Systemic Risk Monitoring of the Austrian Banking System

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Introduction 1

- A regulator who has to safeguard the stability of the banking system has to assess risk exposure at a **system level** rather than at the **level of individual banks.**

- This is necessary because the complicated network of interbank linkages can make exposures of the banking system to aggregate risks invisible at the level of individual institutions.

Introduction 2

- From the viewpoint of systemic stability it is - however - exactly the exposure to aggregate risk, like interest rate risk, exchange rate risk or risk related to the business cycle that is critical.
- The main modeling challenge is to capture, in a tractable way, the two major sources of systemic risk:
  1. correlated exposures: an economic shock may result directly in simultaneous multiple bank defaults
  2. banks may default on their interbank liabilities and cause other banks to default triggering a domino effect

The Model for Austria

- As banks are connected with each other through debt and equity claims we choose a network model.
- There are only few publicly listed companies. Hence, we use balance sheet and supervisory data gathered by the Austrian Central Bank.
- To assess the stability of the system the observed portfolio positions which are assumed to be constant are exposed to simulated shocks and the consequences are analyzed.

A Bank

Banks are assumed to be very simple! Balance sheet consists of

- positions exposed to market risk: FX, equity, interest rate sensitive products
- positions exposed to credit risk: loans
- interbank claims and liabilities
- shareholdings in other banks (nodes)

Market Risk

All balance sheet items exposed to market risk are mapped onto a set of market risk factors

- 4 exchange rates (USD,CHF,JPY,GBP)
- 2 indices: ATX (domestic), MSCI–World–Index
- interest rates for 3 months, 1 year, 5 years, and 10 years in all five currencies

Credit Risk

We have detailed information from the major loans register on loans exceeding 350,000 Euro including

- assigned rating
- credit lines
- collaterals

For loans of less than 350,000 Euro we know the number of loans according to the following buckets: up to 10,000, 10,001 to 50,000, 50,001 to 100,000, and 100,001 to 350,000.

Default Probabilities

- We estimate a fractional response model to relate default probabilities of 11 different industry sectors to a set of macroeconomic variables.
- Simulating the macroeconomic variables yields simulated industry default probabilities.
- If applicable we map a loan onto the industry of the obligor and multiply the default probability (as given by the rating) with the ratio of simulated to average default probability of the mentioned industry sector.

Credit Risk Model

- The distribution of losses due to credit risk is calculated as in CreditRisk+.
- Conditional on the (simulated) default probability obligors default independently. Dependency is hidden in the default probabilities.

If the procedure is not applicable we use averages instead.

Network Model

Let e_i be the (simulated) value of all positions excluding the interbank market (debt and equity) of bank i. We say that bank i is in default if e_i plus the claims from the interbank market are insufficient to cover the liabilities of bank i. In case of default creditors are rationed proportionally. The clearing procedure (including a detailed seniority structure and cross holdings) reveals which banks are bankrupt due to a shock directly and which banks are drawn into bankruptcy by other banks (Eisenberg and Noe (2002), Elsinger (2006)).

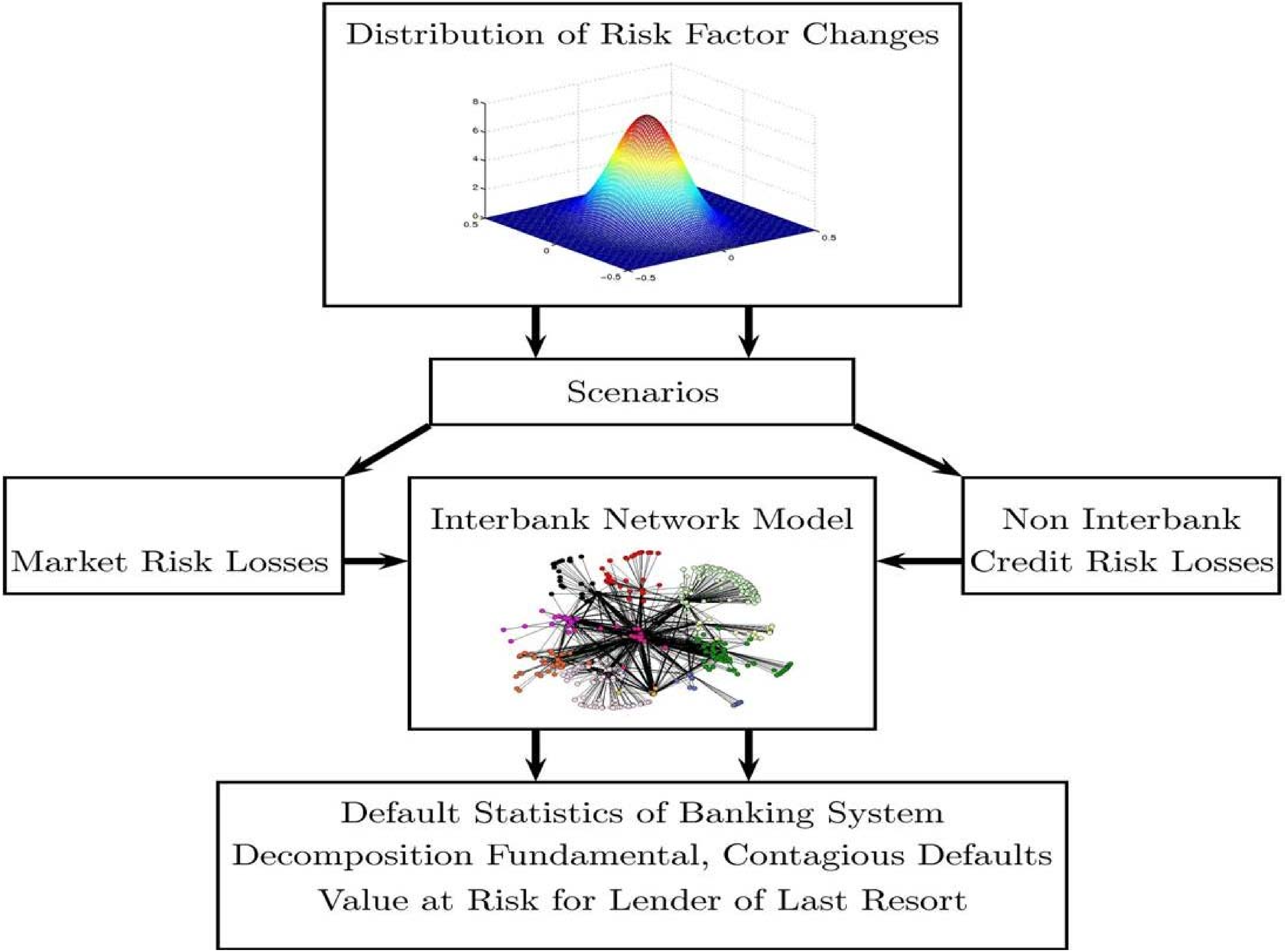
Scenario Generation

The major objective of our approach is to model the dependency structure well. Hence, we need the joint distribution of the macroeconomic and the market risk factors.

- We estimate a VAR model for the macroeconomic variables.
- In a second step we fit a multivariate distribution (grouped t–Copula or normal) to the residuals of this estimation and the changes in the market risk factors.

Scenario Generation 2

- A scenario is drawn from this joint distribution.
- The simulated macro variables are used to simulate default probabilities and calculate the loan losses.
- The simulated changes in market risk factors are used to reevaluate the portfolio positions.
- Adding this up we get e_i^s and start the clearing procedure.


Distribution of Risk Factor Changes
Scenarios
Market Risk Losses
Interbank Network Model
Non Interbank
Credit Risk Losses
Default Statistics of Banking System
Decomposition Fundamental, Contagious Defaults
Value at Risk for Lender of Last Resort

Fundamental and Contagious Default

September 2002

Defaults		no contagion	contagion
0-10	98.98%	98.98%	0.00%
11-20	0.49%	0.49%	0.00%
21-30	0.22%	0.22%	0.00%
31-40	0.08%	0.08%	0.00%
41-50	0.10%	0.10%	0.00%
more	0.12%	0.08%	0.05%
Total	100.00%	99.95%	0.04%

Fundamental and Contagious Default

March 2006

Defaults		no contagion	contagion
0	74.49%	74.49%	0.00%
1-5	25.51%	25.51%	0.00%
more	0.00%	0.00%	0.00%
Total	100.00%	100.00%	0.00%

Default Probabilities

	10%-Quant.	Median	90%-Quant.
Small	0.00%	0.00%	0.92%
Medium	0.00%	0.00%	0.09%
Large	0.00%	0.00%	0.00%
All banks	0.00%	0.00%	0.18%

Rating

OeNB	S&P	abs.	rel.
1	AAA	800	94.67%
2	AA	0	0.00%
3	A	8	0.95%
4	BBB	15	1.78%
5	BB	13	1.54%
6	B	8	0.95%
7	CCC	1	0.12%

Lender of Last Resort

Quantiles	95%	99%	99.5%	99.9%
Fundamental	3	53	181	712
% of all assets	0.00%	0.01%	0.03%	0.12%
Contagious	0	0	0	0
% of all assets	0.00%	0.00%	0.00%	0.00%

Robustness

We performed A LOT OF robustness checks:

- across time
- including operational risk (as good as possible)
- different procedures to generate market returns
- different procedures to estimate default probabilities
- netting

The results are reasonably robust

Stress Testing

The model allows to analyze hypothetical situations in various ways:

1. simulate in the standard way but substitute a prespecified value for some risk factor(s)
2. fix some risk factor(s) and simulate conditionally on this value
3. assume that some bank loses a certain amount (fraud)
4. overrule the rating assigned by the banks

My Favourite

The major loans register includes the rating assigned by the banks. The same obligor might have quite different ratings. Let us substitute the given rating with the worst rating assigned by some bank.

Bank	PD assigned rating	PD worst rating
A	0.00%	8.75%
B	0.00%	2.32%
C	1.96%	2.30%
D	0.00%	1.65%

Conclusion

- Our model is a first step towards an integrated risk analysis of the banking system.
- It allows to interpret a vast amount of data (as gathered by the Austrian Central Bank) on a standardized basis.
- The feasibility of conditional scenario generation extends the concept of stress testing considerably.
- We do not know what amount of risk should be borne by the banking industry. What would be an efficient distribution of risk amongst banks? We have to improve our understanding of these important questions.