The Heterogenous Bank Lending Channel of Monetary Policy

Jorge Abad[†]   Saki Bigio[‡]   Salomon Garcia-Villegas[†]   Joel Marbet[†]   Galo Nuño[†]

[†]Banco de España [‡]UCLA

5th WS1 ChaMP Workshop
Central Bank of Ireland, February 2025

Bank heterogeneity and monetary policy transmission

Transmission of monetary policy to lending depends on bank-level characteristics:

- Liquid assets and size (Kashyap and Stein, 2000)

- Leverage (Jimenez et al., 2012; Dell'Ariccia et al., 2017; Altavilla et al., 2020)

- Interest rate risk exposure (Gomez et al., 2021)

- Loan-rate fixation (Altunok, Arslan and Ongena, 2023)

Bank heterogeneity and monetary policy transmission

Transmission of monetary policy to lending depends on bank-level characteristics:

- Liquid assets and size (Kashyap and Stein, 2000)

- Leverage (Jimenez et al., 2012; Dell'Ariccia et al., 2017; Altavilla et al., 2020)

- Interest rate risk exposure (Gomez et al., 2021)

- Loan-rate fixation (Altunok, Arslan and Ongena, 2023)

  $\rightarrow$ How does heterogeneity affect aggregate responses?

Our contribution

1. We document EA banks' heterogeneity in capital ratios and loan-rate fixation

Our contribution

1. We document EA banks' heterogeneity in capital ratios and loan-rate fixation

2. We build a heterogeneous-banks quantitative macro model with:

- Ex-post heterogeneity in capital ratios

- Ex-ante heterogeneity in loan-rate fixation: Fixed vs Variable rates

Preview of the results

A calibrated heterogeneous-bank model for the EA:

- Long-run distributional features:
  Cross-sectional dist. of assets, capital ratios and marginal propensities to lend

Preview of the results

A calibrated heterogeneous-bank model for the EA:

- Long-run distributional features:
  Cross-sectional dist. of assets, capital ratios and marginal propensities to lend

- We study aggregate and individual response to monetary policy shocks:
  - Stronger contraction in credit of banks with...
    - Fixed-rate loans
    - Lower capital ratios
  - Also: implications for financial stability

Outline

1. Stylized facts about bank heterogeneity in the EA

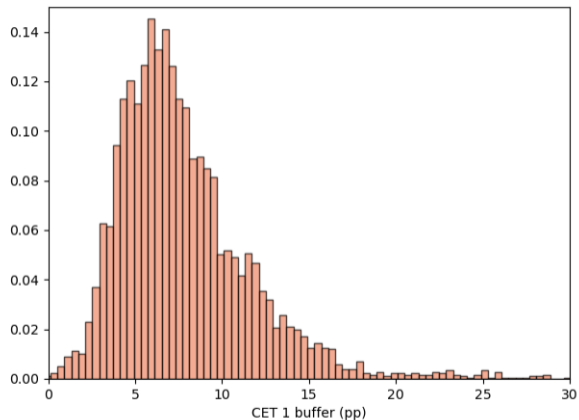2. A heterogeneous bank model

3. Results

Heterogeneity in bank leverage

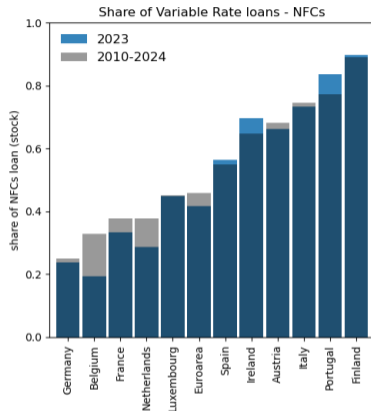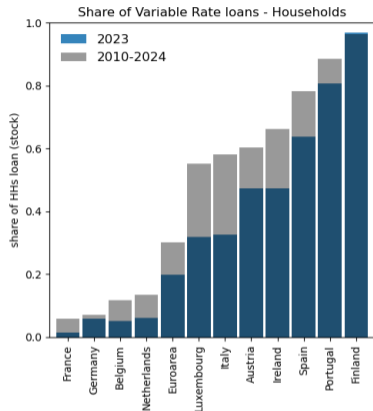CET1 capital ratios distribution across European banks
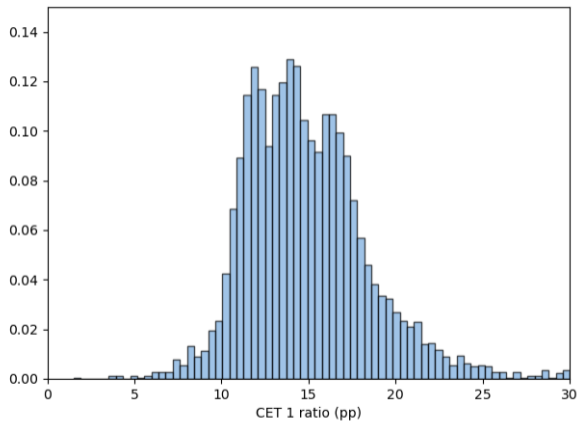
Heterogeneity in bank leverage

Voluntary CET1 capital buffer distribution across European banks

Heterogeneity in loan-rate fixation

- Fixed raters: Germany, France, Belgium, and Netherlands
- Variable raters: Spain, Portugal, Italy, Finland
- Loan-rate fixation patterns are highly persistent over time

The model

The model

Banking sector

- Atomistic, perfectly competitive banks
- Assets: central bank reserves and risky long-term loans
- Liabilities: short-term (insured) deposit and equity
- Regulation: (i) Minimum capital requirement, (ii) Buffer requirement, (iii) Liquidity requirement
  $\rightarrow$ Failure to comply may lead to bank resolution (i) or dividend payout restrictions (ii)

The model

Banking sector
- Atomistic, perfectly competitive banks
- Assets: central bank reserves and risky long-term loans
- Liabilities: short-term (insured) deposit and equity
- Regulation: (i) Minimum capital requirement, (ii) Buffer requirement, (iii) Liquidity requirement
  → Failure to comply may lead to bank resolution (i) or dividend payout restrictions (ii)

Non-financial sector
- Entrepreneurs: Rely on bank loans for funding investment projects
- Households: Save in deposits and govt. bonds, consume, own the banks
- Govt: monetary policy, deposit insurance scheme, and tax receipts and transfers

The model

Banking sector
- Atomistic, perfectly competitive banks
- Assets: central bank reserves and risky long-term loans
- Liabilities: short-term (insured) deposit and equity
- Regulation: (i) Minimum capital requirement, (ii) Buffer requirement, (iii) Liquidity requirement
  → Failure to comply may lead to bank resolution (i) or dividend payout restrictions (ii)

Non-financial sector
- Entrepreneurs: Rely on bank loans for funding investment projects
- Households: Save in deposits and govt. bonds, consume, own the banks
- Govt: monetary policy, deposit insurance scheme, and tax receipts and transfers

We consider two alternative institutional environments: fixed rate and variable rate loans

Banks' balance sheet

- Bank j starts with a portfolio of legacy loans L_{jt} and accumulated pre-dividend equity E_{jt}

- Need to choose origination of new loans N_{jt}, deposits D_{jt}, and reserves B_{jt}

- Dividends X_{jt} follow an exogenous rule

- The bank's balance sheet:

$$L_{jt} + N_{jt} + B_{jt} = D_{jt} + K_{jt},$$

with $K_{jt} \equiv E_{jt} - X_{jt}$ post-dividend equity

Assets

Loan portfolio: continuum risky long-term loans with atomistic size

- Principal of 1 and per-period avg. effective rate $\bar{r}_{jt}^{L}$

Assets

Loan portfolio: continuum risky long-term loans with atomistic size

- Principal of 1 and per-period avg. effective rate $\bar{r}^L_{jt}$
- Mature with iid prob. δ (as in Leland and Toft, 1996)

Assets

Loan portfolio: continuum risky long-term loans with atomistic size

- Principal of 1 and per-period avg. effective rate $\bar{r}^L_{jt}$
- Mature with iid prob. δ (as in Leland and Toft, 1996)
- Default with prob. p and suffer loss λ

Assets

Loan portfolio: continuum risky long-term loans with atomistic size

- Principal of 1 and per-period avg. effective rate $\bar{r}_{jt}^{L}$
- Mature with iid prob. δ (as in Leland and Toft, 1996)
- Default with prob. p and suffer loss λ
- Loan defaults correlated at the bank level $\rightarrow \omega_{jt+1}$: stochastic default rate

Assets

Loan portfolio: continuum risky long-term loans with atomistic size

- Principal of 1 and per-period avg. effective rate $\bar{r}_{jt}^L$
- Mature with iid prob. δ (as in Leland and Toft, 1996)
- Default with prob. p and suffer loss λ
- Loan defaults correlated at the bank level $\rightarrow \omega_{jt+1}$: stochastic default rate
- Law of motion: $L_{jt+1} = (1 - \omega_{jt+1})(1 - \delta)(L_{jt} + N_{jt})$

Assets

Loan portfolio: continuum risky long-term loans with atomistic size

- Principal of 1 and per-period avg. effective rate $\bar{r}_{jt}^L$
- Mature with iid prob. δ (as in Leland and Toft, 1996)
- Default with prob. p and suffer loss λ
- Loan defaults correlated at the bank level $\rightarrow \omega_{jt+1}$: stochastic default rate

- Law of motion: $L_{jt+1} = (1 - \omega_{jt+1})(1 - \delta)(L_{jt} + N_{jt})$

- Technology: Issuance of new loans N_{jt} incurs an increasing and convex cost $f\left(\frac{N_{jt}}{E_{jt}}\right) E_{jt}$

Assets

Loan portfolio: continuum risky long-term loans with atomistic size

- Principal of 1 and per-period avg. effective rate $\bar{r}_{jt}^L$
- Mature with iid prob. δ (as in Leland and Toft, 1996)
- Default with prob. p and suffer loss λ
- Loan defaults correlated at the bank level $\rightarrow \omega_{jt+1}$: stochastic default rate
- Law of motion: $L_{jt+1} = (1 - \omega_{jt+1})(1 - \delta)(L_{jt} + N_{jt})$

- Technology: Issuance of new loans N_{jt} incurs an increasing and convex cost $f\left(\frac{N_{jt}}{E_{jt}}\right) E_{jt}$

- Banks can also invest in short-term reserves B_t remunerated at the policy rate r_t^B

Equity and profits

- Equity is accumulated through retained earnings

$$E_{jt+1} = E_{jt} - X_{jt} + (1 - \tau)\Pi_{jt+1},$$

where τ is the corporate tax rate and profits Π_{jt+1}

Equity and profits

- Equity is accumulated through retained earnings

$$E_{jt+1} = E_{jt} - X_{jt} + (1 - \tau)\Pi_{jt+1},$$

where τ is the corporate tax rate and profits Π_{jt+1}

- Profits:

$$
\begin{aligned}
\Pi_{jt+1} = &\ \bar{r}_{jt}^L \left(1 - \omega_{jt+1}\right)\left(L_{jt} + N_{jt}\right) - \lambda\omega_{jt+1}\left(L_{jt} + N_{jt}\right) && \text{(return of loans)} \\
&+ r_t^B B_{jt} && \text{(return of reserves)} \\
&- r_t^D D_{jt} && \text{(remuneration of liabilities)} \\
&- f\left(N_{jt}/E_{jt}\right) E_{jt} - \bar{\pi} E_{jt} && \text{(operational costs)}
\end{aligned}
$$

Regulation

- Pre-dividend equity needs to satisfy a *minimum capital requirement*:

$$E_{jt} \geq \gamma L_{jt}$$

$\rightarrow$ Failure to comply results in resolution of the bank

Regulation

- Pre-dividend equity needs to satisfy a *minimum capital requirement*:

$$E_{jt} \geq \gamma L_{jt}$$

  $\rightarrow$ Failure to comply results in resolution of the bank

- New lending and dividends constrained by a *buffer requirement*:

$$K_{jt} \equiv E_{jt} - X_{jt} \geq (1 + \kappa_t)\gamma(L_{jt} + N_{jt})$$

Regulation

- Pre-dividend equity needs to satisfy a *minimum capital requirement*:

$$E_{jt} \geq \gamma L_{jt}$$

  $\rightarrow$ Failure to comply results in resolution of the bank

- New lending and dividends constrained by a *buffer requirement*:

$$K_{jt} \equiv E_{jt} - X_{jt} \geq (1 + \kappa_t)\gamma(L_{jt} + N_{jt})$$

- *Liquidity requirement* proportional to bank deposits:

$$B_t \geq \theta D_t$$

Non-financial sector

- Aggregate credit demand by entrepreneurs:

$$N_t = \begin{cases} g(r_t^L), & \text{for fixed-rate loans} \\ \\ g\left(r_t^L, r_{t+1}^L, ...\right), & \text{for variable-rate loans} \end{cases}$$

Non-financial sector

- Aggregate credit demand by entrepreneurs:

$$N_t = \begin{cases} g(r_t^L), & \text{for fixed-rate loans} \\ \\ g\left(r_t^L, r_{t+1}^L, ...\right), & \text{for variable-rate loans} \end{cases}$$

- Aggregate deposit demand by households: $D_t = h(r_t^D)$

Non-financial sector

- Aggregate credit demand by entrepreneurs:

$$N_t = \begin{cases} g(r_t^L), & \text{for fixed-rate loans} \\ \\ g\left(r_t^L, r_{t+1}^L, ...\right), & \text{for variable-rate loans} \end{cases}$$

- Aggregate deposit demand by households: $D_t = h(r_t^D)$

- Central bank supplies reserves B_t and sets policy rate r_t^B

Non-financial sector

- Aggregate credit demand by entrepreneurs:

$$N_t = \begin{cases} g(r_t^L), & \text{for fixed-rate loans} \\\\ g\left(r_t^L, r_{t+1}^L, ...\right), & \text{for variable-rate loans} \end{cases}$$

- Aggregate deposit demand by households: $D_t = h(r_t^D)$

- Central bank supplies reserves B_t and sets policy rate r_t^B

- Government collects taxes and runs a deposit insurance scheme

Calibration

- Quarterly frequency

- We replicate the balance sheet and key variables of the euro area banking sector:
    - Bank capital ratios, share of liquid assets
    - Avg. loan maturity, interest rates of different assets and banks' ROE
    - Avg. loan default rates, LGDs and prob. of bank failure
    - Basel III requirements

Calibration

- Quarterly frequency

- We replicate the balance sheet and key variables of the euro area banking sector:
  - Bank capital ratios, share of liquid assets
  - Avg. loan maturity, interest rates of different assets and banks' ROE
  - Avg. loan default rates, LGDs and prob. of bank failure
  - Basel III requirements

- Target empirical responses of bank lending and loan rates to unexpected MP shocks

Calibration

- Quarterly frequency

- We replicate the balance sheet and key variables of the euro area banking sector:
  - Bank capital ratios, share of liquid assets
  - Avg. loan maturity, interest rates of different assets and banks' ROE
  - Avg. loan default rates, LGDs and prob. of bank failure
  - Basel III requirements

- Target empirical responses of bank lending and loan rates to unexpected MP shocks
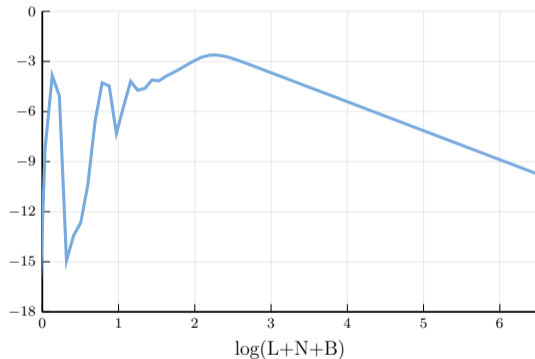
- Still work in progress!

Results

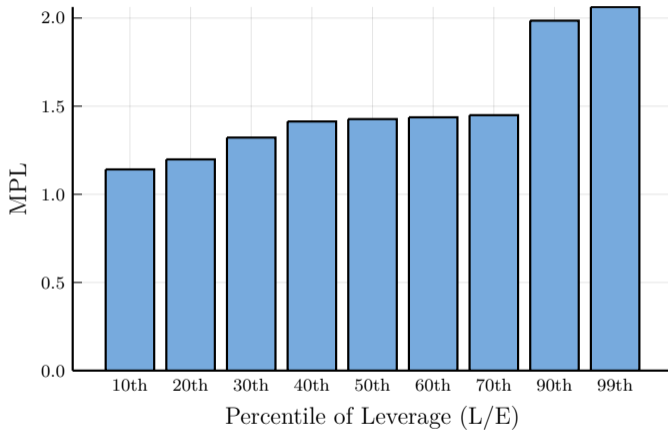# 1. Long-run results: Distribution of bank assets

Histogram

Log-log plot

log(L+N+B)

log(L+N+B)
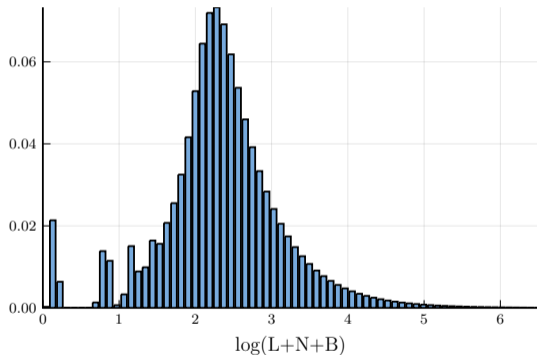
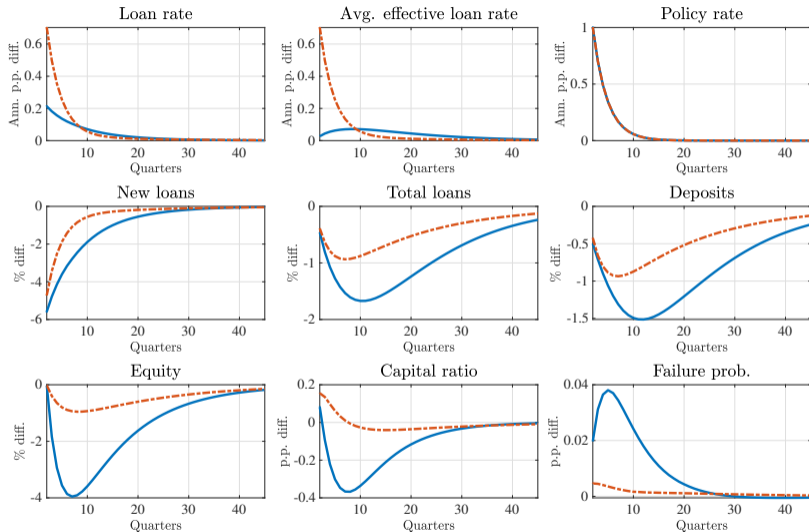# 2. Long-run results: Capital ratios
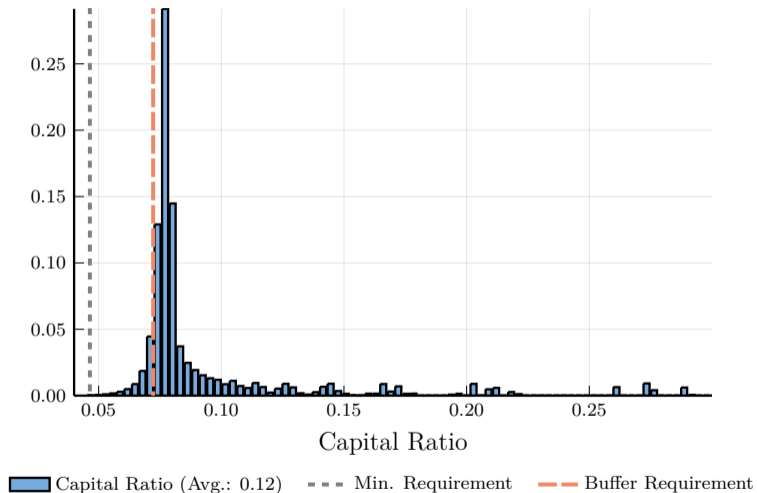
3. Long-run results: Leverage and marginal propensities to lend

4. Aggregate responses to a MP shock

5. Cross-sectional heterogeneity in the transmission to lending
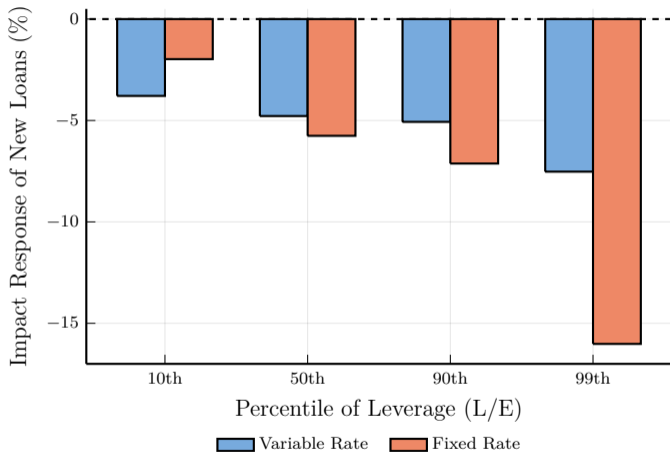
Concluding remarks

- We document stylized facts about bank heterogeneity in the EA

- We develop a model of banks with heterogeneous leverage and loan-rate fixation

- We study aggregate and individual responses to monetary policy shocks:
  - Stronger contraction in credit of banks with...
    - Fixed-rate loans
    - Lower capital ratios