Money as a coordination device: some historical lessons
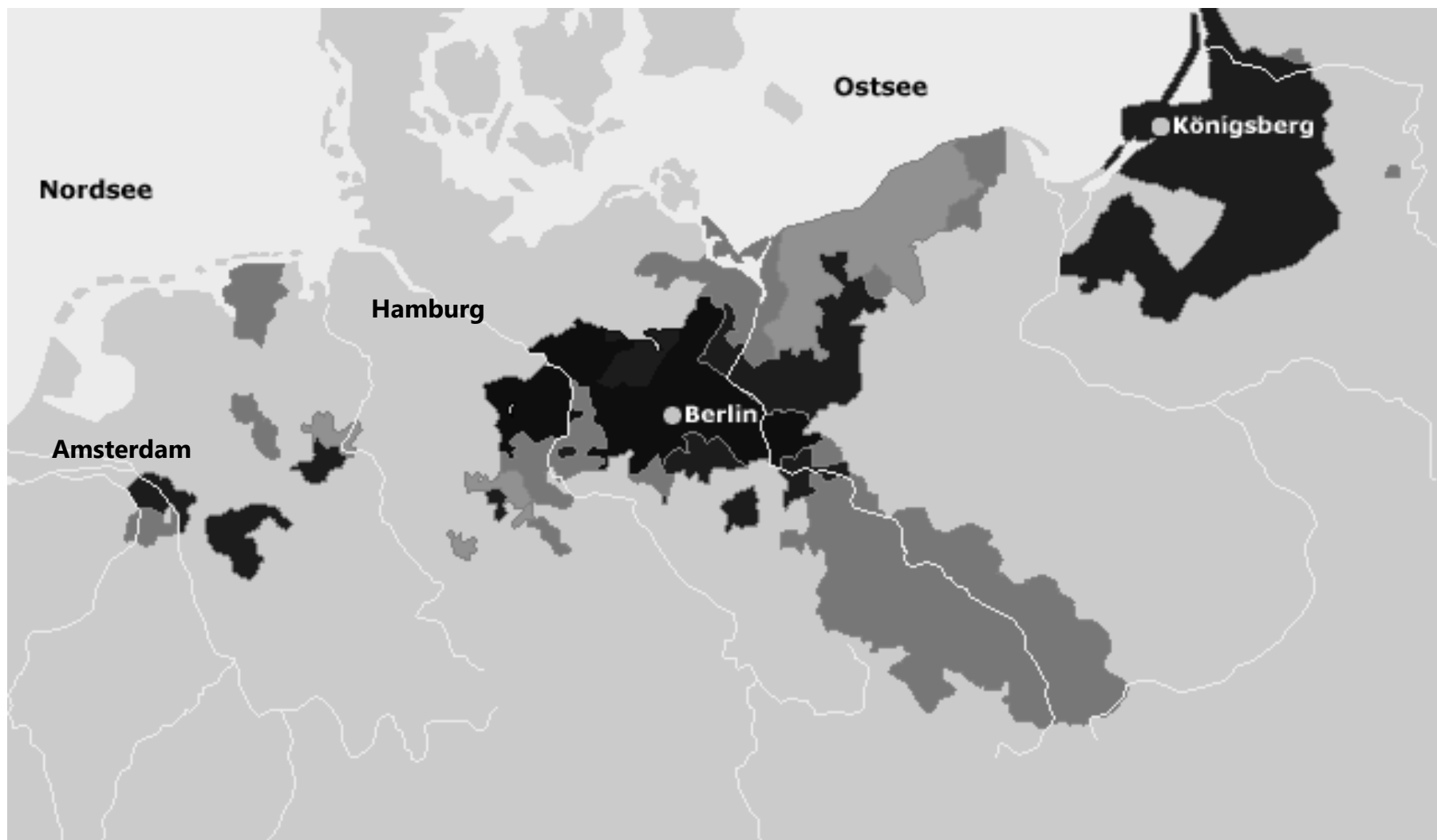
Hyun Song Shin, Economic Adviser and Head of the Monetary and Economic Department, BIS

14th ILF Conference on the Future of the Financial Sector, 27 January 2026

History holds lessons on the role of the central bank in the monetary system; the Bank of Amsterdam (1609-1820) is a good example

Bank of Amsterdam issued arguably the first global currency and supported long-distance trading networks of merchant-bankers

Bills of exchange were both a monetary instrument and a credit instrument; the elasticity of money was there at the beginning of wholesale payments
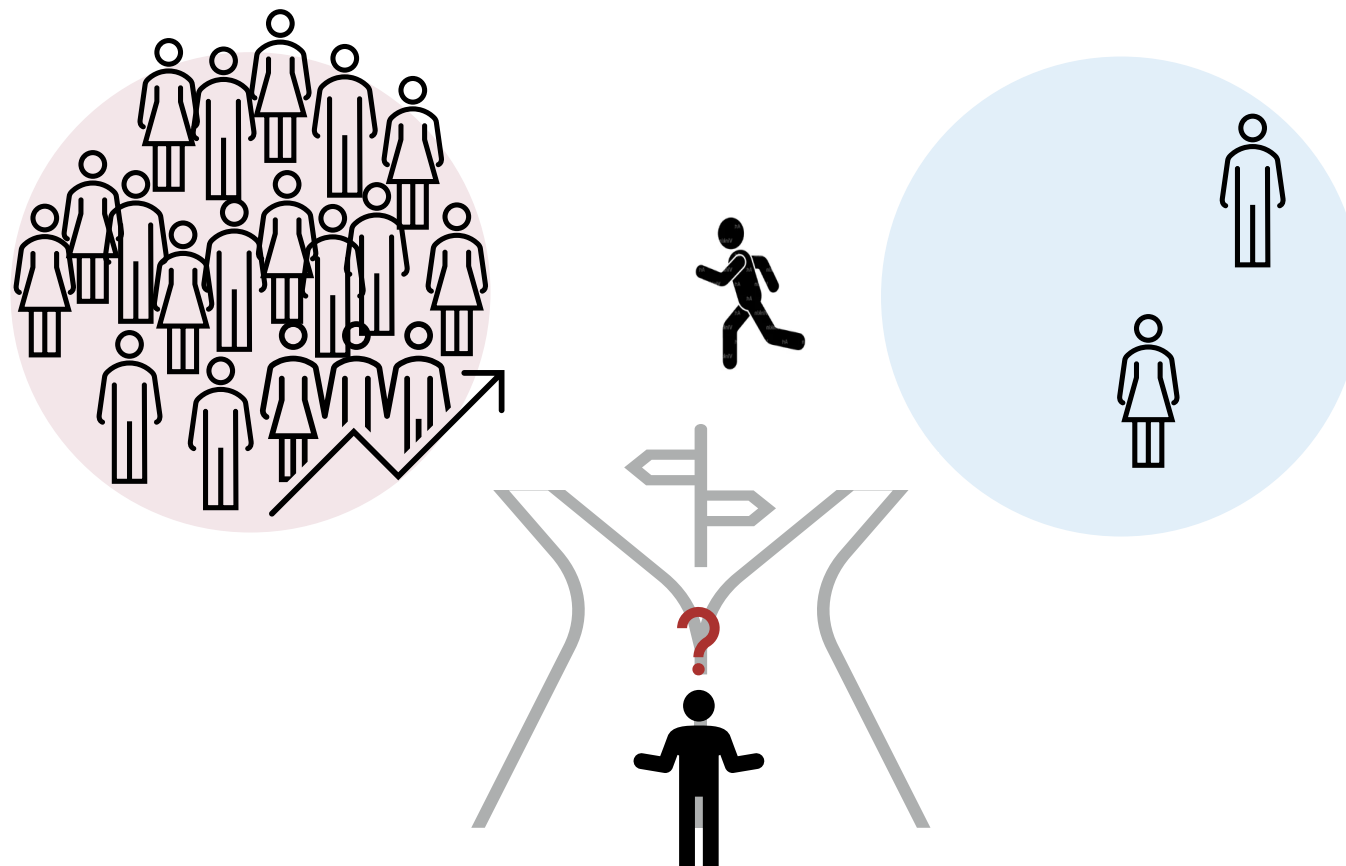
A bill from Darmstadt (Germany) in 1733

(On the recto)

(On the verso)

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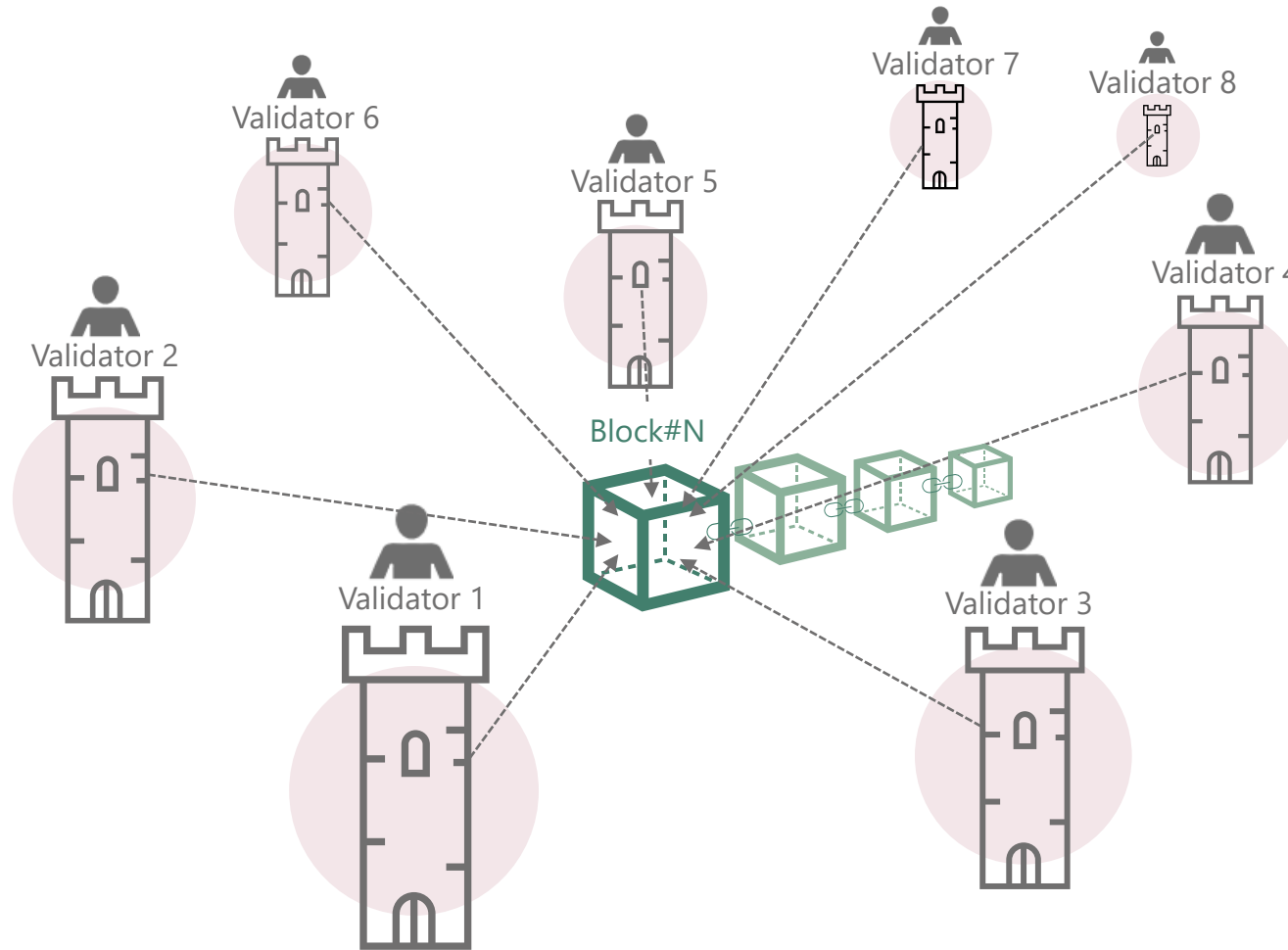
- Bills of exchange are an *order* to pay, not a *promise* to pay

- Supply chain example: Berlin → Hamburg → Amsterdam
  - Hamburg merchant draws a bill on an Amsterdam merchant with Berlin merchant as beneficiary (Hamburg merchant orders the Amsterdam merchant to pay the Berlin merchant)
  - Amsterdam merchant "accepts" the bill, thereby entering into the obligation
  - Bill can be "endorsed" and passed on as a payment instrument

- Settlement takes place on the accounts of the Bank of Amsterdam
  - Gave rise to early form of "singleness of money"
  - Two-tier monetary system developed later

Network effects underpin the coordination role of money; key to its role is the feedback loop between greater acceptance and greater use

Decentralisation agenda in money

The decentralisation agenda rejects a centralised notion of trust (eg, provided by central banks); money depends on achieving consensus among dispersed validators

Validator 7

Validator 8

Validator 6

Validator 5

Validator 4

Validator 2

Block#N

Validator 1

Validator 3

Consensus mechanisms need to be self-sustaining with self-interested validators

Chain	Consensus mechanism	How it works	Key features
Bitcoin	Proof of work	- "Proof of work": miners solve hash puzzles	- Winner adds new block to chain
Ethereum	Proof of stake	- "Proof of stake"	- Validators pledge stake and face "slashing" of stake in case of successful challenge to malfeasance
BNB Smart Chain	Proof of staked authority	- Validators elected by BNB stake produce and sign blocks in rotation	- About 21 active validators
Solana	Proof of history (PoH)[1] and a Byzantine fault tolerant (BFT)[2] voting process	- A stake-weighted leader proposes blocks - A cryptographic clock orders events - Validators vote to finalise	- Technically demanding, leading to fewer validators
Tron	Delegated proof of stake	- TRX holders elect 27 super representatives who rotate to produce and sign blocks	- Rapid confirmation at the cost of greater centralisation

[1] PoH is the PoS auxiliary mechanism that cryptographically proves the order of events to facilitate consensus on transaction ordering
[2] BFT ensures consensus even if up to one-third of nodes are faulty or malicious.
Sources: bitcoin.org; ethereum.org; bnbchain.org; solana.com; tron.network

Some congestion is necessary for validator incentives; finding the right capacity at the outset is a difficult balancing act
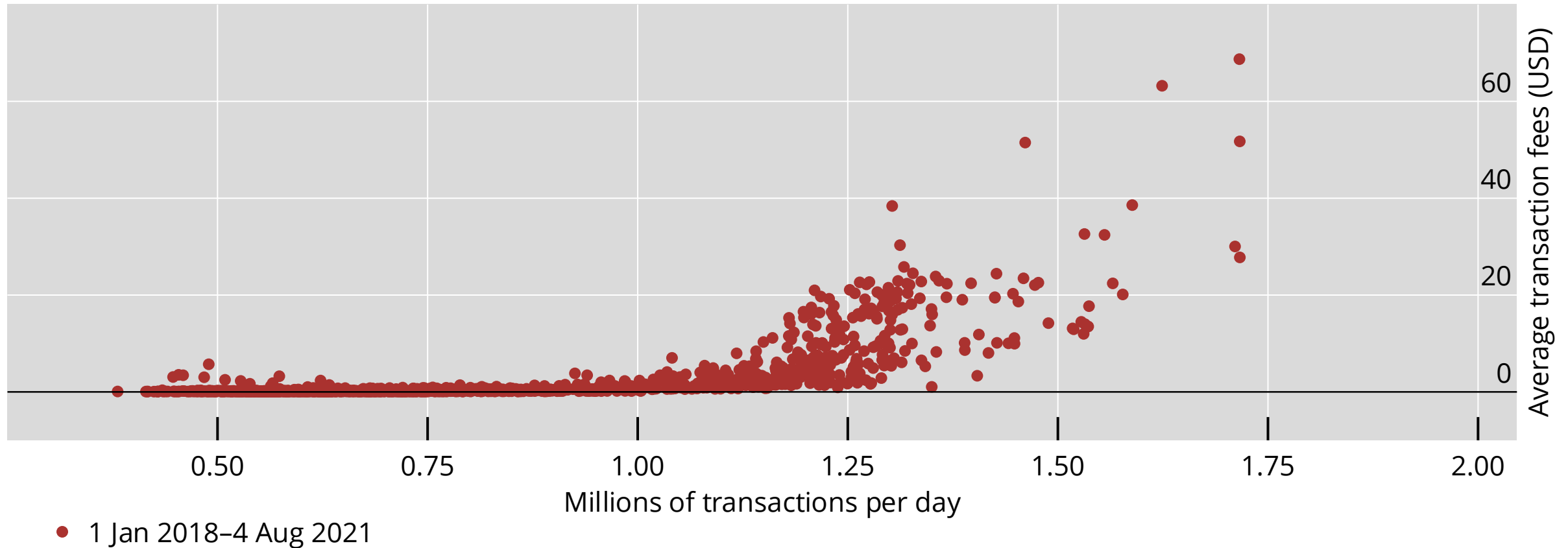

Samson Mow ✓
@Excellion

"Guys, no one's using our 8 lane highway."
"We need 32 lanes."
"You're a genius."#Overheard #TransactionSuperhighway
#Bcash

9:06 AM - May 8, 2018

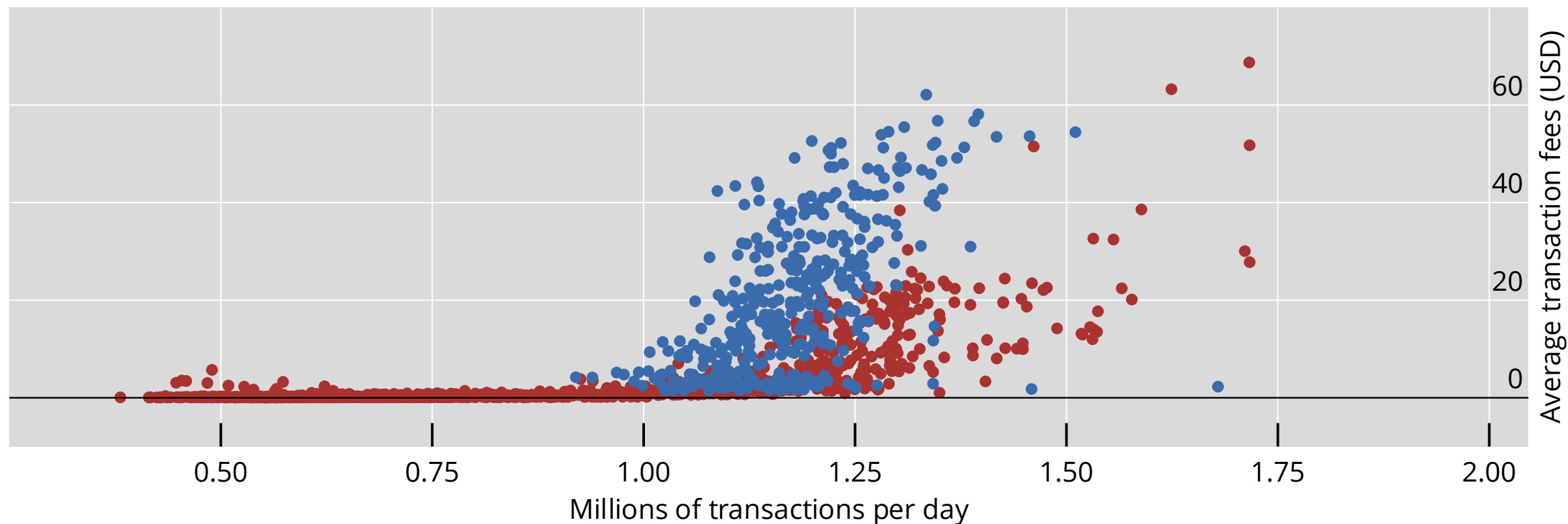♡ 1,595   ○ 397 people are talking about this

Decentralisation versus capacity

Decentralised consensus depends on incentives of validators to maintain the infrastructure; validators need to receive sufficient rents

1 Jan 2018–4 Aug 2021

Decentralised consensus depends on incentives of validators to maintain the infrastructure; validators need to receive sufficient rents
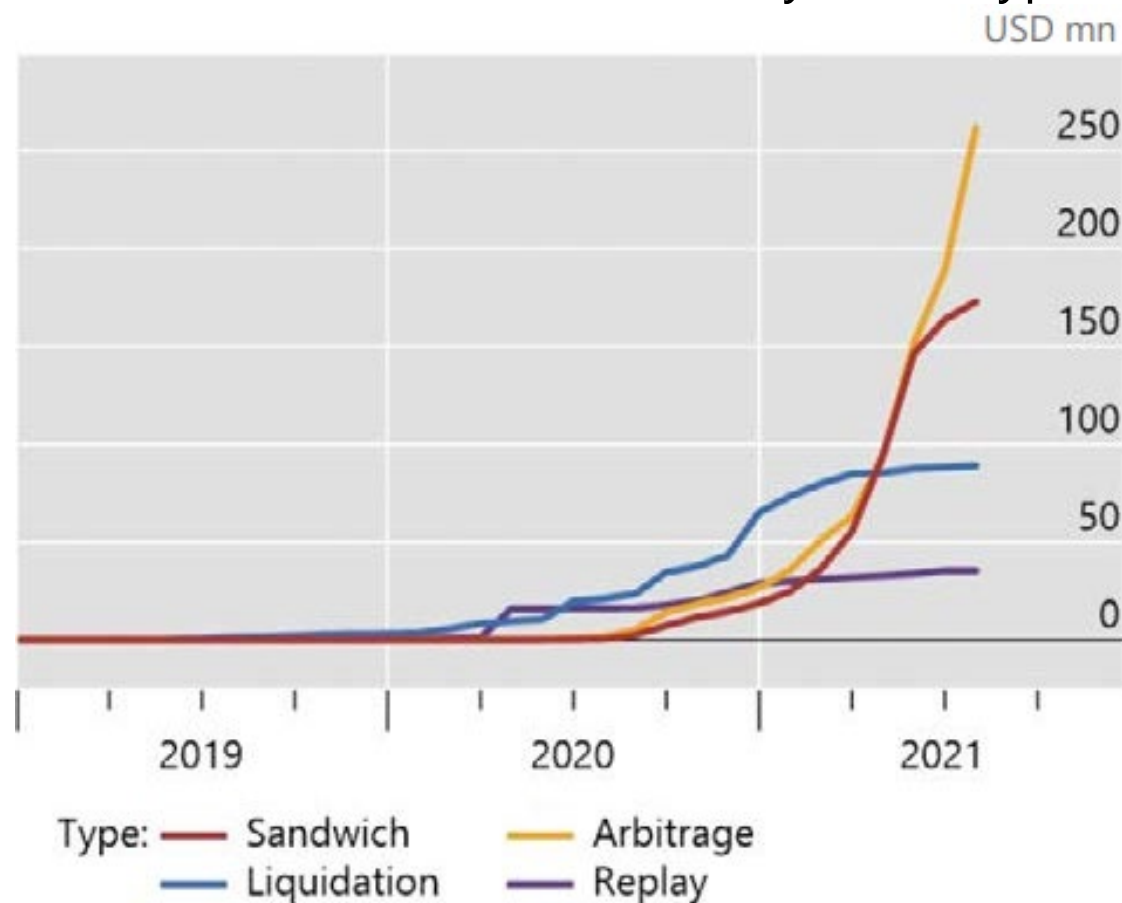

- 1 Jan 2018–4 Aug 2021
- Post-Ethereum London hard fork: 5 Aug 2021–14 Sep 2022

Source: Boissay et al (2022); BIS (2025)

Some rents accrue in the form of "miner extractable value" (MEV)

Cumulative extractable value by attack type

Sources: Auer et al (2022); Qin et al (2021)

There is a tradeoff between the *capacity* of the blockchain and the true extent of *decentralisation*

- Stylised consensus mechanisms that rely on coordination among validators
    - Blockchain functions as intended provided that proportion $\hat{\chi}$ or more work to fulfil governance duties
    - High $\hat{\chi}$ corresponds to greater decentralisation; more "censorship resistant"
    - Two special cases: $\hat{\chi} = 1$ (unanimity), $\hat{\chi} = 0$ (centralisation)

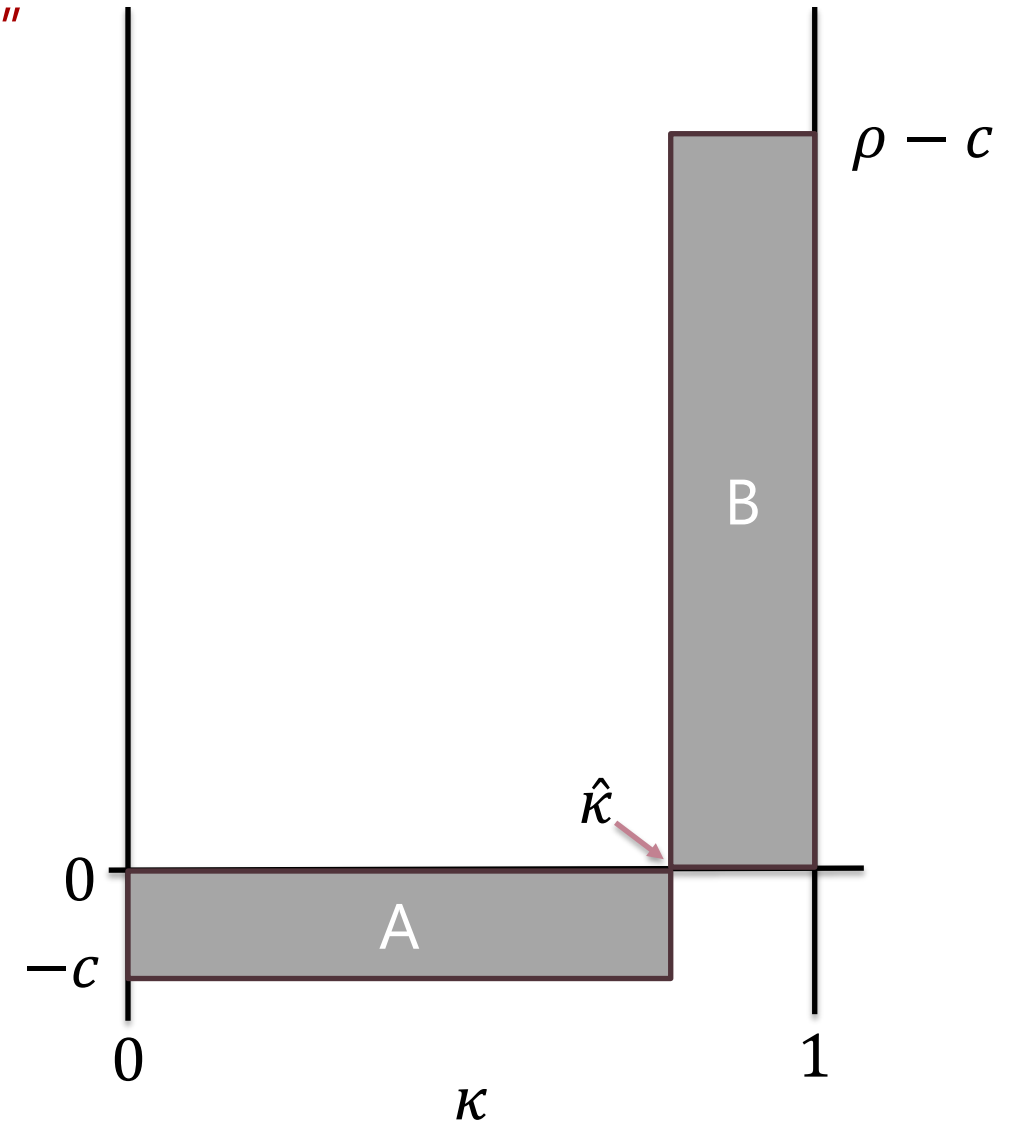# There is a tradeoff between the *capacity* of the blockchain and the true extent of *decentralisation*

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- If blockchain functions well, validators who contribute to governance earn reward $\rho > 0$
  - Coordination problem: validator wants to fulfil governance duties provided critical mass of other validators do so
  - Cost of performing governance duties distributed tightly around $c > 0$
  - Payoff to opting out is zero, irrespective of actions of others

Solution to the "governance contribution game"

- Validator works to fulfil governance duties if and only if

$$\text{cost} \le c^* = \rho(1 - \hat{\kappa})$$

- Result follows from techniques developed in global games
  - Marginal validator has "Laplacian beliefs" (uniform density) over κ
  - Morris and Shin (1998, 2003), Auer, Monnet and Shin (2025)

Decentralised consensus depends on incentives of validators to maintain the infrastructure; validators need to receive sufficient rents

- For blockchain to function as intended, rents received by validators must be sufficiently large

$$\text{Rents} = \rho - c \geq \frac{\widehat{\chi}c}{1-\widehat{\chi}}$$

- The higher the required rent, the smaller must be the capacity of the blockchain to capture users willing to pay ρ or more. As $\hat{\chi} \to 1$, rents increase without bound, capacity shrinks to zero
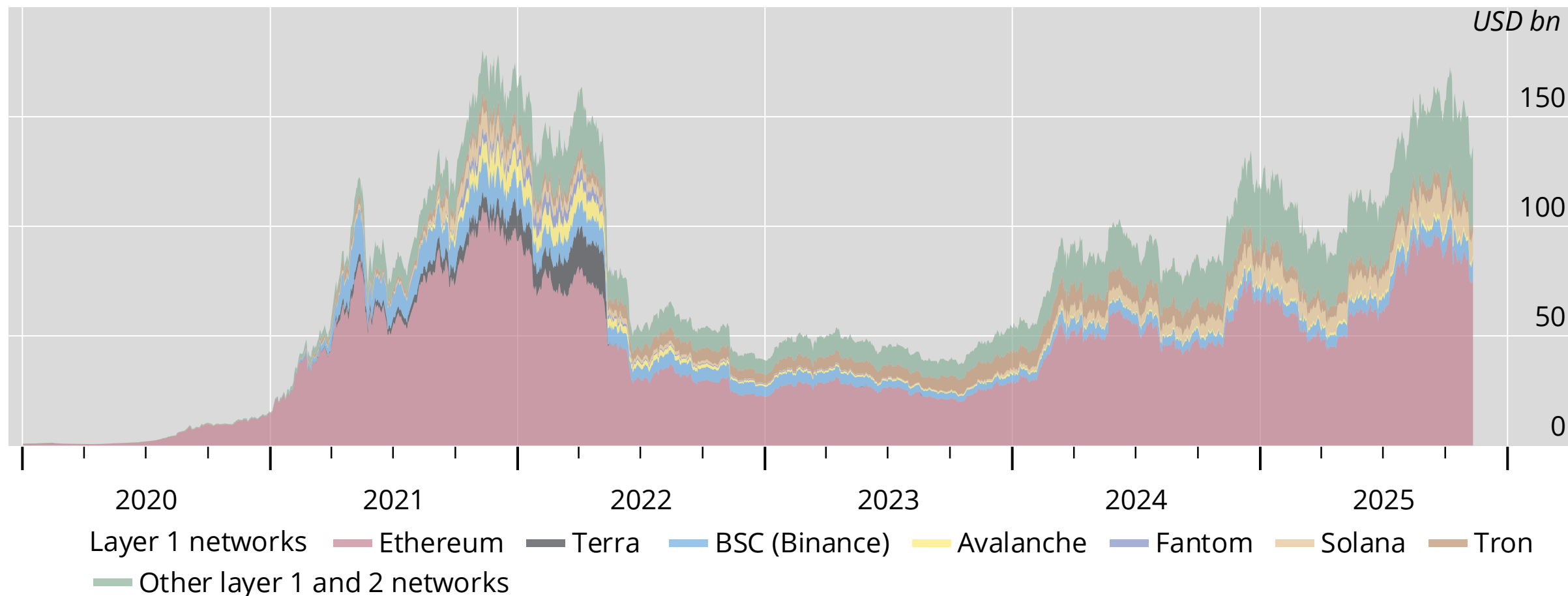
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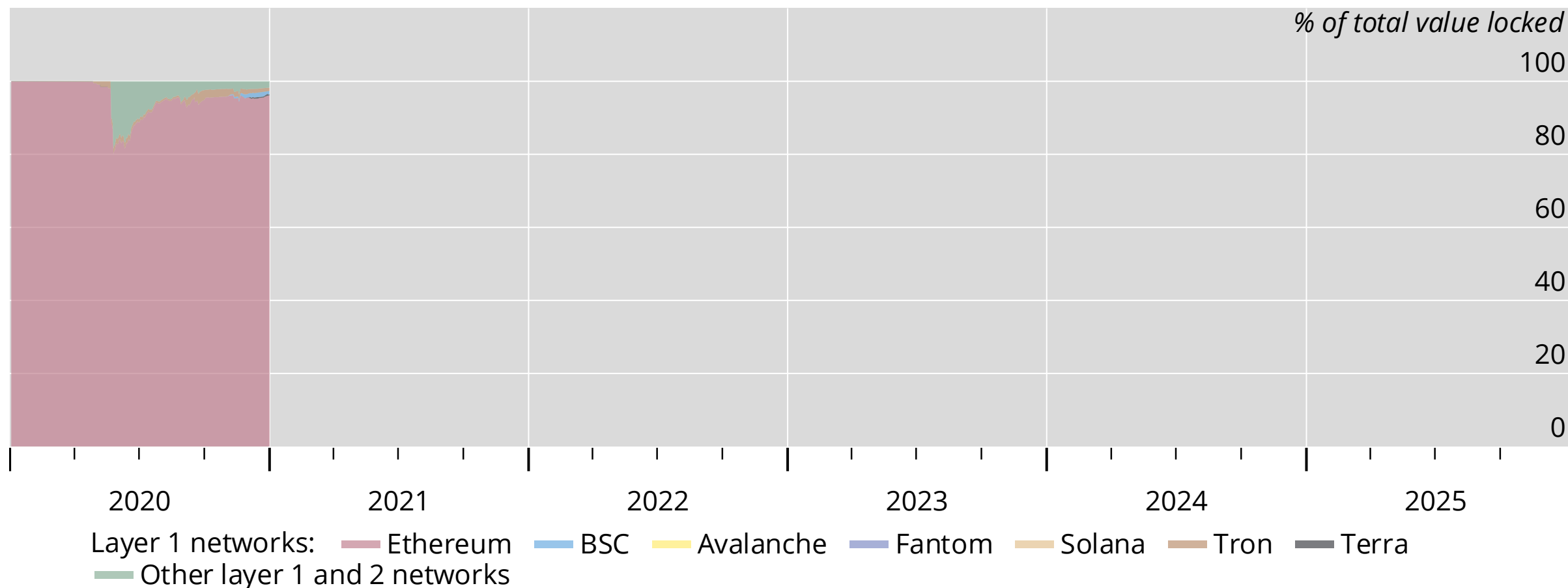$$\text{Rents} = \rho - c \geq \frac{\widehat{\chi}c}{1-\widehat{\chi}}$$

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- Fundamental tradeoff between **decentralisation** and **capacity**
- Network effects of money are lost when trust is decentralised

$\Longrightarrow$ Leads to greater fragmentation of the monetary system as less secure blockchains fill the gap

Total value locked (TVL) across layer 1 and layer 2 networks illustrates the tendency toward fragmentation
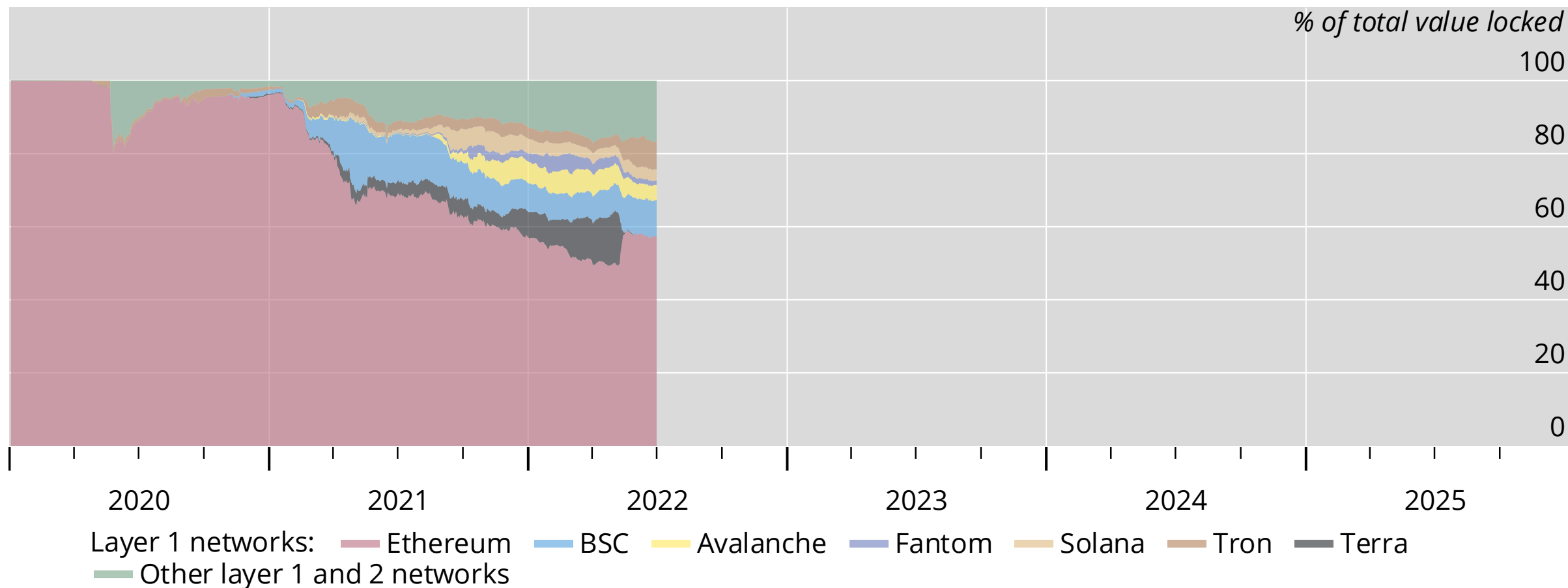

USD bn

Legend: Layer 1 networks — Ethereum — Terra — BSC (Binance) — Avalanche — Fantom — Solana — Tron — Other layer 1 and 2 networks

Total value locked (TVL) across layer 1 and layer 2 networks illustrates the tendency toward fragmentation

% of total value locked

Layer 1 networks: — Ethereum — BSC — Avalanche — Fantom — Solana — Tron — Terra
— Other layer 1 and 2 networks
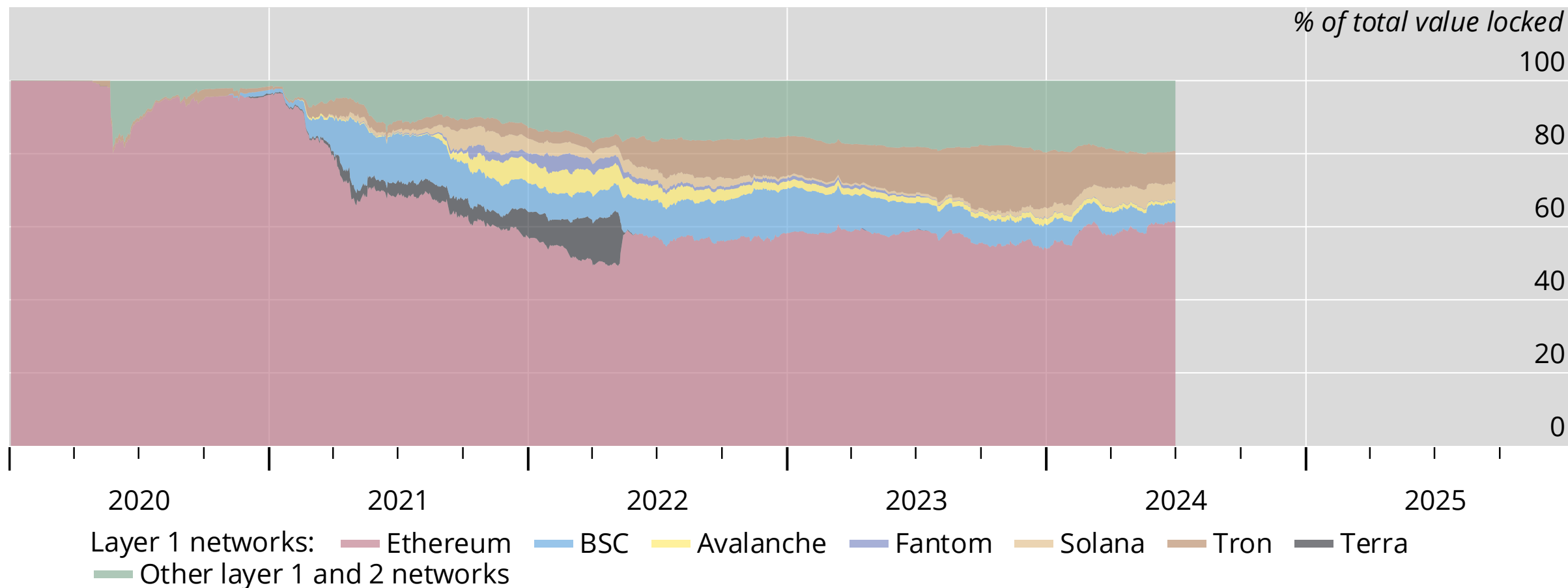
Sources: Boissay et al (2022); BIS (2025)

Total value locked (TVL) across layer 1 and layer 2 networks illustrates the tendency toward fragmentation

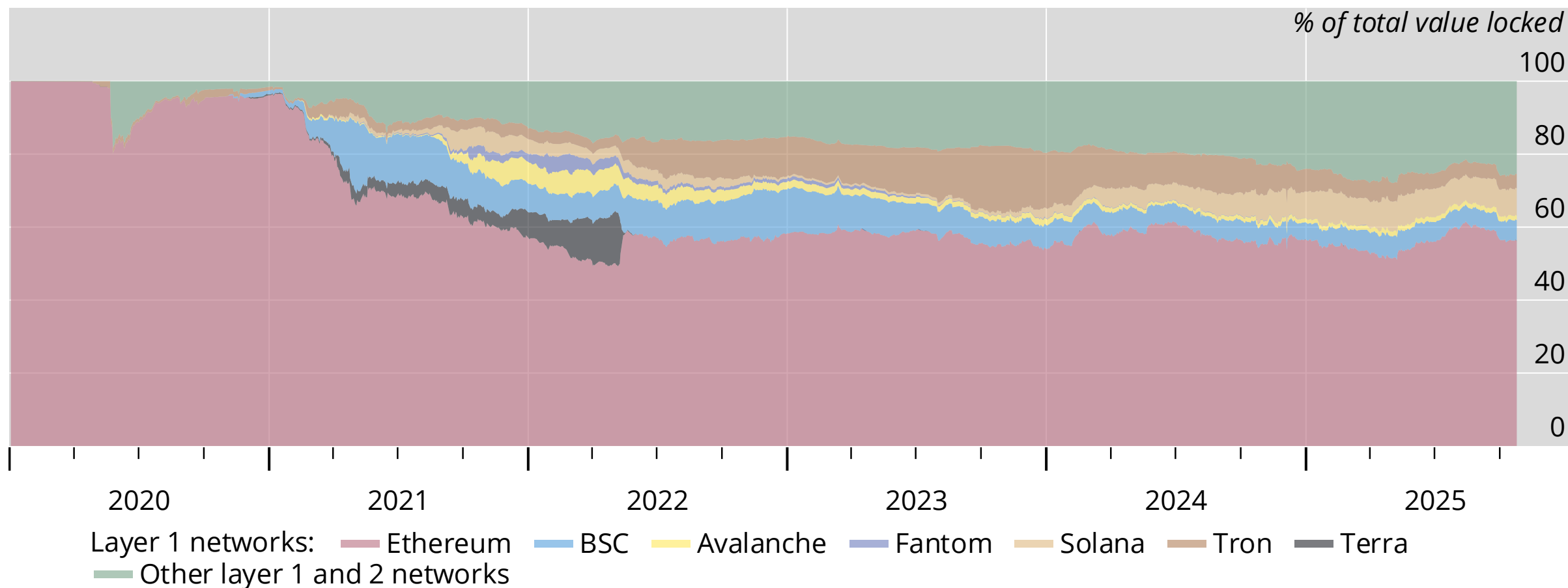*% of total value locked*

Layer 1 networks: — Ethereum — BSC — Avalanche — Fantom — Solana — Tron — Terra
— Other layer 1 and 2 networks

After the collapse of the Terra blockchain, Ethereum gained ground again...

% of total value locked

Layer 1 networks: ▬ Ethereum ▬ BSC ▬ Avalanche ▬ Fantom ▬ Solana ▬ Tron ▬ Terra
▬ Other layer 1 and 2 networks
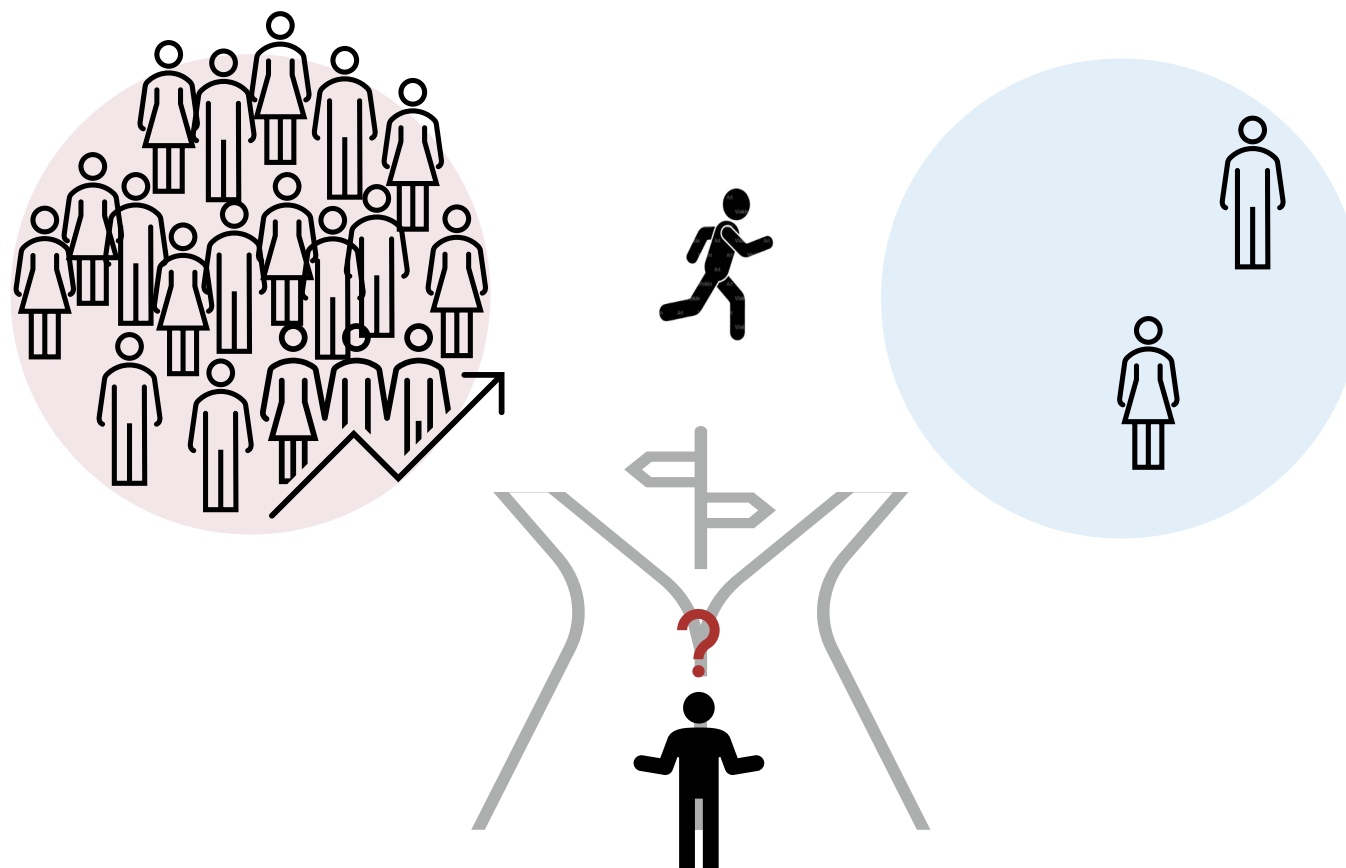
Sources: Boissay et al (2022); BIS (2025)

....but since then, a greater role or other layer 1 and layer 2 networks

% of total value locked
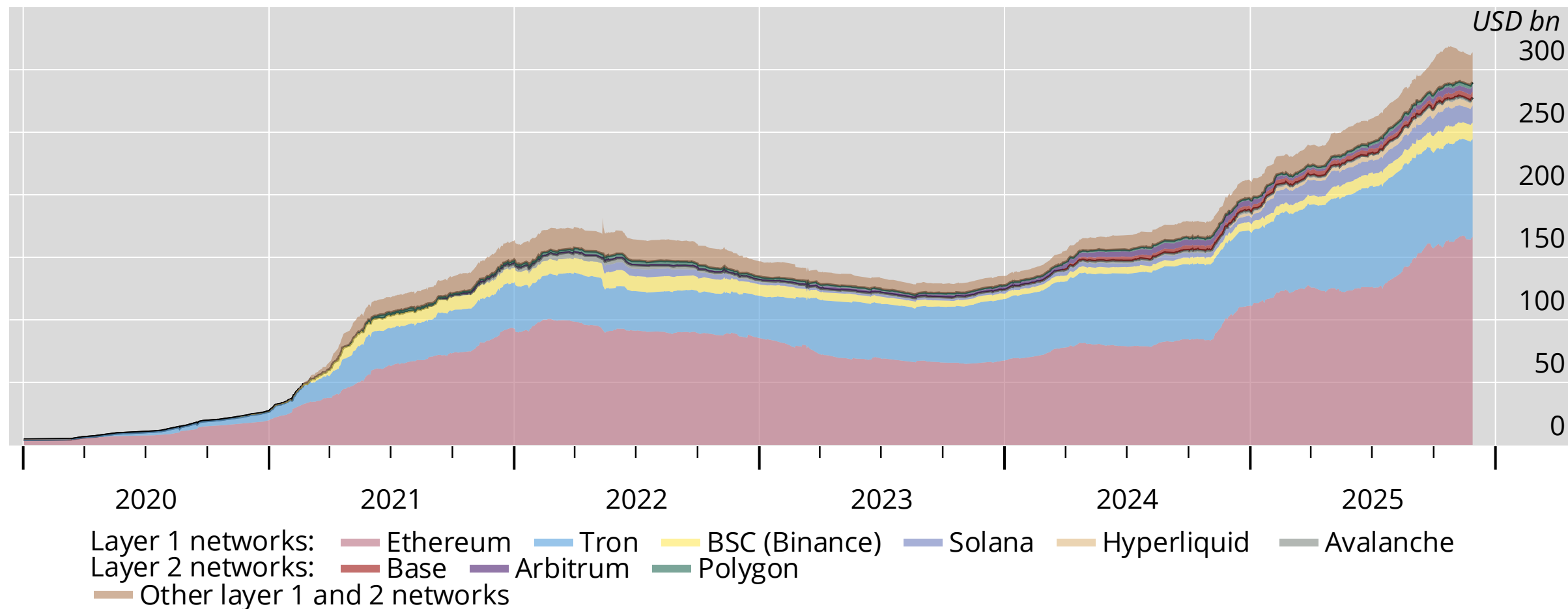
Layer 1 networks: Ethereum · BSC · Avalanche · Fantom · Solana · Tron · Terra · Other layer 1 and 2 networks

Congestion in decentralised ledgers undercuts the network effects of money; new blockchains (with lower security) emerge as a response to congestion
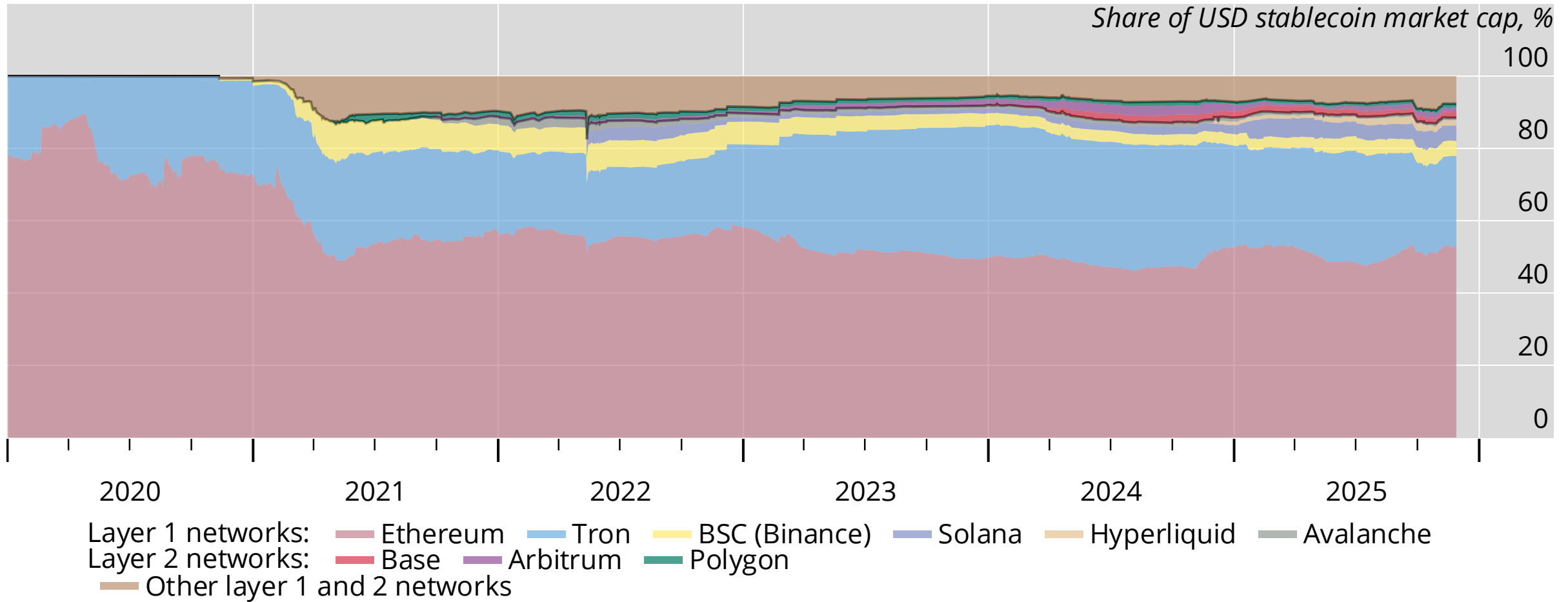
As the circulating value of stablecoins increases, they are circulating in a more fragmented infrastructure
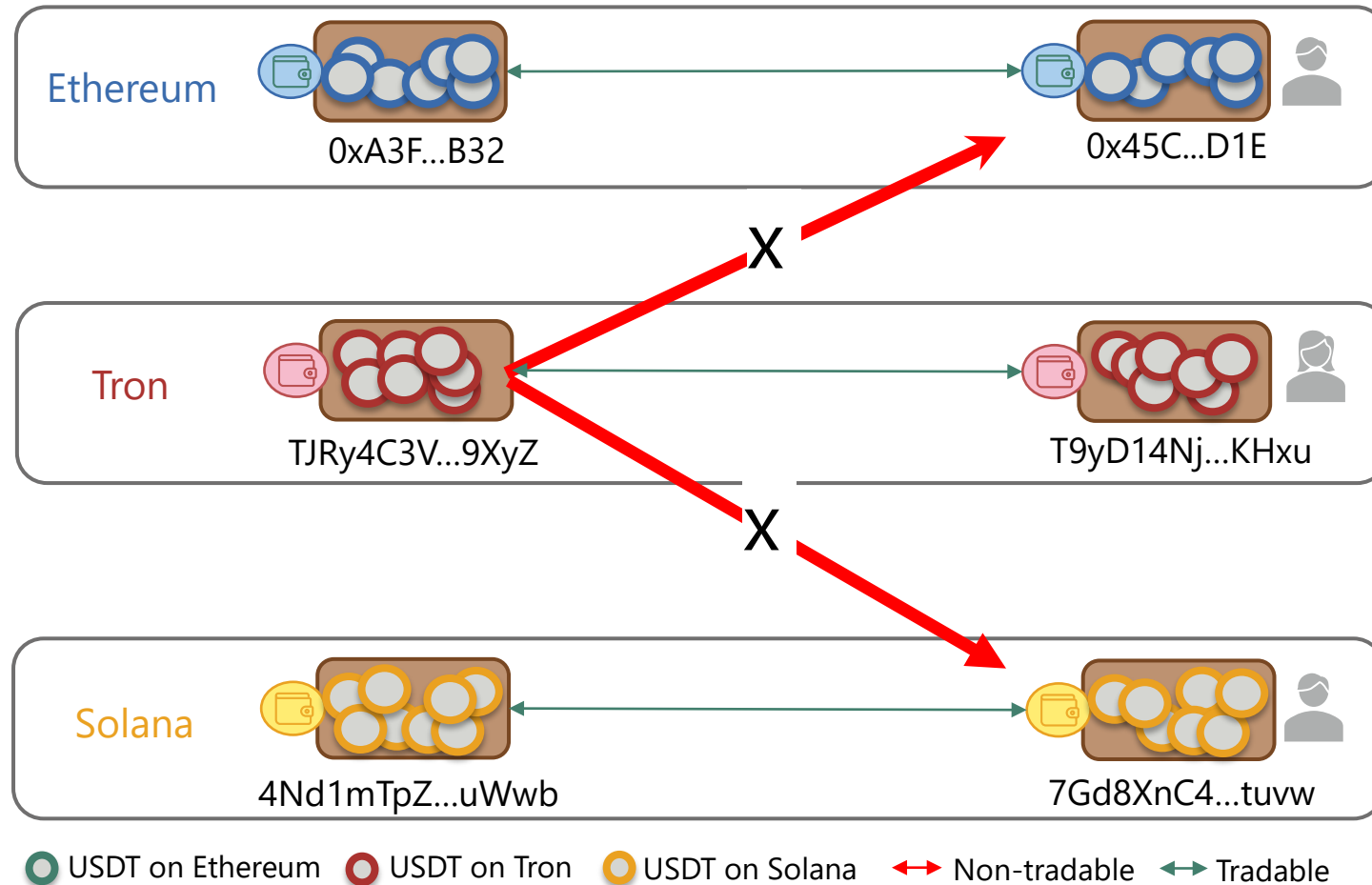

Source: DeFiLlama

Ethereum and Tron are largest, but other blockchains have gained ground
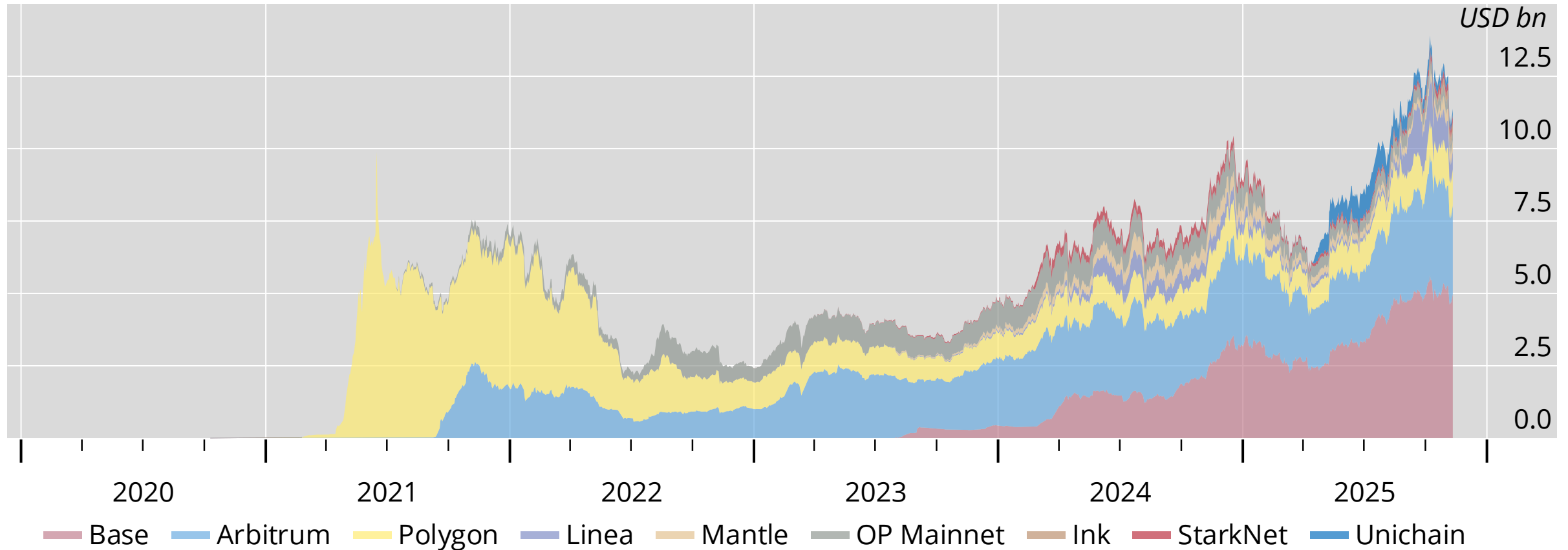

Share of USD stablecoin market cap, %

Layer 1 networks: Ethereum · Tron · BSC (Binance) · Solana · Hyperliquid · Avalanche
Layer 2 networks: Base · Arbitrum · Polygon
Other layer 1 and 2 networks

Source: DeFiLlama

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Stablecoins are not interoperable across blockchains; users need to resort to "bridges" or to centralised intermediaries (ie, exchanges)

Ethereum
0xA3F...B32   0x45C...D1E

Tron
TJRy4C3V...9XyZ   T9yD14Nj...KHxu

Solana
4Nd1mTpZ...uWwb   7Gd8XnC4...tuvw

USDT on Ethereum   USDT on Tron   USDT on Solana   ←→ Non-tradable   ←→ Tradable

Layer 2 blockchains ease congestion by "rolling up" transaction information for submission to Layer 1 blockchain, but at the cost of centralisation
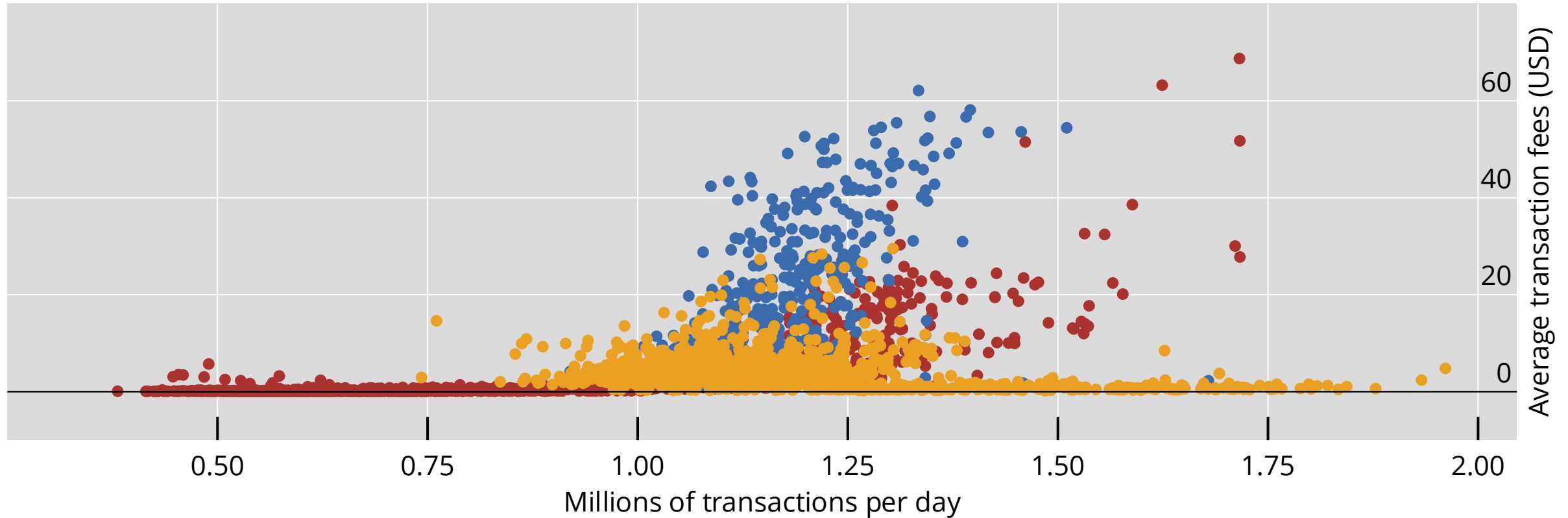

USD bn

Legend: Base, Arbitrum, Polygon, Linea, Mantle, OP Mainnet, Ink, StarkNet, Unichain

Source: DeFiLlama

Many layer 2 blockchains have emerged, fragmenting the supporting infrastructure for stablecoins

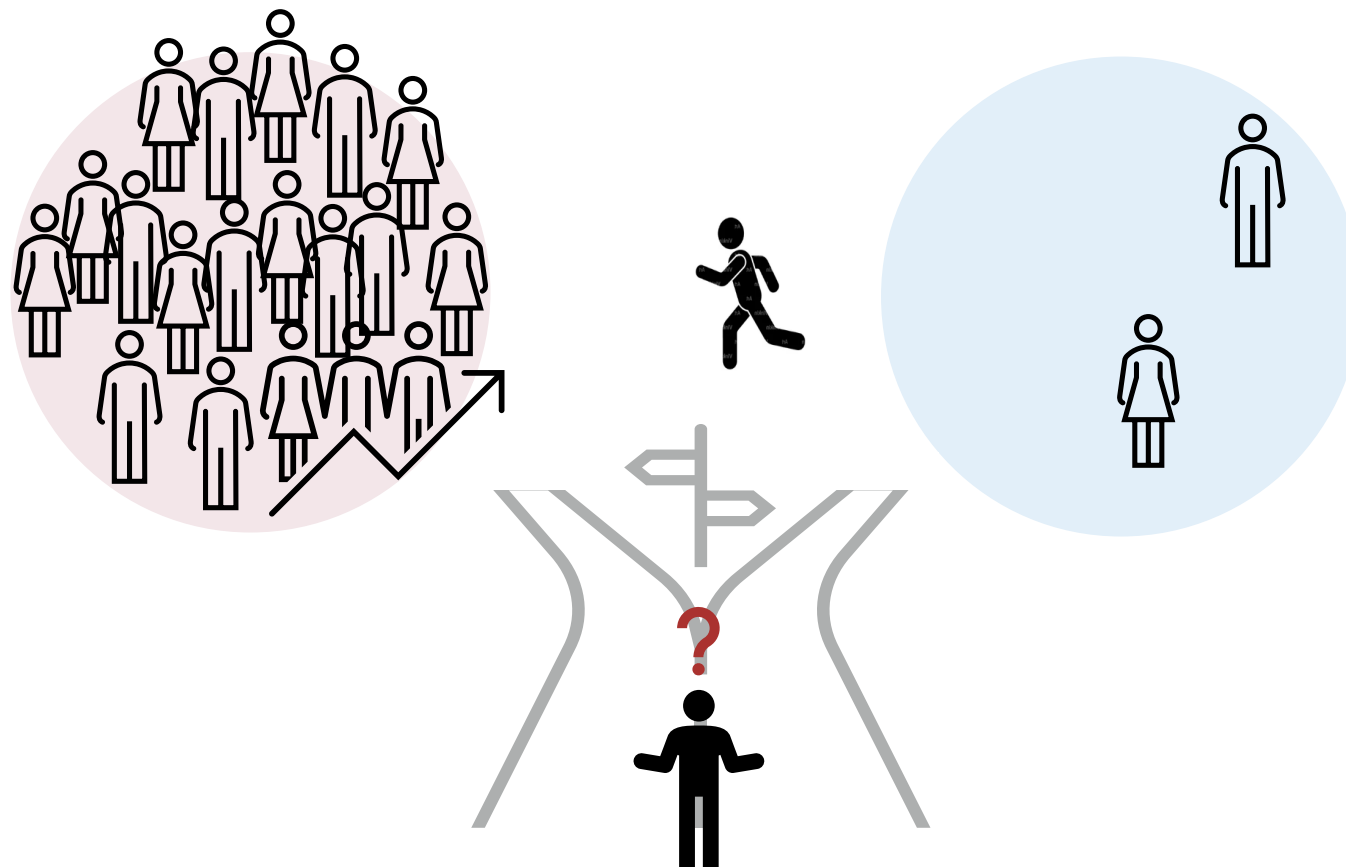|				
Arbirum One	Base Chain	OP Mainnet	Lighter	Linea
Skarknet	Zksync Era	Katana	Ink	Unichain
Scroll	Abstract	Paradex	Zksync Lite	Loopring
Polygon zkEVM	Facet v1	Phala	Polygon PoS	Mantle
World Chain	Celo	EdgeX	Blast	Fraxtal
Mode	Lisk	Metis	Soneium	Plume Network

Source: L2beat

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Ethereum's move to proof of stake and the prevalence of layer 2 "roll-ups" have reduced transaction fees at the cost of greater fragmentation and centralisation
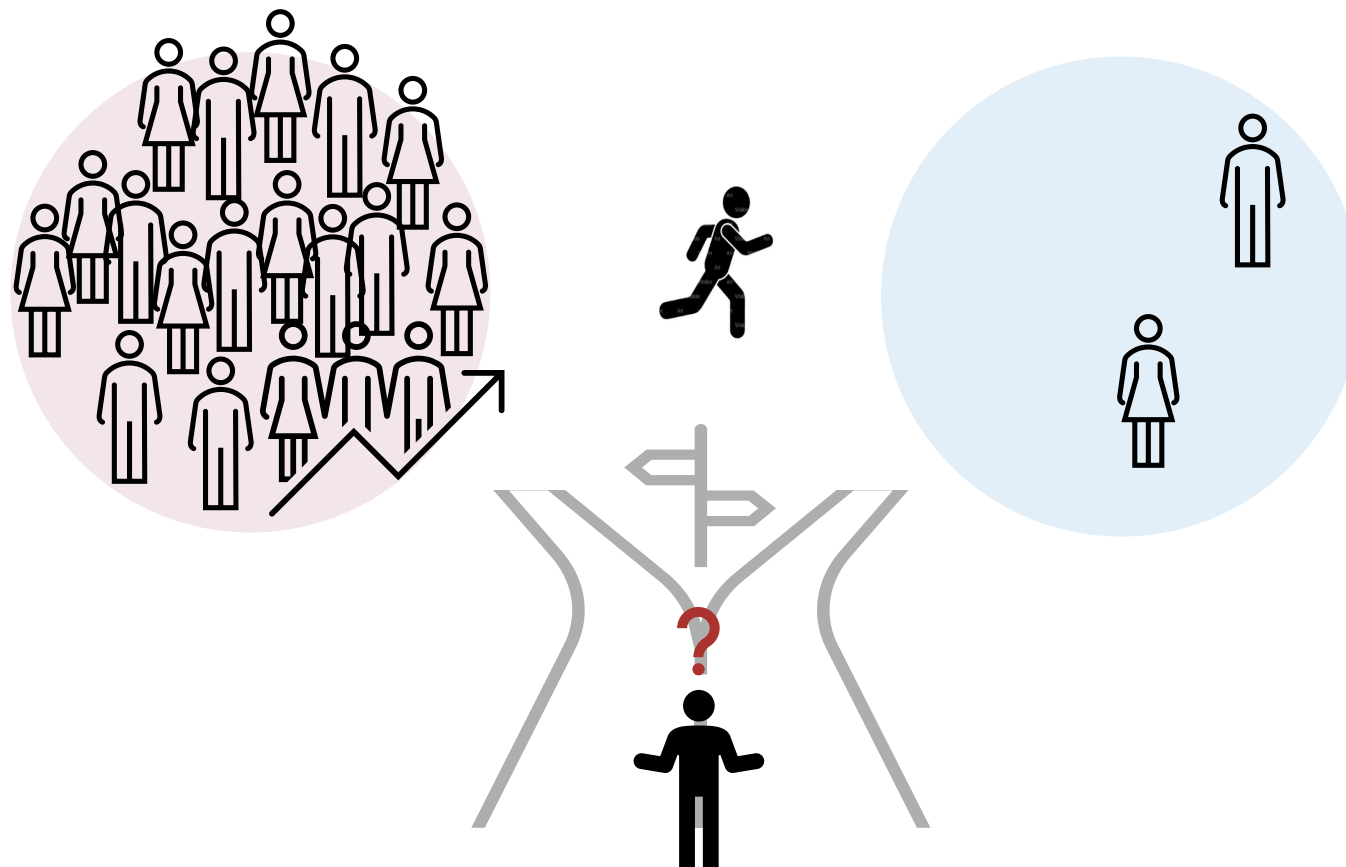

- 1 Jan 2018–4 Aug 2021
- Post-Ethereum London hard fork: 5 Aug 2021–14 Sep 2022
- Post-Ethereum merge: 15 Sep 2022–26 Nov 2025

Source: Boissay et al (2022); BIS (2025)

Network effects underpin the coordination role of money; key to its role is the feedback loop between greater acceptance and greater use

Congestion in decentralised ledgers undercuts the network effects of money; new blockchains emerge; fragmentation is the consequence

For central banks, maintaining the coordination role of money is key

- How should the monetary system built around central bank money interact with stablecoins circulating on public permissionless blockchains?

  - How to maintain the coordination role of money?

  - How to deal with the fragmentation of the supporting infrastructure for stablecoins?

  - On- and off-ramps emerge as key players; what is their role in the monetary system?