Digital Currencies in Financial Networks

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Motivation and Background

- Digital currencies have the potential to revolutionise banking and finance
- Over 70% of Central Banks are interested in the possibility of issuing a digital currency (BIS)
- 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

This paper

- We introduce digital currency in the Euro Area Financial Accounts using the Macro-Network framework (Castrén and Rancan, JBF 2014)
- Digital currency is classified as a deposit scheme with different designs:
  - Central bank digital currency: central bank issues a digital currency
  - A domestic stablecoin initiative: private domestic entity issues a stablecoin
  - A global stablecoin initiative: "rest of the world" sector issues a foreign stablecoin
- Identification of the risks associated with banking disintermediation and funding constraints for other sectors
- The network approach allows to capture the impact on third parties and the dynamic rebalancing of accounts

Literature

- General equilibrium model of payments or bank intermediation with digital currency: Andolfatto (2018), Agur et al. (2019), Brunnermeier and Niepelt (2019), Keister et al. (2019), Fernandéz-Villaverde et al. (2020)
- Financial balance sheet approach: Kumhof and Noone (2018), Juks (2018), Bindseil (2020)
- Networks in finance: Allen and Gale (2000), Glasserman and Young (2015), Caccioli et al. (2014), Mistrulli (2011), Craig and von Peter (2014), Peltonen et al. (2014), Acemoglu et al. (2016)

The financial system

- n institutional sectors, $i = 1, \ldots, n$, with $n = 10$
- Balance sheet of each sector i in time t is represented by assets $A_{i,t}$ and liabilities $L_{i,t}$

$$A_{i,t} = EQ^A_{i,t} + DD^A_{i,t} + OI^A_{i,t}$$

$$L_{i,t} = EQ^L_{i,t} + DD^L_{i,t} + OI^L_{i,t} + NW^L_{i,t}$$

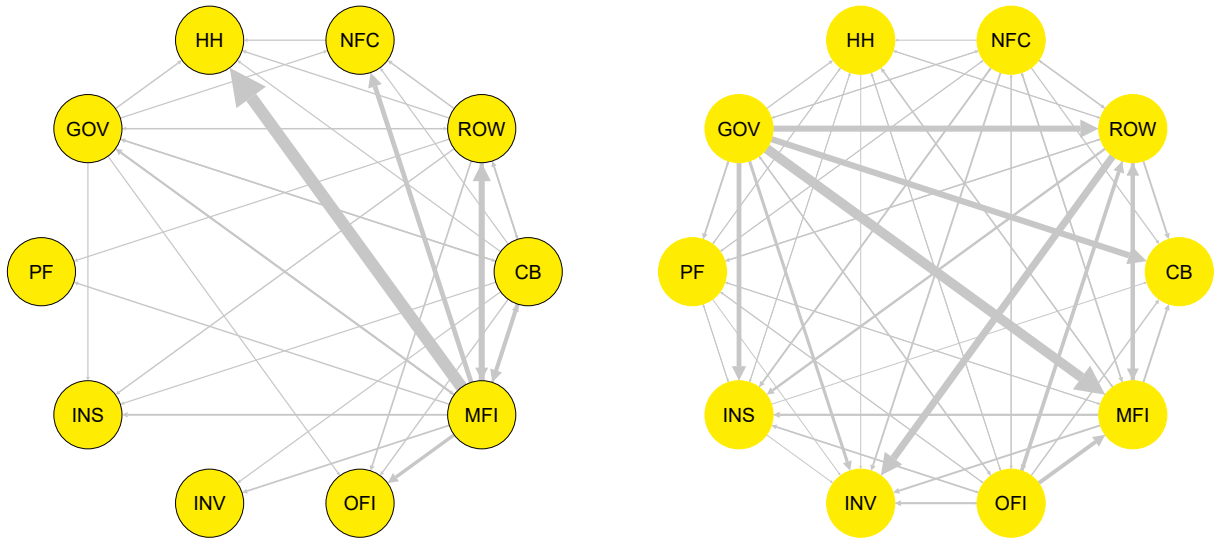
where EQ represents quoted and unquoted equity shares; DD deposits, debt securities and loans ($DD = D + B + C$); OI other items; NW net wealth. At the system level, with ROW, we have

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

The Macro-Network

- A network of interlinked balance sheets at the level of institutional sectors (Nodes): households (HH), non-financial corporations (NFC), banks (MFI), central bank (CB), insurance companies (INS), pension funds (PF), other financial intermediaries (OFI), non-money-market-fund investment funds (INV), general government (GOV), and the rest of the world (ROW)
- Networks are drawn using data on who-to-whom (Links) for different instrument categories (deposits, loans, debt securities, equity shares...) based on the Euro Area Accounts

The Macro-Network - Examples



(Deposits) (Debt Securities)

Figure: Data Q1 2019. Arrows run from liabilities to assets.

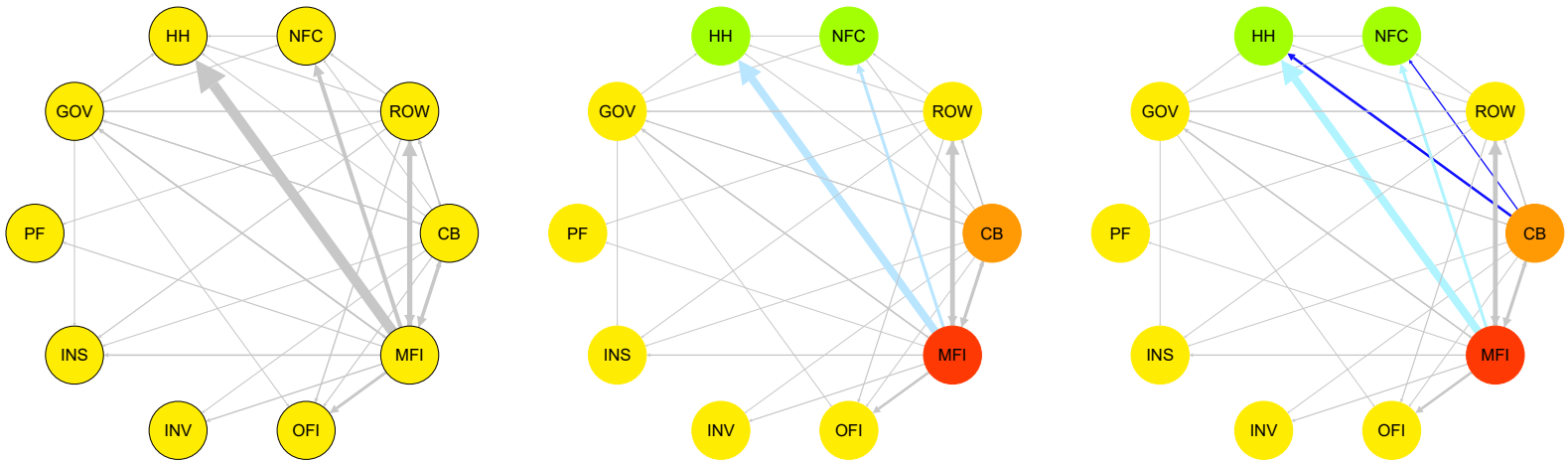
The issuance of a digital currency I

- In t, digital currency is issued by CB, INV, or ROW
- In $t+1$, the introduction of the digital currency implies a shock ε in the form of a switch withdrawal of deposits by HH and NFC from MFI to the sector y hosting the digital currency, with $y \in \{CB, INV, ROW\}$

$$L_{MFI,t+1} = EQ^{L}_{MFI,t+1} + (DD^{L}_{MFI,t+1} - \varepsilon) + OI^{L}_{MFI,t+1} + NW^{L}_{MFI,t+1}$$

$$L_{y,t+1} = EQ^{L}_{y,t+1} + (DD^{L}_{y,t+1} + \varepsilon) + OI^{L}_{y,t+1} + NW^{L}_{y,t+1}$$

Central Bank Digital Currencies (CBDC)



(Panel A) (Panel B) (Panel C)

Figure: Macro network, Instrument Deposits.

The issuance of a digital currency II

In $t+2$, the sector issuing digital currency may choose one of the following options:

i) $A_{y,t+2} = EQ^{A}_{y,t+2} + (DD^{A}_{y,t+1} + \delta D) + OI^{A}_{y,t+2}$

ii) $A_{y,t+2} = EQ^{A}_{y,t+2} + (DD^{A}_{y,t+1} + \delta B) + OI^{A}_{y,t+2}$

iii) $A_{y,t+2} = EQ^{A}_{y,t+2} + (DD^{A}_{y,t+1} + \delta C) + OI^{A}_{y,t+2}$

with $\delta D = \delta B = \delta C \equiv \varepsilon$

Hp: Sector y keeps exposures to different sectors constant

The issuance of a digital currency III

In $t+2$, the MFI may choose one of the following options:

i) $L_{MFI,t+2} = EQ^{L}_{MFI,t+2} + (DD^{L}_{MFI,t+1} + \delta D) + OI^{L}_{MFI,t+2} + NW_{MFI,t+2}$

ii) $A_{MFI,t+2} = EQ^{A}_{MFI,t+2} + (DD^{A}_{MFI,t+1} - \delta B) + OI^{A}_{MFI,t+2}$

iii) $A_{MFI,t+2} = EQ^{A}_{MFI,t+2} + (DD^{A}_{MFI,t+1} - \delta C) + OI^{A}_{MFI,t+2}$

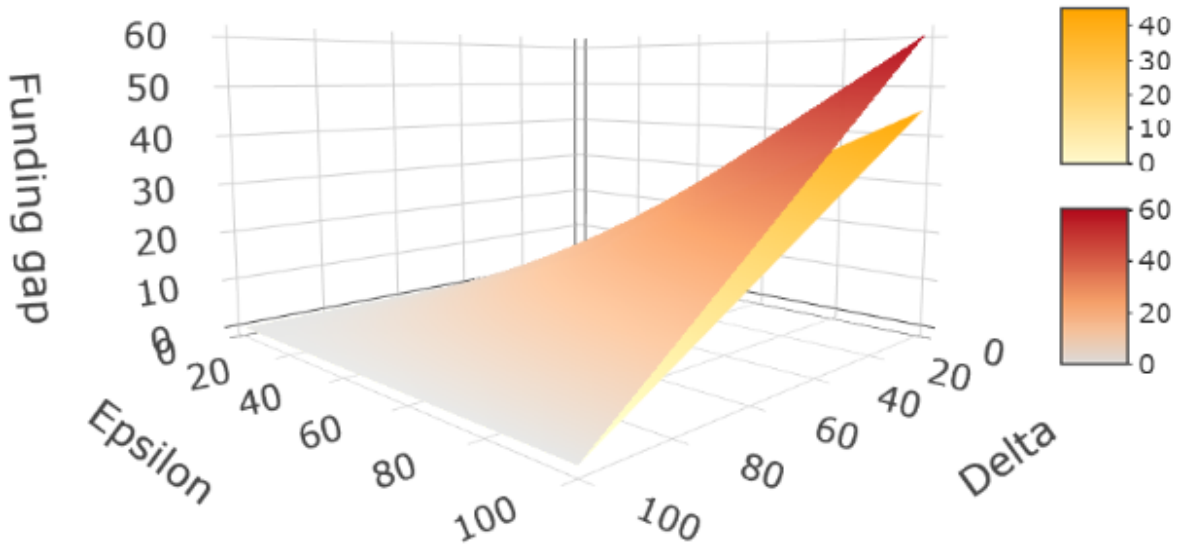
iv) $L_{MFI,t+2} = EQ^{L}_{MFI,t+2} + (DD^{L}_{MFI,t+1} + \delta B) + OI^{L}_{MFI,t+2} + NW_{MFI,t+2}$

with $\delta D = \delta B = \delta C = \delta B \equiv \varepsilon$

Hp: MFI keeps exposures to different sectors constant

CBDC - Banks funding gap

CB redeposits the funds with the commercial banks (MFIs) to offset the increase in its deposit liabilities (option i)



CBDC - Imbalances in the bond market

In $t+2$, CB chooses to buy bonds & MFI chooses to sell bonds (option ii)

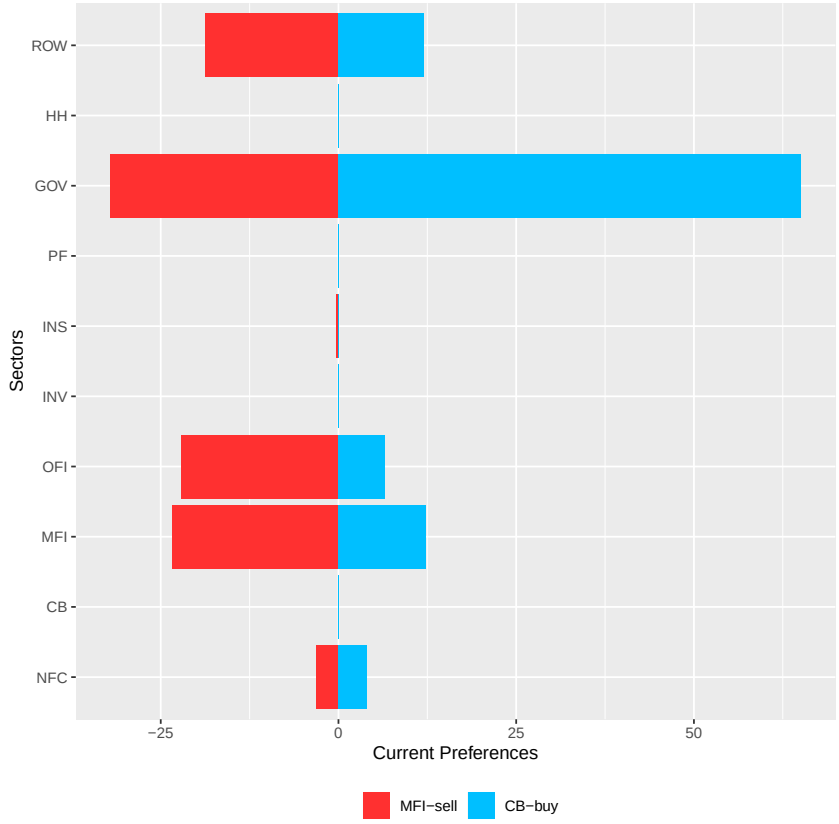


Figure: All values are normalized and expressed in percentage terms.

Scenarios

iii) The MFI redeems loans (assets) to offset the reduction in its deposit liabilities; the sector which loses bank financing replaces loans by issuing its own debt securities; the CB purchases debt securities to offset the increase in its deposit liabilities

- Funding difficulties for sectors relying heavily on bank loans
- Alternative source of external funding
- CB interventions

iv) The MFI issues debt securities (liabilities) to offset the reduction in its deposit liabilities; the CB purchases debt securities to offset the increase in its deposit liabilities

- Banks access to bond market
- What sectors can buy these additional banks bonds?

Additional results

- Severity of the effects depends on the key hypotheses of the model (shock size, shock source,)
- Introduction of CBDC affects the network structure and relative importance of the different sectors
- Effects change over time (period Q1 2015-Q1 2021)
- Our framework flexible enough to consider alternative designs:
  - digital currency issued by a private entity operating as part of the investment funds sector (INV)
  - a foreign stablecoin located in the "rest of the world" (ROW) sector but with part of its global reserve fund assets denominated in the domestic currency

Conclusion

i) 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.

ii) 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.

iii) 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

iv) 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 the network may be more or less able to diffuse shocks