Session 10: Central banks and the digital revolution:

Fintech, DeFi, crypto assets and labor markets

S 10 Outline

- S 10.1 Digital technology and new bank runs
- S 10.2 Crypto-currencies
- S 10.3 Big Techs
- S 10.4 Fast payments
- S 10.5 A “Future” Monetary System?

Issues

- New money or crypto assets? Fintech and DeFi: the progress and the risks
- Digital technologies and the role in better measurement of risk in credit markets with Big Data and digital ID
- Fast payments systems, CBDC, new insurance mechanisms
- Financial inclusion and exclusion
- Public platforms, inter-operability and the potential for new financial public goods

S 10.1 Digital technology and new bank runs

- AI, algorithms, information and “digital” financial crises: the Silicon Valley Bank run
- Deregulation of medium-size banks after GFC; loose supervision by regulators, supervisors and CBs
- Balance sheet vulnerabilities: non-insured large deposits (liabilities), re-valuation of assets under FED tightening, big loans to SV start-ups
- Information in new digital age: confidence decline, deposit withdraw, realization of losses, liquidity problems occur much faster
- Speed of new bank run spiral with digital banking; CB intervention; bankrupcy

Classical bank run model (Diamond-Dybwig)

- Banks lend LT (to firms, HH) with long maturity and receive ST deposits (from HH) with short maturity
- Normal times: depositors withdraw small and random; banks keep small fraction in ST liquid assets; can lend LT and make profit of difference in deposit and lending rate
- Stress / crisis time: too many depositors withdraw at same time; LT loans illiquid; banks can sell assets (sometimes losing value); at some point run out of cash; liquidity problem can become insolvency
- Role of CB: if problem is liquidity; Bagehot's rule *to avert panic, central banks should lend early and freely (ie without limit), to solvent firms, against good collateral, and at 'high rates'*

SVB Additional problems in digital era

- **Valuation losses** on safe assets (FED tightening)
  - Bond prices move in inverse fashion to interest rates, called **interest rate risk**. If bond yields decline, the value of bonds already on the market move higher. If bond yields rise, existing bonds lose value.
- **Concentration** of uninsured depositors
  - FDIC threshold set at $250K maximum to avoid moral hazard; if small number of depositors have large amounts; a few withdraws can cause liquidity problem
- **Speed of spreading rumors**, information about Banks health and capacity to withdraw deposits
  - Smartphone technology allows today anyone to receive information instantly and take action (withdraw deposits) also instantly

Typical Bank run picture 19th century: long queuing to withdraw

Digital Bank run picture 21st century: instant withdraw

Bank Runs: When Banks Get Caught in a Spiral of Fear

The negative feedback loop behind many bank failures

Perceived or **actual weakness** of a bank, in most cases liquidity concerns

Uncertainty and **fear** among the bank's clients

Customers **withdraw deposits**

Confidence falls further

Mass withdrawals cause/ **worsen liquidity problems**

Bank is **forced to sell assets** (often at a loss) to create liquidity

Insolvency/ collapse

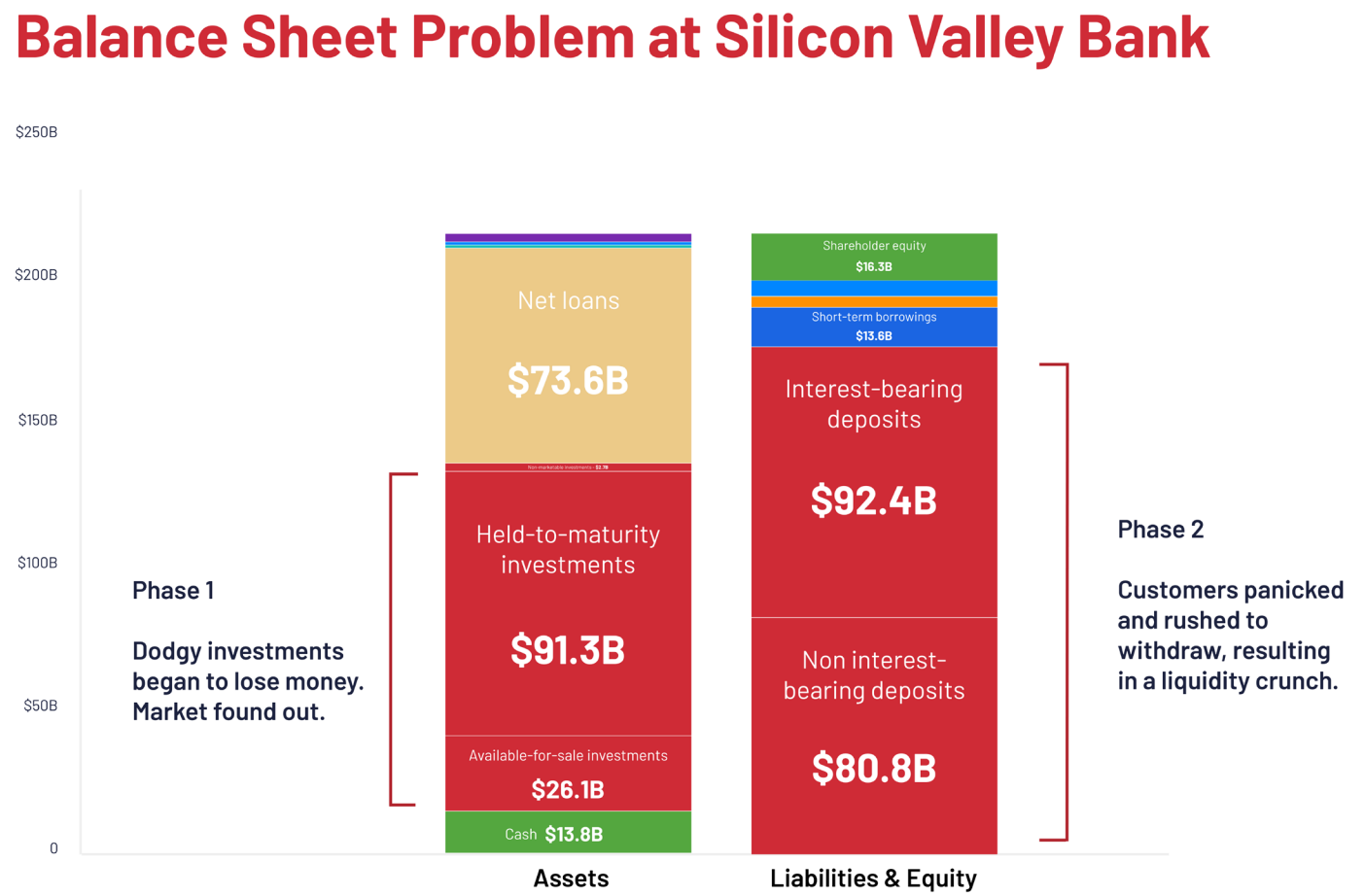
Fear turns into **panic**

Source: Statista research

statista

SVB: Business Model fragility

- Loans to Silicon Valley start-ups can run into problems
- “Safe assets” (Treasuries) face re-valuation due to FED tightening cycle; selling brings accounting loss
- Rumors start spreading

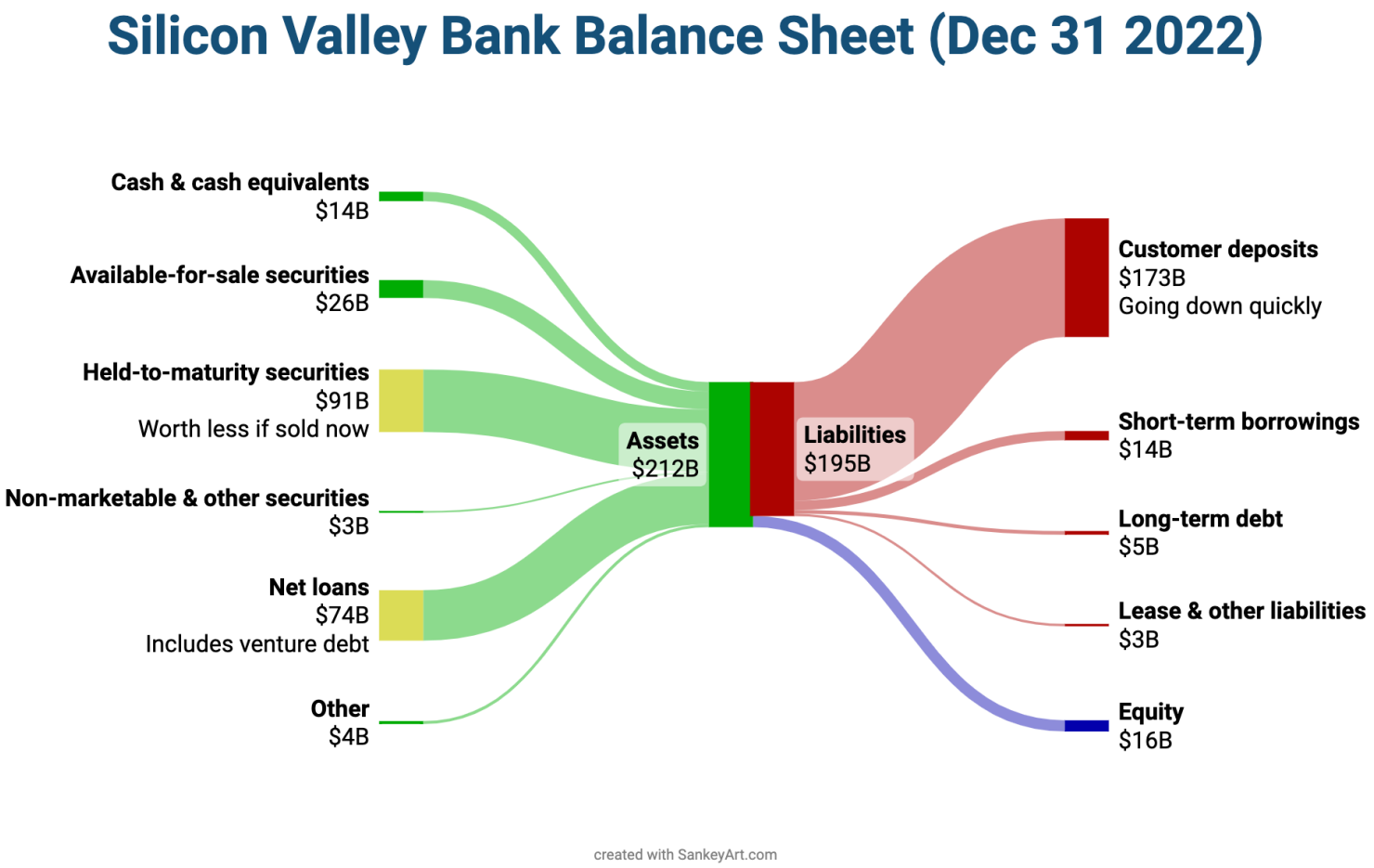


Source: Silicon Valley Bank 2022 December balance sheet

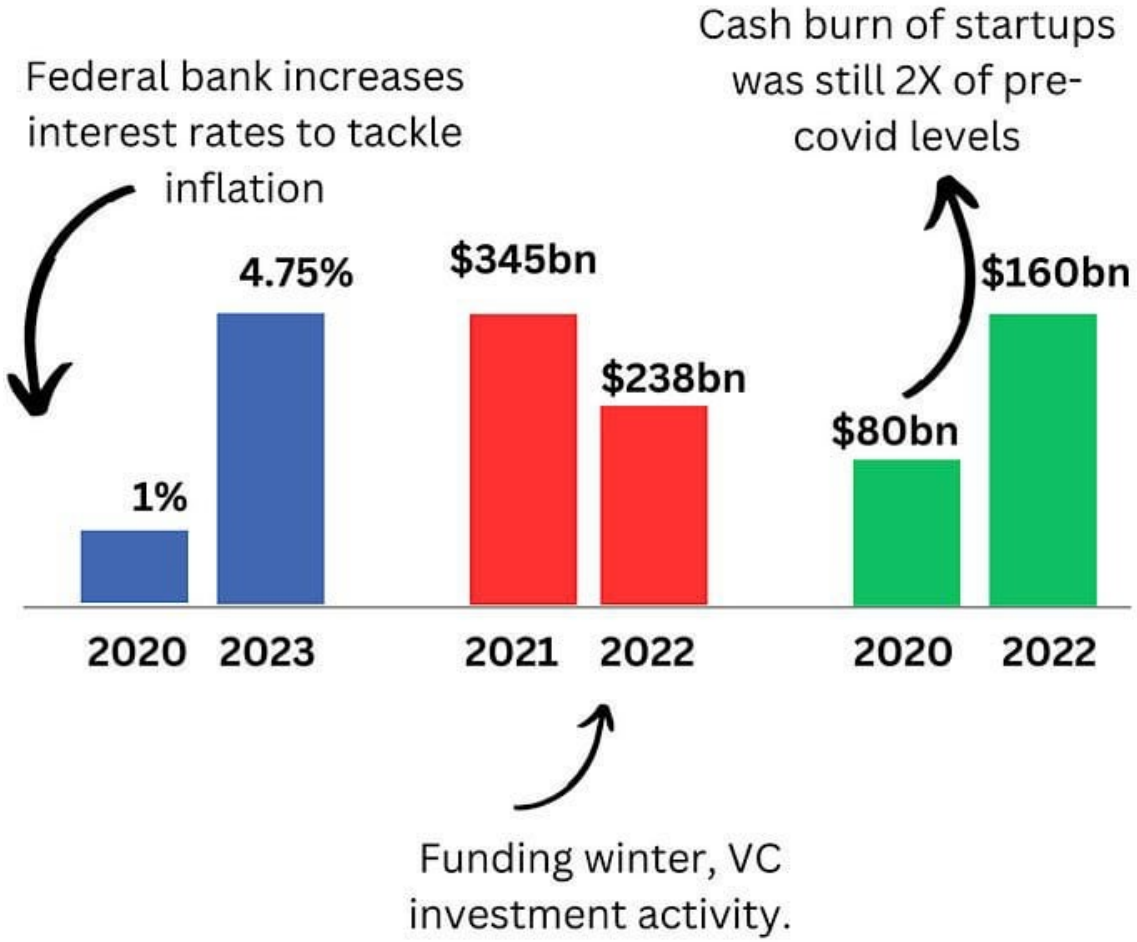
Created by genuine impact

More charts: genuineimpact.substack.com

SVB: Balance sheet fragility and depositors concentration



SVB: FED Tightening Cycle with “risky clients”



Cash burn rate: how fast a startup spends its cash reserves; it is a financial runway — for how long it can sustain operations before running out of cash = financial health of your startup

Lessons, technology, regulatory and supervision failure

On April 28, FED Vice Chair for Supervision Michael S. Barr released a lengthy review of the Fed's supervision and regulation of SVB. The Fed highlighted four causes of the bank's failure:

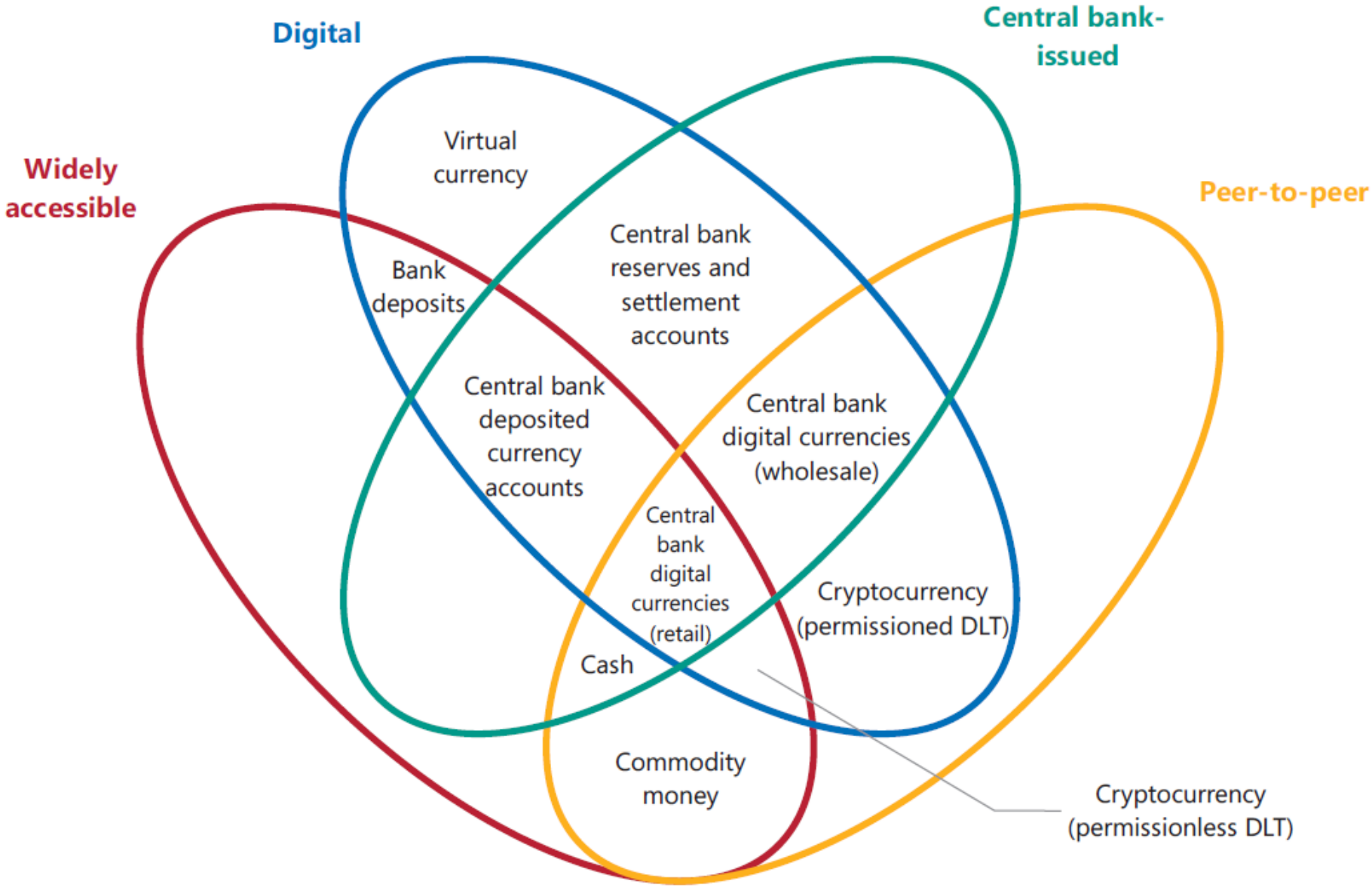
- SVB's board of directors and management failed to manage their risks (eg., lack of a Chief Risk Officer for one year).
- Fed supervisors did not fully appreciate the extent of the vulnerabilities as SVB grew in size and complexity. When supervisors did identify vulnerabilities, they did not take sufficient steps to ensure that SVB fixed those problems quickly enough. https://www.federalreserve.gov/publications/2023-April-SVB-Federal-Reserve-Supervision.htm
- Failed regulation ? The 2018 law—the Economic Growth, Regulatory Relief, and Consumer Protection Act, lightened the oversight of some mid-sized banks— still SVB was quite large (over $200b total assets).
- Failed supervision? Despite identified problems, no action by supervisors. https://oversight.house.gov/release/hearing-wrap-up-silicon-valley-bank-collapse-is-a-case-of-failed-supervision/

S 10.2 Crypto-currencies

- S 10.2.1. Putting the rise of cryptocurrencies into perspective
- S 10.2.2. The current monetary and payment system
- S 10.2.3. Cryptocurrencies: the elusive promise of decentralised trust
- S 10.2.4. Distributed ledger technology in cryptocurrencies
- S 10.2.5. Assessing the economic limitations of permissionless cryptocurrencies
- S 10.2.6. Policy implications and regulatory challenges posed by cryptocurrencies

The money flower: a taxonomy of money

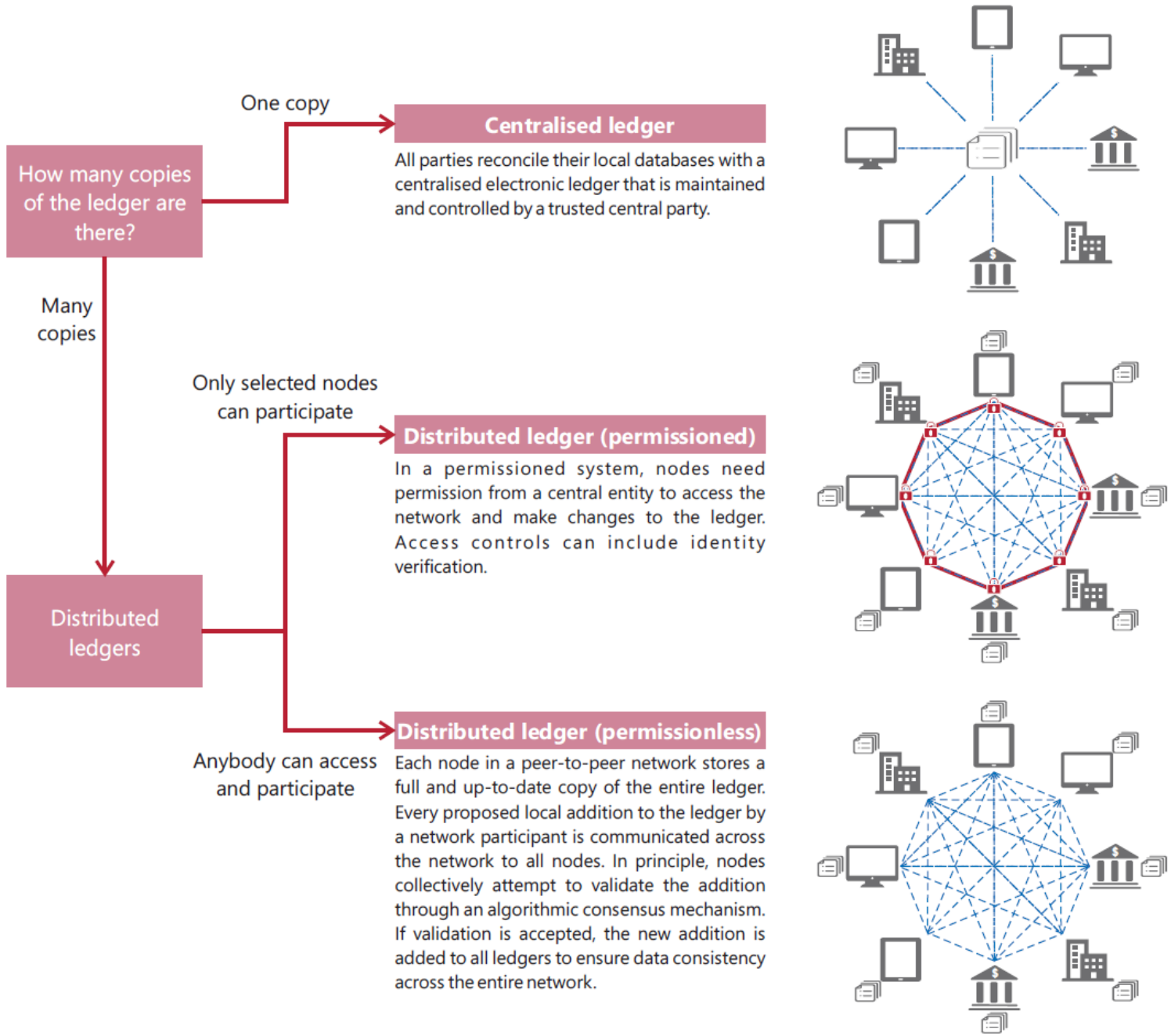
Graph V.1



Source: Adapted from M Bech and R Garratt, "Central bank cryptocurrencies", *BIS Quarterly Review*, September 2017, pp 55–70.

Centralised ledger and permissioned/permissionless decentralised ledgers

Graph V.2

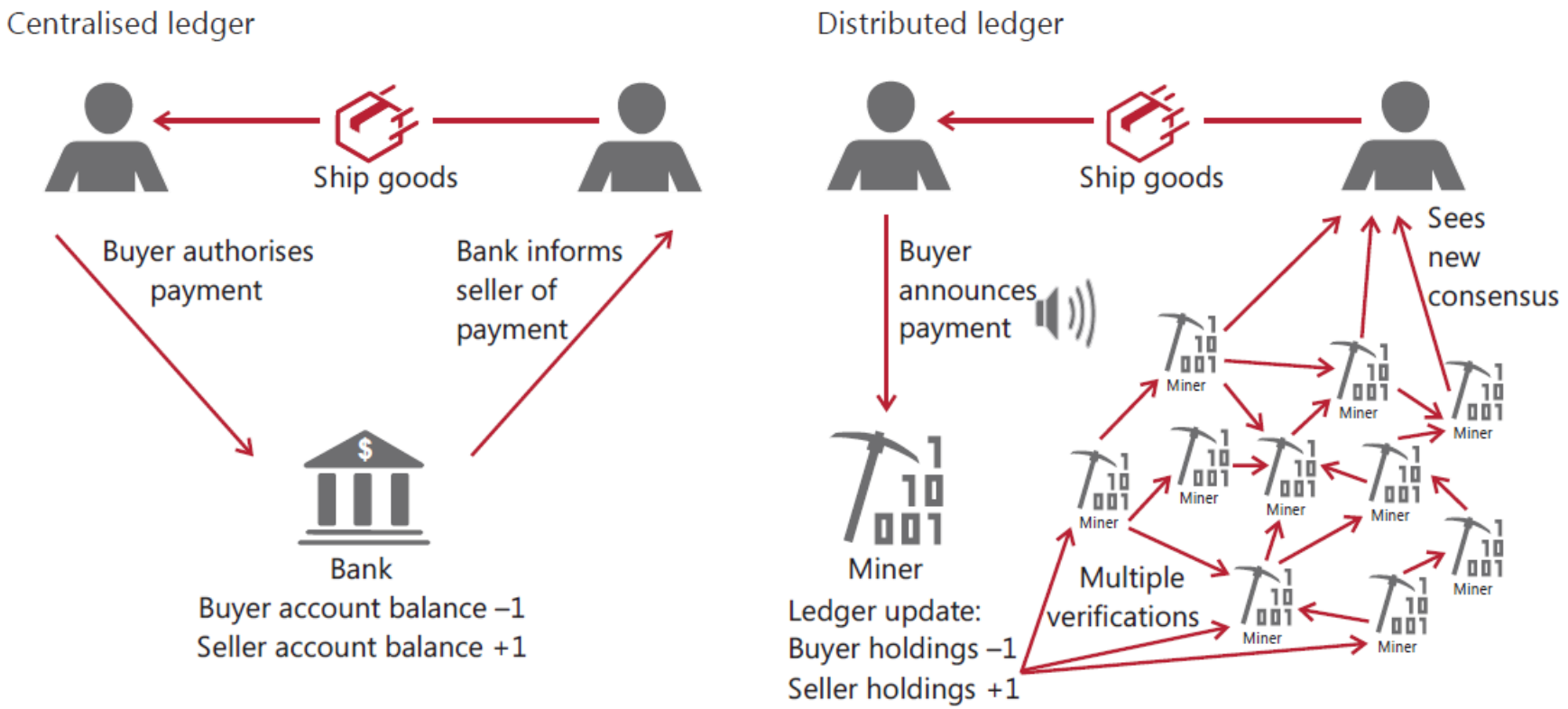


		Private electronic money based on fiat system	Privately issued cryptocurrencies	
			Permissioned	Permissionless
1	Storage of balances/holdings	Ledger (accounts) stored centrally by banks and other financial institutions	Decentralised storage of ledger	
2	Verification to avoid double-spending	Identity-based concept	Peer-to-peer concept: distributed ledger can be checked to see whether a specific unit of a currency has already been spent	
3	Processing of transactions	Accounts updated by bank	Updating of ledger via trusted nodes	Updating of ledger via proof-of-work Rule to follow longest chain
4	Finality/settlement concept	Settlement ultimately via central bank	Settlement in cryptocurrency itself	Probabilistic concept of finality via rule to follow longest chain
5	Elasticity of supply	Central bank policy, eg regarding intraday credit	Protocol can be changed by trusted nodes	Protocol-determined
6	Trust-creating mechanisms	Reputation of banks and central banks, banking supervision, lender of last resort, legal tender laws, central bank independence and accountability, AML/CFT checks, cyber-security	Reputation of issuing firm and nodes Trusted nodes, some of which may be subject to regulation	Proof-of-work requires honest computing majority

Sources: Adapted from H Natarajan, S Krause and H Gradstein, "Distributed ledger technology (DLT) and blockchain", World Bank Group, *FinTech Note*, no 1, 2017; BIS.

Valid transactions in a centralised ledger/bank account and in a permissionless cryptocurrency

Graph V.3

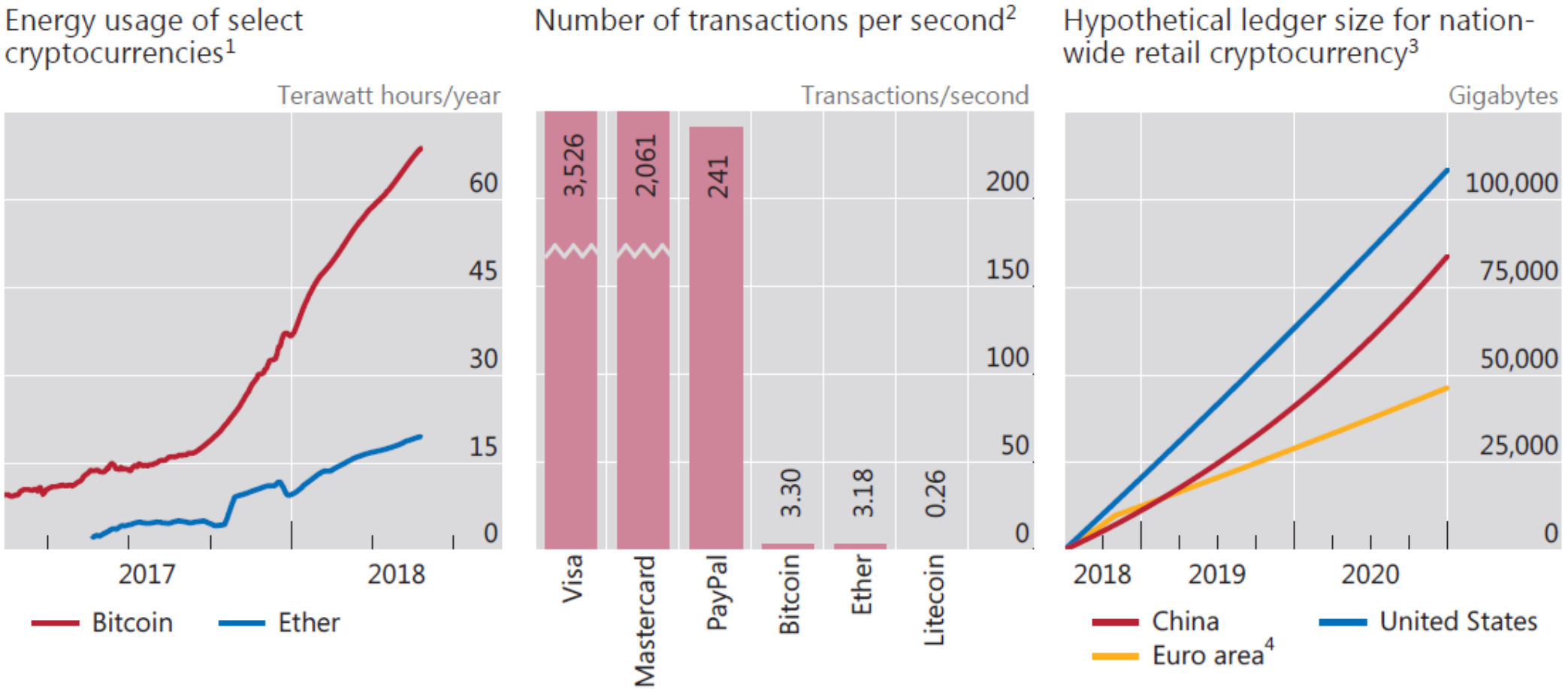


A buyer purchases a good from the seller, who initiates shipment upon perceived confirmation of the payment. If the payment takes place via bank accounts – ie via a centralised ledger (left-hand panel) – the buyer sends the payment instruction to their bank, which adjusts account balances debiting the amount paid from the buyer's account and crediting it to the seller's account. The bank then confirms payment to the seller. In contrast, if payment takes place via a permissionless cryptocurrency (right-hand panel), the buyer first publicly announces a payment instruction stating that the cryptocurrency holdings of the buyer are reduced by one, while those of the seller are increased by one. After a delay, a miner includes this payment information in a ledger update. The updated ledger is subsequently shared with other miners and users, each verifying that the newly added payment instruction is not a double-spend attempt and is authorised by the buyer. The seller then observes that the ledger including the payment instruction emerges as the one commonly used by the network of miners and users.

Source: Adapted from R Auer, "The mechanics of decentralised trust in Bitcoin and the blockchain", *BIS Working Papers*, forthcoming.

Energy consumption and scaling issues

Graph V.4

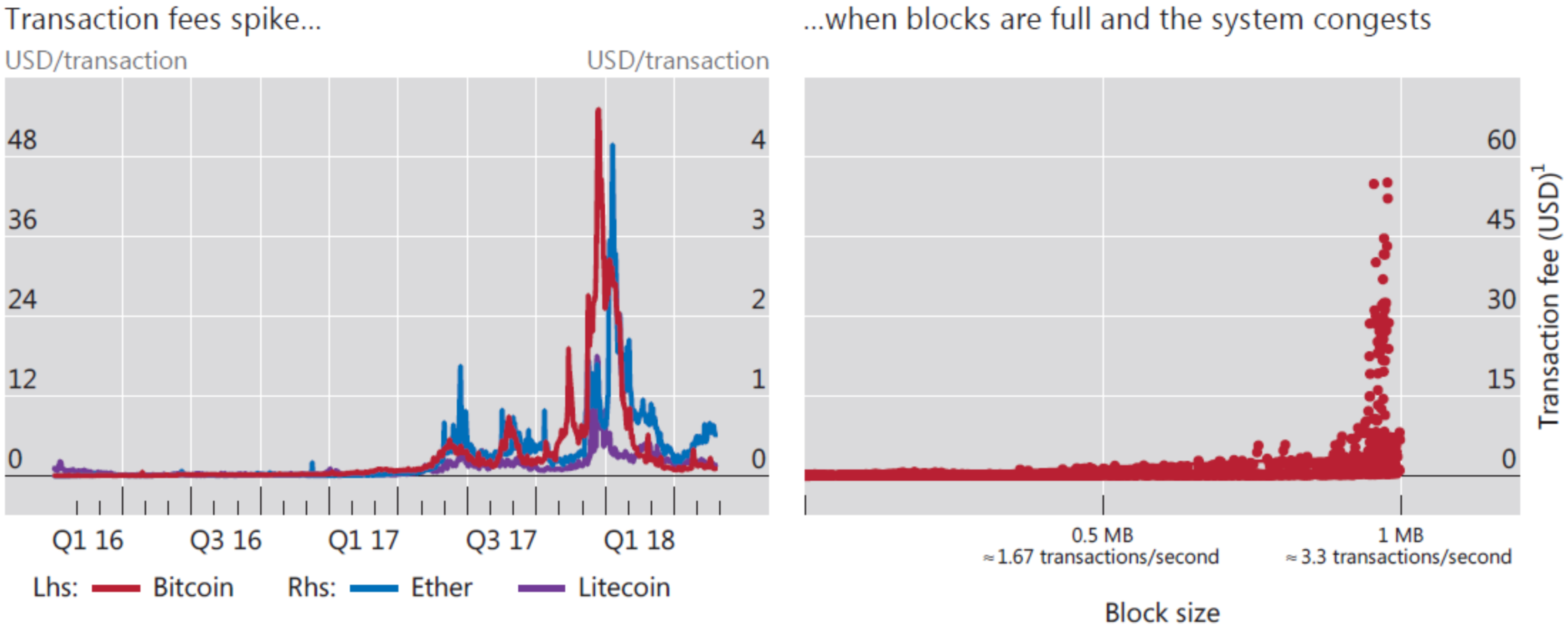


[1] Estimated. [2] 2017 data. [3] The displayed hypothetical size of the blockchain/ledger is calculated assuming that, starting from 1 July 2018, all non-cash retail transactions of either China, the United States or the euro area are processed via a cryptocurrency. Calculations are based on information on non-cash transaction numbers from CPMI (2017) and assume that each transaction adds 250 bytes to the ledger. [4] BE, FR, DE, IT and NL.

Sources: Committee on Payments and Market Infrastructures, *Statistics on payment, clearing and settlement systems in the CPMI countries*, December 2017; www.bitinfocharts.com; Digiconomist; Mastercard; PayPal; Visa; BIS calculations.

Transaction fees over time and in relation to transaction throughput

Graph V.5

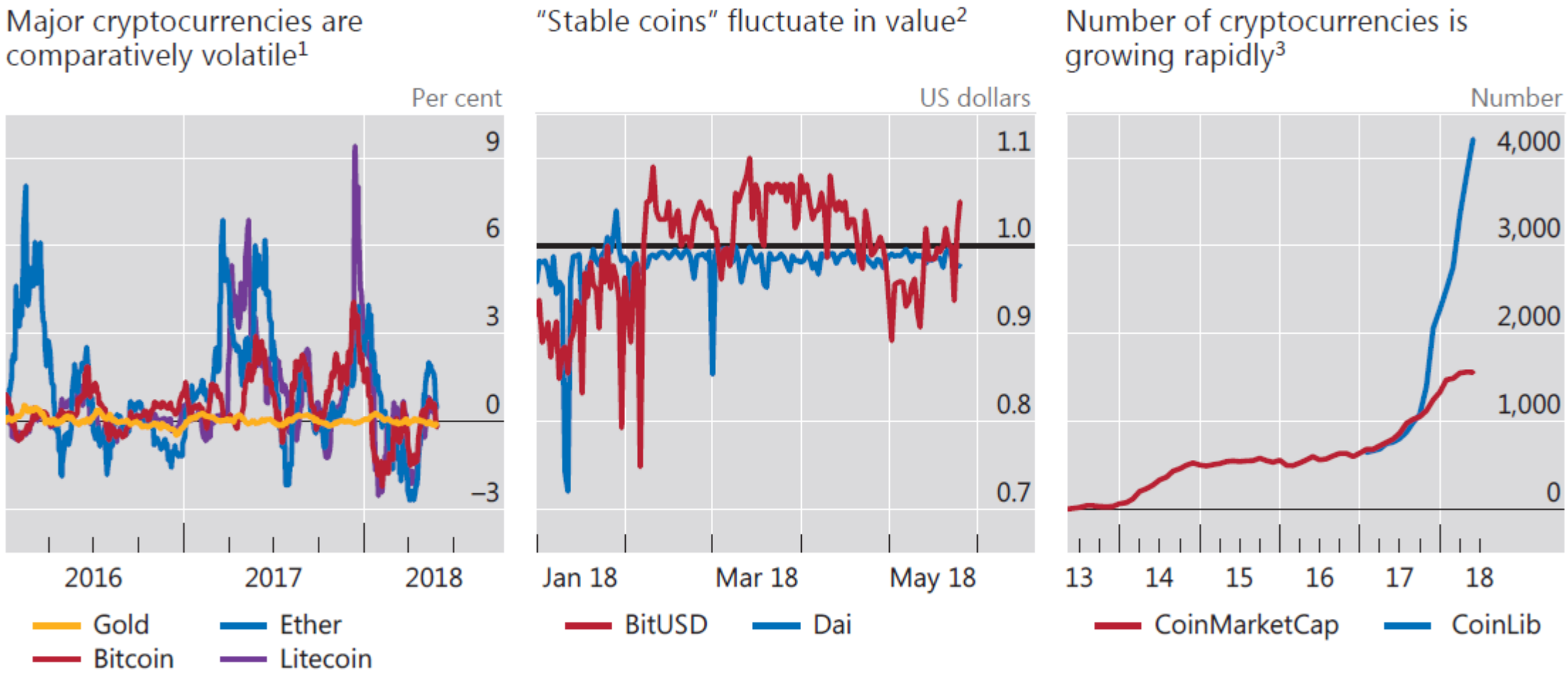


[1] Transaction fee paid to miners over the period 1 August 2010–25 May 2018; daily averages.

Sources: www.bitinfocharts.com; BIS calculations.

Volatility of select cryptocurrencies and number of cryptocurrencies

Graph V.6



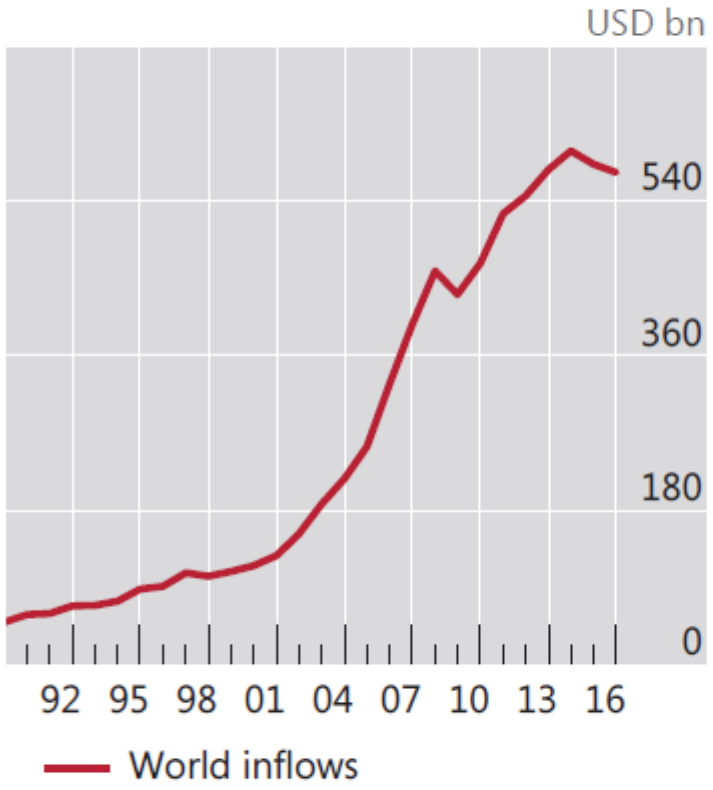
[1] Thirty-day moving averages of daily returns. [2] Daily price minimum. [3] Based on monthly snapshots from two different providers. CoinMarketCap includes only cryptocurrencies with a minimum 24-hour trading volume of $100,000; CoinLib does not use a threshold.

Sources: www.bitinfocharts.com; www.coinlib.io; www.coinmarketcap.com; Datastream.

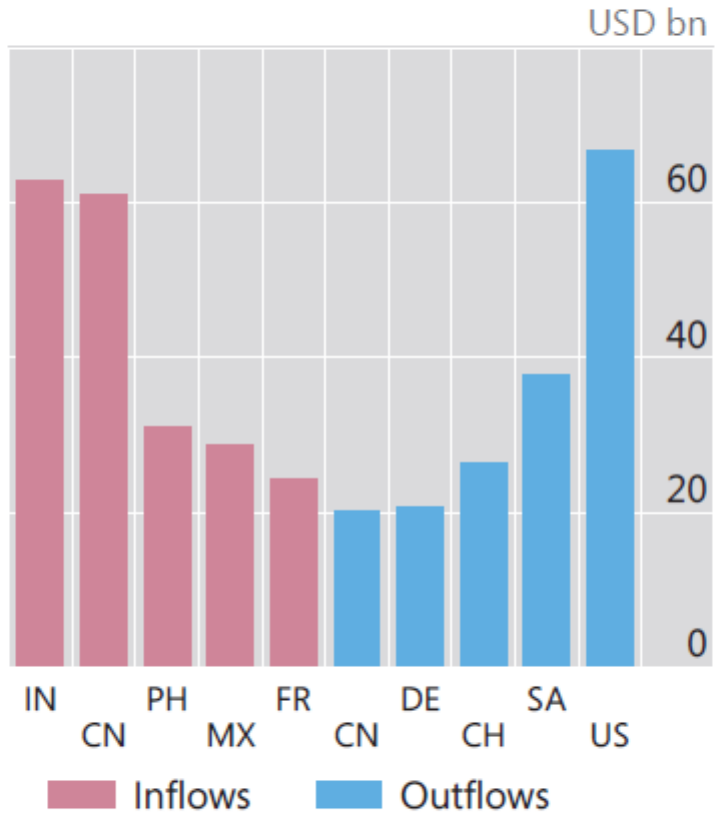
Indicators of the volume and cost of remittances

Graph V.8

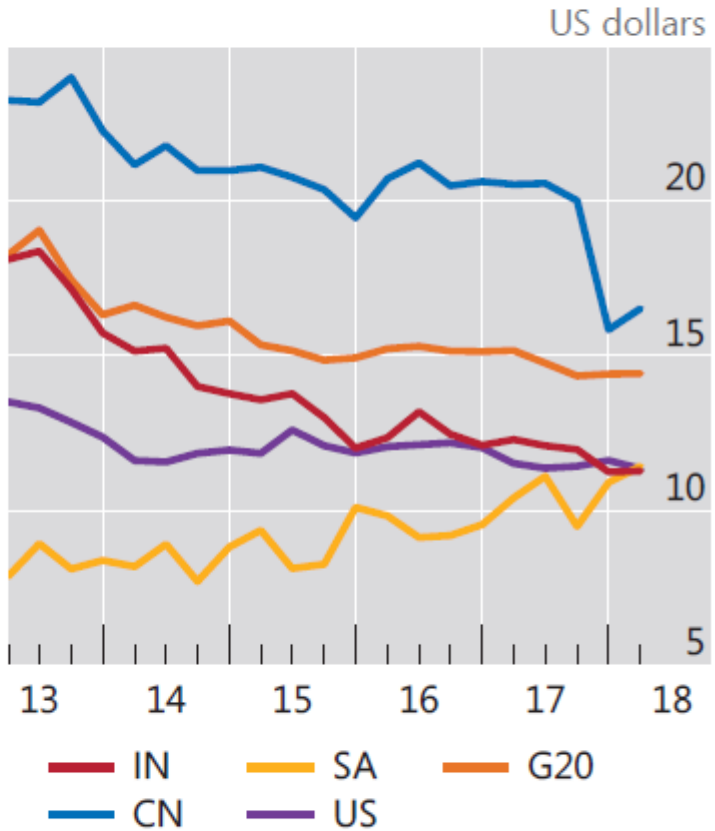
Remittance volumes are on the rise, resulting in...



...a large volume of low-value payments between often illiquid currency pairs...[1]



...at high average costs[2]

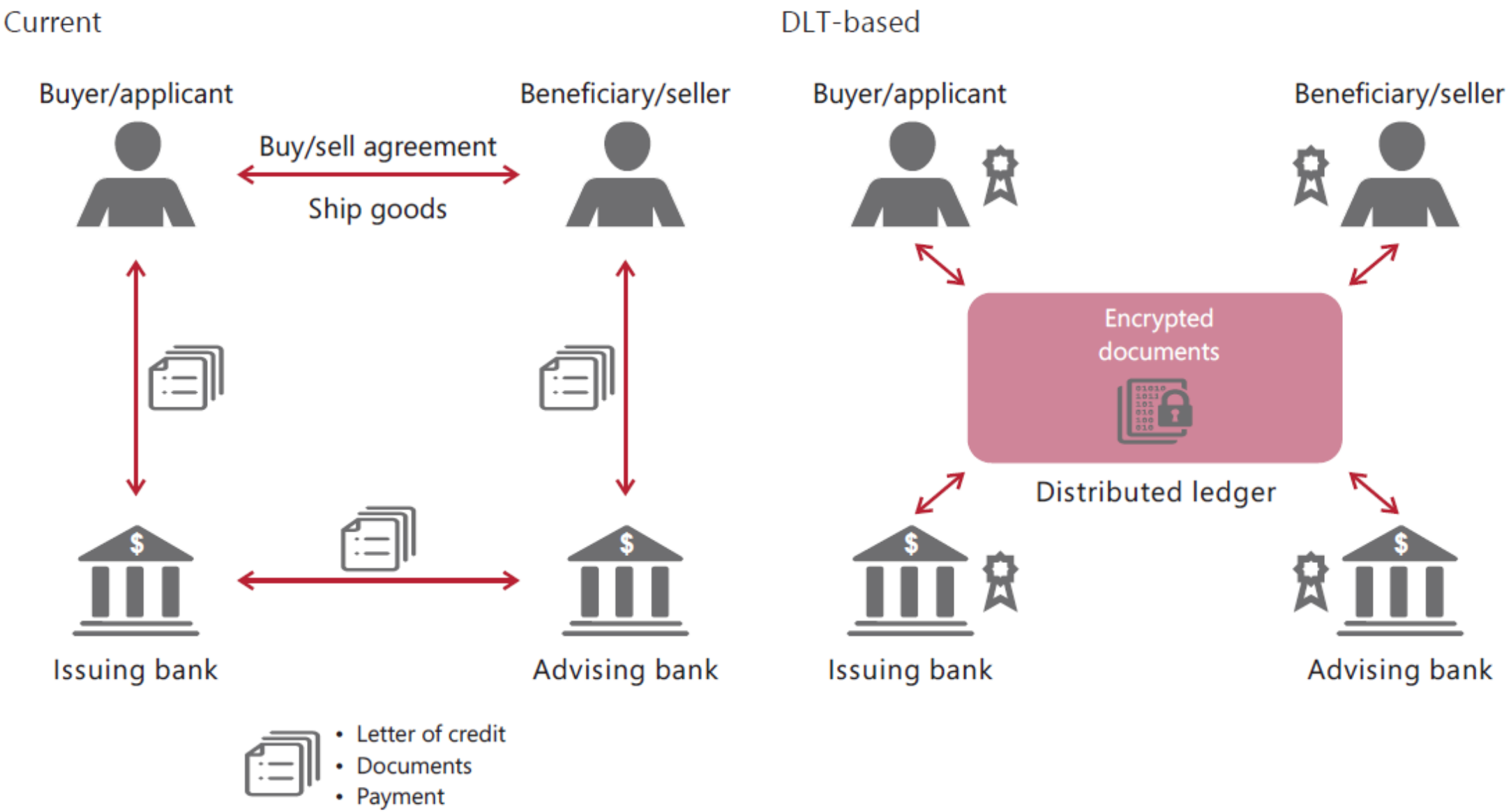


[1] Data for 2016. [2] Average total cost for sending $200 with all remittance service providers worldwide. For CN and IN, receiving country average total cost; for G20, SA and US, sending country average total cost.

Sources: World Bank, *Remittance Prices Worldwide*, remittanceprices.worldbank.org; World Bank; BIS calculations.

How trade finance on a distributed ledger works

Graph V.B

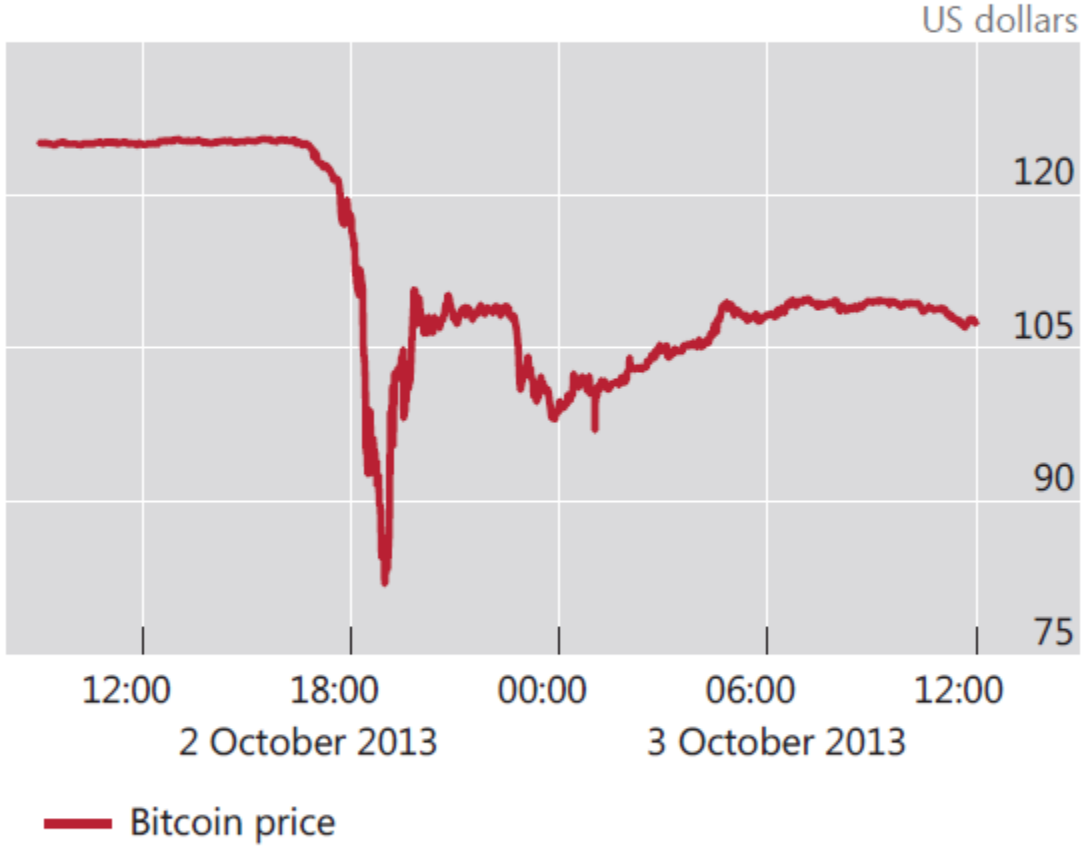


Source: Adapted from www.virtusapolaris.com.

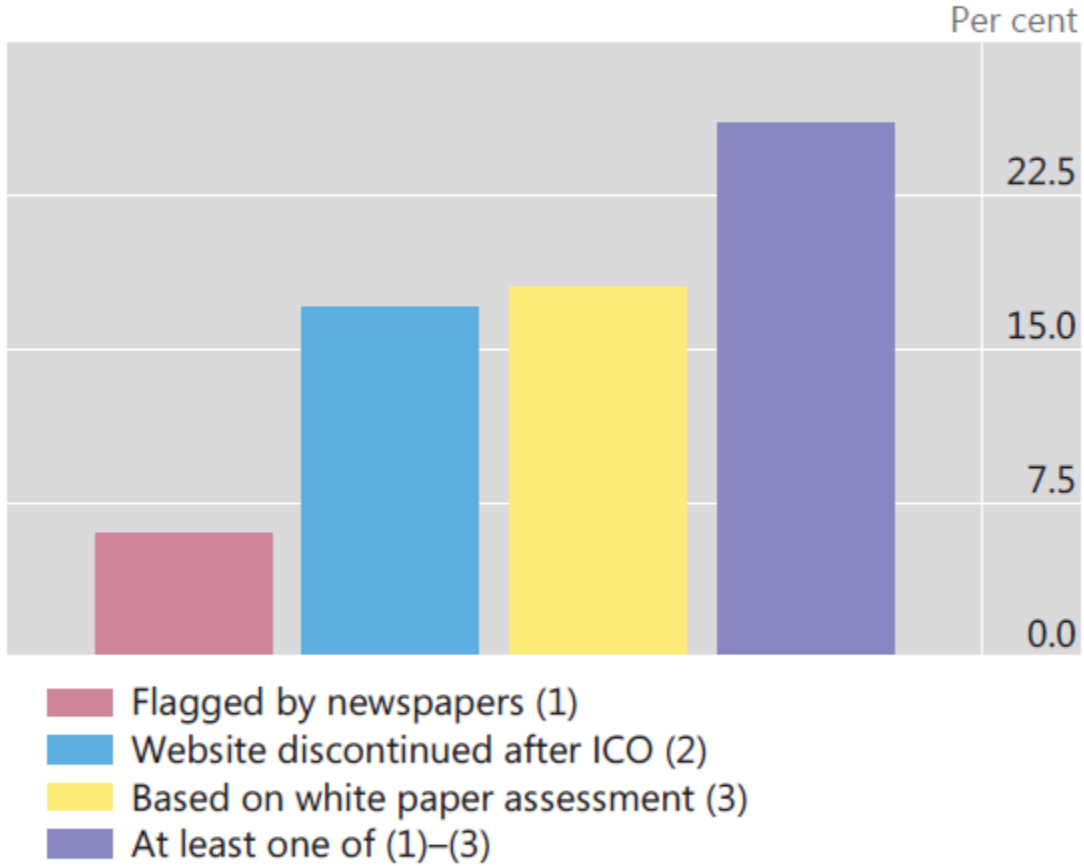
The shutdown of an illegal marketplace and the legitimacy of ICOs

Graph V.9

Cryptocurrency prices react strongly to shutdowns of illegal marketplaces[1]



A large share of initial coin offerings is thought to be fraudulent



[1] Bitcoin price during October 2013 Silk Road shutdown.

Sources: C Catalini, J Boslego and K Zhang, "Technological opportunity, bubbles and innovation: the dynamics of initial coin offerings", *MIT Working Papers*, forthcoming; CoinDesk.

S 10.3 Big Techs

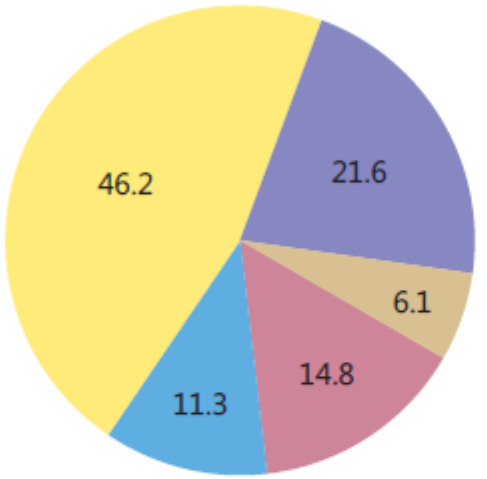
- S 10.3.1. Big techs in finance, opportunities and risks
- S 10.3.2. Why do big techs expand into financial services?
- S 10.3.3. Big techs' impact on financial services
- S 10.3.4. Big techs' potential benefits in lending
- S 10.3.5. Public policy towards big techs in finance "Same activity, same regulation"

Financial services are a small part of big tech business

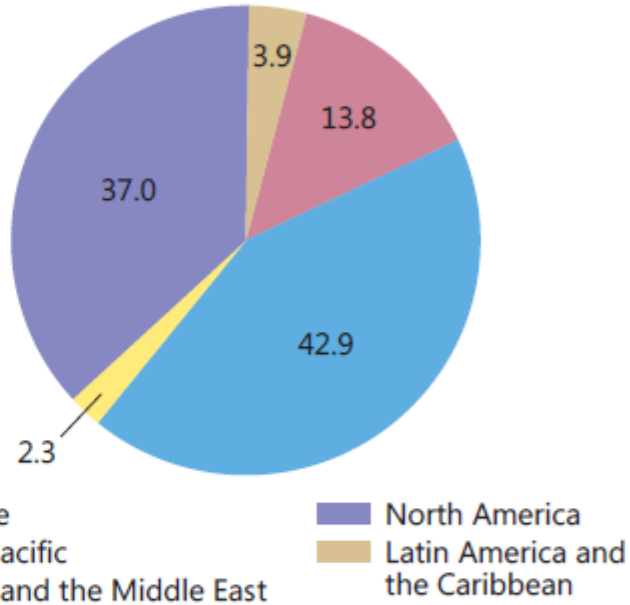
In per cent

Graph III.1

Big techs' revenues by sector of activity[1]



Regional distribution of big techs' subsidiaries[4]



The sample includes Alibaba, Alphabet, Amazon, Apple, Baidu, Facebook, Grab, Kakao, Mercado Libre, Rakuten, Samsung and Tencent.

[1] Shares based on 2018 total revenues, where available, as provided by S&P Capital IQ; where not available, data for 2017. [2] Information technology can include some financial-related business. [3] Includes health care, real estate, utilities and industrials. [4] Shares are calculated on the number of subsidiaries as classified by S&P Capital IQ.

Sources: S&P Capital IQ; BIS calculations.

Financial activities of selected big tech firms

Table III.1

	Main geographical area of activity	Payments	Money market funds and insurance	Credit
Emerging market economies				
Alibaba/Alipay, Tencent	China	Δ	Δ/√	Δ
Baidu	China	Δ	Δ/√	√
Vodafone M-Pesa	East Africa, Egypt and India	Δ		√
Mercado Libre	Argentina, Brazil and Mexico	Δ		Δ
Samsung	Korea	√		
GO-Jek, Ola Cabs	Southeast Asia	Δ		
Grab	Southeast Asia	Δ	√	Δ
KT	Korea	√	Δ	Δ/√
Kakao	Korea	Δ/√		Δ/√
Advanced economies				
Google	Worldwide	√		Δ/√
Amazon, eBay/PayPal	Worldwide	√		√
Apple, Facebook, Microsoft	Worldwide	√		
Orange	France	√		√
Groupon	Worldwide	Δ		
Line, Rakuten	Japan	Δ	Δ	Δ
NTT Docomo	Japan	Δ	Δ	√

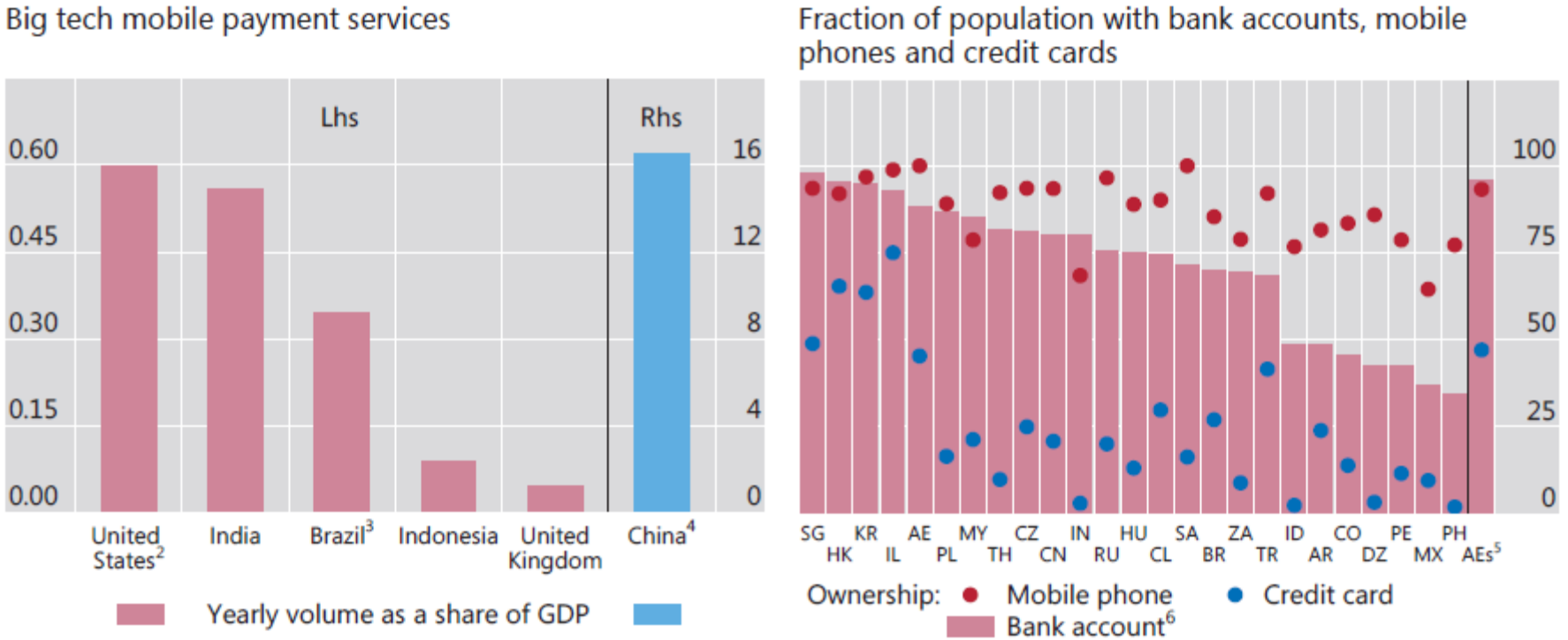
Δ indicates new entities and operations introduced outside the traditional financial and banking network. √ indicates the provision of services as overlays on top of, or in collaboration with, existing financial institutions (especially banks and credit card providers).

Sources: Financial Stability Board; S&P Capital IQ; public sources; BIS.

Mobile payments and bank accounts[1]

In per cent

Graph III.2

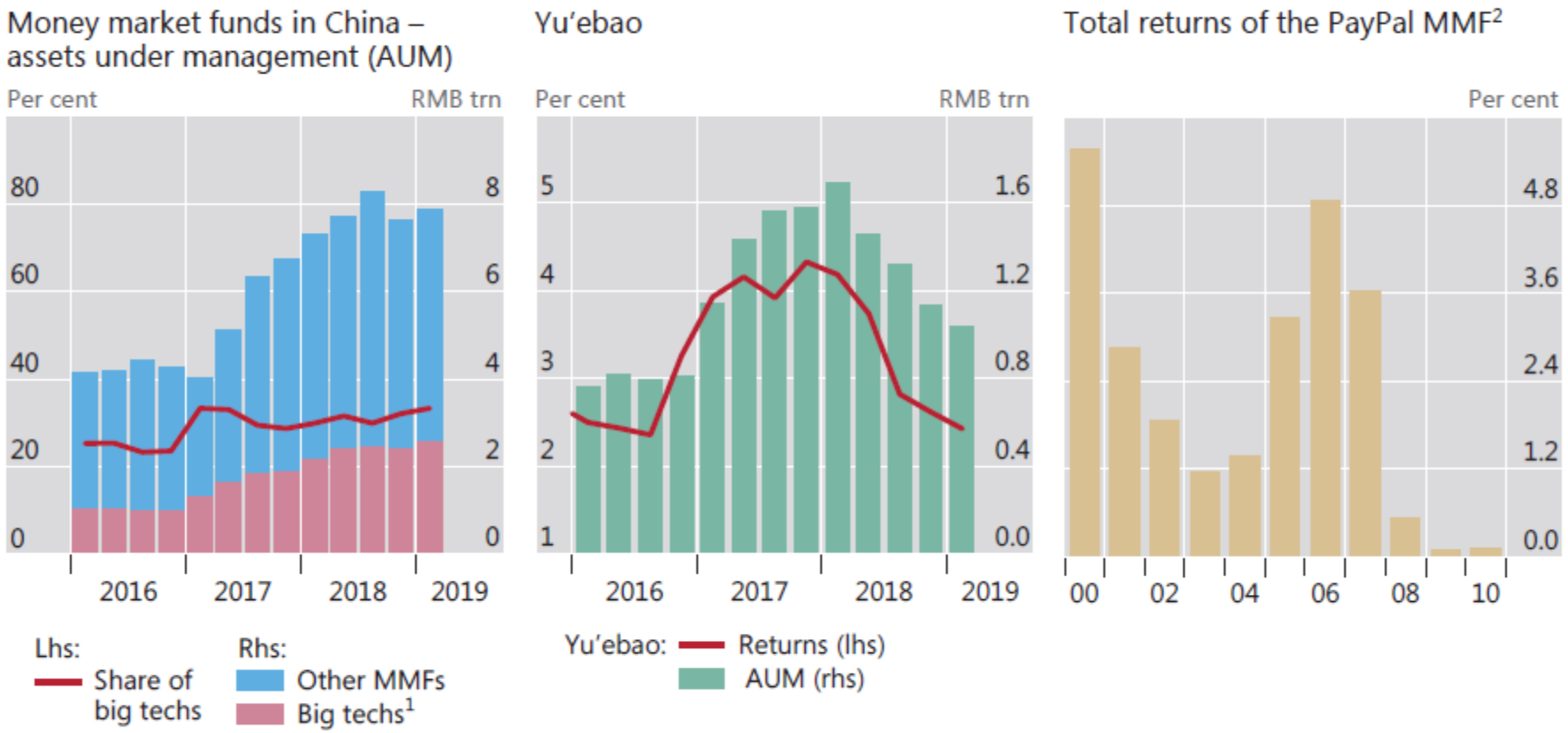


[1] 2017 data. [2] 2016 data. [3] Estimate based on the public data for Mercado Libre. [4] Only mobile payments for consumption data (ie excluding mobile payments for money transfer, credit card payments and mobile finance). [5] Advanced economy (AE) average. [6] Respondents who report having an account at a bank or another type of financial institution or report personally using a mobile money service in the past 12 months.

Sources: J Frost, L Gambacorta, Y Huang, H S Shin and P Zbinden, "BigTech and the changing structure of financial intermediation", *BIS Working Papers*, no 779, April 2019; World Bank; Forrester Research; GlobalData; iResearch; Mercado Libre; Nikkei; Worldpay; national data; BIS calculations.

The rise of big tech money market funds and their sensitivity to returns

Graph III.3

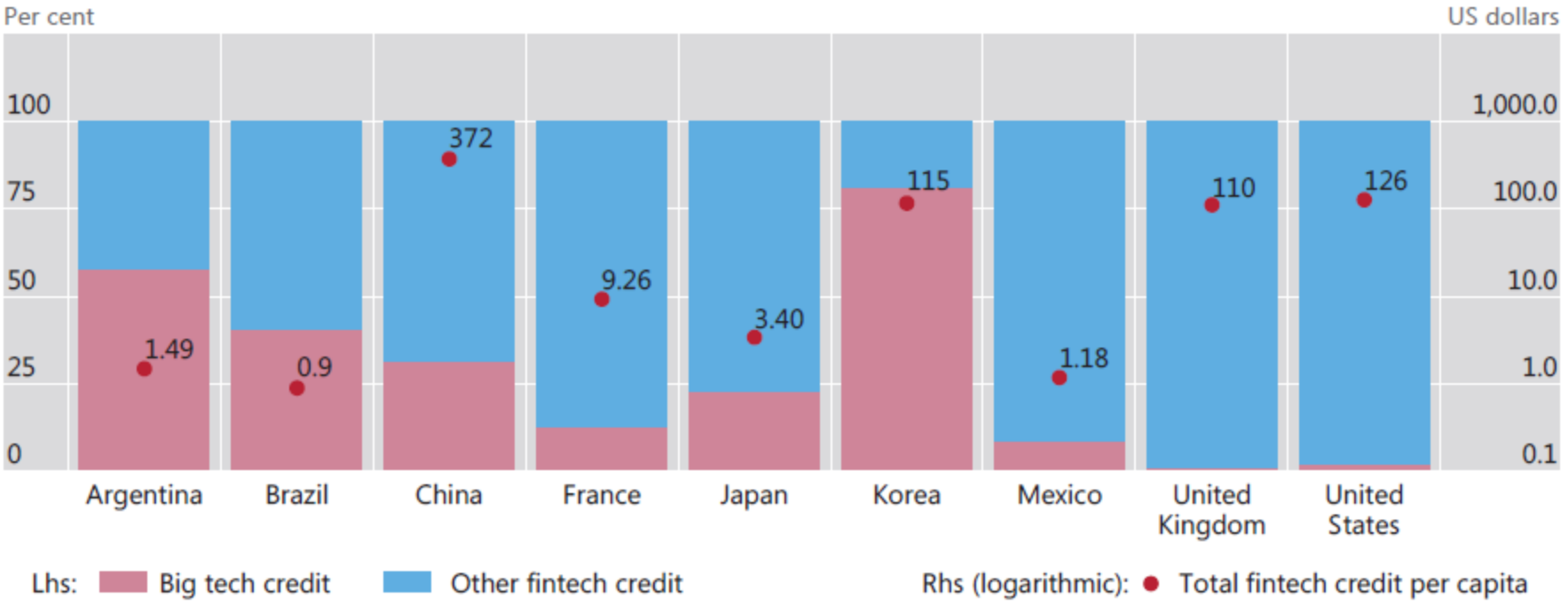


[1] Ant Financial, Tencent, Baidu and JD. [2] Quarterly average of annualised weekly returns.

Sources: Wind; company reports.

Big tech and other fintech credit in selected jurisdictions[1]

Graph III.4



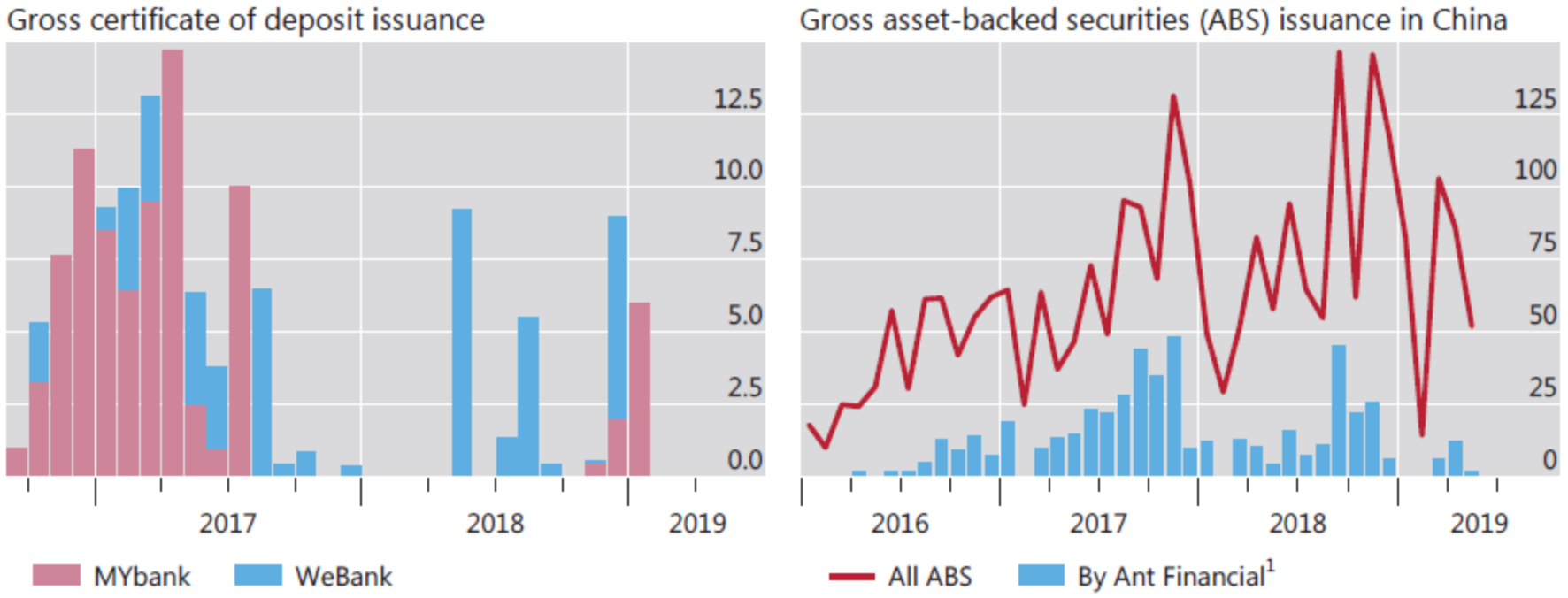
[1] The bars show the share of big tech and other fintech credit in selected jurisdictions in 2017, while the dots show total fintech credit per capita.

Source: J Frost, L Gambacorta, Y Huang, H S Shin and P Zbinden, "BigTech and the changing structure of financial intermediation", *BIS Working Papers*, no 779, April 2019.

Big tech banks in China rely more on non-core deposit funding

In billions of renminbi

Graph III.5



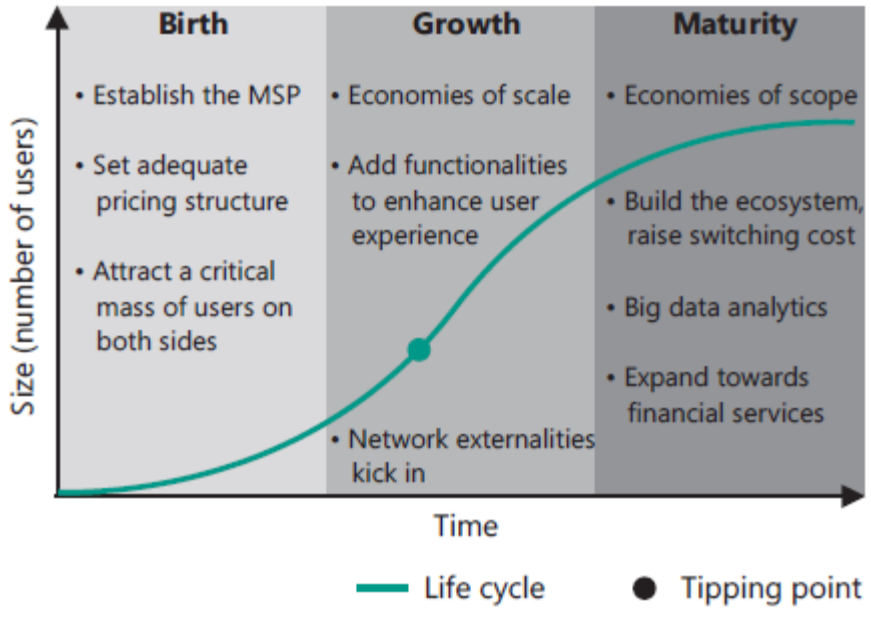
[1] The figures refer to the transactions conducted via exchanges and do not include interbank transactions.

Sources: Wind; company reports.

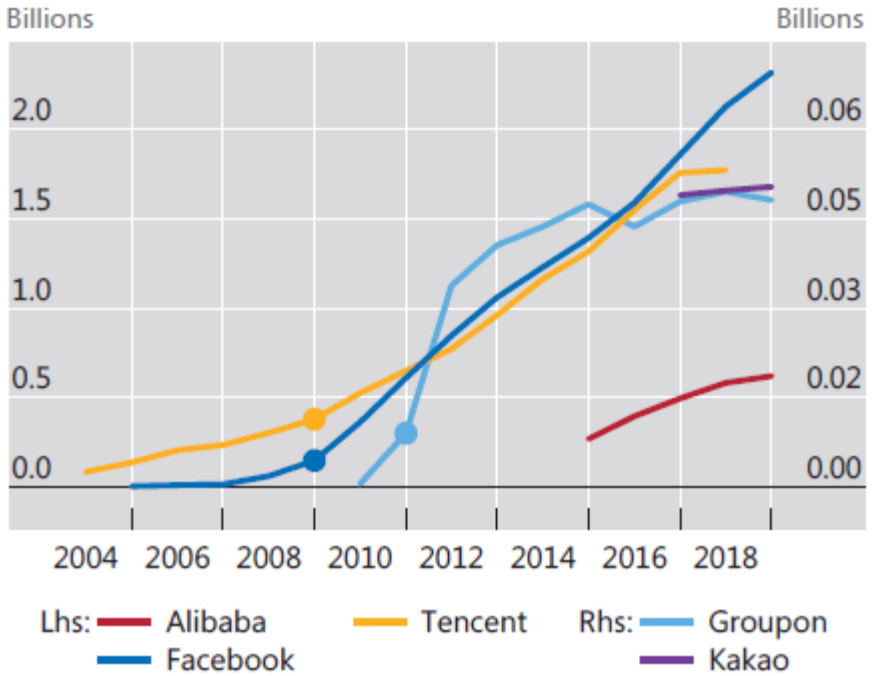
Big techs' life cycle: theory and practice

Graph III.A

From big techs' birth to maturity[1]



Big techs' monthly active users



[1] The firm's life cycle described in the left-hand panel borrows from the synthesis of the literature by Miller and Friesen (1984). Given that big techs are still new and rising firms, we purposely ignore the usual "decline" phase. MSP = multi-sided platform.

Sources: D Miller and P Friesen, "A longitudinal study of corporate life cycle", *Management Science*, vol 30, no 10, 1984; company reports; BIS calculations; BIS.

Banks versus big techs – competitive advantages (+) and disadvantages (–)

Table III.2

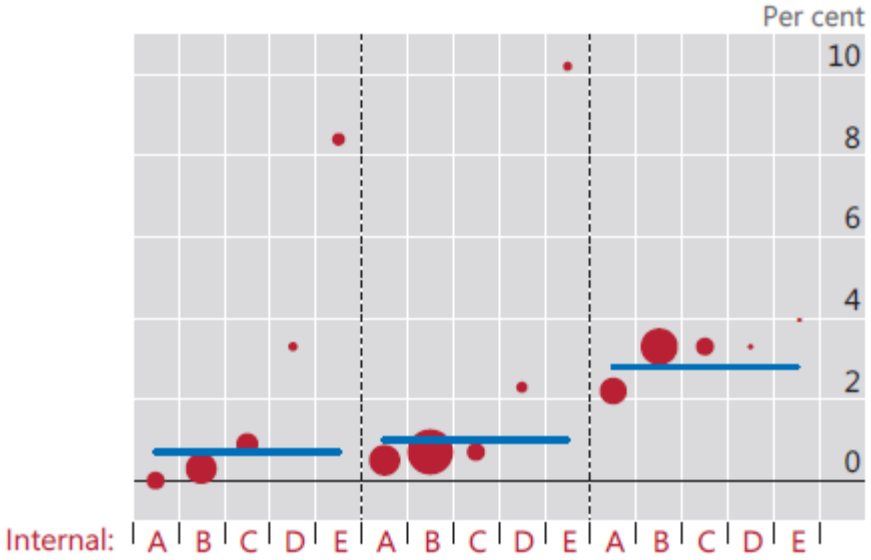
	Large banks	Big techs
Data	+ Verified/reliable customer data with a long history; "soft" information from personal interactions with customers; high importance of data privacy to support customer trust.	– Mixture of verifiable and potentially less reliable data; shorter history of customer data; lower priority placed on data privacy and protection.
	– Small number of customers and limited range of non-financial activities to collect data from; transactional data often "one-sided" (eg counterparty of transactions with another bank); legacy technology limits data processing capabilities.	+ Data on a very large number of customers; technology and business model built to collect and merge data; network of customer interactions is a key data dimension.
Network	+ Large number of financial activities and services already provided.	– Need to reach a large customer base to exploit network externalities.
	– Strict regulatory limits on activities and use of data; higher marginal costs of serving additional customers.	+ Significant network externalities due to wide range of non-financial activities; captive ecosystem with potential high exit costs.
Activities	+ Advantages in high margin and complex products requiring personal interaction (eg corporate finance, investment banking); wider range of financial services; access to large and relatively cheap funding sources; experience in risk management.	– Thus far limited or no footprint in key financial services (eg mortgages, loans to medium and large firms, insurance); funding limitations; lack of regulatory and risk management experience and expertise.
	– Legacy IT systems are a barrier to using existing data to offer new services (low economies of scope); activities limited to financial services.	+ Commoditisable services can be provided at near zero marginal costs; pre-existing commercial activities yield data that can be used to support new services (high economies of scope).

Source: BIS.

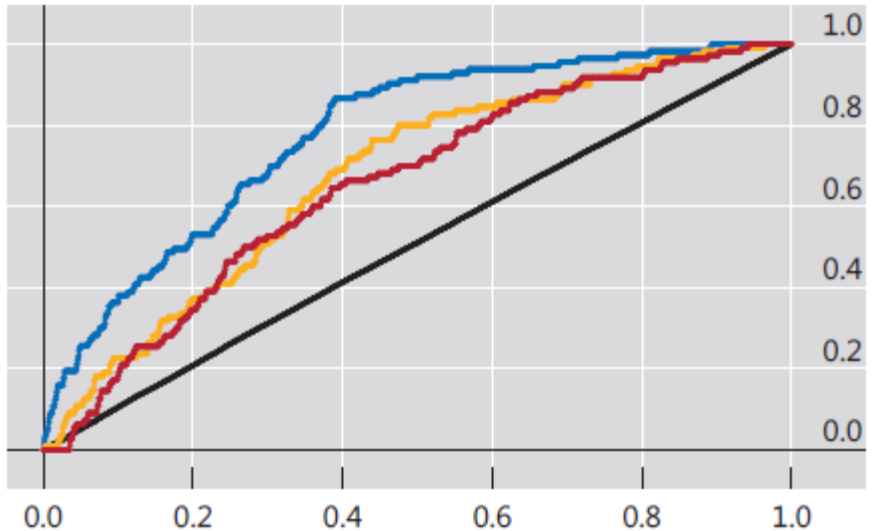
Credit assessment and big data analytics

Graph III.B

Loss rate[1]



Receiver operating characteristics (ROC) curve[2]

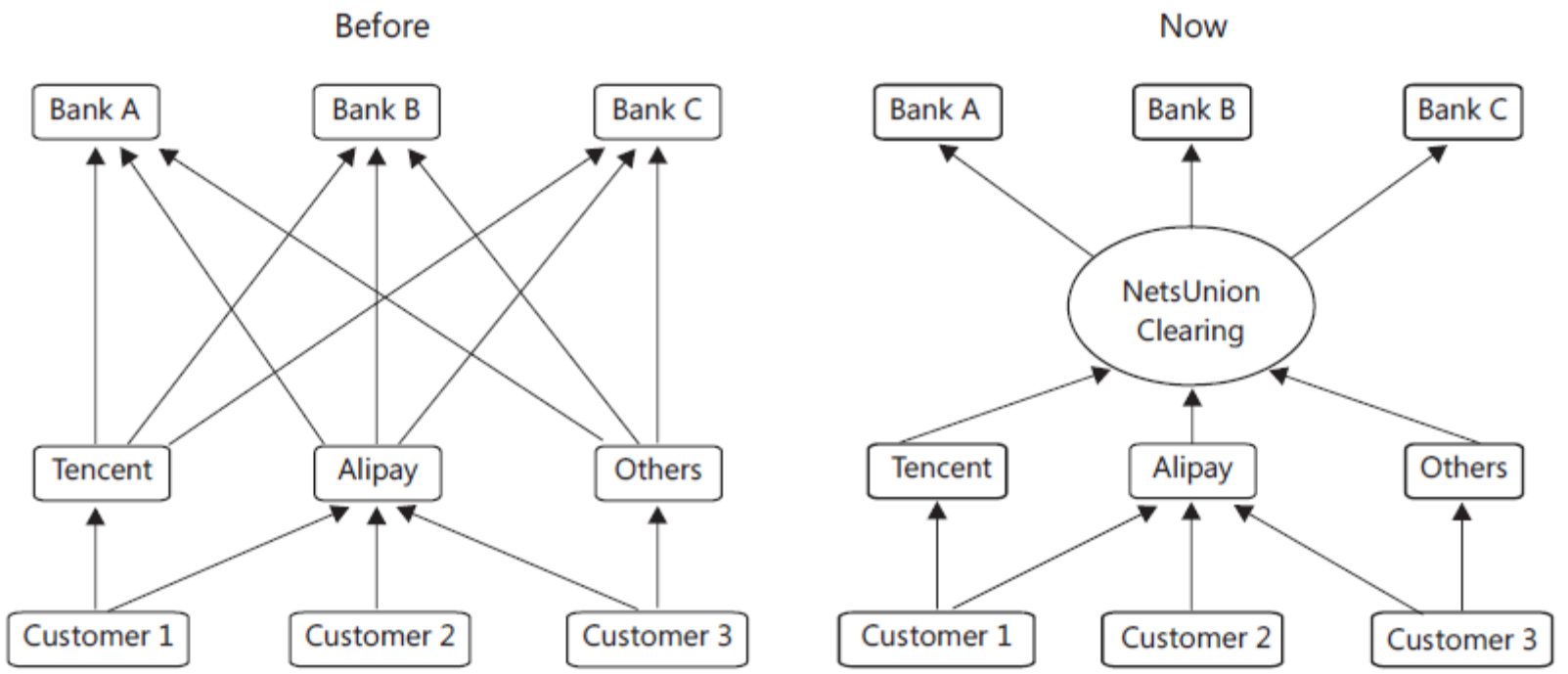


[1] The loss rate is the volume of loans more than 30 days past due relative to the origination volume. In its use to date, the internal rating of Mercado Libre is better able to predict such losses. It segments the originations into five different risk groups versus the three clusters identified by the credit bureau. The size of the dots is proportional to the share of the firms in the rating distribution. The horizontal blue lines indicate the average loss rates for each credit bureau cluster. [2] True positive rates versus false positive rates for borrowers at different thresholds for a logistic model with only the credit bureau score (I), a logistic model with the bureau score and borrowers' characteristics (II), and a machine learning model with the Mercado Libre credit score (III). A random model is included for comparison purposes. The ROC curve shows that the machine learning model has superior predictive power to both the credit bureau score only and the credit bureau score with borrower characteristics.

Source: J Frost, L Gambacorta, Y Huang, H S Shin and P Zbinden, "BigTech and the changing structure of financial intermediation", *BIS Working Papers*, no 779, April 2019.

Introduction of central clearing requirement in China

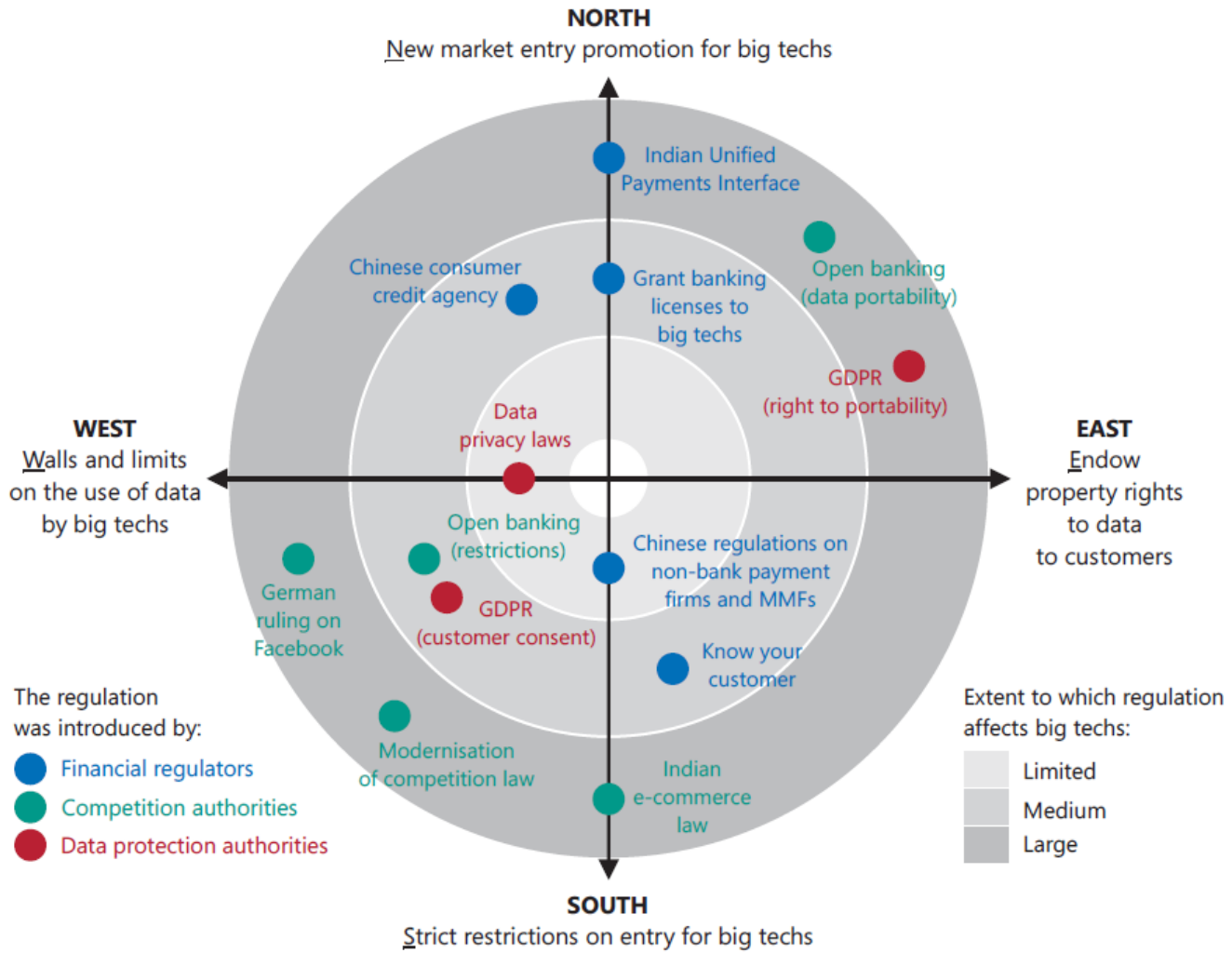
Graph III.C



Source: BIS.

A regulatory compass for big techs in finance

Graph III.8



Each dot refers to a public policy affecting big techs to some degree. Each policy is described in Table III.3. The placement of a policy on the compass reflects the choice of a policymaker (financial regulator, competition authority or data protection authority) in terms of: (i) promoting/restricting big techs' entry into finance (north-south axis); or (ii) endowing customers with data property rights/restricting big techs' use of customer data (east-west axis).

For example, in some jurisdictions, competition authorities have been promoting new entry into finance – including by big techs – (north direction) by enabling individuals (eg borrowers) to share their financial transaction data among multiple financial institutions (east direction). This policy choice is reflected by the placement of the green dot "open banking (data portability)" in the northeast quadrant of the compass.

Source: BIS.

S 10.4 Fast payments

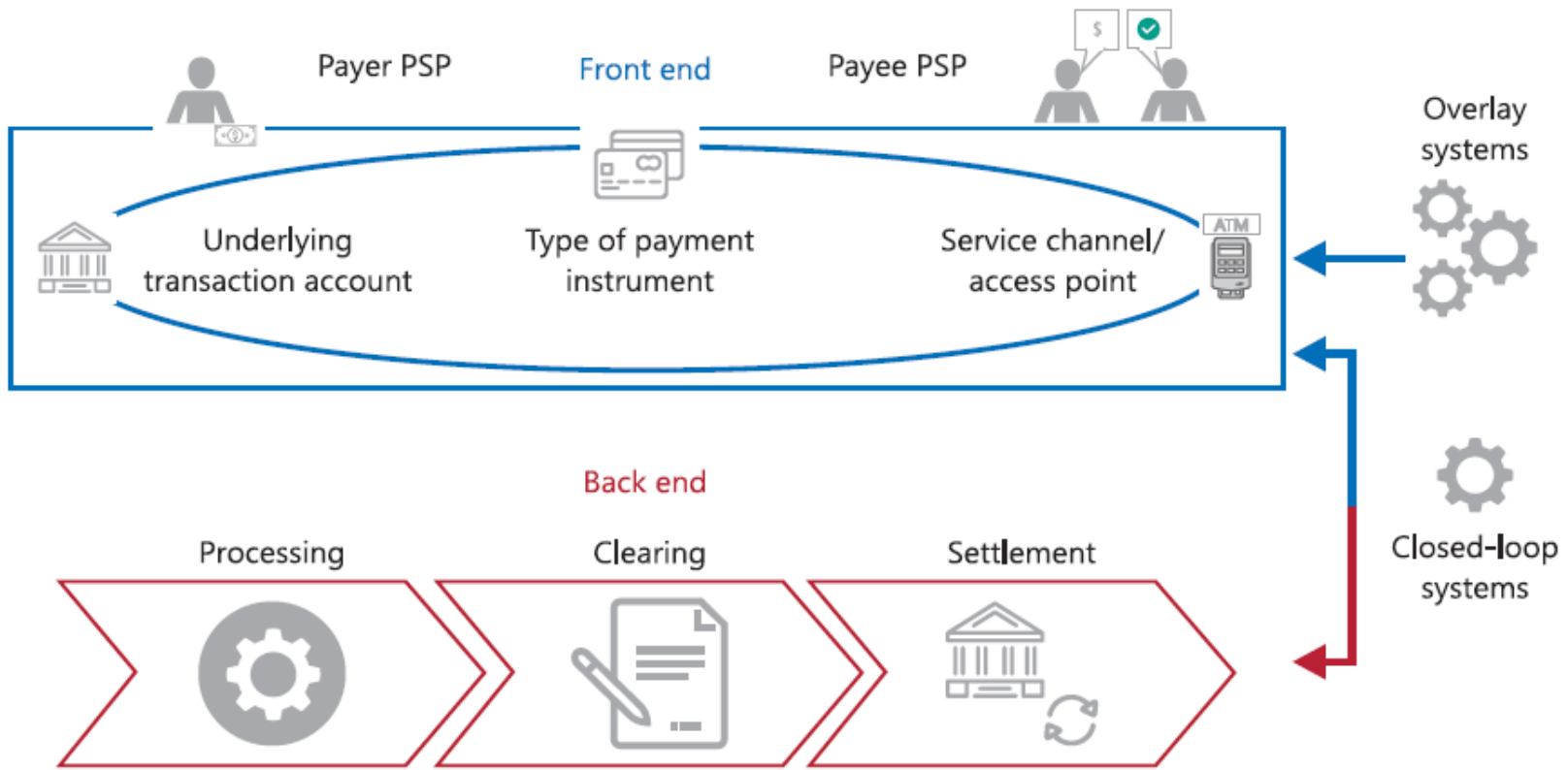
- S 10.4.1 Money and payment systems: the foundation of payment systems, trust and central banks
- S 10.4.2 Today’s payment systems: key facts, access, costs and quality
- S 10.4.3 Central bank policies to improve efficiency. As operator: providing public infrastructures as catalyst: promoting as overseer: guiding and regulating ensuring safety and integrity
- S 10.4.4 CBDC: designing safe and open payments for the digital economy

The payment system deconstructed

A **payment system** is a set of instruments, procedures and rules among participating institutions, including the operator of the system, used for the purposes of clearing and settling payment transactions. Its infrastructure usually involves payments flowing through a "front end" that interacts with end users and a number of "back end" arrangements that process, clear and settle payments (Graph III.B).

Payment infrastructure elements and arrangements

Graph III.B

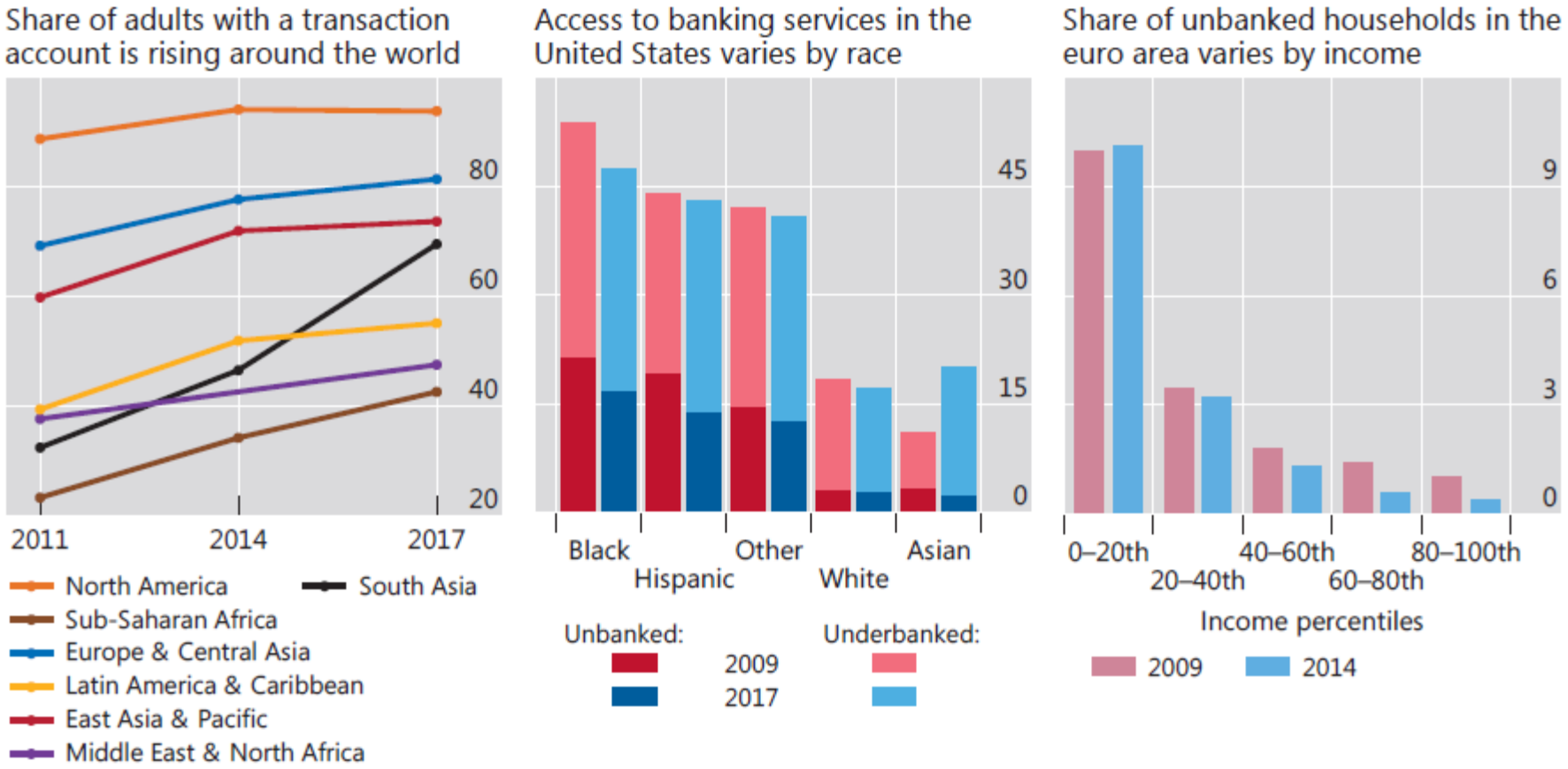


PSP = payment service provider (ie banks and non-banks).

Source: Adapted from Committee on Payments and Market Infrastructures, "*Cross-border retail payments*", February 2018.

Financial inclusion and access are improving, but gaps remain

Shares, in per cent — Graph III.1

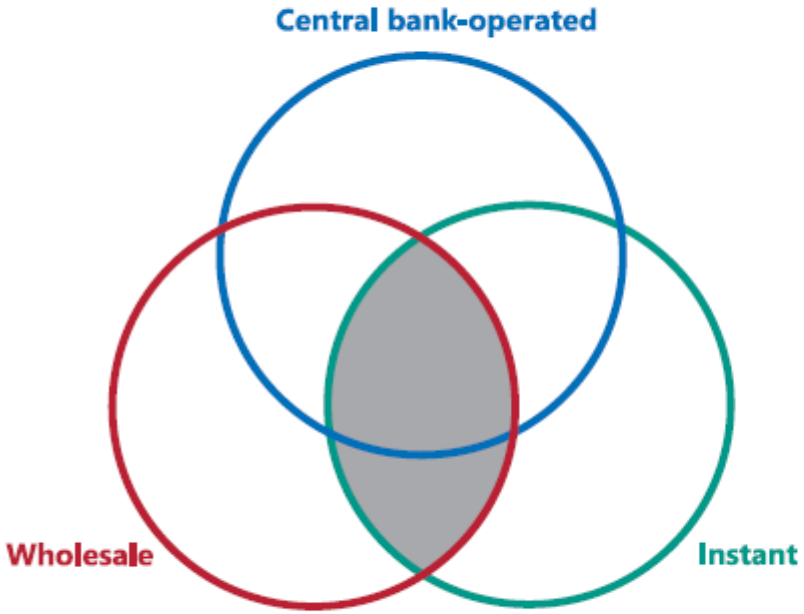


Sources: J Coffinet and C Jadeau, "Household financial exclusion in the Eurozone: the contribution of the Household Finance and Consumption survey", *IFC-National Bank of Belgium Workshop*, May 2017; World Bank, Findex; FDIC, *National Survey of Unbanked and Underbanked Households*.

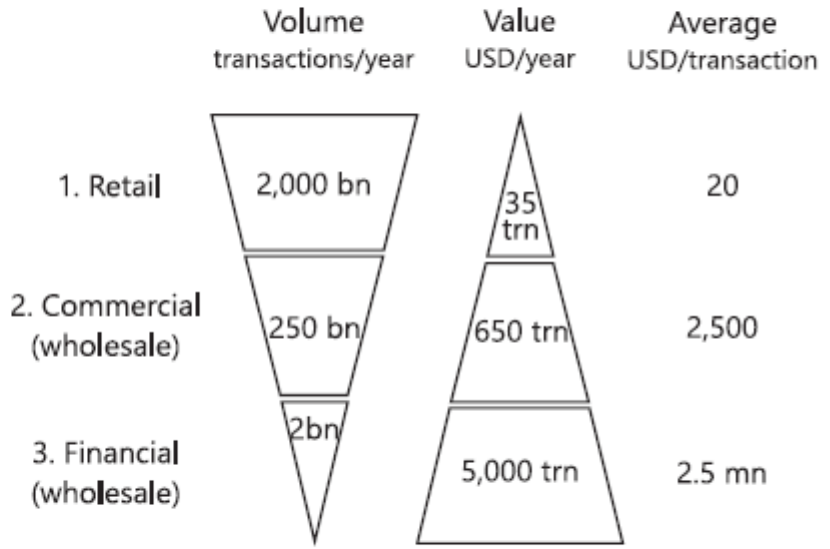
Wholesale payment systems are large-value and instant

Graph III.C

Wholesale payment systems characteristics



Features of retail and wholesale transactions

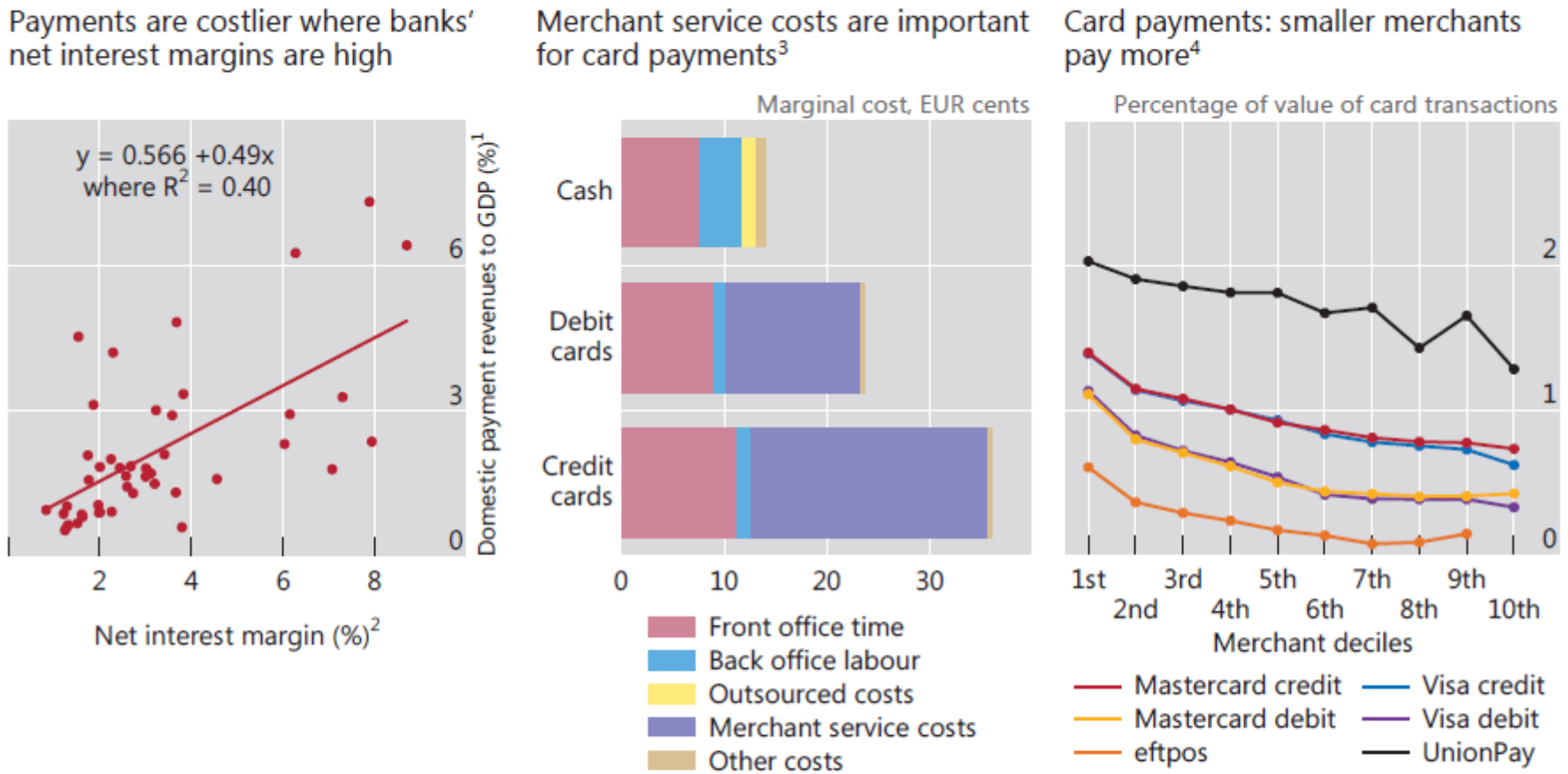


The grey shaded area in the left-hand panel represents instant wholesale payment systems.

Sources: Committee on Payments and Market Infrastructures, Red Book statistics, 2018, with input from Gottfried Leibbrandt; BIS elaboration.

Costs of payments are higher for some economies, users and instruments

Graph III.2



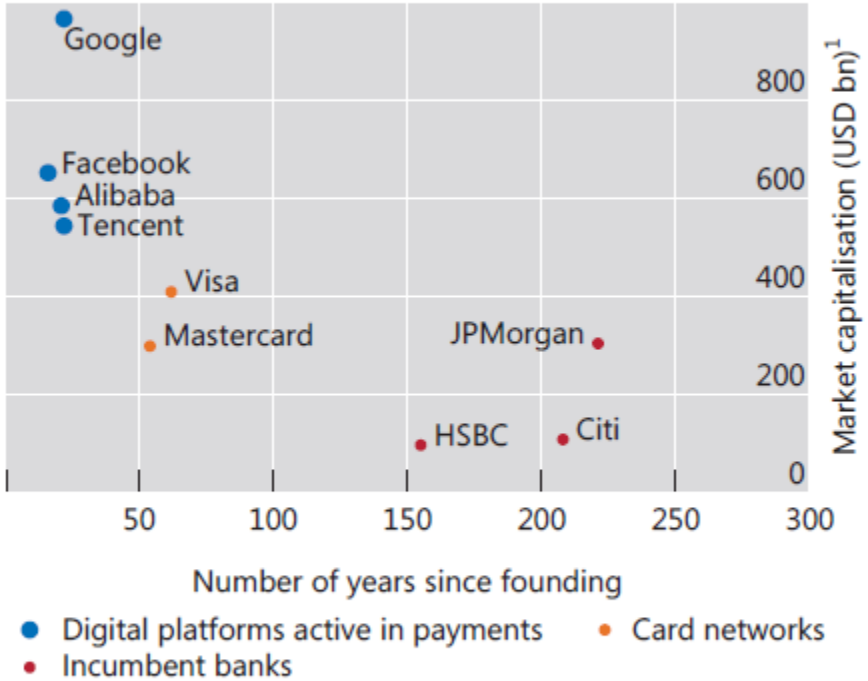
[1] Data for 2019. The numerator is the sum of account-related liquidity, domestic transactions and credit cards (fees and lending net interest income) for consumer and commercial payments. [2] Data for the latest year available. Defined as the accounting value of a bank's net interest revenue as a share of its average interest-bearing (total earning) assets. The sample comprises 45 countries. [3] Data for Europe (AT, BE, DE, ES, FR, GB, IT, NL, PL and SE), 2015. The graph reflects a scenario in which merchants were asked to assess fixed or variable costs for accepting cash, debit card and credit card payments for a €25 transaction over a three- to four-year time horizon. [4] Average cost of card acceptance by merchants in Australia, 2018/19. Ranked in value deciles.

Sources: McKinsey & Company, *Global Payments Report 2019: amid sustained growth, accelerating challenges demand bold actions*, September 2019; K Occhiuto, "The cost of card payments for merchants", Reserve Bank of Australia, *Bulletin*, March 2020; European Commission, *Survey on merchants' costs of processing cash and card payments*, March 2015; IMF, *World Economic Outlook*; World Bank; BIS calculations.

Digital platforms differ from traditional networks

Graph III.4

Digital platforms scale quickly...



...due in part to their characteristics

Traditional network	Today's digital platform
Network externalities	✓
Economies of scale and scope	✓
High fixed cost	X
Low marginal cost	✓ May be even lower
X	Fully digital
X	Aggregator of data
X	Broad user base

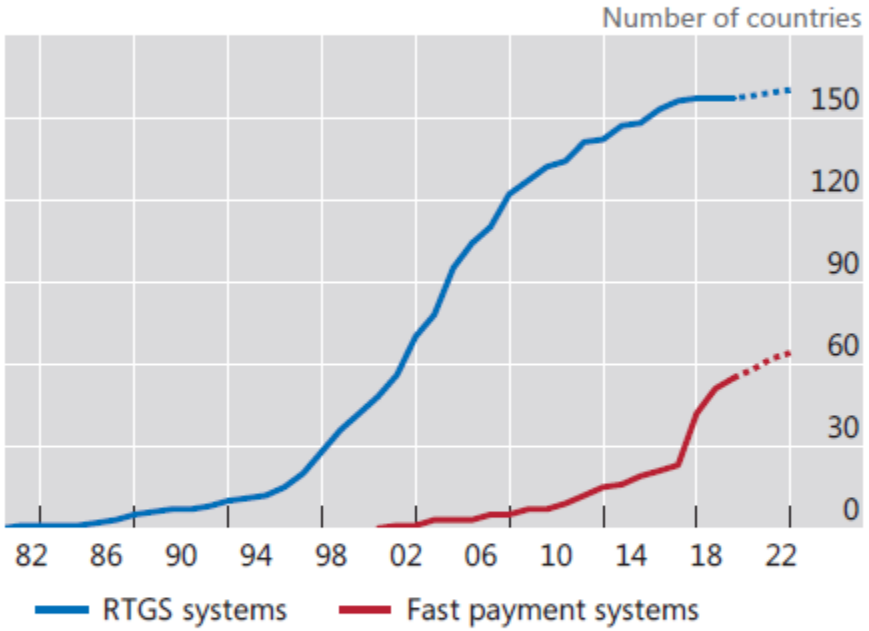
[1] As of 12 June 2020.

Sources: Companies' websites; Refinitiv Eikon; BIS elaboration, building on M Brunnermeier, H James and J-P Landau, "The digitalization of money", *NBER Working Papers*, no 26300, August 2019.

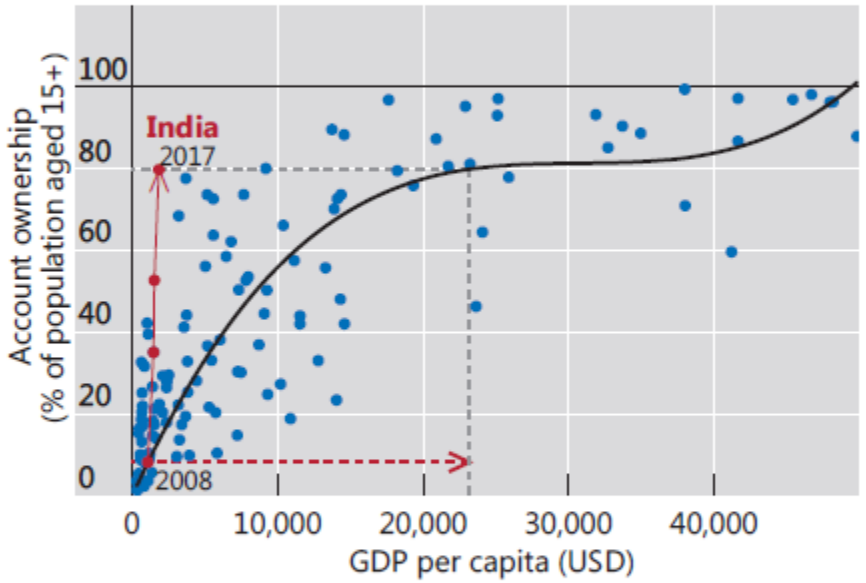
Digital technologies can help support inclusion and convenience

Graph III.5

Diffusion of fast payments[1]



Account ownership rises with income, but countries can leapfrog with new digital ID infrastructures[2]

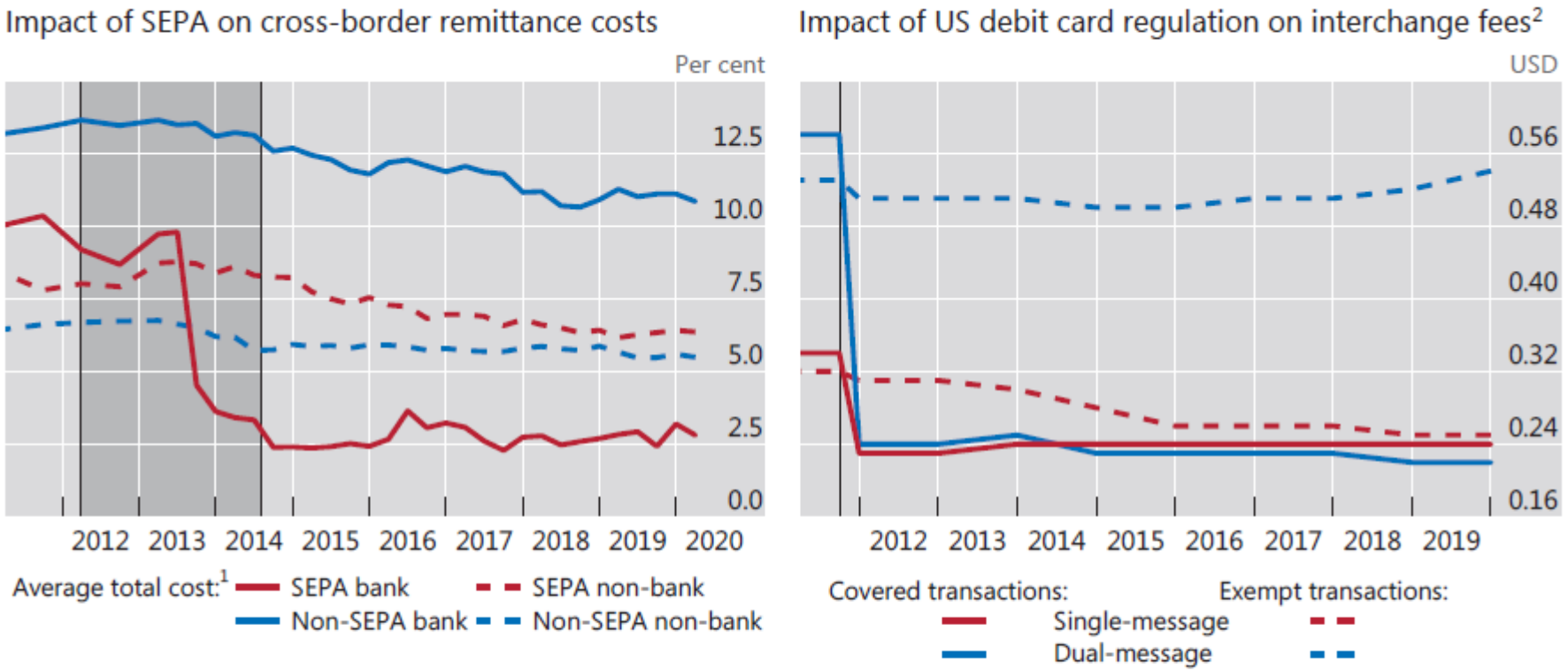


[1] The dotted part of the lines corresponds to projected implementation. [2] Data for 2011, and (for India) 2008 (estimate), 2011, 2014 and 2017.

Sources: D D'Silva, Z Filková, F Packer and S Tiwari, "The design of digital financial infrastructure: lessons from India", *BIS Papers*, no 106, December 2019; BIS, "Analysis of the 2018 Red Book statistics", November 2019; CPMI Survey; FIS, *Flavors of Fast report*, 2018; IMF, *World Economic Outlook*, October 2019; World Bank, Findex data; Instapay; national data.

Mandating change: policy interventions can lower payment costs

Graph III.7



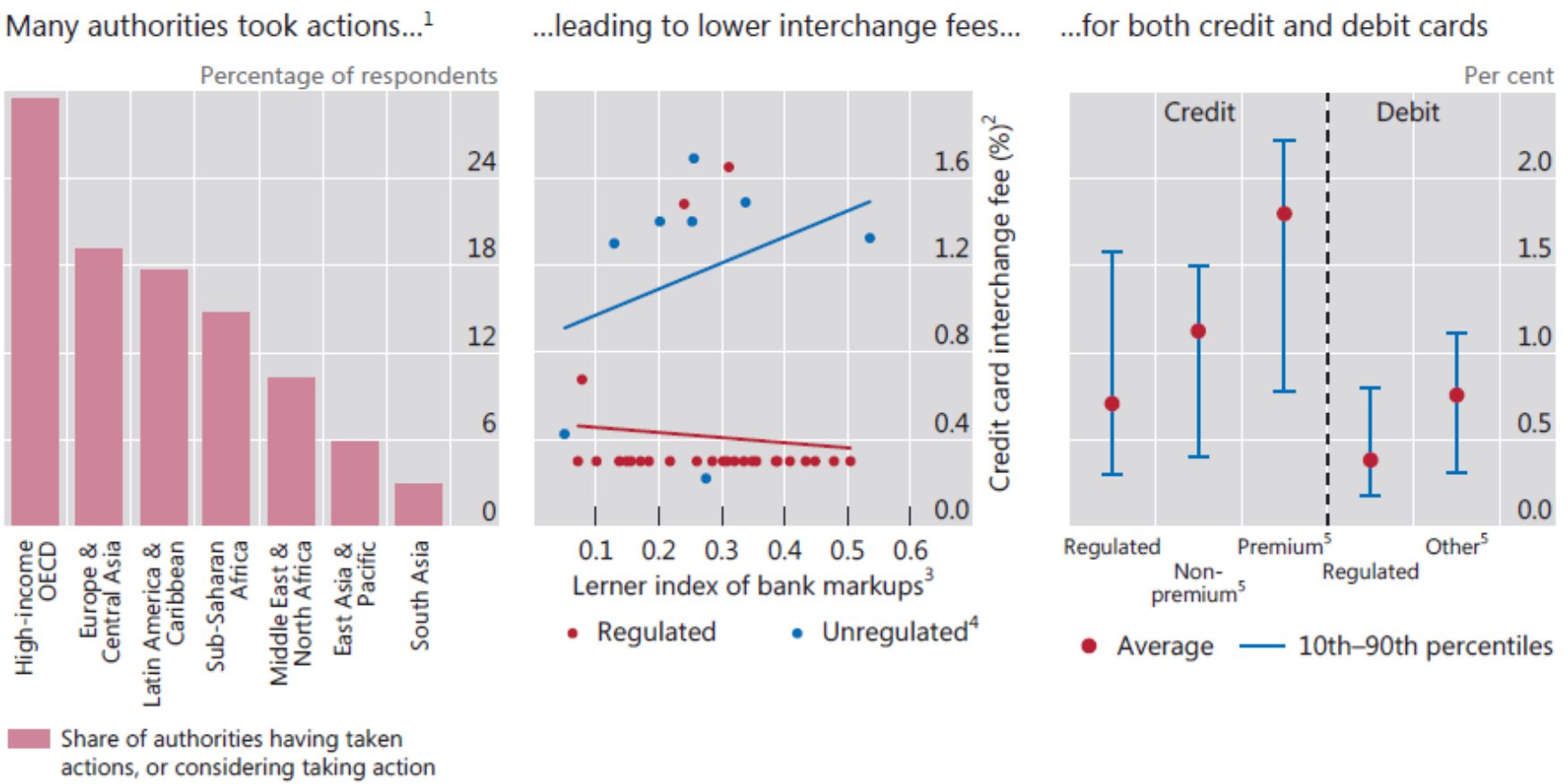
The vertical lines delimiting the shaded area in the left-hand panel indicate 31 March 2012 (entry into force of regulation (EU) no 260/2012) and 1 August 2014 (end date for the migration of domestic and intra-European credit transfers and direct debits in euros to the new SEPA standard). The vertical line in the right-hand panel indicates 1 October 2011 (Regulation II (Debit Card Interchange Fees and Routing) takes effect).

[1] Average total cost of sending $200 or euro equivalent. For bank costs, average of bank, bank and other provider cost. Based on 13 SEPA member countries and 99 countries not participating in the SEPA. [2] Average interchange fee per transaction.

Sources: Board of Governors of the Federal Reserve System; World Bank, *Remittance Prices Worldwide* (remittanceprices.worldbank.org); BIS calculations.

Interchange fees are significantly lower after policy action

Graph III.8



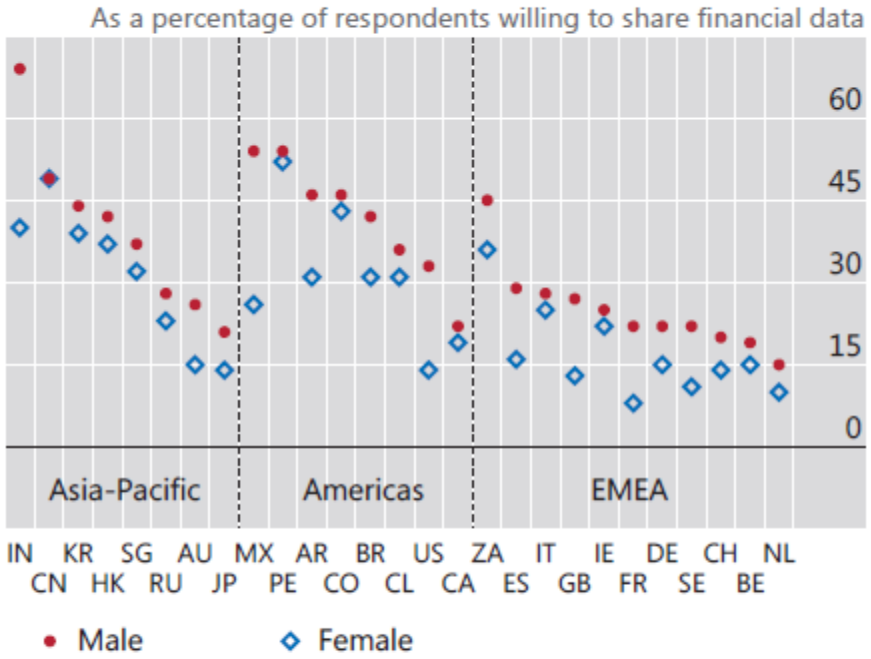
[1] Based on survey responses from 68 countries. [2] On retail face-to-face transactions. [3] The Lerner index measures market power in the banking sector; higher markups imply a less competitive market. The index has been extrapolated from World Bank data using estimates from Igan et al (2020). Data for 2017. [4] Average of Mastercard and Visa non-premium card retail face-to-face interchange fees. [5] Average of Mastercard and Visa cards.

Sources: F Hayashi, S Minhas and R Ruiz , "Credit and debit card interchange fees in various countries", Federal Reserve Bank of Kansas City, *Payments System Research*, August 2019; D Igan, M Martinez Peria, N Pierri and A Presbitero, "When they go low, we go high? Bank market power and interest rates", *IMF Working Papers*, forthcoming, 2020; World Bank, Global Payment Systems Survey, 2018; World Bank; BIS calculations.

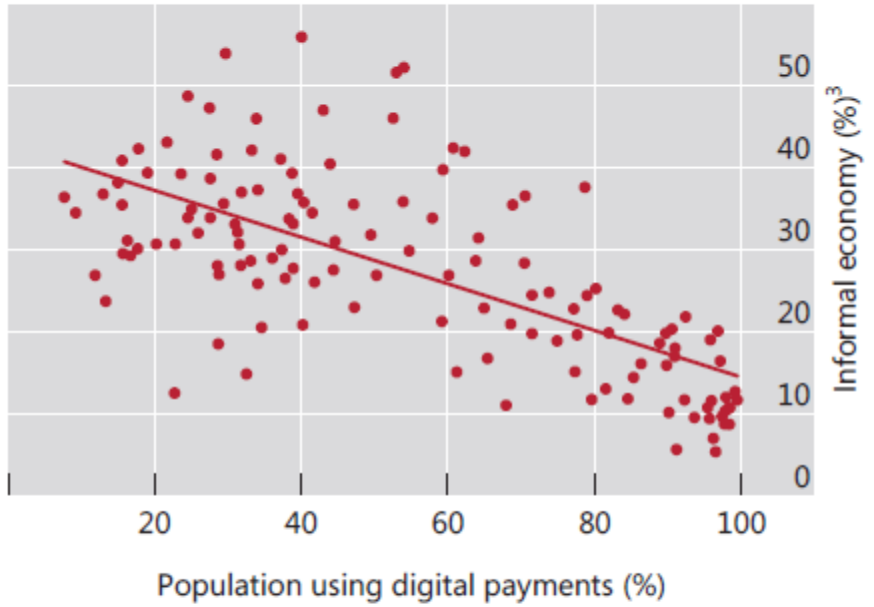
Digital payments create a data trail, bringing both risks and benefits

Graph III.9

Views on data privacy differ across and within societies[1]



The informal economy is smaller where digital payments are more widely used[2]



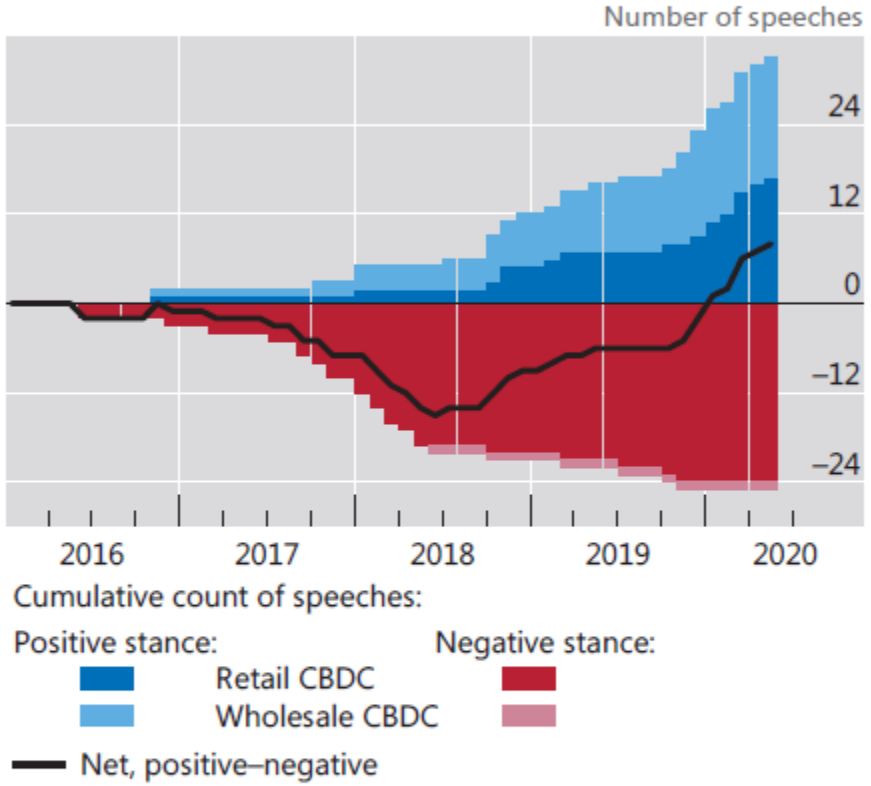
[1] Based on a survey of 27,000 individuals across 27 countries. The exact question reads: "I would be comfortable with my main bank securely sharing my financial data with other organisations if it meant that I received better offers from other financial intermediaries". For Belgium, the figure covers Belgium and Luxembourg. The dots visualise the percentage of respondents answering the question affirmatively. EMEA = Europe, the Middle East and Africa. [2] Data as of 2017. [3] Estimates of the informal ("shadow") economy based on a multiple indicator–multiple cause approach.

Sources: S Chen et al, "Data versus privacy: the role of gender and social norms", *BIS Working Papers*, forthcoming, 2020; EY, "FinTech adoption index", September 2019; L Medina and F Schneider, "Shedding light on the shadow economy: a global database and the Interaction with the official one", *CESifo Working Papers*, no 7981, 2019; World Bank; BIS calculations.

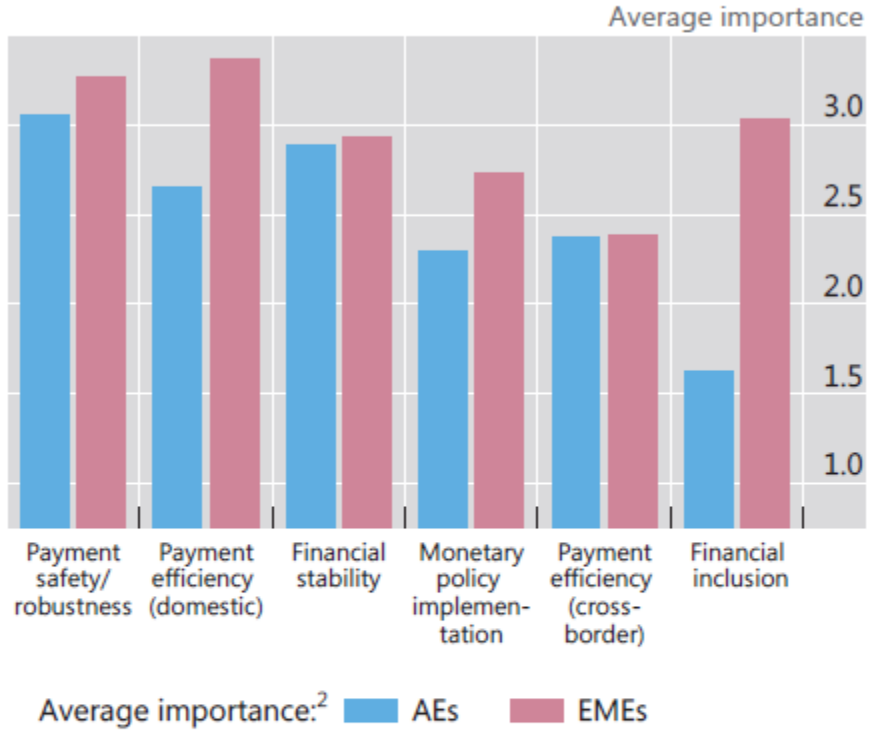
CBDC: an increasingly likely option

Graph III.10

Central bank speeches on CBDC[1]



Motivations for issuing a general purpose (retail) CBDC



[1] Search on keywords "CBDC", "digital currency" and "digital money". The classification is based on authors' judgment. The score takes a value of –1 if the speech stance was clearly negative or in case it was explicitly stated that there was no specific plan at present to issue digital currencies. It takes a value of +1 if the speech stance was clearly positive or a project/pilot was launched or was in the pipeline. Other speeches (not displayed) have been classified as neutral. [2] 1 = not so important; 2 = somewhat important; 3 = important; and 4 = very important.

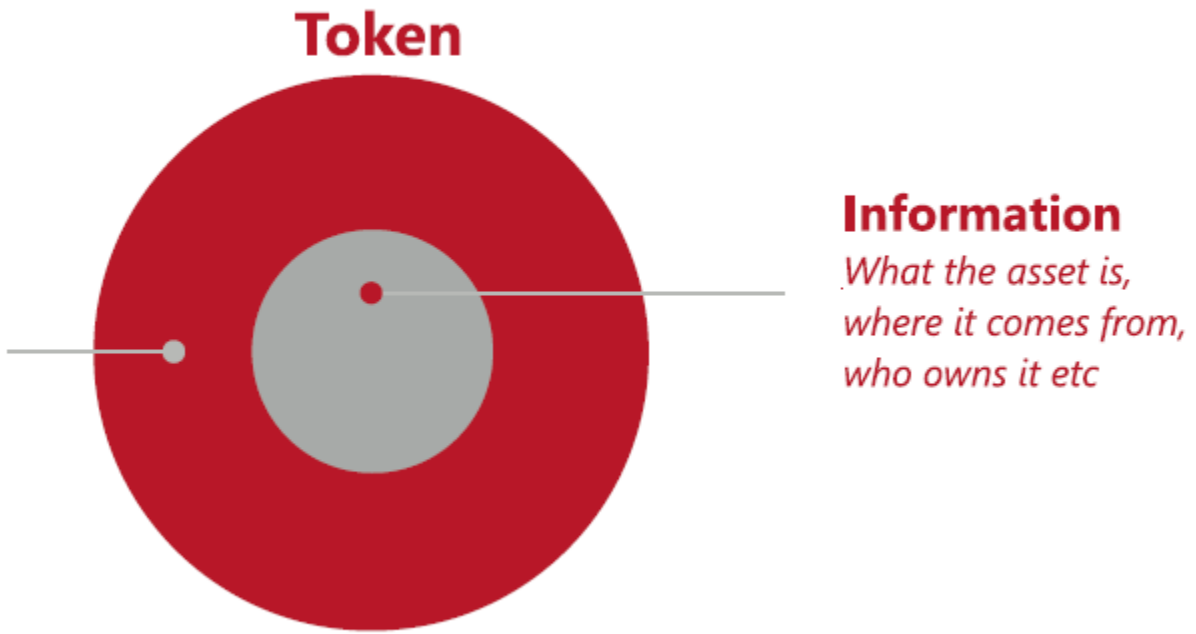
Sources: R Auer, G Cornelli and J Frost, "The rise of central bank digital currencies: drivers, approaches and technologies", forthcoming, 2020; C Boar, H Holden and A Wadsworth, "Impending arrival – a sequel to the survey on central bank digital currency", *BIS Working Papers*, no 107, January 2020.

S 10.5 A “Future” Monetary System?

- S 10.5.1. What do we want from a monetary system
- S 10.5.2. Tokenising money and assets
- S 10.5.3. Achieving seamless interoperability through unified ledgers
- S 10.5.4. Vision for the future monetary system

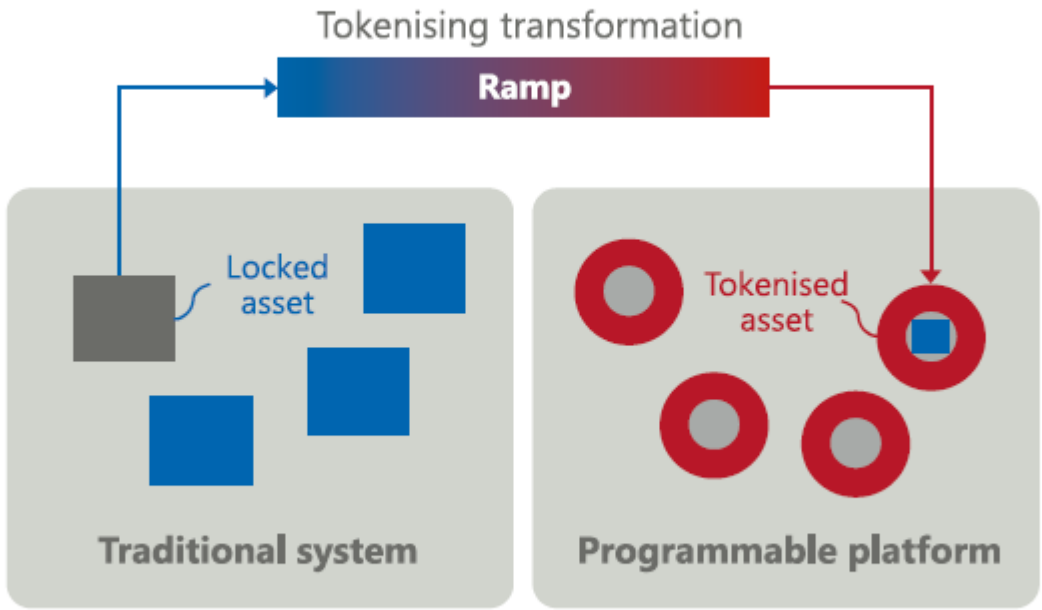
Tokens both define assets and specify what can be done with them

Graph 1



Source: Aldasoro et al (2023).

Ramps map assets to their tokenised counterparts on programmable platforms Graph 2



Source: Aldasoro et al (2023).

A bird's eye view of BIS Innovation Hub projects on CBDC and tokenisation — Table A1

	Helvetia	Jura	Genesis	Dunbar	mBridge	Dynamo
Main use case	Tokenised assets settlement in wholesale CBDC	Cross-border settlement with wholesale CBDC	Tokenised green bonds + delivery of carbon credits	International settlements using multiple CBDCs	Multilateral payments using multiple CBDCs	Smart contract programmability in trade finance
BIS IH Centre	Switzerland	Switzerland	Hong Kong SAR	Singapore	Hong Kong SAR	Hong Kong SAR
Participants	SNB	BDF, SNB	HKMA	MAS, SARB, RBA, BNM	HKMA, BOT, PBC, CBUAE	HKMA
Relevant currencies	CHF	EUR, CHF	HKD	AUD, MYR, SGD, SAR	HKD, CNY, THB, AED	HKD
PvP	✗	✓	✗	✓	✓	✗
DvP	✓	✓	✓	✗	✗	✗

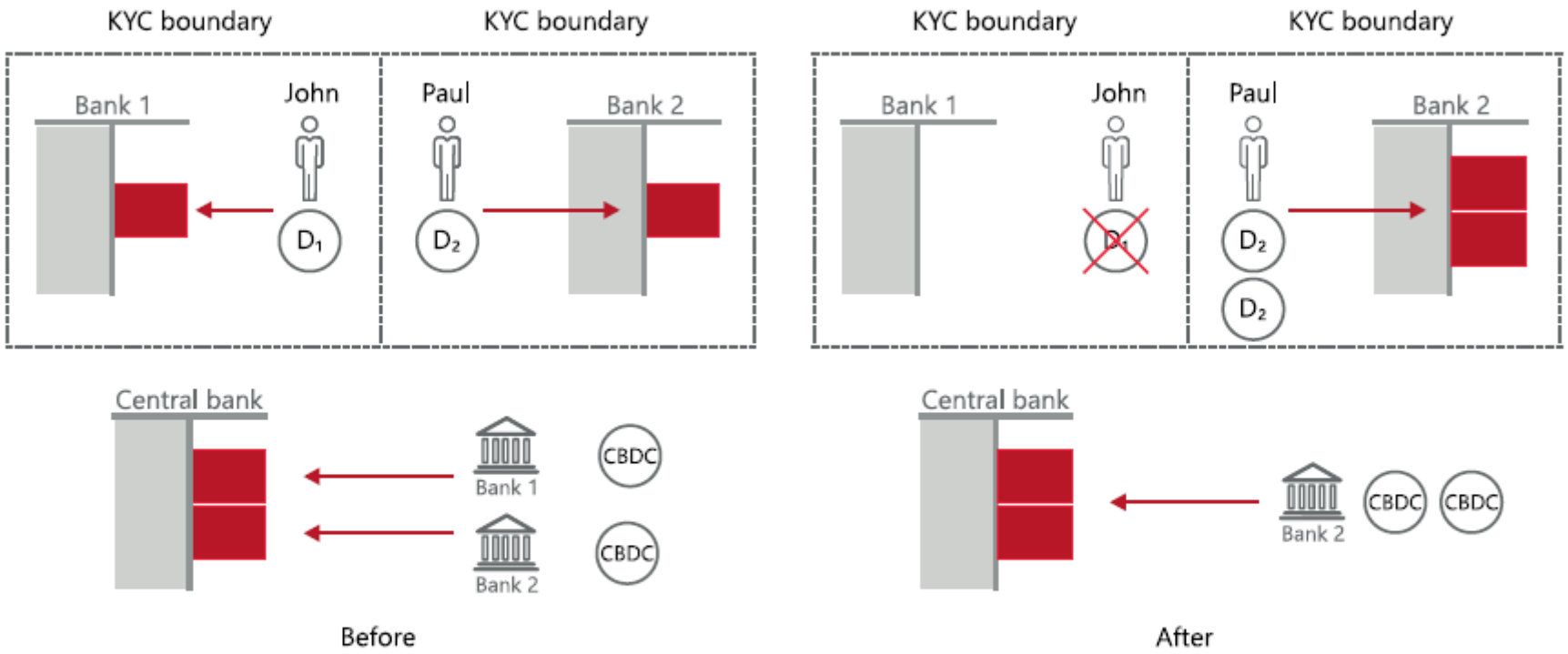
PvP = payment versus payment; DvP = delivery versus payment.

BDF = Bank of France; BNM = Central Bank of Malaysia; BOT = Bank of Thailand; CBUAE = Central Bank of the United Arab Emirates; HKMA = Hong Kong Monetary Authority; MAS = Monetary Authority of Singapore; RBA = Reserve Bank of Australia; SARB = South African Reserve Bank; SNB = Swiss National Bank.

Source: BIS.

Non-bearer instrument model of tokenised deposits

Graph 3

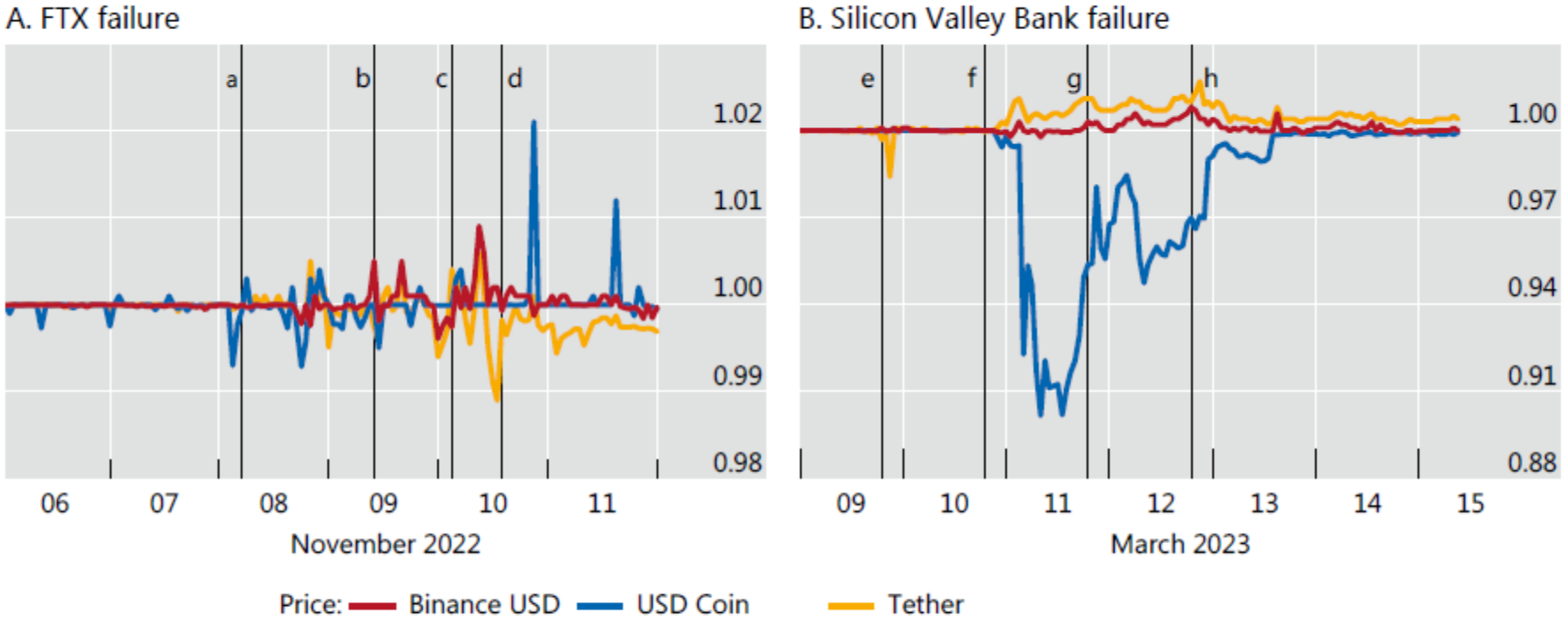


Dotted lines denote know-your-customer (KYC) boundaries. The red rectangles indicate the liabilities of the respective issuers (Banks 1 and 2 and the central bank), with red arrows originating from the holder of those liabilities. D_1 and D_2 denote the tokens held by John and Paul, which are liabilities of their respective banks.

Source: Garratt and Shin (2023).

Failures of FTX and Silicon Valley Bank coincide with stablecoin price volatility

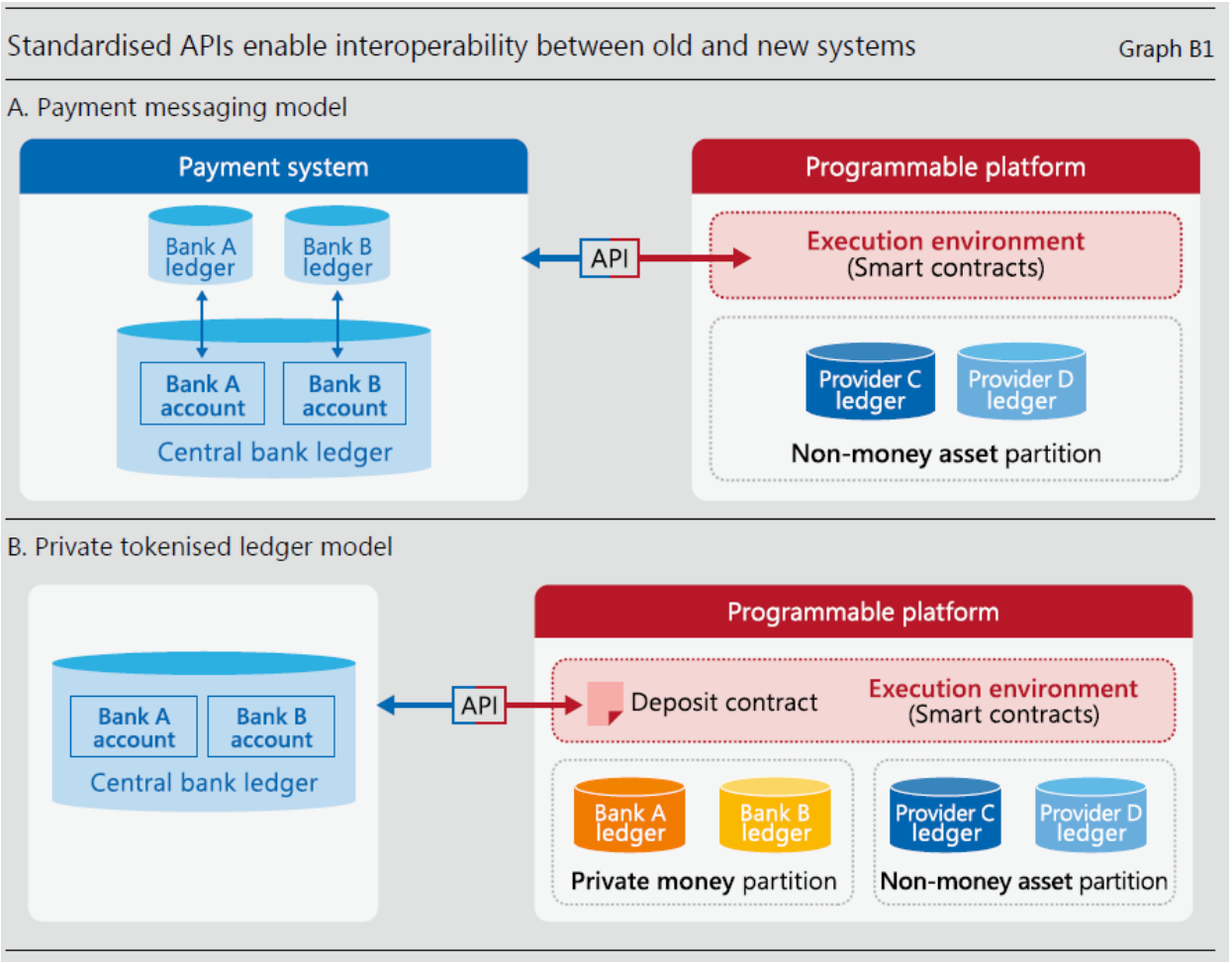
In US dollars — Graph 4

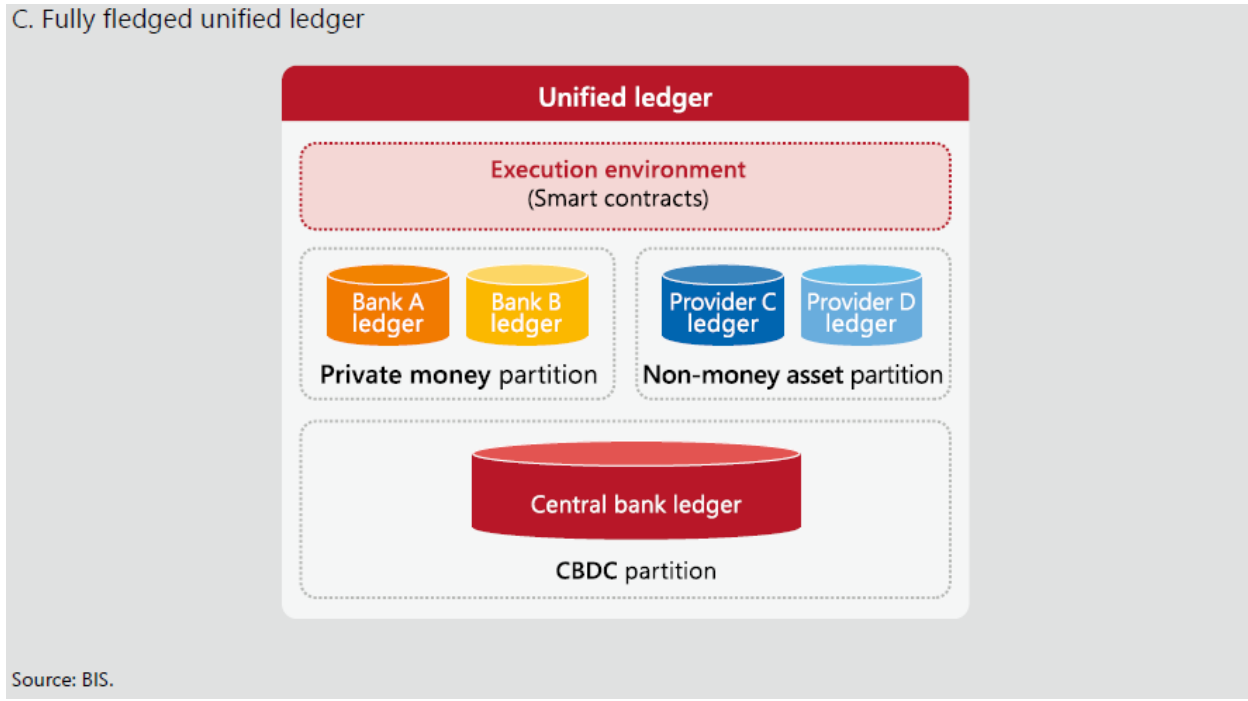


[a] FTX strikes an acquisition deal with Binance for its non-US business. [b] Binance backs out of the deal. [c] FTX CEO Sam Bankman-Fried apologises on Twitter. [d] Bahamas securities regulator freezes FTX assets. [e] Silicon Valley Bank announces that it will raise additional capital by selling stock. [f] SVB Financial seeks a buyer. A few hours later, a California regulator shuts Silicon Valley Bank and appoints the Federal Deposit Insurance Corporation (FDIC) as receiver to take control of its parent company. [g] Employees of Silicon Valley Bank offered 45 days of employment at 1.5 times their salary by the FDIC. [h] "Depositors will have access to all of their money starting Monday, March 13," say the US Treasury, Federal Reserve and FDIC in a statement, adding that no losses associated with the resolution of Silicon Valley Bank will be borne by the taxpayer.

Sources: CCData; Garratt and Shin (2023).

Standardised APIs enable interoperability between old and new systems Graph B1

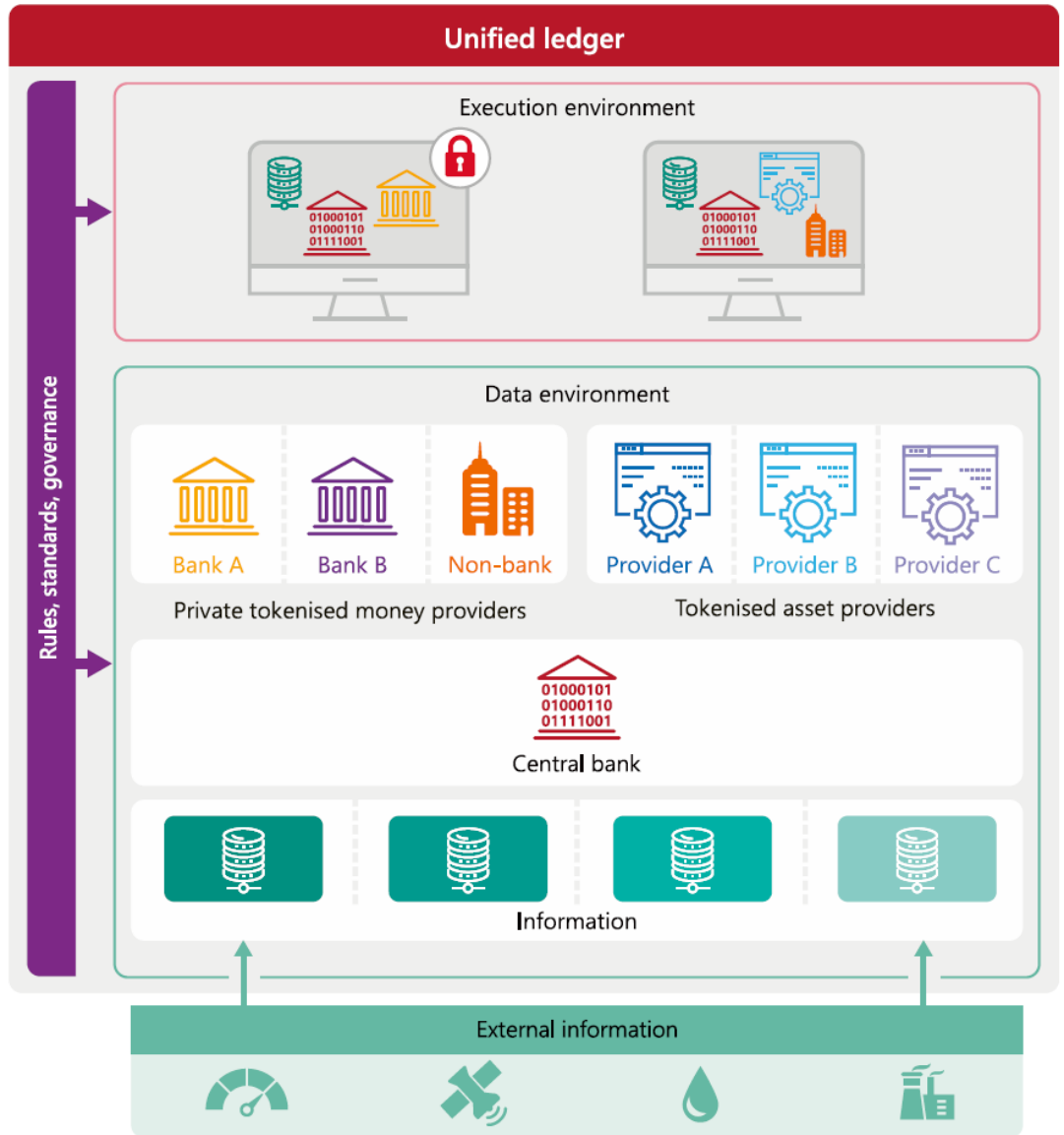




Source: BIS.

Stylised representation of a unified ledger

Graph 5

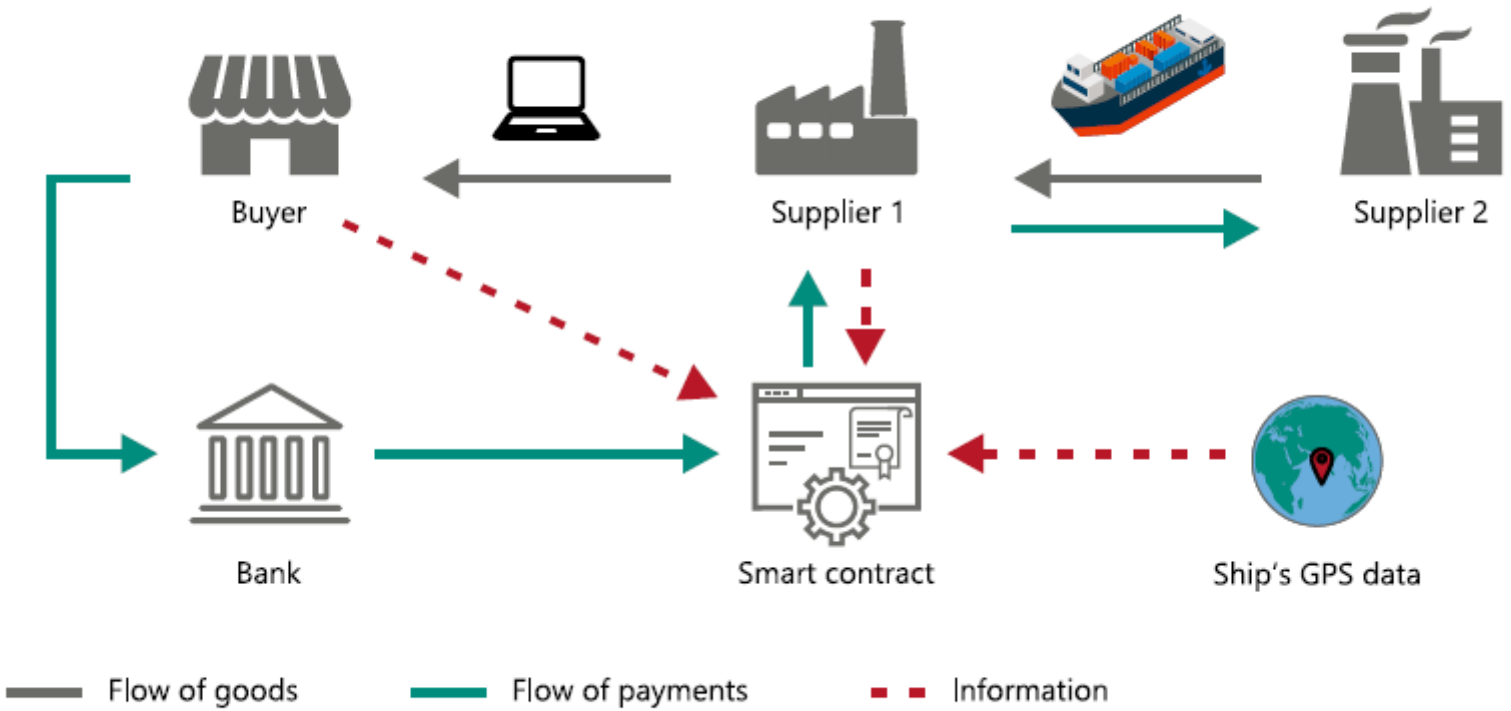


The unified ledger comprises its data and execution environments as well as the rules, standards and governance applying to those environments. The data environment contains money, assets and information (internal or external to the ledger). Each of these includes partitions (denoted by dashed lines) delineating ownership and/or access by the relevant entities. Operations involving one or more of these elements are carried out in the execution environment, either directly by users or through smart contracts. The lock indicates that some operations may be performed on confidential encrypted data.

Source: BIS.

Trade finance on a programmable platform

Graph 6

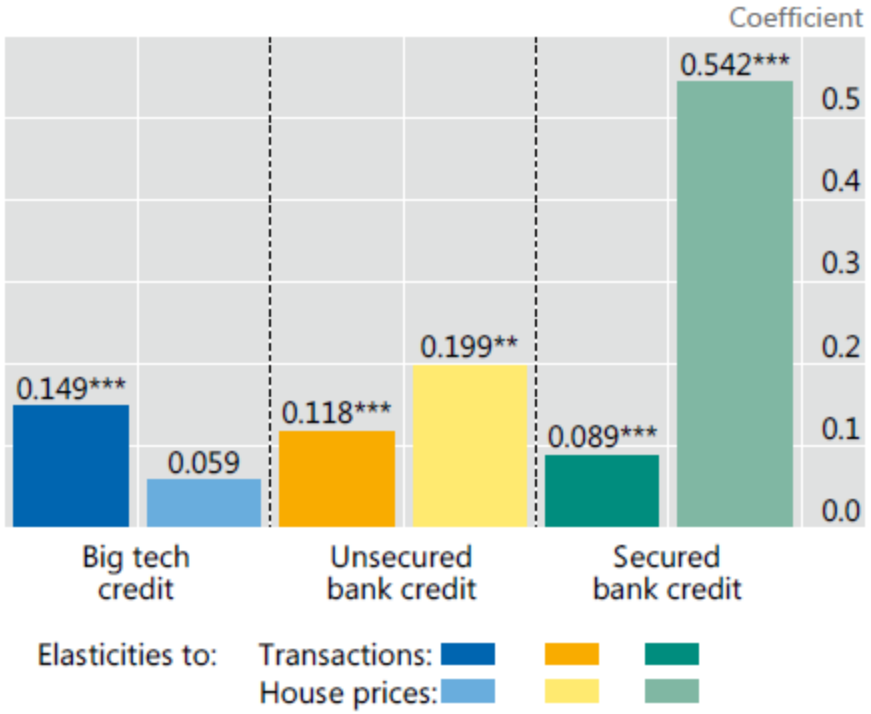


Source: BIS.

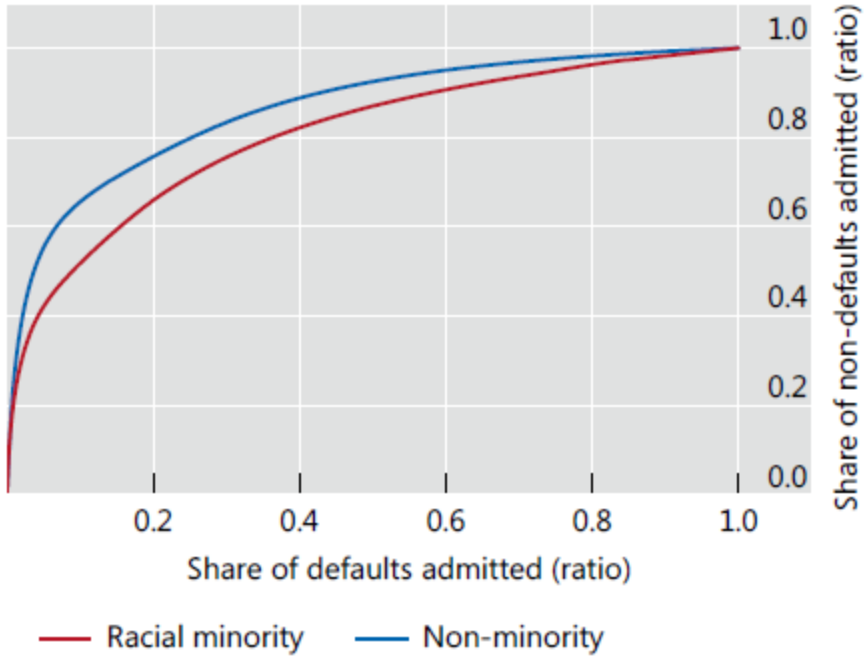
Data can obviate the need for collateral and improve credit scoring models[1]

Graph 7

A. Use of big data and machine learning reduces the importance of collateral in lending[2]



B. Traditional credit scores are worse at predicting default for disadvantaged segments of the population[3]



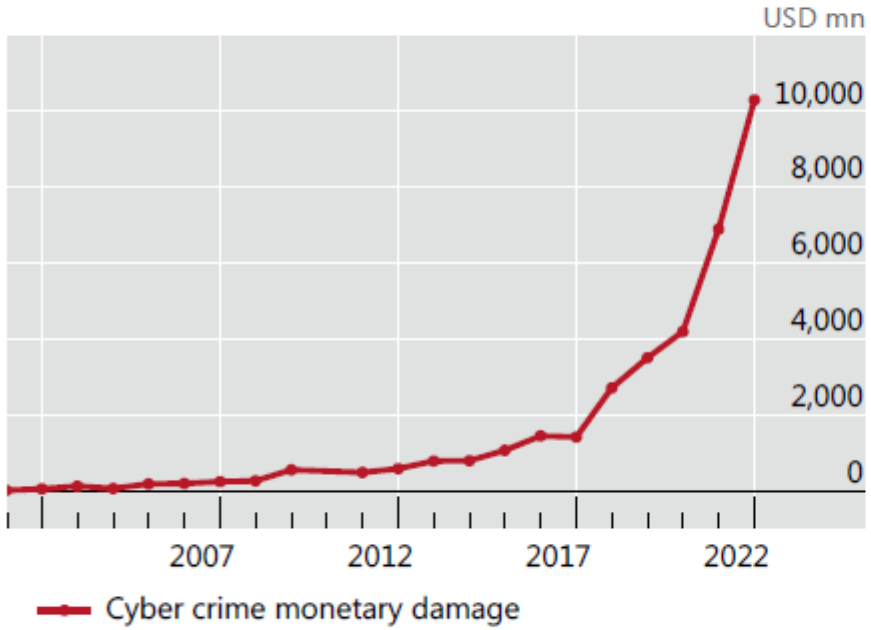
[1] See technical annex for details. [2] ***/** denotes statistical significance at the 1/5% level. [3] The red and blue lines show the receiver operating characteristic (ROC) curves for the VantageScore 3.0 credit score in a sample of mortgage applicants in the 2009–16 period for racial minorities and non-minorities, respectively.

Sources: Blattner and Nelson (2021); Gambacorta et al (2023).

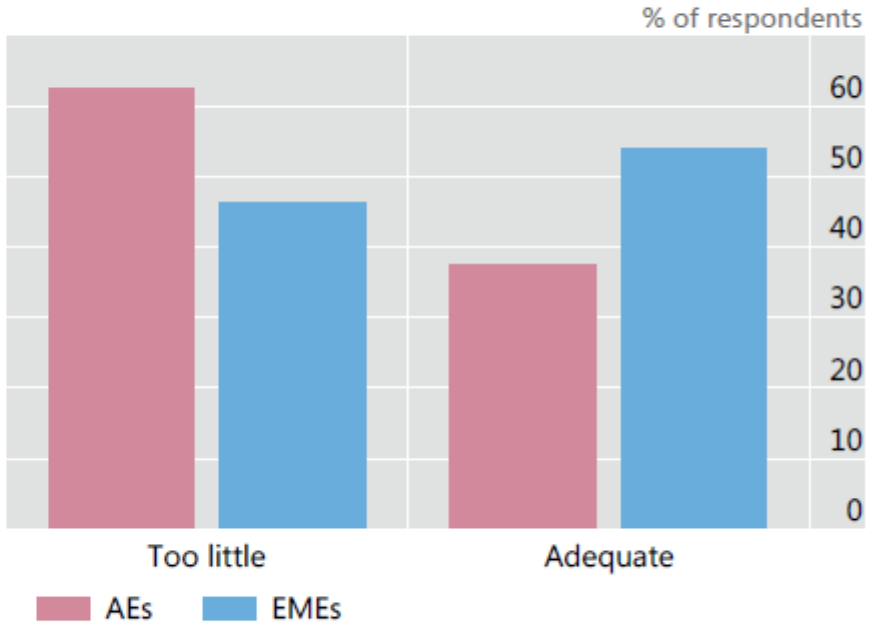
Cyber incidents are rising but spending on security is inadequate[1]

Graph 8

A. The cost of cyber attacks is rising rapidly



B. IT spending in the financial sector is deemed inadequate



[1] See technical annex for details.

Sources: Doerr et al (2022); Statista.

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