# Are low interest rates firing back? Interest rate risk in the banking book and bank lending in a rising interest rate environment

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**Are low interest rates firing back? Interest rate risk in the banking book and bank lending in a rising interest rate environment**

└─ Focus and motivation

## Focus of the paper

▶ **Descriptively show banks' build up of interest rate risk**
  ⊙ Low for long interest rate environment altered the duration of bank balance sheets
  ⊙ Unexpected pace of the MP tightening lead to materialization of interest rate risk

▶ **Look at the implications for bank lending supply in a rising interest rate environment**
  ⊙ Lending contraction
  ⊙ Lending portfolio reshuffling

▶ **Identify borrowers affected by the contraction/reshuffling in lending supply**
  ⊙ MSMEs
  ⊙ No substitution effects

## Overview of the literature

▶ **Bank maturity transformation and monetary policy** (Drechsler et al., 2017, Drechsler et al., 2021, Greenwald et al., 2023)

▶ **Bank lending channel** (e.g., Kashyap and Stein, 1995, Jiménez et al., 2012, Gambacorta and Shin, 2018)

▶ **Interest rate risk, monetary policy and lending**
  ⊙ Beutler et al., 2020: banks with a larger *duration gap* reduce lending more when interest rates rise to remain in compliance with capital requirements (Swiss bank-level data, 2001Q2-2013Q3)
  ⊙ Gomez et al., 2021: banks with a larger *income gap* reduce lending less when interest rates increase because of increased net interest income (US bank and bank-firm level data, 1986Q1-2013Q4)

# Contribution to the literature

**Our contribution:**

▶ Detailed and extensive loan-level credit registry data for the euro area (*AnaCredit*)

▶ Unique supervisory dataset to capture the *behavioral* maturity mismatch across the whole maturity/repricing structure of the balance sheet, including information on hedging

▶ Evaluating the effects of banks' exposure to interest rate risk on lending after a monetary tightening subsequent to a prolonged period of low interest rates

# What happened during the low interest rate environment?

▶ Banks issued more fixed rate loans with a large maturity to compensate for compressed margins

▶ This increased the duration of banks' asset-side
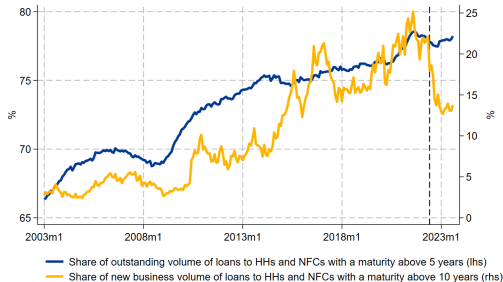


(a) Share of loans with a large maturity (%), Jan 2003 - July 2023. Source(s): ECB Balance Sheet Items and MFI Interest Rate Statistics.
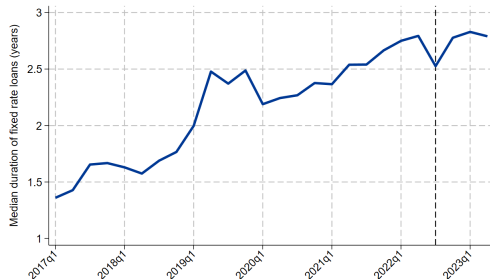
(b) Duration of fixed rate loans (years), 2017Q1-2023Q2. Source(s): ECB Supervisory data.

# What happened during the low interest rate environment?

► There was a large inflow of sticky overnight deposits, which behaviourally have a larger duration than term and redeemable deposits

► This increased the duration of banks' liabilities, counterbalancing the increase in the duration of the assets
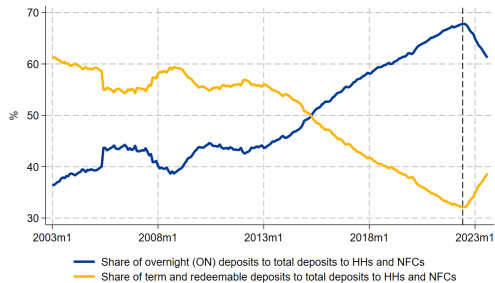
(a) Share of deposit types in total deposits to HHs and NFCs (%), Jan 2003 - July 2023. Source(s): ECB Balance Sheet Items.

(b) Duration of deposits types (years), Median 2022Q2 Source(s): ECB Supervisory data.

# What happened since interest rates started to increase?

▶ There has been a material shift from overnight to term and redeemable deposits, reducing the duration of banks' liability-side

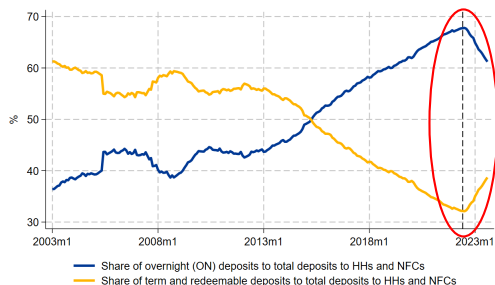▶ **Materialisation of interest rate risk (net duration risk)!**



(a) Share of deposit types in total deposits to HHs and NFCs (%), Jan 2003 - July 2023. Source(s): ECB Balance Sheet Items.
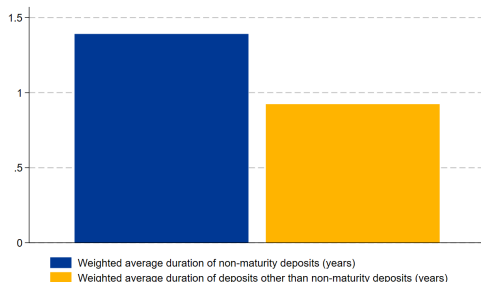
(b) Duration of deposits types (years), Median 2022Q2. Source(s): ECB Supervisory data.

# What happened since interest rates started to increase?

▶ **Materialisation of interest rate risk (net duration risk)!**



Duration gap (scaled by total assets) of euro area banks (%), 2019Q2-2023Q2. Source(s): ECB Supervisory data.

# Measuring interest rate risk

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

Where $j$ represent the maturity buckets and $Z$ represents total assets

▶ Based on bank-level supervisory data on **cash-flows for each repricing/maturity bucket**

▶ = Time to receive the cash-flows from the assets side – time to receive cash-flows from the liability side (weighted by their present value)

▶ **Positive** duration gap signals **losses** in economic value of equity when interest rates increase

▶ Takes into account **behavioural assumptions** and **hedging**

# Why should interest rate risk matter for bank lending?

▶ Banks try to have stable duration gap over time (Drechsler et al., 2021) or to **match the duration of assets and liabilities** (Kirti, 2020) to lock in long-term profits with stable funding

▶ Net duration risk entails **lower expected profitability** (English et al., 2018) and, consequently, **capital accumulation** in the medium run

▶ Banks want to **avoid supervisory scrutiny** and capital surcharges in the form of P2R and P2G
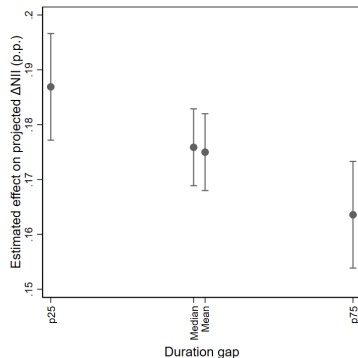


Impact of duration gap on 12 month projected ΔNII (p.p.), coefficients and 95% confidence bands. Source(s): ECB Supervisory data.

# Empirical challenges

▶ **Controlling for credit demand** by using firm-time or industry-location-size-time fixed effects
▶ **Controlling for interest rate type** by using interest rate type fixed effects
▶ **Controlling for positive impact of MP tightening on bank profits in the short-term** by controlling the heterogeneous impact of NII on lending after MP tightening
▶ **Exogeneity of monetary policy?**



Governing Council Monetary Policy Decision Meeting Dates

- Expectations (January 2022)
- Expectations (June 2022)
- Realised

Source(s): Survey of Monetary Analysts
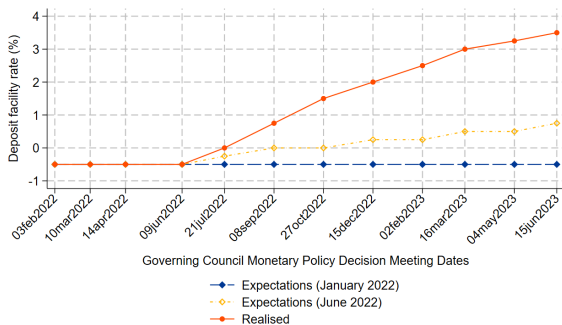
# Empirical strategy

**Bank-firm-quarter level estimations:**

$$\Delta log(loans)_{c,b,f,t} = \gamma DurationGap_{c,b,t-1} + \beta \left( DurationGap_{c,b,t-1} * \Delta PolicyRate_t \right)$$
$$+\kappa \tilde{X}_{c,b,t-1} + \lambda \left( \tilde{X}_{c,b,t-1} * \Delta PolicyRate_t \right) + \eta_{f,t,i} + [\alpha_{c,t}] + \epsilon_{b,f,t} \tag{2}$$

▶ Bank-firm-quarter level data on firm lending from *AnaCredit* combined with bank-level characteristics (bank size, profitability, income gap, funding structure, capitalization, liquidity, NPL)

▶ Time frame: 2021Q1-2023Q2

▶ 73 significant institutions

▶ > 2 million observations  `Go to descriptives`

# Intensive margin results

| | Dependent variable: Δ Log (loans) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Duration gap/TA (lag) | 0.000144 | 0.000193* | 0.000144 | 0.000194* |
| | (1.34) | (1.75) | (1.33) | (1.72) |
| Duration gap/TA (lag) × Δpolicy rate | -0.0292** | -0.0300*** | -0.0294** | -0.0302*** |
| | (-2.26) | (-3.04) | (-2.25) | (-3.00) |
| Observations | 2028673 | 2013105 | 2028661 | 2013091 |
| Control variables × Δpolicy rate | No | Yes | No | Yes |
| Borrower×Time×Interest rate type FE | Yes | Yes | Yes | Yes |
| Country×Time FE | No | No | Yes | Yes |

Note: ***: 0.01,**: 0.05,*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.

▶ When interest rates increase by 100 bps, a bank with a duration gap at the 75th percentile **reduces lending by around 90 bps more** than a bank at the 25th percentile

▶ Similar results on the probability of issuing a new loan <span>More results</span>

▶ **= deleveraging!**

# Portfolio reshuffling

| | Short-term loans (maturity $\leq$ 2 years) | | | | Long-term loans (maturity > 2 years) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Duration gap/TA (lag) | 0.000182 | 0.000235 | 0.000113 | 0.000164 | 0.000227 | 0.000277 | 0.000223 | 0.000276 |
| | (0.42) | (0.59) | (0.25) | (0.41) | (1.52) | (1.65) | (1.49) | (1.61) |
| Duration gap/TA (lag) $\times$ $\Delta$policy rate | -0.00230 | 0.0222 | 0.00615 | 0.0350 | -0.0607*** | -0.0557*** | -0.0610*** | -0.0561*** |
| | (-0.05) | (0.48) | (0.12) | (0.74) | (-2.82) | (-3.08) | (-2.79) | (-3.04) |
| Observations | 43873 | 43178 | 43847 | 43158 | 1781033 | 1767958 | 1781017 | 1767942 |
| Control variables $\times$ $\Delta$policy rate | No | Yes | No | Yes | No | Yes | No | Yes |
| Borrower$\times$Time$\times$Interest rate type FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country$\times$Time FE | No | No | Yes | Yes | No | No | Yes | Yes |

*Note: \*\*\*: 0.01,\*\*: 0.05,\*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

▶ Banks with a high duration gap especially reduce their **long-term lending** to reduce their exposure to duration risk and avoid supervisory scrutiny when interest rates increase

▶ Similar results on the probability of issuing a new loan <span>More results</span>

# Portfolio reshuffling

| | Dependent variable: $\Delta$ Log (loans) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Duration gap/TA (lag) | 0.000197* | 0.000243** | 0.000197* | 0.000240** |
| | (1.80) | (2.11) | (1.80) | (2.07) |
| Duration gap/TA (lag) $\times$ $\Delta$policy rate | -0.0249* | -0.0272** | -0.0248* | -0.0268** |
| | (-1.76) | (-2.58) | (-1.75) | (-2.53) |
| Duration gap/TA (pre/lag) $\times$ $\Delta$policy rate $\times$ Floating | -0.00361 | 0.00458 | -0.00394 | 0.00410 |
| | (-0.19) | (0.29) | (-0.21) | (0.25) |
| F-test floating rate loans | -0.0285 | -0.0226* | -0.0288 | -0.0227 |
| | (-1.66) | (-1.77) | (1.62) | (-1.67) |
| Observations | 2803531 | 2780145 | 2803522 | 2780140 |
| Control variables $\times$ $\Delta$policy rate | No | Yes | No | Yes |
| Double interactions | Yes | Yes | Yes | Yes |
| Borrower$\times$Time | Yes | Yes | Yes | Yes |
| Country$\times$Time FE | No | No | Yes | Yes |

*Note: ***: 0.01,**: 0.05,*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

▶ Estimations without interest rate type fixed effects
▶ Banks with a high duration gap especially reduce their **fixed rate lending** to reduce their exposure to duration risk and avoid supervisory scrutiny when interest rates increase
▶ Similar results on the probability of issuing a new loan  More results

## Which borrowers are more affected? Firm-size

|  | Dependent variable: Δ Log (loans) | | | |
|---|---|---|---|---|
|  | (1) | (2) | (3) | (4) |
| Duration gap/TA (lag) | 0.0000182 | 0.0000170 | 0.0000154 | 0.0000187 |
|  | (0.16) | (0.18) | (0.13) | (0.19) |
| Duration gap/TA (lag) × Δpolicy rate | -0.00443 | -0.00233 | -0.00475 | -0.00316 |
|  | (-0.35) | (-0.22) | (-0.36) | (-0.28) |
| Medium-sized firm × Duration gap/TA (lag) × Δpolicy rate | -0.0210* | -0.0222** | -0.0205* | -0.0210* |
|  | (-1.95) | (-2.09) | (-1.90) | (-1.97) |
| Small-sized firm × Duration gap/TA (lag) × Δpolicy rate | -0.0461*** | -0.0491*** | -0.0456*** | -0.0479*** |
|  | (-4.03) | (-4.56) | (-3.92) | (-4.38) |
| Micro-sized firm × Duration gap/TA (lag) × Δpolicy rate | -0.0214** | -0.0281** | -0.0211** | -0.0271** |
|  | (-2.61) | (-2.55) | (-2.42) | (-2.36) |
| Observations | 1981398 | 1966119 | 1981386 | 1966105 |
| Control variables × Δpolicy rate | No | Yes | No | Yes |
| Double interactions | Yes | Yes | Yes | Yes |
| Borrower×Time×Interest rate type FE | Yes | Yes | Yes | Yes |
| Country×Time FE | No | No | Yes | Yes |

*Note: \*\*\*: 0.01,\*\*: 0.05,\*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

▶ Banks with a larger duration gap do not significantly reduce lending to large firms when interest rates increase

▶ When interest rates increase by 100 bps, a bank with a duration gap at the 75th percentile **reduces lending by 90-97 bps more to small firms**, while this is between **40-56 bps for micro- and medium-sized firms**

# Which borrowers are more affected? Substitution effects

| | Dependent variable: $\Delta$ Log (borrowing) | |
|---|---|---|
| | (1) | (2) |
| High exposure | 0.0152*** | 0.0168*** |
| | (24.61) | (21.67) |
| High exposure $\times$ $\Delta$policy rate | -0.750*** | -0.744*** |
| | (-9.17) | (-7.13) |
| Observations | 6400463 | 6375657 |
| Bank-level control variables $\times$ $\Delta$policy rate | No | Yes |
| ILS$\times$Time$\times$Interest rate type FE | Yes | Yes |

*Note: ***: 0.01,**: 0.05,*: 0.1. Clustered standard errors at the firm level are reported in parenthesis.*

▶ Firm-quarter-level analysis
▶ When interest rates increase by 100 bps, firms exposed to banks with a higher duration gap exhibit **around 75 bps lower borrowing** in relative terms
▶ Firms cannot (fully) substitute the contraction in borrowing coming from high-duration gap banks

# Robustness checks

- ▶ Including single bank-firm relationships  Go to results
- ▶ Pre-determined duration gap (2)  Go to results
- ▶ Controlling for overnight deposits composition  Go to results
- ▶ Generalised propensity score weighting  Go to results
- ▶ Extensive margin analysis  Go to results
- ▶ Non-linearities  Go to results
- ▶ Excluding mixed rate loans  Go to results
- ▶ Different thresholds for short- vs long-term lending
- ▶ Additional control variables
- ▶ Different clustering of standard errors

## Conclusions

▶ Banks with a larger duration gap (i.e., higher interest rate risk exposure) **deleverage and reduce long-term and fixed-rate lending more compared to their peers** when interest rates increase to reduce their duration gap and avoid supervisory scrutiny

▶ **Small firms** are most affected by this deleveraging and affected firms **cannot fully substitute** the contraction in lending

▶ Important **policy implications**
   ⊙ Heterogeneity in the transmission of monetary policy
   ⊙ (Long-term) lending contraction can exacerbate economic downturn, with most pronounced effects for MSMEs

# Bibliography

Beutler, T., Bichsel, R., Bruhin, A., & Danton, J. (2020).The impact of interest rate risk on bank lending. *Journal of Banking & Finance, 115,* 105797. https://doi.org/https://doi.org/10.1016/j.jbankfin.2020.105797

Drechsler, I., Savov, A., & Schnabl, P. (2017).The Deposits Channel of Monetary Policy. *The Quarterly Journal of Economics, 132*(4), 1819–1876. https://doi.org/10.1093/qje/qjx019

Drechsler, I., Savov, A., & Schnabl, P. (2021).Banking on deposits: Maturity transformation without interest rate risk. *The Journal of Finance, 76*(3), 1091–1143. https://doi.org/https://doi.org/10.1111/jofi.13013

English, W. B., Van den Heuvel, S. J., & Zakrajšek, E. (2018).Interest rate risk and bank equity valuations. *Journal of Monetary Economics, 98,* 80–97.

Gambacorta, L., & Shin, H. S. (2018).Why bank capital matters for monetary policy? *Journal of Financial Intermediation, 35,* 17–29.

Gomez, M., Landier, A., Sraer, D., & Thesmar, D. (2021).Banks' exposure to interest rate risk and the transmission of monetary policy. *Journal of Monetary Economics, 117,* 543–570. https://doi.org/10.1016/j.jmoneco.2020.03

Greenwald, E., Schulhofer-Wohl, S., & Younger, J. (2023). *Deposit convexity, monetary policy, and financial stability* (Working Paper No. 2315). Federal Reserve Bank of Dallas.

Jiménez, G., Ongena, S., Peydró, J.-L., & Saurina, J. (2012).Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. *American Economic Review, 102*(5), 2301–26. https://doi.org/10.1257/aer.102.5.2301

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

Kirti, D. (2020).Why do bank-dependent firms bear interest-rate risk? *Journal of Financial Intermediation, 41,* 100823.

# Sample coverage and descriptives <span>Back</span>

Coverage of countries in the dataset (Nr. of banks)
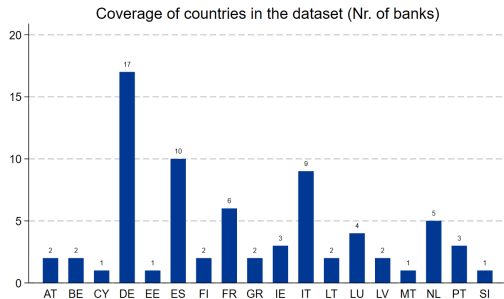
|  | N | Mean | Std.dev. | p25 | p75 | Min. | Max. |
|---|---|---|---|---|---|---|---|
| **Endogenous variables:** | | | | | | | |
| $\Delta Log(loans)$ (%) | 14,582,455 | -2.407 | 25.415 | -6.558 | 0 | -100.606 | 119.647 |
| **Variable of interest:** | | | | | | | |
| Duration gap/TA (%) | 17,167,090 | 4.119 | 26.366 | -11.335 | 19.791 | -62.315 | 80.843 |
| **Bank control variables:** | | | | | | | |
| Income gap/TA (%) | 17,167,090 | 4.090 | 7.276 | -1.152 | 9.776 | -53.903 | 39.449 |
| Log TA | 17,167,090 | 12.909 | 1.183 | 11.896 | 13.671 | 8.057 | 14.718 |
| Cash/TA (%) | 17,167,090 | 14.599 | 4.461 | 11.800 | 17.376 | 1.025 | 36.560 |
| ROA (%) | 17,167,090 | 0.491 | 0.385 | 0.286 | 0.648 | -0.907 | 1.941 |
| Debt securities/TA (%) | 17,129,892 | 10.554 | 6.403 | 7.971 | 11.139 | 0 | 37.618 |
| NPL ratio (%) | 17,167,052 | 3.534 | 1.422 | 2.769 | 4.197 | 0.465 | 13.303 |
| Distance to MDA (%) | 17,167,090 | 4.615 | 2.663 | 3.189 | 5.403 | 0.420 | 26.085 |

*Descriptives for the period 2021Q1-2023Q2.*

# Probability of issuing a new loan  Back

| | Dependent variable: new loan | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Duration gap/TA (lag) | 0.000369*** | 0.000380** | 0.000375*** | 0.000388** |
| | (2.66) | (2.42) | (2.68) | (2.41) |
| Duration gap/TA (lag) × Δpolicy rate | -0.0503** | -0.0603*** | -0.0504** | -0.0607*** |
| | (-2.23) | (-3.59) | (-2.19) | (-3.53) |
| Observations | 2028673 | 2013105 | 2028661 | 2013091 |
| Control variables × Δpolicy rate Borrower/ILS×Time×Interest rate type FE | Borr | Borr | Borr | Borr |
| Country×Time FE | No | No | Yes | Yes |

*Note: \*\*\*: 0.01,\*\*: 0.05,\*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

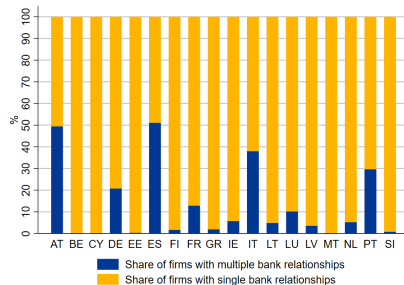# Probability of issuing a new loan (portfolio reshuffling) Back

| | New loan (maturity ≤ 2 years) | | | | New loan (maturity > 2 years) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Duration gap/TA (lag) | 0.0000188 | -0.0000506 | -0.00000241 | -0.0000898 | 0.000392*** | 0.000415*** | 0.000397*** | 0.000421*** |
| | (0.07) | (-0.18) | (-0.01) | (-0.31) | (3.08) | (3.02) | (3.10) | (2.97) |
| Duration gap/TA (lag) × Δpolicy rate | 0.0460 | 0.0630* | 0.0503* | 0.0676* | -0.0611*** | -0.0649*** | -0.0616*** | -0.0654*** |
| | (1.60) | (1.75) | (1.73) | (1.85) | (-3.26) | (-4.40) | (-3.24) | (-4.33) |
| Observations | 43873 | 43178 | 43847 | 43158 | 1781033 | 1767958 | 1781017 | 1767942 |
| Control variables × Δpolicy rate | No | Yes | No | Yes | No | Yes | No | Yes |
| Borrower*Time*Interest rate type FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country*Time FE | No | No | Yes | Yes | No | No | Yes | Yes |

*Note: \*\*\*: 0.01,\*\*: 0.05,\*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

| | Dependent variable: new loan | | | |
|---|---|---|---|---|
| | (5) | (6) | (7) | (8) |
| Duration gap/TA (lag) | 0.000287* | 0.000251 | 0.000292* | 0.000252 |
| | (1.94) | (1.44) | (1.96) | (1.43) |
| Duration gap/TA (lag) × Δpolicy rate | -0.0299 | -0.0394* | -0.0304 | -0.0395* |
| | (-1.06) | (-1.88) | (-1.07) | (-1.89) |
| Duration gap/TA (pre/lag) × Δpolicy rate × Floating | -0.0124 | -0.0233 | -0.0114 | -0.0234 |
| | (-0.32) | (-0.65) | (-0.29) | (-0.65) |
| F-test floating rate loans | -0.0424 | -0.0627** | -0.0417 | -0.0629** |
| | (-1.37) | (2.16) | (-1.32) | (-2.06) |
| Observations | 2803531 | 2780145 | 2803522 | 2780140 |
| Control variables × Δpolicy rate | No | Yes | No | Yes |
| Double interactions | Yes | Yes | Yes | Yes |
| Borrower×Time | Yes | Yes | Yes | Yes |
| Country×Time FE | No | No | Yes | Yes |

*Note: \*\*\*: 0.01,\*\*: 0.05,\*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*
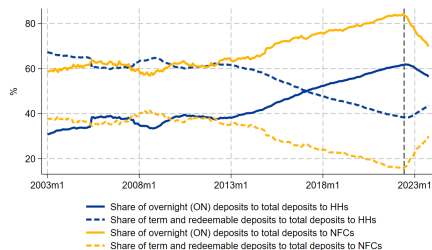
# Including single bank-firm relationships `Back`



|  | Dependent variable: Δ Log (loans) | | | | Dependent variable: Δ Log (loans) | | | |
|---|---|---|---|---|---|---|---|---|
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Duration gap/TA (lag) | 0.000212* | 0.000267** | 0.000237* | 0.000289** | 0.000232** | 0.000292*** | 0.000268** | 0.000319*** |
|  | (1.70) | (2.27) | (1.83) | (2.35) | (2.23) | (2.77) | (2.43) | (2.88) |
| Duration gap/TA (lag) × Δpolicy rate | -0.0338* | -0.0359*** | -0.0349* | -0.0352*** | -0.0334* | -0.0357*** | -0.0349* | -0.0335*** |
|  | (-1.82) | (-3.07) | (-1.84) | (-3.08) | (-1.89) | (-3.12) | (-1.91) | (-3.07) |
| Observations | 8511563 | 8437194 | 8511563 | 8437194 | 6463860 | 6405467 | 6463868 | 6405479 |
| Control variables × Δpolicy rate | No | Yes | No | Yes | No | Yes | No | Yes |
| ILS×Time×Interest rate type FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Time FE | No | No | Yes | Yes | No | No | Yes | Yes |

*Note: ***: 0.01,**: 0.05,*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

Are low interest rates firing back? Interest rate risk in the banking book and bank lending in a rising interest rate environment

└─ Annex

# Robustness checks (Back)



Legend:
- Share of overnight (ON) deposits to total deposits to HHs
- Share of term and redeemable deposits to total deposits to HHs
- Share of overnight (ON) deposits to total deposits to NFCs
- Share of term and redeemable deposits to total deposits to NFCs

| | Collapsed regressions | | Pre-determined duration gap | | Excluding mixed rate loans | | Overnight deposit composition | |
| | | | | Dependent variable: Δ Log (loans) | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Duration gap/TA (pre/lag) | -0.00103* | -0.00108 | 0.000223** | 0.000240** | 0.000194* | 0.000195* | 0.000230** | 0.000234** |
| | (-1.68) | (-1.66) | (2.41) | (2.43) | (1.75) | (1.73) | (2.08) | (2.06) |
| Duration gap/TA (pre/lag) × Δpolicy rate | | | -0.0202** | -0.0215* | -0.0304*** | -0.0305*** | -0.0306*** | -0.0308*** |
| | | | (-2.01) | (-1.99) | (-3.08) | (-3.03) | (-3.32) | (-3.27) |
| Share OV deposits to HH (lag) | | | | | | | 0.000561*** | 0.000574*** |
| | | | | | | | (3.83) | (3.77) |
| Share OV deposits to HH (lag) × Δpolicy rate | | | | | | | -0.0174 | -0.0174 |
| | | | | | | | (-1.04) | (-0.99) |
| Observations | 187845 | 187845 | 2013105 | 2013091 | 2010213 | 2010199 | 2012319 | 2012305 |
| Control variables × Δpolicy rate | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower×Interest rate type FE | Yes | Yes | - | - | - | - | - | - |
| Country FE | No | Yes | - | - | - | - | - | - |
| Borrower×Time×Interest rate type FE | - | - | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Time FE | - | - | No | Yes | No | Yes | No | Yes |

# Generalised propensity score weighting  Back

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
|  | *Dependent variable: Δ Log (loans)* | | | |
| Duration gap/TA (lag) | 0.000178 | 0.000226** | 0.000178 | 0.000228* |
|  | (1.62) | (2.02) | (1.61) | (2.00) |
| Duration gap/TA (lag)× Δpolicy rate | -0.0326** | -0.0330*** | -0.0328** | -0.0333*** |
|  | (-2.50) | (-3.32) | (-2.49) | (-3.27) |
| Observations | 2028673 | 2013105 | 2028661 | 2013091 |
| Control variables × Δpolicy rate | No | Yes | No | Yes |
| Borrower*Time*Interest rate type FE | Yes | Yes | Yes | Yes |
| Country*Time FE | No | No | Yes | Yes |

*Note: \*\*\*: 0.01,\*\*: 0.05,\*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

**Are low interest rates firing back? Interest rate risk in the banking book and bank lending in a rising interest rate environment**

└─ Annex

# Extensive margin: exit and entry dummy  Back

| | Dependent variable: Exit dummy | | | | Dependent variable: Entry dummy | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Duration gap/TA (pre) | 0.000432 | 0.000551 | 0.000359 | 0.000149 | -0.000936** | -0.000862*** | -0.000990** | -0.000993*** |
| | (0.36) | (0.66) | (0.28) | (0.17) | (-2.15) | (-2.67) | (-2.22) | (-3.06) |
| Observations | 1027663 | 1024987 | 1027663 | 1024987 | 925652 | 923053 | 925652 | 923053 |
| Predetermined control variables | No | Yes | No | Yes | No | Yes | No | Yes |
| Borrower×Interest rate type FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country FE | No | No | Yes | Yes | No | No | Yes | Yes |

*Note: ***: 0.01,**: 0.05,*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*

# Non-linearities and PSM  Back

| | Unmatched sample | | | | Matched sample | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Positive duration gap (lag) | 0.00636** | 0.00473 | 0.00629** | 0.00464 | 0.00826** | 0.00373 | 0.00824** | 0.00367 |
| | (2.07) | (1.54) | (2.04) | (1.50) | (2.03) | (0.70) | (2.01) | (0.67) |
| Positive duration gap (lag) × Δpolicy rate | -2.189*** | -1.859*** | -2.187*** | -1.839*** | -1.968*** | -1.512*** | -1.969*** | -1.494*** |
| | (-4.85) | (-5.04) | (-4.84) | (-4.99) | (-3.63) | (-3.53) | (-3.61) | (-3.44) |
| Observations | 2028673 | 2013105 | 2028661 | 2013091 | 1613866 | 1613827 | 1613856 | 1613813 |
| Control variables × Δpolicy rate | No | Yes | No | Yes | No | Yes | No | Yes |
| Borrower×Time×Interest rate type FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country×Time FE | No | No | Yes | Yes | No | No | Yes | Yes |

*Note: \*\*\*: 0.01,\*\*: 0.05,\*: 0.1. Two-way clustered standard errors at both bank and firm level are reported in parenthesis.*