Decentralised finance and CBDCs

Leonardo Gambacorta

Main works used in the presentation

- BIS (2021), "CBDCs: an opportunity for the monetary system", Annual Economic Report, Chapter III, June.

- Gambacorta L (2022), DeFi: opportunities and challenges, ECB/EC virtual conference "An EU financial system for the future", 6 April 2022.

- Auer, R, J Frost, L Gambacorta, C Monnet, T Rice and HS Shin (2022), "Central bank digital currencies: motives, economic implications and the research frontier", Annual Review of Economics (published also as BIS Working Paper, no 976).

- Auer, R, G Cornelli, S Doerr, J Frost and L Gambacorta (2022): "Chained to speculation? Feedback trading in crypto markets", BIS Working Papers, forthcoming.

Disclaimer: The views expressed here are those of the presenter and not necessarily of the Bank for International Settlements.

DeFi: opportunities and challenges

Decentralisation in digital finance: possibilities and limits

- DLT and smart contracts could improve the efficiency of the monetary and financial system

- At the same time, we need to preserve safety and integrity

- DeFi: decentralisation and anonymity

- As it stands now the DeFi system has some problems and could introduce serious risks

    - Limited network effects
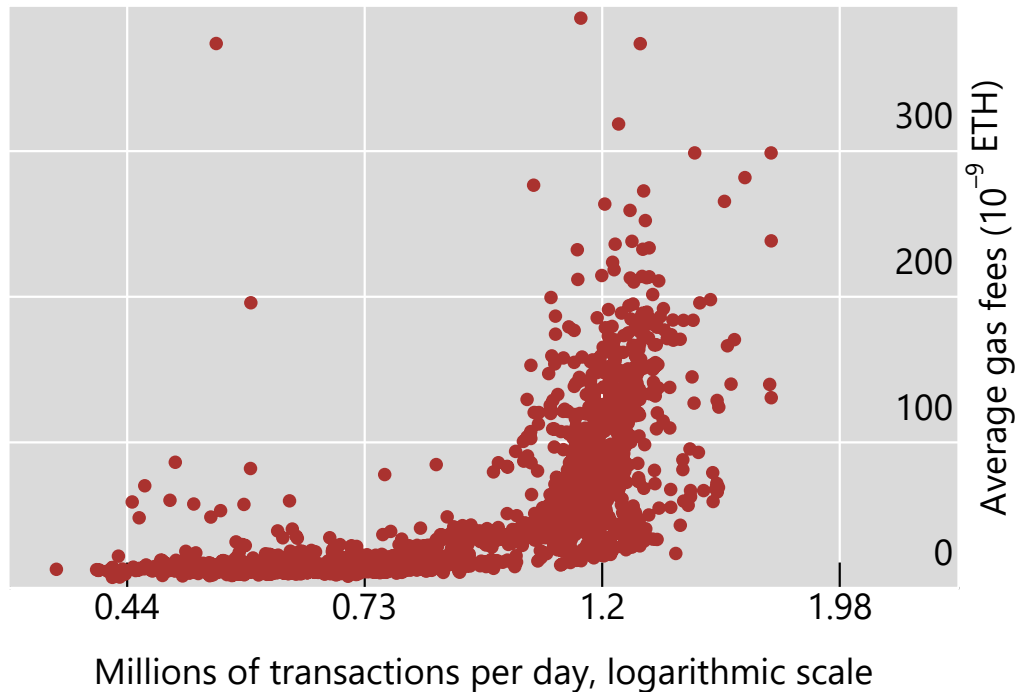   - Prone to congestions
    - Validators extract high rents

Market size of cryptocurrencies and DeFi
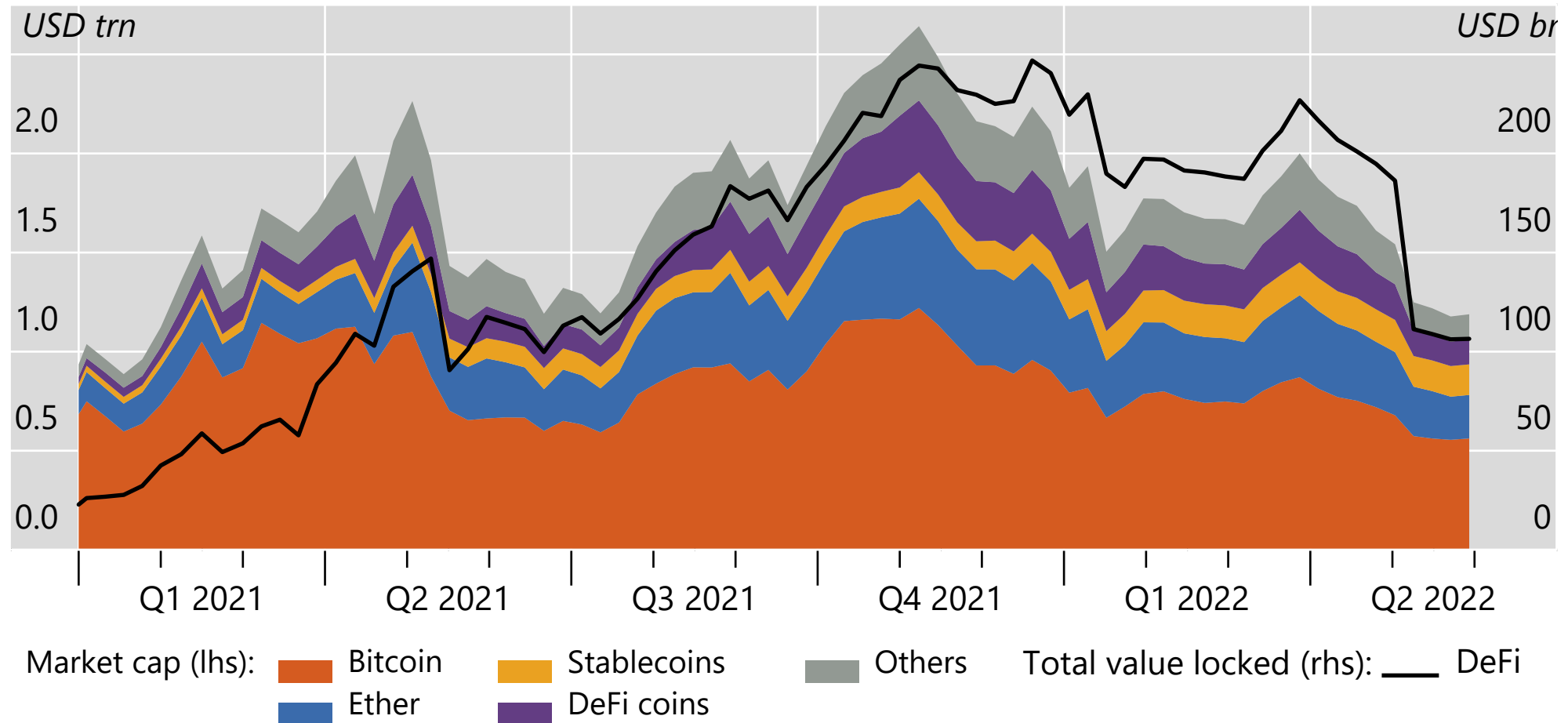
Sources: CoinGecko; DeFi Llama; author's calculations.

Blockchain congestion and fragmentation

Network congestion leads to high fees on the Ethereum network

Average gas fees (10^{-9} ETH)

Millions of transactions per day, logarithmic scale

Fragmentation of layer 1 blockchains

% of total assets locked

Layer 1 networks:
Binance
Solana
Ethereum
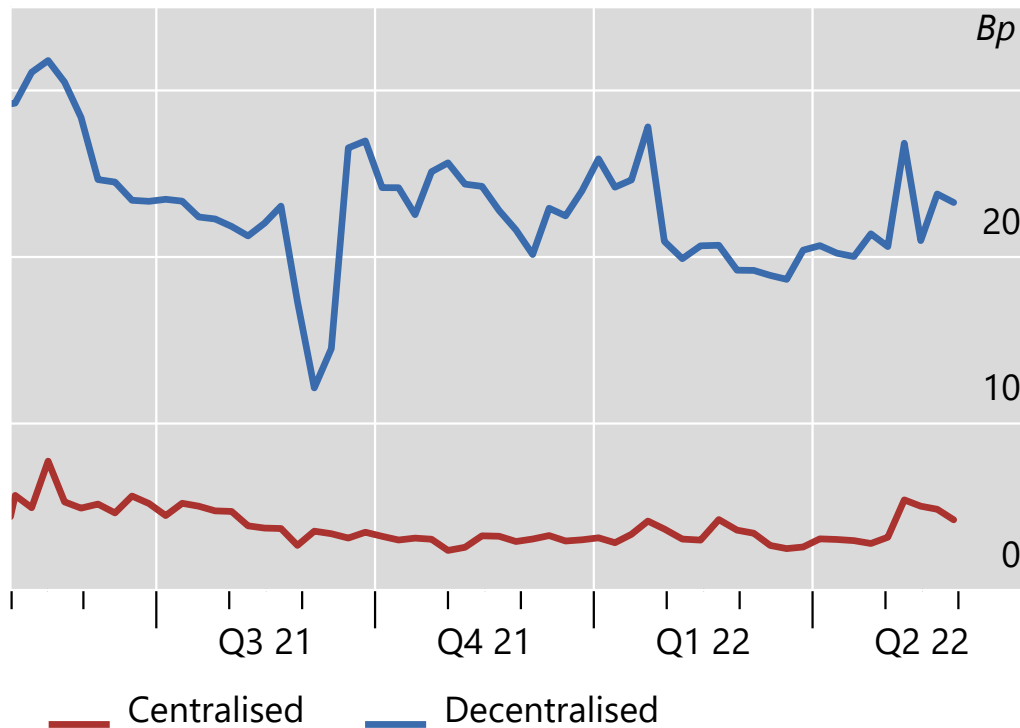Avalanche
Tron
Terra
Fantom

Other layer 1 and 2 networks

Source: F Boissay, G Cornelli, S Doerr and J Frost, "Blockchain scalability and the fragmentation of crypto", *BIS Bulletins*, no 56, June 2022.
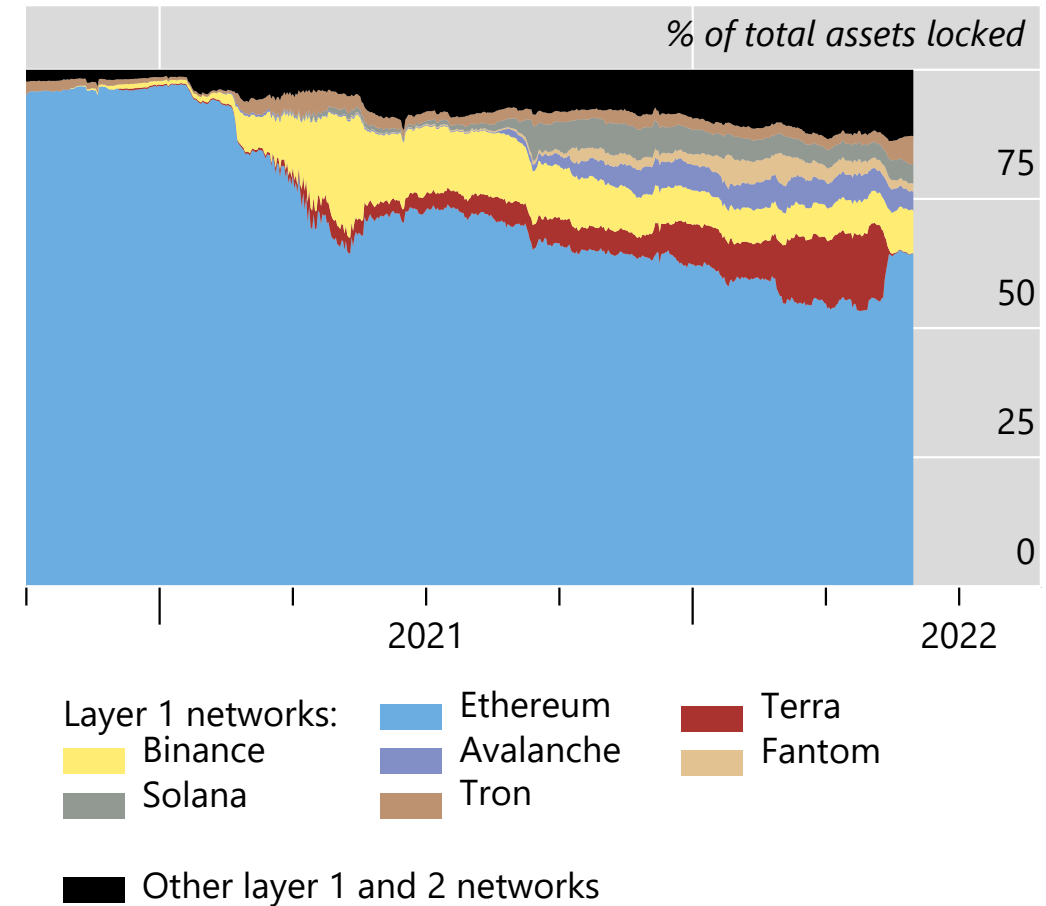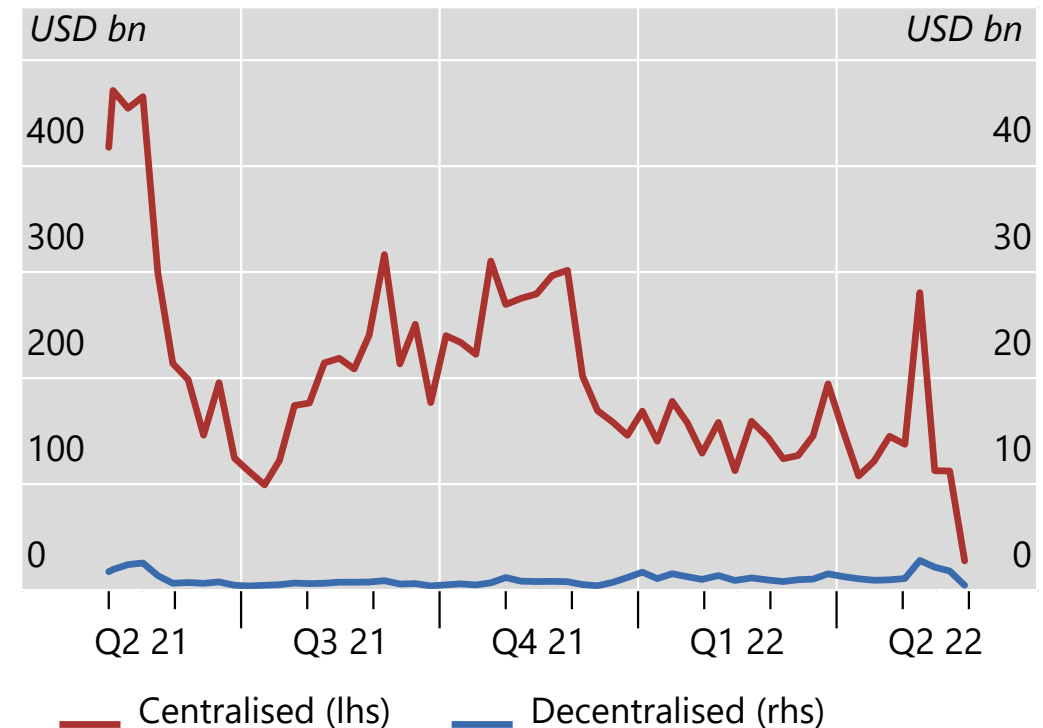
Centralised and decentralised exchanges: costs and volumes

Transaction costs, Tether–ETH pair

Weekly trading volume

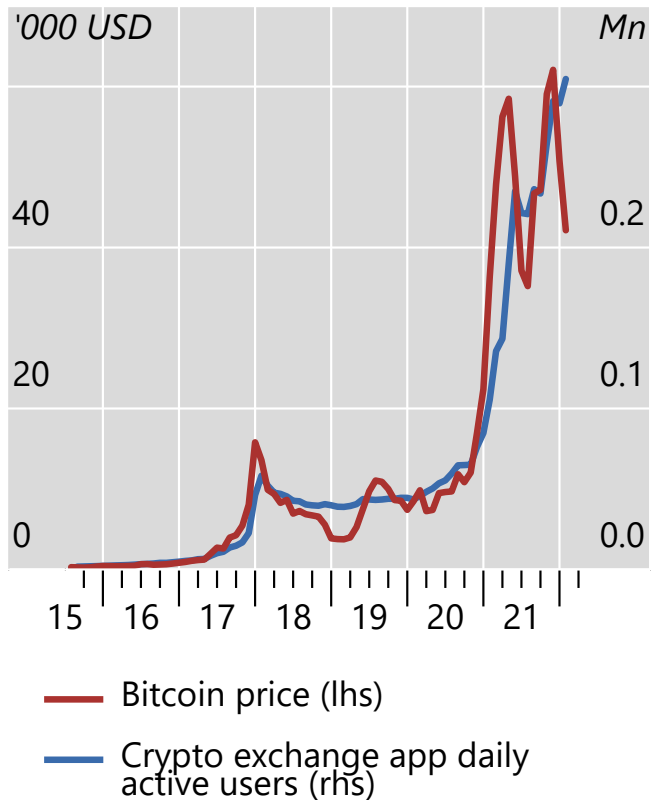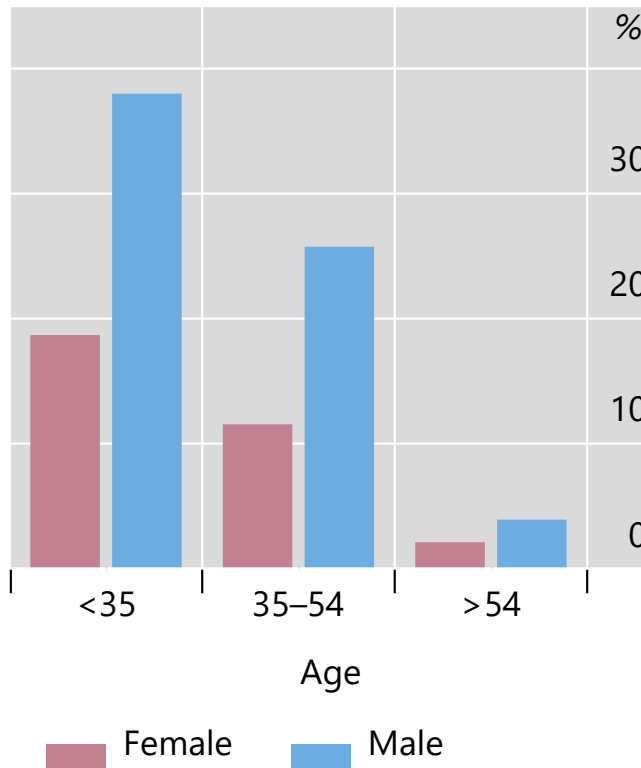# Crypto trading and Bitcoin prices

Retail cryptocurrency adoption is largely fuelled by Bitcoin prices

'000 USD — Mn

- —— Bitcoin price (lhs)
- —— Crypto exchange app daily active users (rhs)

More than one third of crypto exchange app users are young males

%

Age

- ▮ Female ▮ Male

Willingness to take financial risks for US consumers of age 20–79

Index, 1 (lowest)–7 (highest)

Age

- —•— Female —•— Male
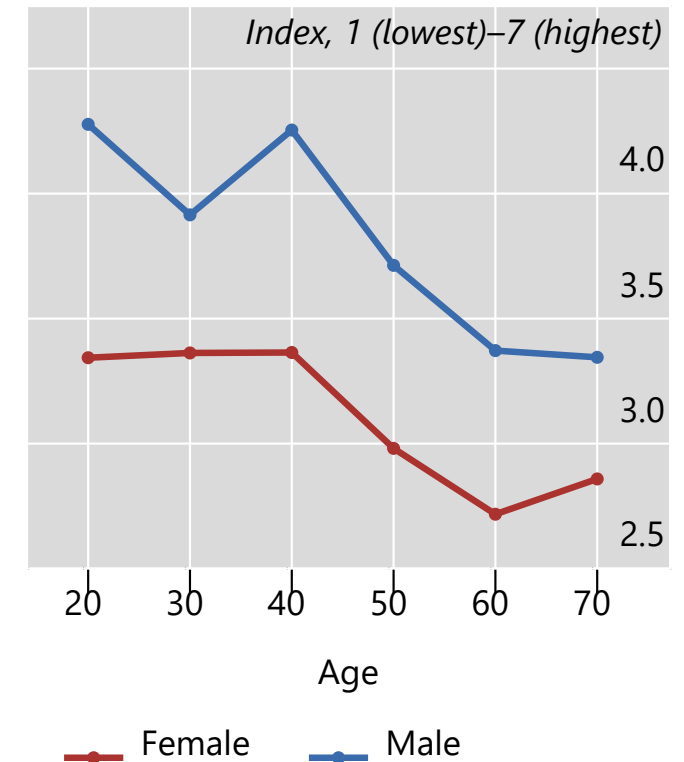
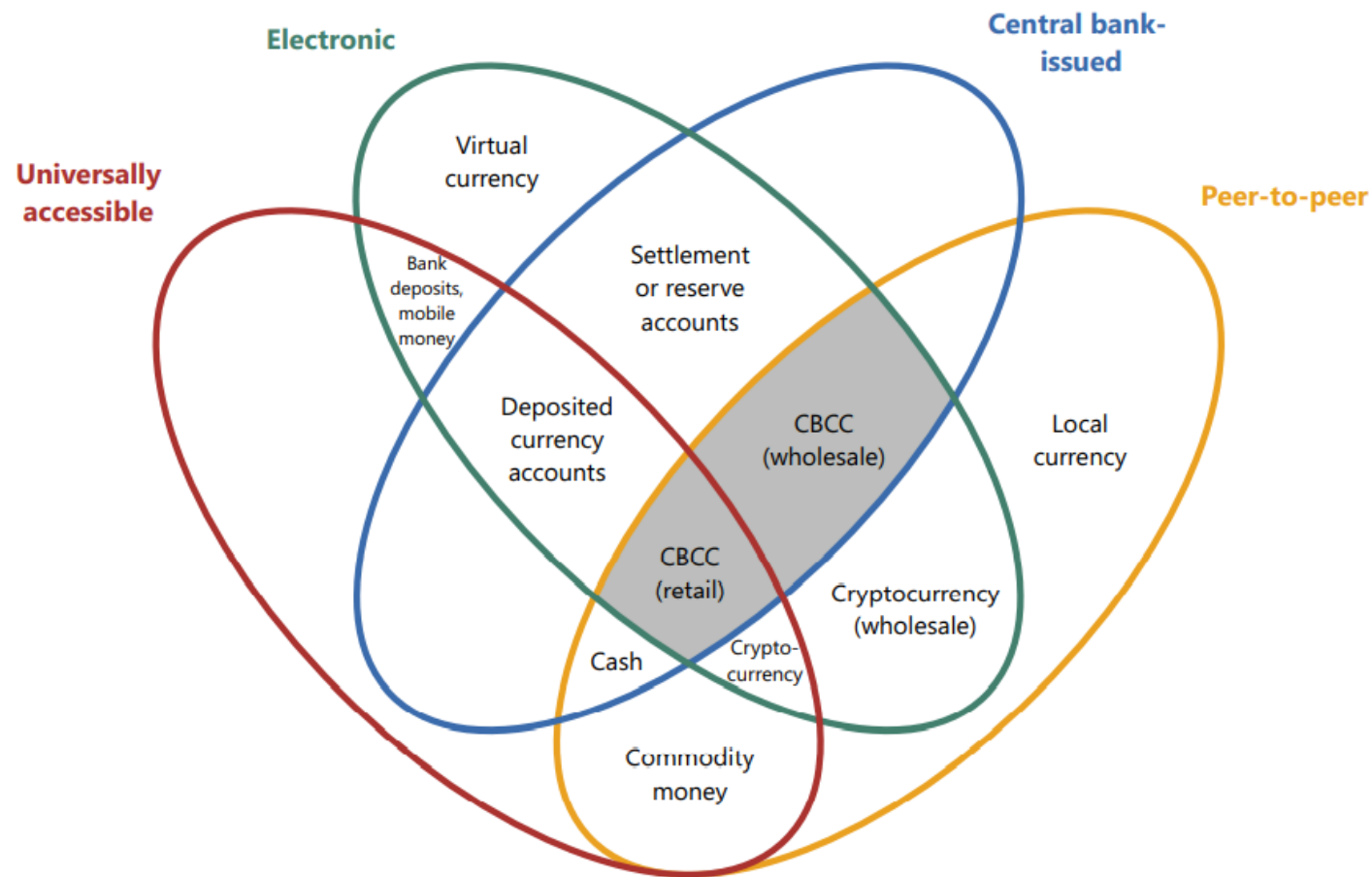Source: Auer, R, G Cornelli, S Doerr, J Frost and L Gambacorta (2022a): "Chained to speculation? Feedback trading in crypto markets", *BIS Working Papers*, forthcoming.

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Central bank foundations for the payment system

Bank B
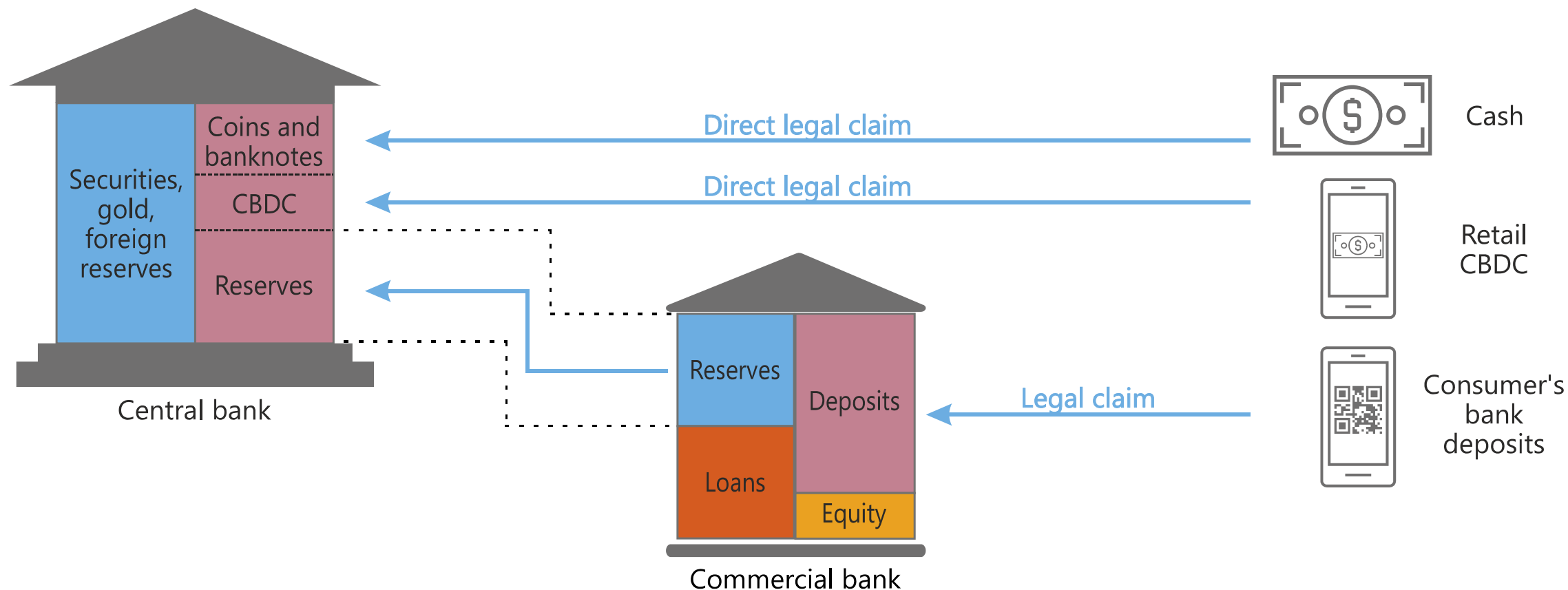
Bank A

PSP
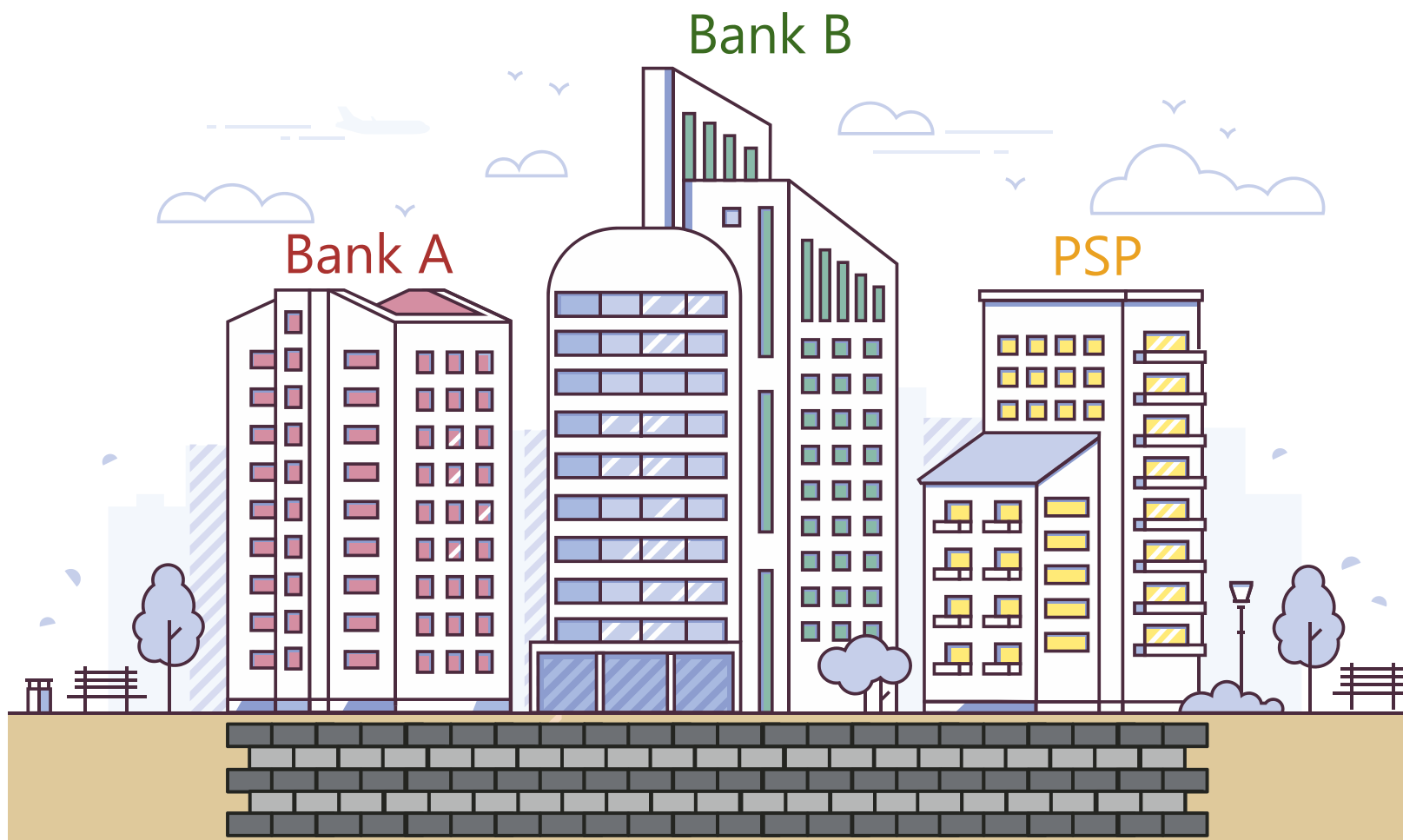
Central bank

Still in full bloom: the money flower

Source: M Bech and R Garratt (2017), "Central bank cryptocurrencies", *BIS Quarterly Review*, September.

An example of a monetary system with retail CBDC and commercial banks

Source: R Auer and R Böhme, "Central bank digital currency: the quest for minimally invasive technology", BIS Working Papers, no 948, June 2021.

CBDCs can be designed to have a limited footprint – like cash today

% of GDP

Legend: Cash in circulation, Bank deposits

Categories: SE, ZA, TR, GB, BR, AU, KR, US, SG, EA, HK, JP

Challenges arising from the centrality of data in the digital economy

Competition

Privacy

Integrity
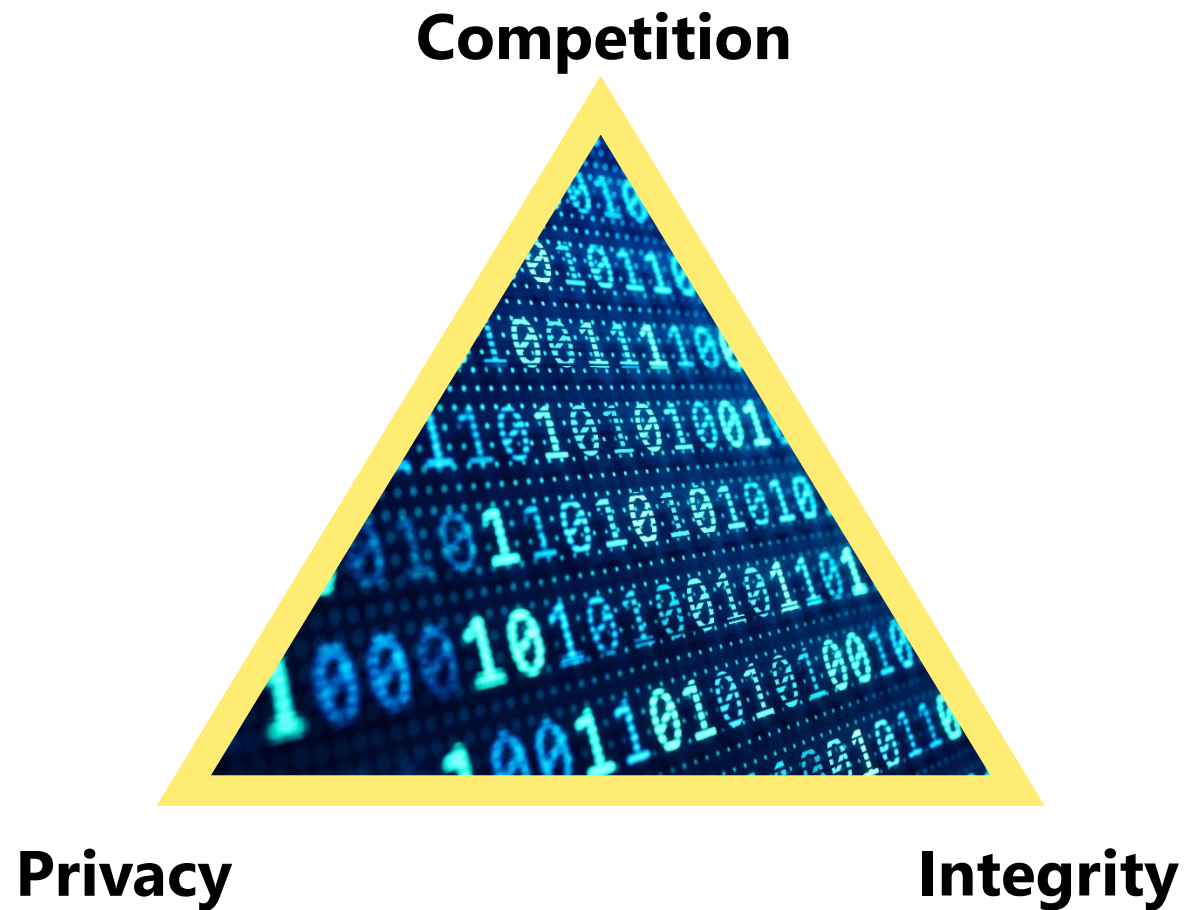
CBDCs in light of
new and emerging
policy issues

1. As cash use falls, digital payments are rising

Use of cash is falling

% of retail transactions

Share of cash in retail transactions: — NL — GB ● EA
— US — JP ● AU
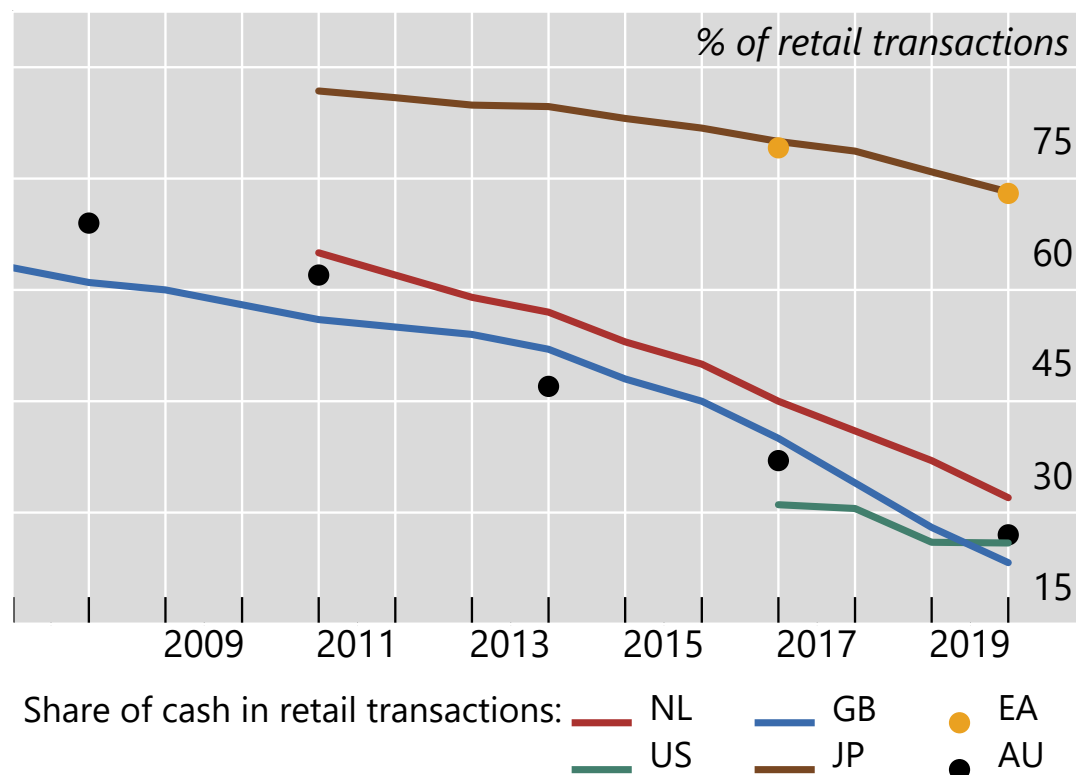
Remote digital payments rose

Ratio

— Median ▮ Interquartile range
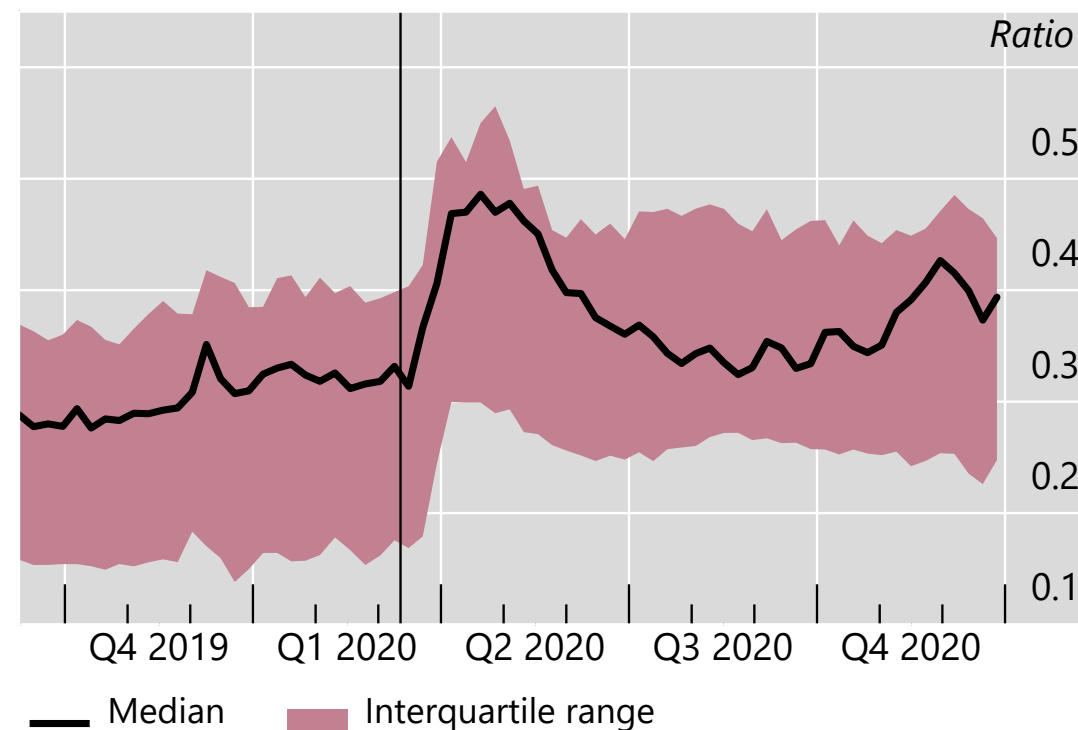
Sources: F Alvarez, R Auer, G Cornelli and J Frost, "The impact of the pandemic on cash and retail payments: insights from a new database", mimeo; central banks' websites; Japan's Ministry of Economy, Trade and Industry; global card networks; BIS calculations.

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2. In spite of technological progress and declining information processing costs, card payments are still more expensive than cash for a €25 transaction

Marginal cost, EUR cents

Legend:
- Merchant service costs
- Front office time
- Back office labour
- Outsourced costs
- Other costs

Categories: Cash, Debit cards, Credit cards
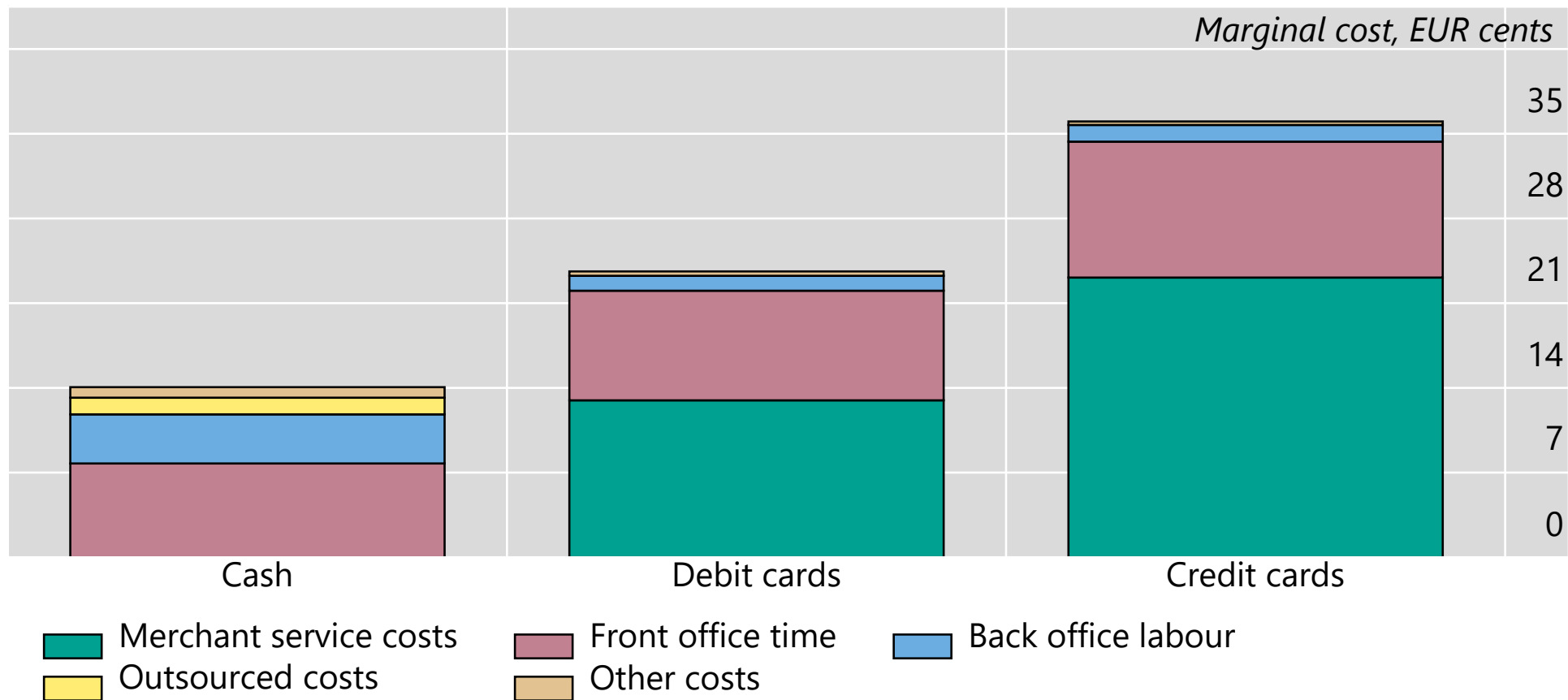
3. Even in advanced economies many households did not have bank accounts, payment cards and mobile phones in 2017
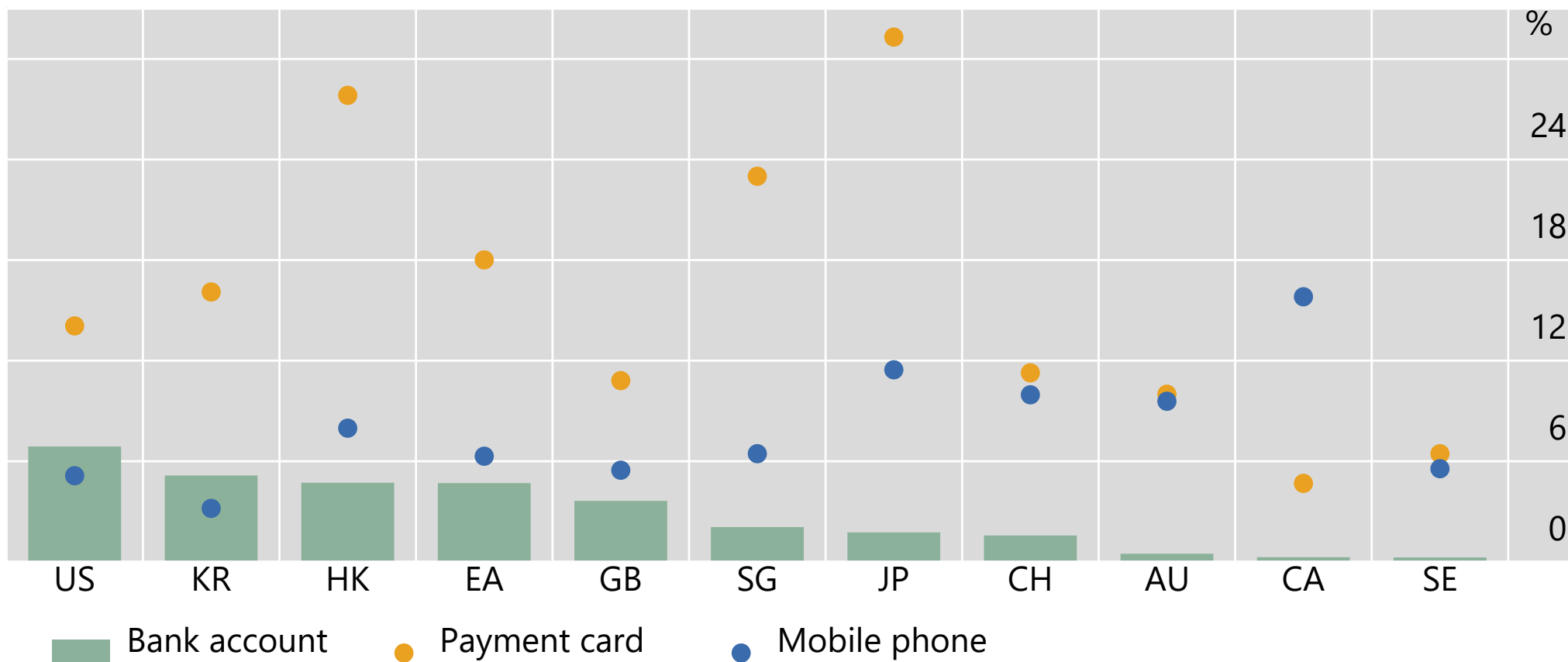
Source: World Bank.

4. Consumers do not trust all counterparties equally to safely handle data

Americans trust big techs the least to safeguard their data

Score, 1–7

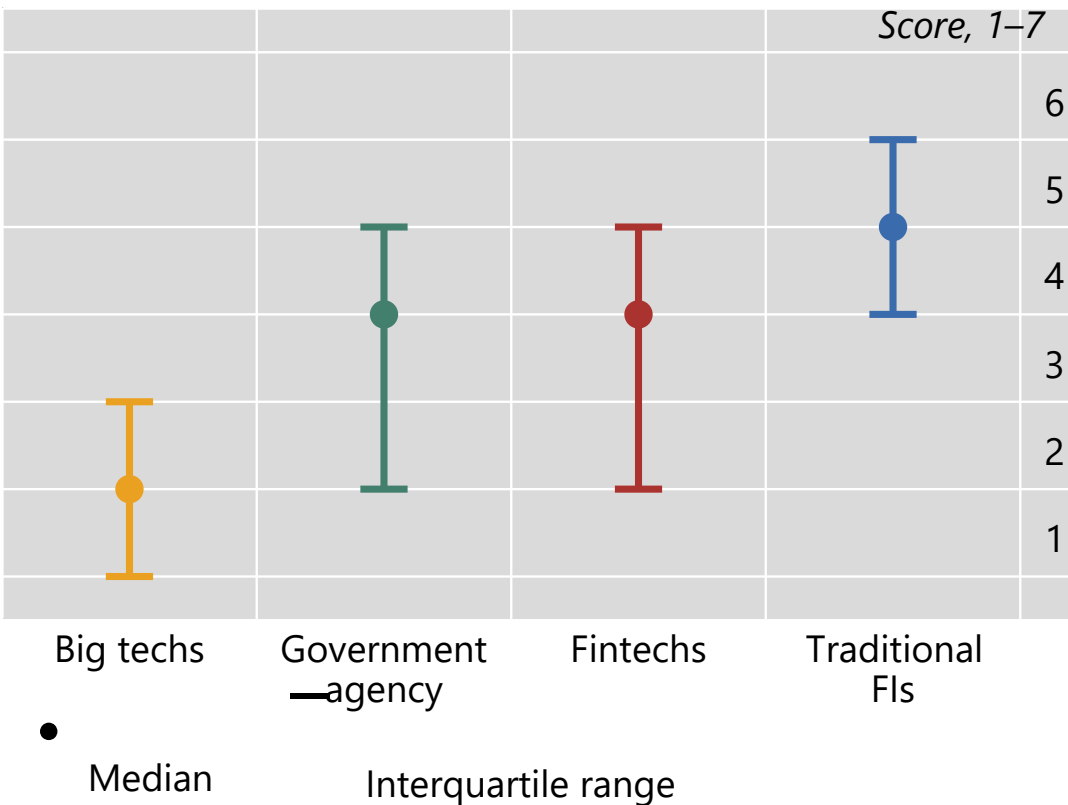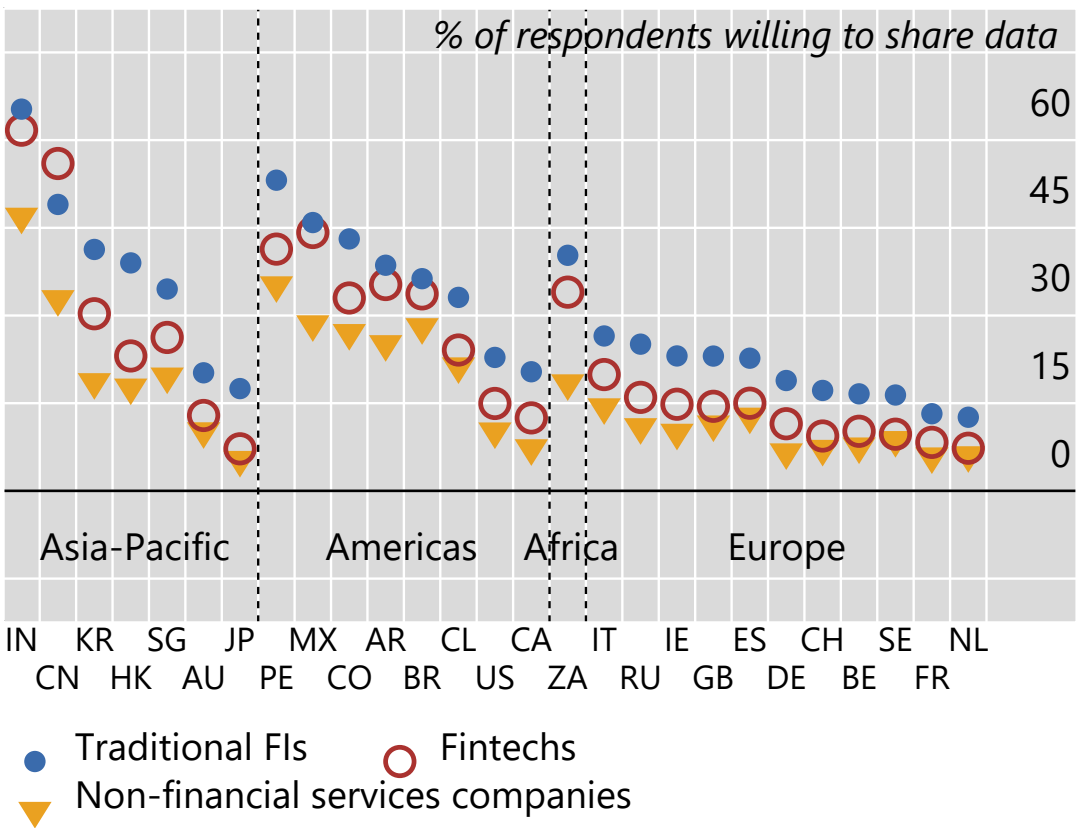Big techs · Government agency · Fintechs · Traditional FIs

● Median

— Interquartile range

Consumers are generally more willing to share data with traditional FIs

% of respondents willing to share data

Asia-Pacific · Americas · Africa · Europe

IN KR SG JP MX AR CL CA IT IE ES CH SE NL
CN HK AU PE CO BR US ZA RU GB DE BE FR

● Traditional FIs   ○ Fintechs
▼ Non-financial services companies

Sources: O Armantier, S Doerr, J Frost, A Fuster and K Shue, "Whom do consumers trust with their data? US survey evidence", *BIS Bulletins*, no 42, May 2021; S Chen, S Doerr, J Frost, L Gambacorta and H S Shin, "The fintech gender gap", *BIS Working Papers*, no 931, March 2021.

CBDC research, pilots and live CBDCs around the globe

Project phase:
- Live retail CBDC
- Retail pilot ongoing
- Retail pilot completed
- Retail research
- Retail research and wholesale project
- Wholesale project
- N/A
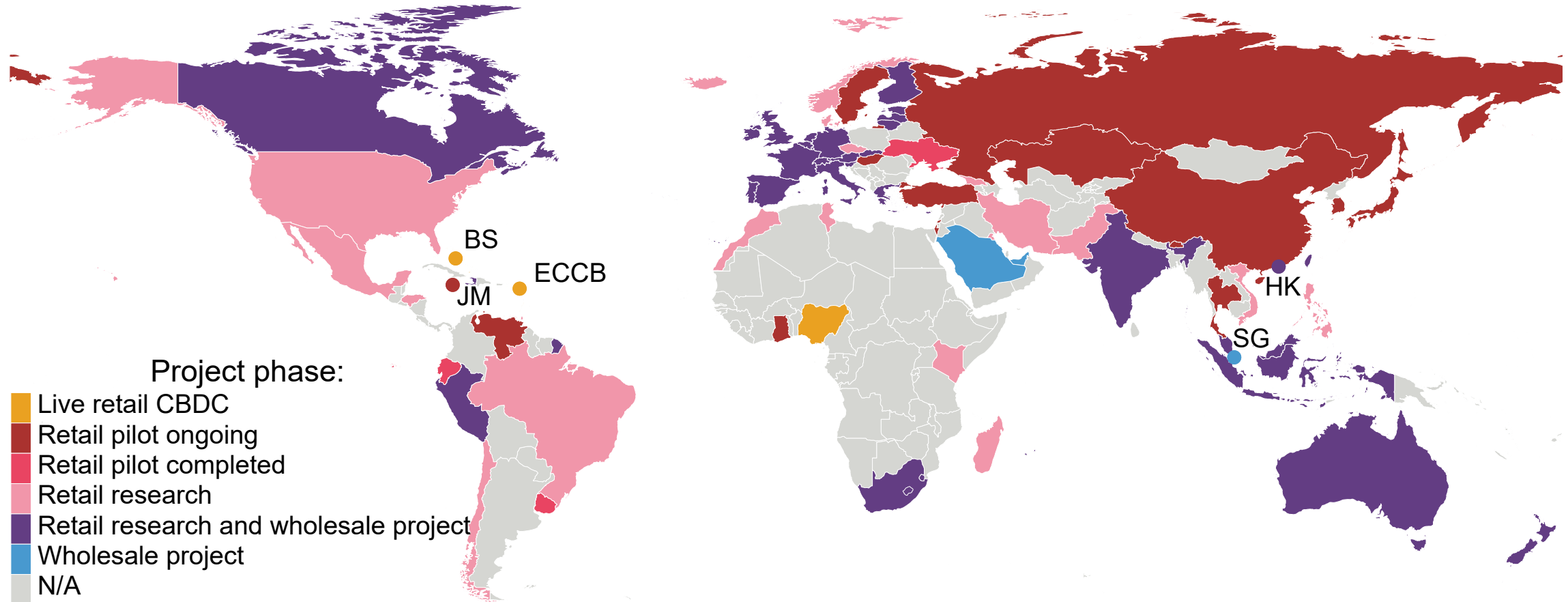
BS = The Bahamas; ECCB = Eastern Caribbean Central Bank; HK = Hong Kong SAR; JM = Jamaica; SG = Singapore. The use of this map does not constitute, and should not be construed as constituting, an expression of a position by the BIS regarding the legal status of, or sovereignty of any territory or its authorities, to the delimitation of international frontiers and boundaries and/or to the name and designation of any territory, city or area.

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.

Motivations for issuing a retail CBDC
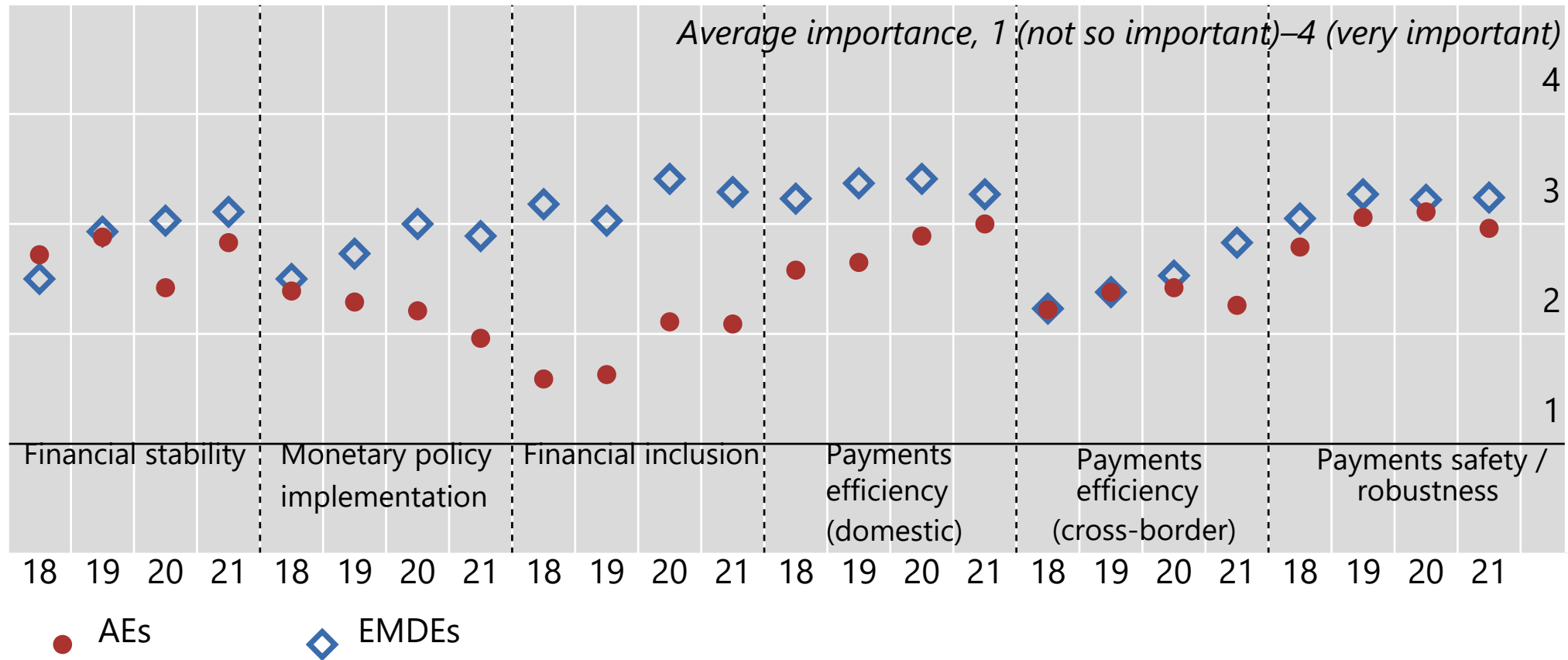
Source: CPMI survey; A Kosse and I Mattei (2022): "Gaining momentum – Results of the 2021 BIS survey on central bank digital currencies", *BIS Papers*, no 125.

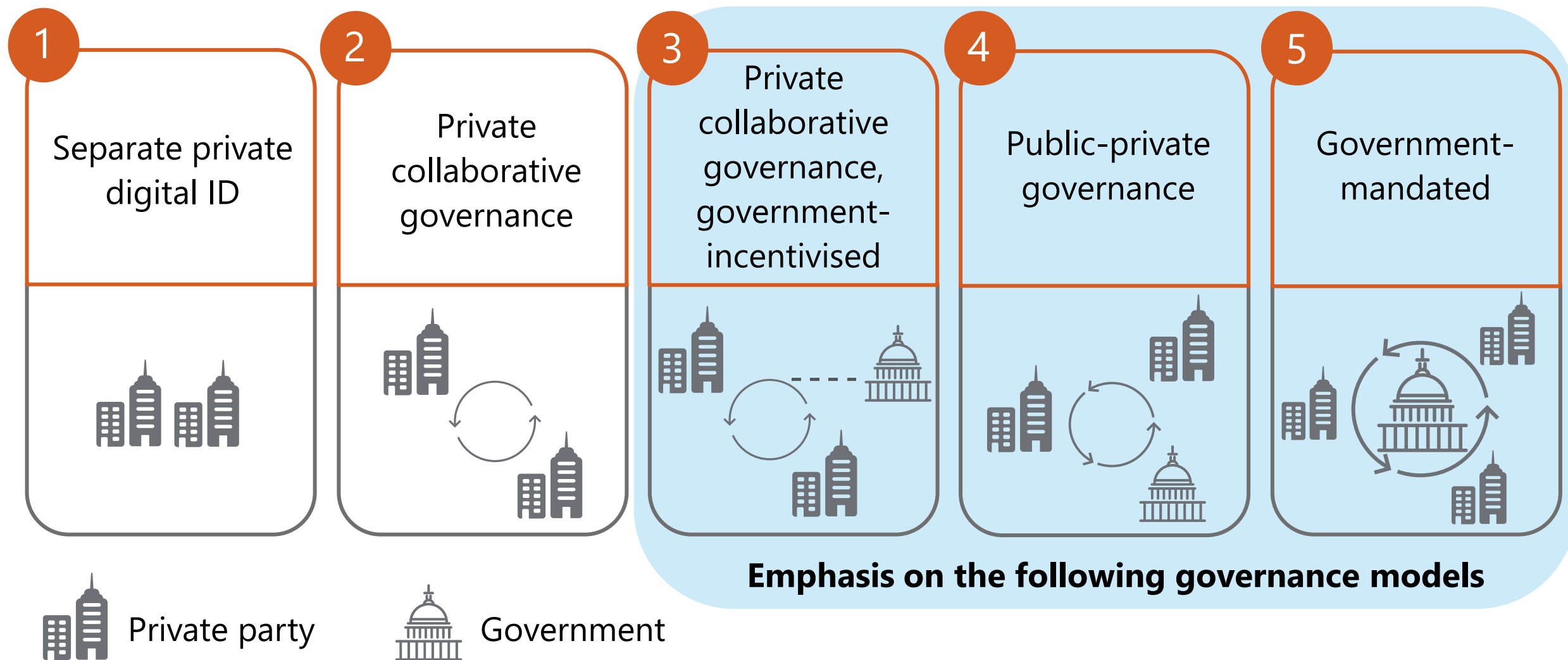# Motivations for issuing a wholesale CBDC
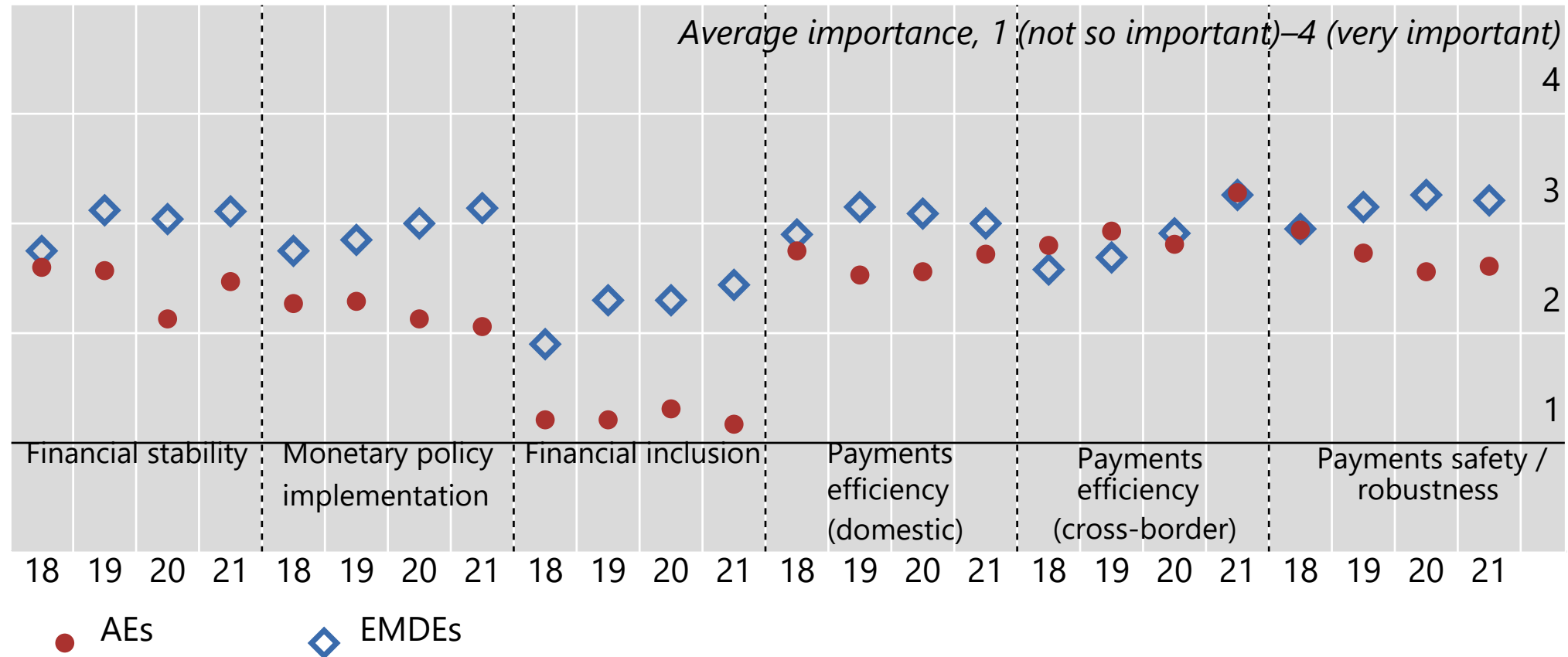
Source: CPMI survey; A Kosse and I Mattei (2022): "Gaining momentum – Results of the 2021 BIS survey on central bank digital currencies", *BIS Papers*, no 125.

Identification and privacy in CBDC design

There is a broad range of governance arrangements for digital ID

1 Separate private digital ID

2 Private collaborative governance

3 Private collaborative governance, government-incentivised

4 Public-private governance

5 Government-mandated

Emphasis on the following governance models

Private party   Government

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Jigsaw puzzle principle: each provider should only have access to data that is strictly necessary for their task and shares only what is needed in a specific case.

PSP

Bank

Big tech
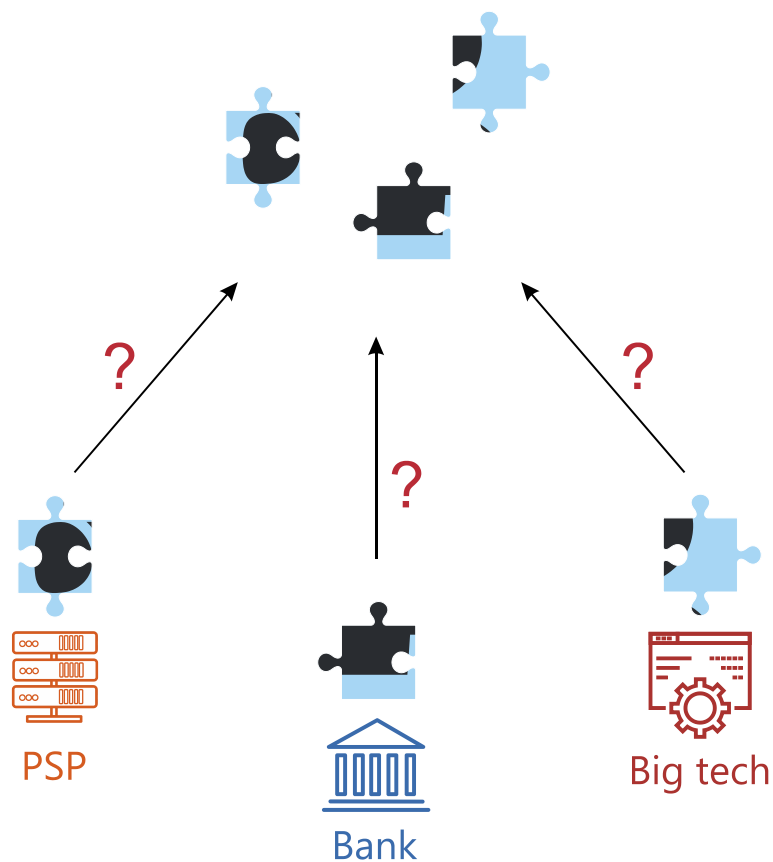
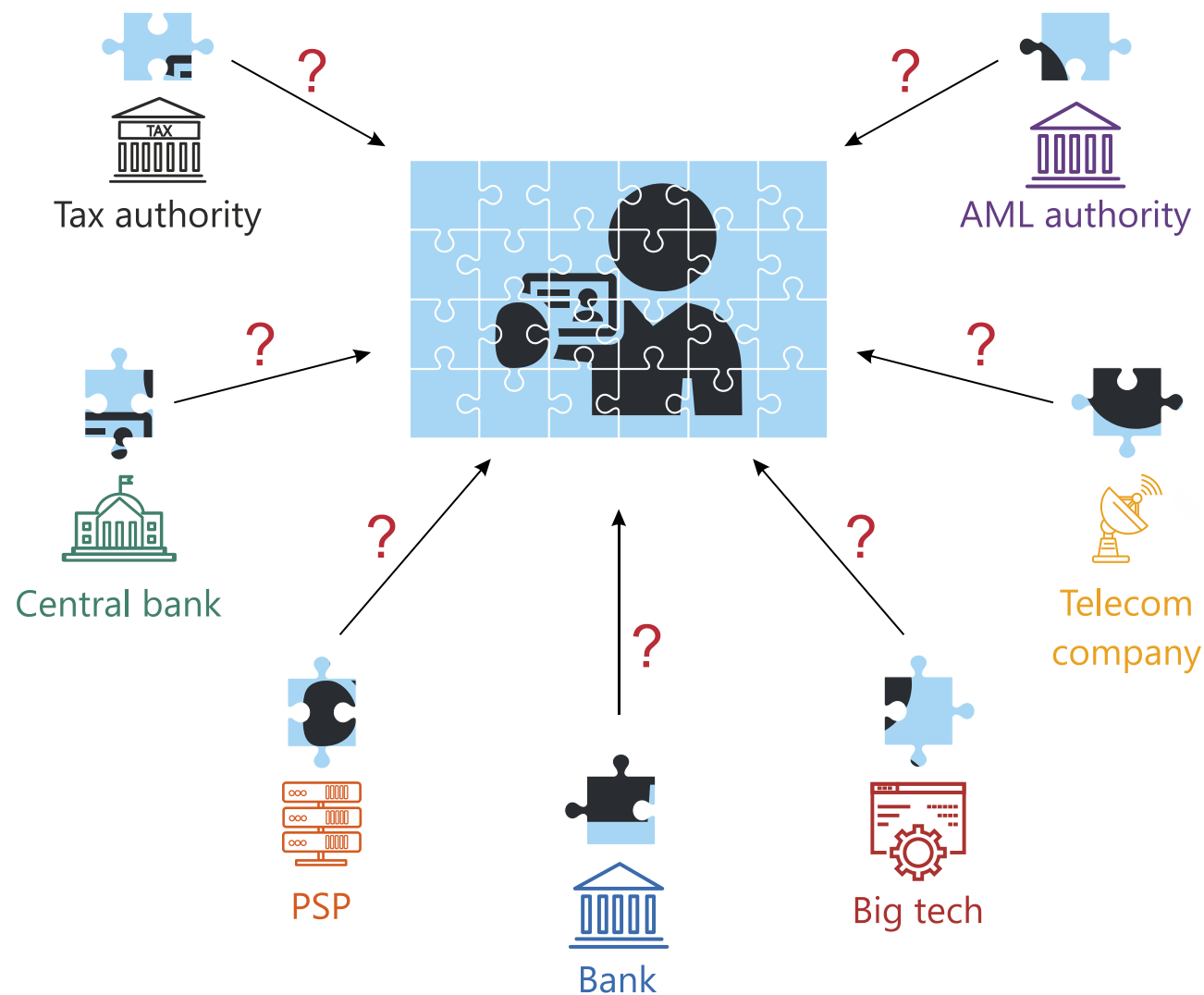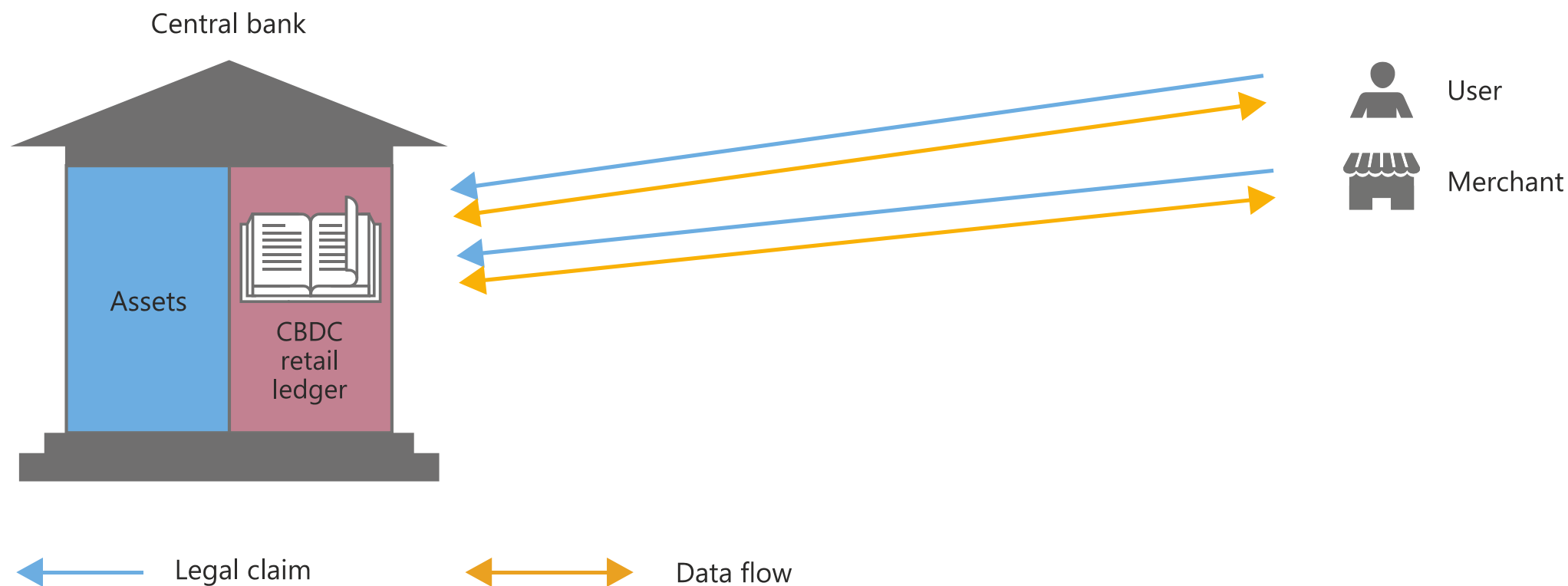# No provider holds all of the pieces of the puzzle; only the individual user does

Tax authority

AML authority

Central bank

Telecom company

PSP

Bank

Big tech

CBDC architectures and the financial system

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The "direct model" of CBDCs entails a large operational role for the central bank
Users and merchants have claims on the central bank without an intermediary

Central bank

Assets

CBDC retail ledger

User

Merchant

→ Legal claim

↔ Data flow

Source: Adapted from R Auer and R Böhme, "Central bank digital currency: the quest for minimally invasive technology", *BIS Working Papers*, no 948, June 2021.

In the "intermediated model" the central bank only has a wholesale ledger of payments between PSPs, not between the individual users

Central bank records wholesale balances
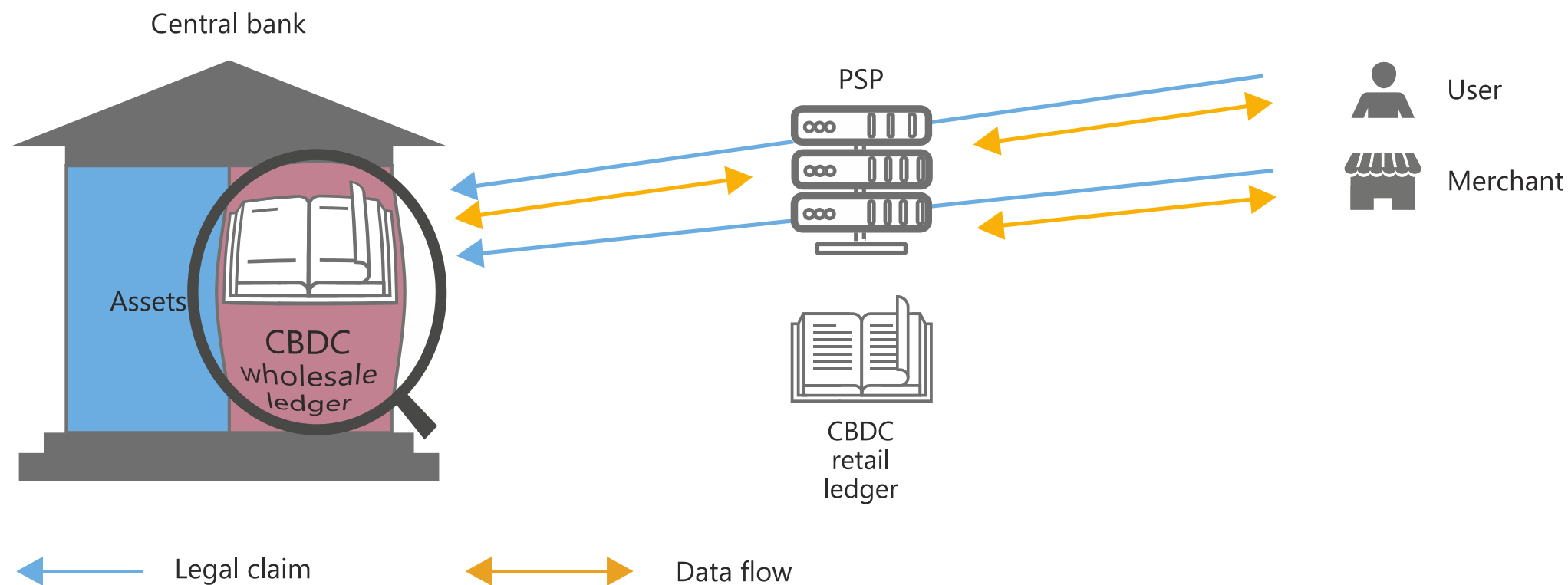
Source: Adapted from R Auer and R Böhme, "Central bank digital currency: the quest for minimally invasive technology", *BIS Working Papers*, no 948, June 2021.

In the "hybrid model", the central bank retains a copy of the full retail ledger

Central bank records retail balances

Central bank

Assets

CBDC retail ledger

PSP

User

Merchant

CBDC retail ledger

Legal claim   Data flow

Source: Adapted from R Auer and R Böhme, "Central bank digital currency: the quest for minimally invasive technology", *BIS Working Papers*, no 948, June 2021.

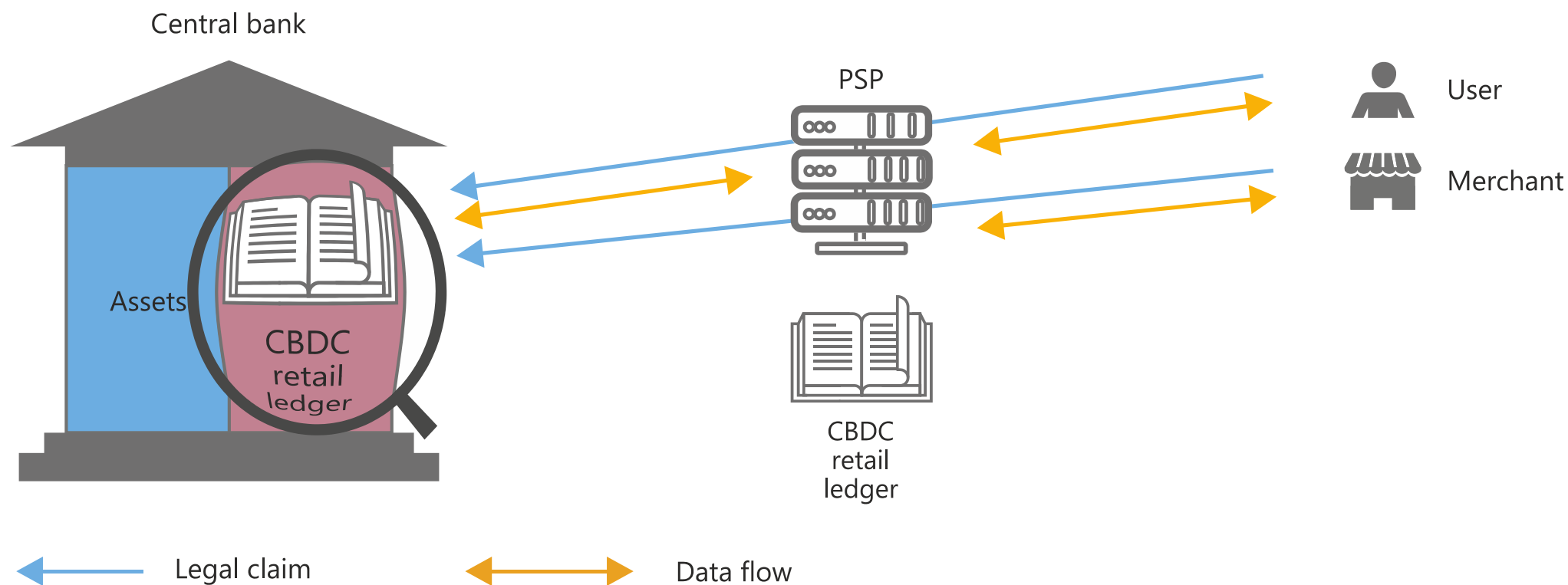# Operational involvement of the central bank is highest in the direct model, and lowest in the intermediated model

Source: Adapted from R Auer and R Böhme, "Central bank digital currency: the quest for minimally invasive technology", *BIS Working Papers*, no 948, June 2021.
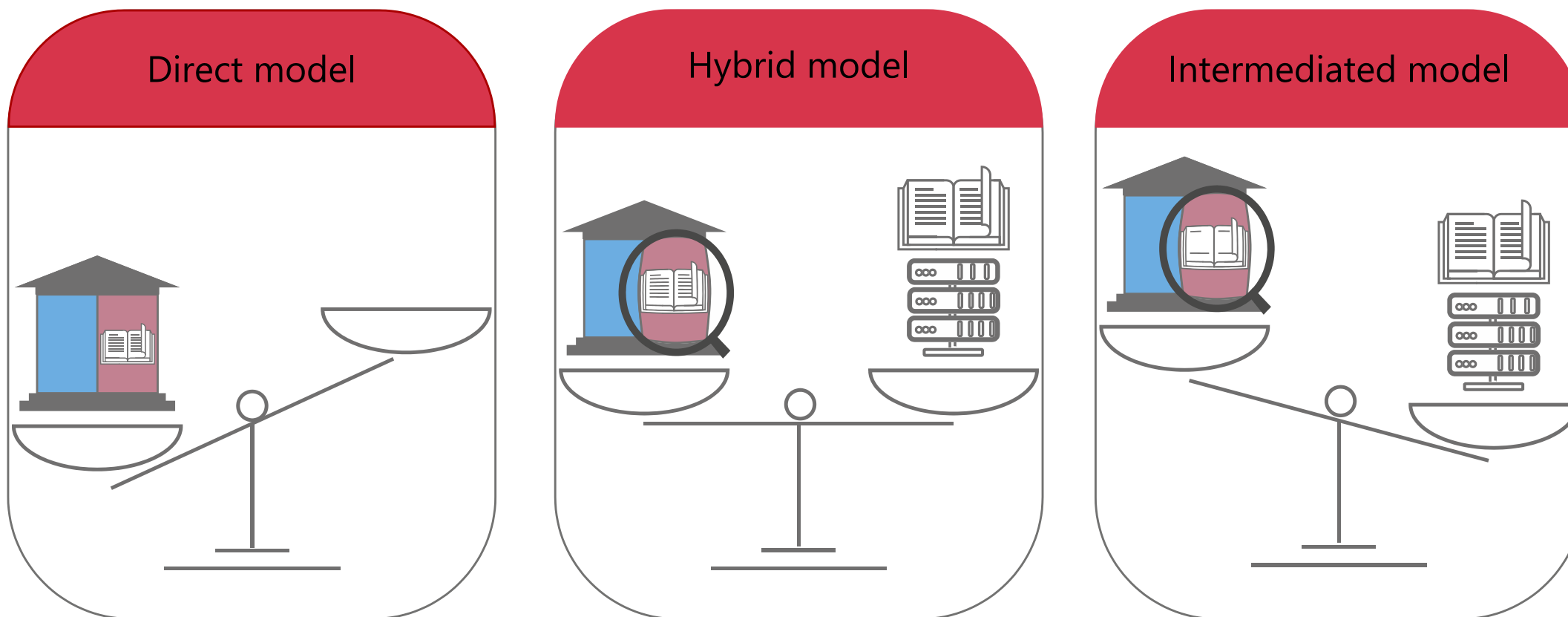
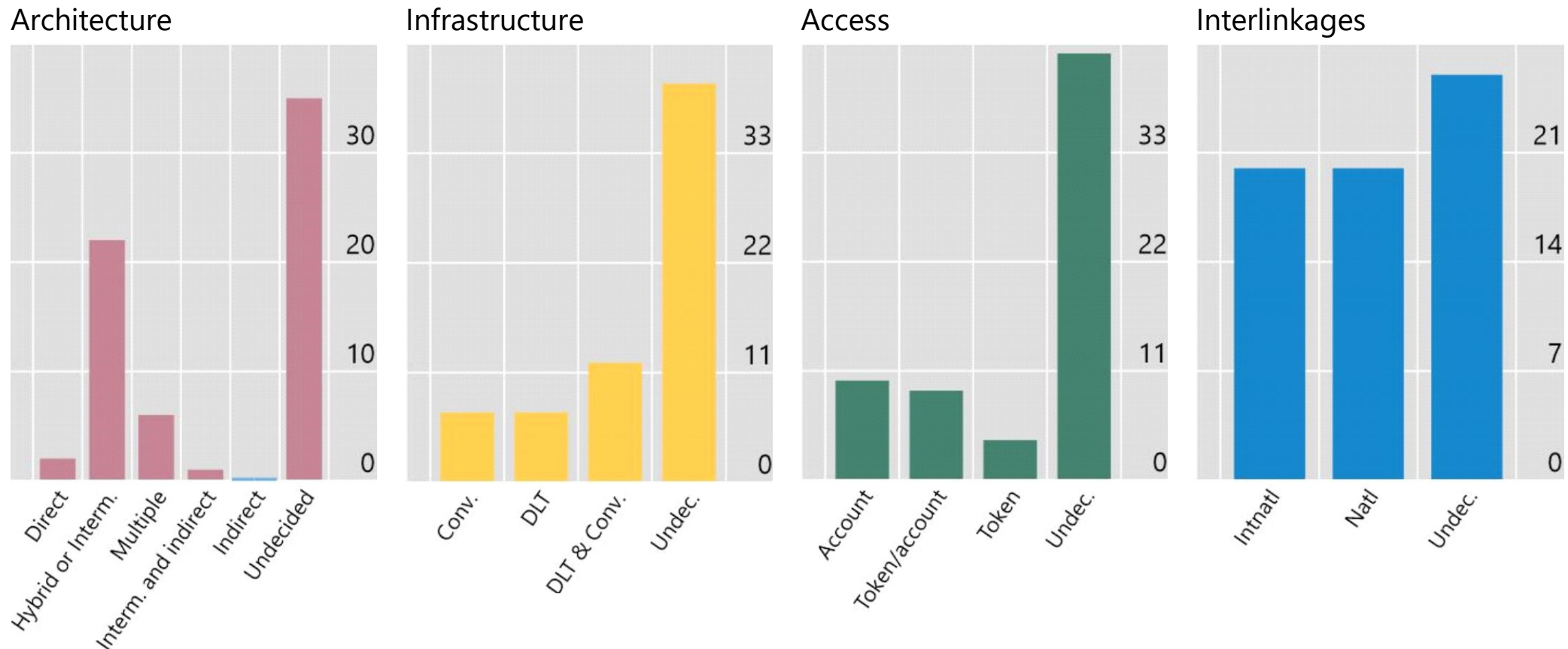# A wide range of infrastructures, access arrangements and interlinkages

Number of retail CBDC projects investigating each design option

Source: Auer, Cornelli and Frost (2020), updated as of January 2022.

Implications for banks, financial stability and monetary policy

Will the central bank take over private lending?

- Several models consider impact of CBDC issuance on banking sector – eg Andolfatto (2021), Keister and Sanches (2020) and Chiu et al (2019)

  - Models differ in terms of degree of competition in the banking system

  - But logic broadly comparable: by offering a CBDC, the central bank induces commercial banks to make their deposits more attractive and increases the costs of funding

- Related work on equivalence between public and private money (Brunnermeier and Niepelt (2019) and Fernández-Villaverde et al (2021)) and when this breaks down (Piazzesi and Schneider (2020))

- Crucially: most retail CBDC designs in consideration are non-remunerated, and some consider explicit limits on CBDC balances (Bindseil (2019))

- Overall, actual CBDC designs explicitly aim to preserve private lending and two-tier system

Breaking through the zero lower bound?

- Could CBDC help to break the zero lower bound? (Bordo and Levin (2017)) Or provide new monetary policy tools to central banks? (Davoodalhosseini (2021))?
- As long as CBDC exists in parallel to cash, natural limits on how deeply negative interest rates can be
- Some work on blurring of fiscal-monetary boundaries (Bassetto and Sargent (2020))
- In practice, monetary policy is not a key consideration for most central bank work
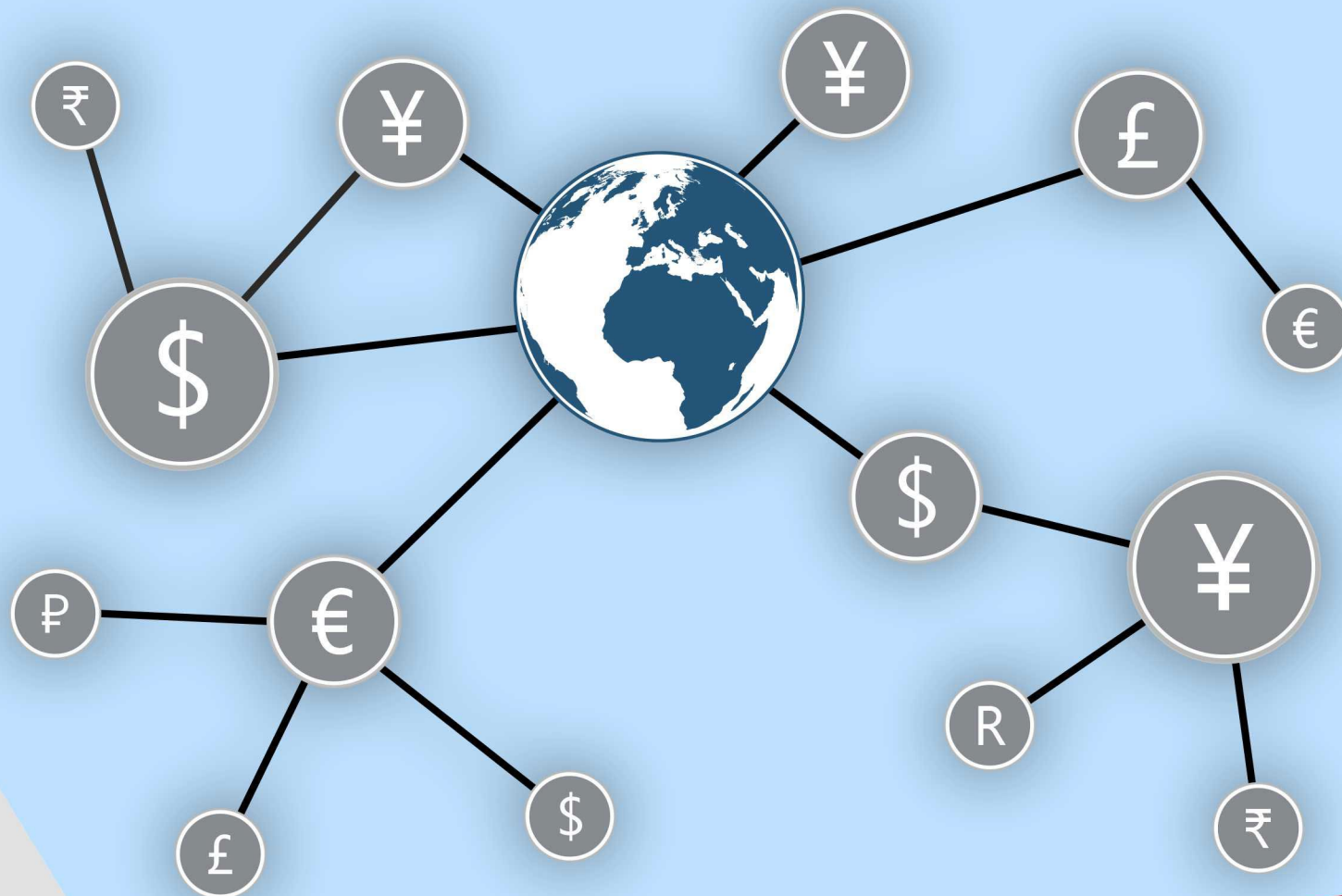
The international dimension of CBDC issuance

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Cross-border payments are a priority area, and there are specific concerns

Globalisation of retail activity

USD trn — 2000 = 100

Migrants' remittance inflows (lhs): —— EMDEs —— Total

—— Int'l tourism expenditure (lhs)

—— Number of int'l dispatched parcels (rhs)
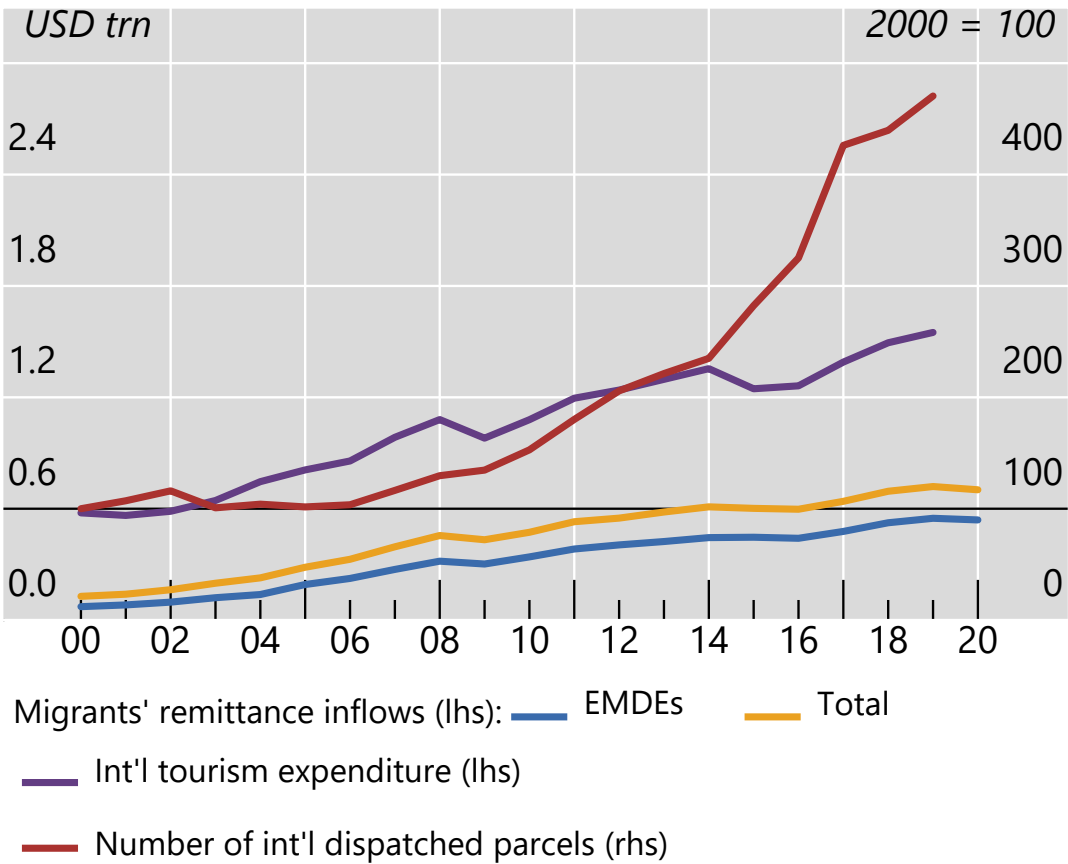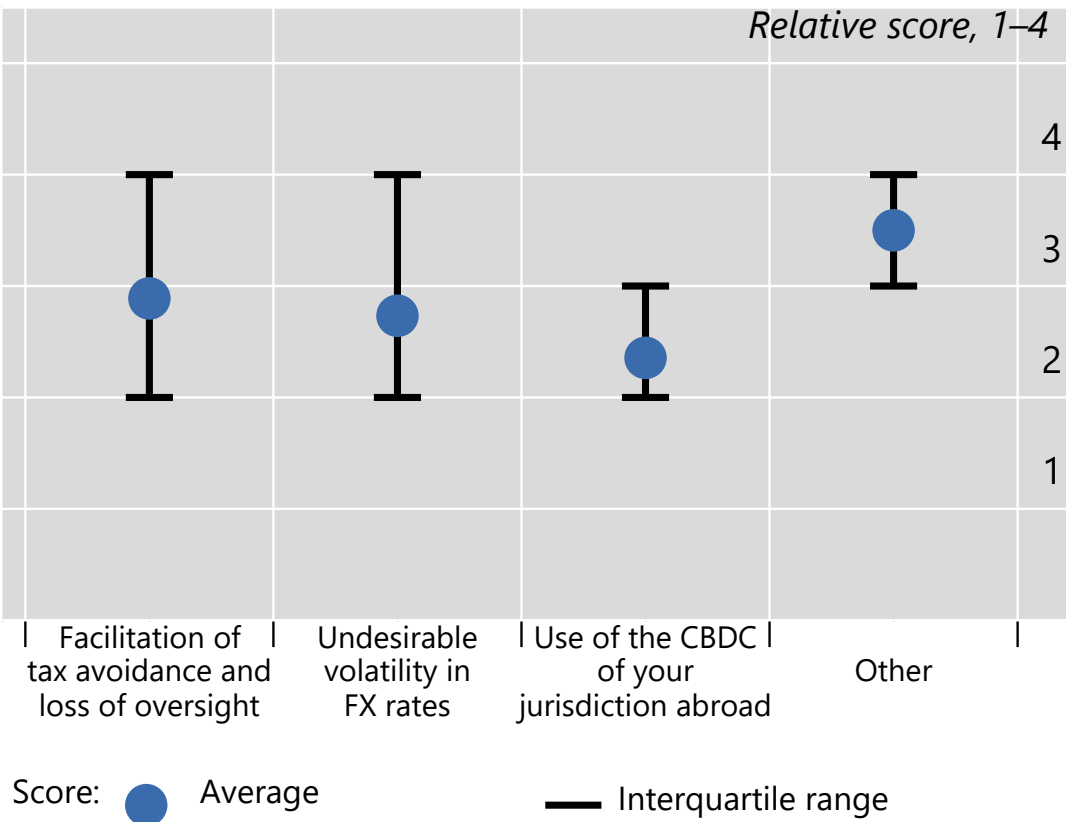
Foreign CBDC issuance risks

Relative score, 1–4

Facilitation of tax avoidance and loss of oversight | Undesirable volatility in FX rates | Use of the CBDC of your jurisdiction abroad | Other

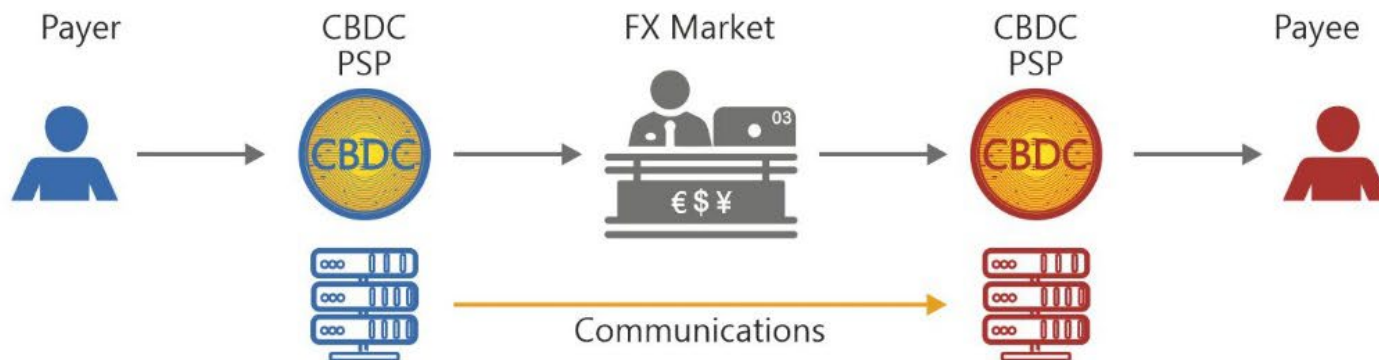Score: ● Average   —— Interquartile range

Sources: R Auer, C Boar, G Cornelli, J Frost, H Holden, A Wehrli, "CBDCs beyond borders: results from a survey of central banks", *BIS Papers*, no 116, June 2021; World Bank; Universal Postal Union; BIS calculations.

CBDCs could simplify the monetary architecture and substantially streamline the cross-border payment chain
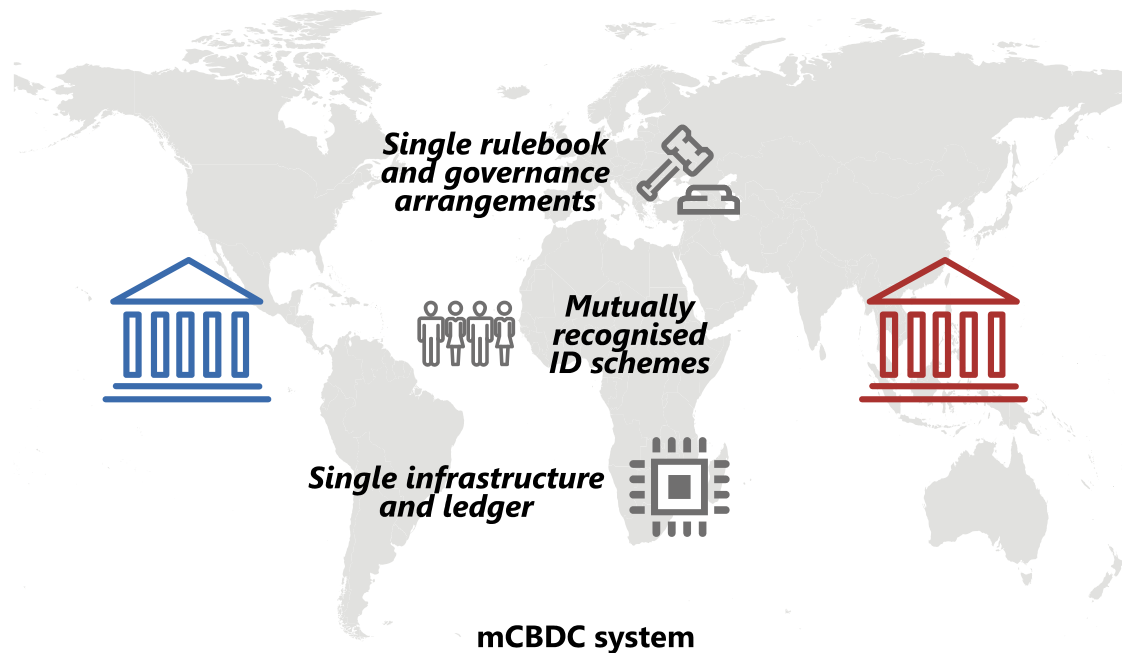

Today's arrangement

Payer → Originating bank → Respondent bank → FX Market → Correspondent bank → Receiving bank → Payee

mCBDC arrangement

Payer → CBDC PSP → FX Market → CBDC PSP → Payee

Communications

Multi-CBDC arrangements can facilitate cross-border payments

Single rulebook and governance arrangements

Mutually recognised ID schemes

Single infrastructure and ledger

mCBDC system

mCBDC Model 3:
Integration into a single system

- Multiple CBDC can be run on a single platform (eg mCBDC Bridge or Project Dunbar)

- Central banks mutually recognise ID schemes

Source: R Auer, P Haene and H Holden, "Multi-CBDC arrangements and the future of cross-border payments", BIS Papers, no 115, March 2021.

Conclusions

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Main takeaways

- DeFi offers a range of new financial applications, as part of a broader vision called "Web3"

- But DeFi is not delivering this in practice:

  - DeFi must incentivise validators through high fees

  - Blockchain applications do not scale, as they cannot harness the network effects

  - DeFi and automated smart contracts do not fully replace for trust

- CBDCs offer in digital form the unique advantages of central bank money

- New capabilities such as programmability, composability and tokenisation are not the preserve of crypto, but can instead be built on top of CBDCs, fast payment systems and associated data architectures

- CBDCs should be designed with the public interest in mind. CBDCs could ensure open payment platforms and a competitive level playing field that is conducive to innovation

- Multi-CBDC arrangements will require international cooperation