



# Statistics of Financial Markets

## Chapter 13: Systemic Risk



Daniel Traian PELE

Bucharest University of Economic Studies

IDA Institute Digital Assets

Blockchain Research Center

AI4EFin Artificial Intelligence for Energy Finance

Romanian Academy, Institute for Economic Forecasting

MSCA Digital Finance

# Outline

Motivation

Systemic Risk Measures

CoVaR

Financial Risk Meter (FRM)

Network Analysis

Applications

Conclusions

References

## Motivation

- ▣ Lessons from the 2007–2009 Global Financial Crisis
- ▣ Why individual risk measures are insufficient for systemic events
- ▣ Macroprudential regulation and the need for systemic risk quantification

## Systemic Risk Measures

- Overview of systemic risk measurement approaches
- Marginal Expected Shortfall (MES)
- Systemic Expected Shortfall (SES)
- SRISK: systemic risk contribution based on capital shortfall
- Comparison of different measures

## CoVaR

- ▣ Adrian and Brunnermeier's (2016) Conditional Value at Risk
- ▣  $\text{CoVaR}_q^{j|i}$ : VaR of institution  $j$  conditional on institution  $i$  being in distress
- ▣  $\Delta\text{CoVaR}$ : contribution to systemic risk
- ▣ Estimation via quantile regression
- ▣ Time-varying CoVaR and state variables

## Financial Risk Meter (FRM)

- ▣ LASSO-based approach to measuring tail risk interconnectedness
- ▣ Penalized quantile regression across financial institutions
- ▣ FRM index construction from estimated network density
- ▣ Real-time monitoring of systemic risk
- ▣ Applications to different financial systems

## Network Analysis

- ▣ Financial networks and contagion channels
- ▣ Adjacency matrices from Granger causality or tail dependence
- ▣ Network topology metrics: degree, centrality, clustering
- ▣ Visualization and interpretation of financial networks

## Applications

- ▣ Computing CoVaR for major financial institutions
- ▣ FRM analysis during crisis periods
- ▣ Network visualization of systemic risk
- ▣ Python implementation

 SFM\_ch13\_systemic\_risk

## Conclusions

- ▣ Summary of systemic risk measurement methodologies
- ▣ Strengths and limitations of each approach
- ▣ Policy implications and regulatory applications

## References

- Adrian, T., Brunnermeier, M.K. (2016). CoVaR.
- Acharya, V.V., Pedersen, L.H., Philippon, T., Richardson, M. (2017). Measuring systemic risk.
- Härdle, W.K., Wang, W., Yu, L. (2016). TENET: Tail-Event driven NETwork risk.