Measuring linkages building the financial system's networks
Experience at the ECB

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Outline

Background on network analysis at the ECB

Essential Components of Networks
  Linkages (bars) in Networks
  Units (nodes) embodying agents
  Transmission of shocks at the units

How networks have been studied at the ECB

Challenges going forward

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Euro area is an ideal framework

- ▶ Natural network of countries with strong cross border activities
- ▶ Network has both "natural" and "political" underlying factors
- ▶ Longer history on network stemming from infrastructures
- ▶ Recent application to financial flows and fragility interconnections

Unique hub of interaction makes it ideal for central bank applications - subject to networks' characteristics and ability to address policy questions

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Linkages
Units
Transmission

Financial connections across units

Interesting linkages include all forms of financial aspects underlying
one financial unit's fortune to that of another

Positions Holdings of or arrangements on securities and overall
strategy

Activities Financing of and shifting positions in line with
strategy

Role Function in infrastructure of payments, settlements,
etc.

Legal Ownership, including network on stance and
operation

Subsidiarity Sensitivity to common shocks, including market
participants' perceptions

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

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Units
Transmission

Choice of connection for analysis

Economic aspect of interest determines desired network,
determining its preferred structure . . .

- ▶ Identifying central knots: concept of systemic importance
- ▶ Identifying fragility of networks linking the system
- ▶ Develop a dynamic mecanism of exposure and/or contagion

. . . clearly on the basis of information availability

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

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Units
Transmission

Type of interaction

Analysis has an ideal unit for desired interaction . . .

Natural Existing partition (country, regulation, etc.)

Sectoral Function-based groups (natural linkage)

Institutional Granular partition, but critically depends on information availability

. . . and selected unit restricts the choice of linkage and/or transmission mechanism

▶ Countries cap linkage and transmission mechanism

▶ Sectors determine linkage and restrict transmission mechanism

▶ Institutions have widest choice of linkages and transmission (complication)

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Linkages
Units
Transmission

At the moment interest centres on institutions

- ▶ Systemic fragility is largely about firm's interconnections ...
- ▶ ...with strong implications to national boundaries and supervisory definitions ...
- ▶ ...but lacks supporting information and common analysis framework

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Linkages
Units
Transmission

Type of transmission

The mechanism transmiting shocks across units is often denoted the behaviour of the node (or agent)

Mechanic Transmission stems from fixed requirements, such as a static balance sheet identity or pricing, together with static rules, such as maturity requirements

Strategic Optimisation leads node (typically an institution) to measure reactions to and transmission of shocks

Transmission assumption is central to pinning down fragility or the systemic importance captured. For financial institutions the constraints imposed by the balance sheets is central

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Networks in the analysis of financial infrastructures

- ▶ Traditionally the oldest and most established
- ▶ Origin on the need summarise large amount of granular information on payment and settlement flows
- ▶ Institutionally based with well defined links and no behavioural aspects
- ▶ Core element in the characterisation of substitutability aspect in systemic importance

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Networks for identifying financial fragilities

- ▶ Recent work motivated by financial instrument holdings (linkages) at sectoral level (unit)
- ▶ Provides link of financial sector and real sectors analysing central role of the financial sector
- ▶ Uses mechanic mark-to-market accounting practices in the balance sheet to study propagation mechanism in the network
- ▶ Alternative model uses relationship between sectoral (unit) measures of credit risk (linkages) to depict sentiment (transmission) effect on covariation
- ▶ Directly derives a notion of losses stemming from shocks in the system and can provide useful tool in stress testing sector

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Networks underlying ownweship structures

- ▶ Most recent motivation stemming from the need to depict concentration of eurosystem liquidity among counterparties (nodes in a centred network)
- ▶ Also supports the depiction of holdings of securities among counterparties from their the collateral pool
- ▶ Aims at identifying the fragilities in the provision of liquidity
- ▶ Provides a concrete measure of the systemic importance of institutions central to Eurosystem operations

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

What network is relevant?

- ▶ Network of networks (unfortunately)
- ▶ Units are less well defined that directives would lead us to believe
- ▶ Reactions at the nodes are anything but deterministic - what is the relevant behavioural assumption?
- ▶ How to prioritise the seemingly endless need for more granular data

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Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Systemic importance is about losses

- ▶ Ultimately the measure of network's criticality is system loss
- ▶ ... and loss critically relies on
  - ▶ agents' reactions assumed in reacting to shock ...
  - ▶ ... and the (unmodelled) interaction between various levels of the network or networks
- ▶ ... suggesting a lower bound in terms of criticality depicted by current analysis, and substantial room for supervisory discretion

Introduction
Network Elements
Implementation a the ECB
Challenges
Last but not least

Remarks on networks being about entire systems

- ▶ Networks tell us about intricate relationships needed for macroprudential analysis
- ▶ Networks are increasingly less about national boundaries, but rather on economic and financial functions
- ▶ Global scope is the silent adressee - need of international body to carry out network analysis is evident
- ▶ Key role of international organisations in this regard

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Many thanks

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