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Hidden weaknesses: the role of unrealized losses in monetary policy transmission

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Abstract

This paper investigates how unrealized losses on banks' amortized cost securities affect monetary policy transmission to bank lending in the euro area. Leveraging the sharp increase in interest rates between 2022 and 2023 and using granular supervisory data on security holdings and loan-level credit register data, we show that a one percentage point increase in the share of unrealized losses on amortized cost securities amplifies the contractionary effect of monetary tightening on lending supply by approximately one percentage point. This effect is more pronounced for weakly capitalized and less liquid banks, and those relying more on uninsured deposits. We further document that banks respond to growing unrealized losses by raising capital and passing through interest rate increases to depositors via higher deposit betas. Importantly, banks that employ interest rate hedging strategies can fully offset the negative impact of unrealized losses on credit supply. The contraction in lending is particularly severe for smaller borrowing firms, highlighting the uneven economic consequences of hidden balance sheet fragilities during a tightening cycle.

Keywords: Unrealized losses, security holdings, monetary policy transmission, bank lending, amortized cost accounting

JEL Classifications: E43, E52, G21, G32, M41

Non-technical summary

The banking turmoil in the United States in March 2023 renewed attention on the adverse effects of rising interest rates on banks, particularly on their debt security portfolios. The collapse of Silicon Valley Bank highlighted how rapid changes in monetary policy can undermine banks' financial health by devaluing long-term fixed-income securities. As interest rates rise, the market value of these securities, especially those with longer maturities, such as government bonds, declines. Although many of these losses are classified as unrealized under accounting standards, they may still significantly reduce the economic value of banks' equity. The question, therefore, remains whether such unrealized losses materially affect the transmission of monetary policy to banks' lending supply.

From a theoretical perspective, there is no clear consensus on this issue. While accounting standards may delay the recognition of losses, as unrealized losses do not immediately reduce the capital reported in regulatory filings, it is not evident that this deferral fully insulates a bank's lending behavior. Under IFRS 9, securities classified as "amortized cost" are valued based on their original purchase price and are not marked to market, meaning that unrealized losses on these assets should not affect reported equity or profit and loss statements. Hence, in theory, this accounting treatment is intended to shield banks from the need to realize losses during times of stress, suggesting that lending behavior should remain unaffected. However, the economic reality reflected in these unrealized losses cannot be entirely ignored. These losses still represent potential declines in value that may materialize if a bank is forced to sell amortized cost securities before maturity, particularly during periods of financial stress when liquidity constraints may necessitate such sales.

This paper examines how unrealized losses on debt securities classified as amortized cost affect bank lending supply during the 2022–2023 monetary policy tightening. In this context, we also analyze whether the interaction of unrealized losses with balance sheet characteristics, such as capital, funding, and liquidity positions, amplifies the effect of monetary policy on lending. Finally, we assess whether the impact of monetary policy tightening differs across borrowing firms of different sizes.

Our empirical analysis is based on a rich micro-level dataset that combines bank-firm lending data with supervisory information on banks' unrealized losses on amortized cost securities. Methodologically, we employ a difference-in-differences approach to estimate the effect of these losses on the transmission of monetary policy to credit supply. This granular dataset and empirical strategy allow us to isolate supply-side effects by comparing lending to the same borrowers across banks with differing levels of unrealized losses.

Our findings indicate that unrealized losses on amortized cost securities significantly constrained lending during the 2022–2023 tightening cycle. Banks with larger unrealized losses reduced lending more sharply following the onset of monetary policy tightening, with the effect more pronounced among banks with weaker capital, funding, and liquidity positions. Moreover, we find an asymmetric impact across borrowers, with smaller firms experiencing a more severe contraction in credit.

Taken together, these results suggest that, although deferred in financial reporting, unrealized losses amplify the contractionary impact of monetary policy on credit supply, particularly for banks already under financial strain.

1 Introduction

The banking turmoil of March 2023, marked by the collapse of Silicon Valley Bank (SVB), renewed attention on how rising interest rates can pressure banks' balance sheets. SVB's failure showed that large unrealized losses on long-term fixed-income securities can erode economic capital, increase liquidity risk, and ultimately destabilize the funding base (Drechsler et al., 2023; Granja, 2023; Granja et al., 2024; Greenwald et al., 2024; Jiang et al., 2024). Although these losses are not immediately reflected in regulatory capital or earnings, they may still undermine confidence and prompt a broader reassessment of the banking sector (Bergant et al., 2025). These events raise several important questions: beyond their accounting treatment, do unrealized losses on amortized cost securities shape how banks behave during a tightening cycle? More specifically, how do such losses affect lending supply when interest rates rise sharply and swiftly, and which banks are most exposed? This paper aims to answer these questions.

From a theoretical standpoint, it is not clear *ex ante* whether unrealized losses on securities held at amortized cost should affect bank lending. Amortized cost accounting is designed to shield banks from temporary market fluctuations by excluding valuation losses from regulatory capital and reported earnings (Ryan, 2011). Yet, economic frictions may still arise. In a rising rate environment, large unrealized losses can reduce the economic value of equity, tighten collateral constraints in funding operations, or increase liquidity pressures if banks fear they may be forced to sell assets and realize losses (Ivashina and Scharfstein, 2010; Diamond and Rajan, 2011; Gambacorta and Marques-Ibanez, 2011; Chodorow-Reich, 2014; Bord et al., 2021). Moreover, such hidden losses can affect the behavior of uninsured depositors or market counterparties, especially when financial conditions deteriorate, potentially increasing the risk of destabilizing outflows or even bank runs (Drechsler et al., 2017, 2021, 2023). As a result, while accounting rules defer recognition, they may not fully eliminate banks' exposure to unrealized losses on amortized cost portfolios. Whether and how these losses affect the transmission of monetary policy to bank lending thus remains an open question.

To address this question, we compile a uniquely granular dataset of more than five million observations at the bank–firm–quarter level by merging multiple confidential supervisory sources available at the European Central Bank (ECB). Specifically, we combine detailed bank-level data on amortized cost securities from the *Securities Holdings Statistics Group* database, firm-level lending information on term loans (including amounts, borrower size, location, and industry) from *AnaCredit* – a large and harmonized credit registry developed by the Eurosystem – and regulatory data on banks' balance sheets from ECB Supervisory Statistics. This rich dataset allows us to precisely measure unrealized losses, which we use to examine how these losses affect the lending behavior of 82 euro area banks to 411,965 borrowing firms across 18 eurozone countries during the 2022–2023 monetary tightening cycle.

Methodologically, we estimate a panel regression at the bank–firm–quarter level, saturated with highly granular fixed effects, to isolate credit supply effects across multiple bank relationships, following the methodoly of Khwaja and Mian (2008). In additional tests, we also focus on single-bank relationships, in line with the approaches of Acharya et al. (2019), Degryse et al. (2019), and Berg et al. (2021). Our identification strategy leverages the sharp and unprecedented monetary tightening cycle in the euro area during 2022–2023. We then interact banks' unrealized losses on amortized cost securities – measured as the difference between nominal and market values at the security holding level and then aggregated at the banking group level – with a monetary policy tightening indicator that captures the start of the ECB's rate hike cycle in July 2022. Importantly, in all our analyses, we control for a wide set of bank characteristics that prior literature has shown to affect bank lending behavior (Kishan and Opiela, 2000; Gambacorta, 2005; Jiménez et al., 2020).

Our results show that unrealized losses significantly amplify the contractionary effects of monetary tightening on credit supply. Specifically, banks with larger unrealized losses reduce lending more than their peers following the start of the 2022–2023 monetary policy tightening cycle. The estimated effect is not only statistically significant but also economically meaningful: a one percentage point increase in unrealized losses is associated with an approximately equivalent decline in lending growth. These results are robust across a wide range of specifications, including controls for losses on fair value securities portfolios, matching techniques, and alternative fixed-effects structures and estimation methods. Finally, our conclusions remain unchanged when we replace the monetary policy indicator with a continuous measure of the deposit facility rate. Across all these tests, the evidence consistently indicates that unrealized losses on amortized cost securities materially amplify the contractionary impact of monetary tightening on bank lending.

An important question that arises is which banks are most exposed to the amplifying effects of unrealized losses during monetary tightening. In cross-sectional analyses, we find that the impact is not uniform but varies systematically with banks' balance sheet vulnerabilities. Specifically, we show that the contractionary effect of unrealized losses is significantly stronger for banks with weaker liquidity positions, limited capital buffers, or a greater reliance on unstable funding sources such as uninsured deposits. In particular, banks with lower liquidity coverage ratios are more likely to restrict lending, as they face stronger incentives to avoid selling securities at a loss to meet short-term funding needs. We also find that banks with smaller capital buffers, *i.e.*, those closer to the Maximum Distributable Amount threshold, cut credit more aggressively to preserve regulatory capital. Finally, banks that depend heavily on uninsured deposits exhibit the largest lending reductions, consistent with greater withdrawal risk and funding pressures. Taken together, these results suggest that unrealized losses can meaningfully intensify the transmission of monetary policy to credit supply, particularly for financially constrained banks.

Next, building on insights from Bischof et al. (2021, 2023), we ask whether banks take active steps to mitigate the adverse effects of these hidden weaknesses. We find that banks with larger unrealized losses on amortized cost securities undertake a range of corrective actions. First, they reinforce their capital buffers by raising their CET1 ratios and increasing their distance to the Maximum Distributable Amount, suggesting a precautionary effort to preserve regulatory capital. Second, these banks more actively pass through policy rate increases to depositors, as reflected in higher deposit betas – a response likely driven by depositor discipline and defensive pricing strategies aimed at stabilizing the funding base. Finally, we find that banks that use derivatives to hedge interest rate risk on amortized cost securities are able to offset the negative lending effects of unrealized losses during the tightening phase. Collectively, these findings suggest that banks respond to rising interest rates not only by tightening credit, but also by actively managing their capital, funding, and interest rate exposure to mitigate risks.

In the last set of analyses, we then examine how the contraction in credit supply associated with unrealized losses is distributed across different types of borrowers. The results point to an uneven impact, with smaller firms disproportionately affected. In contrast, the effect is more muted for larger firms, which typically face fewer informational frictions and have better access to alternative market-based financing sources. These findings are consistent with prior literature showing that smaller firms are more vulnerable to credit supply shocks and less able to substitute away from bank credit (Boot Arnoud, 2000; Becker and Ivashina, 2014, 2018; Chodorow-Reich et al., 2022). Hence, when banks face unrealized losses on their securities portfolios in the wake of a tightening cycle, the resulting lending contraction is borne most heavily by those borrowers least equipped to absorb it.

This paper makes two contributions to the literature. First, we add to the current debate on the role of accounting rules in shaping financial stability and monetary policy transmission during the 2022-2023 tightening cycle. Recent work shows that U.S. banks incurred large unrealized losses on held-to-maturity (HTM) securities as rates rose (Flannery and Sorescu, 2023; Jiang et al., 2024). Some banks, particularly those with lower capital ratios and higher share of run-prone uninsured depositors, responded by reclassifying securities from available-for-sale (AFS) to HTM during 2021 and 2022, in the attempt to protect their balance sheets from mark-to-market losses (Granja, 2023). Relatedly, Drechsler et al. (2023), Haddad et al. (2023), and Amador and Bianchi (2024) highlight the critical interaction between the deposit funding structure and banks' balance sheet vulnerabilities when interest rate increase and long-term asset values decline. Other studies, such as McPhail et al. (2023) and Granja et al. (2024), focus on hedge accounting and show that U.S. banks largely failed to hedge the interest rate risk of their assets during the 2022 tightening cycle, while Gopalan and Granja (2023) examine the supervisory process and find that bank supervisors responded to rising interest rate risk only after tightening began, highlighting a delayed and uneven regulatory response. Within this literature, the closest study to ours is Greenwald et al. (2024), who show that unrealized losses on available-for-sale (AFS) securities lead to credit contractions during the 2022–2023 tightening cycle.[1] Unlike their paper, however, we focus on securities held at amortized cost and show that even these "hidden" unrealized losses – excluded from regulatory capital and earnings – can meaningfully constrain lending, especially for banks with weak liquidity, thin capital buffers, or unstable funding sources. Moreover, while most existing evidence is U.S.-focused, our analysis leverages comprehensive and highly granular supervisory data from the euro area, providing a different perspective on how amortized cost accounting interacts with monetary policy under different institutional and regulatory settings.[2]

Second, our paper also contributes to the broader literature that studies the link between accounting and financial stability (Acharya and Ryan (2016), for a review).[3] This literature has examined, among other things, the role of fair value accounting during the Global Financial Crisis (GFC) of 2007–2009 (Laux and Leuz, 2009, 2010; Badertscher et al., 2012; Bischof et al., 2021), bank disclosure on stability (Dang et al., 2017; Granja, 2018; Costello et al., 2019), and the provisioning for loan losses (Beatty and Liao, 2011; Bushman and Williams, 2012, 2015; Granja and Nagel, 2025). Within this framework, our paper focuses on the effects of amortized cost accounting under IFRS and its interaction with monetary policy transmission. In doing so, we uncover a hidden transmission channel linked to unrealized losses on amortized cost

[1]Other studies examining the impact of monetary tightening on bank lending include Cappelletti et al. (2024); Coulier et al. (2024); Behn et al. (2025) and Burlon et al. (2025).

[2]Our paper is also related to Orame et al. (2025), who study the role of historical cost accounting (HCA) in shaping the transmission of the ECB's quantitative easing program. However, we differ in focus (amortized cost classification under IFRS vs. HCA in macroprudential regulations), policy context (monetary tightening vs. QE), and scope (a cross-country euro area sample vs. only Italian banks). While they find that HCA dampens the effects of QE, we show that amortized cost accounting amplifies the impact of rate hikes on credit supply.

[3]For broader reviews on the literature on banks' financial reporting, see Ryan (2011) and Beatty and Liao (2014).

securities, which materially shapes lending outcomes during a tightening cycle. Our findings suggest that the insulation offered by amortized cost accounting may be limited in high-interest rate environments, raising broader implications for the role of accounting in promoting financial stability.

2 Background on Accounting Classification of Financial Assets and Hypothesis Development

The accounting impact of rising interest rates on the value of banks' amortized cost portfolios depends significantly on their classification under international accounting standards (IAS). Historically, under IAS 39, financial assets were categorized as Held-to-Maturity (HTM), Available-for-Sale (AFS), or Fair Value Through Profit or Loss (FVTPL), each with distinct implications for how valuation adjustments were recognized in financial statements.[4] With the adoption of International Financial Reporting Standards (IFRS) 9 – initially issued in July 2014 and fully implemented on January 1, 2018 – this classification system underwent significant reform. IFRS 9 replaced IAS 39 with a forward-looking, principles-based approach requiring banks to classify financial assets based on their business model for managing those assets and the contractual characteristics of the assets' cash flows. The shift aimed to enhance transparency and comparability in financial reporting, particularly around risk and loss recognition (Laux and Leuz, 2009, 2010; Barth and Landsman, 2010; Bushman and Williams, 2012; Onali and Ginesti, 2014; Novotny-Farkas, 2016; Harris et al., 2018; Beatty and Liao, 2021; López-Espinosa et al., 2021; Wheeler, 2021).

Under IFRS 9, financial assets fall into three main categories: amortized cost (AC), fair value through other comprehensive income (FVTOCI), and fair value through profit and loss (FVTPL). For FVTPL securities, valuation losses immediately impact earnings. FVTOCI securities instead record valuation losses in equity via other comprehensive income, bypassing

[4]For additional information, we refer the reader to the IAS 39 classification: https://www.ifrs.org/issued-standards/list-of-standards/ias-39-financial-instruments-recognition-and-measurement/.

the profit and loss account but still affecting a bank's financial position. Securities held at amortized cost are typically intended to be held to maturity, with valuation losses classified as *unrealized* – not affecting profit or equity.[5] This paper focuses on these unrealized losses, which, despite being unrecognized in financial statements, may have meaningful implications for banks' financial health and credit provision.

Since Q4 2021, when market expectations of rate hikes began to materialize, banks became increasingly exposed to unrealized losses on debt securities classified at amortized cost. This exposure stemmed from a sharp deterioration in market values caused by the swift monetary tightening cycle.[6] Although unrealized losses are not booked against earnings or equity, they still represent material balance sheet risks. Their magnitude suggests that even assets insulated from mark-to-market rules can impose real financial constraints during periods of monetary tightening. By the end of 2022, the book value of debt securities held by EU banks exceeded €2.2 trillion, with around €1.3 trillion held at amortized cost. These holdings generated gross unrealized losses of around €124 billion.[7]

Unrealized losses on amortized cost securities can affect bank lending through three main channels. First, they may reduce the economic value of equity, weakening future earning and capital-generation capacity, and thus reducing credit supply (Peek and Rosengren, 2000; Gambacorta and Marques-Ibanez, 2011; Chodorow-Reich, 2014; Bord et al., 2021). Second, lower valuations diminish the value of assets available as collateral in funding operations, possibly raising funding costs (Berger and Bouwman, 2009; Ivashina and Scharfstein, 2010). Third, liquidity-constrained banks may fear having to sell securities to meet short-term obligations, thereby realizing losses (Diamond and Rajan, 2011). This risk could incentivize preemptive

[5]For IFRS 9 securities' classification, we refer the reader to: https://www.ifrs.org/issued-standards/list-of-standards/ifrs-9-financial-instruments/.

[6]Some banks explicitly disclosed these exposures. For example, Mediobanca's Annual Report (June 2023) states that the rise in interest rates led to unrealized losses of €119.7 million on its Hold to Collect portfolio (measured at amortized cost), and further fair value declines in its FVTOCI portfolio, where the OCI reserve deepened from −€60.9 million in June 2022 to −€73.2 million in June 2023 https://www.mediobanca.com/static/upload_new/ann/annual-report-30-june-2023.pdf.

[7]For additional details, we refer the reader to: https://www.eba.europa.eu/publications-and-media/press-releases/eba-publishes-findings-ad-hoc-analysis-banks-bonds-holdings.

deleveraging through credit contraction. In sum, falling market values for amortized cost holdings can pose significant risks to lending, even if the losses remain unrealized, by creating potential equity shortfalls or liquidity pressures that affect credit decisions.

At the same time, we also note that the structure of the amortized cost accounting is intended to insulate banks from such valuation effects (Barth, 1994; Barth et al., 1995; Ryan, 2011; ESRB, 2017). By excluding unrealized losses on amortized cost securities from profit and equity, the accounting treatment theoretically shields banks from short-term price fluctuations (Kim et al., 2019). In principle, these assets are to be held to maturity, limiting the relevance of interim price movements and reducing pressure to mark them to market.

Together, these forces create an inherent tension in the potential effects of rising interest rates. On the one hand, unrealized losses could impair lending through balance sheet and funding channels. On the other hand, the accounting rules on amortized cost securities are designed to neutralize these effects. As a result, the net impact on credit supply is theoretically ambiguous. Hence, we state our null hypothesis as follows.

Hypothesis: *Unrealized losses do not influence bank lending when monetary policy tightens.*

In the empirical analysis that follows, we first assess whether and to what extent unrealized losses have affected the bank lending channel during the 2022-2023 monetary tightening. We then explore whether certain bank characteristics, such as liquidity, capital buffers, or funding structure, exacerbate or mitigate the transmission of unrealized losses to credit supply.

3 Methodology

To analyze whether and to what extent unrealized losses on amortized cost securities impact the bank lending behavior in response to the 2022-2023 monetary policy tightening, we employ the following bank-borrower-level panel regression model:

$$Loan\ growth_{i,c,j,t} = \alpha + \beta_1 MP\_Tightening_t + \beta_2 UL_{i,c,t-1} + \\ + \beta_3[UL_{i,c,t-1} \times MP\_Tightening_t] + \\ + \beta_4 X_{i,c,t-1} + \beta_5[X_{i,c,t-1} \times MP\_Tightening_t] + \\ + \delta_{j,t} + \gamma_{i,c} + \lambda_{c,t} + \mu_{i,c,j} + \epsilon_{i,c,j,t} \tag{1}$$

In this specification, we regress lending growth, defined as the first-differenced logarithm of the outstanding lending amount ($Loan\ Growth_{i,c,j,t} = \log(Loan_{i,c,j,t}) - \log(Loan_{i,c,j,t-1})$ between bank i in country c and the borrowing firm j, on a monetary policy tightening dummy ($MP\_tightening_t$) that is equal to one after the second quarter of 2022, that is, after the start of the tightening cycle, and zero for the preceding quarters.[8]

This empirical setting is particularly well suited for identification due to the unprecedented pace and magnitude of the ECB's interest rate increases. Starting in July 2022, the ECB implemented its fastest and most substantial hiking cycle since the inception of the euro, with cumulative increases far exceeding market expectations at the time. As Figure 1 shows, while some increase in interest rates was anticipated due to inflationary pressures that began in the summer of 2021 (Gagliardone and Gertler, 2023), the pace and magnitude of the hikes were significantly larger than expected. The ECB Survey of Monetary Analysts (SMA) indicates that expectations prior to July 2022 were considerably lower than the realized rates,[9] limiting the ability of banks to fully adjust their balance sheets and lending activities in advance.[10] Importantly, even as late as June 2022, forecasts still suggested only modest rate increases,

[8] In our baseline regression, we use the monetary policy tightening dummy to capture the effects of the monetary tightening. However, in Section 5.5, as a robustness test, we use the quarter-on-quarter change in the deposit facility rate as our monetary policy measure instead of the monetary policy tightening dummy and find unchanged results.

[9] The SMA collects information on capital market participants' expectations about the evolution of key monetary policy parameters, financial market variables, and the wider economy around the time of the Governing Council meetings. For further information, please see https://www.ecb.europa.eu/stats/ecb_surveys/sma/html/index.en.html

[10] While our analysis focuses on euro area banks, evidence from the United States suggests a similar lack of balance sheet adjustments during the initial stages of monetary tightening (Fuster et al., 2024).

making the nearly 4 percentage point rise over the subsequent 12 months all the more surprising. These unexpected and rapid rate increases allow us to examine whether and the extent to which unrealized losses on amortized cost securities constrain bank lending behavior (see, for example, Behn et al. (2025) for a similar approach).

To isolate the role of unrealized losses in shaping banks' lending responses to the 2022–2023 monetary policy tightening, we interact lagged unrealized losses ($UL_{i,c,t-1}$) with the monetary policy tightening dummy ($MP\_Tightening_t \times UL_{i,c,t-1}$).[11] We calculate unrealized losses as the difference between the nominal and market values for each security held in a bank's portfolio, using security data at the International Securities Identification Number (ISIN) level. This high degree of granularity, combined with detailed accounting classification data, is a key and distinctive feature of our analysis, as it enables us to accurately quantify unrealized losses at the security holding level across euro area banks. These losses are subsequently aggregated at the banking group level and scaled by total assets in the preceding quarter, enabling our model to reflect the relative importance of these losses within a bank's balance sheet. Importantly, we lag unrealized losses by one quarter to mitigate concerns of reverse causality, ensuring that our measure of loss exposure is predetermined in time $t-1$ with respect to lending decisions in time t. Furthermore, it is worth pointing out that our group-level aggregation is consistent with prior empirical studies such as Benetton and Fantino (2021), Bottero et al. (2022), and Orame et al. (2025).

The coefficient of interest is the interaction term β_3. Given our discussion on amortized cost securities' prices in Section 2, we do not have any *ex ante* expectation regarding the sign and significance of the coefficient. As argued earlier, lower prices of amortized cost securities alone should not influence lending growth following the initiation of monetary policy tightening, as banks are not supposed to sell these securities to free up resources. However, price declines of amortized cost securities increase the risk of realizing losses, should a bank be forced to sell

[11] We acknowledge that the composition of banks' securities portfolios is an internal and potentially endogenous choice. However, we leverage the fact that the pace and magnitude of the ECB's tightening cycle were largely unanticipated at the time these portfolio choices were made. This should mitigate concerns that our results are driven by banks' anticipation of policy changes and strengthen our identification strategy.

off its amortized cost securities when asset prices are low (and thus realize or crystallize the loss by selling securities at a discount to book value, Fuster et al. (2024)). Such a realization, in turn, could reduce a bank's lending capacity. Considering this tension, our null hypothesis predicts that the β_3 coefficient will be statistically insignificant (β_3=0).

We also include a vector of control variables in all models ($X_{i,c,t-1}$), lagged by one period to address potential endogeneity and reverse causality concerns. We begin by controlling for the distance to the Maximum Distributable Amount (MDA). This variable measures the distance between the bank's current CET1 ratio and the level of its capital requirements and controls for bank solvency beyond mandatory capital requirements (Couaillier et al., 2024). We also control for multiple lagged bank-level factors known from prior research to affect bank-firm lending (Kishan and Opiela, 2000; Gambacorta, 2005; Gambacorta and Marques-Ibanez, 2011; Jiménez et al., 2020). Specifically, we control for return on assets (ROA) and the cost-to-income ratio (CIR) to measure differences in profitability and cost structure, $Bank\ size$ to account for differences in the size of banks' balance sheet and non-performing loan ratios (NPL) to control for the asset quality of the loan portfolio, cash over total assets ($Cash$) to proxy for bank liquidity positions, and risk-weighted assets (RWA) to account for the riskiness of banks' assets. Importantly, we follow the approach of Gomez et al. (2021) and allow each control to have a heterogeneous impact on lending following the initiation of the monetary policy tightening by interacting it with the monetary policy tightening dummy ($MP\_Tightening_t \times X_{i,c,t-1}$). Conditional on the monetary policy tightening, this approach ensures that any lending effect stems only from unrealized losses and is not due to the heterogeneous impact of other bank-specific characteristics. We winsorize continuous variables at the 2.5% and 97.5% percentiles to address outliers and report detailed variable definitions in Appendix A.[12]

To control for various unobserved factors, we also saturate the model with other highly granular fixed effects: $\delta_{j,t}$ represents borrower-quarter fixed effects, $\mu_{i,c,j}$ accounts for banking group–borrower fixed effects, and $\gamma_{i,c}$ denotes banking group fixed effects. Borrower-quarter

[12]In Table OA1 of the Online Appendix, we alternatively winsorize at the 1% and 99% levels and find qualitatively similar results.

fixed effects are particularly important in this setting, as they allow us to exploit variation in lending by different banks to the same borrowing firm in the same period, thereby controlling for firm-specific credit demand shocks and other time-varying heterogeneity at the borrower level (Khwaja and Mian, 2008). Moreover, the inclusion of banking group–borrower fixed effects allows us to address the endogenous matching between banks and firms and to control for unobserved heterogeneity in credit access (Paligorova and Santos, 2017). Banking group fixed effects control for unobserved time-invariant bank-specific characteristics, such as the business model, which, under the IFRS 9 regulation, must align with securities classification.[13] Furthermore, in some econometric specifications, we include country–quarter fixed effects ($\lambda_{c,t}$), thus effectively controlling for any macroeconomic and policy changes at the country level during the monetary policy tightening period. Given that we include borrower–quarter fixed effects across all our models, the indicator variable for monetary tightening ($MP\_Tightening_t$) is entirely subsumed by these fixed effects and therefore does not appear separately in the analyses. Finally, standard errors are two-way clustered at the bank and borrower levels across all regression specifications to account for potential correlation within these clusters (Petersen, 2008).

[13] We acknowledge that a bank's business model, including its internal risk preferences or strategic motivations for holding certain securities, may evolve over time and affect a bank's investment strategies (Hodder et al., 2002; Ellul et al., 2014; Paananen et al., 2012; Bischof et al., 2023). However, IFRS 9 requires securities classification to reflect the bank's business model at the time of initial recognition, and reclassification is limited to rare cases, as regulators heavily scrutinize these reclassifications (Orame et al., 2025). Moreover, our analysis focuses on a relatively short time window (2021–2023), during which such structural shifts are less likely to occur broadly or rapidly. Hence, the banking group fixed effects should reasonably control for time-invariant dimensions of business models, mitigating concerns about omitted variable bias from unobserved heterogeneity. Nonetheless, to verify whether reclassifications played a role in our setting, we reviewed the annual reports of the 82 banks in our sample for the fiscal years 2022 and 2023 and found no evidence of material reclassification. This contrasts with the United States, where banks appear to have used such accounting tools during the recent monetary tightening cycle (Granja, 2023; Granja et al., 2024).

4 Data and descriptive statistics

4.1 Data

To analyze the effect of unrealized losses on loan supply during the recent monetary tightening cycle, we construct a large and highly granular dataset at the banking group–borrowing firm level, relying on multiple confidential data sources. We proceed as follows. First, we collect lending data and borrower characteristics from the *AnaCredit* database, the pan-European credit register of the European System of Central Banks, which contains corporate credit information on all individual bank loans to borrowing firms above EUR 25,000.[14] Developed jointly by the European Central Bank and national central banks, *AnaCredit* provides a harmonized reference for bank credit across the euro area, making it particularly well suited for cross-country analysis. Specifically, the database offers detailed information on various loan characteristics, such as outstanding amounts, as well as on borrowing firms (e.g., size, location, and industry) and lending banks (including location and group structure). Since the data are reported at the individual banking entity level, we consolidate the lending activity at the banking group–borrower level (see, for example, Cappelletti et al. (2024) and Behn et al. (2024), for a similar approach). Importantly, we restrict the sample to term loans, as they represent the largest component of supply-side loan-level data in *AnaCredit*. Moreover, prior literature suggests that other instruments, such as credit lines, are primarily demand-driven (Greenwald et al., 2020).[15]

Second, we gather data on banking groups' amortized cost securities from the Securities Holdings Statistics Group (*SHSG*) database, which provides end-of-quarter ISIN-level information on securities holdings to compute unrealized losses. As outlined in Section 3, we measure unrealized losses as the difference between the nominal and market values for each

[14]For further information on *AnaCredit*, we refer the reader to `https://www.ecb.europa.eu/stats/money_credit_banking/anacredit/html/index.en.html`.

[15]This focus on term loans should also help address concerns about heterogeneity in loan types raised by Acharya and Ryan (2016), who emphasize that different types of loans may be subject to different accounting treatments and loss recognition standards, potentially confounding supply-side effects. By restricting our analysis to a single loan type, we aim to mitigate this source of variation.

security holding at the ISIN level.[16] Third, we collect information on bank characteristics from two administrative databases: the ECB's financial reporting (*FINREP*) and common reporting (*COREP*) supervisory statistics. Both are confidential supervisory databases based on harmonized reporting standards, and euro area banks are required to provide accurate information.[17]

After intersecting multiple data sources, the final matched sample comprises quarterly data on lending activity, unrealized losses on amortized cost securities, and bank and borrower characteristics for 82 banks from the third quarter of fiscal year 2021 to the second quarter of fiscal year 2023. Similar to Greenwald et al. (2024), we focus on a relatively short period to examine how unrealized losses on amortized cost securities impact bank lending in a monetary policy tightening environment while avoiding other confounding events, such as, for example, fiscal policy measures, to influence bank lending behavior in the post-pandemic years.[18]

Figure 2 illustrates the distribution of the 82 banks by country, with Germany (15 banks), Italy (12 banks), and Spain (10 banks) being the most represented, while smaller countries like Estonia, Lithuania, and Slovenia contribute only one bank each to the sample. This distribution is broadly in line with the relative economic sizes of the euro area economies, as larger economies such as Germany, Italy, and Spain are expected to have a greater number of banks in the sample, reflecting their overall economic scale and financial sector size (Kosekova et al., 2025). Relatedly, the distribution of bank-firm observations, while uneven, reflects the economic relevance and depth of credit markets across euro area countries. As shown in Table 1, France, Italy, and Spain account for the vast majority of observations, followed by

[16] For papers relying on similar data sources see, for example, Barbiero et al. (2024). For additional information on the SHSG database, we refer the reader to: `https://data.ecb.europa.eu/methodology/securities-holdings-statistics`.

[17] COREP is the standardized reporting framework issued by the European Banking Authority (EBA) to comply with the Capital Requirements Directive (CRD). It covers credit risk, market risk, operational risk, own funds, and capital adequacy ratios. The FINREP database includes bank balance sheets, income statements, disclosures of financial assets and liabilities, off-balance sheet activities, and non-financial instrument disclosures. For further details, please see: `https://www.ecb.europa.eu/stats/supervisory_prudential_statistics/html/index.en.html`.

[18] Please see the IMF's overview of fiscal policies during COVID-19: `https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19.`

Germany and Portugal. Together, these five countries represent more than 95% of total bank-firm-quarter observations in the sample. This composition is broadly consistent with that of Coulier et al. (2024), lending further support to the representativeness of our data. Finally, it is worth pointing out that all sample banks are significant institutions subject to the ECB supervision, which provided more than EUR 1.65 trillion in lending at the end of 2022 to firms across 18 euro area countries.

4.2 Descriptive Statistics

Table 2 presents descriptive statistics for the variables used in our analysis. The average bank-borrower lending growth is negative across banks over the sample period (i.e., about -5%). Regarding unrealized losses on securities at amortized cost for the banks in our sample, the average ratio of unrealized losses over total assets is equal approximately to 0.26 percent, although there is significant variation across the distribution. Specifically, a bank at the 25th percentile has unrealized gains (i.e., negative unrealized losses) of about 0.01% of total assets. In contrast, a bank at the 75th percentile has unrealized losses of about 0.47% of total assets. In line with this reasoning, Figure 3 illustrates the distribution of unrealized losses as a percentage of total assets across banks. The histogram shows the proportion of banks (y-axis) relative to the share of unrealized losses (x-axis) on amortized cost securities over total assets. Roughly one-quarter of banks exhibit unrealized losses close to zero, while about 40% report positive unrealized losses within the range of 0% to 0.5%. However, the distribution is notably right-skewed, with a non-negligible share of banks exhibiting unrealized losses around or above 0.5%, and a few extreme cases reaching losses as high as 2%. This variation highlights the heterogeneous impact of rising yields on the market value of fixed-income securities within banks' amortized cost portfolios.

Furthermore, Figure 4 shows the evolution of the market value of unrealized losses (or gains) on fixed-income securities held at amortized cost by banks in our sample. Specifically, Panel A tracks aggregate unrealized losses from Q3 2018 to Q2 2023. It highlights a sharp increase beginning in Q2 2022, broadly coinciding with the onset of the monetary tightening cycle, and peaking in Q4 2022, when unrealized losses reached approximately €80 billion.[19] Panel B breaks down these unrealized losses (or gains) by the issuer sector over the same period, highlighting the dominant contribution of sovereign bonds to the total unrealized losses, with corporate and other fixed-income securities playing smaller but still significant roles (Popov and Van Horen, 2015; Balduzzi et al., 2018; Bofondi et al., 2018; De Marco, 2019). Finally, Panel C provides a country-level breakdown of unrealized losses for Q2 2023, showing an uneven distribution across euro area countries. This distribution also seems to reflect, to some extent, the materiality of banks' holdings of sovereign bonds across countries (Acharya et al., 2018). This variation in unrealized losses is considerable both across countries, with a cross-country standard deviation of 0.47, and within countries across different banks. These findings suggest that there is meaningful variation in unrealized losses across and within countries for assessing their impact on monetary policy transmission to lending supply when monetary policy tightens.

The main statistics of the remaining variables are consistent with those reported in prior studies using euro-area credit registry data. For example, the cost-to-income ratio is 62%, which compares favorably with 69% in Couaillier et al. (2024). Similarly, the average bank in our sample has risk-weighted assets relative to total assets of approximately 36%, which is close to 39% found in Dautovic et al. (2023).

[19] To put this figure in perspective, the total amount of unrealized losses represents about 0.26% of total assets for EU-headquartered credit institutions, whose aggregate balance sheet stood at €30.85 trillion in December 2022 (https://www.ecb.europa.eu/press/pr/date/2024/html/ecb.pr240613~2a1d054108.it.html). This aggregate ratio closely matches the average unrealized losses over total assets in our sample, suggesting that our bank-level estimates are broadly representative of the overall exposure. Note also that the reported €80 billion corresponds to *net* unrealized losses, i.e., after accounting for hedge adjustments. Gross unrealized losses, before hedging effects, would have amounted to approximately €124 billion (https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.Report_unrealised_losses~445dcf8a99.en.pdf).

5 Empirical Results

5.1 Baseline Results

Table 3 presents the estimated results of Equation (1) using *Loan growth* as the dependent variable. In Column (1), we find that the coefficient on our main variable of interest, *i.e.*, on the interaction term between the share of unrealized losses and the monetary policy tightening dummy, is negative and statistically significant at the 1% level, indicating that banks with a larger share of unrealized losses reduce lending growth more than their peers following a monetary policy tightening. The magnitude of the coefficient, approximately –1, implies that a one percentage point increase in unrealized losses is associated with a one percentage point decline in loan growth during the tightening period. These results remain robust when we include country-quarter fixed effects to account for time-varying country-specific macroeconomic or policy changes (Columns (2) and (4)), and when we control for bank-firm lending relationships through banking group-borrower fixed effects (Columns (3) and (4)).[20] Altogether, these results across several econometric specifications suggest that banks with larger unrealized losses on amortized cost securities contract lending more than their peers with lower unrealized losses after monetary policy tightening, supporting the rejection of our null hypothesis.

To further quantify the economic relevance of our findings, we assess the effect size using the approach of Faccio and Xu (2015). Specifically, we multiply the estimated coefficient on our variable of interest in Column (1) of Table 3 by the standard deviation of unrealized losses as follows: $[(\frac{dy}{dx}) \times \text{STD}(x)]$. This yields an implied decline in loan growth of about 0.47 percentage points for a one standard deviation increase in unrealized losses. To put this effect into perspective, the average bank–firm loan growth rate during the monetary tightening period is approximately −5%. A bank with unrealized losses one standard deviation above

[20]The reduction in observations in columns (3) and (4) is due to the inclusion of banking group–borrower fixed effects. Specifically, bank–firm pairs observed in only one period are dropped from the estimation, as they do not provide within-pair variation over time.

the sample mean therefore reduces lending by an additional 0.47 percentage points, *all else equal*, implying a nearly 10% larger contraction in lending relative to the average.[21] As a robustness check, we apply the interquartile range transformation $[(\frac{dy}{dx}) \times \text{IQR}(x)]$, which similarly implies that moving from the first to the third quartile of unrealized losses leads to a 0.48 percentage point larger decline in loan growth during the tightening cycle. Taken together, these estimates indicate that unrealized losses on amortized cost securities materially amplify the contractionary effect of monetary tightening on bank lending.

Finally, before exploring the channels driving our main findings, we note that the coefficients on the control variables yield results that are in line with the results from previous literature. For instance, as in Kim and Sohn (2017), bank size is negatively related to lending growth. As in Tölö and Virén (2021), the share of non-performing loans (NPL) hinders bank lending.

5.2 Channels of Amplification: Liquidity, Capital, and Funding Constraints

The preceding empirical results suggest that unrealized losses on amortized cost securities amplify the transmission of monetary policy to bank lending supply in a rising interest rate environment. Building on these baseline findings, we next examine how specific bank characteristics condition the strength of this transmission. Specifically, we test whether the effect of unrealized losses on lending during monetary tightening is more pronounced for banks that are less liquid, have limited capital headroom, or rely more heavily on unstable funding sources.

There are several reasons to expect that these characteristics act as channels through which unrealized losses constrain credit supply. First, unrealized losses can exacerbate liquidity strains as banks become reluctant to sell securities at a loss, thereby limiting their lending

[21] A one-standard deviation increase in unrealized losses (0.469) reduces loan growth by approximately 0.47 percentage points. This corresponds to about 9.49% of the average contraction in loan growth, since $-1.0121 \times 0.469 = -0.4745$ and $\frac{-0.4745}{-5.001} \approx 0.0949$. To gauge the aggregate relevance of unrealized losses, we scale the 0.47 percentage point estimate by the total volume of bank-firm credit at the end of 2022 (€1.65 trillion), which coincides with the peak of unrealized losses. This implies an additional lending contraction of approximately €7.8 billion, under the assumption that all banks in the sample were equally exposed to unrealized losses, at a level one standard deviation above the mean. We caution, however, that this figure is based on a back-of-the-envelope calculation and abstracts from cross-bank heterogeneity in exposure to unrealized losses.

capacity (Diamond and Rajan, 2011). In addition, fair value losses on debt securities held at amortized cost are incorporated into the calculation of high-quality liquid assets (HQLA) used as collateral, thereby restricting banks' ability to obtain secured funding, such as from the ECB or via repurchase agreements, which could otherwise support credit provision (Berger and Bouwman, 2009; Ivashina and Scharfstein, 2010).

Second, unrealized losses can influence bank capital if banks are forced to sell amortized cost securities at a loss. Although such losses do not immediately affect regulatory capital, their eventual realization can lead to capital depletion. This potential for realized losses may, in turn, prompt banks, particularly those with lower capital buffers, to reduce their lending activities. Banks close to the Maximum Distributable Amount threshold may curtail credit provision preemptively to preserve regulatory buffers, especially since breaching capital triggers entails restrictions on dividend distributions, bonuses, and coupon payments, as well as heightened supervisory oversight (Couaillier et al., 2024). Furthermore, unrealized losses reduce a bank's economic value of equity, weakening, *ceteris paribus*, its medium-term earnings and internal capital-generation capacity, and thereby leading to a reduction in lending supply (Peek and Rosengren, 2000; Gambacorta and Marques-Ibanez, 2011; Chodorow-Reich, 2014; Bord et al., 2021).

Finally, the funding dimension is largely shaped by the composition of a bank's depositor base. Banks with greater unrealized losses may face increased scrutiny from large uninsured depositors, whose funding is more interest rate-sensitive and prone to withdrawal compared to stable retail deposits (Drechsler et al., 2017, 2021, 2023; Jiang et al., 2024). In a rising rate environment, this vulnerability is heightened, as uninsured depositors have stronger incentives to reallocate funds toward higher-yielding alternatives, increasing the likelihood of withdrawals.[22] To mitigate this risk, banks may preemptively hoard liquidity by limiting

[22]In line with this reasoning, the U.S. Office of Financial Research (December 2023) similarly noted that "the rate hikes created significant fair-value losses in banks' securities portfolios. At the same time, bank customers began to redeploy cash held in deposits into higher-yielding liquid investments such as money market funds. These two trends made banks with large unrealized losses in their securities portfolios and a significant amount of unsecured deposits (as a percentage of total deposits) vulnerable to loss-of-confidence events" https://www.financialresearch.gov/briefs/2023/12/27/two-new-metrics-bank-securities-portfolio-risk/.

credit provision. Moreover, reliance on short-term or uninsured funding exposes banks to refinancing risk that is sensitive to prevailing market conditions. In such cases, the ability to hold securities to maturity becomes contingent on interim market valuations, despite the amortized cost accounting treatment (Bischof et al., 2021). Consequently, unrealized losses can erode funding stability and indirectly constrain credit supply, even in the absence of formal balance sheet recognition.[23]

To formally assess the potential effects on the monetary policy transmission to credit supply stemming from the interaction of the aforementioned channels with unrealized losses on securities at amortized cost, we employ a triple-difference-in-differences approach. Specifically, we estimate the following bank-borrower-level panel regression model, introducing a triple interaction term that captures the differential impact of unrealized losses on the monetary policy transmission to credit supply across the three key channels as follows:

$$
\begin{aligned}
Loan\ growth_{i,c,j,t} = {} & \alpha + \beta_1 MP\_Tightening_t + \beta_2 UL_{i,c,t-1} + \\
& + \beta_3 [UL_{i,c,t-1} \times MP\_Tightening_t] + \\
& + \beta_4 Channel_{i,c,t-1} + \beta_5 [MP\_Tightening_t \times Channel_{i,c,t-1}] + \\
& + \beta_6 [UL_{i,c,t-1} \times Channel_{i,c,t-1}] + \\
& + \beta_7 [UL_{i,c,t-1} \times MP\_Tightening_t \times Channel_{i,c,t-1}] + \\
& + \beta_8 X_{i,c,t-1} + \beta_9 [X_{i,c,t-1} \times MP\_Tightening_t] + \\
& + \delta_{j,t} + \gamma_{i,c} + \lambda_{c,t} + \mu_{i,c,j} + \epsilon_{i,c,j,t}
\end{aligned} \tag{2}
$$

where the triple interaction term $UL_{i,c,t-1} \times MP\_Tightening_t \times Channel_{i,c,t-1}$ provides

[23] Anecdotal evidence is consistent with this reasoning. For example, Bankinter's 2022 annual report highlights its strategy of minimizing wholesale refinancing risk through "*limited reliance on wholesale markets*," diversified funding sources and instruments, and managing wholesale funding maturities to "*minimize refinancing difficulties*." https://www.bankinter.com/file_source2/webcorporativa/estaticos/pdf/accionistas-e-Inversores/informacion-financiera/informes-anuales/2022/Informe_Anual_Consolidado_2022_EN.pdf.

insights into how each channel mitigates or amplifies the impact of unrealized losses on the monetary policy transmission to lending supply during the tightening cycle. We expect that an increase in unrealized losses would have an amplifying effect on monetary policy transmission for banks with liquidity levels closer to regulatory thresholds. These banks would have stronger incentives to restrain lending, when policy rates rise, to avoid realizing the unrealized losses by selling securities. Similarly, banks with higher unrealized losses and close to regulatory capital constraints should deleverage more following a tightening than their counterparts with lower unrealized losses. Lastly, banks with an unstable funding base are likely to curtail credit the most, intensifying their response to unrealized losses in a rising interest rate environment. For the remaining variables and interaction terms, the specifications are otherwise similar to those in Equation (1).

We begin by analyzing the liquidity channel. Columns 1 to 4 of Table 4 present the results. We find that banks with lower liquidity levels, measured by the liquidity coverage ratio (LCR), reduce lending more aggressively in response to an increase in unrealized losses, whereas banks with ample liquidity buffers exhibit a more muted response to monetary policy tightening, as evidenced by the positive and statistically significant triple interaction term across all model specifications. To gain further insight into this relationship, Figure 5 plots the estimated loan growth for a 1 percentage point increase in unrealized losses at various levels of LCR during a monetary tightening. Banks with an LCR at or above 180% (approximately the median) are able to offset any impact on lending resulting from unrealized losses following a monetary tightening. However, banks with a LCR below 180% experience a statistically significant contraction in lending, as shown by confidence intervals that do not overlap with zero. The contraction is larger for banks with a lower LCR. In the extreme case of banks at the regulatory threshold (LCR = 100%), the lending contraction is approximately 3.2 percentage points for each percentage point increase in unrealized losses.

Next, we investigate the role of capital buffers. The regressions reported in Table 5 (columns 1 to 4) support the hypothesis that banks with smaller capital buffers, *i.e.*, those with a CET1 ratio closer to the Maximum Distributable Amount trigger, contract lending more in response to a decline in the value of amortized cost securities in a rising interest rate environment, compared to better capitalized banks. The positive and statistically significant triple interaction term indicates that higher capital buffers mitigate the negative effect of unrealized losses on lending supply. Figure 6 plots the estimated loan growth for a 1 percentage point increase in unrealized losses at different levels of banks' distance to the MDA in a monetery tightening. Banks with a distance to the MDA at or above 6% (approximately the median) do not exhibit a statistically significant contraction in lending due to higher unrealized losses when the policy rate rises (the confidence intervals overlap with zero). In contrast, the reduction in credit supply is statistically significant for banks below 6%, and the effect intensifies for those closer to the MDA trigger. Figure 6 further shows that banks that remain solvent but have only a small capital buffer above the MDA threshold (1% distance to the MDA) reduce lending by about 2.5 percentage points in response to a 1 percentage point increase in unrealized losses following a monetary policy tightening.

Finally, we examine the funding dimension, with the regression results reported in Table 6 (columns 1 to 4).[24] As shown, banks with less stable funding bases, i.e., those with a larger share of uninsured deposits relative to total assets, face greater pressure to reduce lending when unrealized losses increase during a monetary tightening. The negative and, in most specifications, statistically significant triple interaction term suggests that a higher share of uninsured deposits exacerbates the effect of unrealized losses on lending supply when the policy rate increases. Although the double interaction term is positive, it is statistically insignificant, indicating that stable funding helps banks shield their credit supply from unrealized losses in a rising interest rate environment. Figure 7 visually represents this relationship, showing the estimated loan growth for a 1 percentage point increase in unrealized losses at varying levels

[24]It is worth noting that in this analysis the number of observations is lower because data on uninsured deposits are not available for some banks in the ECB supervisory statistics. Moreover, data on uninsured deposits are not available at a quarterly frequency. We therefore rely on year-end 2021 values, prior to the onset of monetary tightening, as a proxy for banks' funding structure. This implies that the single term is fully subsumed by the fixed effects.

of uninsured deposits as a share of total deposits in a monetary policy tightening. Banks with a share of uninsured deposits below 40% (approximately the median) do not cut credit provision when unrealized losses rise (the confidence intervals overlap with zero). However, the reduction in lending is statistically significant for banks with a share of uninsured deposits above 40%. In the extreme case of banks that rely solely on uninsured deposits for funding, the lending contraction reaches about 6 percentage points for each percentage point increase in unrealized losses.

Overall, these findings confirm that unrealized losses disproportionately impact the monetary policy transmission to lending supply for more vulnerable banks, while the effect on banks with larger capital and liquidity buffers and with more stable funding is muted or limited.

5.3 Bank Responses to Unrealized Losses During Monetary Tightening

The previous section identifies key bank characteristics, such as liquidity buffers, capital headroom, and funding structure, that condition how unrealized losses affect the transmission of monetary policy, and hence determine the extent to which these losses translate into lending contractions. We now investigate the actions that banks undertake to mitigate the impact of unrealized losses during the tightening cycle. Specifically, we analyze whether banks reinforce capital buffers, adjust deposit pricing, or use financial instruments to reduce exposure to interest rate risk.

Table 7 presents regression results based on bank-quarter level data from estimating the following equation with banking group and quarter fixed effects:[25]

$$\begin{aligned} Y_{i,c,t} = \alpha + \beta_1 UL_{i,c,t-1} + \beta_2 MP\_Tightening_t + \beta_3[UL_{i,c,t-1} \times MP\_Tightening_t] \\ + \beta_4 X_{i,c,t-1} + \beta_5[X_{i,c,t-1} \times MP\_Tightening_t] + \gamma_i + \delta_t + \epsilon_{i,t} \end{aligned} \tag{3}$$

[25] Note that the quarter fixed effects fully subsume the $MP\_Tightening_t$ indicator, which is therefore omitted from the regression specification.

where the dependent variables, $Y_{i,c,t}$, are the logarithm of the Distance to the Maximum Distributable Amount, the logarithm of the CET1 ratio, and the deposit beta, respectively.[26] The set of control variables is otherwise consistent with those employed in Equation (1). In Columns (1) and (2), we find that banks with greater unrealized losses increase their capital buffers following the start of the monetary tightening. The positive and statistically significant interaction terms suggest that these banks actively raise their Distance to MDA and CET1 ratios during the tightening period. These findings are consistent with precautionary capital management, potentially through increased retained earnings, aimed at preserving capital headroom above regulatory thresholds (Gambacorta and Shin, 2018; Bahaj and Malherbe, 2020).[27] Relatedly, in Column (3), the results indicate that banks with larger unrealized losses also exhibit significantly higher deposit betas post-tightening, pointing to a more aggressive pass-through of policy rates to deposit rates (Drechsler et al., 2017, 2021). This behavior may reflect both depositor discipline, where uninsured depositors demand higher compensation due to perceived risk, and banks' defensive strategies to stabilize their funding base when the opportunity cost of holding deposits increases (Diamond and Dybvig, 1983; Goldstein and Pauzner, 2005; Cappelletti et al., 2024; Cipriani et al., 2024). In either case, higher unrealized losses increase funding costs, further constraining credit supply.[28]

Next, we follow McPhail et al. (2023) and examine whether banks also use interest rate derivatives to mitigate the impact of unrealized losses on amortized cost securities on bank lending during the 2022–2023 monetary tightening cycle.[29] Table 8 presents the results. In both specifications, we augment Equation (1) and include the triple interaction term $UL_{i,c,t-1} \times$

[26] The number of observations is lower in the regression on deposit beta due to limited data availability. Specifically, we only have data on 49 out of 82 sample banks.

[27] Retained earnings are a likely source of capital adjustments given the short time horizon of the tightening period in our sample, as equity market transactions are costly and difficult to arrange in such a short span (Cornett and Tehranian, 1994; Cornett et al., 1998).

[28] It is worth pointing out that, the results for all three dependent variables are robust to variations in the sample period. In untabulated analyses (available upon request), we found that extending the sample by a few quarters does not alter the main findings.

[29] The variable *AC Hedging* is defined as the ratio of hedging derivatives for interest rate risk on securities at amortized cost over total assets. The data on the derivatives used to build this variable are sourced from the SHSG database. However, it is worth noting that the number of observations is slightly lower than in the baseline analysis due to limited data availability on interest rate derivatives for some securities.

$MP\_Tightening_t \times AC\ Hedging_{i,c,t-1}$ to test whether interest rate hedging attenuates the contractionary effects of unrealized losses. The double interaction term remains negative and statistically significant, with coefficients ranging from –1.16 to –1.02, confirming that banks with greater unrealized losses reduce lending more in response to the tightening. Importantly, the triple interaction is positive and statistically significant in both columns, indicating that hedging effectively offsets this negative effect. The joint significance tests confirm that the total effect is statistically indistinguishable from zero (p-values of 0.74 and 0.67), suggesting that interest rate derivatives can neutralize the contractionary impact of unrealized losses. These findings stand in contrast to recent U.S. evidence, which finds limited use of hedging derivatives during the tightening cycle (McPhail et al., 2023; Granja et al., 2024), and suggest that when euro area banks do engage in hedging, it can be an effective risk management tool to shield credit supply.[30]

Taken together, these findings suggest that the channels identified in the previous section, namely, liquidity buffers, capital headroom, and funding structure, are not only static characteristics that condition monetary policy transmission, but also dimensions along which banks actively and preemptively adjust. When faced with unrealized losses, banks seek to strengthen their capital positions, adapt deposit pricing, and employ derivatives to mitigate the impact on operations and avoid breaching regulatory thresholds.

More broadly, these responses may be interpreted against the backdrop of heightened supervisory attention during the tightening phase. In early 2023, the ECB and the European Banking Authority (EBA) launched a targeted review of euro area banks' held-to-maturity portfolios and associated interest rate and liquidity risks.[31] Viewed in this light, the observed bank responses may reflect not only internal risk management incentives, but also efforts to

[30] Granja et al. (2024) find that in the United States riskier banks actually reduced their hedging activity during the period of monetary tightening, a behavior consistent with a "gambling for resurrection" strategy (Acharya and Ryan, 2016).

[31] Almost all banks in our sample were subject to this supervisory exercise, aimed at enhancing the assessment of risk in the held-to-maturity portfolios of euro area banks and at furthering the monitoring of interest rate risk and liquidity risk. For additional information on the ECB and EBA's exercise, we refer the reader to: https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.Report_unrealised_losses~445dcf8a99.en.pdf.

align with supervisory expectations and to avoid triggering regulatory interventions.

5.4 Unrealized Losses and the Allocation of Credit Across Borrower Types

After having shown the effect of unrealized losses on lending following monetary policy tightening, we now turn to the heterogeneity in the response across firms of different sizes. Motivated by the notion that smaller firms are typically more vulnerable to credit supply shocks due to greater informational frictions and limited access to alternative market-based financing sources, we assess whether the contractionary impact of unrealized losses is more pronounced for loans extended to smaller firms (Boot Arnoud, 2000; Becker and Ivashina, 2014, 2018).

To proxy for firm size, we use the number of employees from the *AnaCredit* database and estimate an interaction model that tests whether the effect of unrealized losses on lending supply during monetary tightening varies with borrower size:

$$
\begin{aligned}
Loan\ growth_{i,c,j,t} = {} & \alpha + \beta_1 MP\_Tightening_t + \beta_2 UL_{i,c,t-1} + \\
& + \beta_3 [UL_{i,c,t-1} \times MP\_Tightening_t] + \\
& + \beta_4 Borrower\ Size_{j,t-1} + \beta_5 [MP\_Tightening_t \times Borrower\ Size_{j,t-1}] + \\
& + \beta_6 [UL_{i,c,t-1} \times Borrower\ Size_{j,t-1}] + \\
& + \beta_7 [UL_{i,c,t-1} \times MP\_Tightening_t \times Borrower\ Size_{j,t-1}] + \\
& + \beta_8 X_{i,c,t-1} + \beta_9 [MP\_Tightening_t \times X_{i,c,t-1}] + \\
& + \delta_{j,t} + \gamma_{i,c} + \lambda_{c,t} + \mu_{i,c,j} + \epsilon_{i,c,j,t}
\end{aligned}
\tag{4}
$$

The key coefficient of interest is the triple interaction term between monetary policy tightening, unrealized losses, and borrower size (β_7), which captures whether larger firms experience a smaller contraction in lending from banks exposed to unrealized losses following the tightening. Table 9 presents the results from estimating Equation (4).[32] We find that banks with higher unrealized losses reduce lending significantly more to smaller borrowers after the onset of monetary tightening. The coefficient on the interaction between unrealized losses and the policy tightening dummy is negative and statistically significant across specifications ($\beta_3 < 0$). In contrast, the triple interaction term is positive and significant, indicating that the effect is mitigated for larger borrowers ($\beta_7 > 0$). These results are consistent with prior literature that documents the more pronounced effects of monetary policy tightening on smaller firms, as they are more susceptible to credit constraints due to higher information asymmetry and weaker financial positions (Berger and Udell, 1995; Gertler and Gilchrist, 1994; Petersen and Rajan, 1994; Chodorow-Reich et al., 2022).[33]

Taken together, these findings suggest that, when banks face unrealized losses on their amortized cost securities, the resulting contraction in credit supply is unevenly distributed, with smaller firms, typically more reliant on bank lending, bearing a larger share of the adjustment.

5.5 Robustness and supplemental tests

In our final analysis, we examine whether our results are similar when (i) controlling for losses on other security holdings, (ii) using a matching estimation technique, (iii) using an alternative outcome variable, (iv) employing an alternative fixed-effects structure, (v) focusing on multiple versus single-bank relationships, (vi) controlling for debt maturity, and (vii) employing an alternative monetary policy measure.

To isolate the specific role of unrealized losses on amortized cost securities, we start by

[32] The number of observations in this analysis is lower due to missing data on the number of employees for a subset of firms in *AnaCredit*. Additionally, it is worth noting that the variable *Borrower Size* is fully absorbed by the borrower-quarter fixed effects, as it varies at the same level, and therefore does not appear separately in the analysis.

[33] This asymmetry in the lending response, where banks facing unrealized losses reduce lending more significantly to smaller firms, may reflect not only a constrained *ability* to lend but also a reduced *willingness* to lend to perceived riskier borrowers, which is, in turn, shaped by banks' understanding of loan risks. See, for example, Acharya and Ryan (2016) for a broader discussion on the effects of banks' accounting treatments and systems on banks' willingness to supply loans.

extending the baseline analysis and controlling for losses on other parts of banks' securities portfolios, namely, those classified as fair value through other comprehensive income and fair value through profit or loss. To this end, we augment Equation (1) to include interactions between these loss components and the monetary policy tightening dummy. Table 10 presents the results. Across all columns, the interaction between unrealized losses on amortized cost securities and monetary tightening remains negative and, in most cases (except for one), statistically significant. This result confirms that unrealized losses, although not reflected in income statements or regulatory capital, represent a distinct and economically meaningful constraint on lending during the 2022–2023 tightening cycle.

Unrealized losses on FVTOCI securities are also negatively associated with lending, in line with recent evidence observed in the U.S. setting (Greenwald et al., 2024). However, their relative size on euro area banks' balance sheets is considerably smaller. On average, unrealized losses on amortized cost securities amount to 0.26% of total assets, compared to just 0.067% for FVTOCI and 0.024% for FVTPL. Rescaling the coefficients accordingly suggests that the impact of amortized cost losses is at least as large as, if not greater than, that of FVTOCI losses. We do not find a significant effect of FVTPL losses interacted with the tightening cycle. This is likely due to the fact that such losses are associated with trading securities, which are marked to market and reflected in financial statements irrespective of the monetary policy stance. However, in untabulated results (available upon request), we find that losses on FVTPL securities are negatively associated with lending when not interacted with the tightening indicator.

To further contextualize these findings, Figure 8 illustrates the composition of banks' securities portfolios by accounting classification from the third quarter of 2021 through the second quarter of 2023. The distribution remains relatively stable over this period, with only a modest increase in the share of securities held at amortized cost during the tightening cycle. This pattern supports the interpretation that the estimated effect is not driven by significant shifts in portfolio composition during the monetary policy tightening.[34]

Next, we assess whether banks with higher unrealized losses on amortized cost securities differ systematically from other banks in observable ways prior to the tightening cycle. Table OA2 of the Online Appendix presents cross-sectional regressions of the level of unrealized losses on a broad set of bank-specific characteristics. We find that most coefficients are small and statistically insignificant. Only return on assets and NPL show weak associations, with more profitable banks tending to hold slightly larger unrealized losses. Importantly, other key covariates, such as bank size, distance to MDA, and RWA, do not appear to be systematically correlated with amortized cost losses. These findings suggest that, at least on observable characteristics, the distribution of unrealized losses across banks was not driven by systematic differences in banks' balance sheet structure in the pre-tightening period.

Nonetheless, to further mitigate concerns that selection into unrealized loss exposure might confound the results, we implement the *covariate-balancing generalized propensity score* (CBGPS) method proposed by Fong et al. (2018). This approach calculates weights that minimize the correlation between the continuous treatment variable, *UL*, and a set of pre-tightening bank-level covariates. The reweighted regressions in Table 11 yield estimates that are qualitatively similar to the baseline, with interaction coefficients that remain negative and statistically significant at conventional levels.

To address the concern that our main specification could potentially confound the effects of preexisting unrealized losses with those of new losses arising during the monetary tightening period, especially given the correlation between $UL_{i,t}$ and $UL_{i,t-1}$, we introduce an additional robustness test. Specifically, in Table 12, we include the change in unrealized losses ($\Delta UL_{i,t} = UL_{i,t} - UL_{i,t-1}$) as an additional control in our regression. This specification allows us to isolate

[34] The modest increase in amortized cost holdings likely reflects a combination of two factors: a decline in the reported value of FVTOCI securities as interest rates rose, and, to some extent, the use of amortized cost classification for *new* purchases to mitigate earnings and capital volatility. While reclassification of *existing* securities is permitted under IFRS 9, it is allowed only under restrictive conditions, specifically when a change occurs in the bank's business model for managing financial assets, which seems an unlikely scenario over our relatively short sample period, as discussed in Section 3. Consistent with this reasoning, statistical tests on portfolio composition across quarters generally suggest no significant differences, aside from a few exceptions (e.g., 2020 Q4 versus 2022 Q4).

the role of preexisting exposures (i.e., the interaction term $UL_{i,t-1} \times MP\_\ Tightening_t$) from the contemporaneous effect of new valuation losses. We find that our main results continue to hold. The coefficient on the interaction between lagged unrealized losses and the monetary tightening dummy remains negative and statistically significant, suggesting that preexisting exposures meaningfully amplify the lending response to monetary policy over and above the effect of contemporaneous losses. Importantly, in this test, we do not interact $\Delta UL_{i,t}$ with the tightening dummy, as this variable is itself directly induced by the policy shock and lacks a clear interpretation outside the tightening period.

In Table OA3 of the Online Appendix, we examine the probability of issuing new loans computed while still exploiting *AnaCredit* data. Following De Jonghe et al. (2020), in columns (1) to (4), we replace our dependent variable in Equation (1) with a dummy variable, *New loan*, which takes the value of one when the outstanding lending relationship between a bank i and a borrowing firm j increases from $t-1$ to t, and zero otherwise, and perform a linear probability model estimation. Importantly, these regressions control for the same set of control variables and high-dimensional fixed effects as in Table 3 to ensure that observable and unobservable country, borrower, and bank factors do not explain loan origination differences between banks with high versus low unrealized losses on amortized cost security holdings. We find that for banks with a larger share of unrealized losses, the probability of extending new credit to existing borrowers decreases when monetary policy tightens. In economic terms, the decrease in new loans ranges between 1.2 to 1.7 percentage points for a 1 percentage point increase in unrealized losses, substantially in line with our baseline analyses.

In the next robustness test, we address potential biases stemming from credit demand heterogeneity by employing an alternative fixed-effects structure based on borrower characteristics such as industry, location, and size (ILS), following the methodologies of Acharya et al. (2019), Degryse et al. (2019), and Berg et al. (2021). The industry classification is based on NACE4 codes, while the locations are categorized at the zip code level. The size classification includes micro, small, medium, and large firms as reported in the *AnaCredit* database.

This approach allows us to control for time-varying credit demand across observably similar borrowers, addressing a limitation of our baseline specification that uses borrower fixed effects and excludes firms with a single bank relationship, as in Khwaja and Mian (2008). This extension is important because firms borrowing from multiple banks are better able to shield their borrowing from bank-specific shocks (Detragiache et al., 2000; Gopalan et al., 2011). In contrast, single-bank firms represent a large share of credit relationships in several euro area countries (Kosekova et al., 2025) and are more vulnerable to credit shocks due to switching costs and informational *lock-in* effects, whereby lenders hold an informational advantage over borrowers (Sharpe, 1990; Degryse and Ongena, 2005).

While we acknowledge that this approach cannot fully account for unobserved, time-varying firm-specific characteristics that may affect credit demand within the same ILS fixed-effects cluster, we believe our construction of the clusters, based on granular NACE4 industry codes and zip-code-level locations, provides a relatively strict partitioning. This likely ensures that credit demand is homogeneous within each ILS-quarter cluster. Moreover, incorporating firm-level controls would require dropping a substantial portion of single-bank firms due to missing data in publicly available databases. Thus, the ILS fixed-effects strategy represents a practical compromise to control for demand heterogeneity while preserving sample coverage.

Table OA4 of the Online Appendix presents the results. We find that the interaction term remains negative and statistically significant across all specifications. The economic magnitude of the coefficients remains stable and statistically significant at conventional levels, indicating that banks with greater unrealized losses on amortized cost securities systematically reduce their lending to all borrowers during the monetary policy tightening. To further refine the analysis, in columns (3) and (4), we focus exclusively on single bank-firm relationships, where borrowers cannot substitute credit from another bank, mitigating self-selection concerns by firms with multiple bank relationships. The consistent results across these models reinforce our baseline findings, suggesting that the contraction in lending is primarily driven by supply-side constraints linked to unrealized losses on amortized cost securities, rather than borrower-specific demand factors.

In Table OA5 of the Online Appendix, we further control for the average debt maturity of the bank-firm lending relationship. Longer-term lending relationships are typically more stable and less sensitive to short-term interest rate fluctuations, which could otherwise bias the estimation of loan growth. Hence, including this control accounts for potential differences in the structure of banks' loan portfolios that may influence their lending behavior. Reassuringly, after controlling for debt maturity, we continue to find that the interaction term remains negative and statistically significant across all specifications, confirming the robustness of our baseline findings reported in Table 3. Moreover, in Table OA6, we estimate weighted least squares regressions (WLS), using loan amounts as weights, instead of ordinary least squares, and find qualitatively similar results in terms of sign, statistical significance, and magnitude. The use of WLS is particularly appropriate in our context because it accounts for the heterogeneity in loan sizes across bank-firm relationships. In cases where a firm borrows from multiple banks, the outstanding loan amount from each bank can potentially differ. WLS ensures that loans with larger amounts, which arguably represent more economically significant exposures, receive proportionally greater influence in the estimation, thereby addressing potential distortions arising from unweighted regressions.

Finally, in Table OA7 of the Online Appendix, we replace the dummy variable $MP\_Tightening$ with the continuous variable $\Delta Policy\ Rate$, which represents the first-differenced deposit facility rate from $t-1$ to t as an alternative measure of monetary policy tightening.[35] First, in column (1), we replicate the baseline test in Table 3, and the results remain consistent in terms of sign, statistical significance, and magnitude. Economically, a one-standard-deviation increase in the quarterly change in the deposit facility rate results in an approximate 0.42% contraction in lending. Second, in columns (2) through (4), we re-examine the liquidity, capital, and funding channels. The results suggest that less capital headroom, smaller liquidity buffers and greater dependence on unstable funding sources tend to amplify the effect of un-

[35] The ECB deposit facility rate is available at: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html.

realized losses on securities at amortized costs on the monetary policy transmission to lending supply consistently with the channels outlined in Section 5.2.

6 Conclusion

This paper investigates how unrealized losses on amortized cost securities affect monetary policy transmission to bank lending in the euro area. Exploiting the sharp interest rate increases between 2022 and 2023, and combining granular security holdings with loan-level credit register data, we find that banks with higher unrealized losses on amortized cost securities reduce lending more significantly than their counterparts following monetary policy tightening. A one percentage point increase in unrealized losses is associated with an additional one percentage point decline in lending supply, highlighting the economic relevance of these latent losses.

The effect is particularly pronounced for banks with weaker capital positions, smaller liquidity buffers, and greater reliance on unstable funding sources. We also show that banks respond to growing unrealized losses by raising capital and increasing deposit betas. These findings suggest that such losses, though not reflected in profit and loss statements or regulatory capital, can influence funding strategies and internal risk management practices. Importantly, we also find that banks that hedge their interest rate risk can neutralize the contractionary impact of unrealized losses on credit supply.

Furthermore, we document that the effect of unrealized losses on bank lending is not evenly distributed. Smaller borrowing firms, which are more dependent on bank financing and less able to access alternative market-based funding sources, bear a greater share of the reduction in credit availability. In addition, we find that unrealized losses on amortized cost securities are at least as significant as those on FVTOCI securities, suggesting that the size of the exposure itself is non-trivial.

Overall, these findings provide novel evidence on the broader role of accounting in shaping financial stability during the 2022–2023 monetary tightening. While amortized cost accounting generally prevents valuation losses from affecting reported profits and regulatory capital, it does not fully shield banks from the economic consequences of these losses when interest rates rise sharply. In such high-rate environments, lending supply contracts even in the absence of formal balance sheet recognition, highlighting a hidden transmission channel through which monetary policy operates. Thus, the insulation offered by amortized cost accounting appears conditional on the pace and magnitude of interest rate changes, rather than offering blanket protection under all conditions.

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A Variable Definitions

Variable	Definition
Loan growth	Change in the logarithm of the outstanding amounts granted from bank i to borrowing firm j from $t-1$ to t. (*Source*: AnaCredit)
Log (Distance to MDA)	Logarithm of a bank i's CET1 capital over the maximum distributable amount. (*Source*: ECB Supervisory Statistics)
Log (CET1)	Logarithm of a bank i's CET1 capital. (*Source*: ECB Supervisory Statistics)
Deposit Beta	Ratio of weighted demand, reedemable at notice and term deposit rates to ECB policy rate. Deposit volumes are used as weights. (*Source*: ECB Supervisory Statistics)
New loan	Dummy variable equal to 1 when the outstanding credit amount in lending relationships increases from $t-1$ to t, and zero otherwise. (*Source*: AnaCredit)
UL	Difference between the nominal and market values for each security holding of a bank i's portfolio. We aggregate the unrealized losses at the banking group level and scale them by the previous quarter's total assets. (*Source*: SHSG database and ECB Supervisory Statistics)
MP_Tightening	Dummy variable equal to one after the onset of the tightening cycle in 2022 Q3, and zero otherwise. (*Source*: ECB Key Interest Rates)
Δ*Policy rate*	Change in the deposit facility rate from $t-1$ to t. (*Source*: ECB Key Interest Rates)
Distance to MDA	CET1 ratio over the maximum distributable amount. (*Source*: ECB Supervisory Statistics)
ROA	Ratio of net income to total assets. (*Source*: ECB Supervisory Statistics)
Bank size	Logarithm of a bank i's total assets. (*Source*: ECB Supervisory Statistics)
CIR	Ratio of operating expenses to operating income. (*Source*: ECB Supervisory Statistics)
NPL	Ratio of non-performing loans to gross loans. (*Source*: ECB Supervisory Statistics)
Cash	Ratio of cash and cash held at the central bank to total assets. (*Source*: ECB Supervisory Statistics)
RWA	Ratio of risk-weighted assets to total assets. (*Source*: ECB Supervisory Statistics)
LCR	Ratio of a bank i's stock of high-quality assets divided by the total net cash outflows over the next 30 calendar days (*Source*: ECB Supervisory Statistics)
Uninsured Deposits	Ratio of wholesale uninsured deposits to total assets (*Source*: ECB Supervisory Statistics)
Borrower Size	Number of a borrowing firm j's employees. (*Source*: AnaCredit)
AC hedging	Ratio of hedging derivatives for interest rate risk divided by total assets at the banking group level. (*Source*: SHSG database and ECB Supervisory Statistics)

$FVTOCI$	Aggregate losses on securities classified at fair value through other comprehensive income at the banking group level and scaled by the previous quarter's total assets. (*Source*: ECB Supervisory Statistics)
$FVTPL$ *securities*	Aggregate losses on securities classified at fair value through profit or loss at the banking group level and scaled by the previous quarter's total assets.(*Source*: ECB Supervisory Statistics)
Debt maturity	Logarithm of the number of days from the origination until the final repayment of a loan is due from borrower j to bank i. (*Source*: AnaCredit)

B Tables

Table 1: Distribution of observations, banks, and firms by country.

This table reports the distribution of observations, banks, and firms across countries in the sample. *No. Obs* refers to the number of bank-firm-quarter observations; *No. Banks* is the number of unique reporting banks; *No. Firms* indicates the number of distinct borrowing firms; and *%* represents each country's share of total observations.

Country	No. Obs	No. Banks	No. Firms	%
AT	11,325	7	2,370	0.21
BE	672	5	478	0.01
CY	516	2	163	0.01
DE	87,423	15	15,946	1.64
EE	45	1	10	0.00
ES	1,767,499	10	135,839	33.22
FI	75,496	3	7,369	1.42
FR	1,490,602	8	167,040	28.02
GR	246	4	55	0.00
IE	5,066	3	630	0.10
IT	1,779,530	12	153,049	33.45
LT	60	1	18	0.00
LU	2,176	2	754	0.04
LV	114	1	28	0.00
MT	51	1	13	0.00
NL	20,621	4	5,896	0.39
PT	78,109	2	12,966	1.47
SI	285	1	118	0.01
Total	**5,319,836**	**82**	**411,965**	**100.00**

Table 2: Descriptive statistics.

This table reports summary statistics for the main variables in the regression models. We report the number of observations (N), mean (Mean), standard deviation (SD), and the 25th, 50th, and 75th percentile of the distribution (p25, p50, p75, respectively). All continuous variables are winsorized at the 2.5% and 97.5% levels. Appendix A provides detailed definitions of the variables.

Variable	N	Mean	SD	p25	p50	p75
Panel A: Bank-firm statistics (AnaCredit)						
Loan growth (%)	5,319,836	-5.001	14.666	-8.860	-4.636	-0.792
New loan (0/1)	5,319,836	0.121	0.326	0.000	0.000	0.000
MP_Tightening (0/1)	5,319,836	0.563	0.495	0.000	1.000	1.000
Δ *Policy Rate* (%)	5,319,836	0.566	0.548	0.000	0.500	1.250
Borrower Size (log)	4,524,581	2.377	1.627	1.386	2.302	3.367
Borrower Size (No.)	4,524,581	10.772	5.088	3.998	9.994	28.991
Debt Maturity (log)	5,268,393	7.644	0.833	7.458	7.692	8.023
Debt Maturity (years)	5,268,393	5.720	0.006	4.749	6.002	8.357
Panel B: Bank statistics (AnaCredit)						
UL (%)	5,319,836	0.255	0.469	-0.011	0.045	0.468
Distance to MDA (%)	5,319,836	6.751	2.724	4.372	6.310	9.089
ROA (%)	5,319,836	0.324	0.255	0.115	0.249	0.470
Bank size (log)	5,319,836	25.751	1.120	24.777	25.288	26.486
CIR (%)	5,319,836	62.168	12.432	51.511	61.186	71.004
NPL (%)	5,319,836	2.958	1.507	1.540	2.486	3.770
Cash (%)	5,319,836	15.189	5.425	11.602	15.799	20.761
RWA (%)	5,319,836	36.422	7.678	29.592	34.815	43.689
LCR (%)	5,319,836	201.454	52.906	160.598	189.093	232.530
Uninsured Deposits (%)	4,794,702	42.640	16.637	30.416	42.125	51.665
AC Hedging (%)	5,248,575	0.481	1.178	0.000	0.011	0.296
FVTOCI (%)	5,243,951	0.067	0.187	-0.020	0.020	0.103
FVTPL (%)	5,243,951	0.024	0.093	-0.013	0.003	0.034
Panel C: Bank statistics (Supervisory Data)						
Distance to MDA (log)	504	21.601	1.196	20.922	21.619	22.428
CET1 (log)	504	22.510	1.289	21.701	22.368	23.320
Deposit Beta (%)	329	19.755	55.229	1.000	3.268	20.767

Table 3: Unrealized losses on amortized cost securities and bank lending during the 2022-2023 monetary policy tightening cycle.

This table analyzes the impact of banks' unrealized losses on amortized cost securities on monetary policy transmission to lending supply during the 2022-2023 monetary tightening cycle. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in all regressions but are omitted from the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-1.0121***	-0.8145*	-1.1950***	-1.0754**
	(0.009)	(0.064)	(0.002)	(0.020)
UL_{t-1}	0.5780	0.5528	0.9595**	0.8415*
	(0.164)	(0.211)	(0.023)	(0.070)
$Distance\ to\ MDA_{t-1}$	0.0955	0.1082	0.1349	0.1116
	(0.339)	(0.309)	(0.205)	(0.306)
ROA_{t-1}	0.9414	1.3215*	1.2734**	1.4548**
	(0.115)	(0.057)	(0.040)	(0.045)
$Bank\ size_{t-1}$	-3.0385*	-4.8217***	-5.7456***	-7.6920***
	(0.097)	(0.005)	(0.008)	(0.000)
CIR_{t-1}	0.0831***	0.0906***	0.0802***	0.0890***
	(0.000)	(0.000)	(0.000)	(0.000)
NPL_{t-1}	-0.3679*	-0.3877*	-0.5448**	-0.5103**
	(0.094)	(0.080)	(0.021)	(0.032)
$Cash_{t-1}$	0.0790	0.0863	0.0817	0.1051
	(0.202)	(0.187)	(0.206)	(0.123)
RWA_{t-1}	0.0303	0.0078	-0.0461	-0.0222
	(0.733)	(0.930)	(0.578)	(0.787)
N	5,319,836	5,319,834	5,216,716	5,216,712
Controls × $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.42	0.42	0.58	0.59

Table 4: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: The role of liquidity buffers.

This table examines how the impact of unrealized losses on amortized cost securities on bank lending during the 2022–2023 monetary policy tightening cycle varies with the liquidity coverage ratio (LCR). The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in all regressions but omitted from the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-6.5081***	-5.3146***	-5.5529***	-3.9943**
	(0.000)	(0.006)	(0.001)	(0.039)
$UL_{t-1} \times MP\_Tightening_t \times LCR_{t-1}$	0.0248***	0.0200***	0.0188***	0.0126*
	(0.006)	(0.006)	(0.006)	(0.006)
UL_{t-1}	6.0075***	5.2726***	6.6817***	5.5323***
	(0.000)	(0.002)	(0.000)	(0.001)
LCR_{t-1}	0.0053	0.0051	0.0081	0.0089
	(0.006)	(0.008)	(0.007)	(0.008)
N	5,319,836	5,319,834	5,216,716	5,216,712
Pairwise interaction terms	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Controls × $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.42	0.42	0.58	0.58

Table 5: Unrealized losses on amortized cost securities and bank lending during the 2022-2023 monetary policy tightening cycle: The role of capital buffers.

This table examines how the impact of unrealized losses on amortized cost securities on bank lending during the 2022–2023 monetary policy tightening cycle varies with capital strength, proxied by the distance to the Maximum Distributable Amount (*Distance to MDA*). The dependent variable is *Loan growth*. *MP_Tightening* is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with *MP_Tightening* are included in the regressions but are not shown in the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-2.5733***	-2.8538***	-2.9273***	-3.1646***
	(0.010)	(0.002)	(0.003)	(0.001)
$UL_{t-1} \times MP\_Tightening_t \times Distance\ to\ MDA_{t-1}$	0.2728*	0.3457**	0.3047*	0.3592**
	(0.096)	(0.040)	(0.078)	(0.049)
UL_{t-1}	1.8655	2.7354**	1.9942*	2.6045**
	(0.123)	(0.025)	(0.065)	(0.030)
$Distance\ to\ MDA_{t-1}$	0.1081	0.1400	0.1419	0.1336
	(0.335)	(0.246)	(0.238)	(0.285)
N	5,319,836	5,319,834	5,216,716	5,216,712
Pairwise interaction terms	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Controls $\times$ $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.42	0.42	0.58	0.58

Table 6: Unrealized losses on amortized cost securities and bank lending during the 2022-2023 monetary policy tightening cycle: The role of unstable funding sources.

This table examines how the impact of unrealized losses on amortized cost securities on bank lending during the 2022–2023 monetary policy tightening cycle varies with funding instability. Funding instability is proxied by the share of uninsured deposits over total assets (*Uninsured Deposits*). The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in the regressions but are not displayed in the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	2.0537	1.2649	1.6658	0.4322
	(0.237)	(0.362)	(0.349)	(0.751)
$UL_{t-1} \times MP\_Tightening_t \times Uninsured\ Deposits_{t-1}$	-0.0786**	-0.0564*	-0.0706*	-0.0366
	(0.044)	(0.060)	(0.078)	(0.223)
UL_{t-1}	-2.9547*	-1.9758	-2.7129*	-1.5764
	(0.085)	(0.168)	(0.096)	(0.228)
N	4,794,702	4,794,702	4,783,311	4,783,311
Pairwise interaction terms	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Controls × $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.42	0.42	0.56	0.56

Table 7: Unrealized Losses on amortized cost securities and bank responses during the 2022–2023 monetary policy tightening cycle.

This table examines whether banks adjust their capital positions or deposit pricing in response to unrealized losses on amortized cost securities during the 2022–2023 monetary policy tightening cycle. The dependent variables are the logarithm of the distance to the Maximum Distributable Amount (*Distance to MDA*), the logarithm of the Common Equity Tier 1 ($CET1$) ratio, and the deposit beta (*Deposit Beta*). $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in the regressions but omitted from the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Log(Distance to MDA)	**Log(CET1)**	**Deposit Beta**
	(1)	(2)	(3)
$UL_{t-1} \times MP\_Tightening_t$	0.1069***	0.0505**	0.3885**
	(0.040)	(0.020)	(0.149)
UL_{t-1}	-0.0578	-0.0370*	-0.2246**
	(0.036)	(0.020)	(0.093)
N	504	504	329
Controls	Yes	Yes	Yes
Controls × $MP\_Tightening_t$	Yes	Yes	Yes
Banking group FE	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes
$R2$	0.99	0.99	0.65

Table 8: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: The role of interest rate hedging.

This table examines whether interest rate hedging mitigates the impact of unrealized losses on amortized cost securities on bank lending during the 2022–2023 monetary policy tightening cycle. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. $AC\ Hedging_{t-1}$ captures the extent of interest rate hedging on amortized cost securities using derivatives. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in the regressions but omitted from the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth	
	(1)	(2)
(**A**) $UL_{t-1} \times MP\_Tightening_t$	-1.1581**	-1.0158**
	(0.026)	(0.050)
(**B**) $UL_{t-1} \times MP\_Tightening_t \times AC\ Hedging_{t-1}$	1.4549**	1.3730**
	(0.048)	(0.027)
UL_{t-1}	0.5080	0.4910
	(0.385)	(0.405)
$AC\ Hedging_{t-1}$	0.1016	0.1675
	(0.423)	(0.158)
Joint significance: (A+B)		
F-test	0.29	0.35
P-value	0.74	0.67
N	5,216,716	5,216,712
Pairwise interaction terms	Yes	Yes
Controls	Yes	Yes
Controls $\times$ $MP\_Tightening_t$	Yes	Yes
Borrower-quarter FE	Yes	Yes
Banking group FE	Yes	No
Banking group-borrower FE	No	Yes
R2	0.42	0.59

Table 9: Unrealized losses on amortized cost securities and the allocation of credit during the 2022–2023 monetary policy tightening cycle: The role of borrower size.

This table examines whether the effect of unrealized losses on amortized cost securities on the allocation of credit varies with borrower size during the 2022–2023 monetary policy tightening cycle. $Borrower\ Size$ is proxied by the logarithm of the number of employees, sourced from the $AnaCredit$ database. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with the indicator variable $MP\_Tightening$ are included in all regressions but are not tabulated for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides the variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-1.8836***	-1.6174***	-1.8493***	-1.6271***
	(0.000)	(0.002)	(0.000)	(0.001)
$UL_{t-1} \times MP\_Tightening_t \times Borrower\ Size_{t-1}$	0.2963*	0.2789*	0.2265**	0.1926*
	(0.067)	(0.079)	(0.041)	(0.071)
UL_{t-1}	1.0657***	0.9577**	1.7838***	1.5337***
	(0.009)	(0.018)	(0.000)	(0.002)
N	4,524,581	4,524,579	4,434,259	4,434,255
Pairwise interaction terms	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Controls $\times$ $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
$R2$	0.42	0.42	0.58	0.58

Table 10: Unrealized losses on amortized cost securities and bank lending during the 2022-2023 monetary policy tightening cycle: Robustness to controlling for losses on FVTOCI and losses on FVTPL.

This table examines the robustness of the results in Table 3 to controlling for losses on fair value through other comprehensive income (FVTOCI) securities and losses on fair value through profit or loss (FVTPL) securities. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in the regressions but are not displayed in the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-0.7137*	-0.5286	-1.1935***	-1.1024***
	(0.055)	(0.208)	(0.001)	(0.008)
$FVTOCI_{t-1} \times MP\_Tightening_t$	-2.3101***	-2.5611***	-2.7531***	-2.9835***
	(0.005)	(0.000)	(0.000)	(0.000)
$FVTPL_{t-1} \times MP\_Tightening_t$	0.4093	0.1276	-0.3415	-0.6329
	(0.714)	(0.935)	(0.792)	(0.728)
UL_{t-1}	0.3549	0.3408	0.9721***	0.9225***
	(0.362)	(0.377)	(0.007)	(0.009)
$FVTOCI_{t-1}$	2.2503**	2.5578***	3.4484***	3.7017***
	(0.029)	(0.004)	(0.000)	(0.000)
$FVTPL_{t-1}$	-1.0792	-1.6894	-0.2541	-0.5658
	(0.402)	(0.265)	(0.849)	(0.734)
N	5,243,951	5,243,949	5,143,159	5,143,155
Controls	Yes	Yes	Yes	Yes
Controls × $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.43	0.43	0.59	0.59

Table 11: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to using the covariate-balancing generalized propensity score weighting method.

This table analyzes the impact of banks' unrealized losses on amortized cost securities on monetary policy transmission to lending supply during the 2022–2023 monetary tightening cycle using the *covariate-balancing generalized propensity score weighting method* proposed by Fong et al. (2018). The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in all regressions but are omitted from the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-1.2110***	-1.0060**	-1.1630**	-1.0640*
	(0.0070)	(0.0480)	(0.0130)	(0.0540)
UL_{t-1}	0.6770	0.6850	0.9070*	0.8370
	(0.1730)	(0.2040)	(0.0840)	(0.1430)
N	5,319,836	5,319,834	5,216,716	5,216,712
Controls	Yes	Yes	Yes	Yes
Controls $\times MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.46	0.46	0.61	0.61

Table 12: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to controlling for the change in unrealized losses.

This table analyzes the robustness of the results in Table 3 to controlling for the change in unrealized losses on amortized cost securities from $t-1$ to t ($\Delta UL_{i,t}$). The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in all regressions but are omitted from the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-1.2964***	-1.0416**	-1.5037***	-1.3139***
	(0.003)	(0.032)	(0.000)	(0.008)
UL_{t-1}	0.3377	0.1898	0.7275*	0.5144
	(0.439)	(0.682)	(0.082)	(0.272)
ΔUL_t	-1.3255**	-1.3199**	-1.2479**	-1.2521**
	(0.014)	(0.012)	(0.017)	(0.017)
N	4,583,384	4,583,382	4,490,645	4,490,641
Controls	Yes	Yes	Yes	Yes
Controls $\times MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.43	0.43	0.60	0.60

C Figures

Figure 1: Market participants' expectations on interest rate rises based on the survey of monetary analysts.

The figure displays the expected and realized ECB deposit facility rate hikes around Governing Council monetary policy meetings.

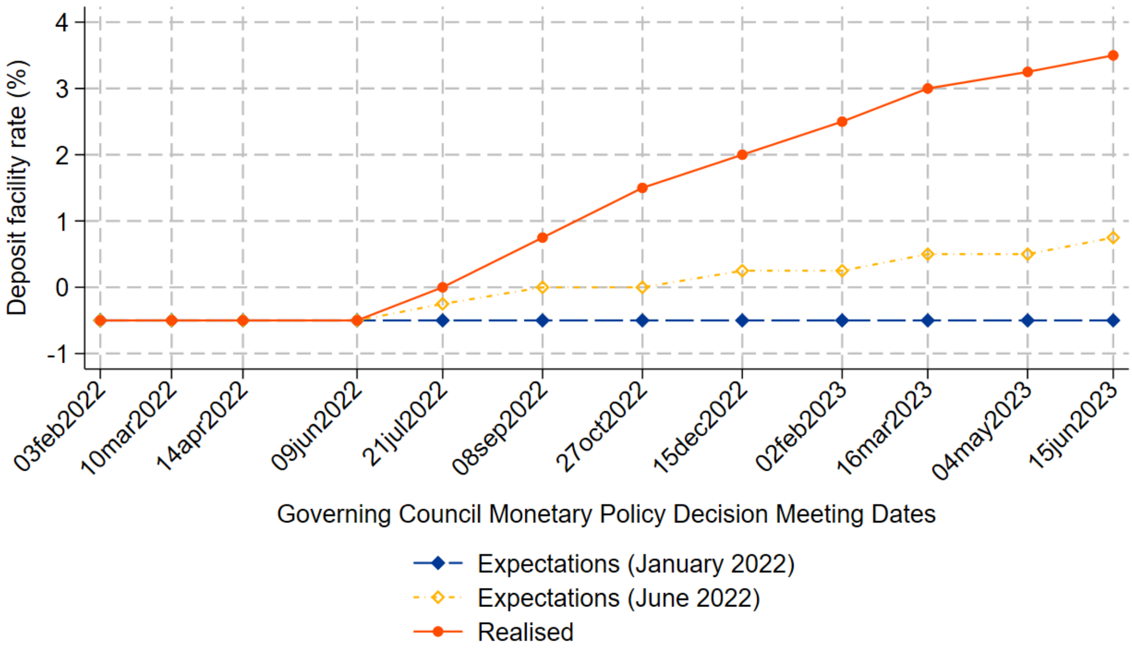


Figure 2: Number of banks by country in the sample.

This figure displays the number of banks categorized by 2-digit ISO country codes.

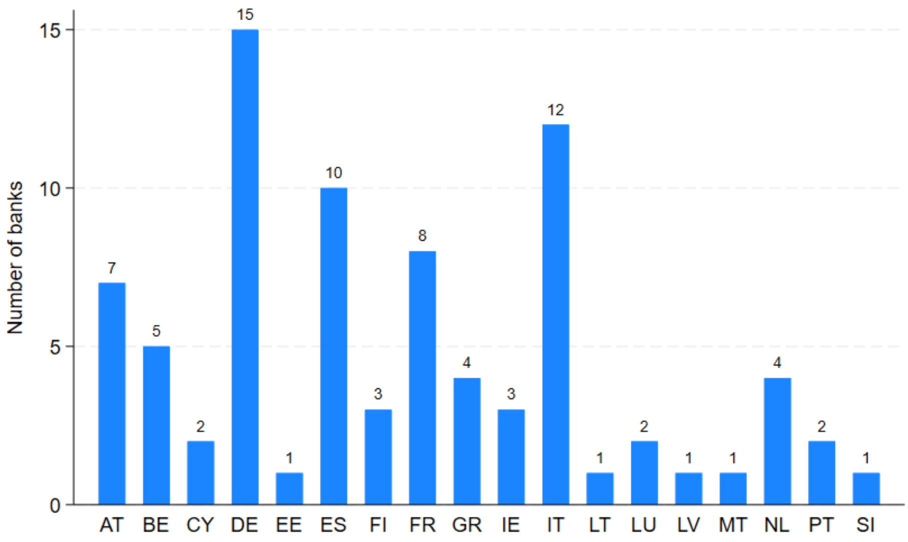


Figure 3: Distribution of Unrealized Losses following the onset of monetary policy tightening.

The figure displays the percentage of banks (y-axis) based on the share of unrealized losses on amortized cost securities relative to total assets (x-axis).

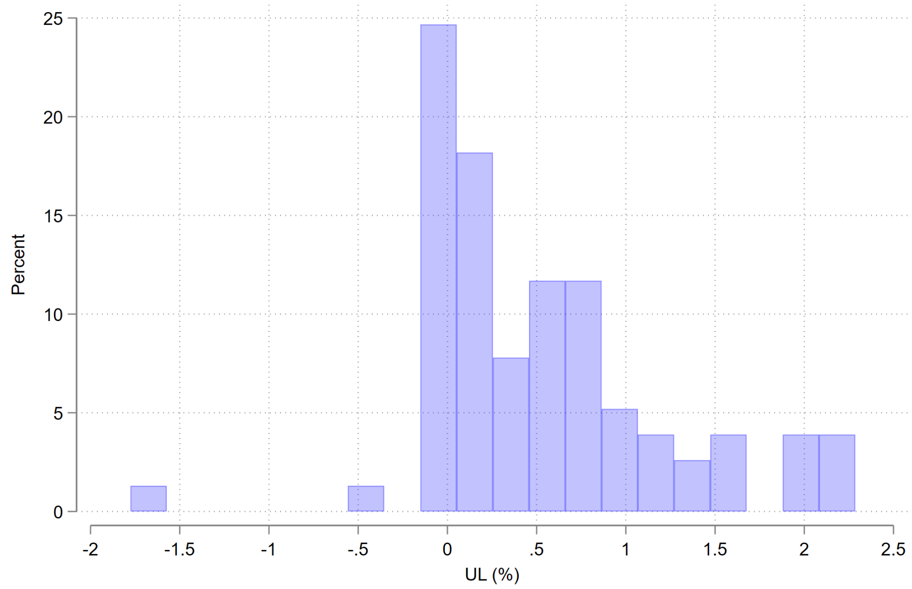
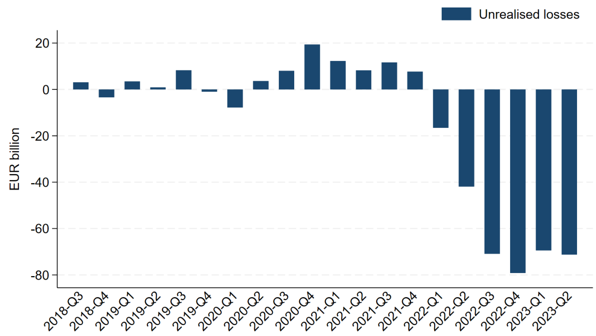


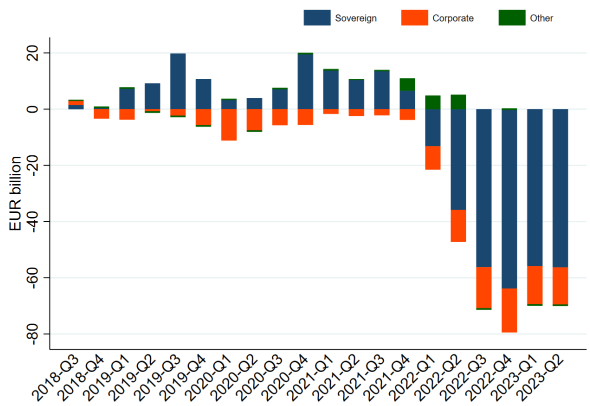
Figure 4: Unrealized losses in banks' amortized cost portfolios.

This figure provides an overview of unrealized losses in banks' amortized cost portfolios. Panel A displays the aggregate unrealized losses across 18 Eurozone countries from 2018 Q3 to 2023 Q2. Panel B presents the aggregate unrealized losses alongside the composition of banks' amortized cost portfolios. Panel C presents a country-level breakdown of unrealized losses for the second quarter of 2023. All amounts are in EUR billion.

(a) Aggregate unrealized losses (EUR bn) in banks' amortized cost portfolios across 18 Eurozone countries from 2018 Q3 to 2023 Q2



(b) Aggregate unrealized losses (EUR bn) and the composition of banks' amortized cost portfolios



(c) Aggregate unrealized losses (EUR bn) in banks' amortized cost portfolios in 2023 Q2 by country

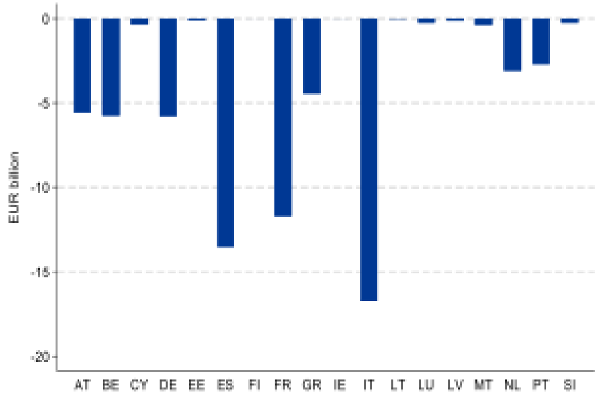


Figure 5: Unrealized losses on amortized cost securities, bank lending, and liquidity buffers.

This figure displays the estimated loan growth (y-axis) for a 1% increase in unrealized losses at various liquidity levels measured by the variable *LCR* (x-axis). The connected line represents the 95% confidence interval.

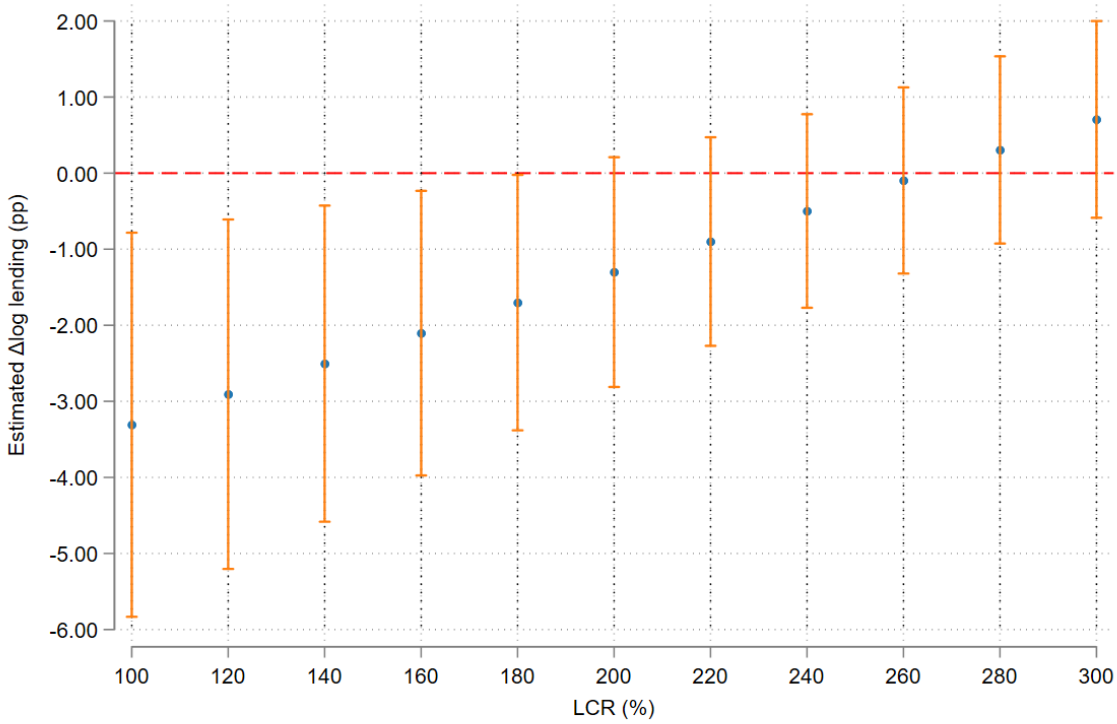


Figure 6: Unrealized losses on amortized cost securities, bank lending, and capital headroom.

This figure displays the estimated loan growth (y-axis) for a 1% increase in unrealized losses at different levels of capital headroom measured by the variable *Distance to MDA* (x-axis). The connected line represents the 95% confidence interval.

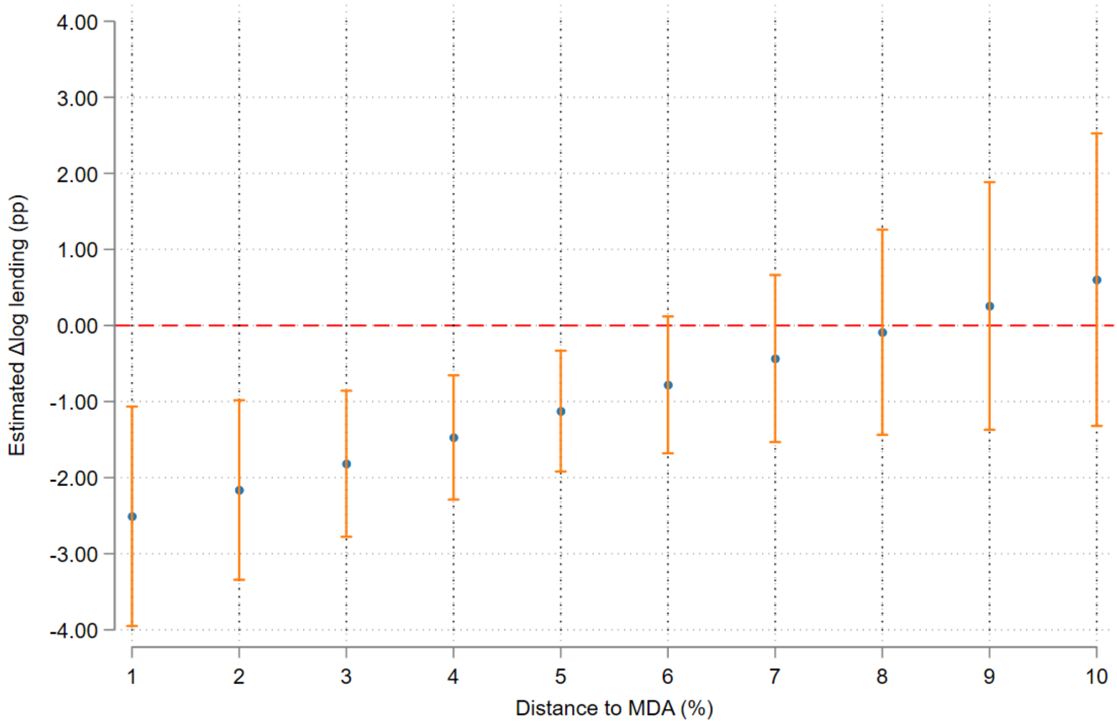


Figure 7: Unrealized losses on amortized cost securities, bank lending, and funding structure.

This figure displays the estimated loan growth (y-axis) for a 1% increase in unrealized losses at different levels of wholesale uninsured deposits measured by the variable *Uninsured Deposits* (x-axis). The connected line represents the 95% confidence interval.

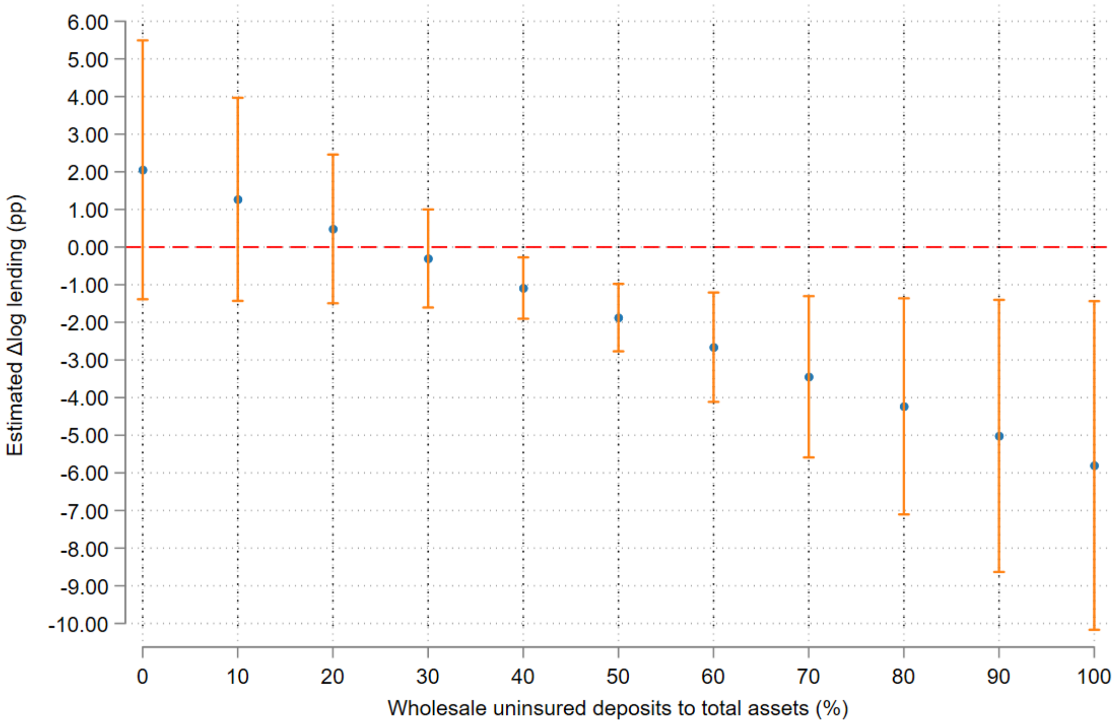
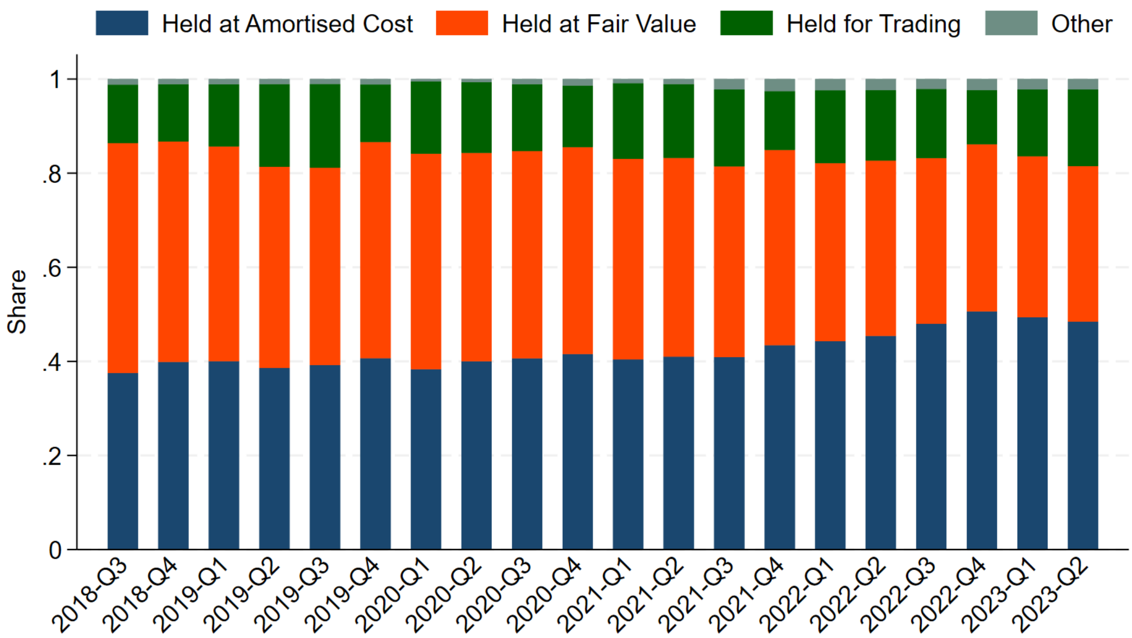


Figure 8: Accounting classification of European banks' securities portfolios over time.

This figure shows the share of total securities held by European banks across four accounting classifications: Held at amortized cost, held at fair value through other comprehensive income, held at fair value through profit or loss, and other from 2018 Q3 to 2023 Q2.



Online Appendix of the Paper

Overview of Additional Tables

This Online Appendix presents robustness tests and supplemental analyses referenced in Section 5.5 of the paper. Specifically, it includes the following:

- Table OA1: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to winsorizing continuous variables at the 1% and 99% levels.
- Table OA2: Bank characteristics and unrealized losses on amortized cost securities.
- Table OA3: Unrealized losses on amortized cost securities and new loan origination during the 2022–2023 monetary policy tightening cycle.
- Table OA4: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to an alternative fixed-effects structure and analysis of single versus multiple bank-firm relationships.
- Table OA5: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to controlling for debt maturity.
- Table OA6: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to using an alternative estimation technique.
- Table OA7: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Additional analyses using changes in the deposit facility rate as a measure of monetary policy.

Table OA1: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to winsorizing continuous variables at the 1% and 99% levels.

This table examines the role of banks' unrealized losses on amortized cost securities in bank lending during the 2022–2023 monetary tightening cycle. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with the indicator variable $MP\_Tightening$ are included in all regressions but are not tabulated for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides the variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-1.1103**	-0.8679	-1.5546***	-1.3700**
	(0.039)	(0.166)	(0.006)	(0.050)
UL_{t-1}	0.7871	0.6847	1.3521**	1.1917
	(0.217)	(0.346)	(0.047)	(0.123)
$Distance\ to\ MDA_{t-1}$	0.1655	0.1524	0.1996	0.1522
	(0.234)	(0.312)	(0.177)	(0.320)
ROA_{t-1}	0.0138*	0.0173**	0.0182**	0.0203**
	(0.053)	(0.041)	(0.023)	(0.035)
$Bank\ size_{t-1}$	-0.0410	-0.0721**	-0.0819**	-0.1142***
	(0.174)	(0.014)	(0.016)	(0.001)
CIR_{t-1}	0.0014***	0.0015***	0.0014***	0.0015***
	(0.000)	(0.000)	(0.000)	(0.000)
NPL_{t-1}	-0.0061	-0.0060	-0.0088**	-0.0082*
	(0.121)	(0.142)	(0.040)	(0.064)
$Cash_{t-1}$	0.0008	0.0010	0.0010	0.0013
	(0.414)	(0.361)	(0.360)	(0.229)
RWA_{t-1}	0.0005	0.0002	-0.0006	-0.0003
	(0.724)	(0.879)	(0.690)	(0.859)
N	5,319,836	5,319,834	5,216,716	5,216,712
Controls × $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
$R2$	0.42	0.42	0.58	0.59

Table OA2: Bank characteristics and unrealized losses on amortized cost securities.

This table reports the results from cross-sectional regressions of unrealized losses on amortized cost securities on a range of bank-level characteristics. The dependent variable is the sum of the unrealized losses at the banking group level, scaled by the previous quarter's total assets (UL). The table reports heteroskedasticity-robust standard errors clustered at the banking group level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides the variable definitions.

	UL							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance to MDA	-0.6186							-2.3519
	(1.032)							(3.619)
ROA		0.1079**						0.0873*
		(0.053)						(0.050)
Bank size			-0.0799					-1.0514
			(0.617)					(1.704)
CIR				0.0006				-0.0005
				(0.001)				(0.001)
NPL					-0.0425**			-0.0245
					(0.020)			(0.019)
Cash						0.8597		0.7588
						(1.785)		(2.338)
RWA							-0.0176	-0.0172
							(0.019)	(0.025)
Observations	292	292	292	292	292	292	292	292
Banking group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.41	0.41	0.41	0.41	0.41	0.41	0.38	0.42

Table OA3: Unrealized losses on amortized cost securities and new loan origination during the 2022–2023 monetary policy tightening cycle.

This table analyzes the impact of banks' unrealized losses on amortized cost securities on monetary policy transmission to new loan origination during the 2022–2023 monetary tightening cycle. The dependent variable is *New loan*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in all regressions but are omitted from the table for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides detailed variable definitions.

	New loan			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times MP\_Tightening_t$	-0.0155**	-0.0122**	-0.0171**	-0.0111*
	(0.024)	(0.043)	(0.024)	(0.066)
UL_{t-1}	0.0072	0.0099	0.0114	0.0109*
	(0.376)	(0.149)	(0.150)	(0.085)
Observations	5,319,836	5,319,834	5,216,716	5,216,712
Controls	Yes	Yes	Yes	Yes
Controls × $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	No	No
Country-quarter FE	No	Yes	No	Yes
Banking group-borrower FE	No	No	Yes	Yes
R2	0.48	0.48	0.64	0.64

Table OA4: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to an alternative fixed-effects structure and analysis of single versus multiple bank-firm relationships.

This table examines the robustness of the results in Table 3 to using an alternative fixed-effects structure based on the borrower's industry, location, and size to isolate capital demand effects (Acharya et al. (2019); Degryse et al. (2019); Berg et al. (2021)). In columns (1) and (2), we analyze single and multiple bank-firm relationships, whereas in columns (3) and (4) we focus only on single bank-firm relationships. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with $MP\_Tightening$ are included in all regressions but are not tabulated for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides the variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
	Single & Multiple Relationships		*Only Single Relationships*	
$UL_{t-1} \times MP\_Tightening_t$	-0.8966**	-0.9590**	-0.8297**	-0.8692*
	(0.036)	(0.034)	(0.030)	(0.053)
UL_{t-1}	0.5669	0.6015	0.6540**	0.6407*
	(0.115)	(0.146)	(0.025)	(0.088)
N	17,279,928	11,899,516	11,810,812	6,664,981
Controls	Yes	Yes	Yes	Yes
Controls × $MP\_Tightening_t$	Yes	Yes	Yes	Yes
Industry-location-quarter FE	Yes	No	Yes	No
Industry-location-size-quarter FE	No	Yes	Yes	No
Banking group FE	Yes	Yes	Yes	Yes
R2	0.23	0.28	0.23	0.27

Table OA5: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to controlling for debt maturity.

This table examines the robustness of the results in Table 3 to controlling for debt maturity. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with the indicator variable $MP\_Tightening$ are included in all regressions but are not tabulated for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides the variable definitions.

	Loan growth	
	(1)	(2)
	Control for Debt Maturity	
$UL_{t-1} \times MP\_Tightening_t$	-1.0284***	-1.3317***
	(0.009)	(0.000)
UL_{t-1}	0.5994	1.2425***
	(0.144)	(0.003)
$Debt\ Maturity_{t-1}$	-0.5859**	-5.9082***
	(0.025)	(0.000)
N	5,268,393	5,166,181
Controls	Yes	Yes
Controls $\times$ $MP\_Tightening_t$	Yes	Yes
Borrower-quarter FE	Yes	Yes
Banking group FE	Yes	Yes
Banking group-borrower FE	No	Yes
R2	0.42	0.59

Table OA6: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Robustness to using an alternative estimation technique.

This table examines the robustness of the results in Table 3 to using an alternative estimation technique. The dependent variable is *Loan growth*. $MP\_Tightening$ is a dummy variable that equals one after the start of the monetary tightening cycle in July 2022, and zero otherwise. Following the approach of Gomez et al. (2021), all control variables interacted with the indicator variable $MP\_Tightening$ are included in all regressions but are not tabulated for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides the variable definitions.

	Loan growth	
	(1)	(2)
	WLS regressions	
$UL_{t-1} \times MP\_Tightening_t$	-1.0351***	-1.2204***
	(0.009)	(0.002)
UL_{t-1}	0.5855	0.9574**
	(0.182)	(0.029)
N	5,319,836	5,216,716
Controls	Yes	Yes
Controls $\times$ $MP\_Tightening_t$	Yes	Yes
Borrower-quarter FE	Yes	Yes
Banking group FE	Yes	Yes
Banking group-borrower FE	No	Yes
R2	0.41	0.57

Table OA7: Unrealized losses on amortized cost securities and bank lending during the 2022–2023 monetary policy tightening cycle: Additional analyses using changes in the deposit facility rate as a measure of monetary policy.

This table examines the role of banks' unrealized losses on amortized cost securities in bank lending during the 2022–2023 monetary tightening cycle. The dependent variable is *Loan growth*. Δ*Policy Rate* is a continuous variable representing the change in the deposit facility rate from $t-1$ to t over the period 2021 Q3 to 2023 Q2. Following the approach of Gomez et al. (2021), all control variables interacted with the continuous variable Δ*Policy Rate* are included in all regressions but are not tabulated for brevity. The table reports heteroskedasticity-robust standard errors, clustered at the banking group and borrower levels. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. Appendix A provides the variable definitions.

	Loan growth			
	(1)	(2)	(3)	(4)
$UL_{t-1} \times \Delta Policy\ Rate_t$	-0.7631**	-4.9884***	-3.2132***	2.1886*
	(0.017)	(0.000)	(0.000)	(0.082)
$UL_{t-1} \times \Delta Policy\ Rate_t \times LCR_{t-1}$		0.0190***		
		(0.000)		
$UL_{t-1} \times \Delta Policy\ Rate_t \times Distance\ to\ MDA_{t-1}$			0.4221***	
			(0.002)	
$UL_{t-1} \times \Delta Policy\ Rate_t \times Uninsured\ Deposits_{t-1}$				-0.0758**
				(0.014)
UL_{t-1}	0.5626	5.9259***	2.2265**	-3.2151**
	(0.142)	(0.000)	(0.021)	(0.012)
LCR_{t-1}		0.0105		
		(0.105)		
$Distance\ to\ MDA_{t-1}$			0.1143	
			(0.304)	
N	5,216,716	5,216,716	5,216,716	4,783,311
Pairwise interaction terms	No	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Controls $\times\ \Delta Policy\ Rate_t$	Yes	Yes	Yes	Yes
Borrower-quarter FE	Yes	Yes	Yes	Yes
Banking group FE	Yes	Yes	Yes	Yes
Banking group-borrower FE	Yes	Yes	Yes	Yes
R2	0.58	0.58	0.58	0.56

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The views expressed are those of the authors and do not necessarily reflect those of the ECB or the Eurosystem.

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