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Rise of Decentralised Finance | Reimagining Financial Regulation

Shehnaz Ahmed

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*Shehnaz Ahmed**

Abstract *Based on decentralised ledger technology (DLT), decentralised finance (DeFi) involves the provision of financial services without reliance on centralised intermediaries (such as banks). While DeFi seeks to complement existing financial services, its reliance on crypto asset speculation and arbitrage coupled with instances of security, operational and governance failures, may pose risks to consumers and the financial system. Therefore, the proliferation of such markets without any regulatory oversight requires immediate consideration. While existing literature focuses on the innovation potential of DeFi, there is little discussion about the legal implications of DeFi. This article seeks to address this gap in the literature and recommends possible regulatory approaches. The article highlights that DeFi will challenge traditional financial regulations designed for centralised systems where identifying the subject of regulatory obligations is straightforward. Further, participants in a DeFi system can be spread across multiple jurisdictions, challenging the determination of the relevant jurisdiction whose law will apply. As the DeFi market is still evolving, this article argues that regulatory focus must be on specific aspects. This includes regulatory clarity for cryptoassets, regulating gatekeepers of the DeFi ecosystem i.e., service providers (like exchanges, wallets, custodians), and issuance of regulatory guidance on the applicability of existing laws to DLT systems. These regulatory approaches must be supplemented with measures such as designing internationally well-recognised standards for DeFi services, harnessing technology ("Regtech" and "Suptech") for better supervision and compliance and leveraging existing regulatory sandboxes for a cost-benefit analysis of such innovations and determining regulatory responses.*

* Shehnaz Ahmed leads the Fintech research at the Vidhi Centre for Legal Policy, where she undertakes cutting-edge research on issues such as digital currencies, blockchain, and digital payments. At Vidhi, she works with the Government of India and financial sector regulators on designing legal reforms for the financial sector.

Background

As policymakers continue to debate the regulatory response to crypto assets, the financial system is witnessing another manifestation of the crypto economy with the emergence of decentralized finance ("**DeFi**"). Based on the Distributed Ledger Technology ("**DLT**"), DeFi seeks to provide financial services and products to users without the need for centralised intermediaries.

In the summer of 2020, DeFi applications started to gain traction with an increase in its users. The total value of crypto assets 'locked' in DeFi transactions [a common industry measure referred to as total value locked ("**TVL**")] rose from less than $1 billion in 2019 to over $15 billion at the end of 2020 and over $100 billion in December 2021.[1] While the TVL has dropped, reports indicate that there are around 4 million unique addresses (a proxy for the number of users) using DeFi applications,[2] indicating a gradual adoption of such applications. DeFi is a niche market with relatively lower volumes of transactions compared to the global financial system. However, the growth of the market, its innovation potential, and the risks to the financial system from such developments have sparked interest among policymakers, financial institutions, and researchers. Given that such markets mainly operate outside the regulatory perimeter, they have come under regulatory scrutiny. The Financial Stability Board ("**FSB**") notes that "without sufficient regulation and market oversight, DeFi and associated platforms might present risks to financial stability."[3] For instance, DeFi markets have already witnessed several operational and cybersecurity incidents, that have resulted infinancial losses to the users. DeFi related hacks made up over 75% of the total $681 million known hack and theft volume of crypto assets till

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1 FSB, *Assessment of Risks to Financial Stability from Crypto Assets* (16 February 2022) <https://www.fsb.org/wp-content/uploads/P160222.pdf> accessed 8 March 2022; David Gogel *DeFi Beyond the Hype* (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022.

2 Adith Podhar and Kamini Shivalkar, 'Why DeFi is the Biggest Thing in the History of Finance' (*The Economic Times*, 22 February 2022) <https://economictimes.indiatimes.com/markets/cryptocurrency/why-defi-is-the-biggest-thing-in-the-history-of-finance/articleshow/89745980.cms> accessed 8 March 2022.

3 The FSB is an international body which promotes international financial stability. It works with national financial authorities and internationalstandard-setting bodies to recommend supervisory, regulatory, and financial policies. See FSB, "About Us', <https://www.fsb.org/about/> accessed 8 March 2022.

July 2021.[4] If the sector continues to grow outside regulatory frameworks, the vulnerabilities and risks emanating from the markets may have consequences for the broader financial system. Further, DeFi may also crystallise threats emanating from crypto assets (used for DeFi transactions), which may include impacts on financial stability. Therefore, the rapid growth of the DeFi markets warrants attention from market participants and policymakers to promote responsible innovation and avoid the development of a reckless market that may later become too big to regulate.

The purpose of the article is to present an overview of the DeFi ecosystem, examine the risks and opportunities presented by it and study the legal implications of DeFi. The developments in the DeFi sector must be studied in light of the risks to investors, market integrity, security and financial stability. The vision of intermediation without centralisation underlying DeFi services will challenge traditional financial regulation based on centralisation, where the subject of regulation is easily identifiable. Therefore, DeFi may dilute the traditional forms of accountability and the effectiveness of existing financial regulations and their enforcement. To examine the legal and regulatory implications arising from DeFi, it is crucial to analyse the DeFi ecosystem as it currently exists, especially laying emphasis on its integral components. Such an examination will lead to the identification of critical legal and regulatory issues that DeFi poses. Based on such analysis, this article discusses how regulations and policies must respond to these technological innovations.

Against this background, the article is structured as follows. *Firstly,* it deconstructs the concept of DeFi along with examining the integral components of the DeFi ecosystem. *Secondly*, the article briefly explains the current DeFi services since a study of such services is important to assess the opportunities and risks presented by such services. In doing so however, the article does not comment on the desirability of such services. *Thirdly*, it identifies key legal and regulatory issues raised by such services and how they may (or may not) fit within the existing financial regulatory architecture. *Finally,* the article concludes with possible policy and regulatory responses to promote responsible innovation in the DeFi ecosystem.

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[4] Jamie Crawley, *DeFi Has Accounted for Over 75% of Crypto Hacks in 2021* (*CoinDesk*, 10 August 2021) <https://www.coindesk.com/markets/2021/08/10/defi-has-accounted-for-over-75-of-crypto-hacks-in-2021/> accessed 8 March 2022.

Understanding DeFi

The existing financial system operates through centralised, regulated intermediaries such as banks and financial institutions. Such centralised intermediaries act as agents of trust and provide liquidity, settlement, and security for financial transactions. These intermediaries bring together a range of participants - persons with financial resources (banks, investors) and persons seeking financial resources (borrowers and entrepreneurs). Therefore, traditional finance is marked by the presence of intermediaries "that centralise functions and services."[5] Contrary to this, DeFi envisages a financial system where financial services are provided without reliance on centralised intermediaries through automated protocols (or rules) on DLT and crypto assets to facilitate transactions. DLT is a technological innovation that allows the recording and sharing of information across multiple ledgers. "It allows for transactions and data to be recorded, shared, and synchronized across a distributed network of different network participants."[6]

As the DeFi market continues to evolve, there is no standard definition of decentralised finance. DeFi is broadly used to refer to financial services provided through decentralised financial applications ("**DApps**") that rely on open protocols.[7] As per the International Organization of Securities Commission ("**IOSCO**"), DeFi commonly refers to the "provision of financial products, services, arrangements and activities that use distributed ledger technology ("DLT") in an effort to disintermediate and decentralize legacy ecosystems by eliminating the need for some traditional financial intermediaries and centralized institutions."[8] The Bank for International Settlements ("**BIS**") defines DeFi to mean "financial applications run by smart contracts on a blockchain, typically a permissionless (i.e., public) chain."[9] Most DeFi

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[5] Dirk A. Zetzsche, Douglas W. Arner, Ross P. Buckley, 'Decentralized Finance' (*Journal of Financial Regulation, Volume 6, Issue 2*, 20 September 2020) <https://academic.oup.com/jfr/article/6/2/172/5913239> accessed 8 March 2022.

[6] World Bank Group, *Distributed Ledger Technology (DLT) and Blockchain*, (Fintech Note No. 1, 2017) <https://olc.worldbank.org/system/files/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf> accessed 8 March 2022.

[7] David Gogel, *DeFi Beyond the Hype* (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022.

[8] International Organisation of Securities Commission, *IOSCO Decentralised Finance Report* (March 2022) <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD699.pdf> accessed 10 April 2022.

[9] Established in 1930, the BIS is owned by 63 central banks, representing countries from around the world. It seeks to support "central banks' pursuit of monetary and financial stability through international cooperation, and to act as a bank for central banks". See BIS, 'About BIS-overview' <https://www.bis.org/about/index.htm> accessed 8 March 2022; Sirio Aramonte, Wenqian Huang, Andreas Schrimpf, *DeFi Risks and the Decentralisation Illusion* (BIS Quarterly Review, 6 December 2021) <https://www.bis.org/publ/

services are built on the Ethereum blockchain that allows for the creation of 'smartcontracts'. Smart Contracts are automated contracts written as computer code on blockchain ledgers and automatically executed on the happening of pre-defined trigger events in the code.[10]

The DeFi architecture consists of multiple layers, with each layer serving a distinct purpose. Together, these layers create an open, composable and interoperable infrastructure that allows DeFi users to build on or propose changes to the layer.[11] Broadly, the DeFi stack consists of the following layers -the blockchain and token layer, the applications and protocol layer, and the aggregation layer.[12] The base layer consists of the relevant DLT or blockchain layer along with its native protocol that serves as the foundation of the application. Ethereum is the most commonly used blockchain in DeFi applications, and Ether is its native protocol. The protocol layer sets standards for specific use cases such as decentralised exchanges, debt products, derivatives, etc. The standards are implemented by smart contracts and can be accessed by any DeFi participant.[13] Applications are used to create the interfaces through which users interact with these protocols.[14] The aggregation layer enables aggregators to create user-centric platforms that connect to several applications and protocols.[15]

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qtrpdf/r_qt2112b.htm> accessed 8 March 2022. OECD, 'Initial Coin Offerings (ICOs) for SME Financing' (2019) <https://www.oecd.org/finance/ICOs-for-SME-Financing.pdf> accessed 8 March 2022.

10 OECD, 'Initial Coin Offerings (ICOs) for SME Financing' (2019) <https://www.oecd.org/finance/ICOs-for-SME-Financing.pdf> accessed 8 March 2022.

11 Fabian Schär, 'Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets' (2021) Second Quarter 2021, Vol. 103, No. 2 Federal Reserve Bank of St. Louis Review <https://research.stlouisfed.org/publications/review/2021/02/05/decentralized-finance-on-blockchain-and-smart-contract-based-financial-markets> accessed 8 March 2022.

12 KPMG, 'Crypto Insights #1. An introduction to Decentralised Finance (DeFi)' (October 2021) <https://assets.kpmg/content/dam/kpmg/cn/pdf/en/2021/10/crypto-insights-part-1-an-introduction-to-decentralised-finance.pdf> accessed 8 March 2022.

13 Fabian Schär, 'Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets' (2021) Second Quarter 2021, Vol. 103, No. 2 Federal Reserve Bank of St. Louis Review <https://research.stlouisfed.org/publications/review/2021/02/05/decentralized-finance-on-blockchain-and-smart-contract-based-financial-markets> accessed 8 March 2022.

14 KPMG, 'Crypto Insights #1. An introduction to Decentralised Finance (DeFi)' (October 2021) <https://assets.kpmg/content/dam/kpmg/cn/pdf/en/2021/10/crypto-insights-part-1-an-introduction-to-decentralised-finance.pdf> accessed 8 March 2022.

15 Fabian Schär, 'Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets' (2021) Second Quarter 2021, Vol. 103, No. 2 Federal Reserve Bank of St. Louis Review <https://research.stlouisfed.org/publications/review/2021/02/05/decentralized-finance-on-blockchain-and-smart-contract-based-financial-markets> accessed 8 March 2022.

DeFi services have unique features that distinguish them from centralised traditional financial services ("**CeFi**").[16]

- **Non-custodial**: There is no central authority or intermediary in DeFi systems that is responsible for managing the transactions, private keys, funds, or information. Participants control and manage their private keys and crypto assets for executing transactions. This is different from CeFi services, where a regulated intermediary or custodian holds such funds on behalf of the owner. DeFi systems record transaction details on the blockchain, whereas, CeFi systems rely on the private records of intermediaries (such as centralised exchanges and other platforms).[17]

- **Decentralised ownership and governance**: With no centralized responsible authority, DeFi systems tend to rely on the community of participants for creating network effects. There is a semblance of a governance framework in DeFi applications when governance tokens (discussed in detail later) issued by DeFi applications enable token holders to participate in decisions relating to the application. Such holders typically exercise some form of control over the DeFi protocol.[18] The operation of a DeFi application based on blockchain technologies does not automatically qualify a service to be DeFi. For applications to be decentralized, the governance must be community-based without any central authority controlling the system.[19] The BIS argues that "decentralization in DeFi is illusory" as most DeFi applications have an element of centralisation that revolves around the governance token holders who vote on proposals relating to the

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[16] FSB, *Assessment of Risks to Financial Stability from Crypto Assets* (16 February 2022) <https://www.fsb.org/wp-content/uploads/P160222.pdf> accessed 8 March 2022; David Gogel 'DeFi Beyond the Hype' (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022; OECD, Why Decentralised Finance (DeFi) Matters and the Policy Implications (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

[17] Sirio Aramonte, Wenqian Huang, Andreas Schrimpf, 'DeFi Risks and the Decentralisation Illusion' (*BIS Quarterly Review*, 6 December 2021) <https://www.bis.org/publ/qtrpdf/r_qt2112b.htm> accessed 8 March 2022.

[18] Salami, I. (2021), 'Challenges and Approaches to Regulating Decentralized Finance'. (*AJIL Unbound*, 115, 425-429) <https://www.cambridge.org/core/journals/american-journal-of-international-law/article/challenges-and-approaches-to-regulating-decentralized-finance/1FC6B3EF8DEE460EF534A1F0A5E9DC72> accessed 8 March 2022.

[19] OECD, 'Why Decentralised Finance (DeFi) Matters and the Policy Implications' (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

DeFi protocol.[20] Unlike DeFi services, CeFi services are governed by rules specified by regulators.

- **Composable**: This feature enables the creation of innovative financial products over DeFi applications, thereby increasing the value proposition of such applications. The open-source nature of DeFi applications enables participants to look at the code and use it to develop new applications. For instance, a DeFi user can lock up her crypto assets in a lending protocol to earn rewards. A user locks up her Ether crypto assets on the MakerDAO application in exchange for DAI stablecoins and the governance tokens of MakerDAO.[21] The user can then pledge the DAI as collateral in another DeFi application.

Building Blocks of Defi

The DeFi system is an extension of the growing crypto asset economy. To understand the regulatory implications of DeFi, it is important to study the conceptual framework of DeFi, its building blocks and the nature of services that DeFi can provide.

DLT and Blockchain: DeFi systems rely on DLT, particularly public and permissionless blockchain, to provide financial services.[22] Broadly, DLT is a database or ledger that is distributed across multiple sites, countries, or entities with no centralized controller.[23] The BIS defines DLT to "refer to processes and related technologies that enable nodes in a network(or arrangement) to securely propose, validate and record state changes (or updates) to a synchronised ledger that is distributed across the network's node."[24] A node is a computer participating in a DLT arrangement. There are different ways to design DLT-based systems. Blockchain is a type of DLT and refers to a

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[20] Sirio Aramonte, Wenqian Huang, Andreas Schrimpf, 'DeFi Risks and the Decentralisation Illusion' (*BIS Quarterly Review*, 6 December 2021) <https://www.bis.org/publ/qtrpdf/r_qt2112b.htm> accessed 8 March 2022.

[21] 'The Maker Protocol: MakerDAO's Multi-Collateral Dai (MCD) System' <https://makerdao.com/en/whitepaper> accessed 8 March 2022.

[22] FSB, Assessment of Risks to Financial Stability from Crypto Assets (16 February 2022) <https://www.fsb.org/wp-content/uploads/P160222.pdf> accessed 8 March 2022.

[23] Leon Perlman, 'Regulation of the Financial Components of the Crypto-Economy' (*School of International and Public Affairs Entrepreneurship & Policy Initiative*, Working Paper Series 2019) <https://sipa.columbia.edu/sites/default/files/25222_SIPA-White-Paper-CE-Regulation-web.pdf> accessed 8 March 2022.

[24] Committee on Payments and Market Infrastructures, BIS, Distributed Ledger Technology in Payment Clearing and Settlement – An Analytical Framework (February 2017) <https://www.bis.org/cpmi/publ/d157.pdf> accessed 8 March 2022.

particular form of structuring data on a DLT platform.[25] The popular crypto asset "Bitcoin" uses blockchain technology. DLT systems may be of different types based on their design and architecture. Features like "openness" of the platform (public or private) and the level of permissions required to add information to the ledger (permissioned or permissionless) may impact the type of DLT.[26] DLT systems may be public or private depending on whether the ledgers can be accessed by anyone or only by the participating nodes in the network.[27] Further, DLT systems may be permissioned or permissionless based on whether network participants need permission to make changes to the ledger.[28] Ethereum, the popular DeFi blockchain, is a permissionless blockchain where network participants can "join or leave the network at will, without being pre-approved or vetted by any entity."[29] Systems built on decentralised technologies raise legal issues relating to jurisdiction, the applicability of laws, ownership of ledger and liabilities, and compliance with laws. For instance, since the nodes of a decentralised ledger may be spread across multiple jurisdictions, determining which jurisdictions' law applies to a given transaction may often be challenging. Further, in a public permissionless DLT system, several network participants have access to the ledger, and no single entity takes responsibility for the system, including its security. Therefore, it becomes challenging to identify the ownership of the ledger, the entities in control of it, and the legal liabilities in case of default. In many cases, the concept of such decentralised technologies may not be compatible with existing laws. For instance, data protection laws typically require the party controlling an individual's personal data to comply with legal obligations relating to data security and privacy. Identifying the subject of regulation in a permissionless DLT system where transactions may happen on a peer-to-peer basis is often difficult. Similar issues will also arise for compliance with other laws, including laws relating to anti-money laundering. Since decentralised technologies underpin DeFi solutions, many of these legal issues will also arise in DeFi regulation. This article uses the terms DLT and blockchain used interchangeably.

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[25] *Cryptoassets Taskforce, 'Final Report'*, (October 2018), <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/752070/cryptoassets_taskforce_final _report_final_web.pdf > accessed 8 March 2022.

[26] OECD, 'OECD Blockchain Primer' <https://www.oecd.org/finance/OECD-Blockchain-Primer.pdf> accessed 8 March 2022.

[27] World Bank Group, 'Distributed Ledger Technology (DLT) and Blockchain', (Fintech Note No. 1, 2017) <https://olc.worldbank.org/system/files/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf> accessed 8 March 2022.

[28] ibid.

[29] ibid.

Crypto assets: Crypto assets representing value are often used for DeFi transactions. While there is no globally accepted definition of crypto assets, it may be helpful to refer to the definition provided by FSB, which the BIS and IOSCO have also adopted. FSB defines crypto assets as "a type of private asset that depends primarily on cryptography and distributed ledger or similar technology as part of their perceived or inherent value."[30] While different definitions of crypto assets have emerged, common points of convergence include digital representation of value, issued by a private entity, and reliance on DLT.[31]One of the most popular cryptoassets is Bitcoin (BTC) which was designed to operate as a peer-to-peer payment solution without the need for known and trusted third parties. Examples of other popular cryptoassets are Ether (ETH), XRP, and Litecoin (LTC). The regulation of cryptoassets has been a subject of intense policy debate worldwide. Typically, the classification of financial instruments is essential for financial regulation since such classification determines the nature of regulations that will apply to such instruments. Unfortunately, there appears to be no consensus on the classification of cryptoassets. While certain features may be common for all cryptoassets (such as its underlying decentralised technology), there is no uniformity in its use cases and the players involved. Therefore, it is difficult to pigeonhole such cryptoassets as a single type of financial instrument. For instance, a crypto asset may exhibit features of a payment token (primarily meant for facilitating payments) or a utility token (a payment token that allows access to a service or product provided by the token's issuer). It has been pointed out that crypto assets that may be used for multiple use cases (often referred to as "hybrid token") may raise regulatory challenges if laws seek to make a strict demarcation between different types of crypto assets.[32]. Further, certain crypto assets like Bitcoin do not have any underlying asset, whereas the value of stablecoins (as discussed below) are backed by an underlying asset. The difficulty in categorising crypto assets under traditional laws and asset classes and its pseudonymous nature with a global nature (that can blur geographical boundaries) creates challenges in designing regulations for crypto assets and enforcing them. Such features discussed above and the potential ability of some crypto assets (such as privacy coins)

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[30] FSB, 'Work Underway, Regulatory Approaches and Potential Gaps' <https://www.fsb.org/wp-content/uploads/P310519.pdf>, (May 2019) accessed 8 March 2022.

[31] Shehnaz Ahmed, Swarna Sengupta, 'Blueprint of a Law for Regulating Cryptoassets' (*Vidhi Centre for Legal Policy*, 29 January 2022) <https://vidhilegalpolicy.in/research/blueprint-of-a-law-regulating-cryptoassets/> accessed 8 March 2022.

[32] Prof. Dr Houben R., Snyers A., 'Crypto-assets – Key Developments, Regulatory Concerns and Responses' (Study for the Committee on Economic and Monetary Affairs, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg, 2020) <https://www.europarl.europa.eu/RegData/etudes/STUD/2020/648779/IPOL_STU(2020)648779_EN.pdf> accessed 10April 2022.

to mask the identity of users and transactions heighten concerns of regulators around its misuse for money laundering and financial crimes.[33] In many countries, including India, crypto assetsremain unregulated without checks and balances, exposing investors and the financial system to multiple risks. Therefore, the regulatory response to crypto assets is also important for monitoring the DeFi market.

Stablecoins: Stablecoins are a type of crypto asset whose value is pegged to an asset or commodity. Crypto assets such as Bitcoin and Ether have been infamous for the volatility in their prices. In April 2021, Bitcoin's value touched USD 65,000, followed by a drop of 50% later in the year due to events such as the announcement of a ban by China.[34] To deal with volatility risks associated with crypto assets, stablecoins seek to "maintain a stable value relative to a specified asset, or a pool or basket of assets."[35] Tether (USDT), USD Coin (USDC) and Dai (DAI) are some popular stablecoins. For instance, every Tether token is "1-to-1 pegged to the dollar."[36] Stablecoins may be broadly classified as asset-linked stablecoins and algorithm-based stablecoins based on their stabilisation mechanism.[37] The value of asset-linked stablecoins is linked to assets such as a single fiat currency, basket of currencies, commodities or even crypto assets. Algorithm-based stablecoins rely on an algorithm to maintain a stable value by increasing or decreasing the supply of stablecoins in response to changes in demand.

Stablecoins play an important role in the DeFi ecosystem by facilitating funds transfer between platforms and users. Many stablecoins are "off-chain" stablecoins. They are asset-backed stablecoins that "require a custodian for their safekeeping and are in possession of the issuer of the stablecoins as long as the user does not redeem the stablecoins."[38] DeFi transactions tend

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[33] IMF, 'The Crypto ecosystem and the Financial Stability Challenges', (October 2021) <https://www.imf.org/-/media/Files/Publications/GFSR/2021/October/English/ch2.ashx#:~:text=Challenges%20posed%20by%20the%20crypto%20ecosystem%20include%20operational%20and%20financial,and%20disclosure%20for%20some%20stablecoins.>> accessed 10 April 2022.

[34] Damanick Dantes, *Volatility Ruled Crypto Markets in 2021, From $69K Bitcoin to Elon Musk's 'Dogecoin to the Mooooonn'* (*CoinDesk*, 1 January 2022) <https://www.coindesk.com/markets/2021/12/31/volatility-ruled-crypto-markets-in-2021-from-69k-bitcoin-to-elon-musks-dogecoin-to-the-mooooonn/> accessed 8 March 2022.

[35] FSB, *Addressing the Regulatory, Supervisory and Oversight Challenges Raised by "Global Stablecoin" Arrangements; Consultative Documents* (April 2020) <https://www.fsb.org/wp-content/uploads/P131020-3.pdf> accessed 8 March 2022.

[36] Tether', <https://tether.to/> accessed 8 March 2022.

[37] FSB, Regulation, *Supervision and Oversight of "Global Stablecoin" Arrangements: Final Report and High-Level Recommendations* (October 2020) < https://www.fsb.org/wp-content/uploads/P140420-1.pdf> accessed 8 March 2022.

[38] European Central Bank, 'Stablecoins –No Coins, but are They Stable?' (Issue no 3, November 2019) <https://www.ecb.europa.eu/paym/intro/publications/pdf/ecb.

to rely on "on-chain" stablecoins that are stablecoins backed by assets which are "recorded in a decentralised manner and do not need either an issuer or a custodian to satisfy a claim".[39] To deal with the volatility of the underlying crypto assets, DeFi stablecoins rely on an over-collateralised pool of crypto assets.[40]

The rise of stablecoins raises concerns about its impact on the financial system and its stability. The FSB notes that widely adopted stablecoins with reach and use across multiple jurisdictions (also known as global stablecoins) could pose systemic risks.[41] In such a case, prudential regulation of stablecoin arrangements is important. Considering that various DeFi transactions rely on stablecoins, understanding regulatory issues arising from stablecoins is important. Currently, there is variation in the process of redemption of different stablecoins. This includes variance regarding the person who may present a stablecoin for redemption, the limit on the number of stablecoins that maybe redeemed and the presence of any right against the issuer.[42] There are also concerns regarding the accuracy of disclosures made by such issuers. Stablecoin regulation raises important issues for consideration such as eligibility of issuers, exposure of banks and financial institutions to such stablecoins, redeemability of such stablecoins, provisions on governance arrangements, market integrity, consumer and investor protection, anti-money laundering framework, provisions to deal with resolution or winding down of such arrangements, etc.

Smart Contracts: To effectuate transactions, DeFi systems use open protocols and DApps.[43] These protocols and DApps are powered by smart contracts—programs built on existing blockchains that automatically execute all or certain parts of an agreement when certain pre-defined conditions are

mipinfocus191128.en.pdf> accessed 8 March 2022.

39 ibid.

40 Sirio Aramonte, Wenqian Huang, Andreas Schrimpf, 'DeFi Risks and the Decentralisation Illusion' (*BIS Quarterly Review*, 6 December 2021) <https://www.bis.org/publ/qtrpdf/r_qt2112b.htm> accessed 8 March 2022.

41 FSB, Regulation, *Supervision and Oversight of "Global Stablecoin" Arrangements: Final Report and High-Level Recommendations* (October 2020) <https://www.fsb.org/wp-content/uploads/P131020-3.pdf > accessed 14 January 2022

42 President's Working Group on Financial Markets, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency, 'Report on Stablecoins', (November 2021), <https://home.treasury.gov/system/files/136/StableCoinReport_Nov1_508.pdf> accessed 18 January 2022.

43 Fabian Schär, 'Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets' (2021) Second Quarter 2021, Vol. 103, No. 2 Federal Reserve Bank of St. Louis Review <https://research.stlouisfed.org/publications/review/2021/02/05/decentralized-finance-on-blockchain-and-smart-contract-based-financial-markets> accessed 8 March 2022.

met.[44] The idea of smart contracts was envisaged by computer scientist, and cryptographer Nick Szabo who used the example of a vending machine to argue that many agreements could be "Many kinds of contractual clauses (such as collateral, bonding, delineation of property rights, etc.) can be embedded in the hardware and software we deal with, in such a way as to make a breach of contract expensive (if desired, sometimes prohibitively so) for the breacher."[45] Today, smart contracts may ensure payment of funds upon the happening of trigger events identified in the code. It replaces the intermediary role of centralised financial institutions with automated protocols built into a blockchain. Smart contracts may take different forms with different levels of automation. To a certain extent, existing legal frameworks recognise electronic contracts; therefore, it has been argued that courts may recognise codes that execute provisions of a smart contract.[46] However, the United Kingdom Law Commission notes that as the level of automation in a contract increases and where the entire life cycle of contract formation solely exists on DLT systems with no negotiations in "natural language", it may give rise to novel legal issues about formation, interpretation, remedies and jurisdiction of contracts.[47] For instance, it notes that when parties enter into an agreement in "natural language", which is then performed by a computer code, it will not be difficult to prove that the parties intended to enter into legal relations. However, if an agreement between parties is due to their interaction on a DLT system, challenges may arise in inferring intention, willingness and consent to enter into a contract. Challenges may also arise in the determination of the jurisdiction and the applicable laws in case nodes are spread across different jurisdictions. Even if one argues that smart contracts can be accommodated within the ambit of existing contract law, the major challenge is the disconnect between the operation of smart contracts and the manner in which parties transact business. Typically, most contracts have a provision for amendment or rectification of contractual provisions, which may be challenging where terms are coded on an immutable ledger. Further, smart contracts may not provide the flexibility necessary in contract

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[44] Stuart D. Levi and Alex B. Lipton, 'An Introduction to Smart Contracts and Their Potential and Inherent Limitations' (*Harvard Law School Forum on Corporate Governance*, 26 March 2018) <https://corpgov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/> accessed 8 March 2022.

[45] Nick Szabo, 'The Idea of Smart Contracts' (1997) <https://nakamotoinstitute.org/the-idea-of-smart-contracts/> accessed 9 August 2022.

[46] Stuart D. Levi and Alex B. Lipton, 'An Introduction to Smart Contracts and their Potential and Inherent Limitations' (*Harvard Law School Forum on Corporate Governance*, 26 March 2018) <https://corpgov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/> accessed 10 April 2022.

[47] Law Commission, 'Smart Legal Contracts Summary' (2021) <https://s3-eu-west-2.amazonaws.com/lawcom-prod-storage-11jsxou24uy7q/uploads/2021/11/6.7776_LC_Smart_Legal_Contracts_2021_Final.pdf> accessed 10 April 2022.

performance. For instance, such contracts may not be able to take into common contractual terms of substantial performance such as "best efforts", "reasonable care", or "reasonable time".

Governance tokens: As discussed above, the governance of the DeFi protocol is based on voting by governance token holders. Such tokens confer voting rights on token holders to manage changes to smart contracts or other DeFi protocols.[48] Such token holders can vote on "proposals relating to upgrades, changes in the mechanisms underlying the protocol, introduction of additional stablecoins for trading, change in the level of collateralisation or fees."[49] These tokens are tradeable on certain crypto exchanges.[50] Such tokens incentivise activity in DeFi ecosystems and allow developers to cede more control over DeFi protocols to token holders. The rights associated with the governance tokens will help analyse who controls the system's activities. One of the earlier governance tokens was the MKR token issued by MakerDAO, as explained below, which gives the token holder voting rights.

Types of Services provided by Defi

The previous section presents a conceptual framework of DeFi and its ecosystem. However, it is also important to examine the manifestation of such services in the real economy. This examination is relevant to assess the opportunities and risks presented by DeFi services and accordingly determine appropriate policy response.

A recent paper by the Organisation for Economic Co-operation and Development ("**OECD**") notes that lending is one of the fastest growing DeFi products, followed by other products such as decentralised exchanges, derivatives, asset management, insurance and payments.[51] Such transactions are collateralised by crypto assets, both stablecoins and different types of unbacked crypto assets. Use cases of DeFi are still evolving. While proponents argue about its potential to create more efficiencies for the financial system, sceptics often question its real economy utility and scalability. The

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[48] David Gogel 'DeFi Beyond the Hype' (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022.

[49] OECD, 'Why Decentralised Finance (DeFi) Matters and the Policy Implications' (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

[50] David Gogel 'DeFi Beyond the Hype' (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf>accesrsed 8 March 2022.

[51] OECD, 'Why Decentralised Finance (DeFi) Matters and the Policy Implications' (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

BIS notes that while DeFi may complement traditional financial services, at present, "it has few for the real economy and, for the most part, supports speculation and arbitrage across multiple crypto assets".[52] While DeFi services may not be very different from the services provided by CeFi systems, it seeks to change how CeFi services are provided.

Lending**:** Decentralised loan platforms do not require borrowers or lenders to identify themselves. "Everyone has access to the platform and can potentially borrow money or provide liquidity to earn interest. As such, DeFi loans are completely permissionless and not reliant on trusted relationships."[53] DeFi lending activities rely extensively on collaterals. Typically, users provide liquidity to the platform by locking their crypto assetsas collaterals and receiving rewards (such as tokens native to the platform) for providing liquidity to the system. This is similar to interests earned on deposits with banks. The rates at which users are rewarded are based on the demand and supply of liquidity rather than the creditworthiness of the borrower.[54] DeFi borrower scan access locked up crypto assets from the pool by payment of a fee.[55] Common mechanisms used by DeFi systems to provide loans include lock-up yields that "pays interest for immobilizing digital assets in pools, where they serve as liquidity or collateral for a DeFi service" or liquidity mining "that pays the interest in the form of tokens issued by the DeFi service itself."[56] For instance, MakerDAO is a popular DeFi service provider. MakerDAO is "an open-source project on the Ethereum blockchain and a Decentralized Autonomous Organization, " managed by a community of participants around the world holding its governance token MKR.[57] This DeFi system is based on atwo-token model - MKR governance token and Dai stablecoin. Dai is a collateral backed stable coin built on the Ethereum blockchain whose value is pegged to the US Dollar.[58] The Maker protocol is

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[52] Sirio Aramonte, Wenqian Huang, Andreas Schrimpf, 'DeFi Risks and the Decentralisation Illusion' (*BIS Quarterly Review*, 6 December 2021) <https://www.bis.org/publ/qtrpdf/r_qt2112b.htm> accessed 8 March 2022.

[53] Fabian Schär, *Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets* (2021) Second Quarter 2021, Vol. 103, No. 2 Federal Reserve Bank of St. Louis Review <https://research.stlouisfed.org/publications/review/2021/02/05/decentralized-finance-on-blockchain-and-smart-contract-based-financial-markets> accessed 8 March 2022.

[54] OECD, 'Why Decentralised Finance (DeFi) Matters and the Policy Implications' (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

[55] David Gogel 'DeFi Beyond the Hype' (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022.

[56] ibid.

[57] 'The Maker Protocol: MakerDAO's Multi-Collateral Dai (MCD) System' <https://makerdao.com/en/whitepaper#abstract> accessed 8 March 2022.

[58] 'What is Dai?' <https://makerdao.world/en/faqs/dai> accessed 8 March 2022.

one of the largest DApps on the Ethereum blockchain.[59] The protocol allows anyone to deposit collateral (which can be in the form of crypto assets) into a Maker Vault (which is a "smart contract that escrows collateral and keeps track of the USD-denominated value of the collateral") in return for a "loan" in a Dai stablecoin.[60] Users are required to over-collateralize their positions to open a Maker Vault, and if the value of the collateral falls below a specified threshold, the Vault is liquidated. The borrower must repay the Dai along with interest to retrieve the collateral.[61] MKR tokens grant governance rights to the token holders over the Maker protocol.[62] This may include the right to vote to set the interest rate, collateralization ratio, allowable collateral types, and other attributes.[63]

Unlike traditional lending platforms, DeFi lending platforms bring prospective borrowers and lenders together without a central intermediary such as a bank. Another key difference between traditional and DeFi lending is that there is limited ability to screen or assess the creditworthiness of borrowers in DeFi lending. Typically, the identity of the parties is "hidden behind cryptographic digital signatures", making it difficult to examine the credit information of borrowers.[64]Therefore, DeFi lending is heavily dependent on collaterals. Through smart contracts, platforms fix a margin determining the amount of collateral a borrower must pledge to receive a loan. As discussed, since cryptoassets are provided as collaterals, which tend to have fluctuating value, there tends to be over-collaterisation. To protect the interests of the lender, platforms set a "liquidation ratio" relative to the borrowed amount.[65] Typically, when the collateral falls below the liquidation ratio, the platform will allow anyone to "act as liquidator and seize the collateral, repay the lender and pocket a share of the residual collateral."[66] Interestingly, in DeFi lending transactions, the lender does not exercise the ultimate right

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[59] 'The Maker Protocol: MakerDAO's Multi-Collateral Dai (MCD) System' <https://makerdao.com/en/whitepaper#abstract> accessed 8 March 2022.

[60] Campbell R. Harvey, Ashwin Ramachandran, Joey Santoro, *DeFi and the Future of Finance* (Wiley 2021) 39.

[61] David Gogel 'DeFi Beyond the Hype' (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022.

[62] Campbell R. Harvey, Ashwin Ramachandran, Joey Santoro, *DeFi and the Future of Finance* (Wiley 2021) 39.

[63] David Gogel 'DeFi Beyond the Hype' (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022.

[64] Sirio Aramonte, Sebastian Doerr, Wenqian Huang and Andreas Schrimpf, 'DeFi Lending: Intermediation Without Information?' (*BIS Bulletin No, 57,* 14 June 2022) <https://www.bis.org/publ/bisbull57.pdf > accessed 08 August 2022.

[65] ibid.

[66] ibid.

to liquidate a loan, and the liquidation decision is dependent on the value of the collateral.

Decentralised Exchanges**:** Crypto assets can be traded using both centralised and decentralised exchanges. Centralised exchanges (such as Coinbase and Binance) work like CeFi services where a single authority manages the platform and facilitates the transaction. To trade on a centralised exchange, traders must deposit assets with the exchange, forfeit direct access to their assets, and trust the exchange operator.[67] Decentralised exchanges are not owned or operated by one entity. They use "automated liquidity pools, where investors 'lock' in their crypto assets (in exchange for fees) to facilitate trading".[68] DeFi exchanges avoid taking custody of user assets.[69] Users remain in exclusive control of their assets until the trade is executed. Trade execution happens through a smart contract. Depending on the design of the exchange, the smart contract may assume additional roles, "effectively making many intermediaries such as escrow services and central counterparty clearing houses (CCPs) obsolete".[70] For instance, Uniswap is a popular decentralised exchange that relies on smart contracts that define a standard way to create liquidity pools, provide liquidity, and swap crypto assets."[71] There is no central order book, no third-party custody, and no private order matching engine.[72]

Assessing Opportunities and Risks Presented by DeFi

DeFi services seek to provide efficiencies by enabling the transfer of value through automated processes without the reliance on intermediaries. Such disintermediation and automation in the financial system may lead to "faster,

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[67] Fabian Schär, *Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets* (2021) Second Quarter 2021, Vol. 103, No. 2 Federal Reserve Bank of St. Louis Review <https://research.stlouisfed.org/publications/review/2021/02/05/decentralized-finance-on-blockchain-and-smart-contract-based-financial-markets> accessed 8 March 2022.

[68] FSB, *Assessment of Risks to Financial Stability from Crypto-assets* (16 February 2022) <https://www.fsb.org/wp-content/uploads/P160222.pdf> accessed 8 March 2022.

[69] David Gogel 'DeFi Beyond the Hype' (May 2021) <https://wifpr.wharton.upenn.edu/wp-content/uploads/2021/05/DeFi-Beyond-the-Hype.pdf> accessed 8 March 2022.

[70] Fabian Schär, *Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets* (2021) (*Second Quarter 2021, Vol. 103, No. 2 Federal Reserve Bank of St. Louis Review*) <https://research.stlouisfed.org/publications/review/2021/02/05/decentralized-finance-on-blockchain-and-smart-contract-based-financial-markets> accessed 8 March 2022.

[71] 'Frequently Asked Questions' <https://uniswap.org/faq> accessed 8 March 2022.

[72] ibid.

potentially cheaper and frictionless transactions".[73] Automating processes using smart contracts may also be helpfulin reducing costs associated with issuance, administration, and execution of transactions. To a certain extent, DeFi enables the realisation of value propositions presented by DLT. The FSB notes that decentralised technologies may reduce some of the financial stability risks associated with traditional financial institutions and intermediaries.[74] The growth of financial service providers could increase the diversity in the financial system and reduce concentration risks. Further, DLT-based DeFi systems could reduce the reliance on existing intermediaries to "channel short-term funding into lending, thereby reducing solvency and liquidity risks arising across their balance sheets."[75] The extent to which such benefits are realised depends on the degree of decentralisation. Further, the decentralisation of records / information in DLT-based DeFi systems may be more resilient as there is no single point of failure or attack found in CeFi services. Proponents often argue about the potential of DeFi to provide better access to financial services, primarily in countries where the depth and breadth of the financial system are not well developed. [76] DeFi services enable users to access services without reliance on traditional intermediaries, and its composable nature enables the development of innovative products that are better suited to meet the needs of the customer. However, such a broad claim may be an overstretch given that developing and underdeveloped economies often face infrastructure and financial literacy challenges, which could be the biggest impediment for their citizens to use such services. However, DeFi services may complement CeFi services by providing small businesses with an alternative to transact outside the traditional banking and payment systems. Small businesses could use major DeFi exchanges to make direct payments, convert payment amounts to USD-backed stablecoin for cross-border remittances, or use DeFi lending protocols for financing.[77] Most of the benefits

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[73] OECD, *The Tokenisation of Assets and Potential Implications for Financial Markets* (17 January 2020) <https://www.oecd.org/finance/The-Tokenisation-of-Assets-and-Potential-Implications-for-Financial-Markets.pdf> accessed 8 March 2022.

[74] FSB, *Assessment of Risks to Financial Stability from Crypto-assets* (16 February 2022) <https://www.fsb.org/wp-content/uploads/P160222.pdf> accessed 8 March 2022.

[75] FSB, *Decentralised Financial Technologies* (6 June 2018) <https://www.fsb.org/wp-content/uploads/P060619.pdf> accessed 8 March 2022.

[76] OECD, *Why Decentralised Finance (DeFi) Matters and the Policy Implications* (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022; Rebecca Liao 'How Decentralized Finance Will Transform Business Financial Services – Especially for SMEs' (*World Economic Forum*, 19 July 2021) <https://www.weforum.org/agenda/2021/07/decentralized-finance-transaction-banking-smes/> accessed 8 March 2022.

[77] Rebecca Liao 'How Decentralized Finance Will Transform Business Financial Services – Especially for SMEs' (World Economic Forum, 19 July 2021) <https://www.weforum.

associated with such services broadly emanate from the value proposition of the underlying technology, i.e., DLT. As the DeFi space is still evolving, it is difficult to predict if these purported benefits will be achieved at a large scale and, if yes, whether they will outweigh the potential risks discussed below.

DeFi systems give rise to several risks, including regulatory, operational, investor protection, and systemic risks. Some of these risks are inherent to DLT systems, others such as crypto assets being peculiar to DeFi services. Increased activity in the DeFi sector without regulatory oversight has increased the likelihood of bad actors misusing these developments for fraudulent and illegal activities. There have been numerous reports of DeFi-related scams such as exit schemes and rug pulls, Ponzi schemes, and other fraudulent schemes and theft of private keys.[78] Due to their peculiar characteristics facilitated by crypto assets and DLT, the DeFi system enables such "rug pulls" or "exit schemes". This involves convincing users to place their funds in seemingly legitimate DeFi services, which are then fraudulently withdrawn by developers or influencers promoting such schemes, leaving no recourse for the investor.[79] It has been reported that investors were scammed of around $2.8 billion worth of crypto assets in 2021, through rug pull schemes that accounted for 37% of all crypto asset scams revenue in 2021 as compared to 1% in 2020. There are also reports of crypto assets worth $80 million being stolen from a decentralised finance platform in 2022.[80] Without any regulatory oversight over DApps or crypto assets, there are no standards for risk management or capital reserves. There are no transparency requirements, and most investors do not know how their money is being handled, exposing them to newer kinds of risks facilitated by DeFi services.

Given the decentralised nature of such services, the DeFi ecosystem operates outside the regulatory frameworks of most countries. In many cases, DApps may provide services similar to traditional financial services yet

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org/agenda/2021/07/decentralized-finance-transaction-banking-smes/> accessed 8 March 2022.

78 International Organisation of Securities Commission, *IOSCO Decentralised Finance Report* (March 2022) <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD699.pdf> accessed 9August 2022.

79 World Economic Forum, *Decentralised Finance (DeFi) Policy-Maker Toolkit* (June 2021) <https://www3.weforum.org/docs/WEF_DeFi_Policy_Maker_Toolkit_2021.pdf> accessed 09 August 2022.

80 *Rug Pull Scams Accounted for the Highest Scam Revenue at $2.8 Billion in 2021: Report* (*Financial Express*, 27 May 2022) <https://www.financialexpress.com/digital-currency/rug-pull-scams-accounted-for-the-highest-scam-revenue-at-2-8-billion-in-2021-report/2539575/> accessed 08 August 2022; 'Hackers Steal $80 Million Worth of Crypto from DeFi Platform Qubit Finance', (The Indian Express, 29 January 2022) <https://indianexpress.com/article/technology/crypto/hackers-steal-80-million-worth-of-cryptocurrency-from-defi-platform-qubit-finance-7747355/> accessed 09 August 2022.

remain outside the regulatory perimeter, putting users at risk. For instance, in the case of DeFi lending, as discussed above, many applications arguably provide banking / lending services,i.e., accepting deposits and rewarding the deposit holders (i.e., users that lock crypto assets with the application to provide liquidity) and then lending them. It is argued that such deposit activities in return for a fixed or variable return may also constitute "issuance of a debt instrument or an investment contract that may involve offers and sales of securities" in some jurisdictions.[81] While banks and non-bank companies providing financial intermediation are heavily regulated, both from a prudential and conduct perspective, the DeFi applications remain outside the regulatory perimeter. This gives rise to financial risks and risks to investor protection.

The lack of regulatory safeguards for investor protection leaves investors and financial consumers exposed to newerforms of loss. For instance, there is an absence of recourse in case of unauthorised transactions, lack of recovery or resolution mechanism and market manipulation. In many cases, the average retail customer may not understand the risks emanating from DeFi services due to the lack of information or the technical complexities involved in such services. This exposes retail users to liquidity and credit risks. In case of default or fraud, no credible recourse is available to such users. In most cases, it is often difficult to identify a responsible party to turn to for such defaults. Further, there is no mechanism through which losses may be recovered, exposing participants to complete loss of funds invested in case of a default.

Due to their pseudonymous nature with a global reach through digital means, DeFi services may facilitate money laundering, financing of terrorism and tax evasion. As they operate outside regulatory frameworks, DeFi services are not mandated to comply with anti-money laundering laws, which require financial service providers to undertake customer due diligence and report suspicious transactions to regulators. Without such verifications and checks, anyone with the necessary infrastructure can use DApps and avail DeFi services.[82] DeFi services offer much greater anonymity to users than

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[81] OECD, *Why Decentralised Finance (DeFi) Matters and the Policy Implications* (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

[82] Salami, I. (2021), 'Challenges and Approaches to Regulating Decentralized Finance'. (*AJIL Unbound, 115, 425-429*) <https://www.cambridge.org/core/journals/american-journal-of-international-law/article/challenges-and-approaches-to-regulating-decentralized-finance/1FC6B3EF8DEE460EF534A1F0A5E9DC72> accessed 8 March 2022.

CeFi services.[83] The non-custodian nature of DeFi allows for pseudonymous participation of users in DeFi, as they do not need to go through a regulated or custodial service provider. DeFi participants can remain fully anonymous or pseudonymous without any link to their identity and information about the source of funds.[84] Therefore, while DeFi transactions are traceable and verifiable on the chain, they are anonymous or pseudonymous, without recourse to find out the participant's identity. News reports indicate that DeFi protocols are playing an increasing role in money laundering, with the total value of cryptocurrency laundered rising year over year by 30% in 2021 and DeFi protocols receiving $900 million from illicit addresses in 2021, a 1,964% increase in value from 2020.[85]

DeFi services that rely on volatile cryptoassets may heighten the risks for retail consumers, exposing them to financial loss. Further, hacks are also common in such marketplaces. In 2021, Poly Network, a DeFi platform, was hit by a major attack where hackers stole more than $ 600 million worth of digital assets.[86] In August 2021, it was reported that around 75% of crypto hacks occurred in the DeFi space.[87] It has been pointed out that while DeFi services rely on DLT systems where information is recorded in a decentralised manner, participants typically use identical technology / computer code. Technological advances may "threaten the cryptographic underpinnings of DLT, raising concerns about operational risks.[88]

In its recent report, the FSBalso highlights potential risks to financial stability from unregulated DeFi markets.[89] The sector has already seen numerous operational and cybersecurity incidents and failures of governance. With the expansion of the sector, these risks are likely to become more pronounced.

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[83] Sirio Aramonte, Wenqian Huang, Andreas Schrimpf, 'DeFi Risks and the Decentralisation Illusion' (*BIS Quarterly Review*, 6 December 2021) <https://www.bis.org/publ/qtrpdf/r_qt2112b.htm> accessed 8 March 2022.

[84] OECD, *Why Decentralised Finance (DeFi) Matters and the Policy Implications* (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

[85] Mengqi Sun, *DeFi Increasingly Popular Tool for Laundering Money, Study Finds* (*The Wall Street Journal,* 26 January 2022) <https://www.wsj.com/articles/defi-increasingly-popular-tool-for-laundering-money-study-finds-11643202002> accessed 8 March 2022.

[86] Ryan Browne, 'Hacker Behind $600 Million Crypto Heist Returns Final Slice of Stolen Funds' (*CNBC,* 23 August 2021) <https://www.cnbc.com/2021/08/23/poly-network-hacker-returns-remaining-cryptocurrency.html> accessed 8 March 2022.

[87] Jamie Crawley, *DeFi Has Accounted for Over 75% of Crypto Hacks in 2021* (*CoinDesk,* 10 August 2021) <https://www.coindesk.com/markets/2021/08/10/defi-has-accounted-for-over-75-of-crypto-hacks-in-2021/> accessed 8 March 2022.

[88] FSB, *Decentralised Financial Technologies* (6 June 2018) <https://www.fsb.org/wp-content/uploads/P060619.pdf> accessed 8 March 2022.

[89] FSB, *Assessment of Risks to Financial Stability from Crypto-assets* (16 February 2022) <https://www.fsb.org/wp-content/uploads/P160222.pdf> accessed 8 March 2022.

Further, DeFi may also increase risks to financial stability from cryptoassets as many services rely on such cryptoassets. While the crypto asset industry is still small compared to the global ecosystem, it is often feared that as the ecosystem and the interconnectedness of the crypto ecosystem with CeFi grows, it could have implications for global financial stability.[90]

Technological and operational risks are also associated with such services. Like DLT, DeFi services are also still evolving. It has been pointed out that audits and due diligence processes are not common in such a market since governance is decentralised with no clear accountability.[91] Further, regulators run the risk of reputational risk and loss of public confidence in the financial system if DeFi services lead to substantialinvestor losses and fraud.

It is evident from the aforesaid that DeFi services tend to complement existing financial services. However, in most cases, it relies on crypto asset speculation and arbitrage, heightening concerns about the risks to users of such customers. While currently, there may be limited real economy use cases of such services, the potential of such a market to proliferate without any regulatory scrutiny requires immediate consideration. Accordingly, even in India, the Working Group on Digital Lending constituted by the Reserve Bank of India ("RBI") has recommended that RBI study the risks presented by DeFi to determine an appropriate policy response.[92]

DeFi raises Important Legal Issues

The DeFi market is still evolving, with new cases being explored by market participants. The preceding sections highlight the potential opportunities and risks associated with DeFi services. By enabling the provision of financial services without the involvement of multiple intermediaries, DeFi systems may have the potential to bring in more efficiencies in the speed of execution and costs of transactions. However, DeFi services also give rise to several risks and challenges for participants and the markets, which call for policy and legal consideration. While some of the challenges may be common with CeFi services, given the unique characteristics of DeFi services, such challenges may become more pronounced. Risks associated with the crypto asset

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[90] ibid.

[91] OECD, *Why Decentralised Finance (DeFi) Matters and the Policy Implications* (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

[92] RBI, *Report of the Working Group on Digital Lending including Lending through Online Platforms and Mobile Apps* (18 November 2021) <https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/DIGITALLENDINGF6A90CA76A9B4B3E84AA0EBD24B307F1.PDF> accessed 10 April 2022.

market and DLT based applications also tend to flow to DeFi markets. It has been pointed out that DeFi may undermine the rule of law by posing a "challenge to state-based systems, in that in its strong form (as fully decentralized finance), it seeks to eliminate the role of the state as rule-maker and enforcer."[93] The decentralized nature of DeFi services brings unique challenges for regulators to design regulations for such services and also enforce such regulations. This section highlights key legal issues that regulators are likely to face while designing regulatory and policy frameworks for DeFi markets.

Identifying the entities for regulation: In the case of CeFi services, the financial regulatory framework tends to focus on regulating the specific entities that provide such services. Even financial regulatory frameworks envisaged for newer intermediaries like payment gateways or aggregators focus on centralised systems. Therefore, existing regulations have centralised financial intermediaries at the core and oversight of the provision of CeFi services is regulated through licensing, registration and regulation of such intermediaries. The presence of intermediaries carrying out such functions is contrary to the concept of DeFi. Given the decentralised and community-driven nature of DeFi services, it is often challenging to identify an entity or individual accountable for meeting regulatory obligations. This makes an oversight, attribution of liability and imposition of reporting or disclosure requirements, which have often formed the bedrock of conduct regulation of financial intermediaries, extremely challenging. Further, the composable feature of DeFi services heightens concerns related to supervision and enforcement due to the complexity of products and services developed on the top of the layers, which makes it difficult to assess the operator of such products or services. Even when operators or intermediaries can be identified, they may lack the ability to modify DeFi protocols or stop transactions because of the decentralised nature of the protocols. While existing DApps are not entirely decentralised, going forward, if a DeFi platform is completely decentralised, no single person or entity could be held responsible for the functioning or malfunctioning of the protocol.[94] Developers do not claim responsibility, and it will be difficult to attribute liability to a specific entity when transactions are anonymous or pseudonymous. This challenges the existing regulatory architecture, which seeks to regulate entities. Further, even if regulations are designed, examining the entities against which regulators should proceed will be challenging.

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[93] Dirk A. Zetzsche, Douglas W. Arner, Ross P. Buckley, *Decentralized Finance* (*Journal of Financial Regulation, Volume 6, Issue 2*, 20 September 2020) <https://academic.oup.com/jfr/article/6/2/172/5913239> accessed 8 March 2022.

[94] FSB, *Assessment of Risks to Financial Stability from Crypto-assets* (16 February 2022) <https://www.fsb.org/wp-content/uploads/P160222.pdf> accessed 8 March 2022.

Investor and financial consumer risks: In traditional financial systems, the interests of investors are sought to be protected through various means, including conduct and prudential regulation. In addition to ensuring that regulated entities are financially prudent, regulators also ensure that there is a disclosure of information to consumers about risks, rights and liabilities associated with the services. This is critical for retail investors / customers to make an informed decision to avail of such services. However, in the case of DeFi services, transparency around the DeFi protocols and underlying blockchains may not translate into customer or investor awareness of financial risks since an average retail customer or investor may not have the requisite level of technological and financial literacy to assess the risks associated with the service.[95] Further, in the absence of any entity responsible for the system's management and governance, designing rights and determining liabilities in case of investor loss will be challenging. Such a framework is critical for issues relating to dispute resolution, unauthorised transactions, breaches of customer data, etc.

For instance, as discussed above, DeFi lending is heavily based on the value of the collateral (typically highly volatile cryptoassets). Even the decision to liquidate a loan can be taken by anyone the moment the collateral falls below a certain threshold. Therefore, the lending relationship does not have much value, and the system is collateral driven. The pseudo-anonymous nature of such services means that the identity of the parties is hidden, and there is no scope for assessing the creditworthiness. Being highly asset driven with no ability to screen borrowers, it does not present much innovation potential for solving problems relating to underserved customer segments. While there are measures to protect the interests of lenders, as discussed earlier, it may also be useful to design common standards for the protection of interests of parties involved in such transactions, including standards for assessing the value and nature of collaterals, robust mechanisms for loan recovery, examining possibilities of designing products specifically to serve underserved customer segments who may not have enough assets to present as collaterals, dispute resolution mechanisms, etc.

Jurisdiction and applicable laws: In DeFi services, determining the jurisdiction of courts and applicable law is challenging. Unlike regulated CeFi services, which may be provided within specific territorial limits (unless otherwise authorised), DeFi services are not confined to geographical boundaries. In the case of distributed ledgers such as Ethereum, which is used for

[95] OECD, *Why Decentralised Finance (DeFi) Matters and the Policy Implications* (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

DeFi services, the nodes of the ledger may spread across multiple locations. This may make identifying the applicable law to a DeFi service challenging. A single transaction may involve multiple parties operating in different jurisdictions. There is a risk that DeFitransactions carried through DLT could fall under the law of every jurisdiction in which a node in the DLT network is situated, resulting in an overwhelming number of laws that might apply to such transactions.[96] In the absence of international cooperation and coordination, such an interpretation will give rise to a potentially fragmented regulatory framework that may not be able to address DeFi risks. It will also lead to inefficient regulation, increasing risks of regulatory arbitrage and gaps.[97]

Data Protection and privacy**:** Decentralisation means that data is accessible at many points rather than one. This may have implications for data protection laws. For instance, in a permissionless public blockchain system, there is no single responsible party, and several participants will have access to the data on the network. In the case of personal data, such a structure conflicts with the design of data protection laws that require an entity controlling the personal data of an individual to safeguard the security and privacy of that data by adhering to accepted data protection principles.[98] For instance, under the European Union General Data Protection Regulation and the proposed data protection law in India, different obligations are envisaged for an entity that determines the purposes and means of processing personal data and entities that are responsible for processing personal data on behalf of the controller. This makes it important to determine the activities of entities in a DeFi ecosystem vis-à-vis the personal data of users. However, the unique characteristics of DeFi services and the different types of blockchains that such services rely on will make it challenging to determine such activities of entities, which in turn makes it difficult to apply data protection principles to such services.

Smart Contracts: Legal issues are also likely to arise with the adoption of smart contracts that are the foundation of DeFi services. As discussed above, when the entire lifecycle of a contract formation happens on DLT

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[96] John Salmon and Gordon Myers, 'Blockchain and Associated Legal Issues for Emerging Markets' (January 2019) <https://www.ifc.org/wps/wcm/connect/da7da0dd-2068-4728-b846-7cffcd1fd24a/EMCompass-Note-63-Blockchain-and-Legal-Issues-in-Emerging-Markets.pdf?MOD=AJPERES&CVID=mxocw9F> accessed 8 March 2022.

[97] Dirk A. Zetzsche, Douglas W. Arner, Ross P. Buckley, *Decentralized Finance* (*Journal of Financial Regulation, Volume 6, Issue 2,* 20 September 2020) <https://academic.oup.com/jfr/article/6/2/172/5913239> accessed 8 March 2022.

[98] ibid; John Salmon and Gordon Myers, 'Blockchain and Associated Legal Issues for Emerging Markets' (January 2019) <https://www.ifc.org/wps/wcm/connect/da7da0dd-2068-4728-b846-7cffcd1fd24a/EMCompass-Note-63-Blockchain-and-Legal-Issues-in-Emerging-Markets.pdf?MOD=AJPERES&CVID=mxocw9F> accessed 8 March 2022.

systems without any real-world negotiation, it will raise issues relating to the formation, interpretation, performance, remedies and jurisdiction of contracts under the existing contract law. Further, as discussed above, smart contracts may not afford parties with such flexibility as required for commercial transactions.

Enforcement: Even if regulations are designed for DeFi services, enforcing such regulations will be challenging. Existing financial regulatory approaches tend to focus on the entity providing the service, the customer to whom such service is provided or the market in which such service is provided. Identifying each of these components is problematic in a DeFi ecosystem. As discussed above, in a network economy, there are multiple entities providing different parts of the service, to clients spread across the globe. It has already been discussed how it is difficult to identify the entity that may be held accountable or responsible for the provision of DeFi service in question. In the case of CeFi services, another approach that regulators have used to regulate entities that provide ancillary services across the lifecycle of a transaction is through outsourcing guidelines. Such an approach relies on the regulated entity to ensure compliance with regulations by service providers. Even if such an approach is contemplated for DeFi services by fixing liability on a specific entity which is then made liable for other actors, a question that may arise is if a supervised entity can be held responsible for the actions or inactions of multiple network participants spread across the world and subject to different applicable laws.[99]

Way Forward and Conclusion

With improvements in blockchain technologies, tokenisation of financial assets and suitable regulations for safeguarding the interests of users and the financial system, DeFi services may play an important role in the financial system. As DeFi services are still evolving, regulators and policymakers across the globe are trying to assess the opportunities and risks presented by DeFi. For the time being, regulatory focus has been on specific building blocks or elements of decentralised finance, as discussed below. Going forward, it will be useful to focus on the following aspects of regulation to promote responsible innovation in the DeFi markets and mitigate risks that emanate from the sector.

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[99] Dirk A. Zetzsche, Douglas W. Arner, Ross P. Buckley, *Decentralized Finance* (*Journal of Financial Regulation, Volume 6, Issue 2*, 20 September 2020) <https://academic.oup.com/jfr/article/6/2/172/5913239> accessed 8 March 2022.

First, the regulation of DeFi is closely connected to the regulation of cryptoassets. Currently, the approaches to crypto asset regulation are fragmented across the world. Broadly, approaches adopted globally may be categorised under three broad heads.[100] Under the first approach, regulators rely on existing laws (such as securities law) to clarify their applicability to certain types of crypto assets, primarily security tokens issued during an initial coin offering. This includes clarifications issued by the United States Securities and Exchange Commission and the Australian Securities and Investment Commission.[101] .Under the second approach, regulators amend existing laws (mostly anti-money laundering laws) to bring cryptoasset related services within its ambit. For instance, South Korea has amended its Act on Reporting and Using Specified Financial Transaction Information Act 2001 to define "virtual assets" and to bring "virtual asset providers" within the ambit of the law.[102] The third approach is to adopt a standalone bespoke law to regulate crypto assets. In 2021, the Council of European Union adopted its position on the draft Regulation on Markets in Crypto Assets (MiCA) - a framework governing issuance and provisions of crypto asset related services.[103] Previously, Malta and Thailand have also enacted standalone frameworks for crypto assets.[104] It has been pointed out that existing laws are not designed to capture different types of crypto assets, and accordingly, the first two approaches may not be adequate to address all risks emanating from the crypto sector. Going forward, it may be useful to enact a bespoke regulatory framework for crypto assets.[105] The law should focus on regulating the entry and exit points to the cryptoasset ecosystem. This will includeregulation of gatekeepers (such as exchanges, custodians, and wallet providers), issuers (of stablecoins) and any other service provider that participates in the exchange between crypto assets and fiat currency and exchange between

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[100] Shehnaz Ahmed, Swarna Sengupta, 'Blueprint of a Law for Regulating Cryptoassets' (*Vidhi Centre for Legal Policy*, 29 January 2022) <https://vidhilegalpolicy.in/research/blueprint-of-a-law-regulating-cryptoassets/> accessed 8 March 2022.

[101] Securities and Exchange Commission, *Framework for "Investment Contract" Analysis of Digital Assets*'<https://www.sec.gov/corpfin/framework-investment-contract-analysis-digital-assets#_edn1> accessed 8 March 2022.; Australian Securities and Investments Commission, 'Crypto assets',', <tps://asic.gov.au/regulatory-resources/digital-transformation/crypto assets/#part-a> accessed 8 March 2022.

[102] Financial Services Commission, 'FSC Proposes Additional Rules Change on Virtual Asset Service Providers' (17 February 2021) <https://www.fsc.go.kr/eng/pr010101/75410> accessed 8 March 2022.

[103] Council of European Union (19 November 2021) <https://www.consilium.europa.eu/media/53104/st14066-en21.pdf> accessed 8 March 2022.

[104] Virtual Financial Asset Act, 2018; Emergency Decree on Digital Asset Business, 2018.

[105] Shehnaz Ahmed, Swarna Sengupta, 'Blueprint of a Law for Regulating Cryptoassets' (Vidhi Centre for Legal Policy, 29 January 2022) <https://vidhilegalpolicy.in/research/blueprint-of-a-law-regulating-cryptoassets/> accessed 8 March 2022.

different types of crypto assets. The law should require such intermediaries to be specifically authorised to carry out functions under the law.

For India, keeping in mind the size of the market, the law should rely on the expertise of the RBIand the Securities and Exchange Board of India ("SEBI") to regulate the cryptoasset market. In this process, RBI may be made responsible for prudential regulation, with SEBI responsible for market conduct regulation. For instance, RBI can be empowered with the regulation of stablecoin arrangements, whereas SEBI may be responsible for regulating other market intermediaries (such as exchanges, custodians, etc.). Such regulated intermediaries must comply with regulations relating to capital requirement, governance, safekeeping of consumer funds, grievance redressal, disclosure of information to consumers and regulators, customer due diligence (including know your customer requirements), risk management framework, attribution of liabilities in case of unauthorized loss to customers, and protection of consumer data.

While enacting a law for crypto assets may not be able to address all risks associated with DeFi, it is a step in the right direction, considering most DeFi services rely on cryptoassets for their transactions. A crypto asset law will at least mitigate risks emanating from such assets for the DeFi sector, bring in accountability from regulated entities, and provide necessary guidance to design standards and policies for systems based on decentralised ledgers. Such a regulatory framework is also important for regulators to understand the penetration of such markets and their interconnectedness to the financial system. As cryptoassets remain outside the regulatory perimeter, it is often challenging for regulators to access information about the extent and scope of such markets. The enforcement of such a law also implies that regulators must invest in developing the necessary skillset, expertise, forensic tools and technological solutions to implement such laws. Given the cross-border nature of crypto assets and DeFi transactions, it is equally essential to have global standards of regulation for this sector. The Financial Action Task Force ("**FATF**") has already issued its guidance on designing anti-money laundering frameworks that may apply to crypto asset service providers. [106] This serves as guidance for FATF member countries to design their regulatory framework. Similarly, the FSB has announced its plans to issue possible

[106] The FATF is an international watchdog and standard-setting body for countering global money laundering and terrorist financing. It formulates recommendations and standards to prevent illegal activities, organised crime, corruption and terrorism. See FATF, 'Who we are?", < https://www.fatf-gafi.org/about/> accessed 8 March 2022; FATF, 'Updated Guidance for a Risk-Based Approach Virtual Assets and Virtual Assets Service Providers' (October 2021) <https://www.fatf-gafi.org/media/fatf/documents/recommendations/Updated-Guidance-VA-VASP.pdf> accessed 8 August 2022.

regulatory approaches for regulating crypto assets and global stablecoin arrangements. While such efforts will be instrumental indesigning global standards for crypto assets, it is equally important to create systems and processes for a global exchange of information relating to activities of crypto asset service providers and assistance for cross-border enforcement of actions against such providers for any illegal activity.

Second, it will be necessary to identify access points for supervision of DeFi services. This may include identifying a participant or participants (such as developers of protocol, exchanges, governance token holders, etc.) who can be accountable from a regulation perspective. Risks associated with DeFi services may be mitigated by bringing in some semblance of centralisation by identifying such access points that can be brought within the regulatory ambit. Such identification and regulatory oversight will have to be designed to not completely undermine the decentralised nature of such services.The BIS has pointed out that complete decentralisation may be an "illusion" as many Defi platforms have stakeholders (such as governance token holders) that are usually responsible for taking governance decisions regarding the system.[107]Therefore, a possible approach that may be considered is to regulate gatekeepers to the DeFi ecosystem - i.e., service providers that work as entry and exit to the DeFi ecosystem. This may include exchanges, custodians, and other service providers that act as points to access the DeFi ecosystem when cryptoassets are converted to fiat currency or vice versa. The BIS notes that several stakeholders in the DeFi ecosystem take and implement decisions, thereby enjoying governance benefits and who can become entry points for regulations.[108] The FATF, in its latest guidance,[109] clarifies that a DeFi application (software programme) is not a "virtual asset service provider" ("**VASP**") under the guidance. However, it clarifies that "creators, owners and operators or some other persons who maintain control or sufficient influence in the DeFi arrangements, even if those arrangements seem decentralized, may fall under the FATF definition of a VASP where they are providing or actively facilitating VASP services. This is the case, even if other parties play a role in the service or portions of the process are automated." Therefore, such entities will be responsible for complying with relevant know your customer and anti-money laundering standards in the guidance. If this

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[107] Sirio Aramonte, Wenqian Huang, Andreas Schrimpf, 'DeFi Risks and the Decentralisation Illusion' (*BIS Quarterly Review*, 6 December 2021) <https://www.bis.org/publ/qtrpdf/r_qt2112b.htm> accessed 10 April 2022.

[108] ibid.

[109] FATF, *Updated Guidance for a Risk-Based Approach Virtual Assets and Virtual Assets Service Providers* (October 2021) <https://www.fatf-gafi.org/media/fatf/documents/recommendations/Updated-Guidance-VA-VASP.pdf> accessed 8 March 2022.

approach is adopted, DeFi protocol developers may be treated as banks and other financial institutions that handle consumer funds and, therefore, subject to anti-money laundering regulations. To determine who maintains control or influence in DeFi arrangements, FATF suggests considering factors like control or sufficient influence over assets or aspects of the DeFi protocol, the existence of an ongoing business relationship between themselves and users (even through smart contracts), and whether any party profits from the service or has the ability to set or change parameters, etc. As DeFi markets continue to grow, this may be a preliminary step to regulating the markets.

Third, the regulation of the DeFi system will also require a close analysis of legal issues emanating from DLT based solutions. DLT based systems often raise challenging questions about jurisdiction, data protection, determination of rights and liabilities, etc., as has been discussed earlier. Such issues are also common to DeFi services. Therefore, designing public policy frameworks for accommodating such blockchain-based solutions will also be an important step towards addressing legal uncertainties associated with the DeFi system. This may require countries to identify standards or benchmarks such technologies should meet. This should address issues relating to the determination of rights and liabilities of participants, dispute resolution mechanism, the procedure for handling customer data, security audits, risk management framework for operational resilience, and agreement on jurisdictional issues. Currently, most DLT-based systems rely on contractual arrangements for such matters. While such an arrangement maybe useful for permissioned DLT systems, there will be challenges in designing and implementing governance frameworks (whether through contractual arrangements or policy frameworks) for permissionless DLT systems. Accordingly, regulators will have to rely on soft measures such as public-private collaboration, international cooperation and innovative technological solutions, as discussed below, to monitor such solutions. Currently, most countries are exploring possible legal issues emanating from DLT-based systems and accordingly examine if existing laws need any amendments to accommodate such developments. Data protection regulators in France and Singapore have clarified the applicability of data protection laws to DLT-based systems.[110]

[110] Personal Data Protection Commission Singapore, *Guide on Personal Data Protection Considerations for Blockchain Design* (2022) <https://www.pdpc.gov.sg/-/media/Files/PDPC/PDF-Files/Other-Guides/Blockchain-Guide_final.ashx?la=en> accessed 08 August 2022; Commission nationale de l'informatique et des libertés(CNIL), 'Premiers élémentsd'analyse de la CNIL' (September 2018) <https://www.cnil.fr/sites/default/files/atoms/files/la_blockchain.pdf> accessed 08 August 2022; CNIL, 'Blockchain et RGPD : quelles solutions pour un usage responsableenprésence de donnéespersonnelles?' (24 September 2018) <https://www.cnil.fr/fr/blockchain-et-rgpd-quelles-solutions-pour-un-usage-responsable-en-presence-de-donnees-personnelles> accessed 08 August 2022; Baker

Fourth, international cooperation is critical given the global reach of the DeFi markets and the limitations of existing regulatory approaches to regulate this ecosystem. This is important to create standards that can guide the development of legally compliant DeFi protocols. For instance, the Principles for Financial Market Infrastructures[111] are the international standards for financial market infrastructures, i.e., payment systems, central securities depositories, securities settlement systems, central counterparties and trade repositories. The principles have been issued by the Committee on Payments and Market Infrastructures[112] and the International Organization of Securities Commissions and adopted by the international community and regulators to strengthen and preserve financial stability. Similarly, international standards or principles coupled with adopting a global cooperation framework among regulators will be essential to supervising the DeFi markets.

Fifth, DeFi may present an opportunity for regulators to rely on regulatory technologies or popularly referred to as RegTech and SupTech - the use of technology for regulatory compliance and supervision.[113]This may be achieved by designing regulatory systems that can leverage technological innovations. For instance, in a paper, BIS argues for "embedded supervision" for DLT based systems in which the regulatory framework "provides for compliance in tokenised markets to be automatically monitored by reading the market's ledger, thus reducing the need for firms to actively collect, verify and deliver data."[114] This enables automated compliance monitoring and supervision. Taking this idea forward, Dirk Andreas Zetzscheet al proposes "embedded regulation" - where regulatory objectives "of market integrity, market conduct, and financial stability are included as part of the design of

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Mckenzie, 'French Data Protection Authority Issues Guidance on GDPR and Blockchain' (24 October 2018) <https://insightplus.bakermckenzie.com/bm/technology-media-telecommunications_1/french-data-protection-authority-issues-guidance-on-gdpr-and-blockchain_2/> accessed 08 August 2022.

[111] BIS, 'Principles for Financial Market Infrastructures' <https://www.bis.org/cpmi/publ/d101.htm> accessed 8 March 2022.

[112] It is an international standard setter that promotes, monitors and makes recommendations about the safety and efficiency of payment, clearing, settlement and related arrangements. It also serves as a forum for central bank cooperation in related oversight, policy and operational matters. See BIS, 'CPMI-Overview' <https://www.bis.org/cpmi/about/overview.htm> accessed 8 March 2022.

[113] Dirk Broeders and Jermy Prenio, 'Innovative Technology in Financial Supervision (SupTech) – the Experience of Early Users' (BIS, FSI Insights on policy implementation No 9, July 2018) <https://www.bis.org/fsi/publ/insights9.pdf> accessed 8 March 2022.

[114] Raphael Auer, *Embedded Supervision: How to Build Regulation into Blockchain Finance* (*BIS Working Papers No 811*, September 2019) <https://www.bis.org/publ/work811.pdf> accessed 8 March 2022.

any DeFi system."[115] Such an approach envisages that a DeFi system is built in a manner that includes features of transparency, disclosure, and compliance as a part of its automated structure. Another approach to regulation that is recommended by OECD to regulators is to leverage technological innovations to regulate such services by participating "as nodes in a network and / or intervene at a smart contract level."[116]

Sixth, regulators may consider using regulatory sandboxes to allow companies to test DeFi services in a controlled environment with regulatory oversight. A regulatory sandbox will enable businesses to live test new products and services in a "controlled" environment where regulators may or may not permit regulatory relaxation for testing.[117] Regulatory sandboxes enable regulators and businesses to collect evidence on the opportunities and risks provided by fintech innovation. Findings from the testing can also inform laws and policies designed by regulators for such innovation. Financial sector regulators may use such a regulatory sandbox testing framework to test innovations in the DeFi market to identify use case cases, opportunities and risks of DeFi services. Evidence gathered from such testing may help design regulations for the DeFi market.

Seventh, as the DeFi markets continue to evolve, it may not be possible for regulators to design comprehensive regulations that cover every aspect of DeFi. The unique properties of the DeFi services mean that regulators will have to adopt a co-regulatory approach where public authorities work closely with the private sector to design interventions through which public policy frameworks can interact with the governance structures of DeFi. While the regulator may lay down broad principles that may be followed while designing DeFi protocols and providing DeFi services, it will have to rely on self-regulation through collaboration between different stakeholders of the DeFi ecosystem to develop technical standards for implementing such principles for effective enforcement.

DeFi seeks to improve the efficiency of financial markets by building upon the work done in blockchain and fintech. Whether it achieves this promise is

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[115] Dirk A. Zetzsche, Douglas W. Arner, Ross P. Buckley, *Decentralized Finance* (Journal of Financial Regulation, Volume 6, Issue 2, 20 September 2020) <https://academic.oup.com/jfr/article/6/2/172/5913239> accessed 8 March 2022.

[116] OECD, 'Why Decentralised Finance (DeFi) Matters and the Policy Implications' (19 January 2022) <https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf> accessed 8 March 2022.

[117] Reserve Bank of India *Enabling Framework for Regulatory Sandbox* (8 October 2021) <https://rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=1187#:~:text=The%20RBI%20shall%20bear%20no,with%20the%20relevant%20regulatory%20requirements.> accessed 8 March 2022.

yet to be seen. The DeFi ecosystem is still nascent, and in many cases, complete decentralization is not witnessed in most DeFi applications. There is no common understanding of the nature of such DeFi services and their interconnectedness with the existing financial system. Therefore, in most countries, policy responses correctly have not focused on the DeFi ecosystem as a whole but some of its building blocks, as discussed above. However, a study of the opportunities and risks presented by DeFi and the legal issues underscore that it will pose similar regulatory challenges tocrypto assets, perhaps more heightened due to its ability to mirror existing financial services.

Going by existing reports indicating that India is sixth in terms of DeFi application, India needs to closely follow the developments in the DeFi sector.[118] However, as the market is still evolving, a comprehensive regulatory response to the DeFi ecosystem is not warranted at this stage. Instead, as the first step, it is important to focus on spending regulatory resources and attention on the building blocks of DeFi– which include crypto assets, stablecoins, smart contracts and the DLT system. Regulating these building blocks will also help monitor the entry and exit points to the DeFie cosystem. This must be coupled with other policy approaches suggested above – leveraging technological innovations to regulate regulatory sandboxes and adopting a co-regulation model. The future and growth of the DeFi market and its role in promoting public policy objectives are closely tied to the policy and regulatory response to such markets. Implementing the recommendations discussed above will enable policymakers to design some form of regulatory oversight before the market attains systemic importance or becomes too big to regulate.

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[118] *India* 6th *Biggest Country in Terms of DeFi Adoption: Chainalysis* (*Livemint*, 28 August 2021) <https://www.livemint.com/market/cryptocurrency/india-6th-biggest-country-in-terms-of-defi-adoption-chainalysis-11630121581732.html > accessed 12 April 2022.