

Assessment of Risks to Financial Stability from Crypto-assets



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Executive summary

Crypto-assets markets are fast evolving and could reach a point where they represent a threat to global financial stability due to their scale, structural vulnerabilities and increasing interconnectedness with the traditional financial system. The rapid evolution and international nature of these markets also raise the potential for regulatory gaps, fragmentation or arbitrage. Although the extent and nature of use of crypto-assets varies somewhat across jurisdictions, financial stability risks could rapidly escalate, underscoring the need for timely and pre-emptive evaluation of possible policy responses.

Crypto-asset market capitalisation grew by 3.5 times in 2021 to \$2.6 trillion, yet crypto-assets remain a small portion of overall global financial system assets. Direct connections between crypto-assets and systemically important financial institutions and core financial markets, while growing rapidly, are limited at the present time. Episodes of price volatility have, so far, been contained within crypto-asset markets and have not spilled over to financial markets and infrastructures. Moreover, currently crypto-assets are not widely used in critical financial services (including payments) on which the real economy depends. However, it is challenging to assess inflection points given the rapid evolution of these markets and the significant data gaps that impede authorities' risk assessments. These gaps stem, in part, from the fact that participants, products and markets, including crypto-asset trading and lending platforms, fall outside the regulatory perimeter and the associated reporting requirements or, in some cases, may be failing to comply with applicable laws and regulations. These data gaps make it difficult to assess the full scope of crypto-assets' use in the financial system.

Institutional involvement in crypto-asset markets, both as investors and service providers, has grown over the last year, albeit from a low base. Systemically important banks and other financial institutions are increasingly willing to undertake activities in, and gain exposures to, crypto-assets. The prevalence of more complex investment strategies, including through derivatives and other leveraged products that reference crypto-assets, also has increased. If the current trajectory of growth in scale and interconnectedness of crypto-assets to these institutions were to continue, this could have implications for global financial stability.

There are also vulnerabilities that could undermine the integrity and functioning of crypto-asset markets. These include low levels of investor and consumer understanding of crypto-assets including costs, fees, conflicts of interest and lack of redress and/or recovery and resolution mechanisms, and uncertainties around the operational resilience of some crypto-asset focused institutions. It is possible, given the public prominence of crypto-assets and crypto-asset trading platforms, the rapidly growing retail investor adoption, and the use of leverage that any loss of confidence in crypto-assets could have implications that exceed those commensurate to the actual magnitude and direct financial interconnectedness of crypto-asset markets. Additional vulnerabilities may arise from the environmental impact of energy intensive consensus mechanisms used for certain crypto-assets. There are also wider public policy issues related to crypto-assets beyond the FSB's remit that have important implications, such as the use of crypto-assets in the context of money laundering, cyber-crime and ransomware.

The report examines developments and associated vulnerabilities relating to three segments of the crypto-asset markets: unbacked crypto-assets (such as Bitcoin); stablecoins; and

decentralised finance (DeFi) and crypto-asset trading platforms. These three segments are closely interrelated in a complex and constantly evolving ecosystem, and need to be considered holistically when assessing related financial stability risks.

DeFi has recently become a fast-emerging sector, providing financial services using both unbacked crypto-assets and stablecoins. In part because of the emergence of DeFi, stablecoins issuers have experienced considerable growth and their reserve assets may make them significant holders of short-term debt instruments. The structure of stablecoins means they are exposed to liquidity mismatch, credit and operational risks, which makes them susceptible to sudden and disruptive runs on their reserves. Moreover, a relatively small number of crypto-asset trading platforms that aggregate multiple types of services and activities, including lending and custody, account for the majority of crypto-assets traded. Some of these platforms operate outside of a jurisdiction's regulatory perimeter or are not in compliance with applicable laws and regulations. This presents the potential for concentration of risks, as well as underscores the lack of transparency on their activities.

Stablecoin growth has continued, despite concerns about regulatory compliance, quality and sufficiency of reserve assets, and standards of risk management and governance. At present, stablecoins are used mainly as a bridge between traditional fiat currencies and crypto-assets, which has implications for the stability and functioning of crypto-asset markets. Were a major stablecoin to fail, it is possible that liquidity within the broader crypto-asset ecosystem (including in DeFi) could become constrained, disrupting trading and potentially causing stress in those markets. This could also spill over to short-term funding markets if stablecoin reserve holdings were liquidated in a disorderly fashion.

The FSB and other standard-setting bodies are already working to address threats associated with so-called "global stablecoins". The FSB will continue to monitor developments and risks in crypto-asset markets, based on the framework published in 2018. In 2022, the FSB will also explore potential regulatory and supervisory implications of unbacked crypto-assets, including the types of actions FSB member jurisdictions have taken, or plan to take, to address any associated financial stability threats. Examining the regulatory gaps and challenges that may exist, including those that arise from the cross-border and cross-sectoral nature of crypto-assets, will be a key element of this work. The FSB will also continue to monitor and share information on regulatory and supervisory approaches to ensure the effective implementation of its high-level recommendations for the regulation, supervision and oversight of "global stablecoin" arrangements.

1. Introduction

This report provides the FSB's view on recent developments in crypto-asset markets and their implications for global financial stability. Crypto-assets, as the term is used in this report, are a type of private sector digital asset that depends primarily on cryptography and distributed ledger or similar technology. Crypto-assets can function as, or have characteristics of, digital means of exchange that are not backed by an issuer (such as bitcoin), or other digital tokens, including securities tokens, asset-backed tokens representing ownership interests in property, so-called utility tokens used to obtain access to goods or services on a particular digital platform, or non-fungible tokens used as collectibles or investment instruments. There are a range of instruments based on crypto-assets, and their classification may vary by jurisdiction. This report focuses on private sector crypto-assets and does not consider digital assets issued by public sector entities, including central bank digital currencies.

The vulnerabilities in crypto-asset markets – relating to leverage, liquidity/maturity mismatch, operational/technological fragilities and interconnectedness – are similar to those in traditional finance. The transmission channels through which these vulnerabilities might have implications for financial stability were set out in the FSB's report on crypto-asset markets in 2018.¹ These channels include: (i) **financial sector exposures** to crypto-assets, related financial products and entities that are financially impacted by crypto-assets; (ii) **wealth effects**, i.e. the degree to which changes in the value of crypto-assets might impact their investors, with subsequent knock-on effects on the financial system; (iii) **confidence effects**, through which developments concerning crypto-assets could impact investor confidence in crypto-asset markets (and potentially the broader financial system); and (iv) **extent of crypto-assets' use in payments** and settlements.

The report is structured as follows. The next section examines vulnerabilities concerning 'unbacked' crypto-assets, and the transmission channels through which these might affect financial stability. Vulnerabilities concerning stablecoins – both existing stablecoins, and potential future so-called "global stablecoins" – are examined in the third section. The fourth section examines recent developments concerning DeFi and crypto-asset trading platforms. The fifth section discusses data gaps for crypto-asset risk assessments (Annex 1 provides an overview of metrics and data gaps). A final sixth section concludes and describes next steps.²

This document also contains a glossary (Annex 2) that defines certain terms relating to crypto-assets. To the extent possible, these are aligned with terminology used in FSB work and by other international organisations and standard-setting bodies. However, the use of these terms does not involve a judgment as to their appropriateness in all cases given the rapidly evolving crypto-asset markets – for instance, the distinction between unbacked crypto-assets and stablecoins does not imply that the latter are (fully or at all) backed by assets; stablecoins may not have stable values; and DeFi market structures often exist along a spectrum of centralisation.

¹ See FSB, *Crypto-asset markets: potential channels for future financial stability implications*, October 2018.

² In some cases, this report refers to specific crypto-assets or firms providing related services as examples. These examples are not exhaustive and do not constitute an endorsement by the FSB or its members for any crypto-asset, firm, product, or service.

2. Vulnerabilities concerning unbacked crypto-assets

2.1. Financial sector exposures

Connections between crypto-assets and systemically important financial institutions and core financial markets, though expanding, remain limited at the present time. Episodes of price volatility have, so far, been contained within crypto-asset markets and have not ‘spilled over’ or presented a threat to the resilience of broader financial markets and infrastructures. However, much of the trading activity in crypto-assets, as well as in futures and other derivatives referencing them, takes place on platforms that may be operating outside the regulatory perimeter (or, in some cases, may be failing to comply with applicable laws and regulations) and without regulatory oversight that would provide transparency on the nature and extent of these exposures. If current trends continue, and absent effective regulation and supervision, financial stability risks may emerge as crypto-assets become increasingly interconnected with the wider financial system. This is especially the case in emerging market and developing economies (EMDEs) where crypto-assets may in some situations replace the domestic currency, or offer opportunities to circumvent exchange restrictions, and capital account management measures.

Over the course of 2020-21, there has been growing institutional investor participation in crypto-assets, in addition to the substantial retail ownership of crypto-assets. Hedge funds are allocating increasing amounts of their funds to crypto-assets.³ That said, amongst mainstream asset managers, interest in crypto-asset investments remains limited, owing to high volatility, lack of regulatory compliant products and platforms, a shortage of regulated custody services, as well as broader regulatory uncertainty.⁴ Growing institutional investor involvement in crypto-asset derivatives may both increase access to crypto-assets exposure, and heighten the risk of ‘spill-overs’ to core markets, for example if investors need to sell other assets to meet margin calls on their crypto-asset positions.

A growing number of financial service providers are offering or plan to offer crypto-asset custodial and trading services. Some large financial institutions have also announced plans to launch institutional crypto-asset brokerage and exchange services. And a number of private non-financial corporates began holding bitcoin as a treasury asset, although volumes are small from a system-wide perspective.

The emergence of crypto-asset exchange traded funds (ETFs) has been the subject of much commentary, with some suggesting this could significantly expand ‘mainstream’ institutional exposure to crypto-assets.⁵ In October 2021, the first US-based crypto-asset CME futures ETF launched, the ProShares Bitcoin futures ETF (ticker BITO), and began trading on the New York

³ See “Hedge funds expect to hold 7% of assets in crypto within five years”, *Financial Times*, 15 June 2021. A recent survey by Intertrust group of 100 hedge funds CFOs found that, on average, these expected to allocate 7.2% of their assets to crypto-assets by 2026. If replicated across the hedge fund sector this equate to around US\$312bn of AUM invested in crypto-assets.

⁴ See Oliver Wyman, *Wealth and Asset Management Report*, June 2021.

⁵ The US SEC has previously denied approval of all proposals for Bitcoin exchange-traded products on the basis that those filings did not satisfy the requirement related to the prevention of fraud and manipulation. See, for example, SEC, *Self-Regulatory Organizations: Bats BZX Exchange, Inc.; Order Setting Aside Action by Delegated Authority and Disapproving a Proposed Rule Change to List and Trade Shares of the Winklevoss Bitcoin Trust*, 26 July 2018.

Stock Exchange.⁶ Over the first two days of trading, BITO attracted over \$1 billion in investments, the fastest any ETF had reached that mark. Assets under management (AUM) of BITO stood at almost \$1 billion in late January 2022. CME bitcoin futures trade on regulated markets with price transparency. The US Securities and Exchange Commission (SEC) has not approved any 'physical' spot bitcoin Exchange-Traded Products.⁷ In December, Fidelity Investments launched a 'physical' spot bitcoin ETF that trades on the Toronto Stock Exchange, alongside several other spot bitcoin ETFs launched in Canada in 2021.

Crypto-asset derivative markets remain relatively small but have grown rapidly during 2021. Open interest in crypto-asset futures on regulated exchanges almost doubled between July and December 2021 (from \$11 billion to \$19 billion for bitcoin and from \$6.6 billion to \$12 billion for Ether).⁸ Similarly, open interest in bitcoin options increased from \$6-7 billion to \$12 billion over the same period. Currently, trading in crypto-asset futures or other derivatives takes place on crypto-asset trading platforms that are not, in most cases, operating under comparable regulatory requirements and oversight to mainstream financial exchanges, meaning there is less transparency on the nature and extent of these exposures.⁹ Some contracts also feature very high levels of leverage (up to 125 times), though the size of the positions which permit such high levels of leverage are reportedly small. In contrast, bitcoin trading on registered exchanges, such as CME, reportedly accounts only for 14% of open interest and 4% of trading volume.

If financial institutions continue to become more involved in crypto-asset markets, this could affect their balance sheets and liquidity in unexpected ways. As in the case of the US subprime mortgage crisis, a small amount of known exposure does not necessarily mean a small amount of risk, particularly if there exist a lack of transparency and insufficient regulatory coverage.¹⁰

Access to capital markets by firms providing services associated with crypto-assets has also widened. Coinbase, the large US-based crypto-asset trading platform, undertook a direct public listing in April 2021.¹¹ In July 2021, it was announced that Circle, a crypto-asset business that has sought a US national bank charter, intends to go public.¹²

One potential indicator of the linkages between crypto-assets and the mainstream financial system is the correlation of changes in the price of crypto-assets and other financial assets (Graph 1). Over the past few years, the correlation between the changes in the price of crypto-assets and equities has generally been negligible, but became more positive in 2020 and 2021 (Graph 1, blue line).¹³ This could be consistent with portfolio shifts into crypto-assets along with equities. Meanwhile, the correlation between changes in the price of crypto-assets and commodities such as gold weakened and turned negative in 2021 (Graph 1, red line).

⁶ See Todorov, "Launch of the first US bitcoin ETF: mechanics, impact, and risks", *BIS Quarterly Review*, December 2021.

⁷ See, for example, SEC, Order Disapproving a Proposed Rule Change to List and Trade Shares of the VanEck Bitcoin Trust under BZX Rule 14.11(e)(4), Commodity-Based Trust Shares, 12 November 2021.

⁸ See <https://www.theblockcrypto.com/>.

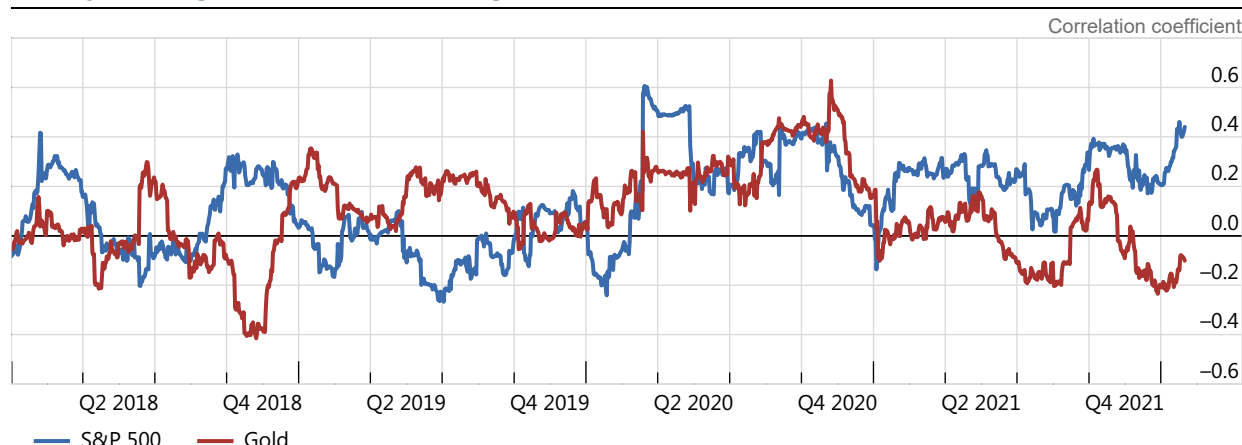
⁹ This, however, might change as providers of crypto-asset services are increasingly expanding into traditional financial services. See for example "Coinbase buys crypto futures exchanges, plans to sell derivatives in U.S.", *Reuters*, 13 January 2022.

¹⁰ See Cunliffe, "Is 'crypto' a financial stability risk?", speech at SIBOS, 13 October 2021.

¹¹ See "Coinbase IPO exceeds all expectations", *Nasdaq*, 19 April 2021.

¹² See "Cryptocurrency operator Circle to go public", *The Wall Street Journal*, 8 July 2021.

¹³ See Iyer, "Cryptic Connections", *IMF Global Financial Stability Notes*, 11 January 2022.

60-day moving correlations of changes in the prices of bitcoin and other assets**Graph 1**

Sources: Bloomberg, CoinGecko; FSB calculations.

2.2. Wealth effects

The significant growth of the unbacked crypto-asset market over 2021 has increased the potential impact of wealth effects. Furthermore, even where the impact may be limited on a global scale, wealth effects could have a significant impact on a domestic level. However, determining precise measures of exposures to crypto-assets is challenging. The peak November 2021 estimated market capitalisation of unbacked crypto-asset markets of \$2.6 trillion was about 3.5 times higher than at the start of 2021, although this has declined more recently (Graph 2, left hand panel). The recent peak amount is equivalent to around 1% of global financial assets.

Available evidence suggests that an increasing share of crypto-assets are being held by small retail investors, although overall ownership is still relatively concentrated. A recent study of bitcoin ownership and concentration showed that individual investors collectively control 8.5 million bitcoins, almost half of those in circulation.¹⁴ There also appears to be significant skewness in ownership, with the top 1,000 investors controlling about 3 million bitcoins and the top 10,000 investors with 5 million (about 16% and 26% of total bitcoin in circulation, respectively). Notably, the balances held (on behalf of institutional and retail clients) at intermediaries such as exchanges have been steadily increasing since 2014 but comprised only 5.5 million bitcoins, about one-third of bitcoin in circulation, by the end of 2020. These findings suggest that the bitcoin ecosystem is still dominated by a few entities, such as large miners, bitcoin holders or exchanges.

Persistently high price volatility underlines the market risk associated with crypto-asset investments. Between January and early November 2021, bitcoin prices rose from \$29,000 to roughly \$68,000 before falling to about \$38,000 in late January 2022 (Graph 2, right hand panel). In some cases, announcements about the use of bitcoin by individual firms caused large price moves. Some recent declines in crypto-asset prices have also coincided with regulatory actions

¹⁴ See Makarov and Schoar, "[Blockchain Analysis of the Bitcoin Market](#)", NBER Working Paper no 29396, October 2021.

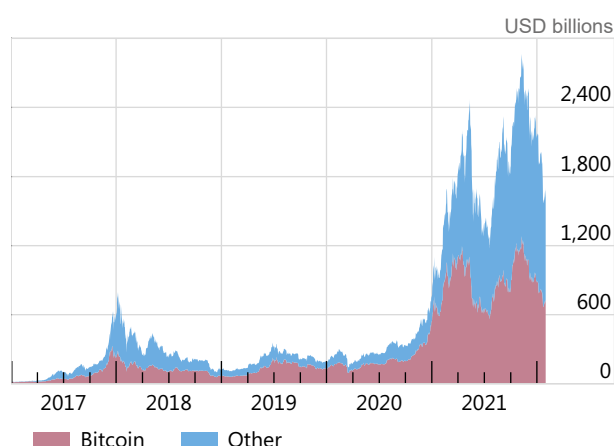
and announcements by some authorities to contain their growth.¹⁵ Three month realized volatility for bitcoin stands at 60% (compared with 13% for gold and 16% for the S&P 500).

The recent price spike and attendant volatility may have been driven in large part by speculation, and increased appetite for ‘risk assets’ from retail investors.¹⁶ Even if the impact is limited on a global scale, the wealth effect could have a significant impact on a domestic level. An extreme case would be when crypto-assets are adopted as fiat currencies (e.g. El Salvador) and mainstream stores of value. As such, impacts in specific jurisdictions may differ widely and would need to be better understood.

Crypto-asset market capitalisation and price drivers

Graph 2

Crypto-asset market capitalisation



Recent changes in the price of bitcoin, including in response to regulatory and other announcements¹



¹ The first line indicates the date of Tesla's announcement to accept bitcoin as means of payment (08.02.2021). The second line indicates the day Elon Musk is tweeting that bitcoin prices "seem high" (20.02.2021). The third line indicates the day of Tesla's announcement to suspend purchases of vehicles made using bitcoin (13.05.2021). The fourth line indicates the announcement by Chinese regulatory authorities that banned financial institutions from providing cryptocurrency-related services (18.05.2021). The fifth line indicates the announcement by Chinese regulatory authorities that declared crypto-asset activities as illegal (24.09.2021).

Sources: Coin Dance, CoinGecko.

2.3. Confidence effects

Widespread holdings of crypto-assets by retail investors with limited knowledge of the market functioning including transaction fees, and given the **lack of investor protections, or recovery and resolution frameworks**, could result in adverse confidence effects. Retail investment in crypto-assets continued to increase in 2020 and 2021, although investment flows are still low compared to other types of financial assets. Survey-based research indicated that in 2021 around 16% of Americans,¹⁷ 12% of Russians, 7% of South Africans,¹⁸ and 6% of Britons invested in, traded or

¹⁵ In June 2021, Chinese authorities intensified the closure of Bitcoin mining activities; in September, they declared all activities related to digital coins as illegal. See "China to shut down over 90% of its Bitcoin mining capacity after local bans", *Global Times*, 20 June 2021, and "China expands crackdown by declaring all crypto activities 'illegal'", *Financial Times*, 24 September 2021. For broader evidence of the impact of regulatory actions, see Auer and Claessens "Cryptocurrency Market Reactions to Regulatory News", CEPR Discussion Paper no 14602, April 2020.

¹⁶ See FCA, *Research Note: Cryptoasset consumer research 2021*, 17 June 2021, Figure 3.

¹⁷ See Pew Research Center, "16% of Americans say they have invested in, traded or used cryptocurrency", 11 November 2021.

¹⁸ See TripleA, *Global Cryptocurrency Ownership Data 2021*, 2021.

used crypto-assets.¹⁹ In the main, these users are under the age of 40, and in professional and managerial socio-economic cohorts.

Some evidence suggests that retail investors' levels of knowledge and understanding of crypto-assets, and the associated risks are low. Approximately 60% of prospective retail investors in crypto-assets in the US report their level of knowledge as 'very low'. In the UK 58% of retail crypto-asset investors said they had a 'good' level of understanding of risks. And 10% of UK crypto-asset investors recalled seeing a warning concerning the potential risks when they purchased crypto-assets. Investors might also increasingly see crypto-assets as complementary to mainstream investments: just 38% of respondents to a survey of retail investors by the UK FCA considered crypto-assets to be a 'gamble'.²⁰ Some financial authorities and regulators have embarked on programmes of investor information and education aimed at highlighting potential risks.²¹ This issue has also been the subject of examination by the International Organization of Securities Commissions (IOSCO).²²

Crypto-assets do not possess the safeguards that are present in bank deposits and other financial instruments. Nor do crypto-assets provide holders with basic investor protections as they largely operate outside of (or, in some cases, in non-compliance with) regulatory frameworks. The sector, including its trading platforms, have seen a proliferation of fraud and abuse involving, among other misconduct, the misuse of holders' personal data or theft of assets.²³ Crypto-assets could also cease to exist; of the 16,000 tokens listed on exchanges over time, only around 9,000 remain. The investment frauds extend beyond crypto-assets and into related digital asset advisory, wallet, and trading businesses.²⁴ In some cases, users' accounts are suddenly frozen or inaccessible, causing additional adverse confidence effects to this sector.

Taken together, this evidence suggests that any abrupt decrease in the value of crypto-assets – including that stemming from an operational incident – might result in a sharp loss of confidence by investors. However, at current levels of adoption, and given low levels of connectedness with the wider financial system, confidence effects are unlikely to cause widespread 'spill-overs' to financial markets. That said, in a future episode of market stress, crypto-asset prices might fall in tandem with broader regulated risky assets, as occurred in March 2020 (see Graph 2 left hand panel). To the extent that this volatility triggered selling by crypto-asset investors who also hold of regulated risk assets, then crypto-asset markets might amplify any broader market correction.

2.4. Use in payments and settlement

Thus far, the use of crypto-assets for payments remains limited. The most popular crypto-assets lack stability as a store of value, do not function as a unit of account, and have performance shortcomings (speed, cost and capacity) that limits their usefulness for mainstream payments.

¹⁹ See FCA, *Research Note: Cryptoasset consumer research 2021*, 17 June 2021.

²⁰ *Ibid.*

²¹ See for example FCA, "FCA warns consumers of the risks of investments advertising high returns based on crypto-assets", 11 January 2021.

²² See IOSCO, *Investor Education on Crypto-Assets*, December 2020.

²³ See IOSCO, *Issues, Risks and Regulatory Considerations Relating to Crypto-Asset Trading Platforms*, February 2020.

²⁴ See, for example, CFTC, "Watch out for digital fraud", 2021, and Crypto Head, "Crypto Breaches & Fraud", 2021.

That said, some mainstream payment service providers have announced steps to support both unbacked crypto-assets and stablecoins. One has conducted a stablecoin pilot using USD Coin (USDC) on the ethereum blockchain. Another launched a decentralised cross-border network based on the Algorand blockchain using stablecoins, including USDC.

Whilst these initiatives are designed primarily to facilitate easier access to crypto-assets as an investment, the projects are also reportedly intended to support the development of crypto-asset payments.²⁵ For instance, one payment service provider is planning to give participating merchants the option to receive payments directly in crypto-assets. In contrast, previous payment products that allowed merchants to accept crypto-assets as payment (including via traditional credit and debit cards) still saw merchants receive funds in commercial bank money via traditional payment rails following conversion of the crypto-asset. Finally, international card schemes are launching debit and credit cards sponsored by crypto-assets services providers or e-money institutions for payment purposes. Those partnerships might go beyond payment services and include options of credit against crypto-assets.

One sign that crypto-assets might be perceived by some of their investors to have the potential to gain acceptance as a wider means of payment is that some recent topical announcements have triggered substantial changes in crypto-asset prices, such as Tesla's announcement in 2021 that it would accept bitcoin as a means of payment.²⁶ Such announcements were associated with substantial increases – but also subsequent declines – in the price of bitcoin (see Graph 1, right hand panel).

In some EMDEs, it has been argued that crypto-assets are becoming more prevalent out of necessity, such as to maintain savings in the face of currency devaluation or to carry out remittances.²⁷ For example, the Turkish lira became the most traded currency against tether in the fourth quarter of 2021.²⁸ In early September 2021, El Salvador announced the adoption of bitcoin as legal tender, placing it on the same legal footing as the US dollar. With 70% of the population unbanked, the Salvadoran government argued that the use of bitcoin within its jurisdiction would facilitate remittances from abroad. Along with legislative approval of bitcoin as legal tender, the legislation also stipulates that businesses must accept bitcoin as payment. Others have argued that the use of bitcoin as currency may add to economic instability.²⁹

A further consideration arises from the environmental impact of energy intensive consensus mechanisms used for certain unbacked crypto-assets (see Box 1). Increasing financial exposures to crypto-assets with a significant energy footprint contributes to increased transition risk for the financial system, as these assets are vulnerable to jurisdictions' climate policies.

²⁵ See "MercadoLibre plans to accept BTC and cryptocurrencies as payment for all products", *Cointelegraph*, 2 December 2021.

²⁶ See "Bitcoin climbs as Elon Musk says Tesla 'likely' to accept it again", *BBC*, 22 July 2021.

²⁷ See Chainalysis, *The 2021 Geography of Cryptocurrency Report*, 2021.

²⁸ See "Turks pile into bitcoin and tether to escape plunging Lira", *The Wall Street Journal*, 12 January 2022.

²⁹ See Adrian and Weeks-Brown, "Crypto-assets as national currency is a step too far", *IMFBlog*, 26 July 2021, and IMF, *Executive Board Concludes 2021 Article IV Consultation with El Salvador*, 25 January 2022.

Box 1: Climate-related financial risk aspects of crypto-assets

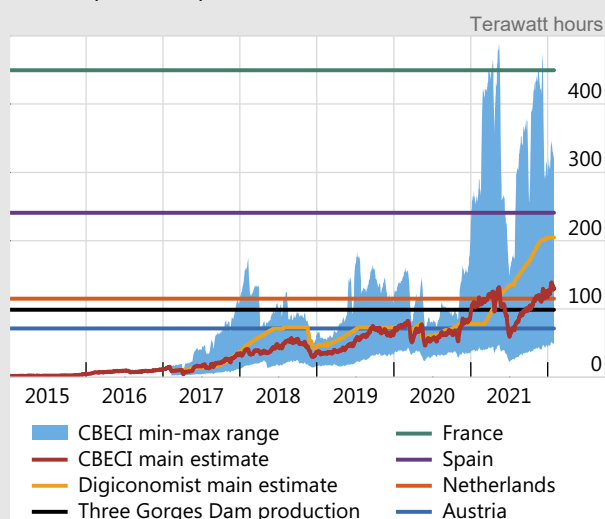
Certain crypto-assets have a significant ecological footprint and estimated annualised energy consumption comparable to that of some countries (Graph 3, left-hand panel). Increasing financial exposures to those crypto-assets contributes to increased transition risk for the financial system.

The main reason for the significant energy consumption of some blockchains is their Proof-of-Work (PoW) consensus mechanism. This procedure is computationally intensive and resource expensive and translates directly to high energy consumption. A more recent class of consensus mechanisms, Proof-of-Stake (PoS), has lower energy consumption. PoS-based crypto-assets have seen some increases in market capitalisation. That said, the market capitalisation of PoW-based crypto-assets remains high, at around 80% of the total crypto-asset market capitalization (Graph 3, right hand panel), though some of the largest crypto-assets have announced their intention to move from PoW to PoS.

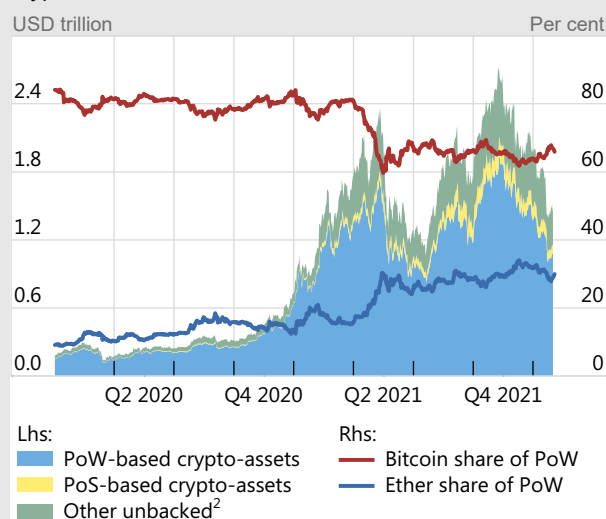
Global bitcoin electricity consumption and market capitalization of PoW-based crypto-assets

Graph 3

Estimated annualised global bitcoin electricity consumption compared to selected countries¹



Market capitalization of PoW- and PoS-based unbacked crypto assets



CBECI = Cambridge Bitcoin Electricity Consumption Index.

¹ Horizontal lines denote annual electricity consumption of countries in 2020 and the annual electricity production capacity of the Three Gorges Dam, which is the world's largest power station in terms of installed capacity. ² 'Other unbacked' is the approximate market capitalisation of other unbacked crypto-assets that are generally based on consensus mechanisms different from PoW and PoS. It also contains a residual for unidentified PoW- and PoS-based unbacked crypto-assets.

Sources: Cambridge Centre for Alternative Finance, Coin Dance, CoinGecko, Digiconomist, International Energy Agency; ECB; FSB calculations.

The significant energy consumption of PoW crypto-assets makes them highly vulnerable to changes in jurisdictions' climate policies and may place strains on local utility infrastructure. If countries were to ban the mining and use of PoW-based crypto-assets, investments in such crypto-assets could become 'stranded'; so they exacerbate climate transition risk in financial institutions' balance sheets.³⁰ Increased activity with PoW crypto-assets could thus impair financial sector resilience and create risks for the financial system. As crypto-assets become increasingly interconnected with the wider financial system, vulnerabilities stemming from large exposures to PoW-based crypto-assets may increase as well.

³⁰ See for example "China's top regulators ban crypto trading and mining, sending bitcoin tumbling", *Reuters*, 24 September 2021.

3. Vulnerabilities concerning stablecoins

Stablecoins are a category of crypto-assets that aim to maintain a stable value with reference to a specified asset (typically US dollars), or basket of assets, and provide perceived stability when compared to the high volatility of unbacked crypto-assets. However, relative price stability may not be the case for all stablecoins owing to variations in the ways in which they are pegged, the nature of reserve assets (if any), and their governance structure. Stablecoins are generally created, and distributed through trading platforms, in exchange for fiat currency. The issuer of a stablecoin can use the proceeds of the fiat currency to invest in the reserves or in other assets. However, the composition and amount of reserve assets backing the stablecoin may vary significantly, some issuers do not appear to adhere to any standards regarding the composition of reserve assets backing the stablecoin, and there may be no direct right by a user against the issuer or reserve to redeem. As a result, the risks of various stablecoins might differ based on their design, including their reserve assets and redemption rights. Moreover, concentration risk is high, with the two largest stablecoins representing around 73% of total market capitalisation. In a recent report, the FSB noted that while the current generation of stablecoins are not being used for mainstream payments on a significant scale, vulnerabilities in this space have continued to grow over the course of 2020-21.³¹

The most frequent use cases of stablecoins include:³²

- Acting as a bridge between traditional fiat currencies and a variety of (typically more volatile) digital assets;
- Serving as collateral in crypto-asset derivative transactions; and
- Facilitating trading/ lending/borrowing and acting as collateral in DeFi (see Section 4).

3.1. Financial sector exposures

As with unbacked crypto-assets, linkages with the core financial system are rising. Stablecoins can have a direct connection to that system through their reserve assets, which may include exposures to short-term money markets. However, stablecoin issuers are not subject to a consistent set of standards regarding the composition of reserve assets backing the stablecoin, and there is a lack of consistency in disclosure practices among stablecoin issuers. For instance, Tether (the largest stablecoin issuer at present) reported that the bulk of its reserves are in cash, equivalents or short-term deposits, with the remainder in loans, corporate bonds and other investments. The cash equivalent portion is purportedly mostly made up of commercial paper, but it is unclear whom the issuers are. Importantly, the financial releases are only 'attestations' rather than audits (see below).³³ Large-scale redemptions or a run on a stablecoin's reserve assets could lead to fire sales of those assets, creating disruptions in the markets in which the reserve is invested, such as the short-term funding markets.

³¹ See FSB, *Regulation, Supervision and Oversight of "Global Stablecoin" Arrangements: Progress Report on the implementation of the FSB High-Level Recommendations*, 7 October 2021.

³² For further detail on these and other use cases, see Medium, "Top use cases and benefits of stablecoins", 12 August 2021.

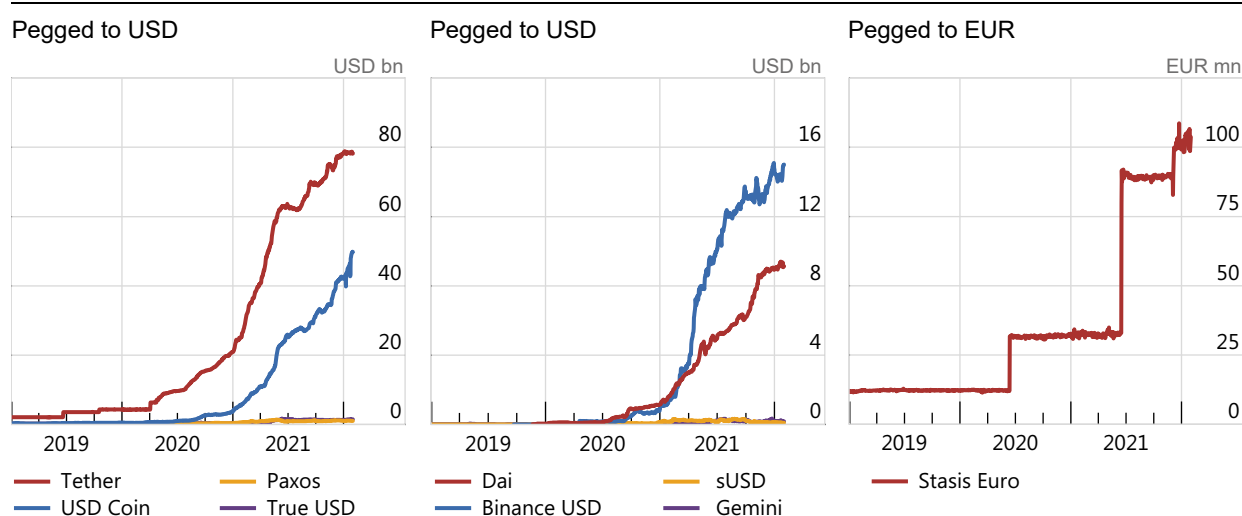
³³ See Drakopoulos et al, "Crypto Boom Poses New Challenges to Financial Stability", IMFblog, 1 October 2021.

3.2. Wealth effects

Largely reflecting links to unbacked crypto-assets, market capitalisation of stablecoins has grown significantly over the course of 2021 along with wider crypto-asset markets. Total market capitalisation of stablecoins reportedly stood at around \$157 billion in December 2021, an increase from \$5.6 billion at the start of 2020. This represents about 6% of total crypto-assets, which is well above the 2-3% pre-pandemic levels. Tether's USDT, launched in 2014, dominates the sector with a market capitalisation of approximately \$76.5 billion, with Circle's USDC, launched in 2018, following at approximately \$42 billion (Graphs 4 and 5). At the end of 2021 Tether had a size approaching that of some of the largest prime money market funds. In aggregate, reported outstanding stablecoin assets are equivalent to almost 20% of the total size of US assets held in institutional and retail prime money market funds, which total \$832 billion.³⁴

Market capitalisation of selected stablecoins

Graph 4



Sources: CoinGecko.

A number of incidents have raised wider concerns about governance, risk management and operational resilience in the stablecoin sector, with certain features that may amplify fragilities and undermine confidence in crypto-asset markets. One of the more prominent examples has been concerns about the adequacy and composition of Tether's reserves, and related legal action in respect of untrue and misleading statements.³⁵

Tether's USDT most recent listing of reserves in September 2021³⁶ disclosed that 40% of (loosely defined) reserves are composed of cash equivalents – cash, bank deposits and money market funds of unknown origin, with the majority of Tether's assets held in the form of commercial paper and certificates of deposit, secured loans, corporate bonds and precious metals. Circle's USDC most recent reserve attestation in October 2021³⁷ noted that its assets are entirely invested in cash and cash equivalents, with no exposure to commercial paper,

³⁴ See OFR, *U.S. Money Market Fund Monitor*, 30 November 2021.

³⁵ See CFTC, "Tether to Pay \$41 million Over Claims that Tether Stablecoin was Fully Backed by US Dollars", 15 October 2021.

³⁶ See Tether, *Consolidated Reserves Report*, 30 September 2021.

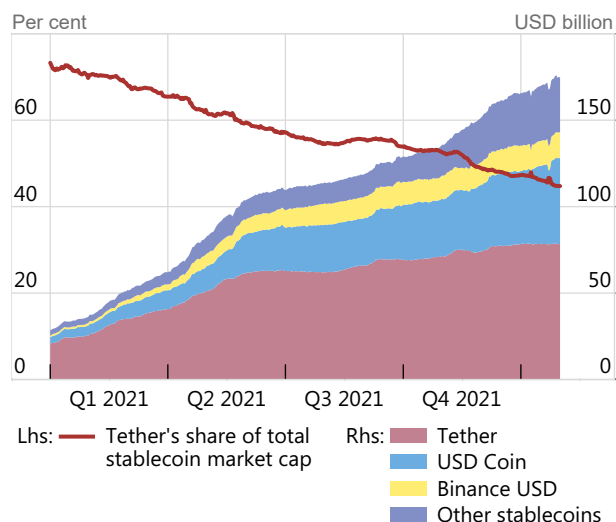
³⁷ See Circle, *Reserve Account Report*, 29 October 2021.

certificates of deposit or corporate bonds; and that the assets are held in segregated accounts with US regulated financial institutions.

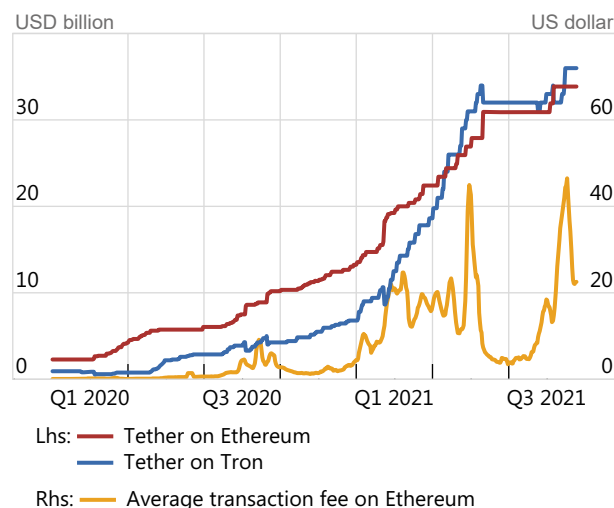
Market capitalisation of stablecoins

Graph 5

Market capitalisation of stablecoins



Tether market capitalisation by blockchain and average transaction fees on Ethereum



Sources: ECB, "The expanding functions and uses of stablecoins", *Financial Stability Review*, November 2021; CoinGecko; FSB calculations.

3.3. Confidence effects

Certain stablecoins display structural features and vulnerabilities, such as maturity and liquidity mismatches, which have some similarities to money market funds. This includes their stated aim (but without a guarantee) to offer redemption at par, although redemption rights are not always well defined. Nor is the entity responsible for carrying out the redemption always clearly specified. Confidence in a stablecoin arrangement could be undermined by a lack of clarity regarding the redemption rights of stablecoin holders. Redemption rights offered to users may also be mismatched with the liquidity of the assets held in the stablecoin reserve. If users of stablecoins lose confidence that issuers can fulfil redemptions because reserve assets are mismanaged, fall in price, become illiquid, or are otherwise not appropriately safeguarded, there could be a disruptive run.³⁸ Operational failures may also reduce confidence and lead to a redemption run in a stablecoin.

At present, stablecoins are being used mainly as a bridge between traditional fiat currencies and digital assets, which in turn are primarily held and traded for speculative purposes. In September 2021, around 75% of all trading on crypto trading platforms involved a stablecoin. Moreover, stablecoin trading volumes have outpaced those of all other crypto-assets (see Graph 6, left hand panel). Trading flows between Bitcoin and other assets suggest that Bitcoin trading activity is highly dependent on stablecoins, especially Tether, while the daily turnover of Tether is much higher than that of Bitcoin (see Graph 6, right hand panel). These close linkages suggest that

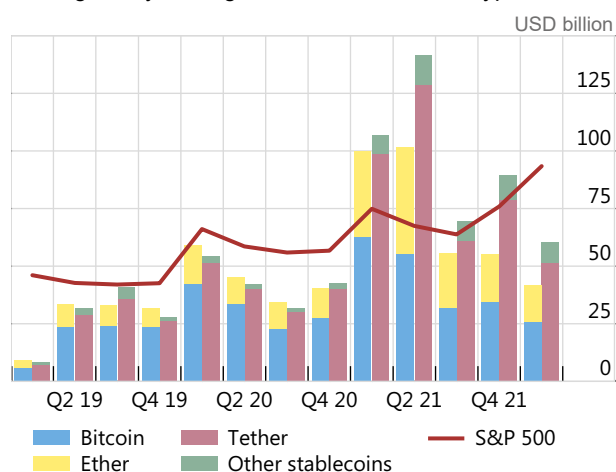
³⁸ For an example of such a run on a smaller stablecoin, see Iron, *Iron Finance Post-Mortem*, 17 June 2021.

the failure of certain stablecoins may pose a threat to the stability of the crypto-asset ecosystem itself, with knock-on effects to confidence in the sector.

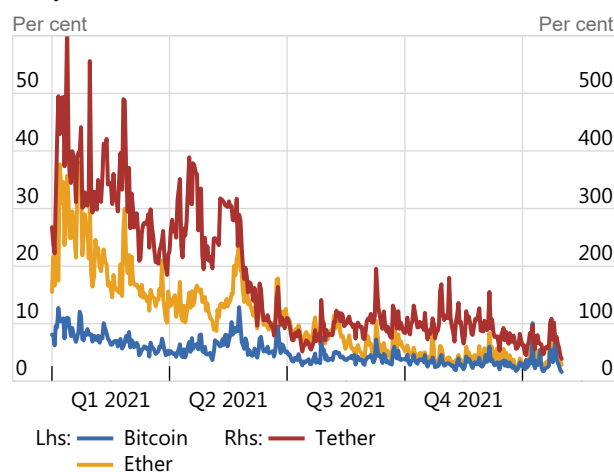
Trading volumes of crypto-assets

Graph 6

Average daily trading volumes of selected crypto-assets



Daily turnover of Tether, Bitcoin and Ether¹



¹ Daily turnover as daily trading volume divided by market capitalisation.

Sources: Bloomberg, CoinGecko; FSB calculations.

3.4. Use in payments and settlement

Stablecoins are at present primarily used to facilitate trading, lending, or borrowing of other crypto-assets on or through crypto-asset trading platforms. While their functions may evolve over time, the current generation of stablecoins are not yet used as a widespread means of payment. Uses for payment purposes are confined to certain types of domestic and international payments. Potential high transaction fees and price volatility on certain blockchains act as an impediment to their use as a form of payment. This situation may change if transaction fees fall, or stablecoins migrate to low or zero fee blockchains (see Graph 5, right hand side).

In the event that stablecoins were used more extensively for payment, they would face many of the same risks as current payment systems, including credit risk, liquidity risk, operational risk, risks arising from improper or ineffective governance, and settlement risk. When not managed effectively and comprehensively, these risks make payment systems less available and less reliable for users. In turn, this may impair the availability of critical financial services on which the real economy depends, threaten confidence, and operate as a channel through which financial shocks spread.

3.5. Potential future global stablecoins

Looking to the future, the emergence of so-called “global stablecoins” (GSCs) would pose risks to financial stability that exceed those of existing stablecoins. This is particularly the case if such a GSC were adopted at scale and entered the mainstream financial system as a store of value or means of payment. A disorderly run due to a loss in confidence on a GSC that has reached significant scale could lead to disruptions in the real economy and spillovers into the broader financial system.

The financial stability risks from a GSC would depend on the value of coins in circulation, value of funds that end users maintain in wallets (i.e. the aggregate value of end user claims on the reserve), quality and management of reserve assets, and the relative importance of reserve assets to the balance sheets of partners within the traditional financial system. A disorderly redemption at a significant stablecoin provider could lead to spillovers to the broader financial system due to fire sales of reserve assets, as well as cause disruption to crypto-asset markets, given the close dependency between unbacked crypto-assets and stablecoins.

Additional financial stability risks could arise **when a GSC is denominated in a currency other than that of the jurisdiction in which it is operating, including stablecoins referencing a basket of multiple currencies, or stablecoins with a mismatch between the currency of issuance and the currency of backing assets.** In such cases, a GSC has the potential to increase currency substitution risks and, in periods of macroeconomic stress, could see large inflows from investors seeking to avoid reductions in wealth, for example due to changes in exchange rates or credit risk on local currency assets. These financial stability risks are particularly relevant for EMDEs, especially in countries where the value of the domestic currency is not stable and payment infrastructures are not well developed. **A wide use of GSCs in foreign currency may provide an additional channel for capital outflows and lead to disintermediation of domestic banking sector.**³⁹

International work on standards and recommendations for regulatory frameworks for stablecoins is ongoing. The FSB published in 2020 a report that set out high level recommendations for the regulation of global stablecoins, which includes an effective risk management framework for reserve management.⁴⁰ The Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (CPMI-IOSCO) are coordinating with the FSB to determine regulatory approaches for GSCs, including those intended for use in mainstream payments.

There is a risk, however, that a stablecoin could launch and scale rapidly before such regulatory frameworks are in place.⁴¹ For example, existing stablecoins could partner with established firms and expand rapidly or migrate into payments space. Furthermore, established payment systems are integrating stablecoins into their platforms, which could accelerate growth further. Crypto-asset business models are rapidly evolving and adapting to the regulatory developments. This could pose challenges for relevant authorities to effectively capture existing and future stablecoin propositions, and may lead to regulatory arbitrage if there are gaps in the regulatory treatment.

4. Decentralised Finance (DeFi) and Crypto-asset Trading Platforms

DeFi is based on distributed ledger technology (DLT) (typically public and permissionless blockchains) to offer financial services and products purportedly without the need for intermediaries. Though DeFi projects claim to be decentralised, DeFi applications and products

³⁹ See IMF, “[The Crypto Ecosystem and Financial Stability Challenges](#)”, *IMF Global Financial Stability Report*, October 2021.

⁴⁰ See FSB, [Regulation, Supervision and Oversight of “Global Stablecoin” Arrangements](#), 13 October 2020. Depending on the activities undertaken by, and economic functions provided by a stablecoin, other regulatory frameworks may also be relevant.

⁴¹ On 31 January 2022 the [Diem Association](#) announced the sale of its intellectual property and other assets related to the running of the Diem Payment Network to Silvergate Capital Corporation.

often exist along a spectrum of centralisation. Stablecoins are used for a growing volume of DeFi activities allowing participants to exchange volatile unbacked crypto-assets into a more stable digital asset. DeFi typically uses ‘smart contracts’ through which transactions can be executed on a peer-to-peer, or peer-to-contract basis, by DLT-based software in accordance with pre-determined terms and rules that may be subject to little or no day-to-day human oversight.⁴² DeFi applications and platforms offer lending, borrowing, trading and custody of crypto-assets. They also include a broader collection of unregulated financial services that mimics that of the mainstream financial system, such as insurance, asset management and trading of derivatives (see Table 1). Transactions are typically collateralised by digital assets, including (but not limited to) unbacked crypto-assets and stablecoins.

Table 1: Summary of existing DeFi initiatives

	Description
Lending	By using smart contracts, users can become lenders or borrowers on DeFi platforms. Users typically post crypto-assets as collateral and then can borrow other crypto-assets. The most prominent platform typically requires \$150 of collateral for every \$100 of lending. Many platforms set interest rates automatically, depending on demand and supply of liquidity. Some of these platforms have characteristics analogous to commercial and/or central banks.
Investment (Asset Management / Derivatives)	Many projects offer a suite of yield-generating crypto-asset products by automatically routing crypto-asset “deposits” to highest-yield opportunities within a set risk-tolerance for particular pools. Other platforms allow derivative products such as synthetic assets, options or perpetual futures as well as crypto-asset tranches
Decentralised Exchanges (DEXs)	Decentralised Exchanges claim to be peer-to-peer marketplaces based on smart contracts that allow trading in crypto-assets. They use automated liquidity pools, where investors ‘lock’ in their crypto-assets (in exchange for fees) to facilitate trading.
Payments	Many applications focus on increasing interoperability between blockchains, with the aim to increase scaling. ⁴³ Others focus on increasing the safety of existing means of payment (e.g. through the use of QR codes), by using the blockchain to validate transactions in real time.
Insurance	Some DeFi protocols, called discretionary mutuals, allow members to pool and share risks from smart contract failure, or mutualise premiums into smart contracts that trigger pay outs when pre-defined risks or events materialise.

The features that distinguish DeFi from traditional finance are:

- **Openness:** DeFi relies on open-source technology where anyone with technical expertise can read the underlying source code.

⁴² See Wharton Blockchain and Digital Asset Project, *DeFi Beyond the Hype: the emerging world of decentralised finance*, May 2021; Schär, *Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets*, Federal Reserve Bank of St Louis, 2021Q2, Vol. 103, No. 2; and OECD, *Why Decentralised Finance (DeFi) Matters and the Policy Implications*, 2022.

⁴³ See Medium, “What does “scalability” really mean in Blockchain?”, 15 May 2019.

- **Trustless:** DeFi platforms allow anyone who can provide the requisite amount of collateral (including, but not limited to, crypto-assets) to use the platform in an automated transaction. Over-collateralisation and programmatic enforcement of the required margins via smart contracts on DeFi platforms substitutes for checking the identity of users and credit risk assessment of borrowers.
- **Permissionless:** anyone can use DeFi protocols as long as they can fulfil the protocol's requirements.
- **Claims of decentralised ownership and governance structure:** Some DeFi protocols purport to rely on **voting by governance** token holders (which could be understood to be analogous to shareholders' voting rights in traditional finance) to make decisions. However, in practice, governance may be concentrated, including through the use of committee structures for management purposes with regular meetings held through social media platforms or individuals associated with the DeFi project who hold disproportionately large portions of the total governance token supply. Typically, there also exists a founding team that holds 'admin keys', who can make unilateral decisions and exercise control of the overall functioning of the internal governance at least during the initial phases of development.

The technology and distributed nature of DeFi poses a number of regulatory challenges and threats. DeFi platforms aim to provide a decentralised governance structure by issuing the governance tokens, making it challenging for public authorities and regulators to identify an entity or individual accountable for meeting regulatory obligations (e.g. if they maintain control of a DeFi application).

In an extreme case, where a DeFi platform is completely decentralised, there may be no single person or entity that could be held responsible for the functioning of the protocol (even though this may not be the case in the current generation of decentralised governance arrangements).⁴⁴ Instead, the DeFi developers' claims of no responsibility or disclaimers of liability would be that responsibility would lie with its entire (pseudonymous) user base. Furthermore, given DeFi's global nature, the **applicable legal jurisdictions** may not always be clear or well-defined.

One of the novel features of DeFi platforms is that visibility and verification of identities of counterparties is not required. Although some platforms have recently introduced know-your-customer (KYC) verification requirements, these are not always necessary for the platforms to function, even though such requirements are required by law in most jurisdictions. In addition, some third-party service providers offer additional privacy-enhancement (or even law evasion) techniques for DeFi users. It can therefore be difficult to trace transactions, increasing the risk of these platforms attracting illegal activities, money laundering, terrorist financing, or circumventing sanctions restrictions.

The total value of assets currently 'locked' in DeFi transactions – an industry measure commonly referred to as the total value locked (TVL) – stood at around \$100 billion in December 2021,

⁴⁴ See Aramonte et al, "DeFi risks and the decentralisation illusion", *BIS Quarterly Review*, December 2021.

about four times as much as at end-2020 (Graph 7), far exceeding the \$35 billion raised by Initial Coin Offerings (ICOs) between 2016 to 2019.⁴⁵

Without sufficient regulation and market oversight, DeFi and associated platforms, might present risks to financial stability. Some of these risks are becoming apparent, such as **concentration risk in terms of protocols and technology used**.⁴⁶ The sector has already seen numerous operational and cybersecurity incidents, and failures of governance. DeFi related hacks made up over 75% of the \$481 million known total hack and theft volume of crypto-assets through September 2021.⁴⁷ If the sector were to continue to increase in size, the crystallisation of these vulnerabilities might have consequences for the functioning of, and confidence in, the broader financial system. DeFi also has the potential to increase risks to financial stability from crypto-assets. In particular, it could lead to greater holdings of crypto-assets, with an associated increase in wealth effects, financial institution exposures and associated confidence effects.

Total value of assets locked in DeFi transactions

Graph 7



Source: DeFi Pulse.

Going beyond DeFi, crypto-asset trading platforms that aggregate multiple types of services and activities, including lending and custody, account for the majority of crypto-assets traded. A **relatively small number of platforms provide these services, exacerbating concentration risk and possible conflicts of interest**. In many instances, these platforms are operating outside of a jurisdiction's regulatory perimeter, or are not in compliance with applicable regulatory requirements. Thus, these activities could fail to provide the market integrity, investor protection or transparency seen in appropriately regulated and supervised financial markets.

5. Data gaps

The ability to identify and quantify risks to financial stability from crypto-assets is hampered by the lack of transparent, consistent and trusted data on crypto-asset markets and their linkages with the core financial system. This is in part due to the fact that crypto-asset products,

⁴⁵ TVL refers to the total dollar amount of assets that is staked across all DeFi protocols. It does not refer to transaction volumes or market cap of cryptocurrencies, but rather to the value of reserves that are "locked" into smart contracts. The TVL may vary depending upon the source. See "[Total Value Locked in DeFi is a 'Deceptively Complicated Metric'](#)", *Cryptonews*, 28 July 2021. On the amount of ICO, see E Lyandres, B Palazzo, D Rabetti, "[ICO Success and Post-ICO Performance](#)", July 2020.

⁴⁶ See FSB, *[Decentralised financial technologies: Report on financial stability, regulatory and governance implications](#)*, June 2019.

⁴⁷ See Coindesk, "[DeFi Has Accounted for Over 75% of Crypto Hacks in 2021](#)", 10 August 2021.

participants and markets fall outside of existing regulatory and supervisory perimeters and the associated reporting requirements or, in some cases, may be failing to comply with applicable laws and regulations. Further, given the borderless nature of crypto-asset markets, international cooperation is needed to collect data that are able to deliver a complete picture of such markets.

Distributed ledger technology (DLT), of which blockchain is one implementation, is at the core of most crypto-asset activity, with most platforms using 'public' versions of DLT. This means that the underlying software and all of the ledger's transaction data are publicly available and free for anyone to download. However, it is difficult to aggregate and analyse such data, especially as many transactions occur "off-chain", rather than on the DLT ledger, and at entities that do not report off-chain data, or through complex protocols and smart contracts. This limits the amount of insight that can be gained with regard to the crypto-asset market structure and functioning. In the absence of mandatory crypto-asset disclosure requirements for financial institutions (or by firms offering crypto-asset services) or, in some cases, compliance with applicable laws, it is very difficult to determine who the market participants are, or where crypto-asset-holdings are concentrated.

Data available on public blockchains is pseudonymous by design. This means that even if insights can be gained in terms of volumes and values of transactions, it is difficult to determine the identity of the users engaging in crypto-asset activity, which is important information for assessing the interconnectedness within the crypto-asset ecosystem and with the broader financial system. These limitations also pose challenges at the local level, where regulators are impeded from obtaining jurisdiction-level data to inform both policy and supervision. To better understand the nature of the market participants, industry and academia are relying instead on analysis of the behaviour of addresses and flows, using various clustering techniques. The result of this type of analysis is typically a classification of addresses and flows into exchanges, institutional and retail investors, which is monitored over time to gain insight on how the behaviour of these clusters evolves.

The challenges in measuring the crypto-asset sector are many and relate to both on-chain and off-chain data. Given the public nature of crypto-asset DLT networks, there is a lot of aggregated information available on public websites, providing metrics for crypto-asset networks, prices, market capitalisation and trading volumes. However, the sources differ in terms of methodologies employed, data coverage, and access to and quality of underlying primary data. These deficiencies are largely due to a lack of standardised reporting requirements and regulation or compliance with regulation, where unsupervised activity in a borderless sector hinders access to reliable information. Tables 1-3 in Annex 1 describe available metrics and data limitations when evaluating financial stability risks from crypto-assets.

6. Conclusion and next steps

Crypto-assets markets are fast evolving and could reach a point where they represent a threat to global financial stability due to their scale, structural vulnerabilities and increasing interconnectedness with the traditional financial system. The rapid evolution and international nature of these markets also raise the potential for regulatory gaps, fragmentation or arbitrage. Although the extent and nature of use of crypto-assets varies somewhat across jurisdictions, financial stability risks could rapidly escalate, underscoring the need for timely and pre-emptive evaluation of possible policy responses.

Considering the crypto asset landscape, areas for ongoing vigilance include:

- **Potential increasing bank sector involvement** in the crypto-asset eco-system, especially where activities give rise to balance sheet exposure to crypto-assets, not captured by (or not in compliance with) appropriate regulatory treatment.
- **Institutional investors** increasing their exposures to crypto-assets relative to the size of their portfolios. Risks could increase further if such exposures employ high levels of leverage, including through the use of derivatives referencing crypto-assets.
- Acceleration in adoption of crypto-assets for **payments**. This could happen via partnerships with established payment firms or retailers/social networks.
- The growth, role and risks associated with crypto-asset trading platforms.
- Losses in crypto-assets, where accompanied by leverage, liquidity mismatch and interconnections with the traditional financial system, may amplify systemic risk arising from wealth effects. Loss of confidence in stablecoins could also trigger sales of their reserve assets, potentially affecting the functioning of short-term funding markets.
- A rapid growth of DeFi, in the absence of clearly identifiable intermediaries or parties responsible for governance, challenges core financial (stability) regulatory and supervisory disciplines and doctrines.
- Differing regulatory approaches could lead to regulatory arbitrage, thus increasing potential systemic risks.
- Data gaps impeding risk assessment and calibration of policy options.

Given the international and diverse nature of the crypto-asset markets, authorities globally prioritize cross-border and cross-sectoral cooperation. Efforts to enhance monitoring and to minimise regulatory arbitrage through further cooperation and information sharing are needed to keep pace with crypto-asset developments.

The FSB and other standard-setting bodies are already working to address threats associated with GSCs. The FSB will continue to monitor developments and risks in crypto-asset markets, including with respect to crypto-asset trading platforms, based on the framework published in 2018. In 2022, the FSB will also explore potential regulatory and supervisory implications of unbacked crypto-assets, including the types of actions FSB member jurisdictions have taken, or plan to take, to address any associated financial stability threats. Examining the regulatory gaps and challenges that may exist, including those that arise from the cross-border and cross-sectoral nature of crypto-assets, will be a key element of this work. The FSB will also continue to monitor and share information on regulatory and supervisory approaches to ensure the effective implementation of its high-level recommendations for the regulation, supervision and oversight of “global stablecoin” arrangements.

Annex 1: Available metrics and data gaps when evaluating financial stability risks from crypto-assets

Table 1: Unbacked crypto-assets

Transmission Channels	Available Metrics	Data gaps	Comments
Wealth Effects	<ul style="list-style-type: none"> • Market capitalisation of crypto-assets • Trading volumes • Realised volatility and gamma • Geographical adoption 	<ul style="list-style-type: none"> • Share of households invested in crypto-assets • Share of assets relative to household wealth • Demographic skew among household's holdings • Owners of unbacked crypto-assets 	<ul style="list-style-type: none"> • Survey-based metrics are updated infrequently/irregularly
Confidence Effects	<ul style="list-style-type: none"> • Share of retail ownership of crypto-assets • Number of clients in infrastructures that provide access to crypto-assets (e.g. trading platforms, wallet providers) 	<ul style="list-style-type: none"> • Volume of crypto-asset fraud 	
Financial Sector Exposures	<ul style="list-style-type: none"> • Share of institutional ownership of crypto-assets • Share of assets invested in crypto-assets • Number of large financial service providers offering crypto-asset services • Volume of crypto-asset derivatives market • Open interest of crypto-asset derivative contracts • Correlations of crypto-assets with other asset classes • Share of transaction volume by transaction size 	<ul style="list-style-type: none"> • AUM and share of holdings of funds that offer exposure to crypto-assets (by asset type e.g. spot, derivative, eco-system and investor type) • Bank sector exposure (absolute vs hedged; change in open interest) • Reporting by financial institutions on crypto-assets held and serviced 	<ul style="list-style-type: none"> • Survey-based metrics are not customisable and updated infrequently/irregularly
Use in Payments and Settlements	<ul style="list-style-type: none"> • Prices and delta (over one week, 1m, 3m, 6m, 1y) • Trading volumes (absolute vs. average) • Number of large payment service providers supporting crypto-assets • Market share of major crypto-asset exchanges 	<ul style="list-style-type: none"> • Number and value of transactions <ul style="list-style-type: none"> – Jurisdiction of the payers and payees – Type of transactions (e.g. remittances, e-commerce, trading) • Types of crypto-assets employed • Acceptance as legal tender 	

Table 2: Data issues for stablecoins

Transmission Channels	Available Metrics	Data gaps	Comments
Wealth Effects	<ul style="list-style-type: none"> • Market capitalisation of stablecoins • Trading volumes • Realised volatility 	<ul style="list-style-type: none"> • Owners of stablecoins 	
Confidence Effects	<ul style="list-style-type: none"> • Share of retail ownership of stablecoins • Number of clients in infrastructures that provide access to stablecoins (e.g. trading platforms, wallet providers) 	<ul style="list-style-type: none"> • Volume of crypto-asset fraud 	
Financial Sector Exposures	<ul style="list-style-type: none"> • Share of institutional ownership of stablecoins • Share of assets invested in stablecoins • Number of large financial service providers offering stablecoin services • Size of stablecoin market relative to US prime money market funds 	<ul style="list-style-type: none"> • Amounts and share of holdings of ETFs that offer exposure to stablecoins (by investor type) • Profit and loss exposures • Reserve assets invested in regulated markets • Liquidity of reserve assets • Granular and robust data on composition of stablecoins reserve assets • Reporting by financial institutions on crypto-assets held and serviced 	
Use in Payments and Settlements	<ul style="list-style-type: none"> • Prices • Trading volumes • Number of large payment service providers supporting stablecoins 	<ul style="list-style-type: none"> • Number and value of transactions • Jurisdiction of the payers and payees • Type of transactions (e.g. remittances, e-commerce, trading) • Usage in crypto-asset trading platforms, by stablecoin • Breakdown of uses of stablecoins 	

Table 3: Data issues for DeFi

Transmission Channels	Available Metrics	Data gaps	Comments
Wealth Effects	<ul style="list-style-type: none"> • Total value locked-in, gross, adjusted and net; realised volatility • Transaction volume of DeFi's Exchange (DEX) • Wallet growth • Market capitalization and transaction volume of governance tokens; • Transaction volume in DeFi lending • Lending rate in DeFi Lending • Utilization rate of liquidity pool of DeFi Lending and Exchange • DeFi yield and return 	<ul style="list-style-type: none"> • Share of retail vs institutional participation • Number of dApps on a blockchain • Liquidity pools, DeFi stablecoins, derivatives (entities within the DeFi space, including types of financial institutions (specialized or traditional financial institutions) to understand linkages of DeFi with the rest of the financial system) • Metrics to measure leverage • Information on the governance tokens holders could be obtained from to see to what extent the governance is decentralized (e.g. if the ownership of governance tokens is concentrated, that entity could be considered the actual developer) 	
Confidence Effects	<ul style="list-style-type: none"> • Share of retail ownership of stablecoins • Number of clients in infrastructures that provide access to DeFi (e.g. trading platforms, wallet providers) 	<ul style="list-style-type: none"> • Volume of crypto-asset fraud • Share of transactions in unbacked crypto-assets vs. stablecoins 	
Financial Sector Exposures	<ul style="list-style-type: none"> • Share of institutional ownership of crypto-assets • Share of assets invested in crypto-assets • Number of large financial service providers offering crypto-asset services • Volume of crypto-asset derivatives market • Open interest of derivative contracts 	<ul style="list-style-type: none"> • Amounts and share of holdings of ETFs that offer exposure to crypto-assets by investor type 	

Transmission Channels	Available Metrics	Data gaps	Comments
	<ul style="list-style-type: none"> • Correlations of crypto-assets with other asset classes • Share of transaction volume by transaction size 		
Use in Payments and Settlements	<ul style="list-style-type: none"> • Price of key players (DOT, UNI, LINK) and delta over one week, one month, three months, six months, one year and 7-day average volume; 	<ul style="list-style-type: none"> • Number and value of transactions • Breakdown of counterparties <ul style="list-style-type: none"> – Jurisdiction of the payers and payees – Type of transactions (e.g. remittances, e-commerce, trading) 	

Annex 2: Glossary

This glossary sets out a (non-exhaustive) list of terms used in the report, which are based primarily on previous reports by the FSB as well as by other international organisations and standard-setting bodies. The use of these terms in the report does not involve a judgment as to their appropriateness in all cases given the rapidly evolving crypto-asset markets.

Asset-backed token: a crypto-asset that represents an interest in a physical asset.

Blockchain: a form of distributed ledger in which details of transactions are held in the ledger in the form of blocks of information. A block of new information is attached into the chain of pre-existing blocks via a computerised process by which transactions are validated.

Crypto-asset: a type of private sector digital asset that depends primarily on cryptography and distributed ledger or similar technology.

Crypto-asset trading platform: any trading platform where crypto-assets can be bought and sold, regardless of the platform's legal status.

Cryptography: the conversion of data into private code using encryption algorithms, typically for transmission over a public network.

Decentralised Finance (DeFi): a set of alternative financial markets, products and systems that operate using crypto-assets and 'smart contracts' (software) built using distributed ledger or similar technology.

Digital asset: A digital instrument that is issued or represented through the use of distributed ledger or similar technology. This does not include digital representations of fiat currencies.

Digital token: any digital representation of an interest, which may be of value, a right to receive a benefit or perform specified functions or may not have a specified purpose or use.

Distributed ledger technology (DLT): a means of saving information through a distributed ledger, i.e., a repeated digital copy of data available at multiple locations.

FinTech: technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services.

Global stablecoin: a stablecoin with a potential reach and use across multiple jurisdictions and which could become systemically important in and across one or many jurisdictions, including as a means of making payments.

Mining: one means to create new crypto-assets, often through a mathematical process by which transactions are verified and added to the distributed ledger.

Stablecoin: A crypto-asset that aims to maintain a stable value relative to a specified asset, or a pool or basket of assets.

Unbacked crypto-assets: crypto-assets that are neither tokenised traditional assets nor stablecoins.

Wallet: an application or device for storing the private keys providing access to the crypto-asset. Hosted wallets are typically held by a third-party provider, unhosted wallets by the user.

Wallet provider: a firm that offers storage services to investors in crypto-assets. These may be connected online ('hot' storage) or kept offline ('cold' storage).