“Who bears interest rate risk?”

Peter Hoffmann (ECB/DG-R)
Sam Langfield (ESRB)
Federico Pierobon (ECB/SSM)
Guillaume Vuilleme (HEC Paris)

EBA Policy Research Workshop,
28-29 November 2018

Disclaimer: The views expressed are those of the presenter and do not necessarily reflect those of the ECB and/or the Eurosystem.
Intro

- We study banks’ exposure to interest rate risk (IRR)

- Relevant for
  - monetary policy (“bank lending channel”)
  - financial stability (e.g. S&L crisis, ECB IRR stress test)

- Laboratory: Euro area
  - institutions from 18 countries → heterogeneity
What we do

- We combine two new datasets
  - supervisory balance sheet data
  - transaction-level derivatives data

- We compute banks’ exposure to interest rate risk
  - three measures, consistent results

- Study cross-sectional variation

- Hedging
What we find

- Banks bear relatively little IRR on aggregate
  - average exposures are close to zero
- Exposures are heterogeneous
  - some banks gain, some lose
  - significant variation across countries
  - little variation across business models
What we find

- We examine the role of mortgage market design
  - important asset class
  - cross-country heterogeneity

- Loan-rate fixation conventions explain variation in banks’ exposures
  - a simple partition accounts for up to 1 SD of dispersion
  - exposures are systematically related to retail lending

- Banks hedge $\sim$ 25% of exposures via interest rate swaps
  - higher on-balance sheet exposures $\rightarrow$ more hedging
  - risk-sharing between heterogeneous banks (incomplete)
Related Literature (incomplete)


Data & Measurement
Data

- ECB supervisory statistics
  - focus on “banking book”
  - breakdown of assets & liabilities into 14 maturity buckets
  - information on behaviour of sight deposits

- EMIR data
  - transaction-level data on derivatives positions
  - contract details + counterparty IDs
  - focus on interest rate swaps (IRS)

- single snapshot from 31/12/2015
  - $N = 104$, covering 97% of SSM assets

- Time-series information on net interest margin
  - Bankscope, annual data since 1999 ($N=102$)
We use three different measures of interest rate risk:

- Net-worth sensitivity ("DV1")
  \[
  \Delta PV = \sum_{t=0}^{\infty} \frac{CF^A_t - CF^L_t}{(1 + r_t + \Delta r)^t} - \sum_{t=0}^{\infty} \frac{CF^A_t - CF^L_t}{(1 + r_t)^t}.
  \]

- Projected change in NIM (based on 1-year "income gap")
  \[
  \Delta NIM = (CF^A_1 - CF^L_1) \times \Delta r
  \]

- DSS-\(\beta\)
  \[
  \Delta NIM_t = \alpha + \sum_{s=0}^{S} \beta^NIM_s \cdot \Delta r_{t-s} + \epsilon_t.
  \]
Measurement

- Sight deposits require particular treatment
  - significant part of liabilities
  - sticky $\rightarrow$ effectively term liabilities
- In practice, banks model deposit behaviour
- We calibrate deposits based on supervisory data

<table>
<thead>
<tr>
<th>Duration of Sight Deposits</th>
<th>Mean</th>
<th>StDev</th>
<th>P25</th>
<th>Median</th>
<th>P75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Sight Deposits</td>
<td>2.00</td>
<td>1.56</td>
<td>0.15</td>
<td>2.03</td>
<td>3.13</td>
</tr>
<tr>
<td>Corporate Sight Deposits</td>
<td>1.02</td>
<td>1.24</td>
<td>0.00</td>
<td>0.33</td>
<td>1.82</td>
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<tr>
<td>Other Sight Deposits</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total Sight Deposits</td>
<td>1.48</td>
<td>1.32</td>
<td>0.01</td>
<td>1.45</td>
<td>2.48</td>
</tr>
</tbody>
</table>

- Durations are correlated with pass-through from market to deposit rates
Banks’ exposure to IRR
The cross-section of exposures

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<th>Mean</th>
<th>StDev</th>
<th>P25</th>
<th>Median</th>
<th>P75</th>
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</thead>
<tbody>
<tr>
<td>ΔPV</td>
<td>-0.09</td>
<td>0.57</td>
<td>-0.38</td>
<td>-0.07</td>
<td>0.22</td>
</tr>
</tbody>
</table>
Drivers of dispersion - country vs. business model

![Bar chart showing the adjusted R² for ΔPV, ΔNIM, and β²NIM with country and business model categories.]

- ΔPV
- ΔNIM
- β²NIM

Country and Business Model categories are represented in different colors.
A role for mortgage markets?

- Mortgages are an important part of bank assets
  - strong growth since 80s (Jorda, Schularick and Taylor, 2016)
  - > 35% of total lending in Euro area

- Mortgages markets differ in design (Campbell, 2012)
  - one important dimension: loan-rate fixation
  - matters for interest rate risk
  - highly heterogeneous in the Euro area
Loan-rate fixation conventions

Loans for house purchase with variable rate (in %)

FR
BE
SK
DE
NL
IT
LU
ES
AT
IE
EE
CY
MT
LT
GR
SI
PT
FI
LV

0
20
40
60
80
100

Loans for house purchase with variable rate (in %)
Loan-rate fixation conventions

- We argue: loan-rate fixation conventions are **exogenous** for banks
  - affect supply of long-/short-maturity loans
  - prevent maturity-matching of assets & liabilities

 Supporting arguments
  - *Albertazzi et al. (2017)*: mortgages from cross-border banks line up with local conventions
  - *Campbell (2012)*: heterogeneity persists in Euro area, despite market integration and convergence in inflation
  - low time-series volatility within countries

- We split banks into 2 country groups (variable- vs. fixed-rate)
Heterogeneity across country groups

Difference in means = 0.35 (\sim 60\% of one SD)
The role of retail loans (85% mortgages in Euro area)

- Mean(Retail Loans/Assets) = 0.25
- Difference at mean = 0.46 (∼ 80% of one SD)
Explaining exposures

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<tbody>
<tr>
<td></td>
<td>$\Delta PV$</td>
<td>$\Delta PV$</td>
<td>$\Delta PV$</td>
<td>$\Delta PV^{BS}$</td>
</tr>
<tr>
<td>$VRM$</td>
<td>$0.348^{**}$</td>
<td>$-0.066$</td>
<td>$0.020$</td>
<td>$-0.035$</td>
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<tr>
<td></td>
<td>(2.40)</td>
<td>(-0.25)</td>
<td>(0.12)</td>
<td>(-0.13)</td>
</tr>
<tr>
<td>Retail Loans/Assets</td>
<td>$-1.390^*$</td>
<td>$-1.768^{***}$</td>
<td>$-1.585^*$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.07)</td>
<td>(-3.09)</td>
<td>(-2.00)</td>
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<tr>
<td>$VRM \times Retail Loans/Assets$</td>
<td>$1.824^{**}$</td>
<td>$1.748^{**}$</td>
<td>$2.182^{**}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.20)</td>
<td>(2.59)</td>
<td>(2.18)</td>
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<tr>
<td>R-squared</td>
<td>0.096</td>
<td>0.210</td>
<td>0.306</td>
<td>0.386</td>
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<td>N</td>
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<tr>
<td>BM FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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- $VRM = 1$ for banks from variable-rate countries (0 otherwise)
## Explaining the asset side

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<tbody>
<tr>
<td>$\Delta PV^{Assets}$</td>
<td>0.736***</td>
<td>0.606***</td>
<td>0.617***</td>
<td>0.405***</td>
<td>0.212***</td>
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<tr>
<td></td>
<td>(10.17)</td>
<td>(8.24)</td>
<td>(9.75)</td>
<td>(4.42)</td>
<td>(4.55)</td>
</tr>
<tr>
<td>$\Delta PV^{Liabilities}$</td>
<td>0.668***</td>
<td>0.189</td>
<td>0.364***</td>
<td>-0.175</td>
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</tr>
<tr>
<td></td>
<td>(3.49)</td>
<td>(1.08)</td>
<td>(3.81)</td>
<td>(-1.05)</td>
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<tr>
<td>$VRM \times Retail Loans/Assets$</td>
<td>-1.386*</td>
<td>-1.586***</td>
<td>0.199</td>
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</tr>
<tr>
<td></td>
<td>(-1.89)</td>
<td>(-3.22)</td>
<td>(0.52)</td>
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<tr>
<td>$VRM \times Retail Loans/Assets$</td>
<td>2.003**</td>
<td>1.811***</td>
<td>0.192</td>
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<tr>
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<td>(2.35)</td>
<td>(3.36)</td>
<td>(0.36)</td>
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<tr>
<td>R-squared</td>
<td>0.519</td>
<td>0.636</td>
<td>0.681</td>
<td>0.675</td>
<td>0.281</td>
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Hedging
Hedging - on- vs. off-balance sheet exposures

\[ \Delta PV_{IRS} = \beta \Delta PV_{BS} + \alpha + \epsilon \]

\[ \beta = -0.707, \text{ t-stat } = -4.44 \]

\[ \alpha = -0.028, \text{ t-stat } = -0.40 \]
Hedging

- Hedging = reduction of exposures (independent of sign)

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<tbody>
<tr>
<td>(</td>
<td>\Delta PV^{BS})</td>
<td></td>
<td>0.54</td>
<td>0.62</td>
<td>0.16</td>
</tr>
<tr>
<td>(</td>
<td>\Delta PV)</td>
<td>0.40</td>
<td>0.39</td>
<td>0.09</td>
<td>0.27</td>
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</table>

| \(|\Delta PV| - |\Delta PV^{BS}\)| | -0.14 | 0.44 | -0.21 | -0.04 | 0.04 |
|\(log(|\Delta PV|) - log(|\Delta PV^{BS}|))| -0.29 | 1.02 | -0.63 | -0.24 | 0.25 |

H0: \(|\Delta PV^{BS}| - |\Delta PV| = 0\)
p-value = 0.030, t-statistic = -2.36

H0: \(log(|\Delta PV|) - log(|\Delta PV^{BS}|) = 0\)
p-value = 0.008, t-statistic = -3.02

- Banks hedge valuation risk, not income risk
  - consistent with hedge accounting rules

- Exposures are reduced by \(\sim 25\%\)
Exposures before and after hedging

![Diagram showing density distribution and ΔPV (in basis points) for ΔPV and ΔPV^{BS}](image)

- ΔPV (in basis points)
- ΔPV and ΔPV^{BS}
## Intensity of hedging

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<tbody>
<tr>
<td>$</td>
<td>\Delta PV^{BS}</td>
<td>$</td>
<td>-0.348*</td>
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<td></td>
<td>(-1.88)</td>
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<tr>
<td>Opp. Sign</td>
<td>-0.570**</td>
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<td>(-2.24)</td>
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<tr>
<td>VRM</td>
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<td>%NPL</td>
<td>0.980</td>
<td>1.132</td>
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<td>(0.97)</td>
<td>(1.56)</td>
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<tr>
<td>Size</td>
<td>0.110</td>
<td>0.057</td>
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<td>(0.99)</td>
<td>(0.70)</td>
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<tr>
<td>R-squared</td>
<td>0.111</td>
<td>0.132</td>
<td>0.079</td>
<td>0.089</td>
<td>0.089</td>
<td>0.174</td>
<td>0.186</td>
<td>0.191</td>
<td>0.177</td>
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Risk-sharing in the IRS market
Recent models stress the re-distributive effects of MP between banks and non-financial sector
  - “stealth recapitalization”

Our findings suggest
  - these effects need not be large
  - re-distributive effects within banking sector are larger

We estimate (+25 bps shock)
  - non-financial sector → banks: €4.6 billion
  - banks ←→ banks: €6.6 billion
Policy implications - households

- Banks also reveal some information about households’ exposures
  - deposits = assets, loans = liabilities
- We find the same cross-country heterogeneity

IRR is borne by different sectors across euro area countries
  - potential challenge for monetary policy
Conclusions

- We examine banks’ exposure to interest rate risk
  - novel data for on- and off-balance sheet exposures
- Banks bear little interest rate risk on aggregate
- Exposures are heterogeneous
- Loan-rate conventions in mortgage markets explain cross-sectional variation
- Banks use swaps to reduce exposures, but hedging is incomplete
- Policy implications