) | (0.117) |
| L.DEP/TA | 0.0725*** | -0.1030 | -0.1034 |
| | (0.025) | (0.123) | (0.123) |
| L.TA (log) | 0.0042*** | 0.0708*** | 0.0724*** |
| | (0.002) | (0.026) | (0.026) |
| L.LOAN/TA | -0.0381* | 0.1486** | 0.1501** |
| | (0.020) | (0.073) | (0.073) |
| L.ROA | 0.0108*** | 0.0109*** | 0.0108*** |
| | (0.003) | (0.003) | (0.003) |
| L.NPLs ratio | 0.0028*** | 0.0074* | 0.0074* |
| | (0.001) | (0.004) | (0.004) |
| L.CASH/TA | 0.0179 | 0.1358** | 0.1352** |
| | (0.023) | (0.066) | (0.066) |
| Constant | -0.1131*** | -0.9538** | -0.9738** |
| | (0.038) | (0.378) | (0.380) |
| Observations | 5,381,057 | 5,381,054 | 5,381,054 |
| Bank FE | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes |
| Country*time FE | No | No | Yes |

**Table 9:** Distance to Regulatory Capital Threhold (MDA)

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. 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. 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) |
| DEP_OUTFLOW | 0.0045 | | |
| | (0.005) | | |
| DEP_OUTFLOW×Tightening | -0.0222*** | -0.0220*** | -0.0221*** |
| | (0.008) | (0.008) | (0.008) |
| Low_D2MDA | -0.0026 | 0.0011 | 0.0010 |
| | (0.003) | (0.003) | (0.003) |
| DEP_OUTFLOW×Low_D2MDA | 0.0020 | -0.0073 | -0.0074 |
| | (0.010) | (0.011) | (0.011) |
| Low_D2MDA×Tightening | -0.0033 | -0.0061 | -0.0062 |
| | (0.004) | (0.005) | (0.005) |
| DEP_OUTFLOW×Tightening×Low_D2MDA | 0.0150 | 0.0246 | 0.0250 |
| | (0.017) | (0.017) | (0.017) |
| L.CET1 ratio | -0.0868*** | -0.0103 | -0.0124 |
| | (0.023) | (0.051) | (0.051) |
| L.DEP/TA | 0.0319*** | 0.1271** | 0.1290** |
| | (0.010) | (0.063) | (0.063) |
| L.TA (log) | 0.0019*** | 0.0039 | 0.0047 |
| | (0.001) | (0.011) | (0.011) |
| L.LOAN/TA | -0.0145* | -0.0206 | -0.0206 |
| | (0.007) | (0.039) | (0.039) |
| L.ROA | 0.0048** | 0.0138*** | 0.0138*** |
| | (0.002) | (0.003) | (0.003) |
| L.NPLs ratio | 0.0008 | 0.0020* | 0.0020* |
| | (0.001) | (0.001) | (0.001) |
| L.CASH/TA | -0.0000 | -0.0073 | -0.0077 |
| | (0.016) | (0.038) | (0.038) |
| Constant | -0.0478*** | -0.1605 | -0.1701 |
| | (0.017) | (0.151) | (0.152) |
| Observations | 11,526,410 | 11,526,397 | 11,526,397 |
| Bank FE | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes |
| Country*time FE | No | No | Yes |

**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 the loan-level analysis, whilst Panel B reports descriptive statistics for the matched sample. The PSM applies a logit model and one-to-one nearest neighbour 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 - PSM

This table shows the results of the bank-firm panel regressions as in equation 1. The quarterly data is from 2021Q1-2023Q1. $\Delta$ 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.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. The PSM applies a logit model and one-to-one nearest neighbour 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:* $\Delta$ *Log (loans)* | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| DEP_OUTFLOW | 0.0057 | | |
| | (0.004) | | |
| DEP_OUTFLOW*Tightening | -0.0282*** | -0.0253*** | -0.0257*** |
| | (0.009) | (0.008) | (0.008) |
| L.CET1 ratio | -0.0634 | 0.1248 | 0.1197 |
| | (0.040) | (0.116) | (0.118) |
| L.DEP/TA | 0.0097 | 0.1089 | 0.1229 |
| | (0.011) | (0.167) | (0.173) |
| L.TA (log) | 0.0027** | 0.0561* | 0.0610** |
| | (0.001) | (0.029) | (0.030) |
| L.LOAN/TA | -0.0122 | 0.0283 | 0.0169 |
| | (0.010) | (0.087) | (0.085) |
| L.ROA | 0.0002 | 0.0158** | 0.0166** |
| | (0.003) | (0.007) | (0.007) |
| L.NPLs ratio | 0.0006 | 0.0034 | 0.0032 |
| | (0.001) | (0.003) | (0.003) |
| L.CASH/TA | -0.0180 | -0.0512 | -0.0585 |
| | (0.029) | (0.092) | (0.092) |
| Constant | -0.0390 | -0.7989* | -0.8579** |
| | (0.024) | (0.412) | (0.432) |
| Observations | 2,199,608 | 2,199,606 | 2,199,597 |
| Bank FE | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes |
| Country*time FE | No | No | Yes |

# **Table 12:** IV regressions

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.

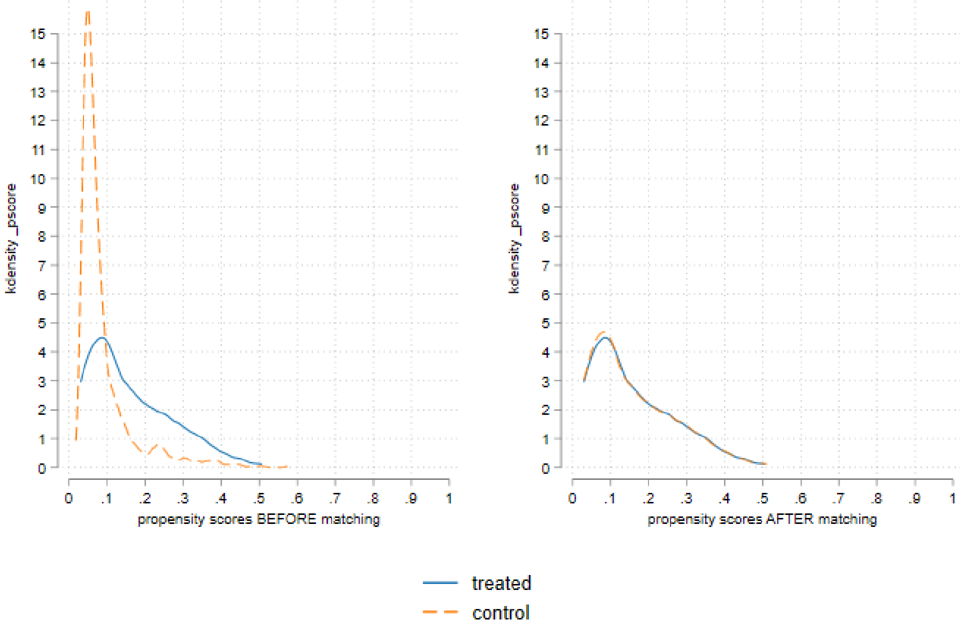
| | *Treated* | $\Delta Log(loans)$ | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Deposit Beta (2021Q2) | 0.4505*** | | |
| | (0.005) | | |
| DEP_OUTFLOW | | 0.1496 | |
| | 0.0045 | | |
| | | (0.164) | |
| | (0.010) | | |
| DEP_OUTFLOW × Tightening | | -0.0515** | -0.0695*** |
| | | (0.020) | (0.026) |
| L.CET1 ratio | 10.602*** | 0.0321 | -0.4080** |
| | (0.028) | (0.248) | (0.194) |
| L.DEP/TA | 0.4005*** | 0.0485 | -0.0233 |
| | (0.0107) | (0.097) | (0.146) |
| L.TA (log) | 0.2581*** | -0.0091 | 0.0009 |
| | (0.000) | (0.016) | (0.036) |
| L.LOAN/TA | 0.4782*** | -0.0801 | -0.0852 |
| | (0.012) | (0.140) | (0.150) |
| L.ROA | -0.2767*** | 0.0003 | 0.0080 |
| | (0.002) | (0.017) | (0.010) |
| L.NPLs ratio | -0.2322*** | 0.0143 | 0.0050 |
| | (0.000) | (0.011) | (0.006) |
| L.CASH/TA | -3.2484*** | 0.1877 | 0.0926 |
| | (0.013) | (0.236) | (0.098) |
| Observations | 6,000,078 | 4,623,573 | 4,623,573 |
| Bank FE | No | No | Yes |
| Borrower*time FE | No | Yes | Yes |
| Cragg-Donald Wald F-statistic | 4276.464 | | |

# A Additional charts

**Table 13:** Number of banks by country

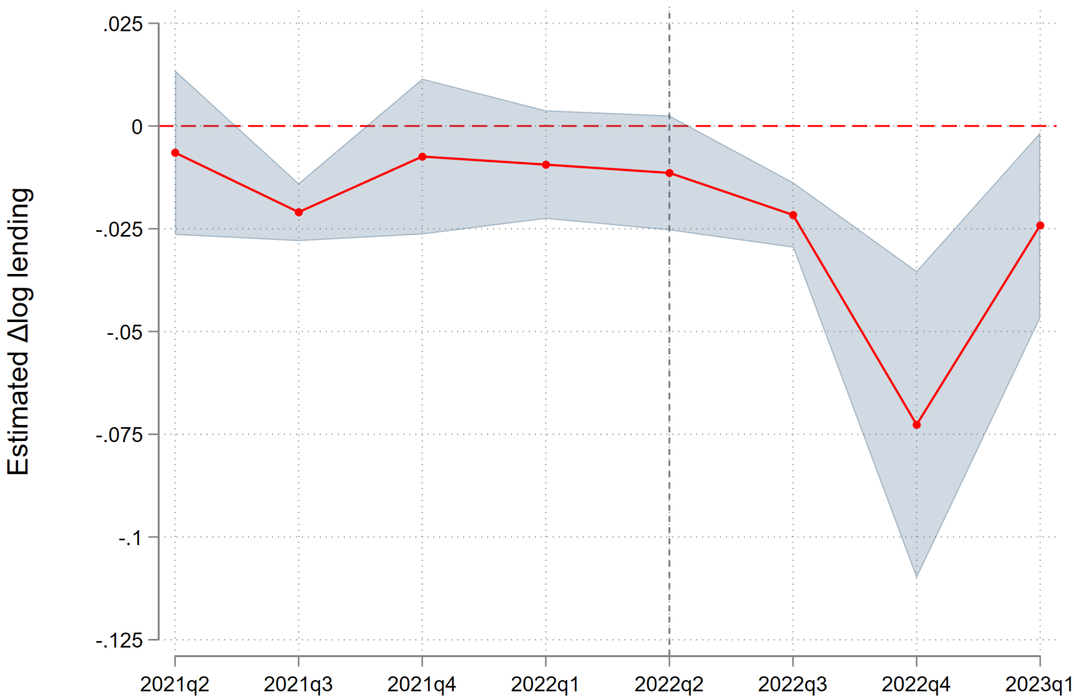
| Country | N.Banks | N.Firms |
|---|---|---|
| AT | 345 | 20,467 |
| BE | 12 | 29,699 |
| CY | 9 | 2,924 |
| DE | 787 | 126,482 |
| EE | 8 | 1,360 |
| ES | 40 | 159,102 |
| FI | 10 | 15,588 |
| FR | 57 | 87,867 |
| GR | 9 | 1,241 |
| IE | 12 | 4,982 |
| IT | 214 | 261,697 |
| LT | 4 | 662 |
| LU | 48 | 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 |

**Figure A.1:** P-score before and after matching



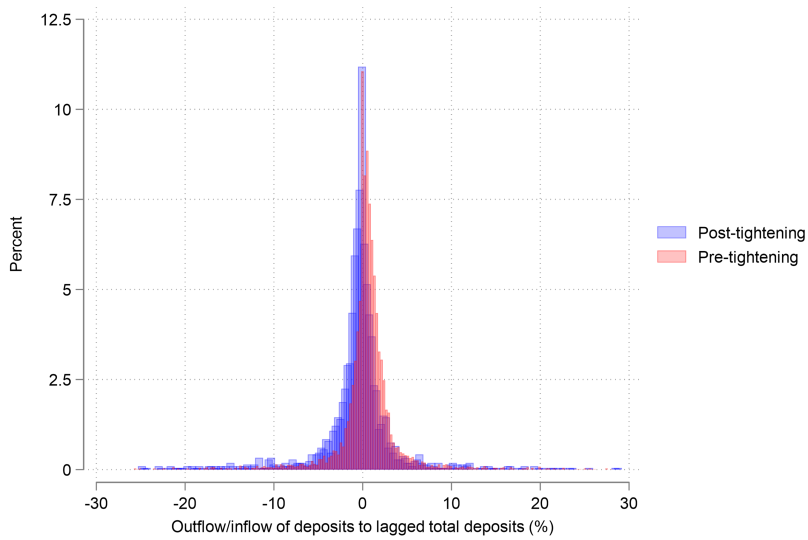

**Note:** The chart plots the Kernel density function of the propensity scores for the treated (blue solid line) and the control (yellow dashed line) before (left) and after (right) the application of the propensity score matching approach. The propensity score matching is applied via a logit model and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

**Figure A.2:** Conditional parallel trend assumption based on PSM



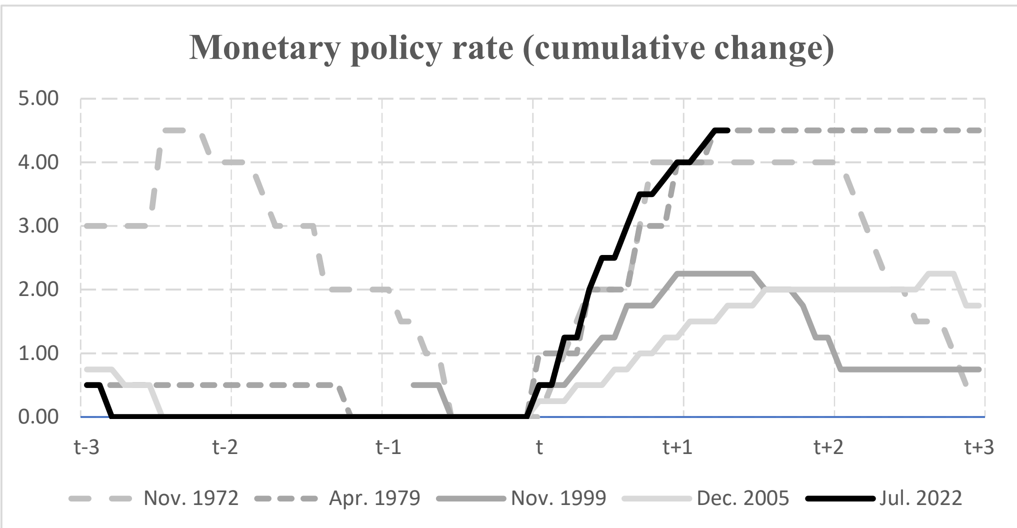

**Note:** The chart plots the PSM point estimates (red solid line) along with the confidence intervals at the 90% level (grey shaded area) from dynamic regressions, where the dummy DEP_OUTFLOW is interacted with quarterly dummies. The horizontal red dashed line indicates the zero while the vertical grey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

**Figure A.3:** Outflows/inflows of deposits distribution pre-post tightening




**Note:** Distribution of net flows of overnight and term deposits before (from the first quarter of 2020 to the second quarter of 2021) and after (from the third quarter of 2021 to the first quarter of 2023) the tightening in the monetary policy.

**Figure A.4:** Cumulative increase of monetary policy rates (ECB and Bundesbank; percentage points)




**Sources:** Sources: ECB and Bundesbank.

**Notes:**: The ECB 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.

**Table A1:** 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 is from 2021Q1-2023Q1. $\Delta$ 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 only for banks experiencing constant deposit inflows post 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 ratio. Standard errors are clustered at bank and firm level. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

| | *Dependent variable: $\Delta$ Log (loans)* | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| DEP_OUTFLOW | 0.0030 | | |
| | (0.006) | | |
| DEP_OUTFLOW*Tightening | -0.0276*** | -0.0205** | -0.0214** |
| | (0.010) | (0.010) | (0.010) |
| L.CET1 ratio | -0.0539* | 0.2881*** | 0.2856*** |
| | (0.033) | (0.104) | (0.106) |
| L.DEP/TA | 0.0525*** | 0.2127 | 0.2416 |
| | (0.018) | (0.175) | (0.178) |
| L.TA (log) | 0.0046*** | 0.1291*** | 0.1425*** |
| | (0.002) | (0.040) | (0.043) |
| L.LOAN/TA | -0.0347** | 0.0160 | -0.0158 |
| | (0.015) | (0.107) | (0.107) |
| L.ROA | -0.0017 | 0.0132* | 0.0134* |
| | (0.003) | (0.007) | (0.007) |
| L.NPLs ratio | -0.0003 | 0.0057 | 0.0055 |
| | (0.001) | (0.007) | (0.007) |
| L.CASH/TA | -0.0797** | -0.1510* | -0.1640* |
| | (0.036) | (0.085) | (0.089) |
| Constant | -0.0673** | -1.7319*** | -1.8851*** |
| | (0.029) | (0.524) | (0.555) |
| Observations | 1,137,038 | 1,137,035 | 1,137,031 |
| Bank FE | No | Yes | Yes |
| Borrower*time FE | Yes | Yes | Yes |
| Country*time FE | 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 2 shows in detail the computation of the duration gap.

$$DurationGap = \sum_{j=1}^{14} \frac{DUR_j}{1+i} \left( \frac{A^j - L^j}{Z} \right) \tag{2}$$

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).[25] 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

[25] 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.

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 controlling for hedging positions against interest rate risk exposure.

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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.

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