Who bears interest rate risk?

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March 2018
Motivation

- **Interest rate risk is aggregate** → Someone has to bear it
  - Macro: $r$ moves when aggregate consumption $\neq$ production
  - Some agents must postpone production
  - Aggregate risk → Cannot be diversified

- **Who bears interest rate risk?**
  - Frictionless: No risk-bearing by banks (Hellwig)
  - Existing evidence: Banks do bear some risk
  - Received view: Bank equity drops when rates go up

- **Current context**
  - Historically low (negative) interest rate rates
  - Rates to increase soon?
  - Interest rate risk can be material (S&L crisis)
Preview of results

- **Significant heterogeneity in cross-section of banks**
  - About 50% of banks gain value when rates increase
  - → In contrast with received view
  - Heterogeneity explained by country-level loan conventions (VR vs. FR)

- **Risk-sharing potential across European countries**
  - Banks hedge with derivatives...
  - ... but hedging is incomplete (≈ 25%)
  - Net worth constraints may explain imperfect hedging

- **Residual exposures have important implications**
  - Redistributive effects of monetary policy
  - Sector bearing IR risk differs across countries
Data

- 104 euro area banks supervised by SSM
  - 80% of total assets of European banks
  - Cross-section as on end-2015
  - No time series

- **On-balance sheet exposures**
  - Banking book exposures
  - Detailed breakdown by 14 maturity buckets

- **Off-balance sheet exposures**
  - Trade-level data from repositories ($\approx 600,000$ trades)
  - Interest rate swaps on Eonia and Euribor
Measurement

- **Present-value approach**
  - $PV_{it}(l_t, \theta_i)$: PV of instrument $i$ at $t$
  - $l_t$: Relevant rates (swap and forward rates)
  - $\theta_i$: Parameters (maturity, etc.)
  
  $$\Delta PV_{it}(l_t, \Delta l, \theta_i) = PV_{it}(l_t + \Delta l, \theta_i) - PV_{it}(l_t, \theta_i),$$

- **Scenario**
  - Parallel shift in the entire yield curve (50 bps)

- **Contractual vs. actual repricing profiles**
  - Deposits: Longer duration than contractual
  - Loan prepayment options: Shorter duration than contractual
  - $\rightarrow$ Internal ECB data to make adjustments
## Contractual maturities (in years)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>StDev</th>
<th>P10</th>
<th>P25</th>
<th>Median</th>
<th>P75</th>
<th>P90</th>
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</thead>
<tbody>
<tr>
<td><strong>Assets:</strong></td>
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<tr>
<td></td>
<td>2.21</td>
<td>1.74</td>
<td>0.48</td>
<td>1.08</td>
<td>1.58</td>
<td>3.13</td>
<td>4.40</td>
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<tr>
<td>Loans*</td>
<td>1.90</td>
<td>1.94</td>
<td>0.27</td>
<td>0.53</td>
<td>1.05</td>
<td>2.95</td>
<td>4.71</td>
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<tr>
<td>Debt securities held</td>
<td>3.38</td>
<td>1.93</td>
<td>1.03</td>
<td>1.88</td>
<td>3.33</td>
<td>4.66</td>
<td>5.92</td>
</tr>
<tr>
<td><strong>Liabilities:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>2.27</td>
<td>1.31</td>
<td>1.20</td>
<td>1.59</td>
<td>1.92</td>
<td>2.56</td>
<td>3.64</td>
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<tr>
<td>Debt securities issued</td>
<td>2.67</td>
<td>2.11</td>
<td>0.23</td>
<td>1.27</td>
<td>2.50</td>
<td>3.75</td>
<td>4.50</td>
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<tr>
<td>Term deposits</td>
<td>1.68</td>
<td>2.06</td>
<td>0.31</td>
<td>0.55</td>
<td>0.86</td>
<td>1.80</td>
<td>4.57</td>
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<tr>
<td>Sight deposits*</td>
<td>2.09</td>
<td>0.74</td>
<td>1.07</td>
<td>1.96</td>
<td>2.30</td>
<td>2.53</td>
<td>2.73</td>
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<tr>
<td><strong>Duration gap (modeled)</strong></td>
<td>-0.06</td>
<td>1.06</td>
<td>-1.32</td>
<td>-0.72</td>
<td>-0.22</td>
<td>0.30</td>
<td>1.30</td>
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</tbody>
</table>
In aggregate, banking sector provides no insurance

- But cross-sectional heterogeneity is significant
Explaining cross-sectional heterogeneity

- **Dummy for whether a bank has positive $\Delta PV$**
  - Regress it on bank and country characteristics
  - Focus first on banking book only: $PV^{BB}$

- **Key variable:** **Fixed-rate vs variable-rate countries** (see next)

<table>
<thead>
<tr>
<th></th>
<th>$PV^{BB} &gt; 0$</th>
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<th>$PV^{BB} &gt; 0$</th>
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</thead>
<tbody>
<tr>
<td>VRC</td>
<td>3.484***</td>
<td>1.161</td>
<td>5.793***</td>
<td>3.445*</td>
<td>2.568</td>
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<tr>
<td></td>
<td>(5.95)</td>
<td>(1.15)</td>
<td>(3.20)</td>
<td>(1.69)</td>
<td>(1.13)</td>
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<tr>
<td>Ret. Loans / Assets</td>
<td>2.045</td>
<td>-1.910</td>
<td>-0.859</td>
<td>-2.637</td>
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<tr>
<td></td>
<td>(1.29)</td>
<td>(-1.03)</td>
<td>(-0.37)</td>
<td>(-0.71)</td>
<td></td>
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<tr>
<td>Ret. Loans / Assets $\times$ VRC</td>
<td>10.42**</td>
<td>9.298*</td>
<td>10.89**</td>
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<td></td>
<td>(2.28)</td>
<td>(1.89)</td>
<td>(2.02)</td>
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<td></td>
</tr>
<tr>
<td>Corp. Loans / Assets</td>
<td>7.421***</td>
<td>11.32***</td>
<td>11.07***</td>
<td>11.78***</td>
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<tr>
<td></td>
<td>(3.47)</td>
<td>(2.83)</td>
<td>(2.70)</td>
<td>(3.05)</td>
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<tr>
<td>Corp. Loans / Assets $\times$ VRC</td>
<td>-9.999</td>
<td>-9.156</td>
<td>-8.331</td>
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<tr>
<td></td>
<td>(-1.48)</td>
<td>(-1.43)</td>
<td>(-1.22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ret. Dep / Assets</td>
<td>2.437</td>
<td>0.999</td>
<td>2.637</td>
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<tr>
<td>Pseudo R-squared</td>
<td>0.383</td>
<td>0.195</td>
<td>0.426</td>
<td>0.120</td>
<td>0.472</td>
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<tr>
<td>N</td>
<td>104</td>
<td>104</td>
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<td>104</td>
<td>104</td>
</tr>
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</table>

Who bears interest rate risk?

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Fixed-rate versus variable-rate countries

Two clear groups of countries
- For both mortgages and corporate loans
- Strong evidence of exogeneity for banks
- The resulting exposures are “imposed” to banks
Hedging

- Exogenous exposures should not matter if hedging frictionless
  - Compare $PV^{BB}$ with $PV^{IRS}$

- Banks indeed hedge

\[ \beta = -0.681, \text{ t-stat} = -4.81 \]
\[ \alpha = 0.105, \text{ t-stat} = 1.91 \]
Hedging

- **Banks in both FRC and VRC hedge**
  - But hedging remains incomplete (≈ 25%)
Why imperfect hedging?

- **Limits to risk management**
  - Hedging requires net worth (collateral)
  - Net worth has an opportunity cost → Foregone financing
  - More constrained banks are less likely to hedge
  - See Rampini, Viswanathan and Vuillemey (2017)

- **Moral hazard**
  - Banks optimally do not want to completely hedge
  - Larger banks more likely to keep open exposures
  - See Farhi and Tirole (2012)

- **Hard to disentangle given data limitations**
Macroeconomic implications

- Residual exposures → **Redistributive monetary policy**
  - ECB cuts interest rates (to recapitalize banks)
  - Banks in FRC increase in value
  - Banks in VRC decrease in value
  - Note: we measure only assets in place, not future business

- **How large?** For an increase of 25 basis points
  - Banks with $\Delta PV > 0$ gain 5.9 bn EUR
  - Banks with $\Delta PV < 0$ lose 10.9 bn EUR
  - Residual is a transfer to the non-bank sector
Risk-bearing by the household sector

- **Households bear risk heterogeneously across countries**
  - FRC: Households get some insurance
  - VRC: Households provide insurance to banks

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Who bears interest rate risk?
Conclusion

- **Banks have non-zero exposure to interest rate risk**
  - Significant cross-sectional heterogeneity
  - Against received view
  - Heterogeneity explained by loan conventions

- **Banks use derivatives for risk-sharing**
  - But hedging remains incomplete

- Residual exposures → **Distributive monetary policy**