Digital Currencies in Financial Networks

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Agenda for the presentation

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3. The Model

4. Introduction of Digital Currencies: Results
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   - Private Initiatives (Stablecoins)

5. Some Comparative Statics

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Motivation and Background

- Digital currencies have the potential to revolutionise banking and finance

- Central bank digital currencies have been long in the making, but business case has been elusive

- Private initiatives have leaped forward thanks to adoption of blockchain technology and network effects

- New opportunities create new risks and make the case for regulation, but technological neutrality should be safeguarded

- EU Commission Digital Finance Package September 2020: digital finance and retail payments strategies plus legislative proposals on crypto-assets and digital resilience

Motivation and Background (cont'd)

- The literature on digital currencies is now expanding rapidly

- Concept papers setting the scene for analysis of crypto assets and digital currencies: Adrian et al (2019), ECB (2019), Brunnermeier et al (2019)

- Papers using static balance sheets to illustrate the impact of digital currencies in financial systems: Kumhof and Noone (2018), Bindseil (2020), Juks (2018)

- But the **network approach** allows for a more thorough analysis of the impact on third parties and of the dynamic rebalancing of accounts

- Contagion effects have been widely investigated in the financial network literature (Allen and Gale, 2000; Gai and Kapadia, 2010; Glasserman and Young, 2015)

- This paper uses the Macro Networks framework introduced in Castrén & Rancan (JBF 2014), with the introduction of digital currencies in the euro area financial accounts

Classification of Digital Currencies

- The classification of crypto assets in all dimensions and contexts is a complex matter

- Harmonised classification is needed, inter alia, for economic, legal, accounting, statistical and prudential/regulatory treatments

- For this paper the relevant discussion is the treatment in the International System of National Accounts (still under discussion)

- OECD and IMF have the most advanced discussions on this, proposing to classify crypto assets either as "currency", "financial instrument" or "investment scheme", depending on the characteristic of the asset

- The wide variety of crypto assets complicates the task. Some crypto assets are no assets at all, as they have no issuing counterparty (Bitcoin)

- For this paper we follow the OECD and FINMA (the Swiss financial market authority) for the national accounts and prudential classifications, respectively

The Model

- The Macro Network approach by Castrén and Rancan (2014): construct a network of interlinked balance sheets at the level of institutional sectors (HH, NFC, GOVT, Financial Sectors, RoW)

- Networks are drawn using data on who-to-whom links for different instrument categories (deposits, loans, debt securities, equity shares...) shock propagation can be simulated with algorithms following pre-specified rules

- Left chart: network of deposits; right chart: network of debt securities. Data: Euro Area Accounts (EEA, following ESA 2010). Q1 2019
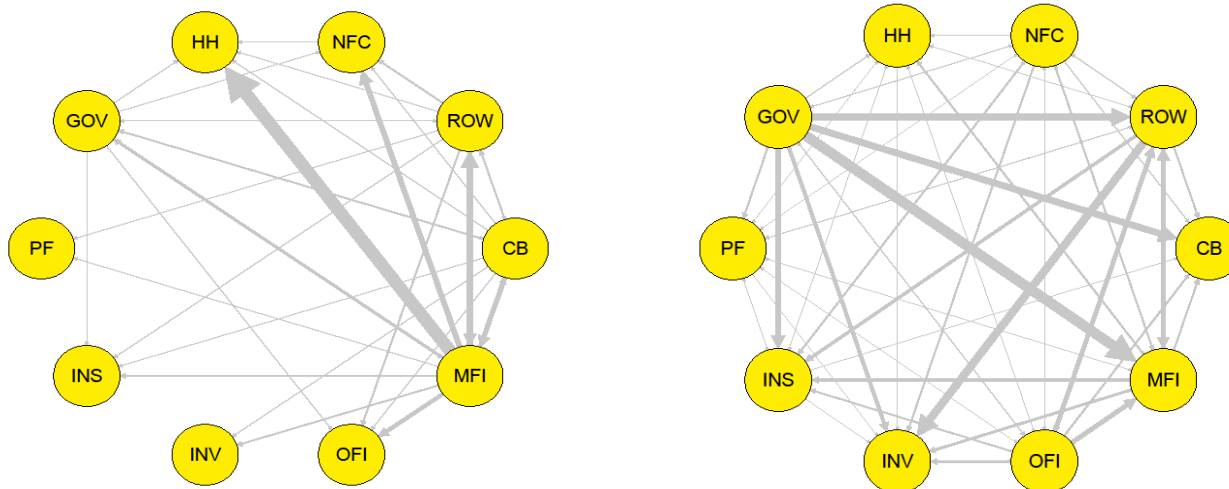
The Model, cont'd

The financial system consists of n institutional sectors i, $i = 1,...,n$, with $n=10$. The liability side of the balance sheet of sector i encompasses X items including quoted and unquoted equity shares (EQ), deposits, credit (loans) and debt securities (DD), other items (OI) and net wealth (NW), where the latter is defined as total assets minus total liabilities. Formally, we have:

$$L_{i,t} = EQ_{i,t}^L + DD_{i,t}^L + OI_{i,t}^L + NW_{i,t},$$

where the superscripts L denote liability items and $DD_{i,t}^L = \sum_{j=1}^n \omega_{i,j,t}^D D_{i,t}^L + \sum_{j=1}^n \omega_{i,j,t}^B B_{i,t}^L + \sum_{j=1}^n \omega_{i,j,t}^C C_{i,t}^L$ is a portfolio of debt items deposits (D^L), bonds (B^L) and credit (C^L), with weights determined by ω. The asset side of sector i is defined as:
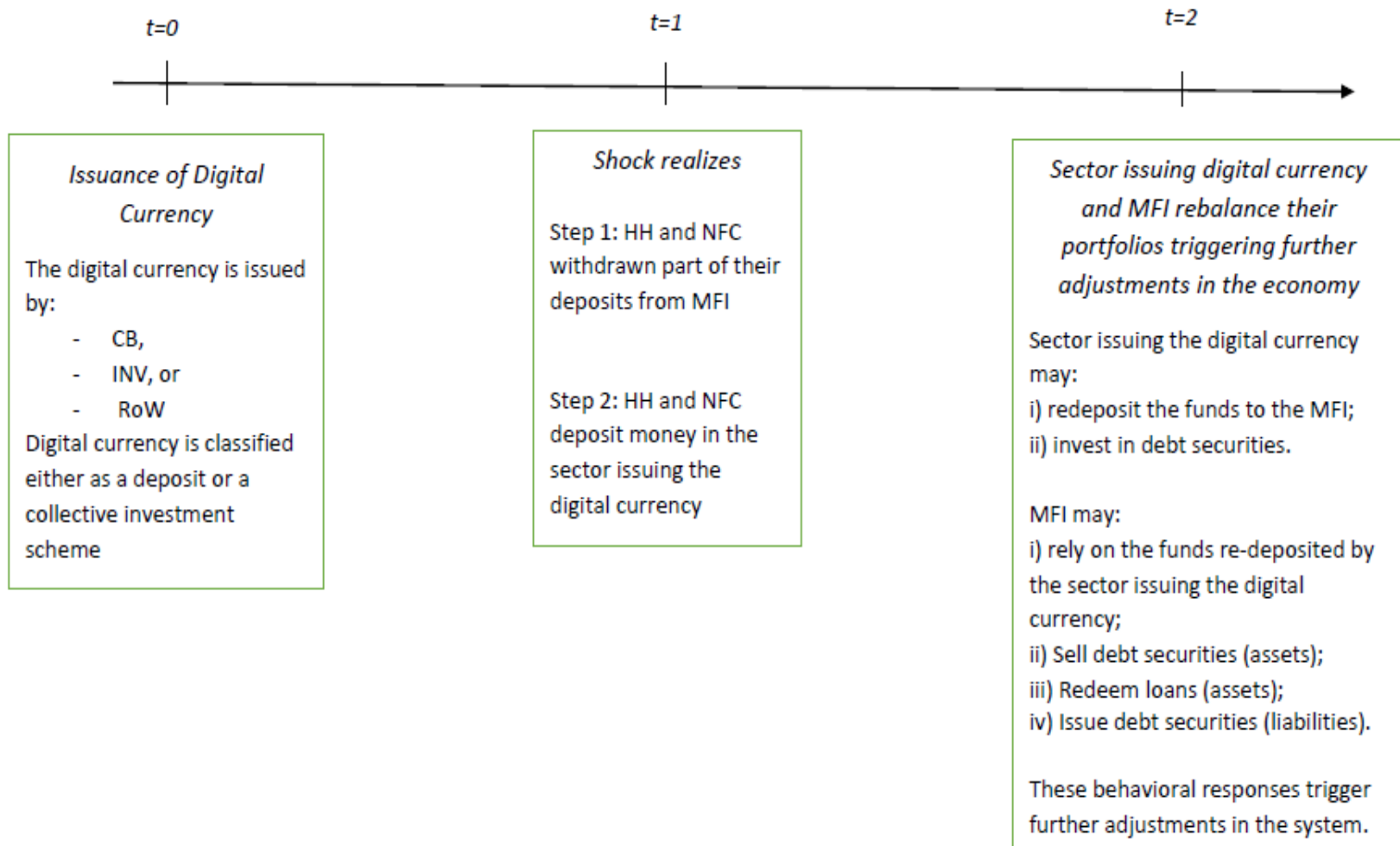
$$A_{i,t} = EQ_{i,t}^A + DD_{i,t}^A + OI_{i,t}^A,$$

where superscripts A denote asset items and $EQ_{i,t}^A = \sum_{j=1}^n \omega_{i,j,t}^{EQ}(EQ_{i,t}^L)$, $DD_{i,t}^A = \sum_{j=1}^n \omega_{i,j,t}^{DD}(DD_{i,t}^L)$ and $OI_{i,t}^A = \sum_{j=1}^n \omega_{i,j,t}^{OI}(OI_{i,t}^L)$ are portfolios of equity, debt and other assets issued by all sectors j, including sector i itself.

At the financial system level, with the rest of the world sector, we have:

$$\sum_{i=1}^n L_{i,t} = \sum_{i=1}^n A_{i,t} \text{ and } \sum_{i=1}^n NW_{i,t} = 0$$

The Timing of Events

t=0   t=1   t=2

Issuance of Digital Currency

The digital currency is issued by:
- CB,
- INV, or
- RoW

Digital currency is classified either as a deposit or a collective investment scheme

Shock realizes

Step 1: HH and NFC withdrawn part of their deposits from MFI

Step 2: HH and NFC deposit money in the sector issuing the digital currency

Sector issuing digital currency and MFI rebalance their portfolios triggering further adjustments in the economy

Sector issuing the digital currency may:
i) redeposit the funds to the MFI;
ii) invest in debt securities.

MFI may:
i) rely on the funds re-deposited by the sector issuing the digital currency;
ii) Sell debt securities (assets);
iii) Redeem loans (assets);
iv) Issue debt securities (liabilities).

These behavioral responses trigger further adjustments in the system.

Introduction of Digital Currencies: The Results

Central Bank Digital Currencies

- The simple case: CBDC triggers deposit shifts out of banks (MFI)
- Network of deposits (status quo: left chart)
- Firms (NFC) and households (HH) move deposits out of MFI to the CB (middle chart)
- CB redeposits the funds it received back to MFI (right chart)
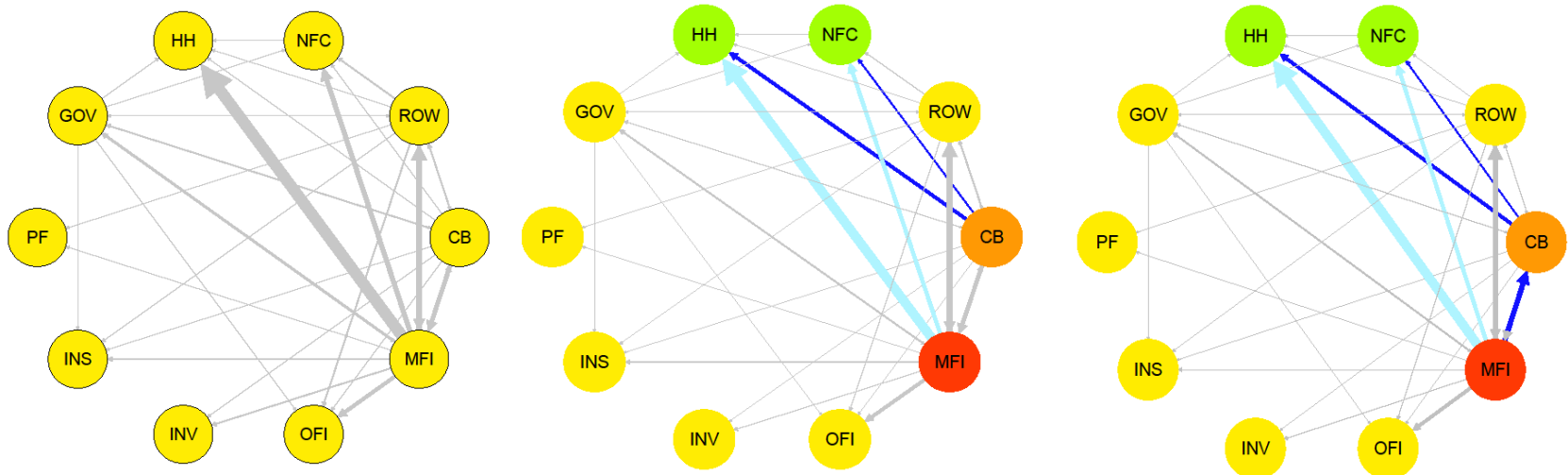
Central Bank Digital Currencies

- After the deposit shift, MFI and CB rebalance their accounts (several options for this)
- Network of debt securities (status quo: left chart)
- MFI reduce their bond holdings **proportionally** by counterparty (middle chart)
- CB increases its bond holdings **proportionally** by counterparty (right chart)
- Other rebalancing rules can be easily implemented
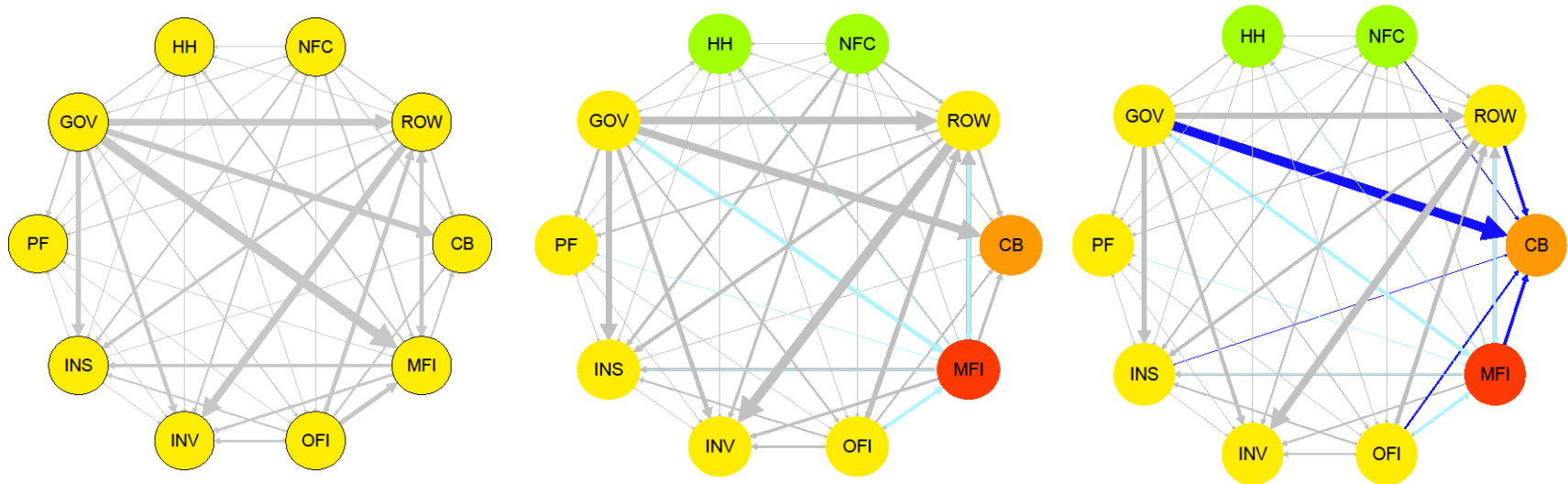
Central Bank Digital Currencies (cont'd)

- Since the compositions of portfolios differ across sectors, the bonds that one sector wants to sell are not necessarily the same than those the other sectors want to buy

- In this particular case, bonds in excess supply are issued by RoW, OFI, and MFI, those in excess demand are issued by Government
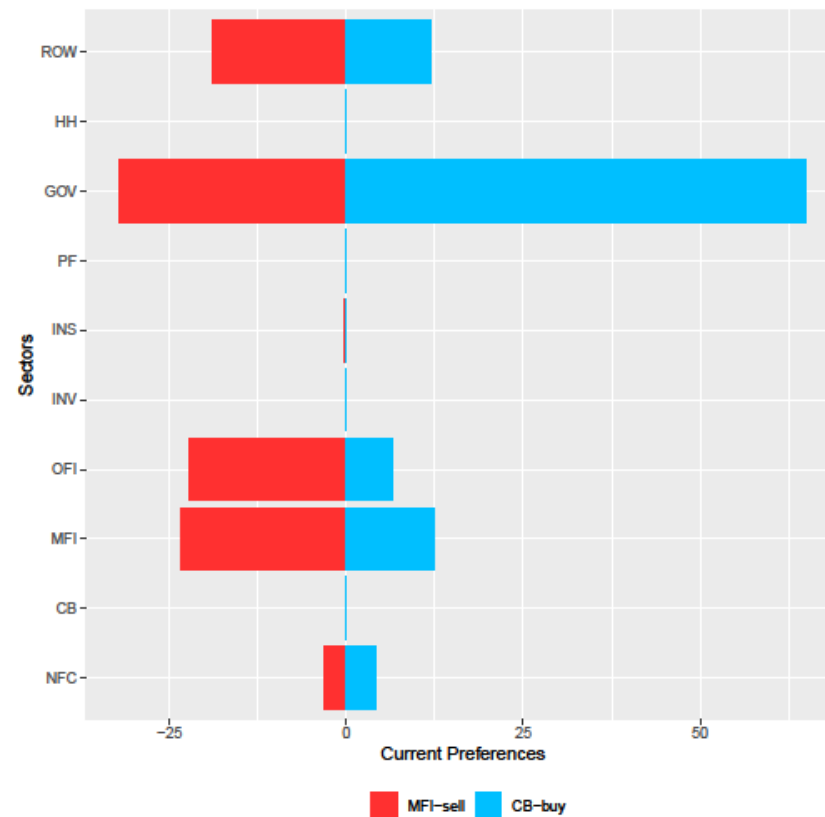
Central Bank Digital Currencies (cont'd)

- Another scenario: MFIs rebalance by issuing new bonds, CB rebalances by buying bonds according to its portfolio, as before

- A large drop in MFI bond prices may be required for the market to clear
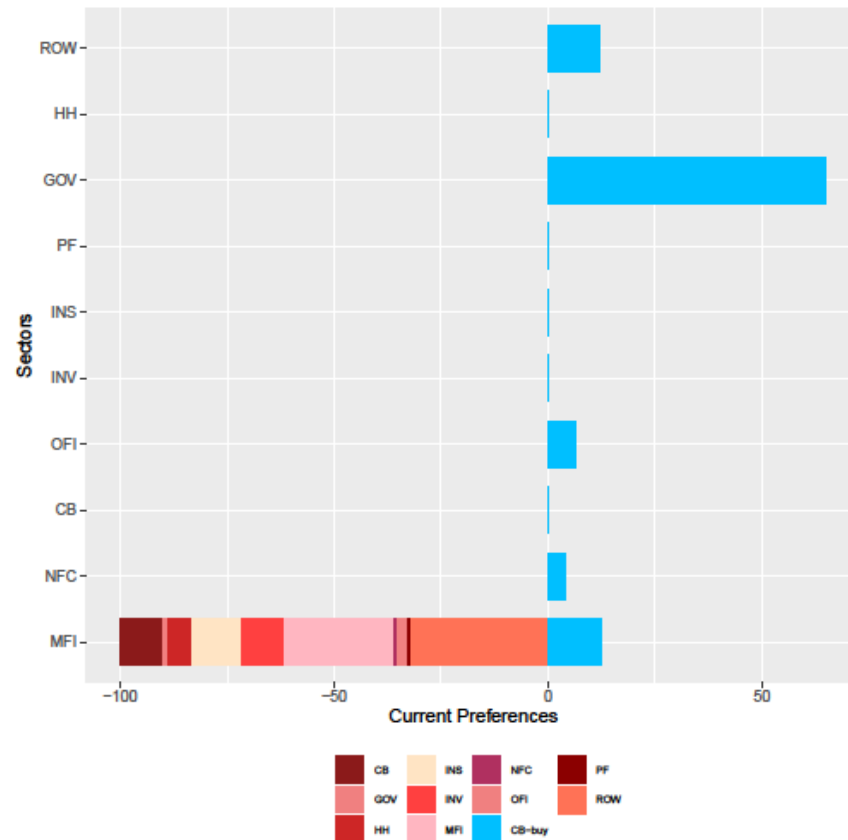
Private Initiatives: Global Stablecoins

- First round: GSC (with share of *γ* of its reserves fund denominated in the domestic currency) triggers a deposit shift out of MFI to RoW
- GSC moves *γ* of deposits to a domestic subsidiary who deposits to MFI (left chart)
- GSC moves *1- γ* of deposits to domestic CB (middle chart)
- MFI fills the funding gap *1- γ* by borrowing from the CB (right chart)
- Second round: price movements now reflect the composition of GSC reserve portfolio
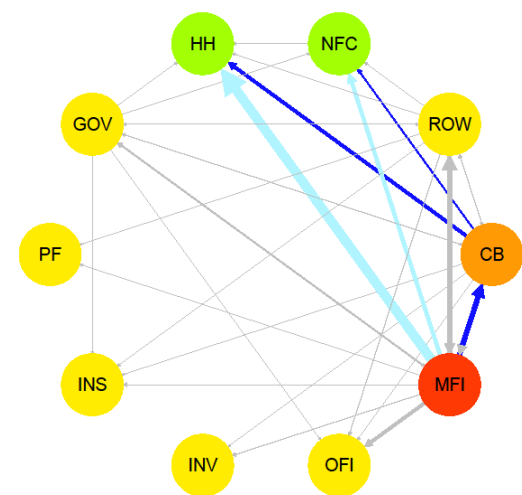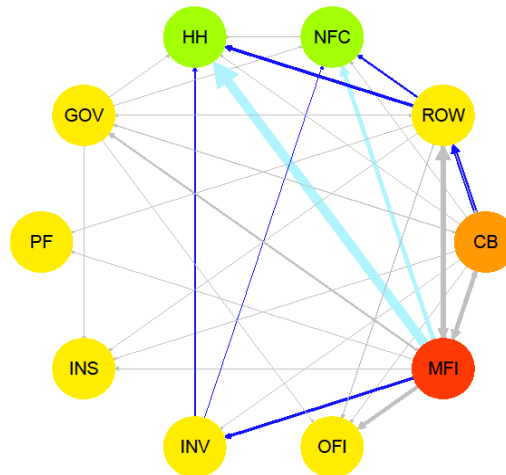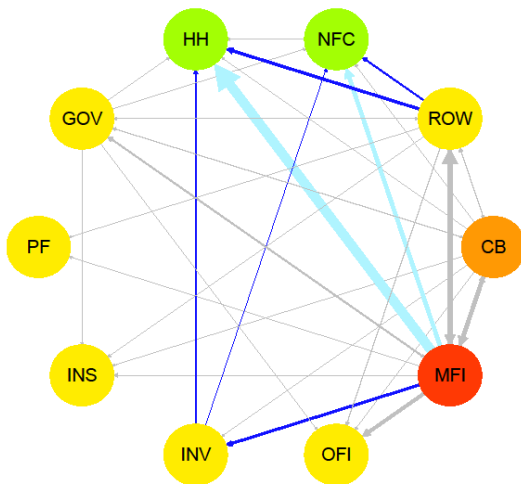
Some Comparative Statics

- **Network statistics** quantify the shape of the network and provide information about its stability, resilience etc.

- "Centrality" measures the relative importance of an individual node in the network

- In the network of deposits, introduction of CBDC increases the centrality of the CB node (left graph) and decreases that of the MFI node (right graph)

- The impact is increasing in the size of the shock but decreases with rebalancing
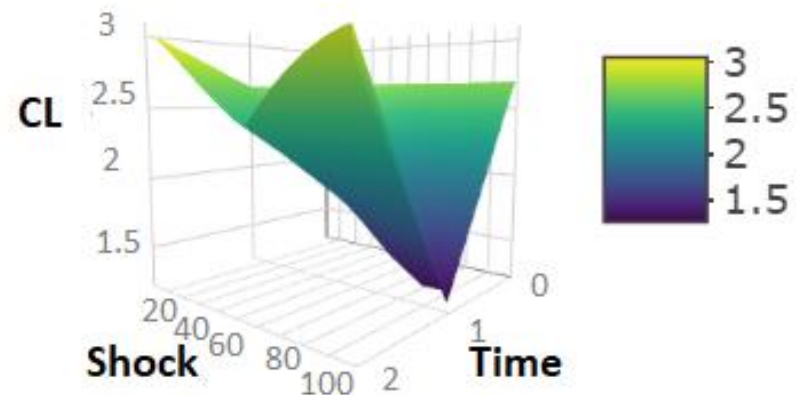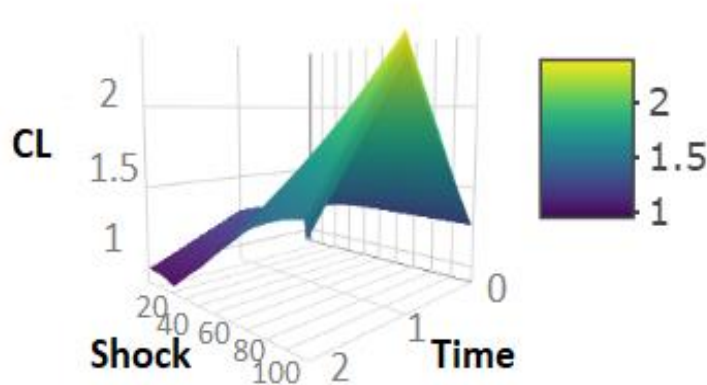
Some Comparative Statics (cont'd)

- Looking at the **status quo networks** reveals that the centrality measures are not constant over time (here: network of deposits)

- In the euro area: sharp increase in the centrality of CB, decrease in the centrality of MFI and RoW, since the start of the eurosystem asset purchases

- The situation has since been vastly exacerbated by the COVID crisis and the pandemic asset purchase programmes (not shown in the charts)
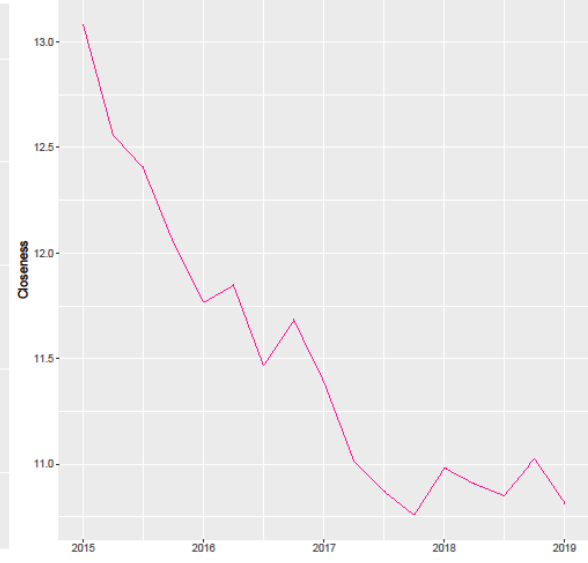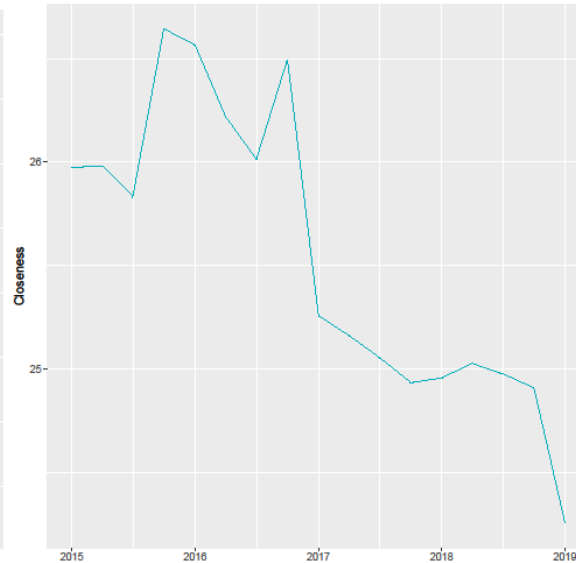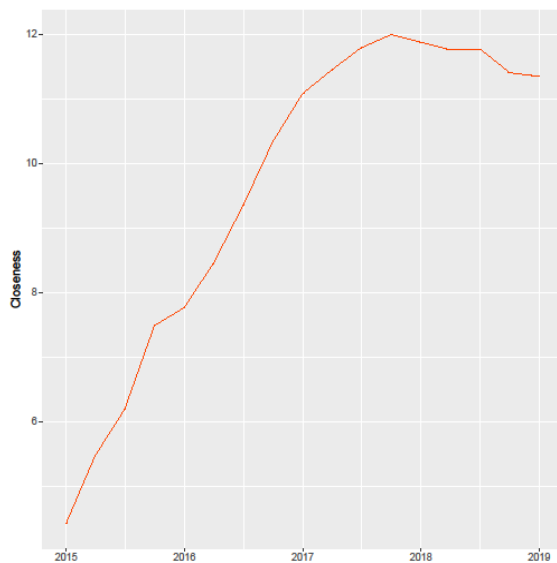
A Sequence of Conclusions

- **Design:** The way the digital currency scheme is established (public or private issuer, classified as currency, deposit, security or investment fund share) makes a difference both for the issuing sector, the banking sector, the regulator and the retail users/depositors.
    → Specific circumstances may favour certain designs over others.

- **Reaction:** The ways the affected parties adjust to the introduction of the digital currency by shifting deposits and rebalancing their accounts depend not only on (i) but also on the incentives and constraints/mandates they face.
    → There may be ways to shape these incentives by mechanism design and public policy.

- **Third parties:** Given that the financial system is a network, third parties will be affected by the introduction of a digital currency and the rebalancing that follows it. The identity of these third parties and the impact they experience may differ depending on how (i) and (ii) play out.
    → Identify the relevant links and mitigate any potential collateral damage ex ante.

- **Timing:** The financial network structures that in part determine (i), (ii) and (iii) are not static but they evolve over time as the intensity of the bilateral links change. This means that, at any point in time, the network may be more or less able to diffuse shocks.
    → The timing of the initiative matters for its success.

Thank You for Your Attention