OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

Paper discussion

Network Linkages to predict bank distress

Conference on network models, stress testing and other tools for financial stability monitoring and macroprudential policy design
November 11, 2015, Mexico City

Christoph Siebenbrunner*)
christoph.siebenbrunner@oenb.at

Banking Supervision and Financial Stability Department
Oesterreichische Nationalbank

*) Views expressed herein are those of the presenter and do not necessarily reflect the official opinion of the OeNB or the Eurosystem.

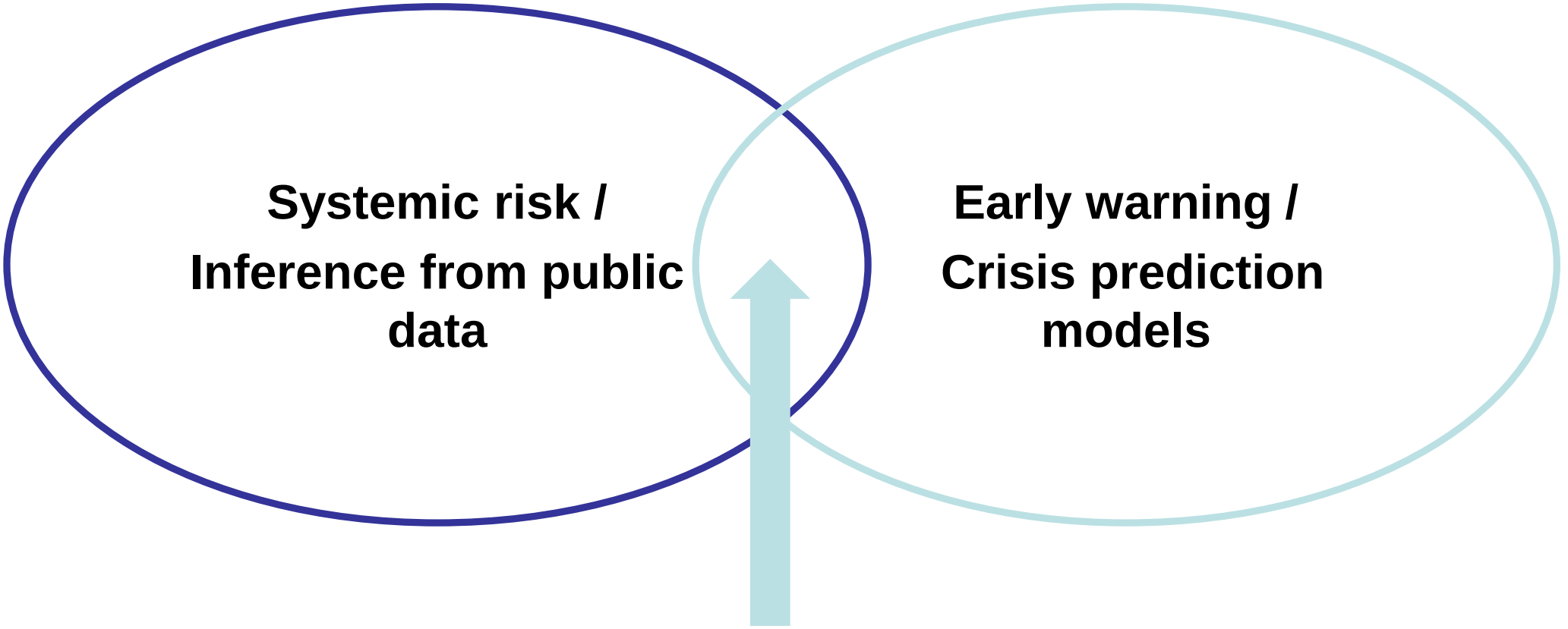
Agenda

Literature Discussion

Model Discussion

Conclusion

The paper connects two strands of literature



The article incorporates network / systemic risk measures into a crisis prediction model

Some literature examples on systemic risk / network inference from public data

Causal links

Model Horse race of interbank link estimation: Anand et al. 2015

Literature survey on interbank exposure contagion: Upper 2011

Co-Movement-based systemic risk and linkage measures

Tail risks based on Quantile Regression:

- CoVaR (Adrian, Brunnermeier 2011)
- Network construction (using LASSO): Hautsch et al. (2014)

Tail risks based on capital shortfalls:

- SRISK (Brownlees, Engle 2012)
- Systemic expected shortfall (Acharya et al. 2010)

Others: e.g. principal components, linear and non-linear Granger causalities (Billio et al. 2012)

The article combines co-movement estimation with extreme value theory to construct networks

Measurement of co-movement

Most closely related to SRISK:

- Dynamic conditional beta estimation
- Accounts for shocks from common factors and heteroscedasticity

Network construction via multivariate EVT

SRISK is not a network measure – network construction:

- Extremal dependency of error terms (Poon et al. 2004)
- Asymptotic probability of receiving a shock when partner has received shock
- Network link = result of hypothesis test (null hypothesis: probability = 1)

The network is used as an additional explanatory variable in an early warning model

Model setup

Early warning model taken from Betz et al. 2014:

- Pooled logit regression, dependent = crisis time series
- Signaling thresholds based on utility f. accounting for Type I and II errors

Other early warning models with linkages

Minoiu et al. (2013): causal links (exposures) between countries (BIS data)

Peltonen et al. (2013): causal links between countries (BIS data) and sectors (estimated from national acounts)

Oet et al. (2013): CoVaR as connectivity measure (linkage bank → system)

The innovation of the article is to introduce a bank-level network into an early-warning model

Agenda

Literature Discussion

Model Discussion

Conclusion

The article builds a comprehensive framework to address highly topical questions

Rationale and contributions of the article

- Why did we miss the crisis? How to make sure we don't miss the next?

→ Build a comprehensive model framework for predicting financial crises

- Financial linkages are suspected to be at the heart of the last crisis

→ Integrate financial networks into crisis-prediction model

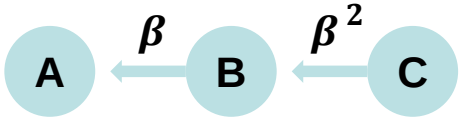
Usefulness for policy analysis (and limitations)

- Can we predict failures such as Lehman, Landsbanki, Anglo-Irish?
- Model works (for selected cases)! Would have predicted Dexia, CoBa
- What about others? Case study Austria: Hypo Group Alpe Adria
  - Largest crisis bank failure in Austria
  - Model cannot be applied (bank was not publicly traded)
- Would the model have worked if it had been traded? Problems:
  - Funding prices were distorted by state guarantees
  - Markets were misinformed (accounting fraud)

Network measure

- Two types of network measures used:
  - Sum of links to banks in distress or existence of link
- Both measures only take into account network paths of length 1:

- Alternative: take all paths, decrease weight for more distant nodes



- Proposal: use modified Katz centrality measures
  - Allow contagion across non-crisis banks:

$$linkage \in \mathbb{R}^n = (I - \beta \mathrm{A})^{-1}\alpha - \alpha$$

  - Allow contagion only across crisis links:

$$linkage \in \mathbb{R}^n = (I - \beta \mathrm{B})^{-1}\vec{1} - \vec{1}$$

Where A is the matrix of estimated linkages, $\alpha \in \mathbb{R}^n, \alpha_i = \mathbb{I}_{crisis}$, $\mathrm{B}_{ij} = A_{ij}\ \mathrm{a}_j$ and $\beta \in [0,1]$ could be set by assumption or optimized using the utility function

Technical Remarks

Transformation of dependent variable

- Dependent = 1 during 8 quarters prior to crisis

→ Model calibration for 2015Q2? Wait for 2017Q2!

→ Serial correlation

Date	Actual crisis	Dependent
2007Q3	0	1
2007Q4	0	1
2008Q1	0	1
2008Q2	0	1
2008Q3	1	0
2008Q4	0	0

Model benchmarking

- 2est benchmark: includes generated signals as additional explanatory to compare models of equal size

→ Interpretation?

- Alternatives: likelihood ratio test, information criteria, model selection (advantage: additional quality check, does variable get selected?)

Link estimation

- Why is the null hypothesis existence of a link?

Agenda

Literature Discussion

Model Discussion

Conclusion

Conclusion

The paper makes an innovative contribution to the literature:

- General and customizable framework for predicting banking crises
- Crisis prediction model with financial network information

We learn that:

- Network linkages are important for explaining the financial crisis
- The crises at Dexia, Commerzbank, National Bank of Greece could have been predicted (!)

Potential extensions:

- Methodology for non-traded banks
- Explore causal links

Literature I

Acharya, V., Pedersen, L., Philippon, T., and Richardson, M. (2010). Measuring Systemic Risk. Technical report, Department of Finance, NYU.

Adrian, T., & Brunnermeier, M. K. (2011). CoVaR (No. w17454). National Bureau of Economic Research.

Anand, K. et al. (2015) The Missing Links: A Global Study on Uncovering Financial Network Structure from Partial Data. Unpublished

Betz, F., Hautsch, N., Peltonen, T., Schienle, M. (2014a) Systemic Risk Spillovers in the European Banking and Sovereign Network. CFS Working Paper 467

Betz, F., Oprică, S., Peltonen, T. A., & Sarlin, P. (2014b). Predicting distress in European banks. Journal of Banking & Finance, 45, 225-241.

Billio, M., Getmansky, M., Lo, A. W., & Pelizzon, L. (2012). Econometric measures of connectedness and systemic risk in the finance and insurance sectors. Journal of Financial Economics, 104(3), 535-559.

Brownlees, T. C., & Engle, R. F. (2015). SRISK: A conditional capital shortfall index for systemic risk measurement. Department of Finance, New York University.

Literature II

Hautsch, N., Schaumburg, J., & Schienle, M. (2014). Financial network systemic risk contributions. Review of Finance, forthcoming

Minoiu, C., Kang, C., Subrahmanian, V. S., & Berea, A. (2013). Does financial connectedness predict crises? (No. 13-267). International Monetary Fund.

Oet, M. V., Bianco, T., Gramlich, D., & Ong, S. J. (2013). SAFE: An early warning system for systemic banking risk. Journal of Banking & Finance, 37(11), 4510-4533.

Peltonen, T., Rancan M., and Sarlin P., Interconnectedness of the banking sector as a vulnerability to crises. mimeo , 2014

Poon, S. H., Rockinger, M., & Tawn, J. (2004). Extreme value dependence in financial markets: Diagnostics, models, and financial implications. Review of financial studies, 17(2), 581-610.

Upper, C. (2011). Simulation methods to assess the danger of contagion in interbank markets. Journal of Financial Stability, 7(3), 111-125.