Measuring Bank Insolvency Risk in CEEC

Lana Ivičić    Davor Kunovac    Igor Ljubaj

Croatian National Bank
Outline

1. Motivation
2. Empirics
   2.1 Bank insolvency risk decomposition (regression analysis)
   2.2 Conditional indicators of insolvency
   2.3 Case study: Croatia
3. Conclusion
Motivation

1. Exploring the factors that affect bank stability in CEEC
2. Construction of an indicator that would link bank insolvency risk with bank-specific and macroeconomic indicators
Empirics

z-score - insolvency risk measure

Assume that bank returns ($R$) follow an arbitrary distribution with first two moments - $\mu_R$ and $\sigma_R$

Definition: $Z = \frac{\mu_R + K}{\sigma_R}$

Distance to insolvency: $P\{R \leq -K\} = P\{R \leq \mu_R - z\sigma_R\}$

Probability of insolvency: $P\{R \leq -K\} \leq \frac{1}{Z^2}$
Empirics
Country Regressions (Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania and Slovakia)

\[ \ln(z_{it}) = \alpha + \beta_0 \ln(z_{it-1}) + \sum_{j=1}^{J} \beta_j X_{jt} + \sum_{k=1}^{K} \gamma_k Y_{ikt} + \varepsilon_{it}, \]

Bank-specific variables \((Y)\) credit growth, liquidity, loan portfolio quality, asset structure, size

Macroeconomic variables \((X)\) real output growth, inflation, interest rate

Banking sector variable market concentration
Empirics
Regression results

1. Considerable heterogeneity among countries
2. In general, bank insolvency risk increases in:
   - credit growth
   - banking sector concentration
   - inflation
3. *Moving window* regression results suggest that estimated relations were not stable over time
Empirics
Systemic insolvency indicators

- Individual \textit{z-scores} are aggregated in systemic indicators, defined as weighted average of individual banks \textit{z-scores}.
- Two different measures of bank stability for each country:
  1. Actual \textit{z-score} based on accounting data
  2. Conditional \textit{z-scores} \(\sim\) fitted values from regressions
- Conditional indicators \textit{directly link} insolvency risk with macroeconomic environment and bank-specific variables
Empirics

Insolvency indicators in CEEC
Empirics
Insolvency probabilities

BULGARIA

CROATIA

CZECH REPUBLIC

HUNGARY

LATVIA

LITHUANIA

SLOVAK REPUBLIC

Upper bound of insolvency probability
Conditional upper bound
Case study: Croatia

- What is different?

1. Country-specific regression: new explanatory variables
2. Alternative z-score, based on annualised data from banks’ quarterly reports
3. More detailed and more reliable data from central bank’s monetary statistics
### Case study: Croatia

Regression estimates, moving window (5 years) and total sample specifications

| Year Range | z(-1) | Credit growth | NPL | Foreign financing | Loans/assets | Total assets | Corp_d Domestic bank | GDP | CPI | HRK/EUR | HHI | $R^2$
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-2000</td>
<td>0.77(**)</td>
<td>-0.04(*)</td>
<td>-2.64(*)</td>
<td>0.39</td>
<td>-2.12(**)</td>
<td>-0.11</td>
<td>0.32(**)</td>
<td>0.21(*)</td>
<td>-1.5(*)</td>
<td>0.68(**)</td>
<td>2.34(**)</td>
<td>0.9(**)</td>
</tr>
<tr>
<td>1997-2001</td>
<td>0.76(**)</td>
<td>-0.04(*)</td>
<td>-2.26(*)</td>
<td>0.50</td>
<td>-1.1(*)</td>
<td>-0.06</td>
<td>0.27(**)</td>
<td>0.21(*)</td>
<td>-47.84(**)</td>
<td>0.59(**)</td>
<td>-73.13(**)</td>
<td>19.02(**)</td>
</tr>
<tr>
<td>1998-2002</td>
<td>0.67(**)</td>
<td>-0.18(**)</td>
<td>-2.75(**)</td>
<td>0.13</td>
<td>-0.26</td>
<td>0.00</td>
<td>0.04</td>
<td>0.31(**)</td>
<td>22.02(**)</td>
<td>0.36(**)</td>
<td>28.57(**)</td>
<td>-5.84(**)</td>
</tr>
<tr>
<td>1999-2003</td>
<td>0.58(**)</td>
<td>0.07</td>
<td>-1.68(*)</td>
<td>-0.43</td>
<td>0.02</td>
<td>0.05</td>
<td>-0.03</td>
<td>0.4(**)</td>
<td>5.60(**)</td>
<td>-0.47(**)</td>
<td>17.86(**)</td>
<td>2.41(**)</td>
</tr>
<tr>
<td>2000-2004</td>
<td>0.55(**)</td>
<td>0.09</td>
<td>-1.52(*)</td>
<td>-1.17(**)</td>
<td>0.97(*)</td>
<td>0.15(**)</td>
<td>-0.01</td>
<td>0.27(**)</td>
<td>44.45(**)</td>
<td>-1.20(**)</td>
<td>32.8(**)</td>
<td>17.61(**)</td>
</tr>
<tr>
<td>2001-2005</td>
<td>0.63(**)</td>
<td>-0.04</td>
<td>-0.61(*)</td>
<td>-0.69(*)</td>
<td>1.66(**)</td>
<td>0.17(**)</td>
<td>-0.05</td>
<td>0.15</td>
<td>36.67(**)</td>
<td>-0.11(**)</td>
<td>-4.43(**)</td>
<td>9.98(**)</td>
</tr>
<tr>
<td>2002-2006</td>
<td>0.63(**)</td>
<td>-0.49(**)</td>
<td>-0.41</td>
<td>-0.89(**)</td>
<td>1.29(**)</td>
<td>0.15(*)</td>
<td>-0.19(*)</td>
<td>0.01</td>
<td>-38.94(**)</td>
<td>-0.07(**)</td>
<td>-1.29(*)</td>
<td>-1.38</td>
</tr>
<tr>
<td>2003-2007</td>
<td>0.61(**)</td>
<td>-0.53(**)</td>
<td>0.07</td>
<td>-0.74(**)</td>
<td>1.37(*)</td>
<td>0.13(*)</td>
<td>-0.15(*)</td>
<td>-0.08</td>
<td>-12.59(**)</td>
<td>-0.14(**)</td>
<td>-4.51(**)</td>
<td>2.44(**)</td>
</tr>
<tr>
<td>1996-2007</td>
<td>0.70(**)</td>
<td>-0.32(**)</td>
<td>-1.41(**)</td>
<td>-0.07</td>
<td>0.43</td>
<td>0.03</td>
<td>-0.10(*)</td>
<td>0.04</td>
<td>1.86(*)</td>
<td>0.19(**)</td>
<td>-6.74(**)</td>
<td>1.90(**)</td>
</tr>
</tbody>
</table>
Case study: Croatia

Insolvency indicators

[Graph showing actual and conditional Z values for Croatia from 1997 to 2007]
Case study: Croatia

Insolvency probabilities

![Graph showing insolvency probabilities from 1997 to 2007. The y-axis represents percentage points, and the x-axis represents years from 1997 to 2007. The graph compares the upper bound of insolvency probability and the upper bound (moving window estimate).]
Conclusion

1. Bank stability in CEEC substantially increased during the last ten years
2. Estimated systemic probabilities of insolvency in the last three years did not exceed 0.1% in any country
3. Regression results suggest that bank insolvency risk increases in:
   - credit growth
   - inflation
   - banking sector concentration