



# Innovation in finance and central banking – a tour d’horizon

iconomix Tagung 2023

Oliver Sigrist, BIS Innovation Hub

Zurich, 1 September 2023

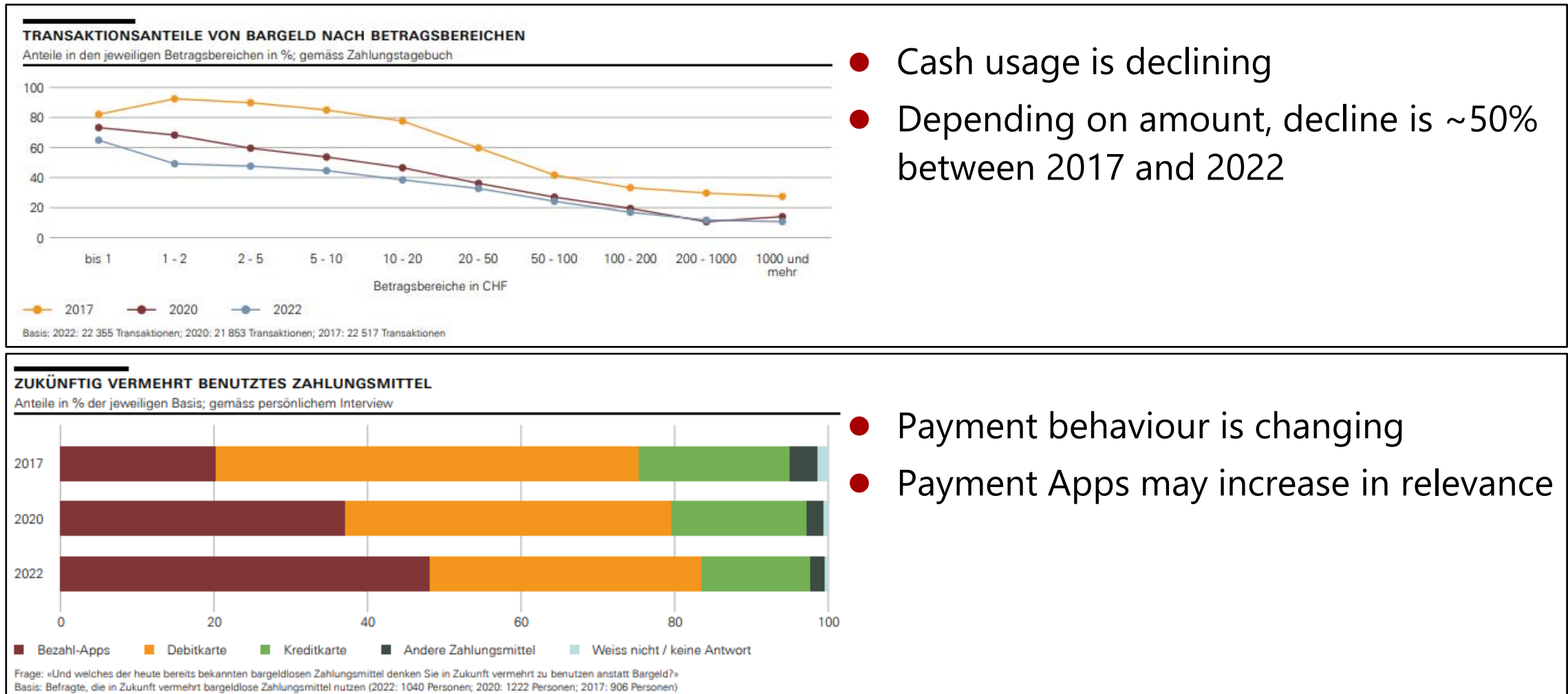
The views expressed here are those of the presenter and not necessarily those of the BIS.

# Agenda

- Finance is changing: payments and digital platforms
- How is this relevant for central banks?
- CBDCs as a possible answer

**Finance is changing**

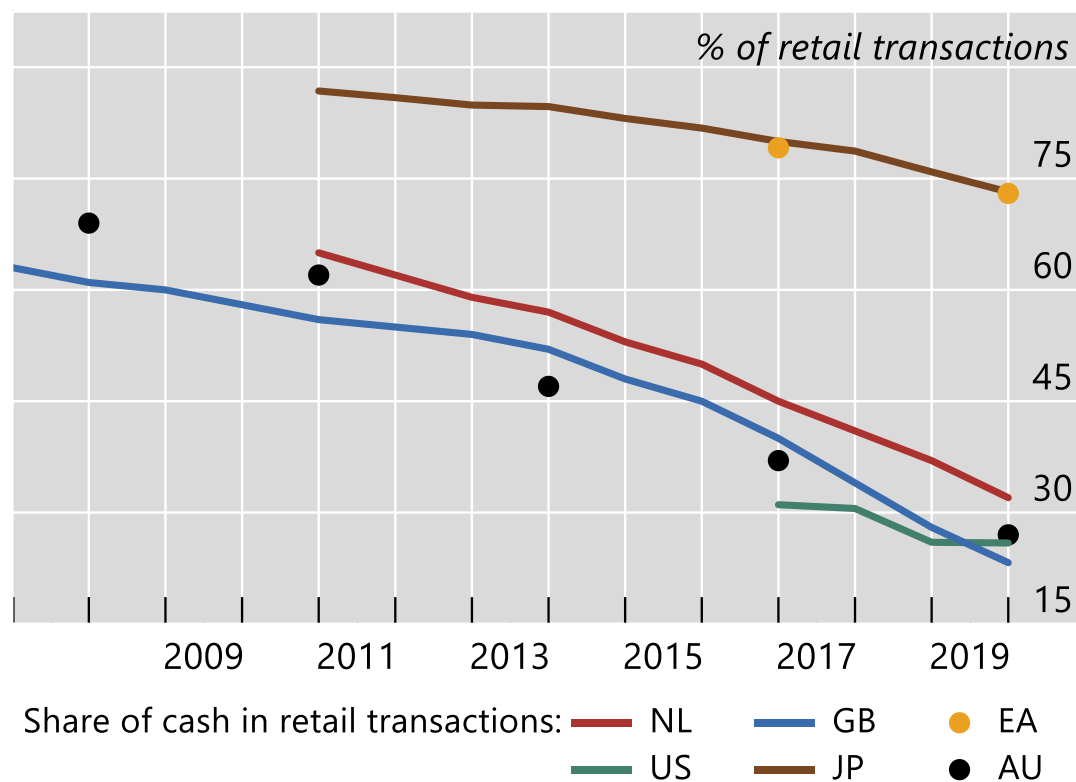
## Changing payments behaviour – two observations from Switzerland...



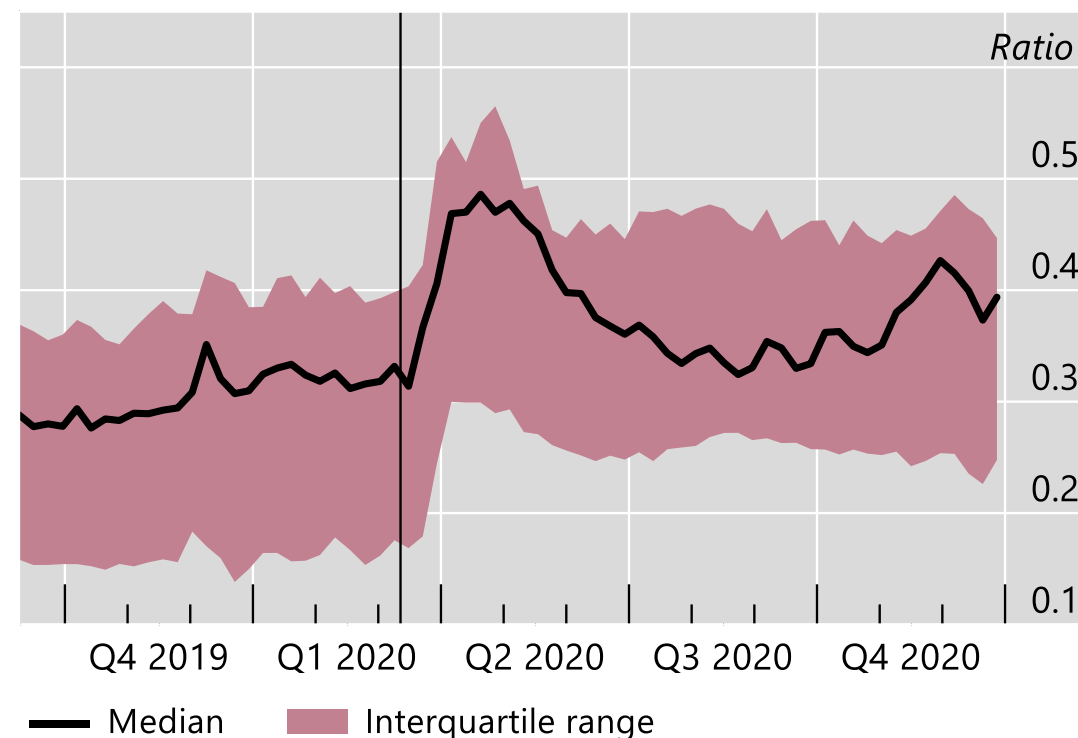
Source: SNB (2023): "Zahlungsmittelumfrage bei Privatpersonen in der Schweiz 2022", June.

## ... and across the world

### Use of cash is falling



### Remote digital payments rose in the pandemic

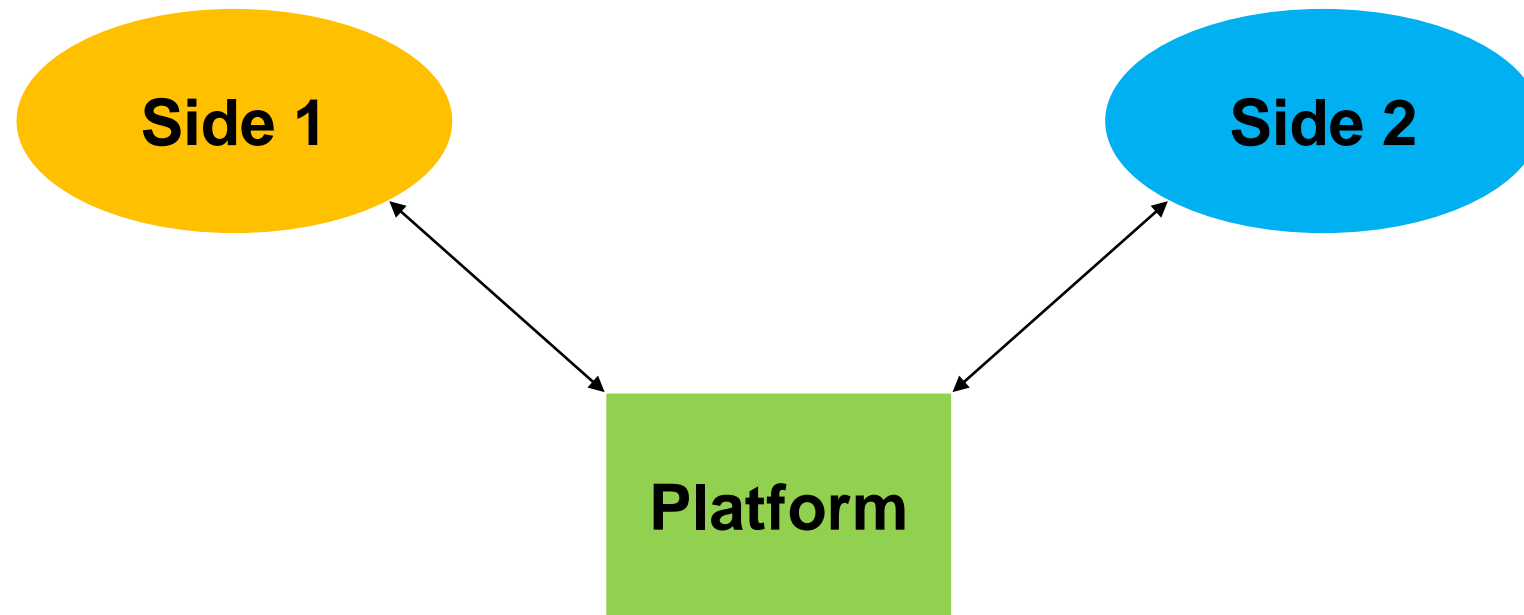


Sources: R Auer, G Cornelli and J Frost, "The pandemic, cash and retail payment behaviour: insights from the future of payments database", BIS Working Paper, no 1055, December; central banks' websites; Japan's Ministry of Economy, Trade and Industry; global card networks; BIS calculations.

# Three types of platforms in finance: definitions and examples

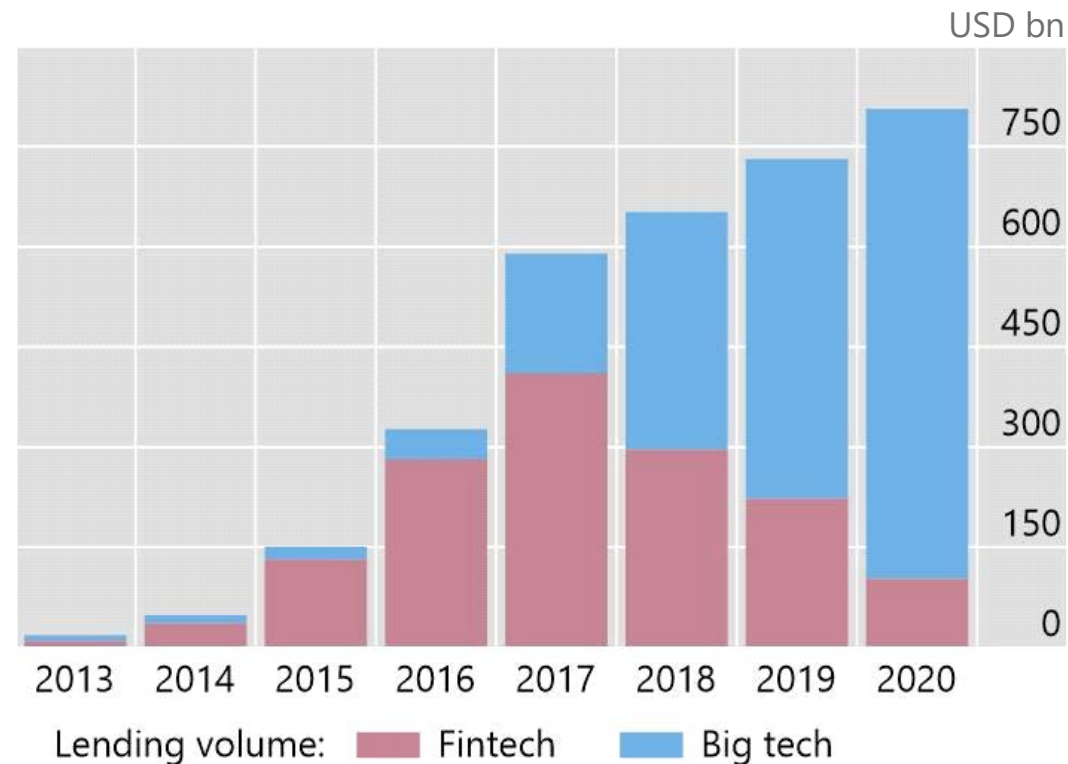
	Fintech	Big tech	Incumbent responses
Definition	Technology-enabled innovation in financial services that could result in new business models, applications, processes or products ... ( <a href="#">FSB</a> , 2017)	Large companies whose primary activity is digital services, rather than financial services ( <a href="#">Frost et al.</a> , 2019; <a href="#">BIS</a> , 2019)	Move to business model that brings together two or more types of economic agents and facilitates trade between them (Evans and Schmalensee, 2014)
Examples			

## Platform economics: a simple representation

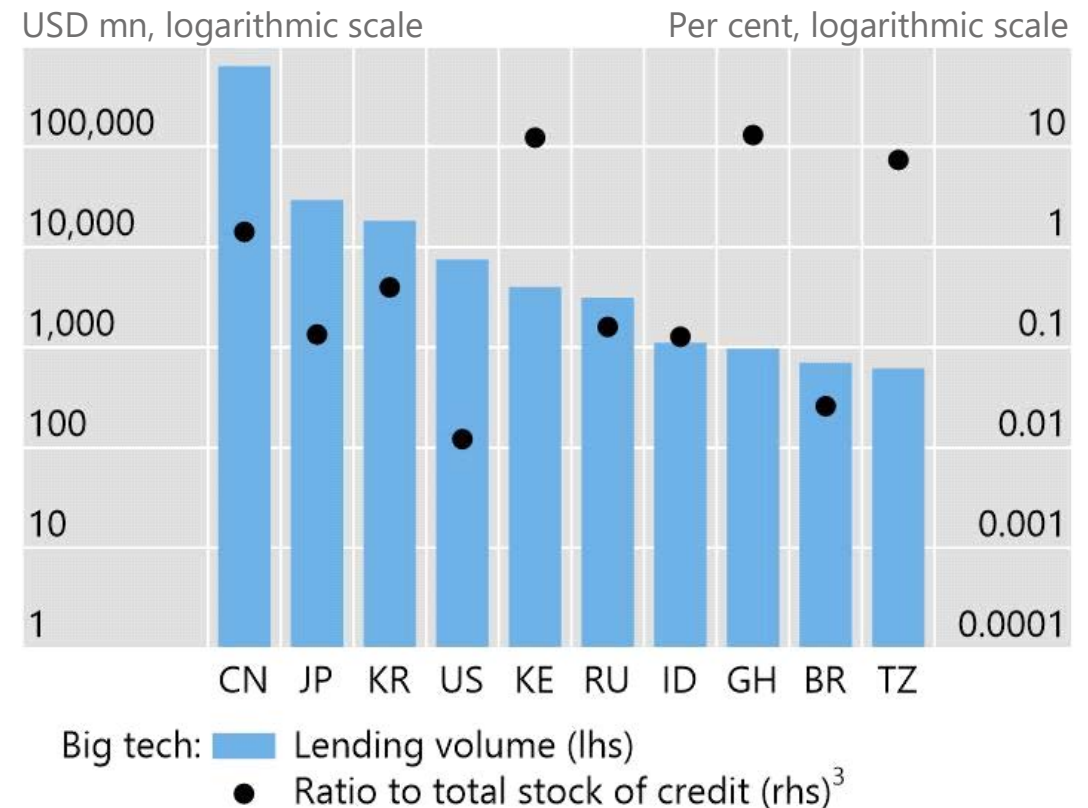


# Platforms scale fast, and especially big tech is booming

Big tech credit grew further during the pandemic<sup>1</sup>



Big tech credit is economically large in some markets<sup>2</sup>



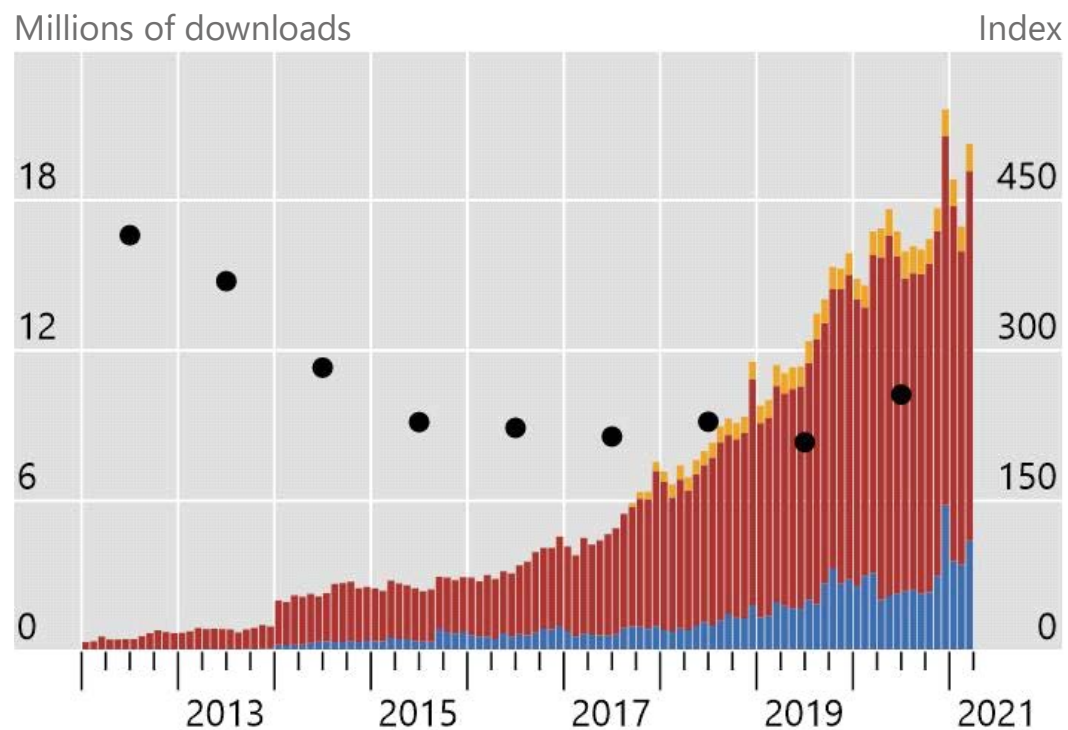
<sup>1</sup> Includes estimates. <sup>2</sup> Data for 2020. <sup>3</sup> Domestic credit provided by the financial sector to the non-financial sector or closest alternative.

Feyen, E, J Frost, L Gambacorta, H Natarajan and M Saal (2021): "Fintech and the digital transformation of financial services: implications for market structure and public policy", BIS Papers N 117, July.



## These forces also mean rising downloads of fintech and big tech payment apps

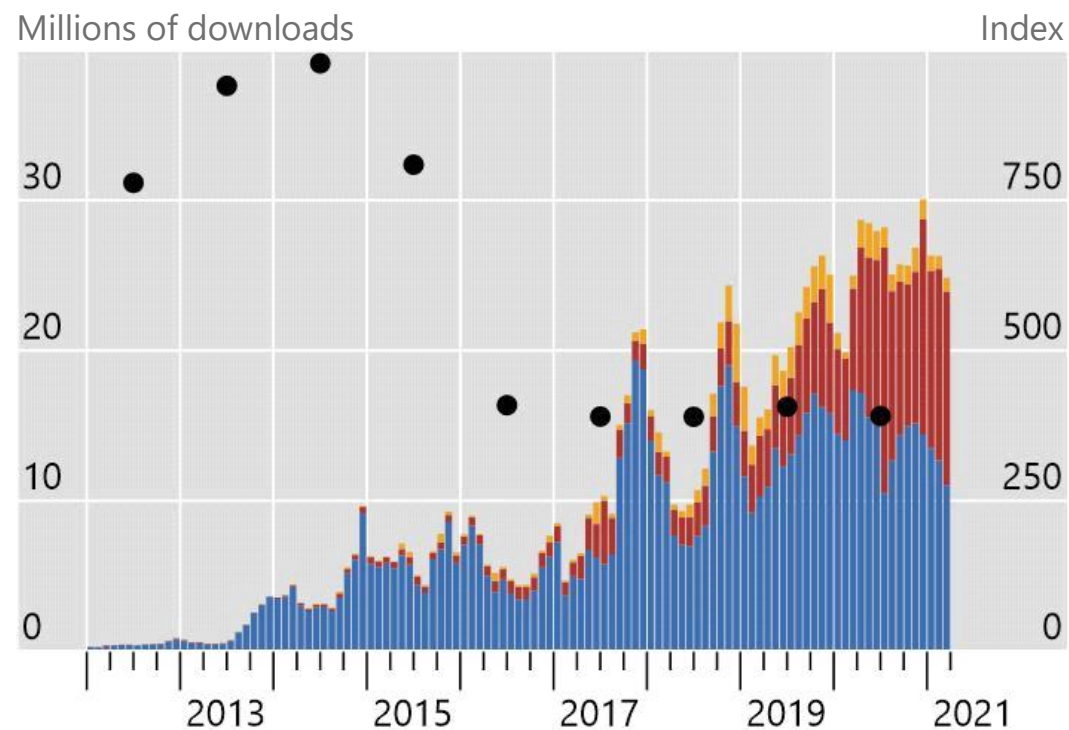
### Advanced economies



Payment app downloads (lhs): ■ Big tech ■ Fintech

Sources: Sensor Tower; authors' calculations.

### Emerging market economies



■ Incumbent financial institutions ■ Big tech ■ Fintech

Rhs: ● HHI

HHI = Herfindahl-Hirschman Index of market concentration

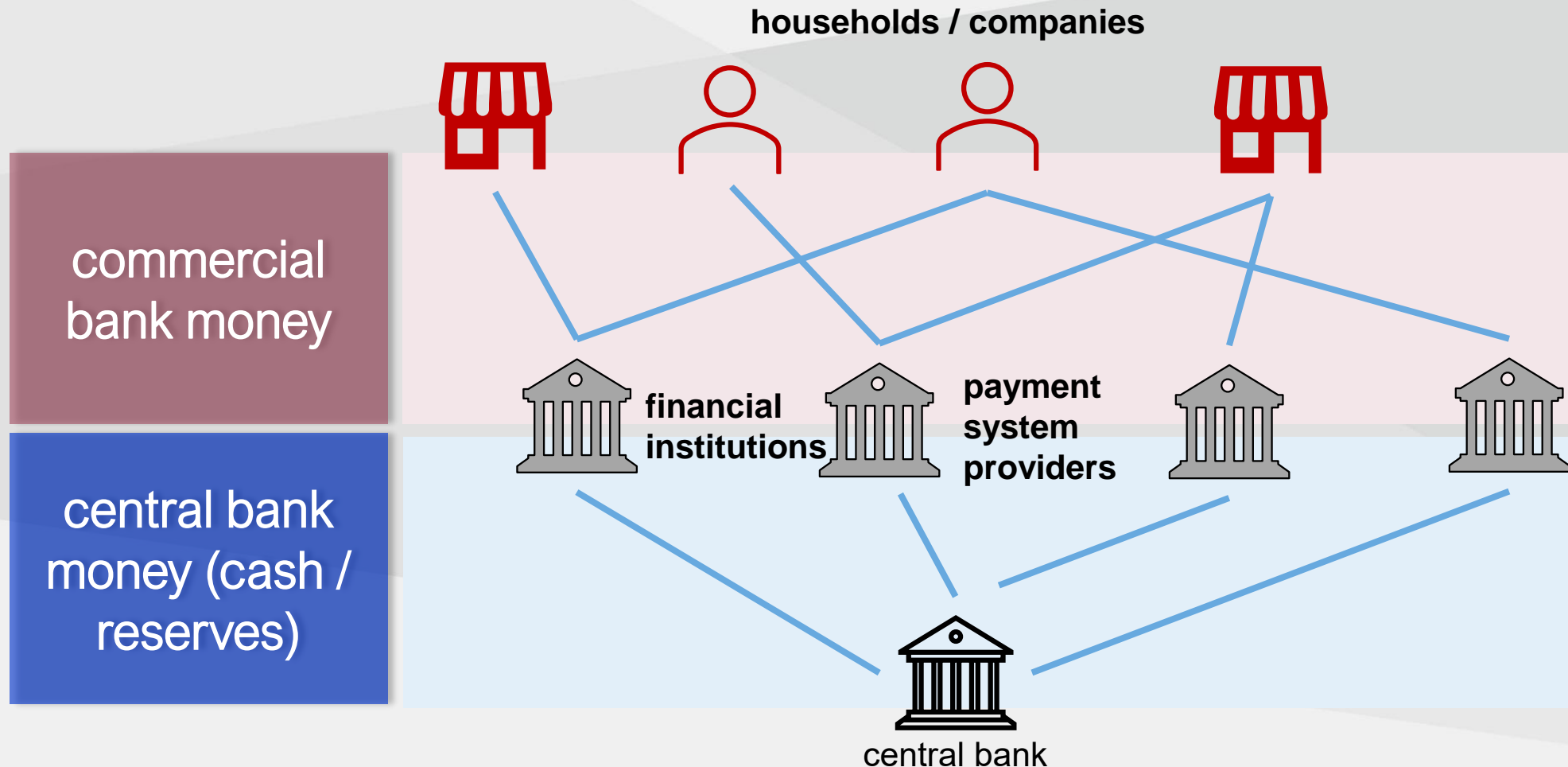
# Overall benefits and risks of digital platforms in finance

Potential benefits	Potential risks
<p>+ Financial inclusion</p> <ul style="list-style-type: none"> <li>❑ Credit scoring techniques based on machine learning and big data outperform traditional models (Frost et al, 2019; Gambacorta et al, 2019)</li> <li>❑ Platform credit serves households and SMEs that are otherwise unbanked (Luohan Academy Report, 2019)</li> </ul> <p>+ Monitoring and collateral</p> <ul style="list-style-type: none"> <li>❑ Vendors have high switching costs, easier to enforce loan repayment with threat or exclusion</li> <li>❑ Platform credit does not require collateral, asymmetric information problems are solved by the use of data</li> </ul>	<p>– Market Power</p> <ul style="list-style-type: none"> <li>❑ Platforms can become dominant, consolidate their position by raising barriers to entry</li> <li>❑ Big techs can favour the distribution of their own products at the expense of third party providers</li> </ul> <p>– Misuse of data and digital monopolies</p> <ul style="list-style-type: none"> <li>❑ Price discrimination and rent extraction</li> <li>❑ Exclusion of high risk groups from socially desirable insurance markets</li> <li>❑ Sophisticated algorithms used to process the data could develop biases (Fuster et al, 2019)</li> </ul>

**How is this relevant for central banks?**

# Basis of today's payment system

1. Two-tiered system
2. Fungibility



## Two-Tiered System

**Central bank** typically

- issues **reserves** and **cash**
- provides **settlement accounts** for ultimate and final settlement
- acts as **operator, catalyst, overseer** in a payment system

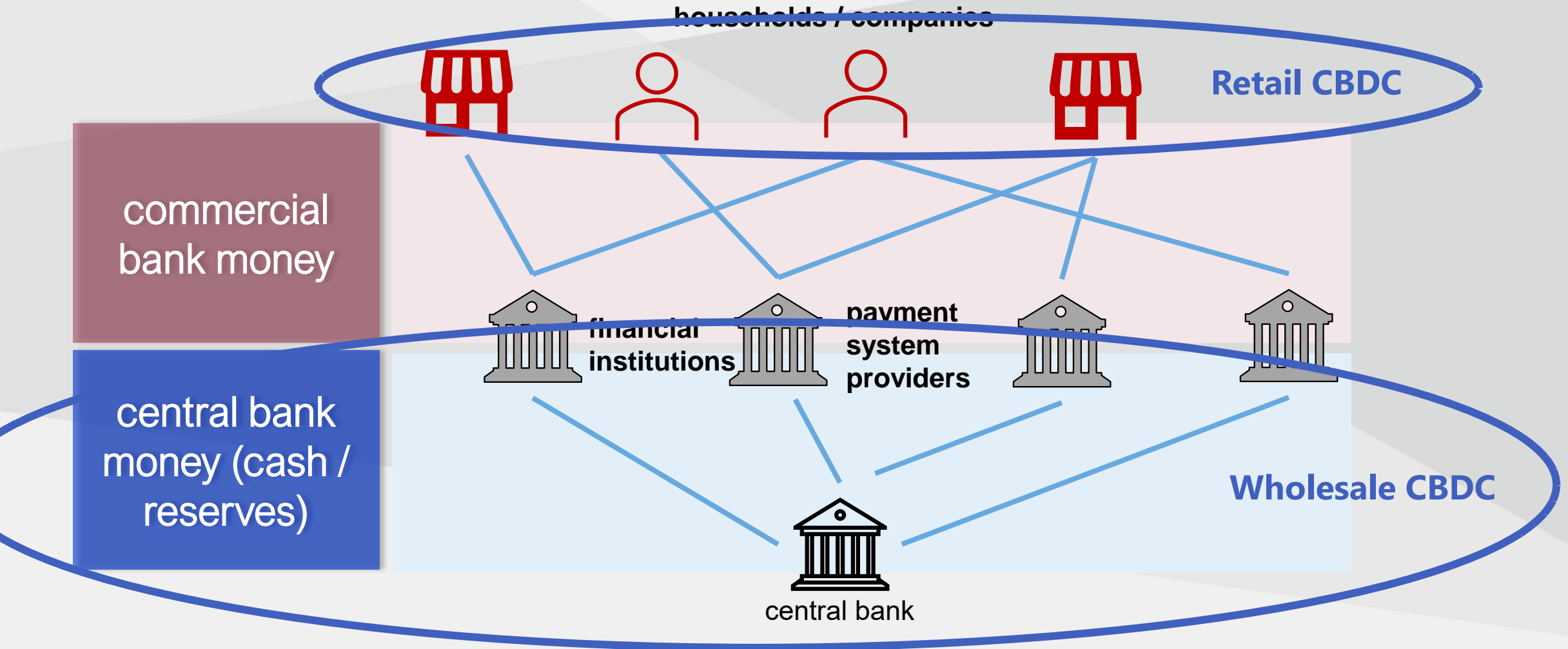
# Fungibility

## Ensuring integrity

- **lender** of last resort
- deposit **insurance** schemes
- **capital** and **liquidity** requirements

# Central bank digital currencies

# CBDCs: addressing (potential) future needs





# One equation to explain CBDC

$$\text{CBDC} = \text{MM}_0\text{GA}$$

**The right-hand side is short for**

**$MM_0GA =$**

**Making  $M_{\text{zero}}$  Great Again**  
**(central bank money)**

# Recall central bank money is ...

$$M_0 = \text{Cash} + \text{Reserves}$$



The diagram illustrates the components of central bank money (M<sub>0</sub>). It shows the equation M<sub>0</sub> = Cash + Reserves. The 'Cash' component is represented by an icon of a stack of banknotes. The 'Reserves' component is represented by an icon of a classical building with columns, a pediment labeled 'CB' (Central Bank), and a large dollar sign on its facade.

# Cash is not the answer for the future ...



# Base money for the future

$$1) M_0^{\text{Future}} = \emptyset$$

$$2) M_0^{\text{Future}} = \text{Reserves}$$
The icon depicts a classical building with columns, representing a central bank. A dollar sign (\$) is positioned in the center of the building's facade. The letters 'CB' are written above the building's roofline.

Reserves

$$3) M_0^{\text{Future}} = r\text{CBDC} + w\text{CBDC}$$

# What are CBDCs?

- A CBDC is a **digital payment instrument**, denominated in the **national unit of account**, that is a **direct liability** of the central bank.
- CBDC is a digital form of central bank money that is **different from balances in traditional reserve or settlement accounts**

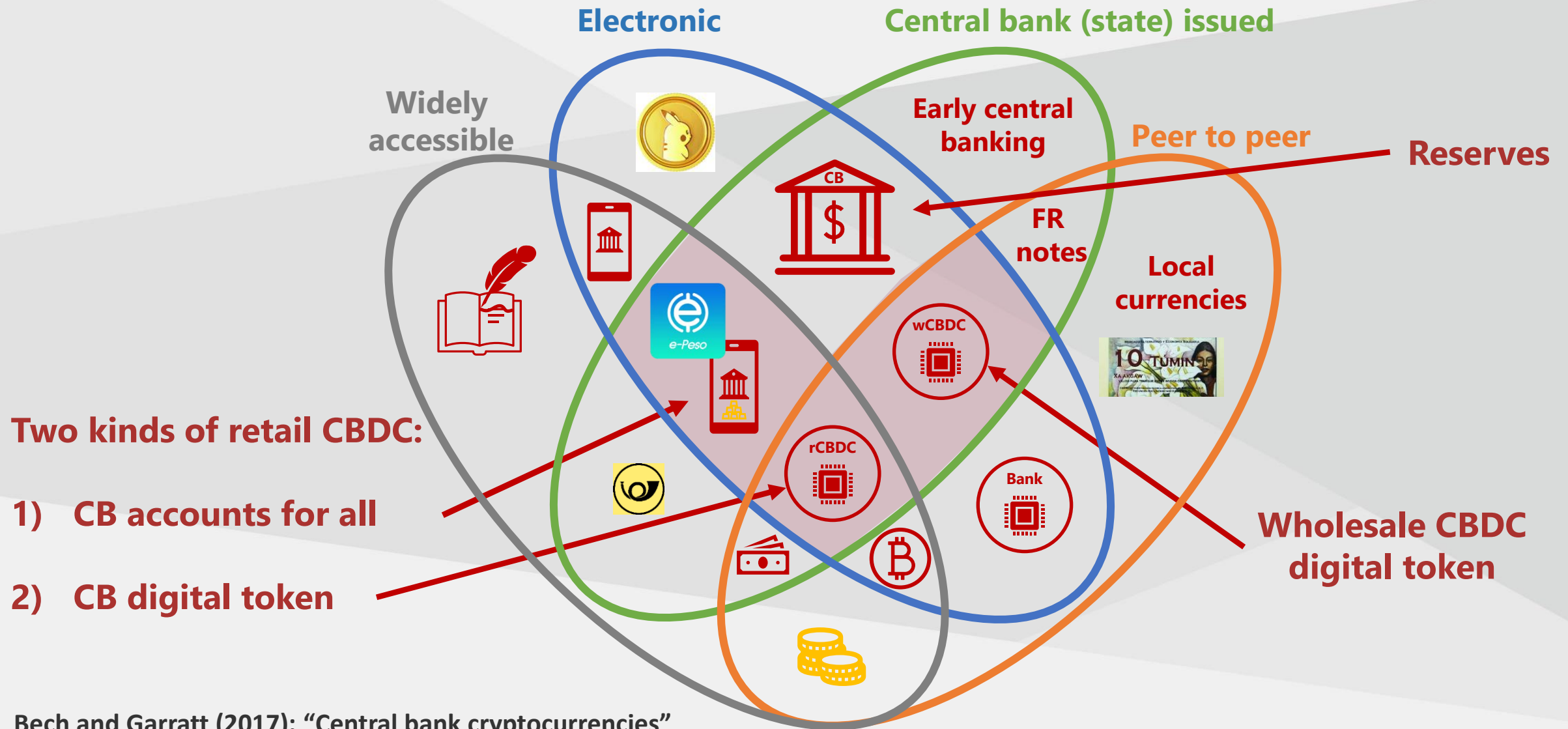
## What sounds like a CBDC but is not?

- A liability issued by a central bank that is not in its own currency



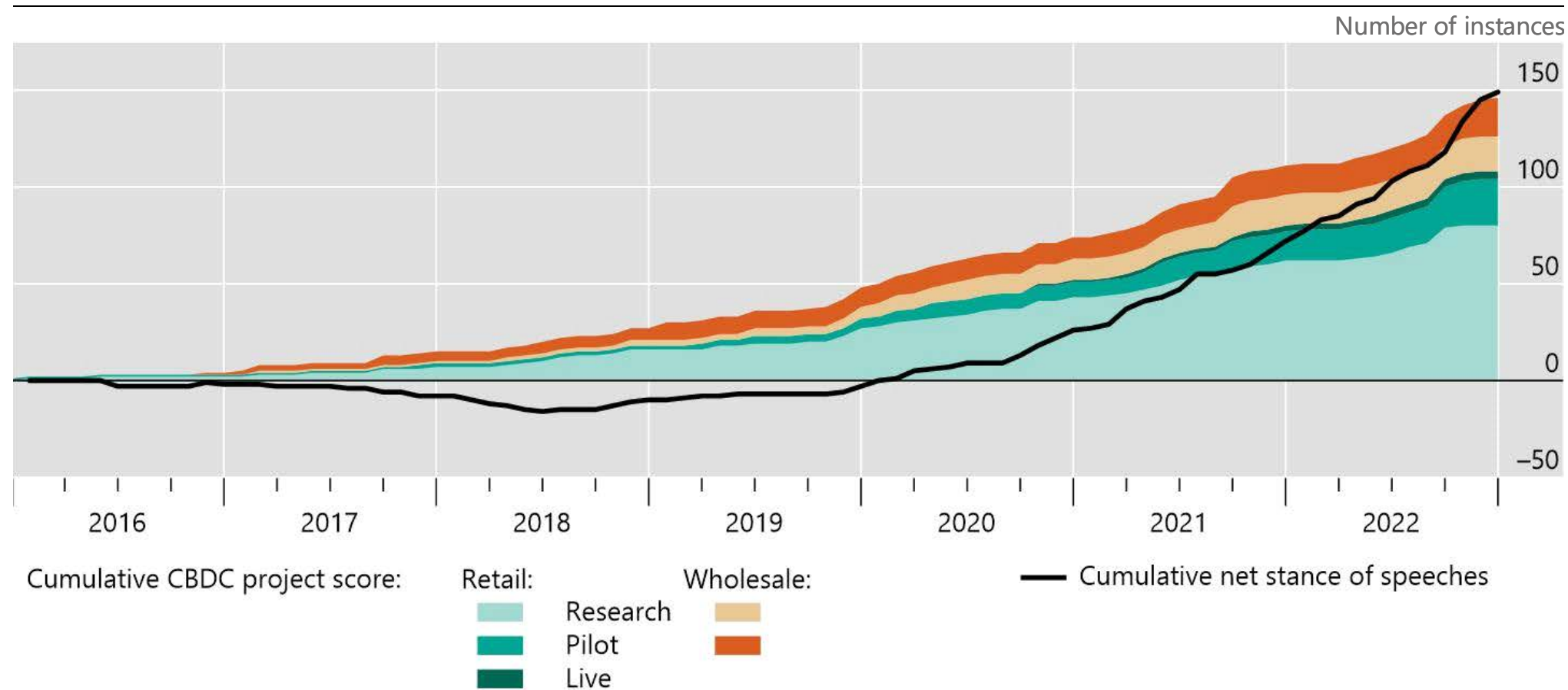
Joint report by The Bank of Canada, ECB, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Federal Reserve Board and BIS (2020)

# Types of CBDCs: The money flower



### Bech and Garratt (2017): “Central bank cryptocurrencies”

## The number of CBDC projects has grown rapidly in the last three years

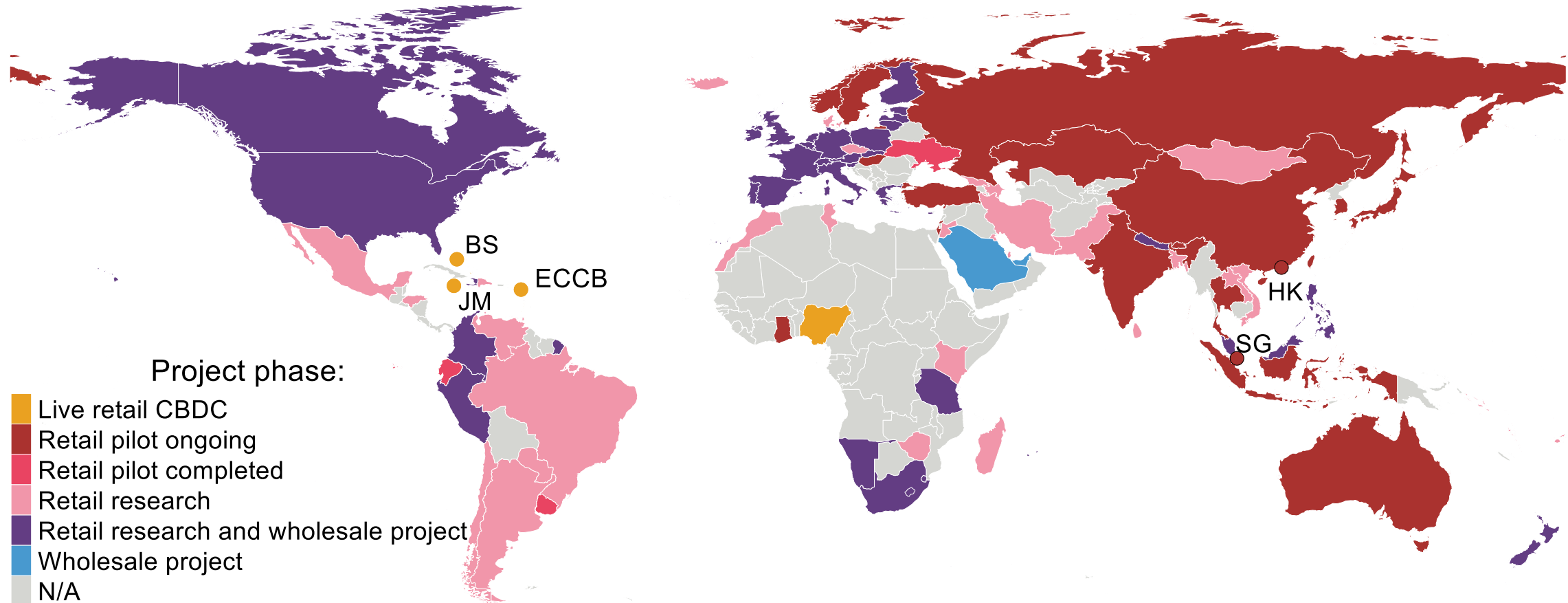


Update 13 January 2023.

Sources: R Auer, G Cornelli and J Frost (2020), "Rise of the central bank digital currencies: drivers, approaches and technologies", *BIS working papers*, No 880, August; central banks' websites.



## CBDC activity – an overview



BS = The Bahamas; ECCB = Eastern Caribbean Central Bank; HK = Hong Kong SAR; JM = Jamaica; SG = Singapore. The use of this map does not constitute, and should not be construed as constituting, an expression of a position by the BIS regarding the legal status of, or sovereignty of any territory or its authorities, to the delimitation of international frontiers and boundaries and/or to the name and designation of any territory, city or area. Update 13 January 2023.

Source: R Auer, G Cornelli and J Frost (2020), "Rise of the central bank digital currencies: drivers, approaches and technologies", *BIS working papers*, No 880, August.

# Why wholesale CBDC?

**Might need a wCBDC, if the private sector**

- **moves to tokenised securities /security tokens**
- **moves to tokenised deposits / deposits tokens**
- **can't improve cross-border payments**

# Why retail CBDC?



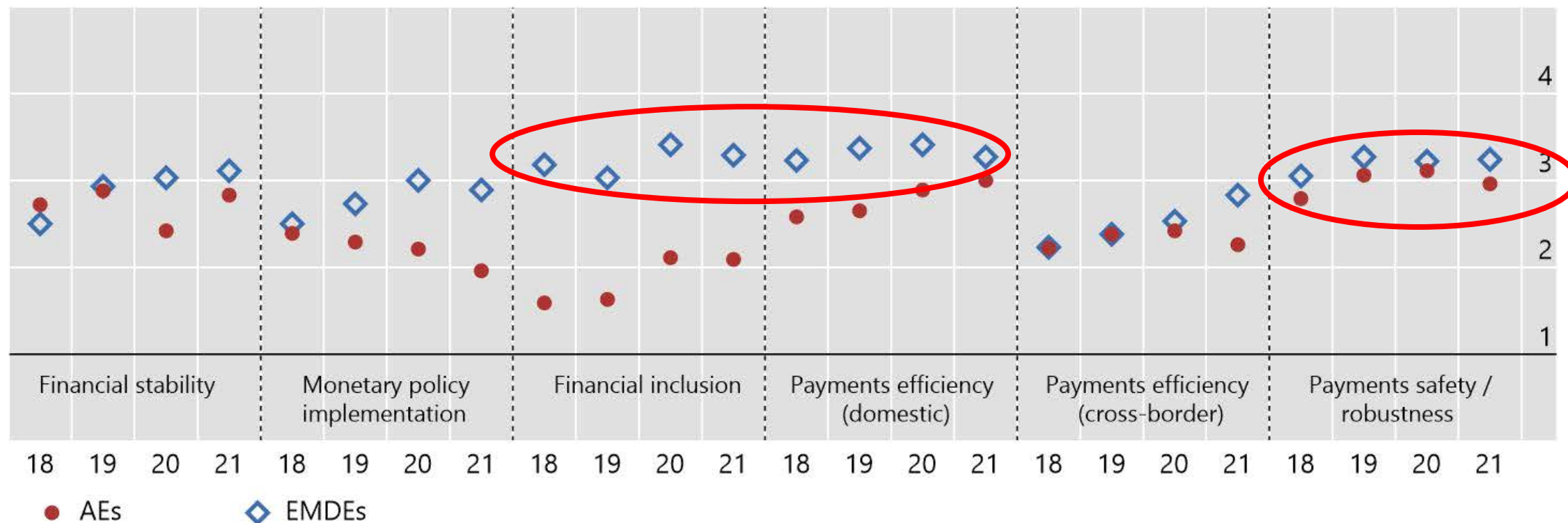
Even if the precise **use cases are not yet definitively fixed**, there are **several material reasons** to consider the issuance of a **digital euro**

1. preserve the **accessibility and usability of central bank money**,
2. support our **monetary sovereignty**,
3. support the **strategic autonomy** of the European continent

*Central bank digital currency (CBDC) and bank intermediation in the digital age – Speech 12 July 2022*

## Why CBDCs? Many central banks, many motivations

*Motivations for retail CBDC; (4) = very important; (1) = not so important*



Source: CPMI survey; Kosse and Mattei (2022).

## **Annex: the BIS Innovation Hub**

# What is the BIS Innovation Hub?



+



~



# Global force for innovation





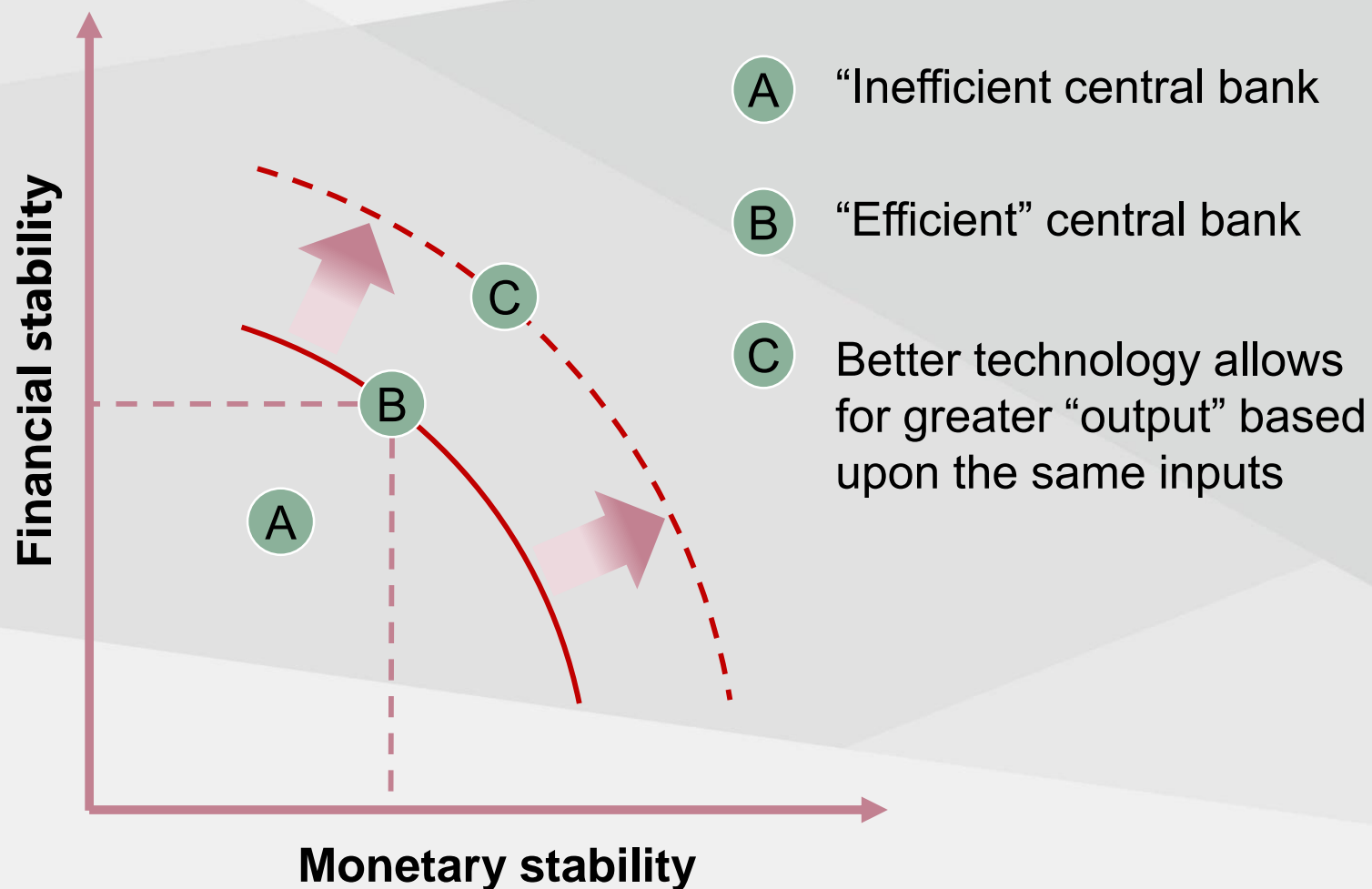
# BISIH strategic themes



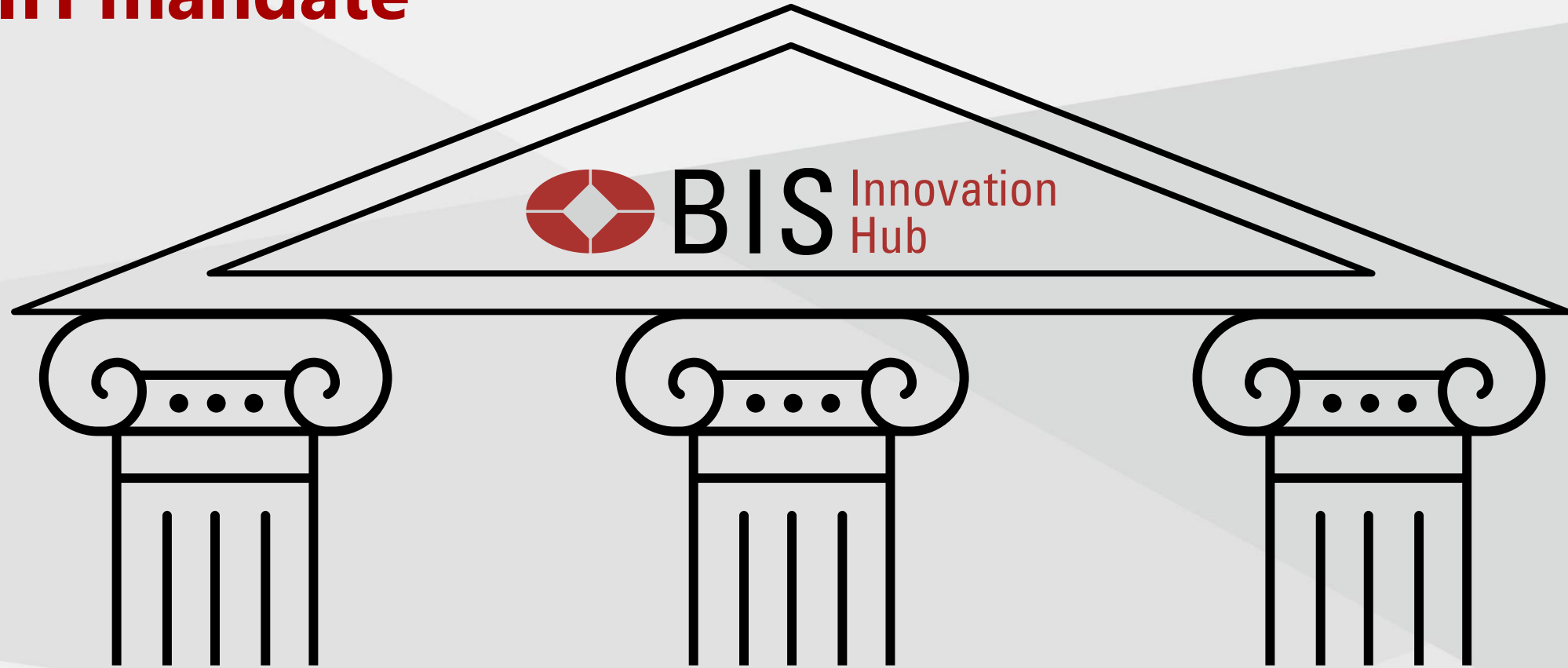




# What we do? - use technology/innovation to enhance monetary and financial stability



# BISIH mandate

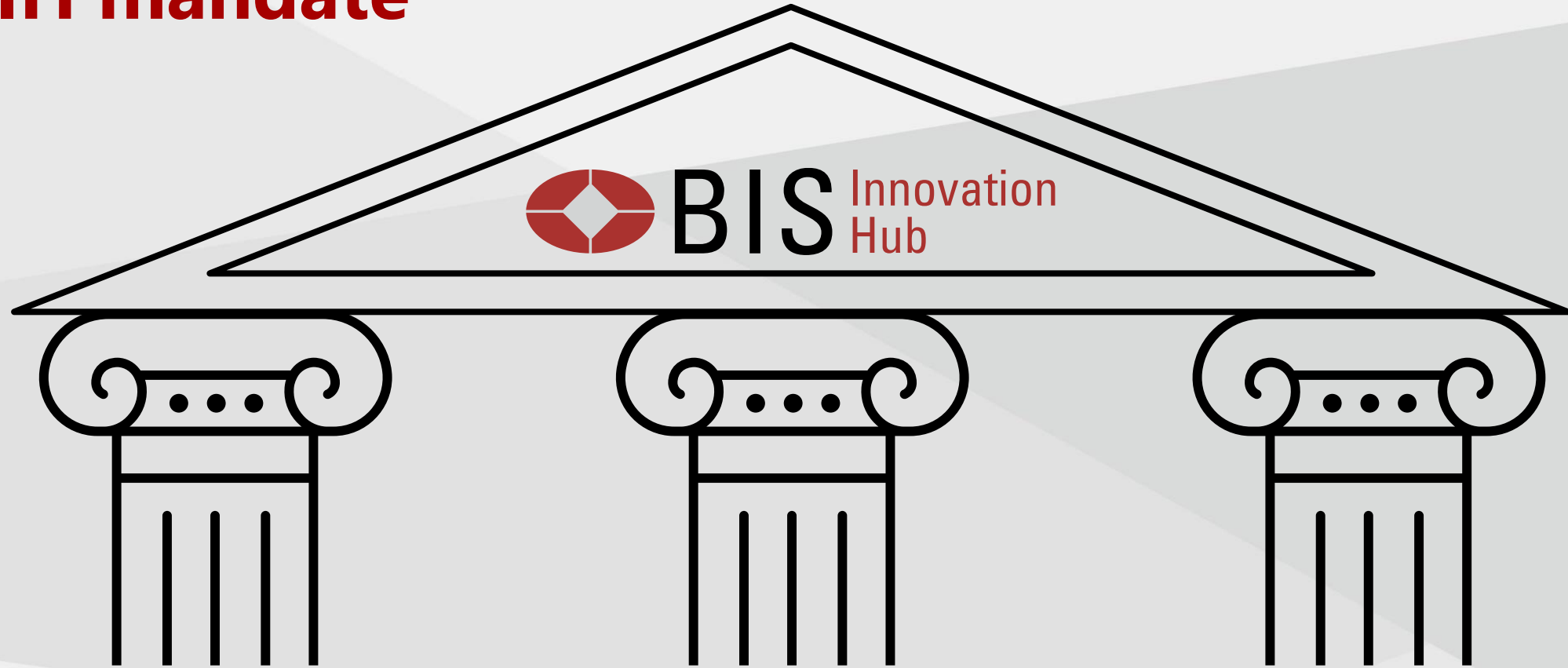


**Horizon  
scanning of  
technologies**

**PoCs and  
prototypes**

**Focal point  
central bank  
innovation**

# BISIH mandate



**Horizon  
scanning of  
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**PoCs and  
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**Focal point  
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Helvetia and Jura overviews

## Why: Looking toward a future with more tokenised financial assets based on DLT

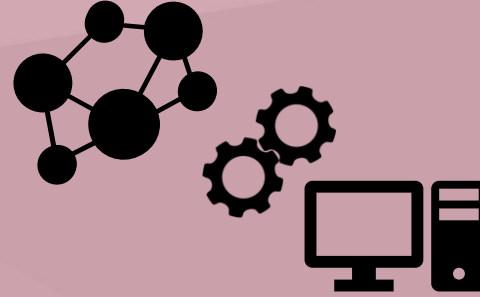


Understand the potential changes brought about by DLT and tokenised assets



Prepare central banks for a “tokenised” future

- Offer settlement in wCBDC
- Extend monetary policy implementation



Explore interoperability between DLT-based and traditional systems

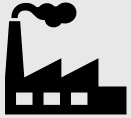


Address shortfalls in today’s cross-border settlement

- Facilitate PvP settlement
- Simplify transaction chains



## How: Conditions and requirements



Realistic experiment...

- Use test environments of production systems (Helvetia)
- Conduct real-value transactions (Jura)



... building on SDX platform ...

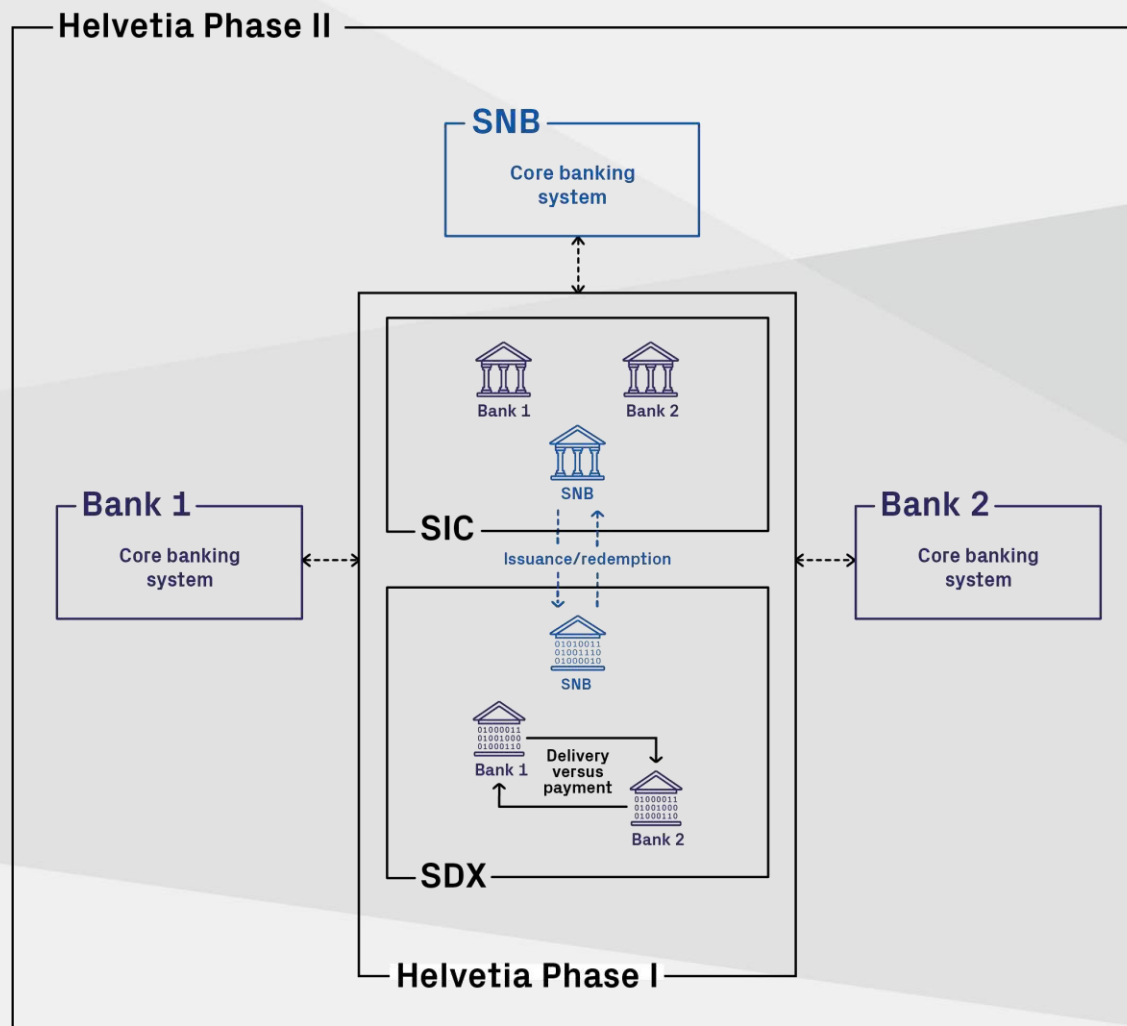
- Issuance of a wCBDC on a platform operated and owned by a third party
- Mechanisms and arrangements assuring central bank control and monitoring capabilities



... and sensible requirements

- Access criteria, remuneration and value date rules identical to those for traditional reserve balances (Helvetia)
- Workable in today's financial system

# How: Solution design of Project Helvetia



## Phase I built on the test environments of...

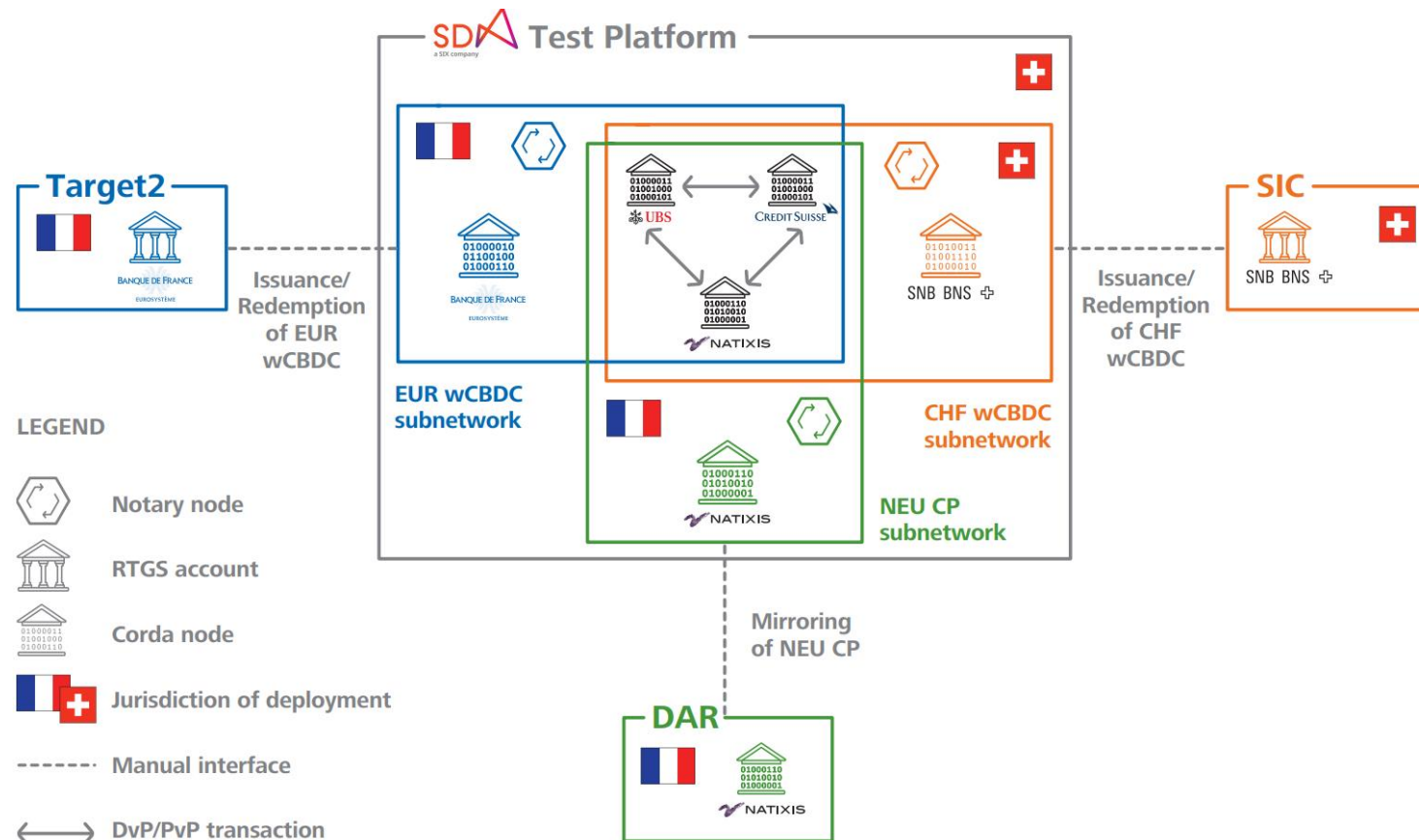
- ...the Swiss real-time gross settlement system, the SIC system;
- ...SIX Digital Exchange (SDX), an infrastructure for the trading and settlement of tokenised assets.

## Phase II expanded on Phase I by...

1. ...adding five commercial banks to the experiment – Citi, Credit Suisse, Goldman Sachs, Hypothekarbank Lenzburg and UBS;
2. ...integrating wCBDC into the core banking systems of the central bank and commercial banks;
3. ...testing the settlement of transactions from end to end;
4. ...identifying necessary control and monitoring capabilities for the central bank.



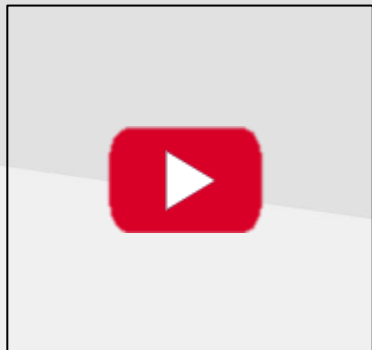
# How: Solution design of Project Jura



- Single multi-currency and multi-asset platform
- Direct access to intraday wCBDCs for resident and non-resident banks
- Central bank control and monitoring functionalities on subnetwork level
- Novel dual-notary signing functionality enables cross-subnetwork settlement
- Deployment of subnetworks in cloud-based data centres in different jurisdiction

# References

## Helvetia Phase II



[Project Helvetia Phase II](#)

[Project Helvetia Phase II: Overview – YouTube](#)

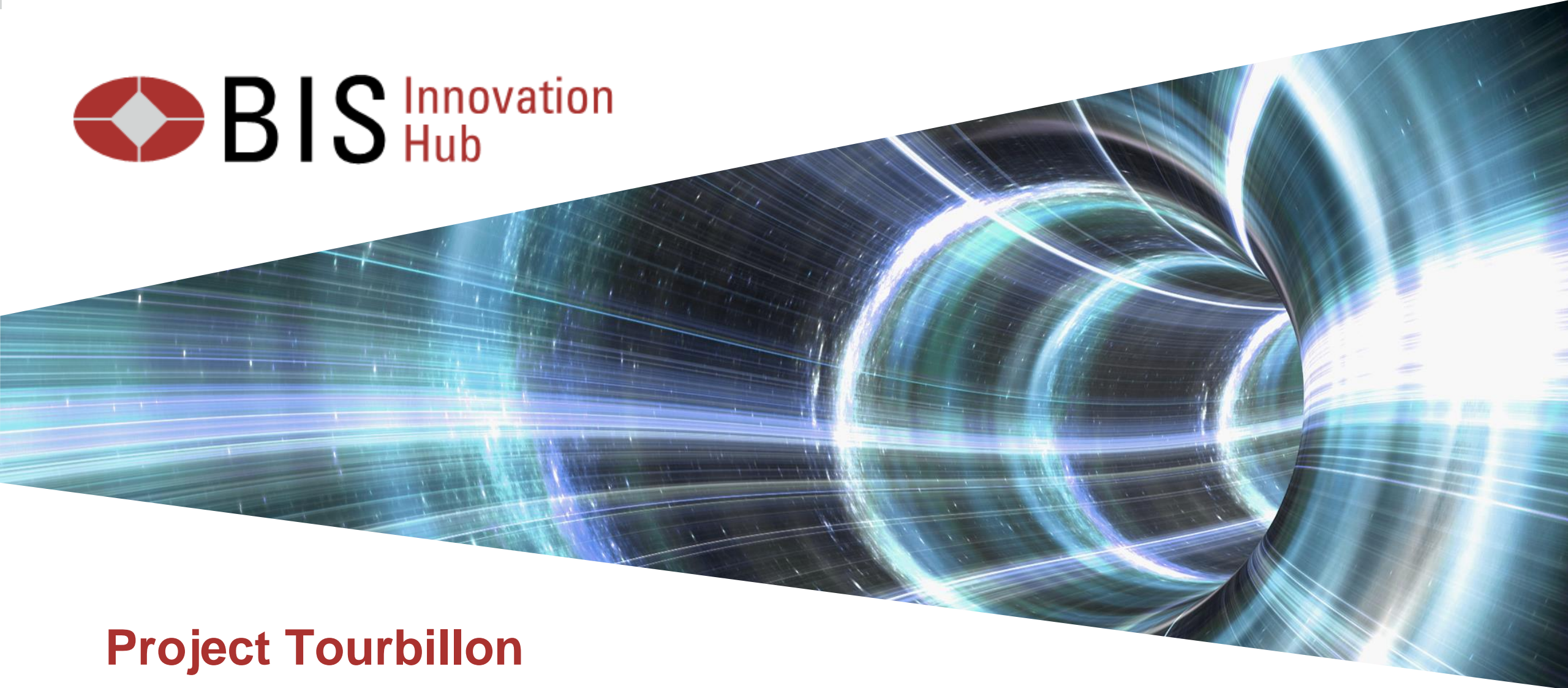
## Jura

[Project Jura](#)

[Project Jura - Cross-border settlement using wholesale CBDC – YouTube](#)

# Lessons learned

- **Wholesale – A (comparatively) small step**
  - Mostly about technology – domain of an innovation hub
    - The exception is access for foreign entities
- **Retail – A giant leap**
  - Complex policy and design questions
    - Not just a question for the central bank
  - Central bank will not enjoy bank note like monopoly
    - Competition with private digital monies
      - Live rCBDC adoption is low
- **Cross border – In the DNA of the BIS**

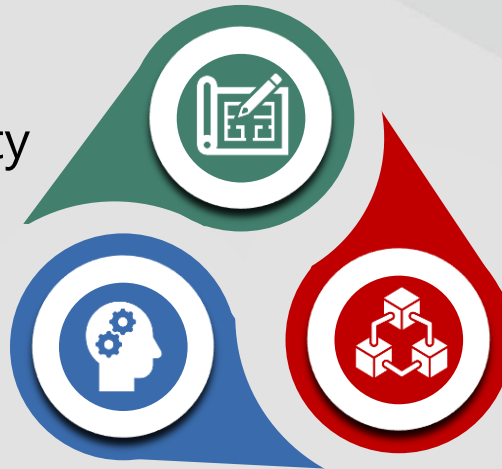


## Project Tourbillon

***Tourbillon =  $f\{design, crypto, research\}$***

**CBDC Design**

Privacy  
Scalability  
Cyber security



**Cryptography**

Blind signatures  
Mix network

**Research capabilities**

Post-quantum cryptography



## Why

### Payment behaviour



# 1'000'000'000'000\*

cashless payments worldwide in 2021  
CPMI member countries

## \*1 trillion

Source: Red Book, BIS.



# Why

## eCash: Ahead of its time?



**eCash**

Original technical team, dated 1994

1996



1997



1997



1997



**1998 company behind eCash  
files for bankruptcy**

WHAT

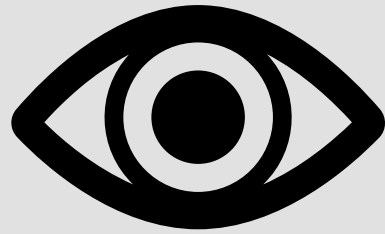
Ahead of its time



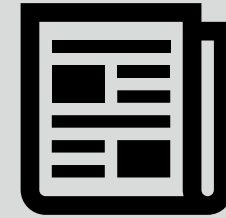
**Electric Car**  
Prototype, 1914



## eCash: Possible reasons for its failure

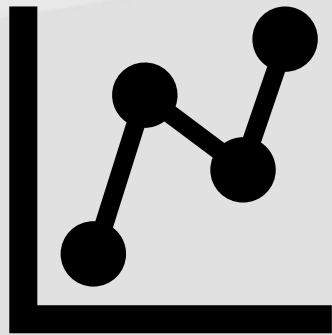


privacy



micropayments

## eCash: Possible reasons for its failure



Data



advertising



privacy-preserving



micropayment

# Why

## Why is privacy important today?

The New York Times

OPINION

### Does the End of Cash Mean the End of Privacy?

March 30, 2022

FINANCIAL TIMES

JS COMPANIES TECH MARKETS CLIMATE OPINION WORK & CAREERS LIFE & ARTS HTSI

Monetary policy [+ Add to myFT](#)

### The end of privacy? Central banks plan to launch digital coins

As regulators crack down on cryptocurrencies, policymakers develop state-run versions

THE WALL STREET

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PRO CYBER NEWS

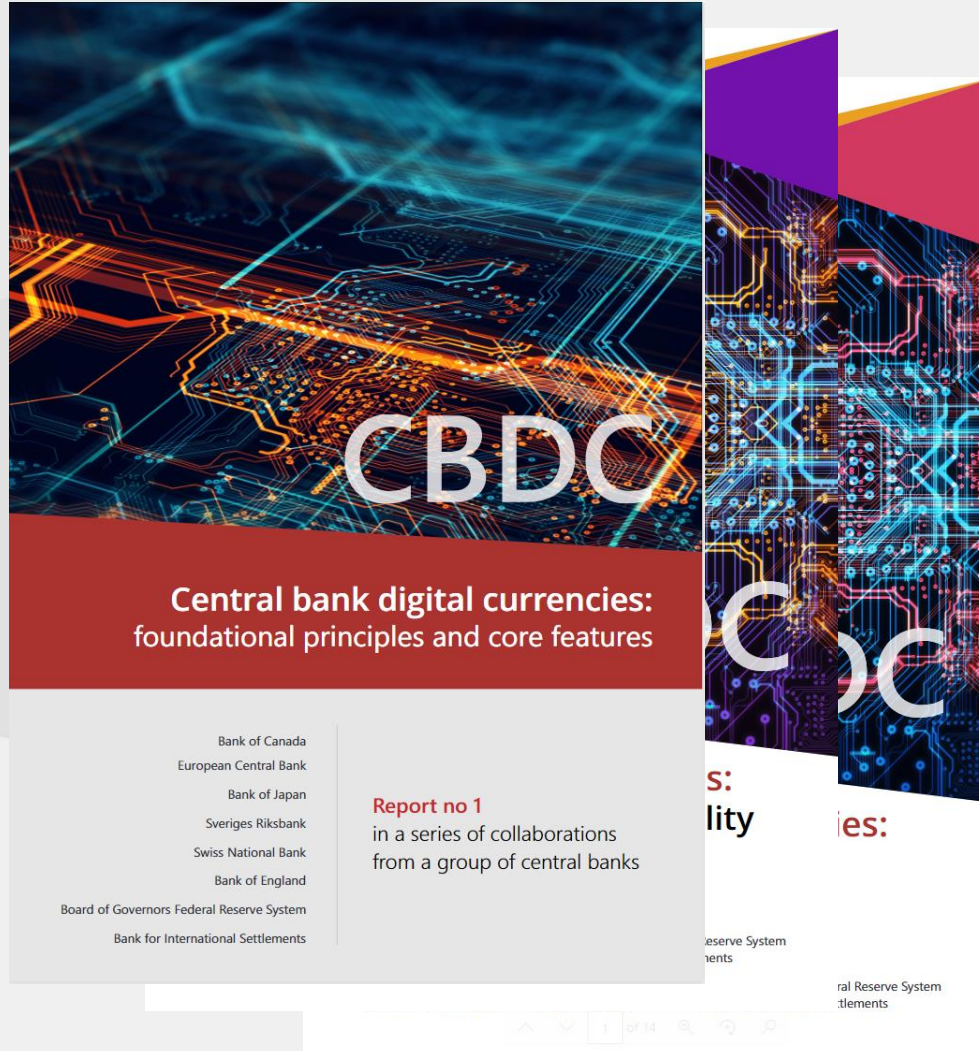
### Surveillance Risks Shape How Central Banks Test Digital Currencies

Race to explore new payment systems highlights trade-offs between performance, privacy and security

SHARE



## CBDCs: New kids on the block

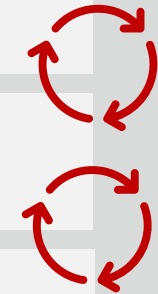


### Core features

Privacy

Scalability

Cyber security



Trade-offs

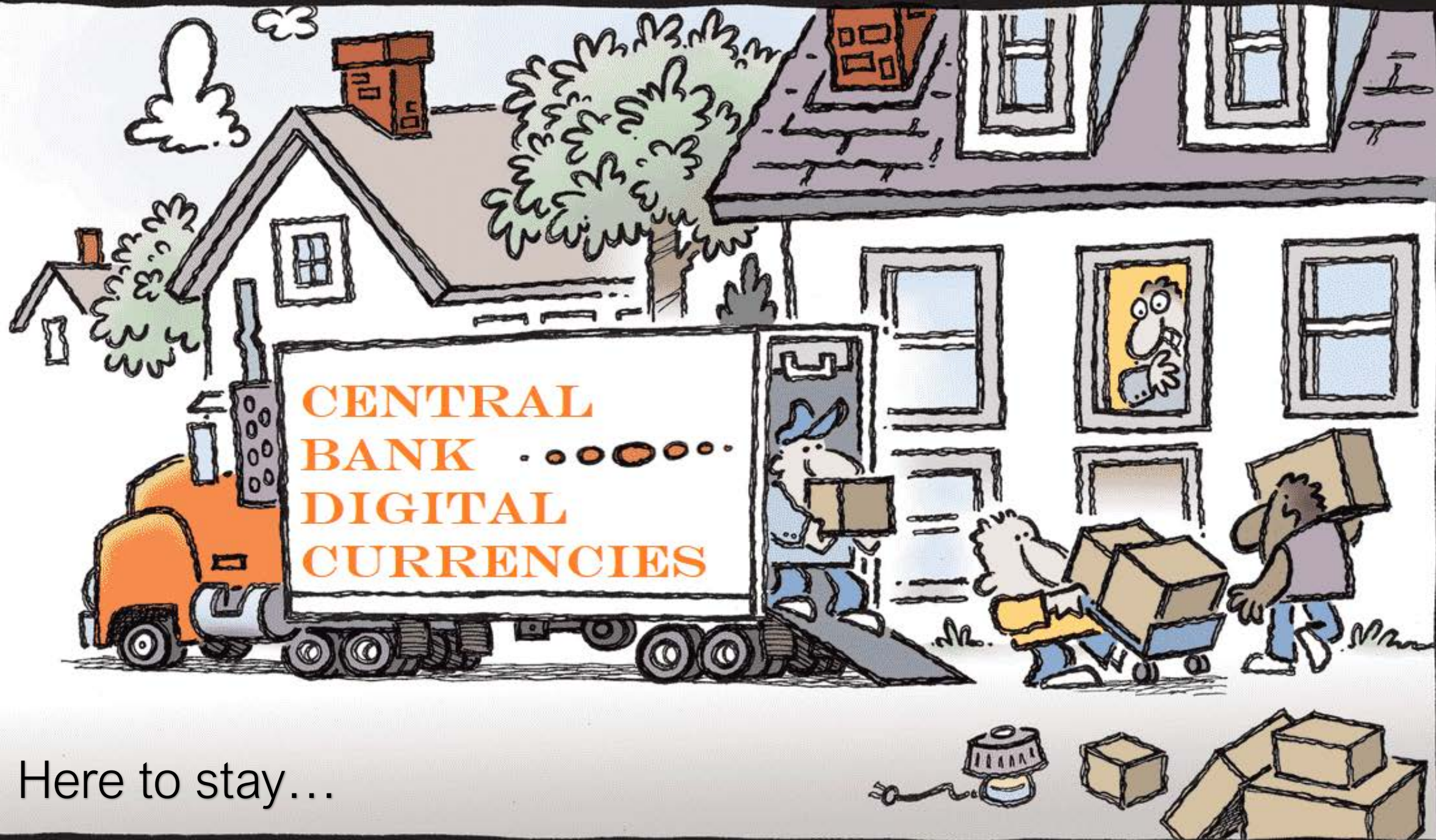
Joint reports by The Bank of Canada, ECB, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors of the Federal Reserve and BIS

# Desirability: Why rCBDC?

Countries	Proponents	Opponents
Developed	<ul style="list-style-type: none"><li>• Trust of public money</li><li>• Monetary sovereignty</li><li>• Strategic autonomy</li><li>• Cross-border payments</li></ul>	<ul style="list-style-type: none"><li>• Solution in search of a problem</li><li>• Disintermediation</li><li>• Financial stability</li><li>• Surveillance state</li></ul>
Developing	<ul style="list-style-type: none"><li>• <b>Financial inclusion</b></li><li>• Remittances</li></ul>	<ul style="list-style-type: none"><li>• Dollarization</li><li>• Offline difficult</li></ul>



\$ Rich — HEDGEYE



Here to stay...