Regulatory Capital Charges for Too-Connected-To-Fail Institutions: A Practical Proposal

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Outline of the Presentation

- Systemic Risk Contribution = Incremental Contribution to Aggregate Social Losses
- Too Connected to Fail Capital Charge
- Numerical Example using Indirect Method
- Conclusions
Systemic risk contribution = Incremental contribution to Risk

- Systemic risk captured by tail of aggregate loss distribution, e.g. tail measures of risk VaR, Expected Shortfall

- Systemic risk of a banking institution = change in the tail of the loss distribution prompted by the default of an institution.

- For bank $i$ and set of $N-1$ other banks in the system

- Systemic risk contribution = Difference between
  
  Tail Measure of $N-1$ aggregate loss distribution if bank $i$ defaults and
  
  Tail Measure of $N-1$ aggregate loss distribution if bank $i$ solvent
TCTF Capital Charge: Incremental Contribution to Societal Loss

Societal losses, conditional on bank $J$ being solvent

Societal losses, conditional on the default of bank $J$

Incremental contribution to societal loss of bank $J$
TCTF Capital Charge: From Incremental Contribution to Capital Charges

- Incremental contribution to societal loss of Bank $J = \text{VaR}_\alpha (\text{Loss distribution when } J \text{ defaults)} - \text{VaR}_\alpha (\text{Loss distribution when } J \text{ is solvent})$

- Too-Connected-to-Fail capital charge for Bank $J = \text{Incremental contribution to societal loss of Bank } J \times \text{Probability of default of Bank } J$
Two-bank example

- Two identical banks, A and B.
- Deposits: $100 million.
- Probability of default = 5 percent.
- Probability of default if other bank defaults = 6 percent.
- If bank defaults, all deposits are lost.
- Deposits fully guaranteed by government.
Two-bank example

Calculation of TCTF Capital Charge for Bank B:

- If Bank B does not default, the expected loss to the government if Bank A defaults is 0.05 \times 100 = \$5\text{ million}.

- If Bank B defaults, the expected loss to the government if Bank A defaults is 0.06 \times 100 = \$6\text{ million}.

- The **incremental loss** due to the failure of Bank B is \$1\text{ million}.
  - \$(6\text{ million} - 5\text{ million})$.

- The TCTF capital charge should be proportional to the incremental loss of \$1\text{ million}.
Tarashev et al, 2009 Capital Charge Approach

Portfolio 1: \( N-1 \) institutions
Portfolio 2: \( N \) institutions

Marginal risk contribution =
Risk of Portfolio 2 minus
Risk of Portfolio 1

Portfolio 1:
Probability of default, Bank \( I \),
conditional on Bank \( J \) solvent

Portfolio 2:
Probability of default, Bank \( I \),
conditional on Bank \( J \) solvent
Portfolio 1: \( N \)-1 institutions
Portfolio 2: \( N \)-1 institutions

Marginal risk contribution
Risk of Portfolio 2 minus Risk of Portfolio 1

Portfolio 1:
Probability of default, Bank \( I \), conditional on Bank \( J \) solvent

Portfolio 2:
Probability of default, Bank \( I \), conditional on failure of Bank \( J \).
Too-Connected-to-Fail Capital Charge Approach: Step-by-step calculations

- Step 1: For each institution other than \( J \), specify the probability of default of the remaining institutions in the events that institution \( J \) survives or defaults.

- Step 2: For each institution in step 1 determine the societal exposure at default and the societal loss given default for each of the two events, i.e. potential losses incurred by government.

- Step 3: Construct the societal loss distributions for incremental portfolio in two events: that \( J \) survives or defaults.

- Step 4: Pick up a given confidence level, i.e. typical values for VaR 95 percent, 99 percent and 99.5 percent (or Expected Shortfall).

- Step 5: Calculate the VaR in the conditional societal loss distributions at the specified confidence level.

- Step 6: Calculate the incremental contribution to societal loss as the difference between the VaR \( (J \text{ defaults}) \) and VaR \( (J \text{ survives}) \).

- Step 7: Calculate the TCTF capital charge as the product of the probability of default of institution \( J \) and its incremental contribution to societal loss.
Too-Connected-to-Fail Capital Charge Approach: The Difficult Steps

- **Step 1**: For each institution other than \( J \), specify the probability of default of the remaining institutions in the events that institution \( J \) survives or defaults.

  - **\( J \) defaults**
    - CoRisk Analysis (direct and indirect exposures, reduced form).
    - Network analysis (direct exposures, requires data on exposures).

- **Step 2**: For each institution in step 1 determine the societal exposure at default and the societal loss given default for each of the two events, i.e. potential losses incurred by government.
  - Regulatory agency criteria.
  - Deposits at banking institutions.
  - Pension fund claims
  - Senior creditor claims (as observed in recent crisis).

- **Step 3**: Construct the societal loss distributions for incremental portfolio in two events: that \( J \) survives or defaults.
  - Portfolio credit risk models.
TCTF Capital Charges: Numerical Example

Data and Model Assumptions used in Example

- Analysis covers 26 financial institutions in 9 countries: U.S., Canada, Spain, France, Germany, Italy, Switzerland, United Kingdom and the Netherlands.
- Weekly expected Default Frequencies (EDFs) from Moody’s KMV use as proxy for probabilities of default.
- Data sample covers period May 2, 2003 – February 27, 2009.
- Probabilities of default in the event of an institution failure calculated using CoRisk analysis; PCA analysis used to find common risk factors.
- One-factor Gaussian model used to model loss distributions.
- Societal exposure at default in the event of default equal to total debt.
- Loss given default is 100 percent, so societal losses equal to total debt.
Probabilities of Default: CoRisk Analysis

- Quantile regression typical equation

\[ PD_i = \alpha + \sum_{k}^{K} \beta_{r,k} R_k + \beta_{r,j} PD_j \]

- Choice of appropriate quantile to use in TCTF capital charge:
  - Subject to discretion of regulatory agency.
  - Tradeoff: efficiency vs. safety.
  - Normal periods: 50 percent quantile.
  - Cautious approach: 95th or 99th percentiles.
  - High quantiles equivalent to “stress regimes.”

- Choice of probability of default
  - Set it equal to 1.
  - Set it equal to a higher quantile of the historical distribution, i.e. 95th or 99th percentiles.

- Choice of common factors: 95th or 99th percentiles = stress scenario
The ToolKit - Probabilities of Default: CoRisk Analysis

AIG and Lehman Brothers CoRisk

Quantile regression, 5th quantile

Quantile regression, 50th quantile

Quantile regression, 95th quantile
Numerical Example
Average increase in the Probability of Default due to Failure of Other Institution, Country Averages

<table>
<thead>
<tr>
<th>Country</th>
<th>United States</th>
<th>Canada</th>
<th>Spain</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Switzerland</th>
<th>United Kingdom</th>
<th>Netherlands</th>
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<tr>
<td>United States</td>
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<td>136</td>
<td>85</td>
<td>152</td>
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</table>
## Numerical Example

<table>
<thead>
<tr>
<th>Probability of default (in percent)</th>
<th>Assets ($ billion)</th>
<th>Total debt ($ billion)</th>
<th>Incremental portfolio, notional amount ($ billion)</th>
<th>Value-at-risk, incremental portfolio event = survival (in percent of incremental portfolio) confidence level</th>
<th>Value-at-risk, incremental portfolio event = default (in percent of incremental portfolio) confidence level</th>
<th>Too-Connected-to-Fail, capital charge (in $ billion)</th>
<th>Too-Connected-to-Fail, capital charge (in percent of assets)</th>
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</thead>
<tbody>
<tr>
<td>Morgan Stanley</td>
<td>5.38</td>
<td>659</td>
<td>289</td>
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</table>

*Note: The confidence levels and capital charges are shown in the table.*
Conclusions and Open Questions

- Intuitive concept; charges proportional to incremental contribution to losses.
- Integrates Credit Portfolio models, CoRisk and Network Analysis into Basel II.
- Easy to calculate: toolkit of simple models to calculate probabilities of default and loss distributions.
- Easy to adopt by regulatory agencies: concepts related to Basel II
- Simplicity increases transparency and facilitates communicating results.
- Perimeter of regulation: Accommodates financial and non-financial firms.

- Procyclicality?
- Who should pay the charge?
- Harmonization of Regulatory Practices?
Thank you