The use of big data in supervision and economic policy

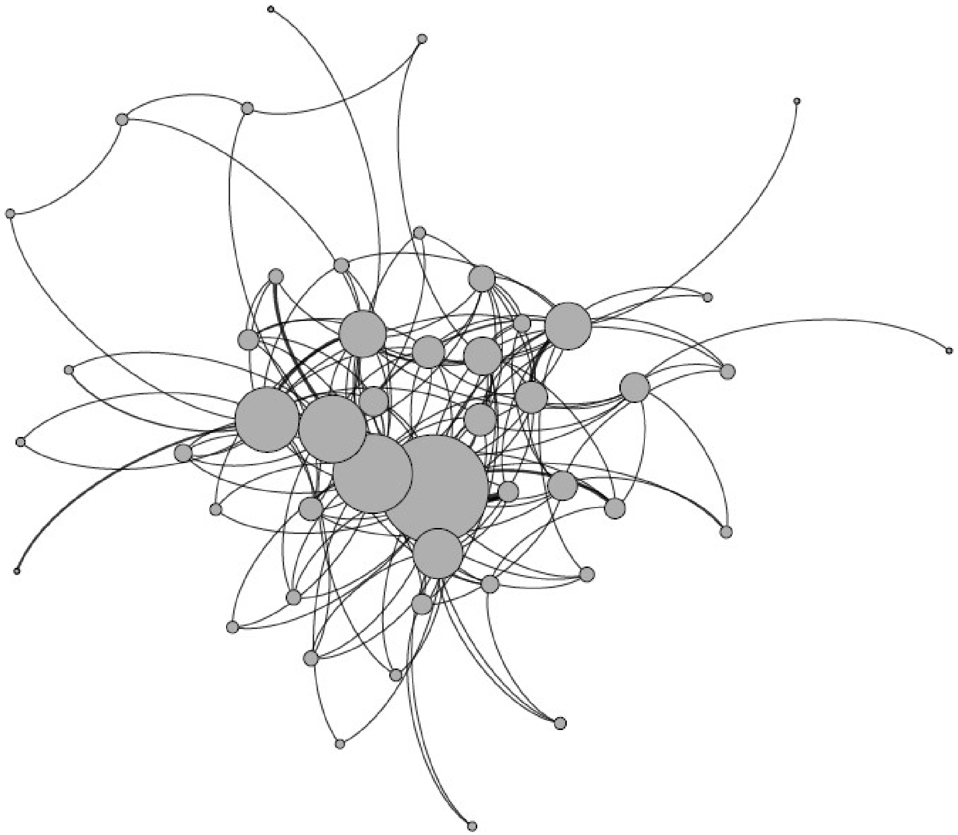
BINUS – 3rd International Lecture Weeks

Digital transformation towards Business Resilience and Sustainability

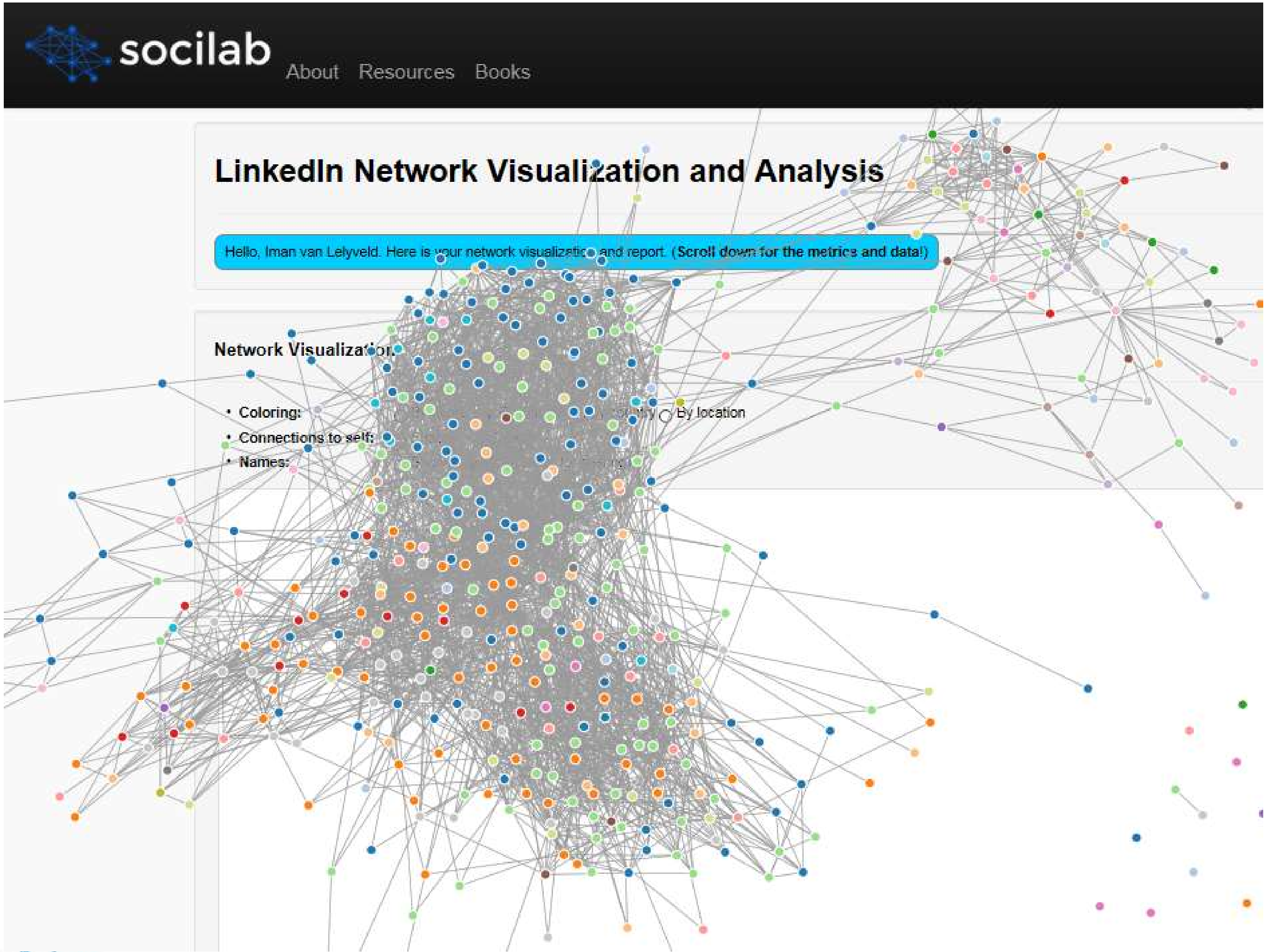
Iman van Lelyveld


AIG

Most financial networks have a core and a periphery



Source: [Blasques, Bräuning and van Lelyveld (2018) JEDC]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About
Resources
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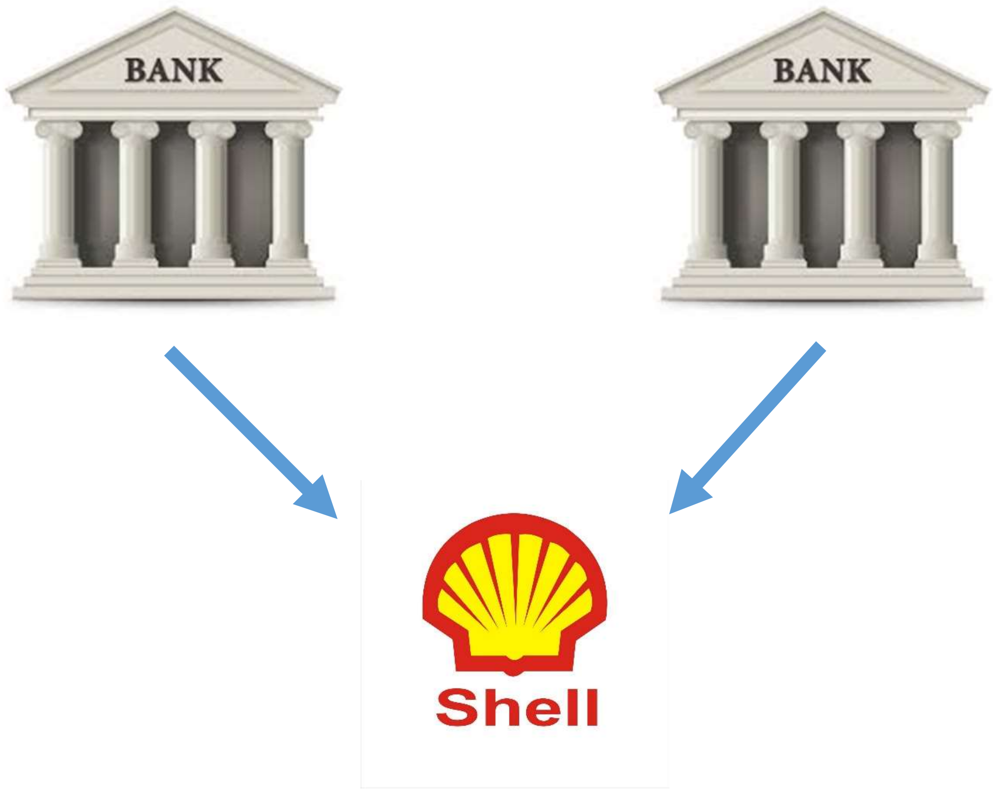
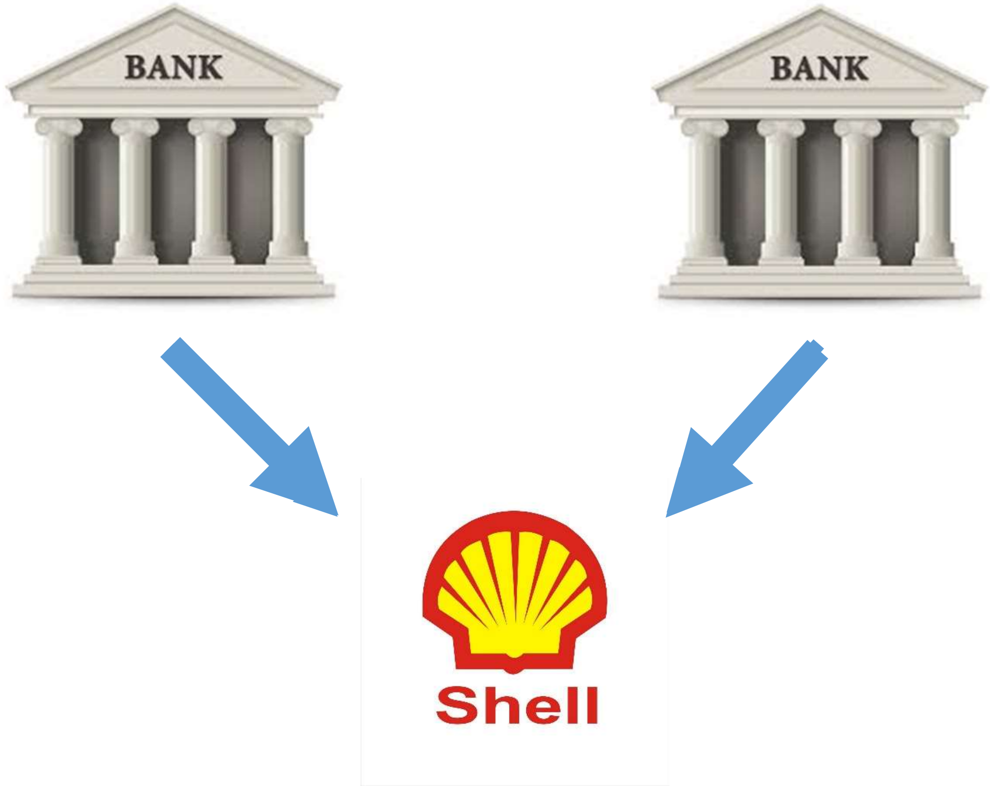
LinkedIn Network Visualization and Analysis
Hello, Iman van Lelyveld. Here is your network visualization and report. (Scroll down for the metrics and data!)
Network Visualization
Coloring:
By location
Connections to self:
Names:

Not just direct exposures …



Not just direct exposures …



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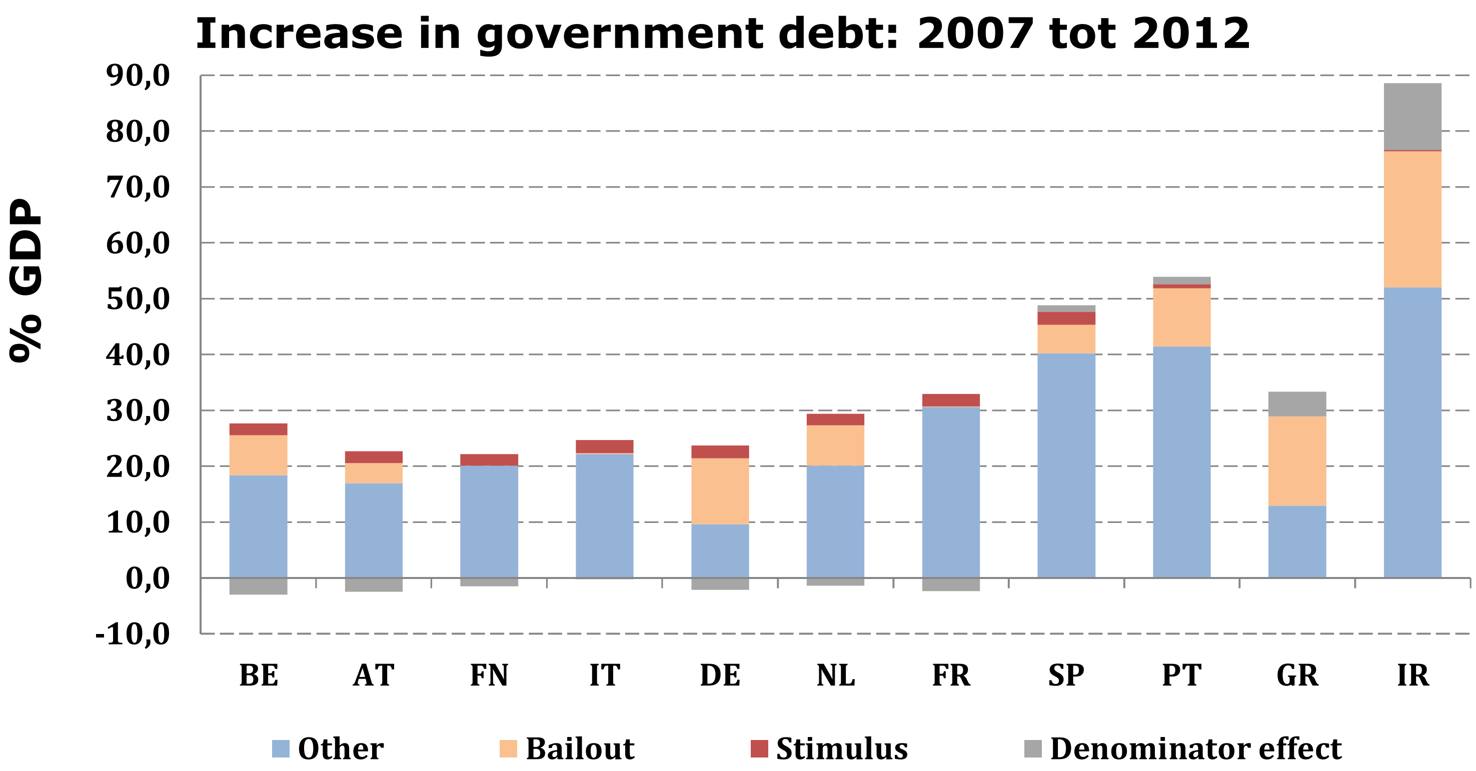
But indirect exposures as well

Indirect cost larger than direct bailout



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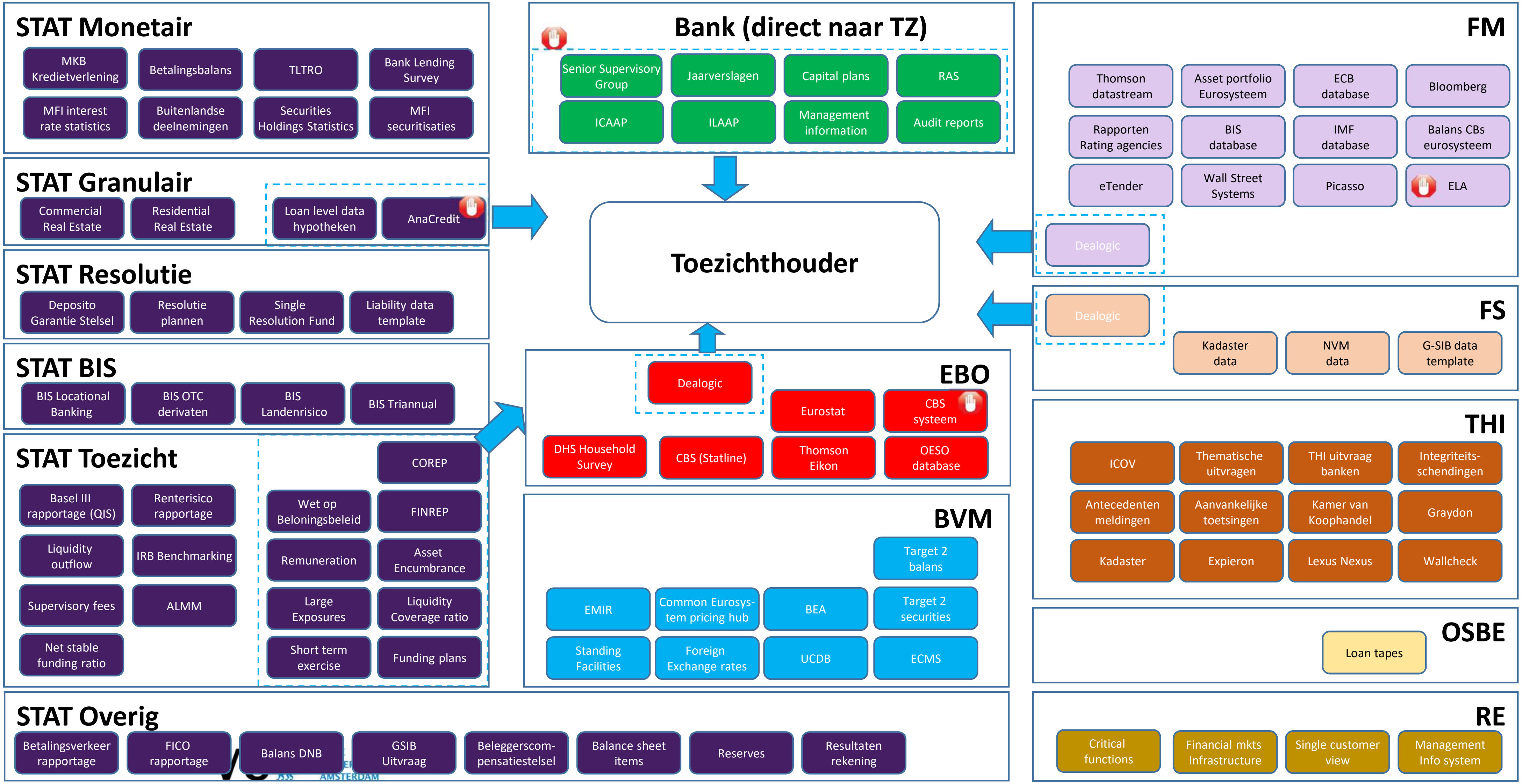
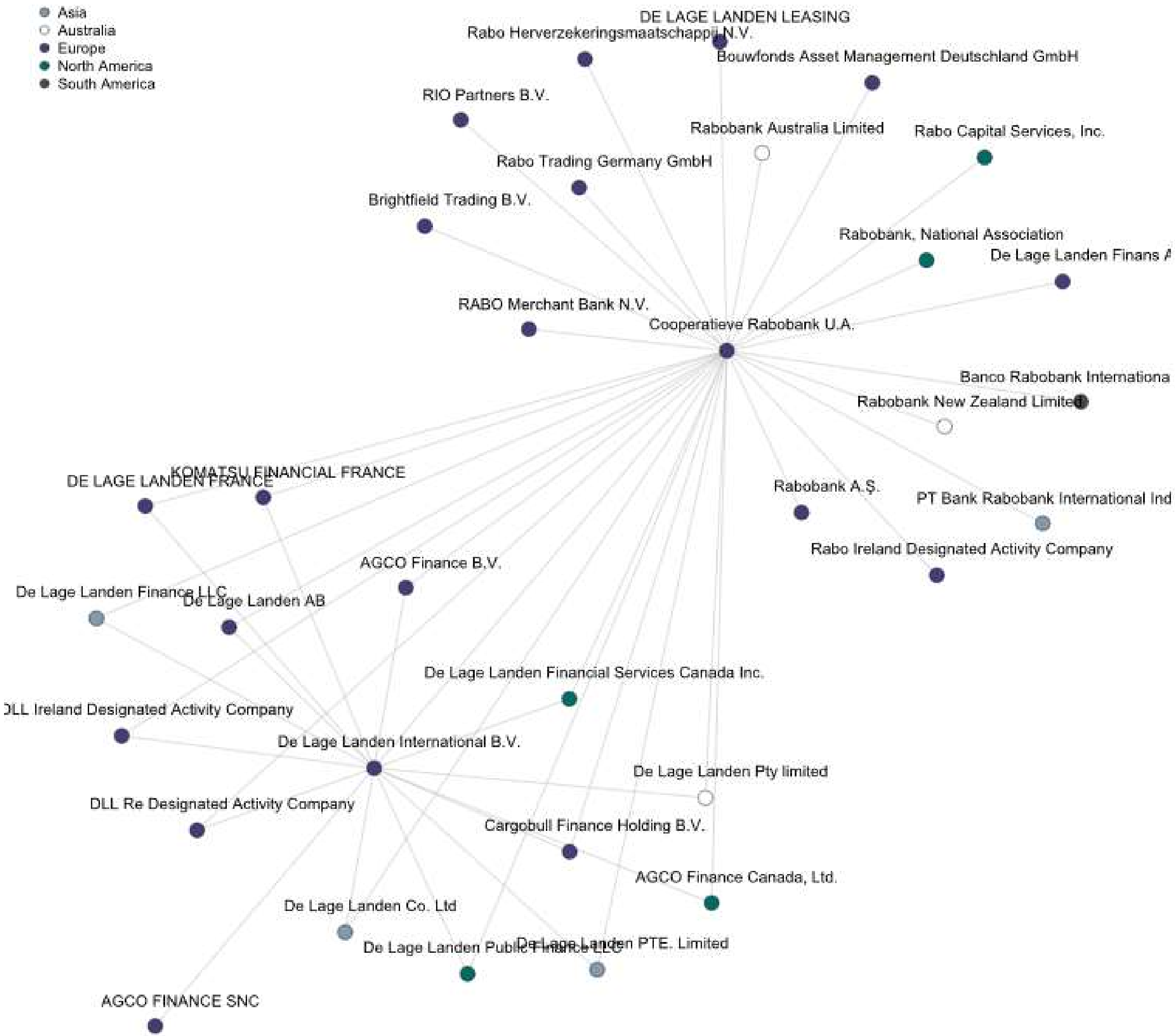
Source: updated from Gilbert and Hessel (2012)

1. New data
2. New methods
3. New organisation

Data comes to DNB in all kinds of ways





Different angles

- Supervision
- Risk
- Accounting
- Macro prudential
- …

Source: [Ullersma and van Lelyveld (2021) CUP]

Available large granular data in the EU

Set	Description
AnaCredit	EU credit registry
EMIR	Derivates
MIFID	Trading on exchanges
MMSR	Interbank money market
SHS	Securities holdings
SFTR	Securities Finance Transactions

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1. New data
2. **New methods**
3. New organisation

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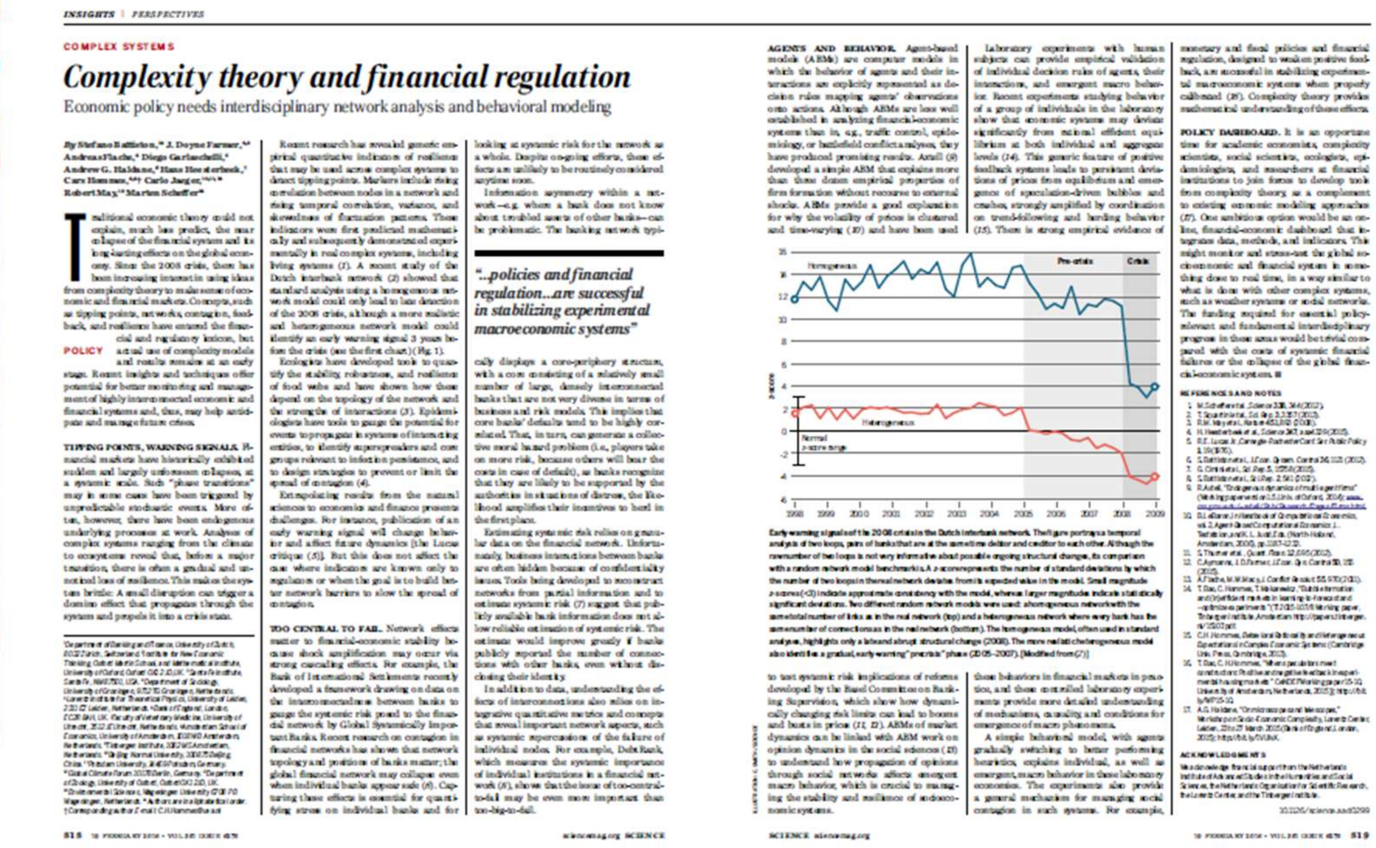
Science, February 19, 2016

Policy Dashboard based on Complexity Theory

Stefano Battiston, J. Doyne Farmer, Andreas Flache, Diego Garlaschelli, Andrew G. Haldane, Hans Heesterbeek, Cars Hommes, Carlo Jaeger, Robert May, Marten Scheffer


INSIGHTS | PERSPECTIVES

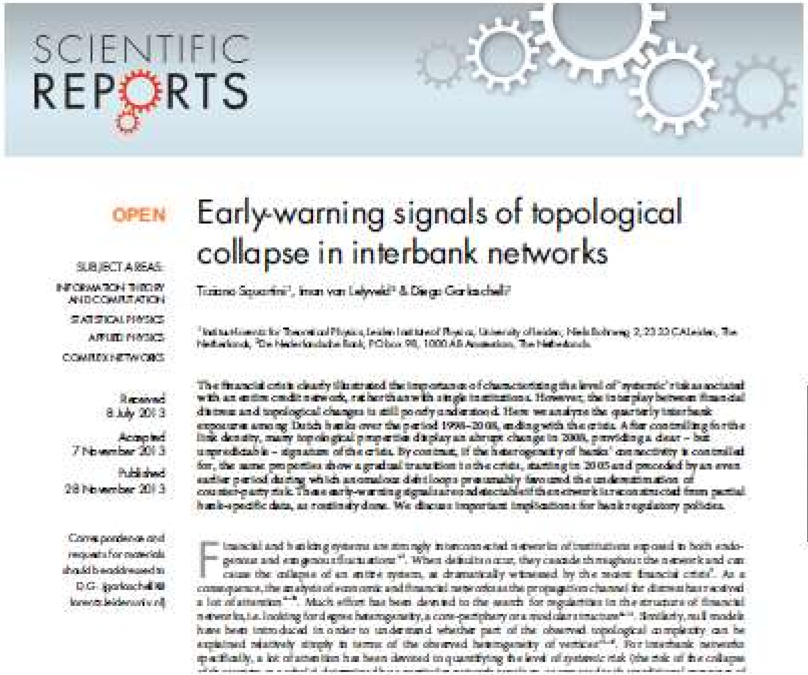
COMPLEX SYSTEMS

Complexity theory and financial regulation

Economic policy needs interdisciplinary network analysis and behavioral modeling

"...policies and financial regulation...are successful in stabilizing experimental macroeconomic systems"

Network structure can help to see change early


SCIENTIFIC REPORTS

OPEN

Early-warning signals of topological collapse in interbank networks

SUBJECT AREAS:
INFORMATION THEORY AND COMPUTATION
STATISTICAL PHYSICS
APPLIED PHYSICS
COMPLEX NETWORKS

Tiziano Squartini[1], Iman van Lelyveld[2] & Diego Garlaschelli[1]

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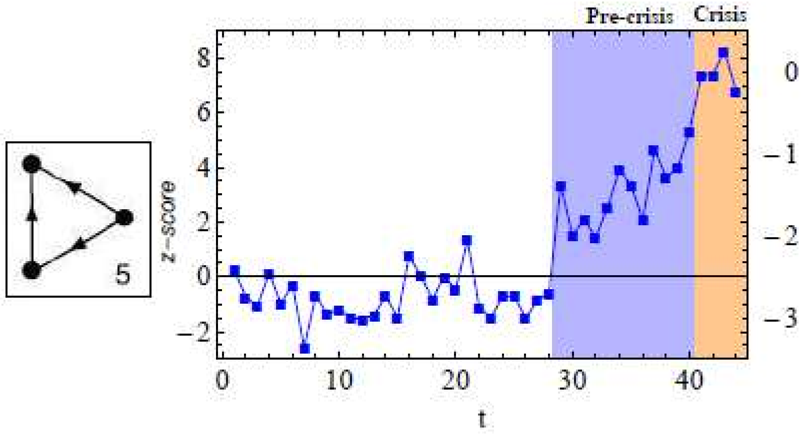
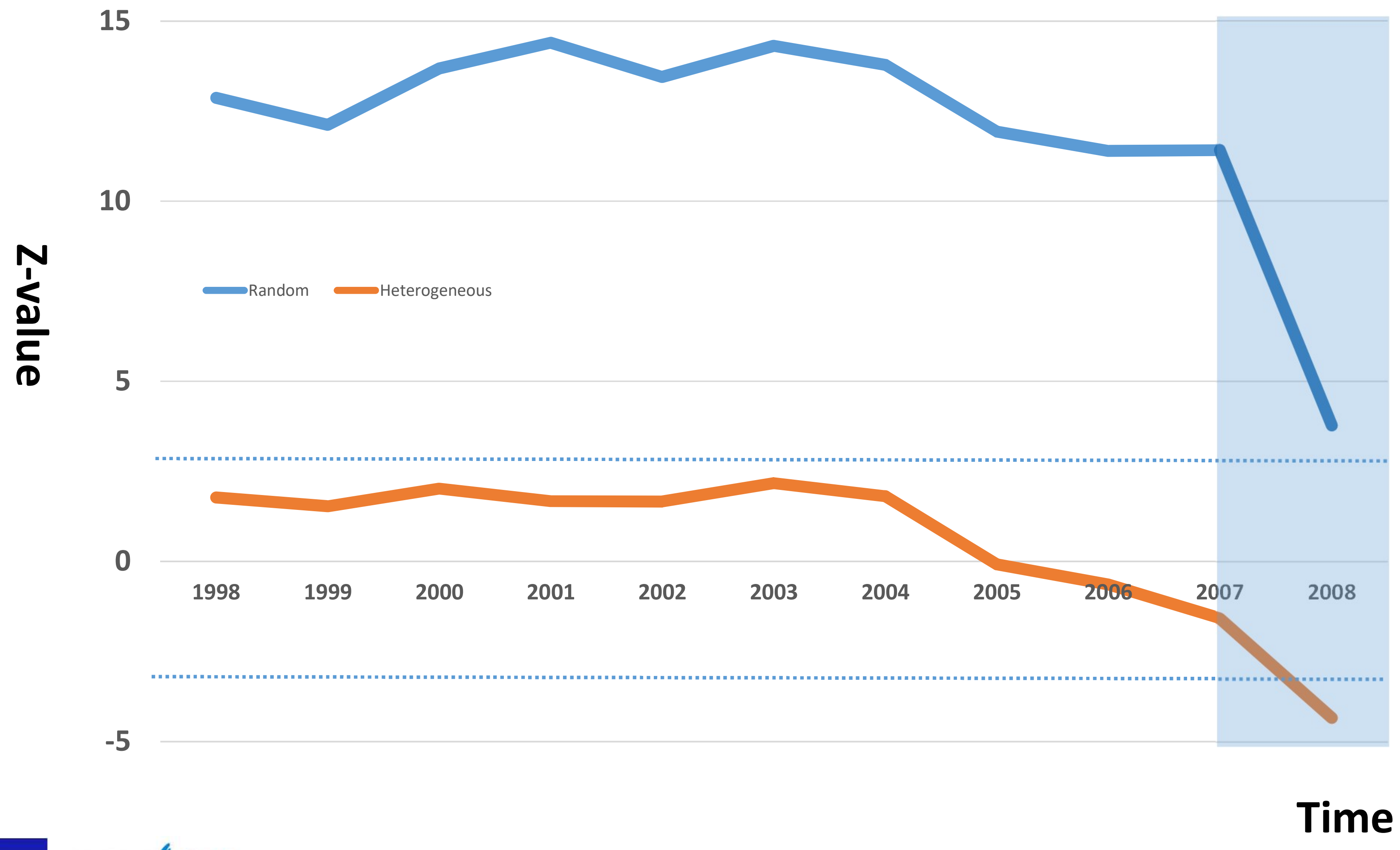
The financial crisis clearly illustrated the importance of characterizing the level of 'systemic' risk associated with an entire credit network, rather than with single institutions. However, the interplay between financial distress and topological changes is still poorly understood. Here we analyze the quarterly interbank exposures among Dutch banks over the period 1998–2008, ending with the crisis. After controlling for the link density, many topological properties display an abrupt change in 2008, providing a clear – but unpredictable – signature of the crisis. By contrast, if the heterogeneity of banks' connectivity is controlled for, the same properties show a gradual transition to the crisis, starting in 2005 and preceded by an even earlier period during which anomalous debt loops presumably favored the underestimation of counter-party risk. These early-warning signals are undetectable if the network is reconstructed from partial bank-specific data, as routinely done. We discuss important implications for bank regulatory policies.

Correspondence and requests for materials should be addressed to D.G. (garlaschelli@lorentz.leidenuniv.nl)

Financial and banking systems are strongly interconnected networks of institutions exposed to both endogenous and exogenous fluctuations. When defaults occur, they cascade throughout the network and can cause the collapse of an entire system, as dramatically witnessed by the recent financial crisis. As a consequence, the analysis of economic and financial networks as the propagation channel for distress has received a lot of attention.

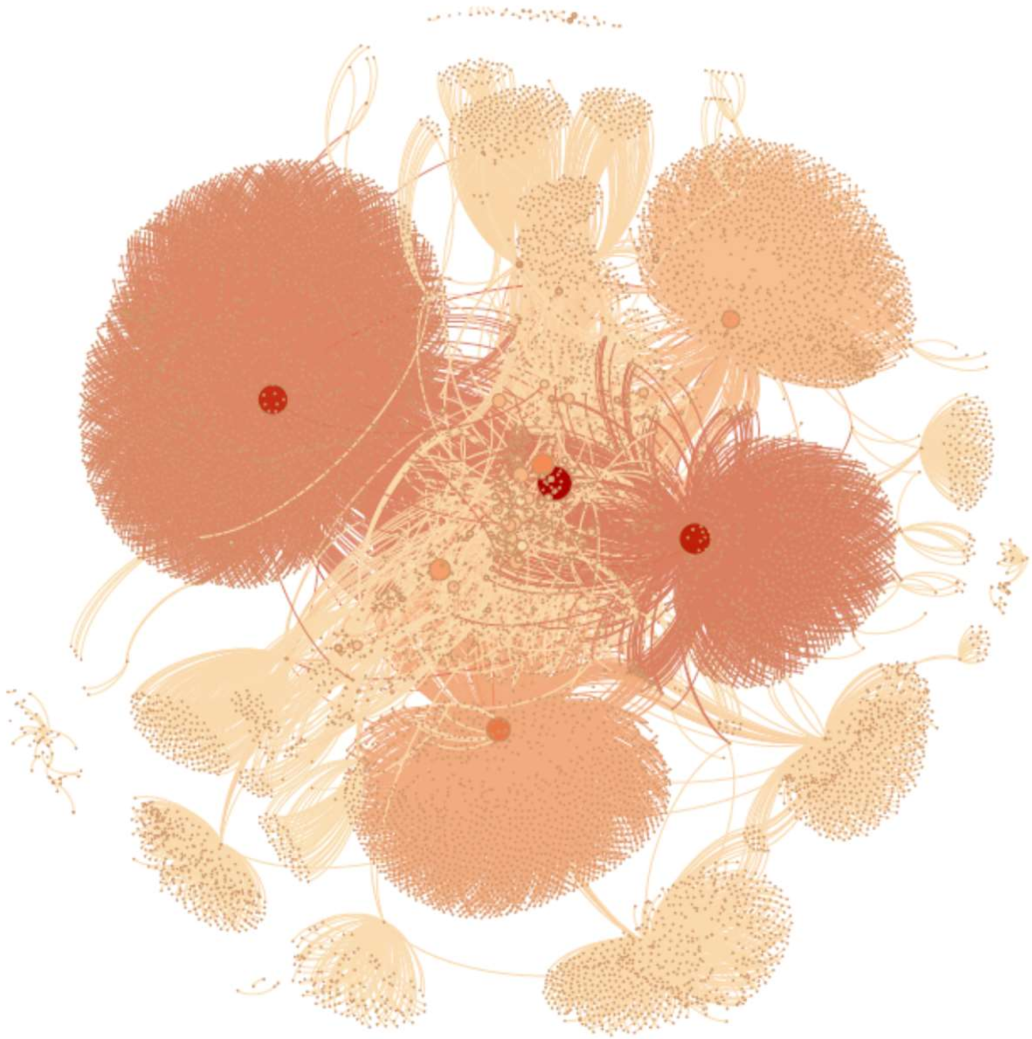


Source: [Squartini, van Lelyveld and Garlaschelli (2013) Nature Scientific Reports]



15
10
5
0
-5
Z-value
Random
Heterogeneous
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Time

The interest rate swaps (IRS) hairball



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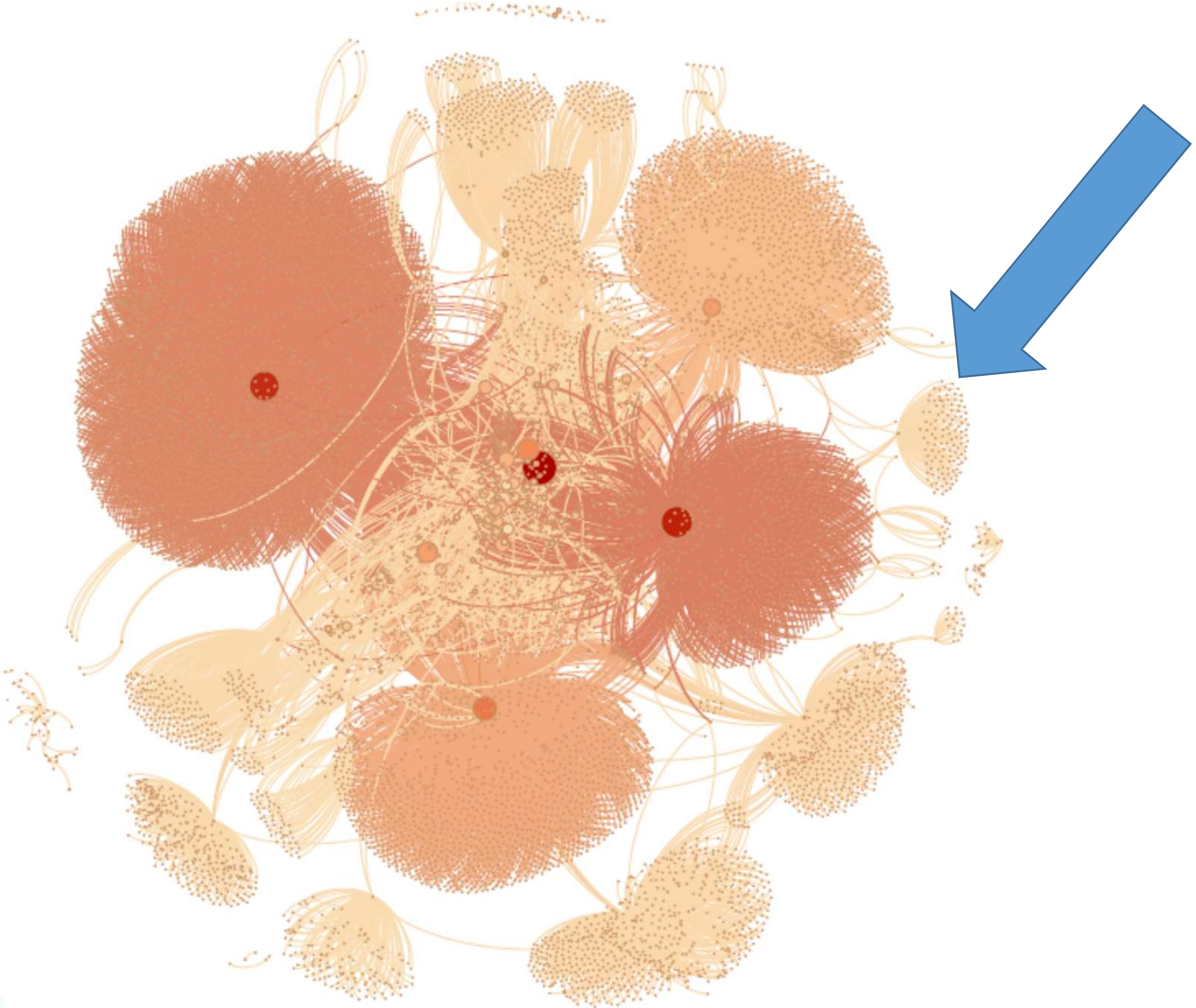

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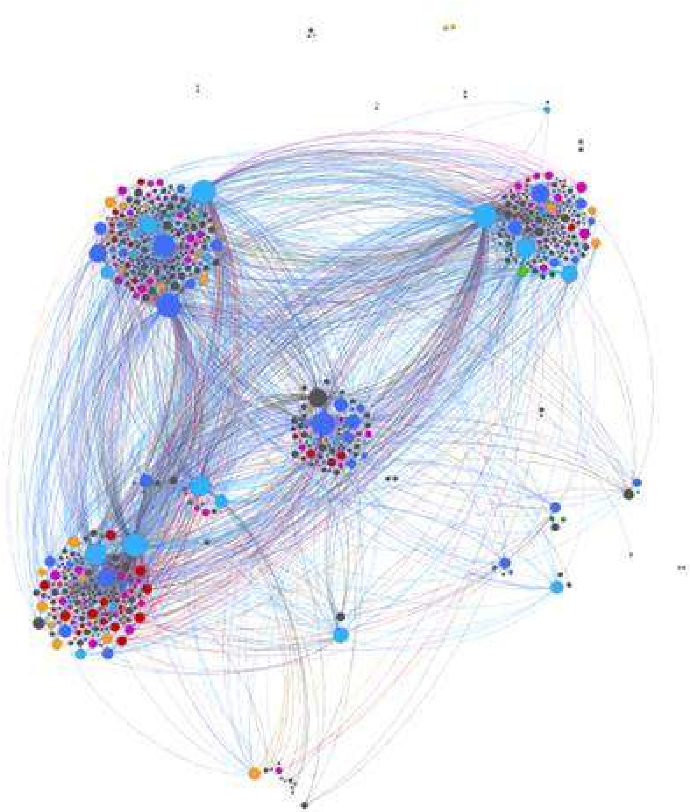
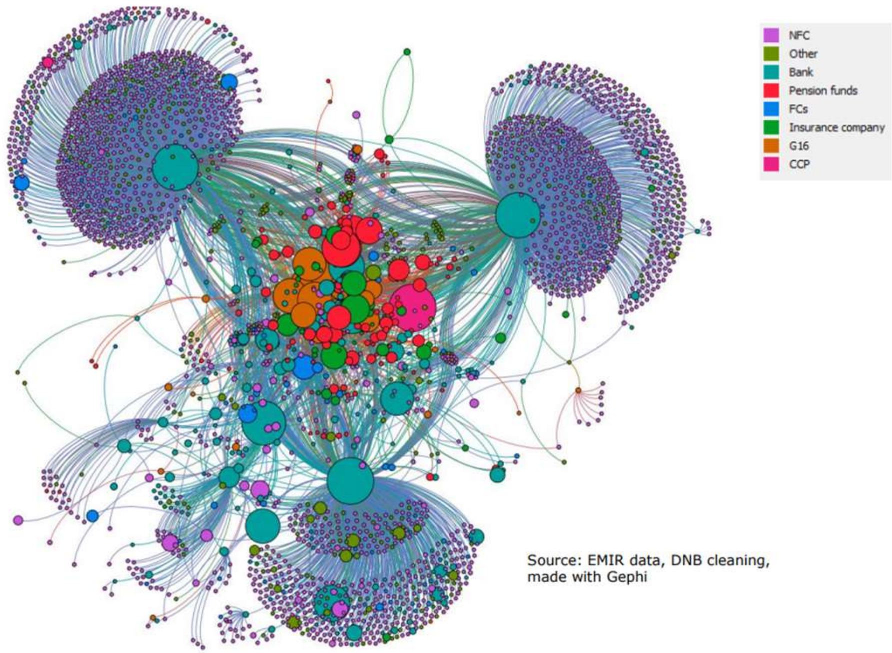
Stocks and bonds



IRS



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Source: [van den Boom, Hofman, Jansen and van Lelyveld (2021) DNB Analysis]

1. New data
2. New methods
3. **New organisation**

Necesary elements for Data Science

Tooling

- Data Science and Analytics Platform (DSAP)
- Cloud deployment; Data(platform) connectivity,
- Open source tooling (e.g. R,Python, Git, Neo4J, SQLlight, MySQL, …..)

Approach

- Professional / scientific approach
- Statistical methods
- Code in ‘interpreter’ languages (Python, R, ...) en tools (Git , Anaconda, Jupyter Notebooks, ...)

Organisation

- Central vs. decentral
- Governance, data protection
- Deployment of analysis
- Agile, pilots
- FTE’s

Community

- Informal: lunches, seminars
- Hackathons
- Manifest

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Thank you for your attention

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Annexes

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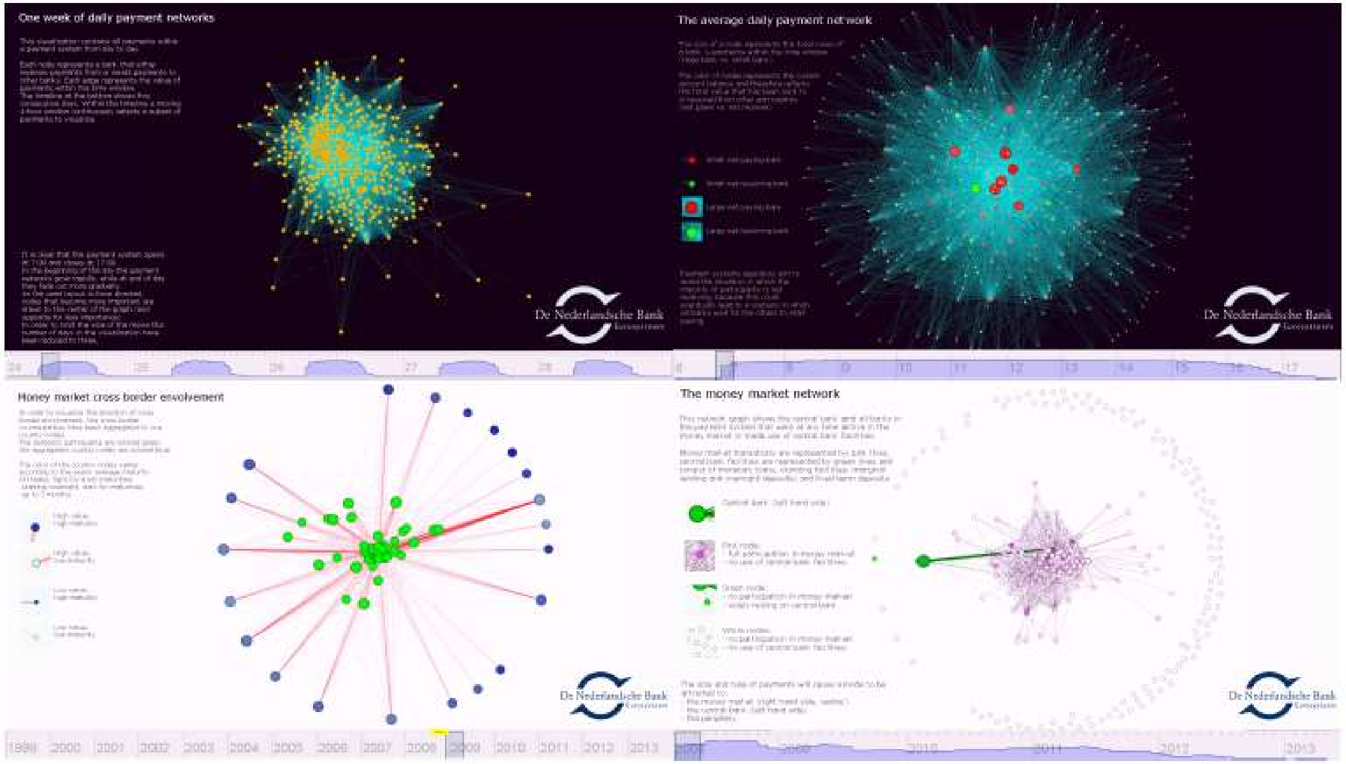
Dynamic visualisations as an additional tool



Heijmans, R., R. Heuver, C. Levallois, I. van Lelyveld (2016), “Dynamic visualization of large financial networks”, *Journal of Network Theory in Finance*

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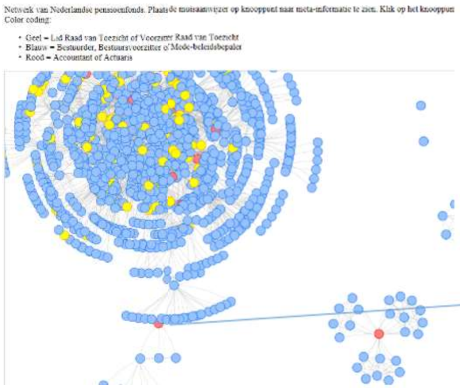
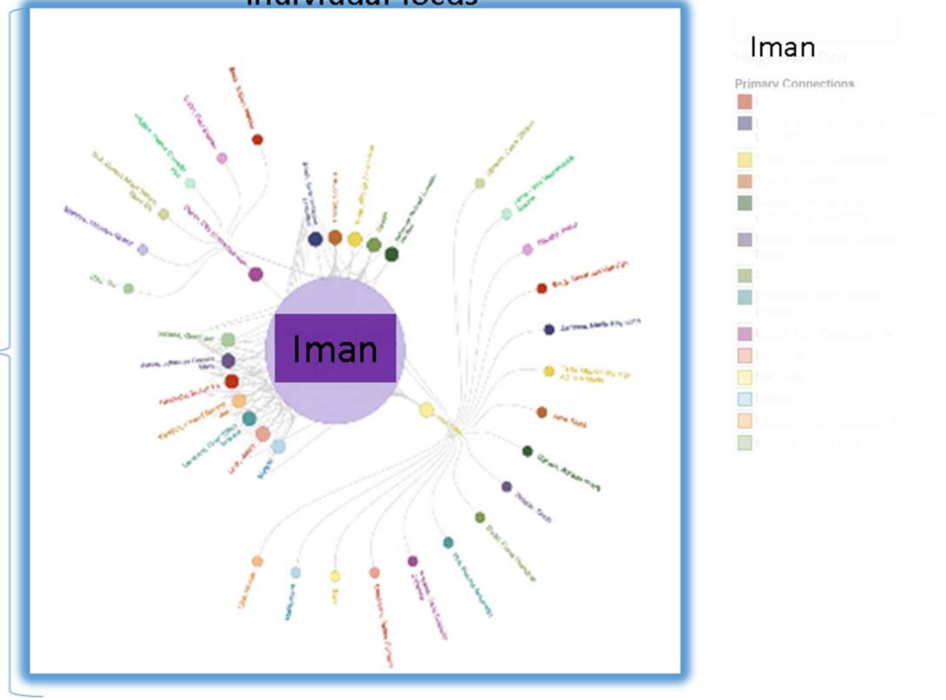
New tools to see interconnections in Dutch pension fund governance

Customer Relationship Manament information

Complete network with role



Individual focus



Purpose:

- Identify the central players in pension fund world
- Should be interactive and available on intranet

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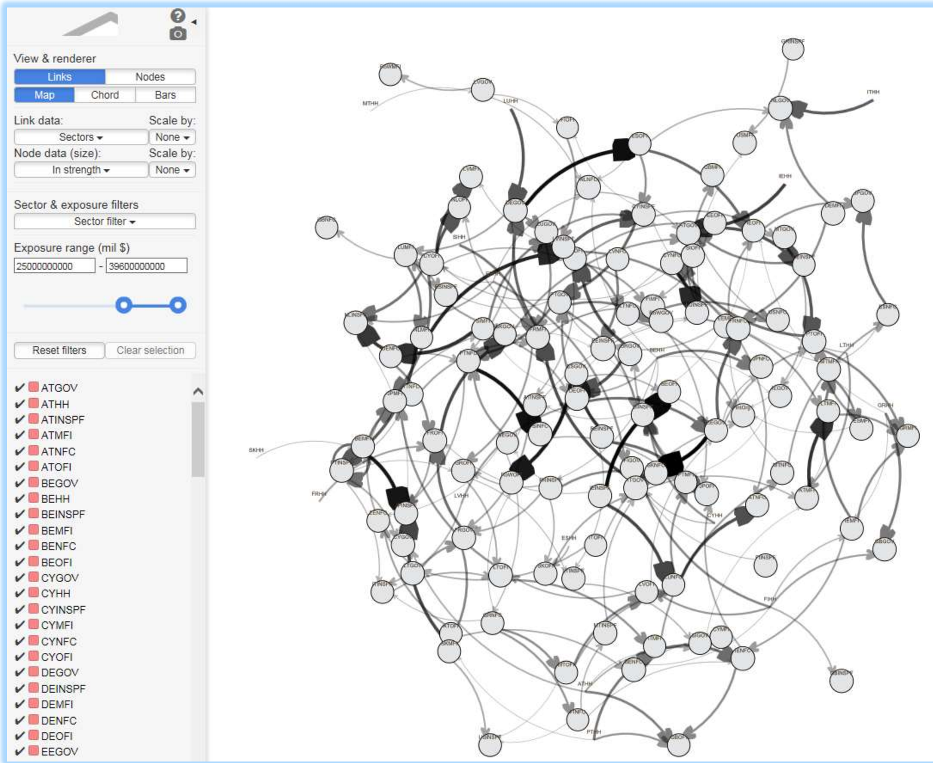
New tools to visualise massive amounts of securities data (SHSs)

- Each quarter 2,5 GB in Stata format
- Sector-country holdings of securities (ISIN) issued by other sector-country units
  - Granularity too high → collapse
- Build an interactive visualisation tool (with the help of Peter Sarlin)
- Helps to identify linkage



http://apps.infolytika.com/dnb/#/netrics Click

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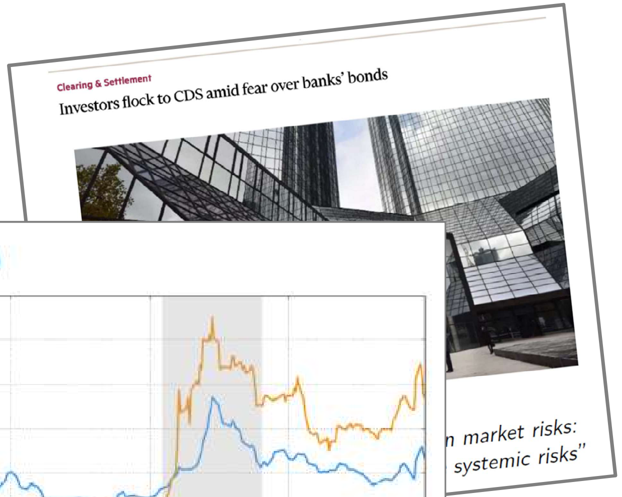
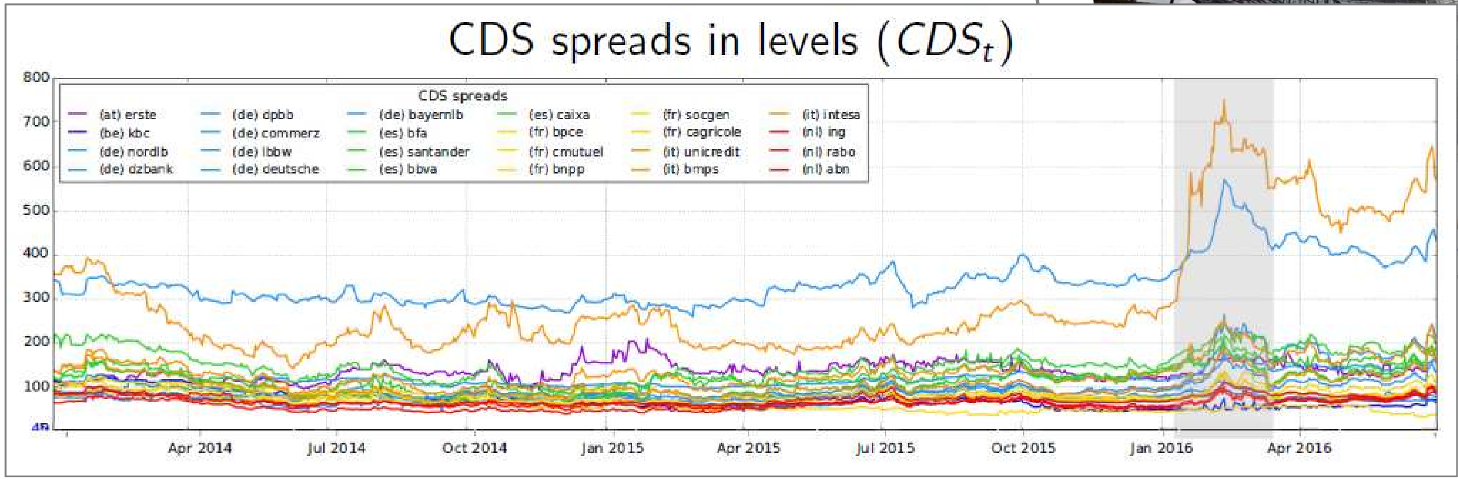
Contagion in bank CDS

Dieter Wang





- Credit Default Swaps (CDS) prices reflect the (perceived) credit risk of the underlying entity (ie. bank)
- Poorly explained by structural (bank-specific or economic) variables
- Hypothesis: Banks with similar holdings likely affect each other in stress times -> **contagion**

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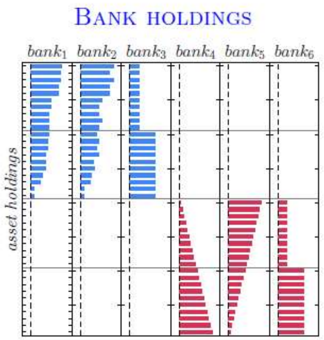
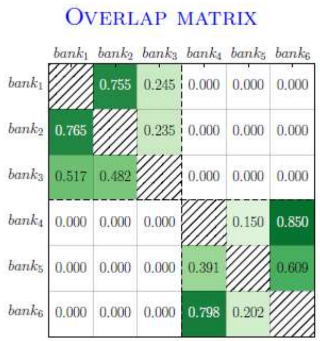
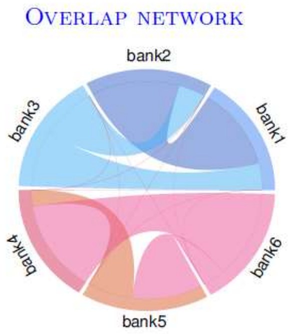
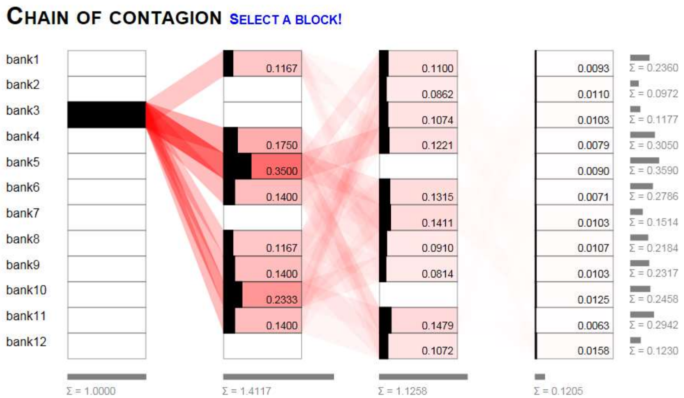
Capturing the underlying network

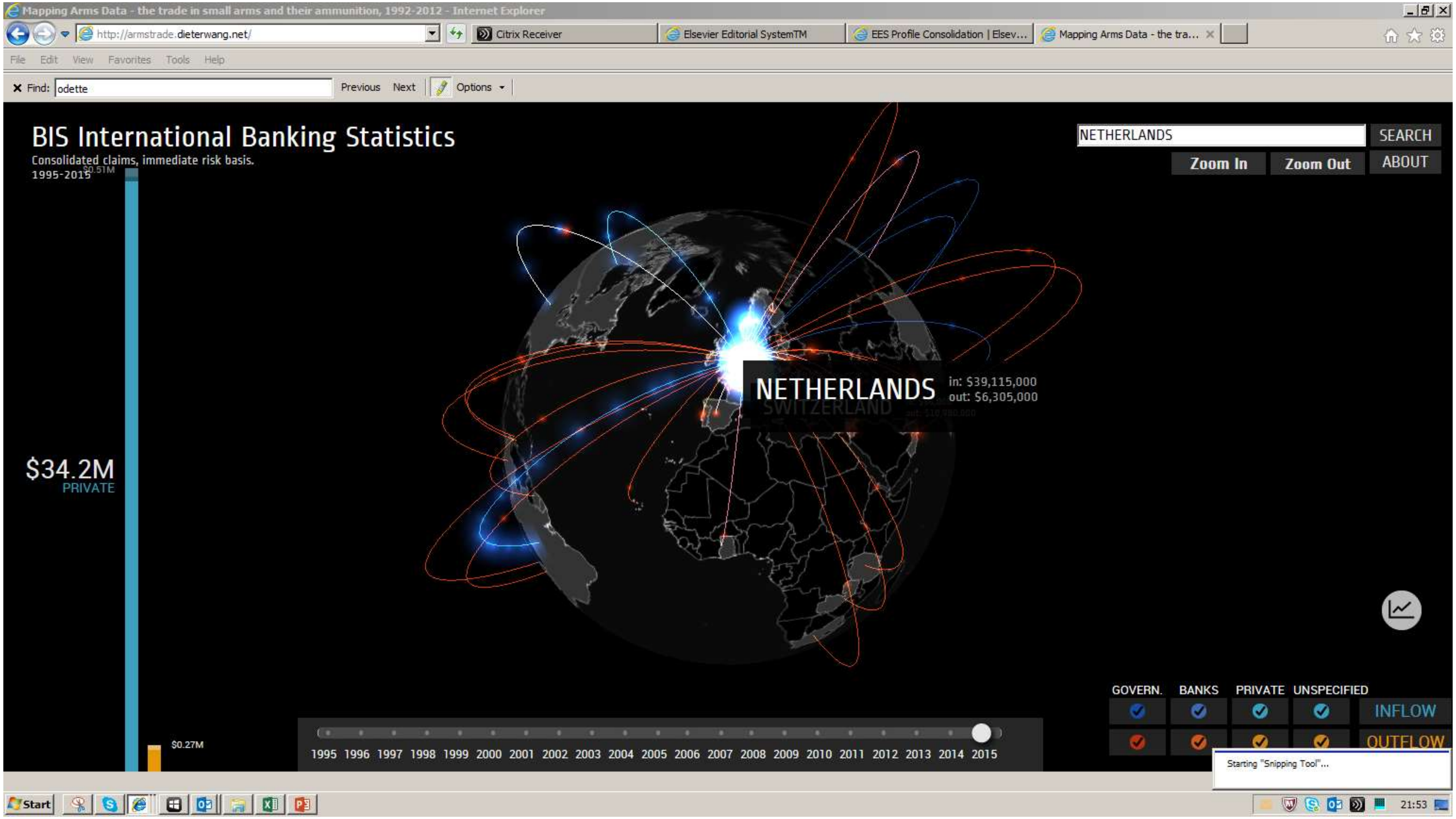






- Model contagion network by looking for similarity of bank’s holdings
- Use to simulate default contagion in stress





Iman van Lelyveld (2016), "Risks in a connected world", Inaugural lecture for the Chair of Banking and Financial Markets at VU University, June 2016. All credits to Dieter Wang. Current version: http://dieter.wang/internationalbanking